Rum River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

October 2016

Legislative charge

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Authors

MPCA Rum River Watershed Report Team:
Aaron Onsrud, Dereck Richter, Chandra Henrich, Dave Christopherson, David Duffey, Bruce Monson, Shawn Nelson, Kris Parson, Jim MacArthur, Sophia Vaughan

Contributors/acknowledgements

Citizen Stream Monitoring Program Volunteers
Minnesota Department of Natural Resources
Minnesota Department of Health
Minnesota Department of Agriculture
Anoka County SWCD
Isanti County SWCD
Mille Lacs County SWCD

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

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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

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

K Potassium

LRVW Limited Resource Value Water

M Mesotrophic

MCES Metropolitan Council Environmental Services

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MINLEAP Minnesota Lake Eutrophication Analysis Procedure

MNDNR Minnesota Department of Natural Resources

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

NH3 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 Water Pollutant Load Monitoring Network

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Executive summary

The Rum River Watershed covers 1584 square miles (mi^2) of the Upper Mississippi River Basin in central Minnesota stretching from Mille Lacs Lake in the north to the confluence with the Mississippi River in the city of Anoka. The Rum River flows out of Mille Lacs Lake which drains southwest Aitkin, southeast Crow Wing, and northwest Mille Lacs counties. As the Rum River flows south, mainly within Mille Lacs and Isanti counties, its watershed also includes eastern Morrison, northeast Benton, and eastern Sherburne counties on the western border of the watershed and southwestern Kanabec and northwestern Chisago on its eastern borders and northwestern Anoka county at the mouth of the Rum River. The upper third of the Rum River Watershed is dominated by hardwood forest and wetland complexes. The middle third still has wetland complexes and hardwood forest, but cropland and rangeland make up the majority of the land use. Fenced cattle pastures and forage crops such as alfalfa and hay are more abundant than row crops like soybeans and corn. The lower third of the Rum River Watershed is the most densely populated area of the Rum River Watershed with urbanization occurring on it banks. The river also flows through downtown Anoka before cascading over a dam and into the Mississippi River. The Rum River's largest tributary, the West Branch Rum River, flows into the Rum River from the west side of the watershed in the city of Princeton. The Rum River was added to Minnesota's Wild and Scenic River Program in 1978. The designated stretch extends along Mille Lacs, Sherburne, Isanti, Kanabec, and Anoka counties.

Many streams in the Rum River Watershed sit within a broad, shallow valley that was formed during the late Wisconsinan glaciation by fast-flowing, meltwater streams that ran beneath the glaciers (Wright 1990). These "tunnel valleys" are now primarily occupied by lakes, wetlands, and low gradient streams. Due to their wetland characteristics and extremely low gradient, low dissolved oxygen can be a natural condition in this area. These characteristics create difficulties in determining if fish and invertebrates are being impacted by human-caused low dissolved oxygen or if they are impacted by a naturally occurring condition. This is one of the primary reasons the MPCA watershed assessment teams employ a multiple-lines-of-evidence approach when assessing aquatic life use support.

Fifty-eight of the 177 stream reaches were assessed. Of the assessed streams, 19 streams are considered to be fully supporting aquatic life uses and 10 streams are fully supporting aquatic recreation uses. 6 reaches were not assessed due to their classification as limited resource waters. Throughout the watersheds, 16 stream reaches do not support aquatic life uses and 5 do not support aquatic recreation uses. All of the remaining stream reaches either had insufficient or no data to assess.

Of the 212, lakes in the watershed that are greater than ten acres, 41 had sufficient information to assess. Aquatic life uses are supported on 12 lakes; only 2 do not support aquatic life uses (Francis Lake: 30-0080-00 and Green Lake: 30-0136-00). For aquatic recreation, 26 out of 40 lakes meet the standard. Skogman Lake (30-0022-00), Fannie Lake (30-0043-00), and Green Lake (30-0136-00) were listed for aquatic recreation impairment in 2008 and the current data supports those listings. Rogers Lake (02-0104-00) and Francis Lake (30-0080-00) were also listed for aquatic recreation impairment in 2006 and 2002; the current data also supports those impairments. There was insufficient information to determine if aquatic life and aquatic recreation uses are being met on 23 lakes.

Fourteen water chemistry stations were sampled from May through September in 2013, and again June through August of 2014, to provide sufficient water chemistry data to assess all components of the aquatic life and recreation use standards. Water chemistry stations were placed at the outlet of each major tributary to the Rum River that are >40 square miles in area. Of the 15 stream reaches sampled for bacteria, 10 support aquatic recreation while 5 do not. All 5 that do not support aquatic recreation are in the lower 2/3 of the watershed.

Minnesota Department of Natural Resources (MNDNR) has documented numerous wild rice populations in the watershed. They are located in the general vicinity of Mille Lacs Lake and scattered throughout the southern third of the watershed. Wild rice beds are plants that do not grow well in polluted systems.

Chemical contaminants were examined in fish tissues from 11 lakes within this watershed. All but 2 of the sampled lakes exhibited high levels of mercury and are listed as impaired for aquatic consumption. In addition to these lakes, the mainstem of the Rum River is impaired for aquatic consumption due to high levels of mercury found in fish sampled in the river.

There are currently 18 MPCA groundwater monitoring wells (17 monitoring, 1 domestic) within the Rum River Watershed. Of the 18 wells, 15 are located in residential areas with subsurface sewage treatment systems (SSTS) (also referred as septic systems), two are located in undeveloped areas, and one is within a sewered residential area. The three most commonly occurring contaminants of emerging concern detected in these wells when sampled from 2010 to 2014 include sulfadimethoxine (10.3%), isophorone (8.4%), and 2-methylanaphthalene (7.5%).

While the Rum River Watershed is in decent shape compared to other watersheds in the southern half of Minnesota, additional efforts are necessary to improve the water quality in areas affected by human disturbance. Improvements in water quality should target nonpoint sources of pollution. Implementation of best management practices (BMP) should target sensitive features on the landscape that are known to impact water quality, to insure a high return on investment for valuable restoration dollars. Reductions in sediment loading could be made by taking efforts to limit erosion and soil loss from agricultural sources using buffer strips and limiting cattle access to streams in the southern part of the watershed. The abundance of natural wetlands allows for more retention on the landscape and reduce the impacts of high flows on stream bank erosion and instream sediment loading along with filtering excess nutrients within the watershed. Great care should be taken to protect and even replace these natural filters. Areas in the southern two-thirds of the watershed have a higher potential for impaired stream reaches for aquatic life due to the increased agricultural land use and development along the waterways. Stream restoration efforts could include perennial vegetation buffers to stabilize stream banks and reduce erosion. Plans to reduce bacteria in the southern two-thirds of the watershed and nitrate levels should include measures to better control livestock waste, fertilizer management, and fix failing septic systems. Surface water quality improvements will be dependent on local cooperation as using regulatory authority to reduce nonpoint source pollution is currently limited.

Introduction

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

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

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

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

This watershed-wide monitoring approach was implemented in the Rum River Watershed beginning in the summer of 2013. This report provides a summary of all water quality assessment results in the Rum River Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring and monitoring conducted by local government units.

The watershed monitoring approach

The watershed approach is a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 80 major watersheds. The major benefit of this approach is the integration of monitoring resources to provide a more complete and systematic assessment of water quality at a geographic scale useful for the development and implementation of effective TMDLs, project planning, effectiveness monitoring and protection strategies. The following paragraphs provide details on each of the four principal monitoring components of the watershed approach. For additional information see: Watershed Approach to Condition Monitoring and Assessment (MPCA 2008) (http://www.pca.state.mn.us/publications/wq-s1-27.pdf).

Pollutant Load Monitoring Network

Watershed Pollutant Load Monitoring Network

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 MNDNR flow gaging stations with water quality data collected by the Metropolitan Council Environmental Services (MCES), local monitoring organizations, and Minnesota Pollution Control Agency to compute pollutant loads for 200 stream and river monitoring sites across Minnesota. Monitoring sites span three ranges of scale with annual loads calculated for basin and major watershed sites and seasonal loads for subwatershed sites:

Basin – major river mainstem sites along the Mississippi, Minnesota, Rainy, Red, Des Moines, and St. Croix rivers

Major Watershed – tributaries draining to basin rivers with an average drainage area of 1,350 square miles (8-digit HUC scale)

Subwatershed – major branches or nodes within major watersheds with average drainage areas of approximately 300-500 square miles

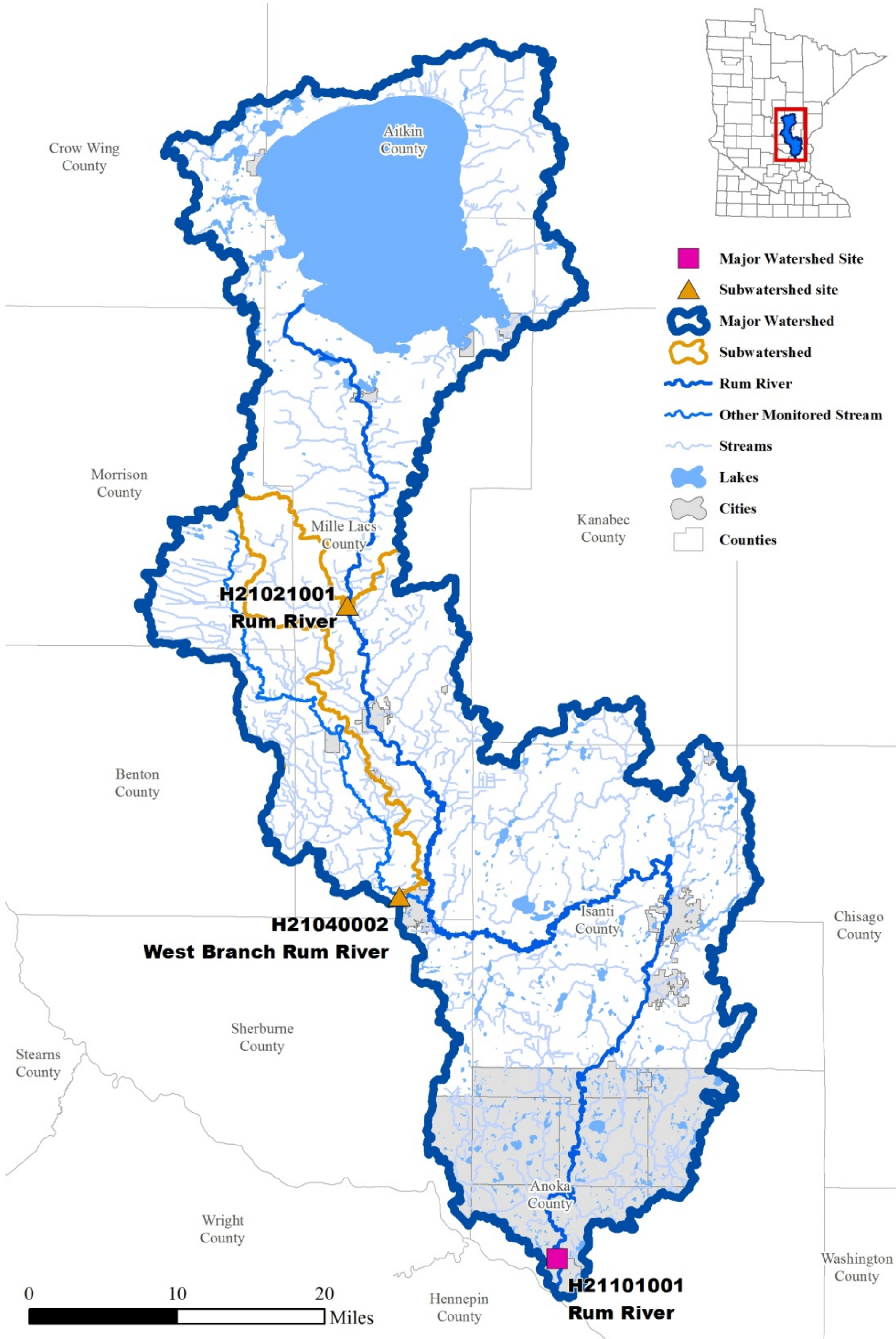

Figure 1. WPLMN monitoring sites in the Rum River Watershed.

The Rum River at Anoka, Main St (MNDNR/MPCA ID H21101002) is monitored by the Metropolitan Council Environmental Services as part of their Stream Monitoring Program (Figure 1). The river is sampled in Anoka with flows estimated by the MNDNR using USGS stream gage data from the Rum River near St. Francis, Minnesota (USGS ID 05286000) and paired discharge measurements between the two sites. Two subwatershed sites were established in the watershed during 2015, the Rum River near Milaca, CSAH16 (MNDNR/MPCA ID 21021001, EQuIS ID S002-955), and the Rum River West Branch near Princeton, CR102. (MNDNR/MPCA ID 21040002, EQuIS ID S002-953).

Data will also be used to assist with: Total Maximum Daily Load (TMDL) studies and implementation plans; watershed modeling efforts; watershed research projects and watershed restoration and protection strategies.

More information can be found at the WPLMN website.

Intensive watershed monitoring

The intensive watershed monitoring strategy utilizes a nested watershed design allowing the sampling of streams within watersheds from a coarse to a fine scale (Figure 2). Each watershed scale is defined by a hydrologic unit code (HUC). These HUCs define watershed boundaries for water bodies within a similar geographic and hydrologic extent. The foundation of this approach is the 80 major watersheds (8-HUC) within Minnesota. Using this approach many of the smaller headwaters and tributaries to the main stem river are sampled in a systematic way so that a more holistic assessment of the watershed can be conducted and problem areas identified without monitoring every stream reach. Each major watershed is the focus of attention for at least one year within the 10-year cycle. River/stream sites are selected near the outlet of each of three watershed scales, 8-HUC, aggregated 12-HUC and 14-HUC (Figure 2). Within each scale, different water uses are assessed based on the opportunity for that use (i.e., fishing, swimming, supporting aquatic life such as fish and insects). The major river watershed is represented by the 8-HUC scale. The outlet of the major 8-HUC watershed (purple dot in (Figure 3) is sampled for biology (fish and macroinvertebrates), water chemistry and fish contaminants to allow for the assessment of aquatic life, aquatic recreation and aquatic consumption use support. The aggregated 12-HUC is the next smaller subwatershed scale which generally consists of major tributary streams with drainage areas ranging from 75 to 150 mi^2. Each aggregated 12-HUC outlet (green dots in (Figure 2) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Within each aggregated 12-HUC, smaller watersheds (14 HUCs, typically 10-20 mi^2), are sampled at each outlet that flows into the major aggregated 12-HUC tributaries. Each of these minor subwatershed outlets is sampled for biology to assess aquatic life use support (red dots in (Figure 3).

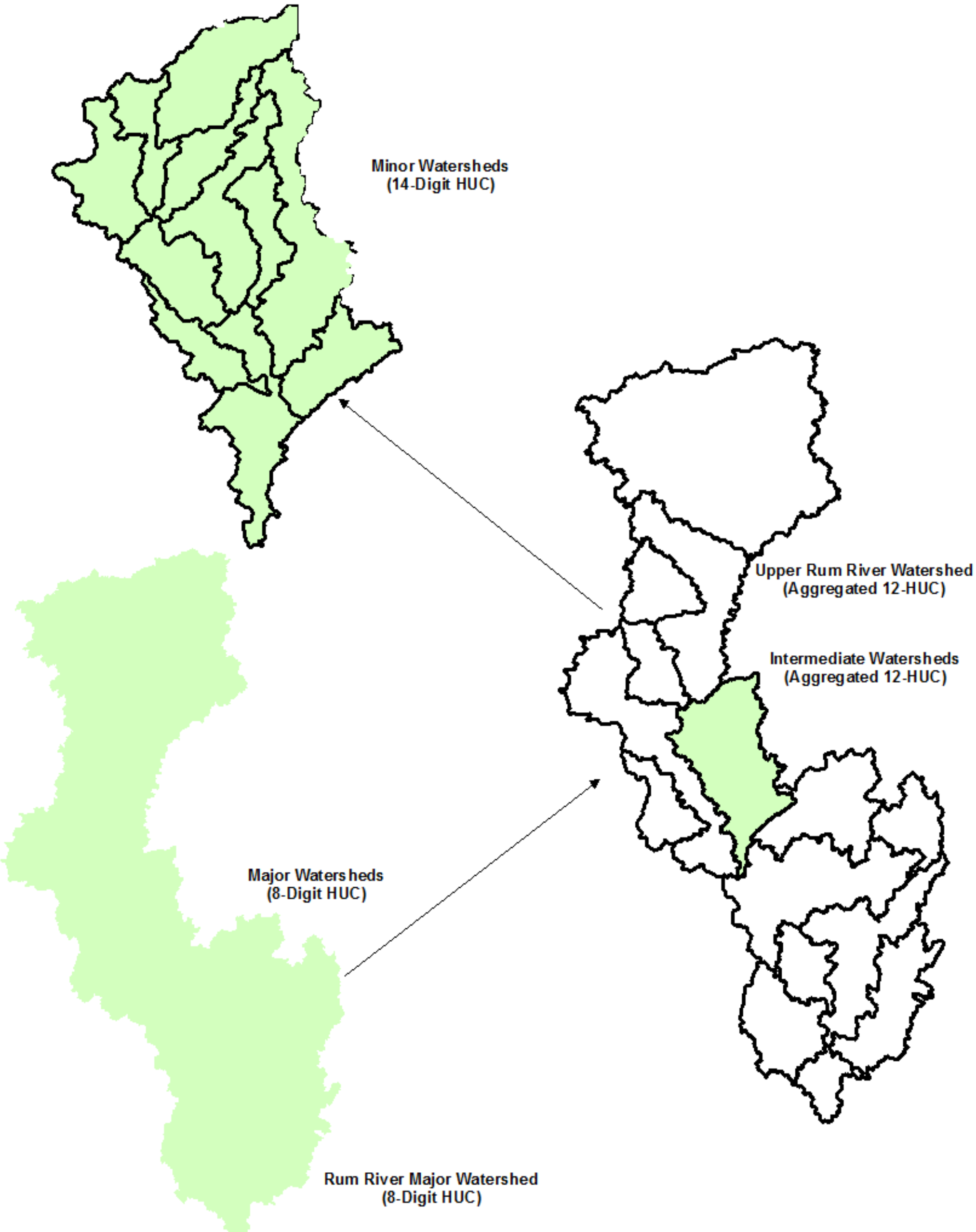

Figure 2. The intensive watershed monitoring design.

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

Specific locations for sites sampled as part of the intensive monitoring effort in the Rum River Watershed are shown in Figure 3 and are listed in Appendix 2, Appendix 4.2, and Appendix 4.3.

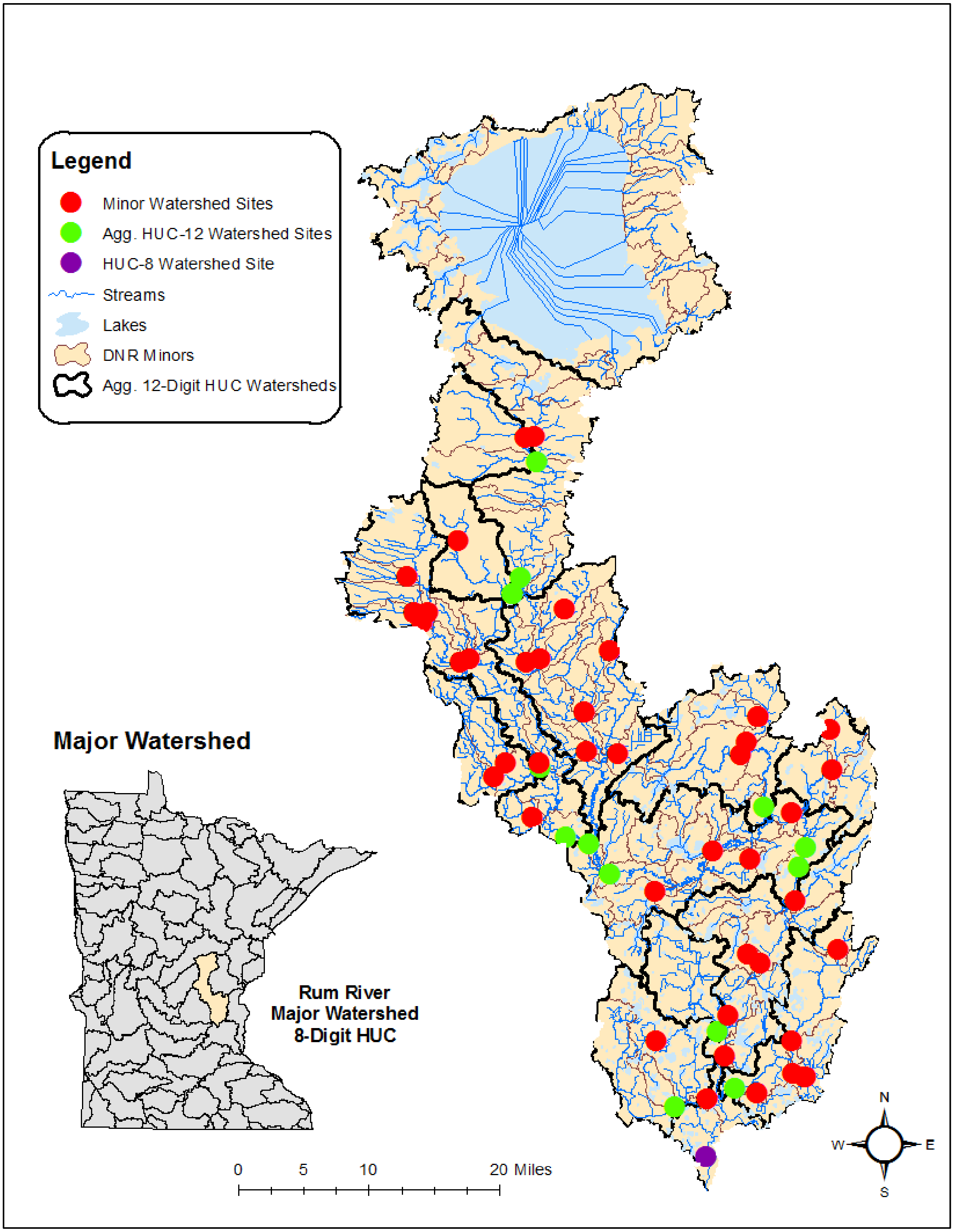

Figure 3. Intensive watershed monitoring sites for streams in the Rum River Watershed.

Citizen and local monitoring

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

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

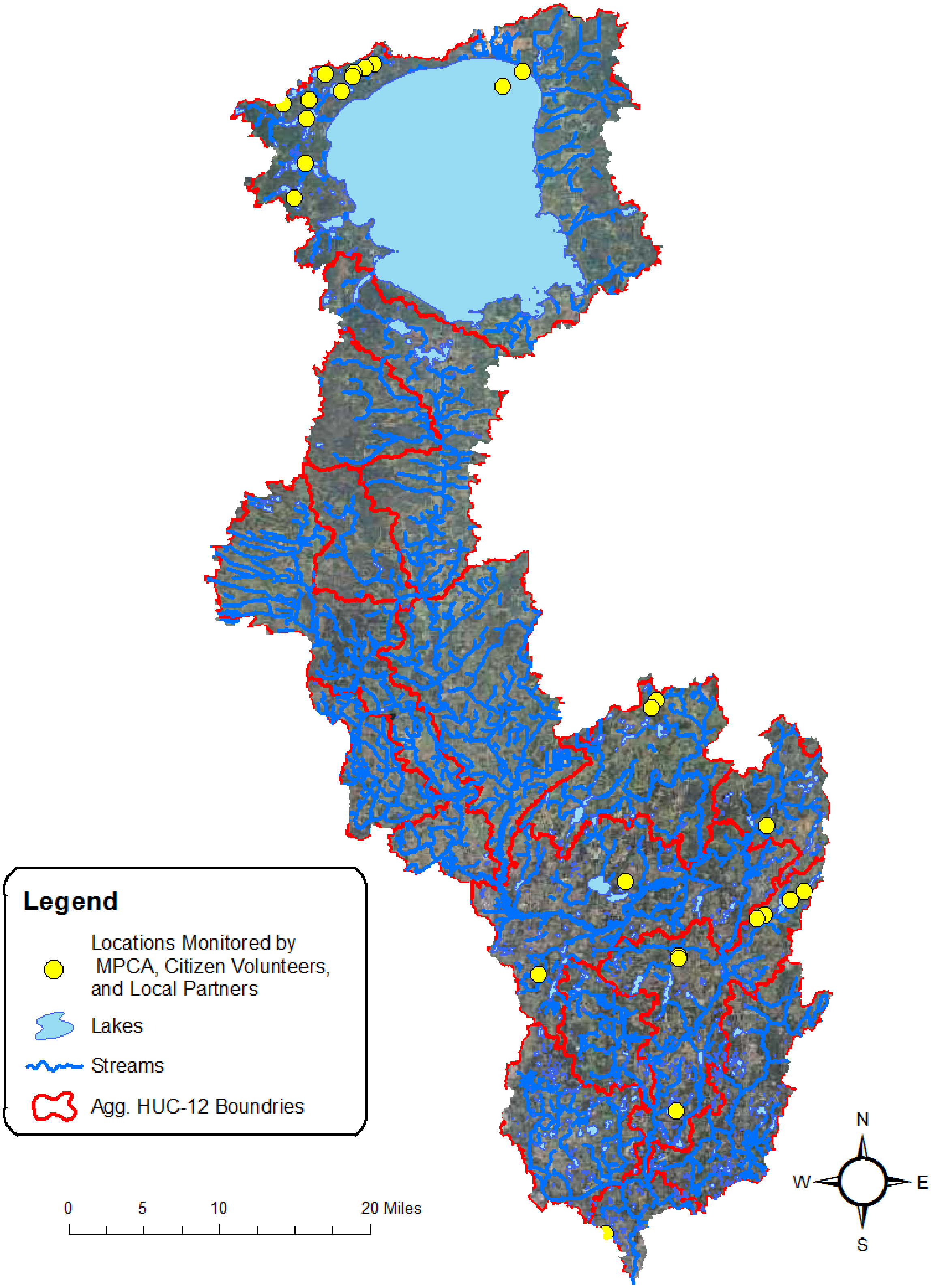

Figure 4. Monitoring locations of groups, citizens and the MPCA lake monitoring staff in the Rum River Watershed.

Assessment methodology

The Clean Water Act requires states to report on the condition of the waters of the state every two years. This biennial report to Congress contains an updated list of surface waters that are determined to be supporting or non-supporting of their designated uses as evaluated by the comparison of monitoring data to criteria specified by Minnesota Water Quality Standards (Minn. R. ch. 7050 2008; https://www.revisor.leg.state.mn.us/rules/?id=7050). The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment methodologies see: Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List (MPCA 2012). https://www.pca.state.mn.us/sites/default/files/wq-iw1-04.pdf.

Water quality standards

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

Protection of aquatic 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. To effectively use biological indicators, the MPCA employs the Index of Biotic Integrity (IBI). This index is a scientifically validated combination of measurements of the biological community (called metrics). An IBI is comprised of multiple metrics that measure different aspects of aquatic communities (e.g., dominance by pollution tolerant species, loss of habitat specialists). Metric scores are summed together and the resulting index score characterizes the biological integrity or "health" of a site. The MPCA has developed IBI's for (fish and macroinvertebrates) since these communities can respond differently to various types of pollution. Because the rivers and streams in Minnesota are physically, chemically, and biologically diverse IBI's are developed separately for different stream classes to account for this natural variation. Further interpretation of biological community data is provided by an assessment threshold or biocriteria against which an IBI score can be compared within a given stream class. In general, an IBI score above this threshold is indicative of aquatic life use support, while a score below this threshold is indicative of non-support. Additionally, chemical parameters are measured and assessed against numeric standards developed to be protective of aquatic life, including pH, dissolved oxygen, un-ionized ammonia nitrogen, chloride and turbidity.

Protection for aquatic life uses are divided into three tiers: Exceptional, General, and Modified. Exceptional Use waters support fish and macroinvertebrate communities that have minimal changes in structure and function from the natural condition. General Use waters harbor "good" assemblages of fish and macroinvertebrates that can be characterized as having an overall balanced distribution of the assemblages and with the ecosystem functions largely maintained through redundant attributes. Modified Use waters have been extensively altered through legacy physical modifications which limit the ability of the biological communities to attain the General Use. Currently the Modified Use is only applied to waters with channels that have been directly altered by humans (e.g., maintained for drainage, riprapped). These tiered uses (Table 1) are determined before assessment based on the attainment of the applicable biological criteria and/or an assessment of the habitat. For additional information, see: http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html).

Table 1.Proposed Tiered Aquatic Life Use Standards

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

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

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

A small percentage of stream miles in the state (~1 percent 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 MNDNR. 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. Flowchart of aquatic life use assessment process..

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

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

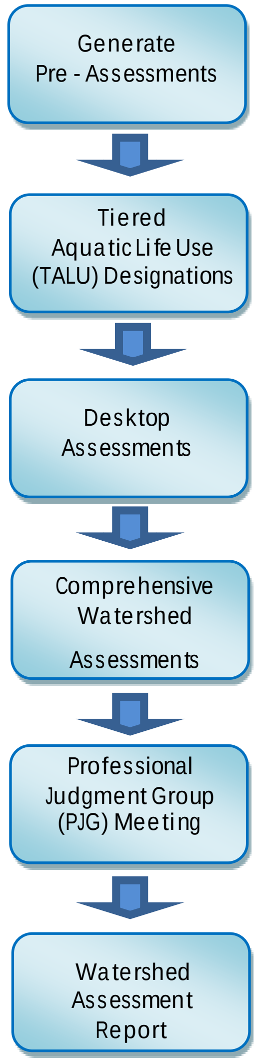

Figure 5. Flowchart of aquatic life use assessment process.

The next step in the process is a Comprehensive Watershed Assessment meeting where reviewers convene to discuss the results of their desktop assessments for each individual waterbody. Implementing a comprehensive approach to water quality assessment requires a means of organizing and evaluating information to formulate a conclusion utilizing multiple lines of evidence. Occasionally, the evidence stemming from individual parameters are not in agreement and would result in discrepant assessments if the parameters were evaluated independently. However, the overall assessment considers each piece of evidence to make a use attainment determination based on the preponderance of information available. See the *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA 2012) https://www.pca.state.mn.us/sites/default/files/wq-iw1-04.pdf for guidelines and factors considered when making such determinations.

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

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.

Watershed overview

The Rum River Watershed (HUC 07010207) is located in the eastern edge of the Upper Mississippi River Basin, in east central Minnesota, bordering the St. Croix basin to the east. The watershed is a moderately agricultural region within the Northern Lakes and Forests Ecoregion and North Central Hardwoods Forest Ecoregion, draining an area of 1,584 square miles (Figure 6). The Rum River Watershed includes parts of Aitkin (12.7%), Crow Wing (3.4%), Morrison (6.4%), Mille Lacs (36.1%), Kanabec (1.2%), Benton (2.3%), Isanti (23.8%), Chisago (0.3%), Sherburne (3.1%), and Anoka (10.7%) counties (USDA, NRCS). The watershed's surface waters include 212 lakes (over ten acres) and 233 streams segments, or assessment units (AUIDs), throughout the watershed. From its source at Mille Lacs Lake, the Rum River runs south for a total length of 145 miles and confluences with the Mississippi River at Anoka. The watershed elevation ranges from approximately 800 to 1400 feet above sea level, decreasing from north to south.

The east central portion of Minnesota was called "Minsisagaigon" by the Ojibwa (Chippewa) meaning "the country of all sorts of lakes" which was later translated by French traders and trappers to "la region de Mille Lacs" meaning "the region of a thousand lakes". Mille Lacs later was applied to the largest lake in the area now Mille Lacs Lake (Minnesota Historical Society 1942). The native Dakota (Sioux) tribes called the river flowing out of Mille Lacs "Wahkon Wakpa" translated into English as "Spirit River". This name was misinterpreted by early trapper and pioneers to mean the spirituous liquor, rum (MNDNR 1973). There has been a recent push to bring back the original name and not the misinterpreted name. The land around Mille Lacs Lake was claimed the possession of King Louis XIV by

Daniel Greysolon, Sieur du Luth in 1679. The area only had a few European trappers and traders until the early 1800s when the logging of the expansive white pine forests to build Fort Snelling occurred. Logs were cut along the Rum River and floated down to St. Anthony Falls where they were cut for the fort. Land treaties in the 1830 opened the land in the Rum River Watershed to white settlers who cut down the majority of the white pine forests and the lumber was milled at locations along the river.

Mille Lacs Lake is the source is the source of the Rum River. The Rum flows south out of Mille Lacs Lake to the city of Princeton where the West Branch Rum flows into it. The West Branch Rum is the largest tributary to the Rum River. The river then flows east to the city of Cambridge then turns south again and flows into the Mississippi River in the city of Anoka.

The entire Rum River Watershed is classified as warmwater. The northern half of the watershed has higher gradient streams that are dominated by coarse substrate. Near the middle of the watershed many streams become low gradient with softer bottoms dominated by detritus. These streams usually have wide wetland margins. These areas were caused by the rapid moving streams under the glaciers leaving low spots within the watershed. These “tunnel valleys” are evident throughout the middle section of the Rum River Watershed. The lower third of the watershed has mainly sandy soils so the streams are neither high or low gradient but tend to have only a little coarse substrate.

Prior to settlement of the area white pine forests dominated the landscape. Today the watershed extends from the suburbs of Minneapolis to the wilds of cabin country. From north to south the Rum River changes from a heavily forested areas north of Milaca to the mainly agricultural areas near the city of Princeton and Cambridge to an urban dominated region around the city Anoka.

The northern half of the watershed half of the watershed is in the Northern Lakes and Forests Ecoregion and is dominated by Mille Lacs Lake, forest, and wetlands. The southern half of the watershed is within the North Central Hardwood Forest Ecoregion (Figure 6). Agricultural and urban land use dominates the North Central Hardwood Forest Ecoregion.

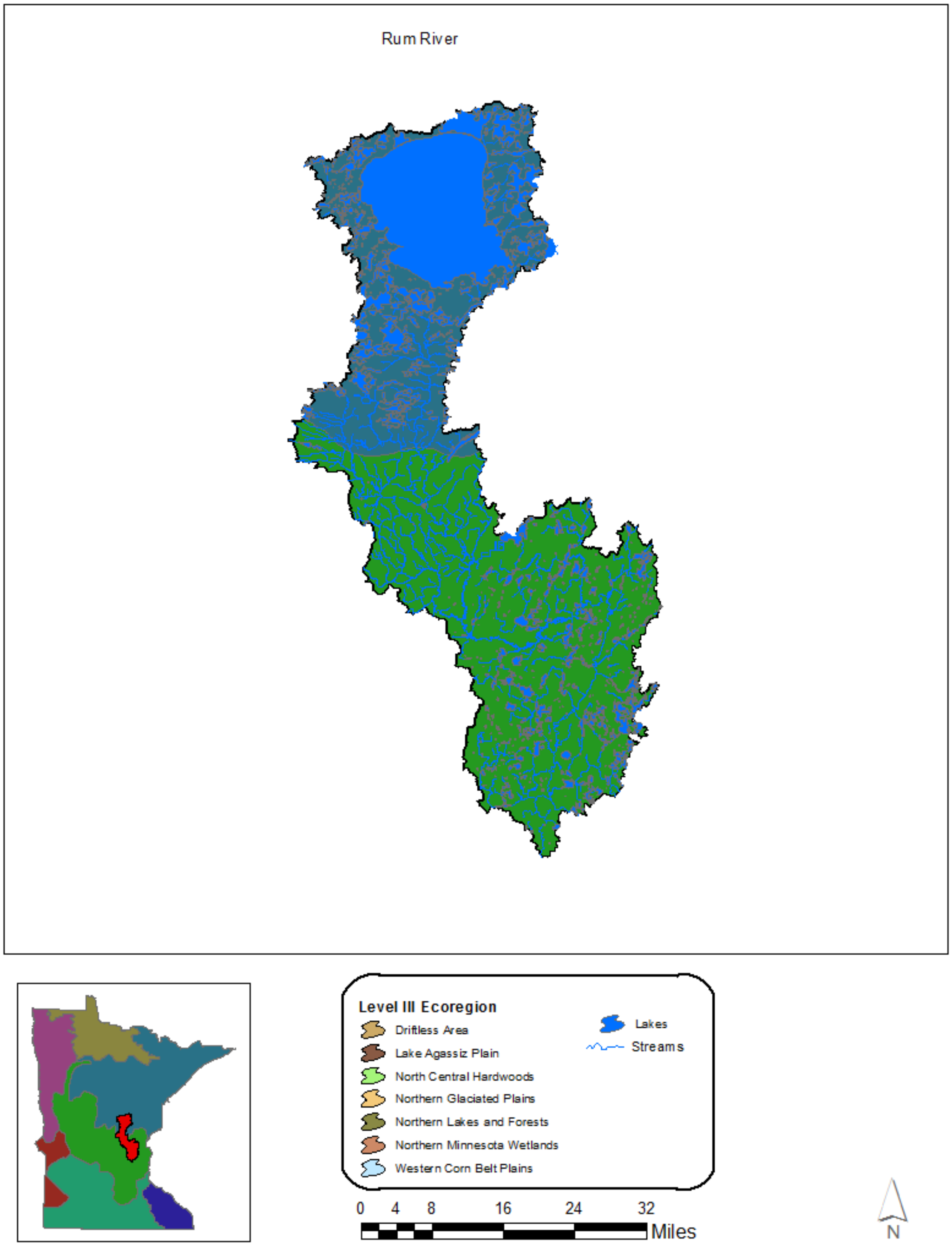

Figure 6. The Rum River Watershed within the Northern Lakes and Forest and North Central Hardwood Forest ecoregions of Central Minnesota.

Land use summary

The Rum River Watershed has land uses that are broken into three distinct regions. The most northern third of the Rum River Watershed is mainly forest and wetland and is dominated by Mille Lacs Lake but has little development and agriculture. The middle third still has wetland and forest especially along the stream corridors but the predominant land use is agriculture mainly cattle pastures and fields cultivated for food for cattle such as hay and alfalfa. The lower third is much like the middle only it has a much higher human density and more urban areas.

The land is moderately agricultural with 38% utilized for cropland and pasture (USDA, NRCS). The land is owned predominately by private owners (90.6%), while the remaining land is county (0.1%), State (6.5%), other public (0.5%), Tribal (0.2%) and private major (2.0%) (USDA, NRCS). Other land use and cover includes: forest (30.6%), wetlands (10.6%), open water (14.8%), grass/pasture/hay (20.4%), cropland (18.1%) and residential/commercial development (5.3%) (Figure 7) (USDA, NRCS). The total population count of the watershed is 110,366 with an estimated 2,153 farms (USDA, NRCS).

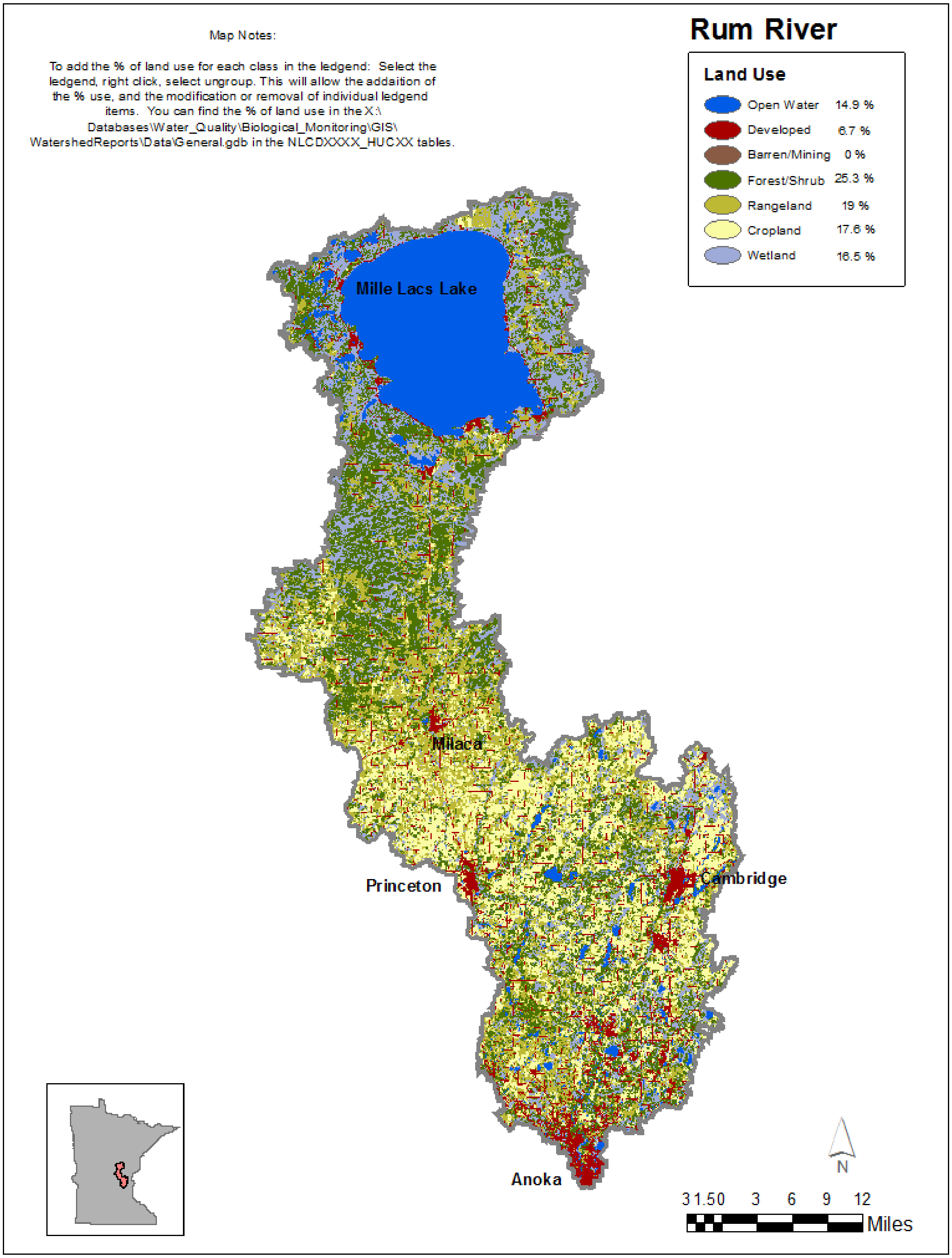

Figure 7. Land use in the Rum River Watershed.

Surface water hydrology

The Rum River Watershed's surface hydrology is comprised of open water (14.8%) and wetlands (10.6%). The watershed has 212 lakes over ten acres in size, 1,656 stream miles (233 Assessment Unit Identification Determination (AUID)), and 9,912 acres of wetlands (Figure 8) (USDA, NRCS). From its source at Mille Lacs Lake, the Rum River runs south for a total length of 145 miles and confluences with the Mississippi River at Anoka (MPCA, 2015a). Other major rivers and creeks in the watershed include Bogus Brook and Mike Drew Brook and major lakes include Mille Lacs, Onamia and Borden (MPCA, 2015a).

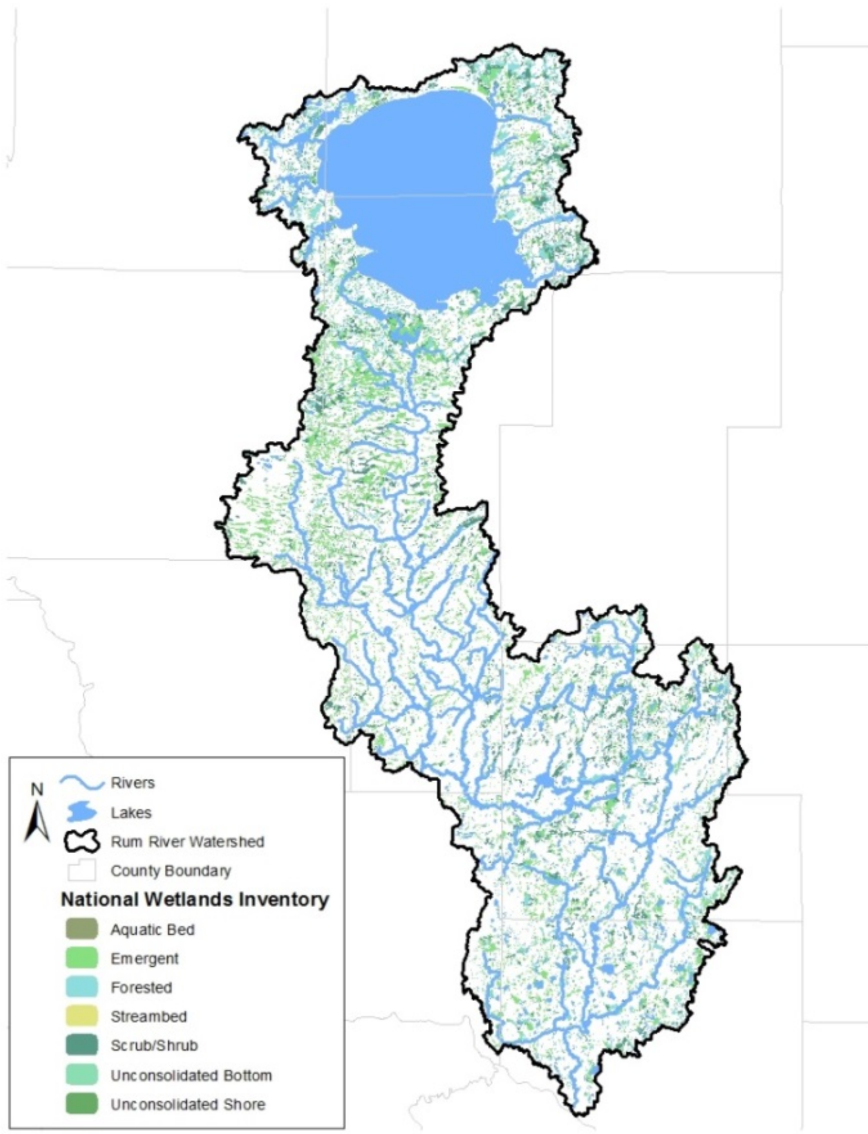

Figure 8. Lakes, wetlands and waterbodies in the Rum River Watershed.

Streamflow

Stream flow data from the United States Geological Survey's real-time streamflow gaging stations for one river in the Rum River Watershed was analyzed for annual mean discharge and summer monthly mean discharge (July and August). Figure 9 is a display of the annual mean discharge for the Rum River near St. Francis, MN from water years 1995 to 2014. The data shows that although streamflow appears to be slightly increasing, there is no statistically significant trend. Figure 10 displays July and August mean flows for the same time frame, for the same water body. Graphically, the data appears to be increasing in July and August, but neither at a statistically significant rate. By way of comparison at a state level, summer month flows have declined at a statistically significant rate at a majority of streams selected randomly for a study of statewide trends (Streitz, 2011). For additional streamflow data throughout Minnesota, please visit the USGS website: http://waterdata.usgs.gov/mn/nwis/rt.

Some of the tributaries to the Rum River have been altered by channelization (ditched) to promote drainage of some areas in the watershed to increase crop productivity (Figure 12). Although alteration is not as severe as in some watersheds of the state, drainage ditches are a pervasive feature in this watershed. Based on the MPCA's statewide Altered Watercourse Project, 64.5% of the tributaries have been channelized, while 33.3% remain natural (Figure 11).

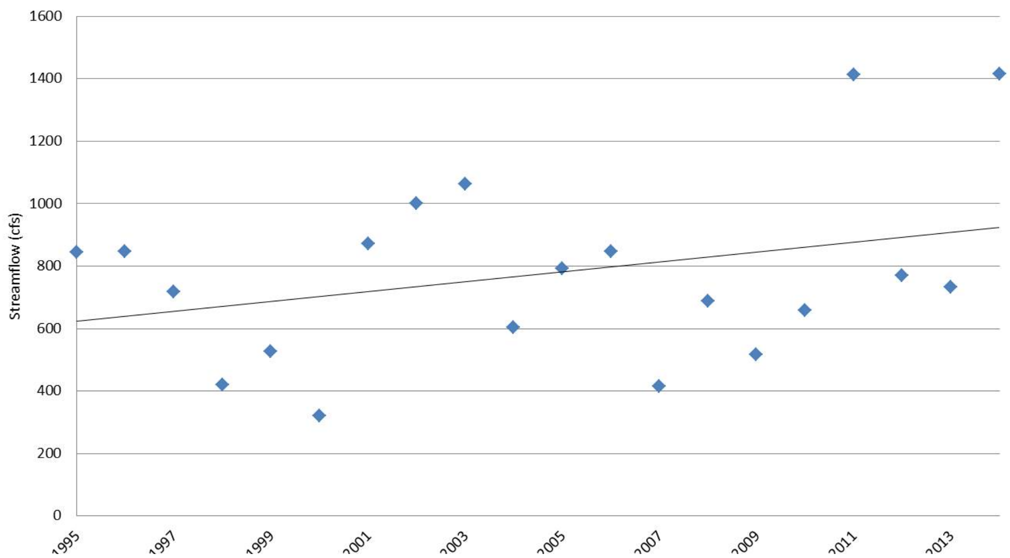

Figure 9. Annual mean discharge for Rum River near St. Francis, Minnesota (1995-2014).

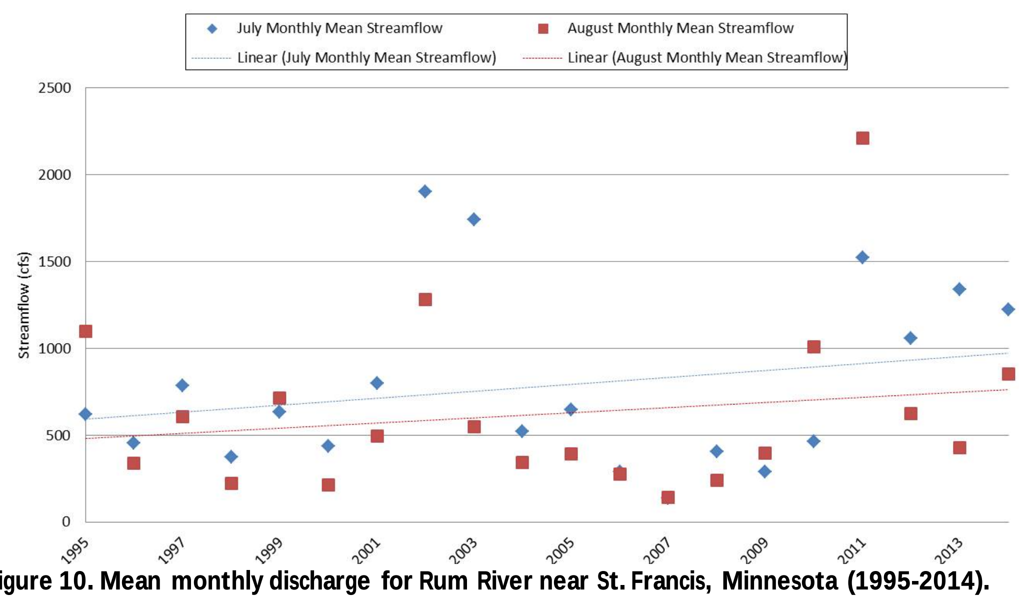

Figure 10. Mean monthly discharge for Rum River near St. Francis, Minnesota (1995-2014).

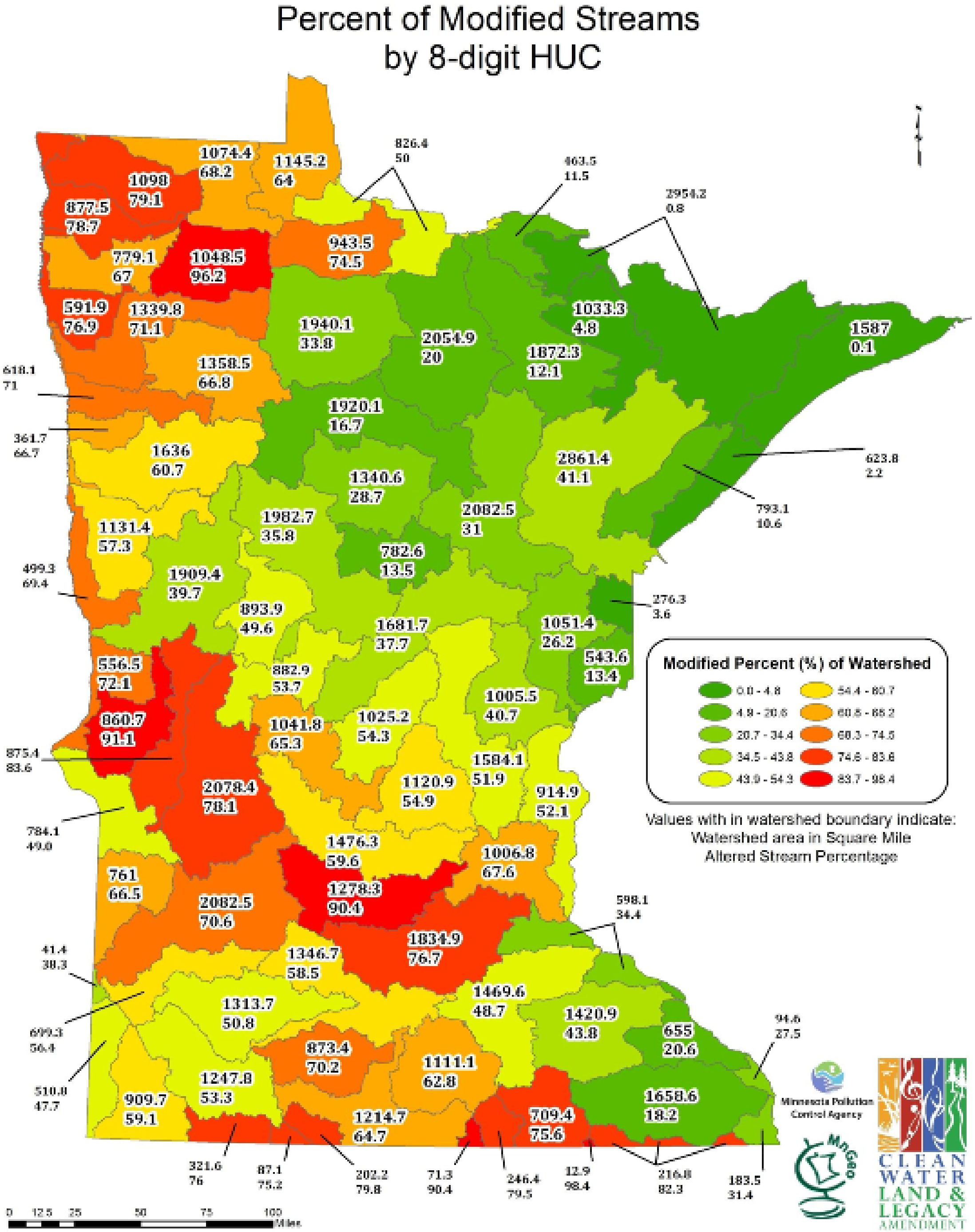

Figure 11. Map of percent modified streams by major watershed (8-HUC).

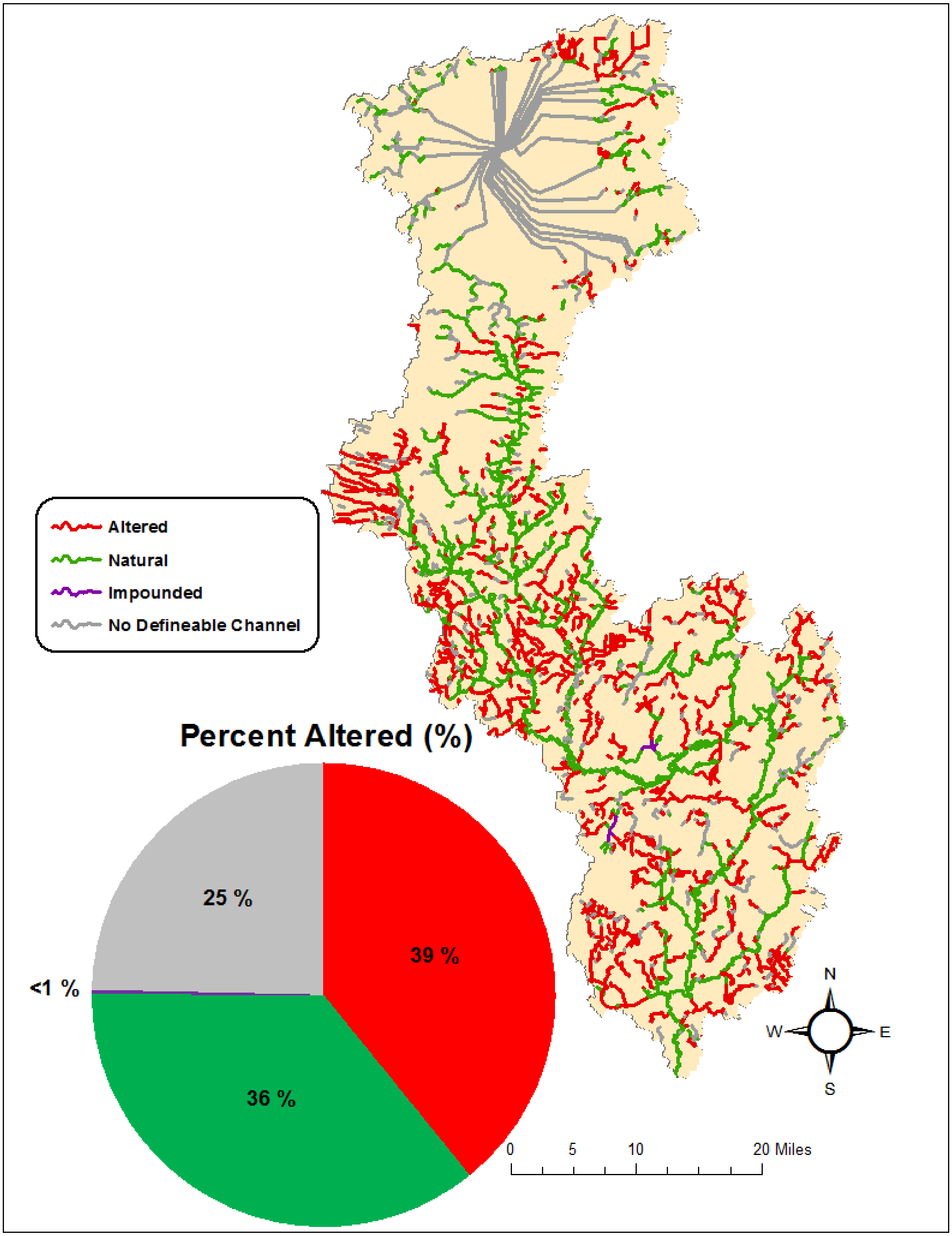

Figure 12. Comparison of natural to altered streams in the Rum River Watershed (percentages derived from the State-wide Altered Water Course project).

Climate and precipitation

Minnesota has a continental climate, marked by warm summers and cold winters. The mean annual temperature for Minnesota is 4.6˚C (NOAA, 2016); the mean summer temperature for the Rum River Watershed is 18.3˚C and the mean winter temperature is -11.1˚ C (MNDNR: Minnesota State Climatology Office, 2003).

Precipitation is an important source of water input to a watershed Figure 14 and Figure 15 so precipitation treads. Figure 13 shows two representations of precipitation for calendar year 2013. On the left is total precipitation, showing the typical pattern of increasing precipitation toward the eastern portion of the state. According to Figure 13, the Rum River Watershed area primarily received 28 to 32 inches of precipitation in 2013. The display on the right shows the amount those precipitation levels departed from normal for the Rum River Watershed. The map shows that precipitation ranged about normal in 2013.

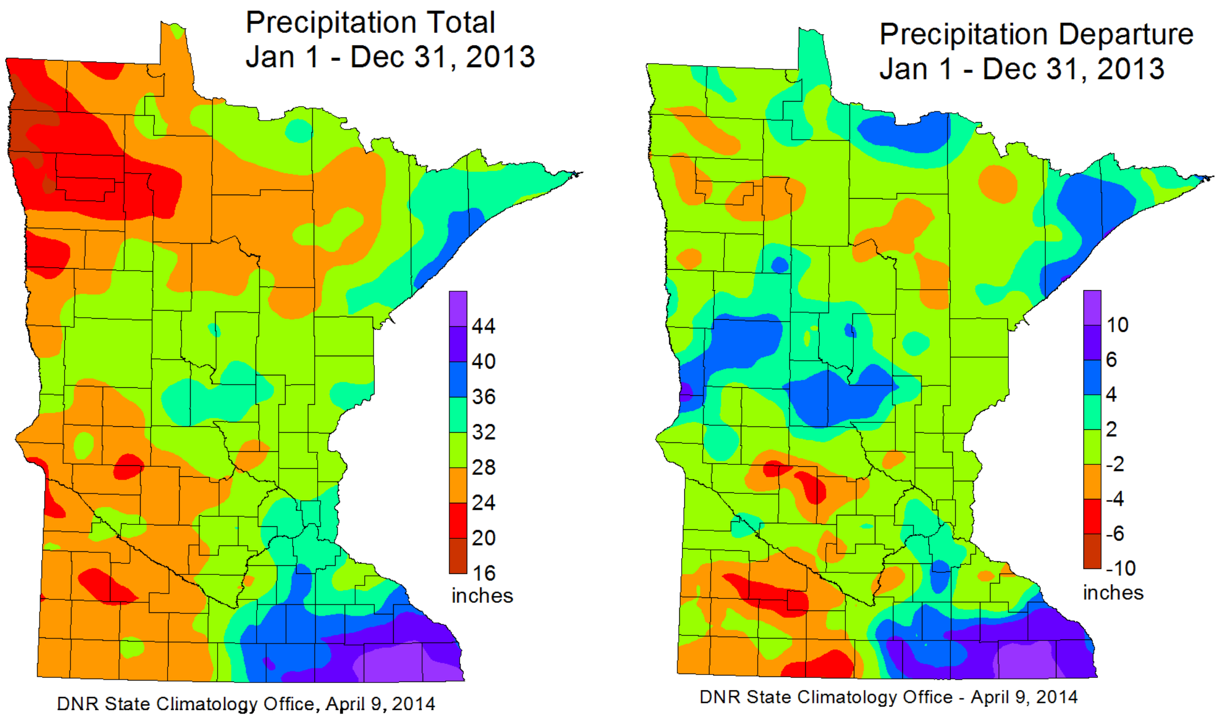

Figure 13. State-wide precipitation levels during the 2013 water year.

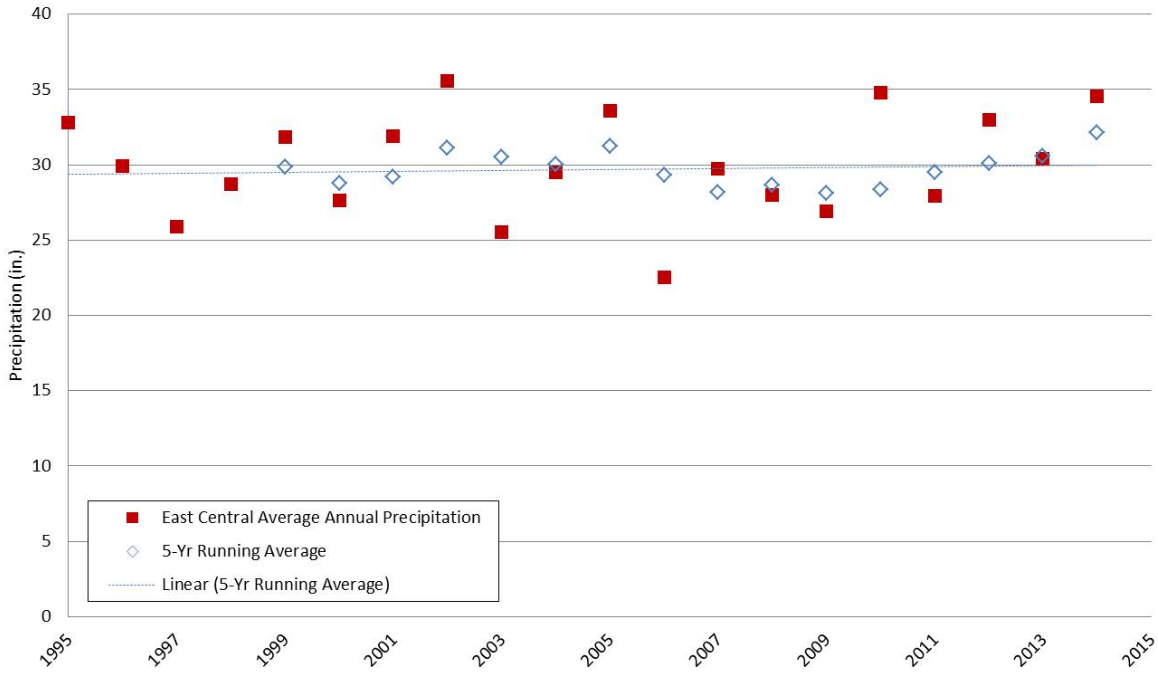

Figure 14. Precipitation trends in East Central Minnesota (1994-2014) with five-year running average.

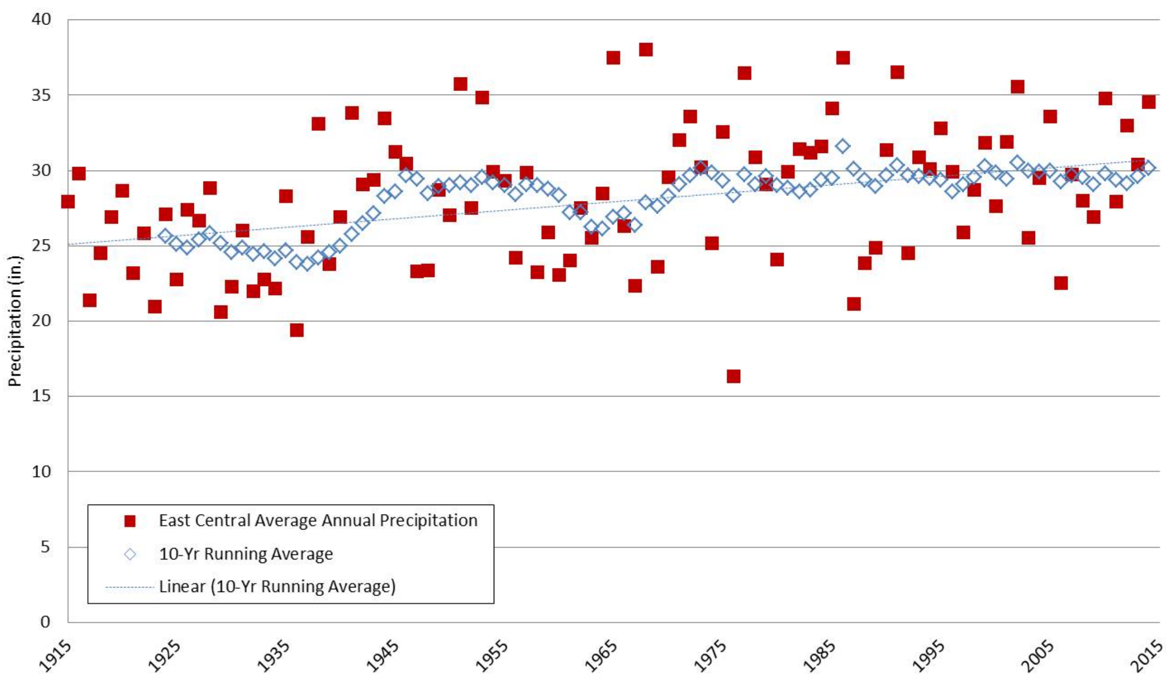

Figure 15. Precipitation trends in East Central Minnesota (1914-2014) with ten-year running average.

Hydrogeology and groundwater quality

Approximately 75% of Minnesota's population receives their drinking water from groundwater, undoubtedly indicating that clean groundwater is essential to the health of its residents. The Minnesota Pollution Control Agency's Ambient Groundwater Monitoring Program monitors trends in statewide groundwater quality by sampling for a comprehensive suite of chemicals including nutrients, metals, and volatile organic compounds. These Ambient wells represent a mix of deeper domestic wells and shallow monitoring wells. The shallow wells interact with surface waters and exhibit impacts from human activities more rapidly. Available data from federal, state and local partners are used to supplement reviews of groundwater quality in the region.

There are currently 18 MPCA Ambient Groundwater Monitoring well (17 monitoring, 1 domestic) within the Rum River Watershed. Figure 16 displays the locations of ambient groundwater wells within and around the specified watershed. Data collection ranged from 2004 to 2015; however, the majority of the wells were added in 2010. Therefore, data analysis was conducted on the current MPCA Ambient Groundwater Wells from 2010 to 2015.

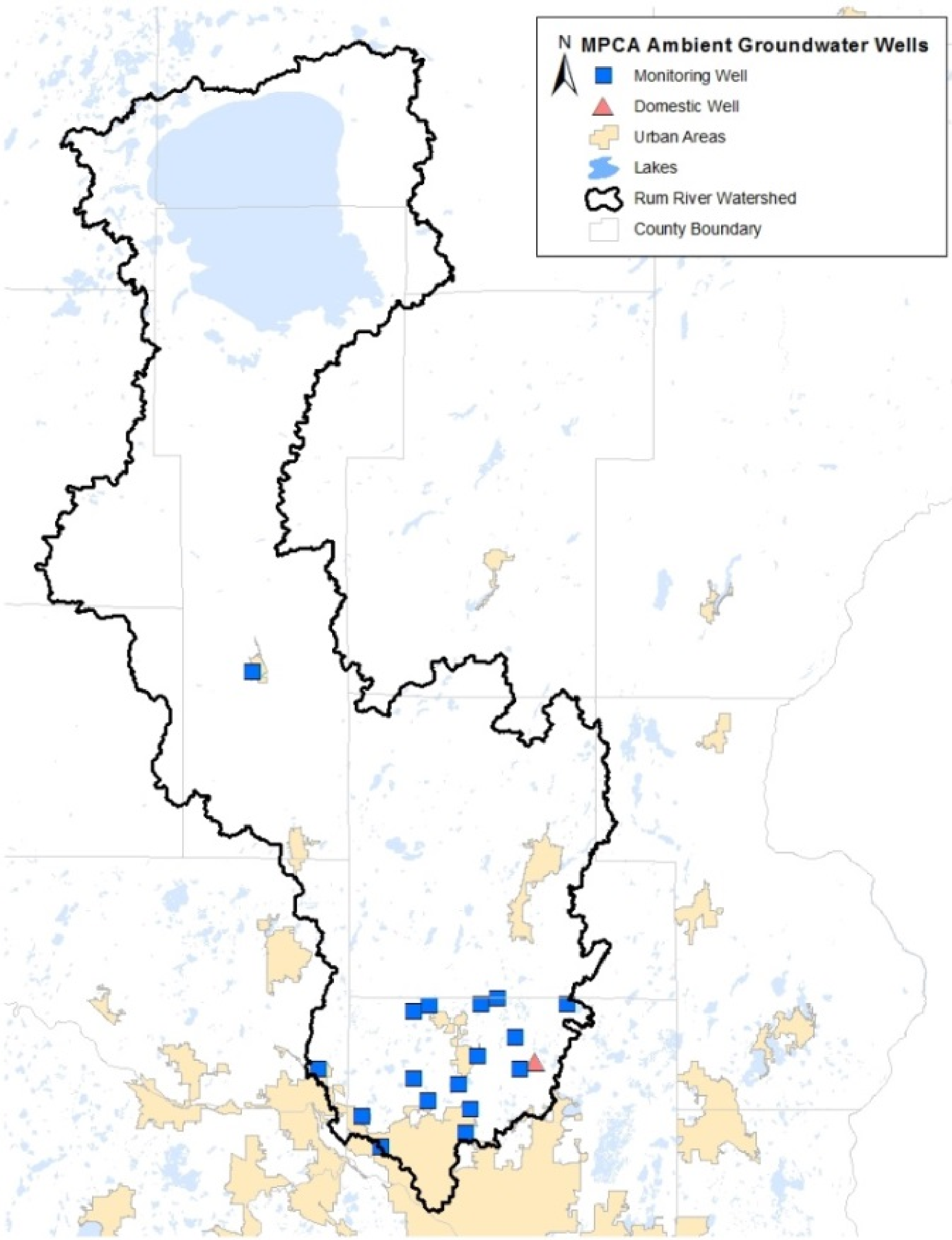

Figure 16. MPCA ambient groundwater monitoring well locations within the Rum River Watershed.

The groundwater wells are primarily located within the southern extent of the watershed, with many near urbanized areas (Figure 16). Urbanized areas tend to pose a greater threat for groundwater pollution due to faulty or leaking sewage and septic systems, close vicinity to roads where salt is often used as a deicing agent, and additional emissions from vehicles and infrastructure. Of the 18 wells, 15 are located in residential areas with subsurface sewage treatment systems (SSTS) (also referred as septic systems), two are located in undeveloped areas, and one is within a sewered residential area. In a study of contaminants of emerging concern (CECs) of ambient groundwater in urbanized areas of Minnesota conducted by USGS and MPCA, samples from wells located in sewered residential land use area were identified to have higher percentages of CEC detections when compared to undeveloped or septic residential land uses (SSTS) (Erickson et al., 2014). CECs are predominantly manmade chemicals, although some may be naturally occurring or endocrine active chemicals, and include pharmaceuticals, fire retardants, pesticides, personal-care products, hormones, and detergents (Erickson et al., 2014). The three most commonly occurring CEC detections for the wells sampled within the Rum River Watershed from 2010 to 2014.

Chloride has become an increasing concern in developed areas where salt is used as a deicing agent, where higher chloride concentrations can affect the taste of drinking water (Kroening & Ferrey, 2013). Chloride has a secondary MCL set as 250 milligrams per liter for taste. Chloride detection frequency within the watershed was 93.9% with 10 occurrences exceeding the secondary limit (Figure 17). Sodium is also a naturally occurring chemical, but it can also be associated with road salt application. There is no drinking water standard at this time, but high concentrations can be a concern for those with a low sodium diet. Sodium had elevated concentrations in these wells, with a 98.7% detection frequency, ranging from 1.45 to 201 mg/L (Figure 18). Another chemical of concern is nitrate, a form of nitrogen, which has a MCL of 10 milligrams per liter. This limit is primarily set for the risk of methemoglobinemia (blue-baby syndrome) in infants under the age of six months. Nitrate detection frequency occurred 95.2% of the time, with three exceedances of the MCL (Figure 19). Other common chemical and contaminant detections identified in these wells were sulfate, bromide, aluminum, iron, magnesium, manganese, potassium, strontium, barium, boron and phosphorus.

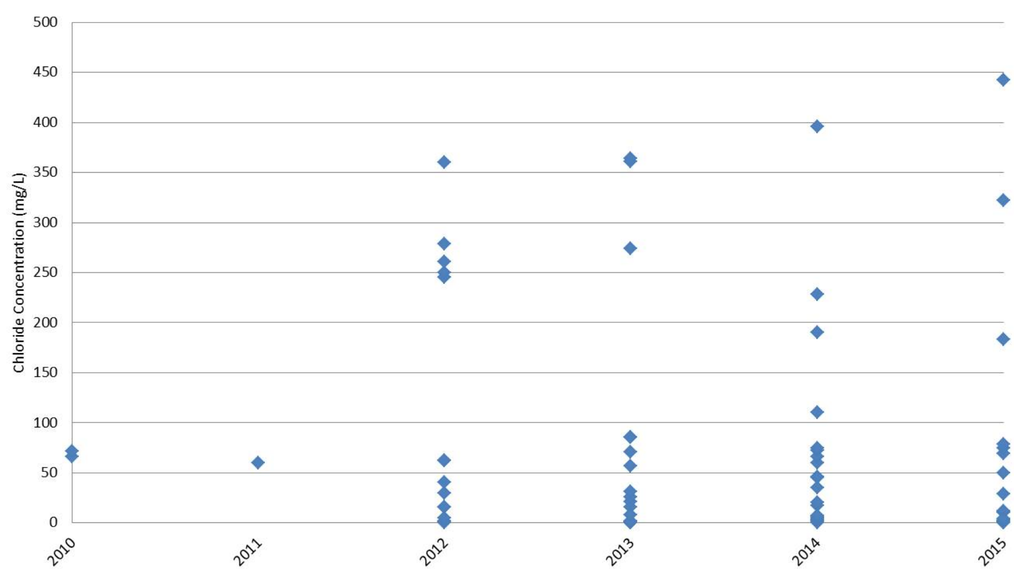

Figure 17. Ambient groundwater monitoring data for chloride concentrations (2010-2015).

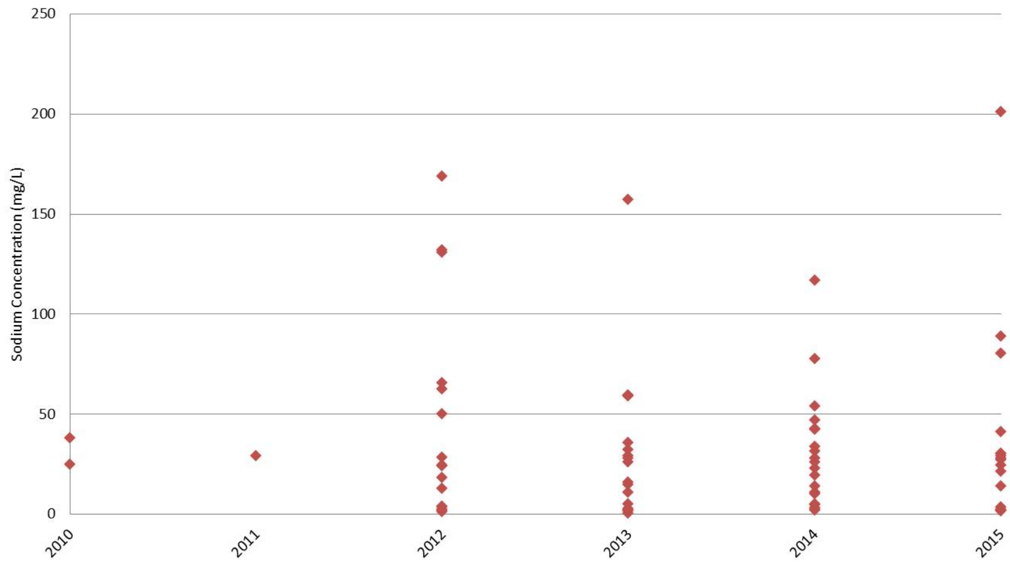

Figure 18. Ambient groundwater monitoring data for sodium concentrations (2010-2015).

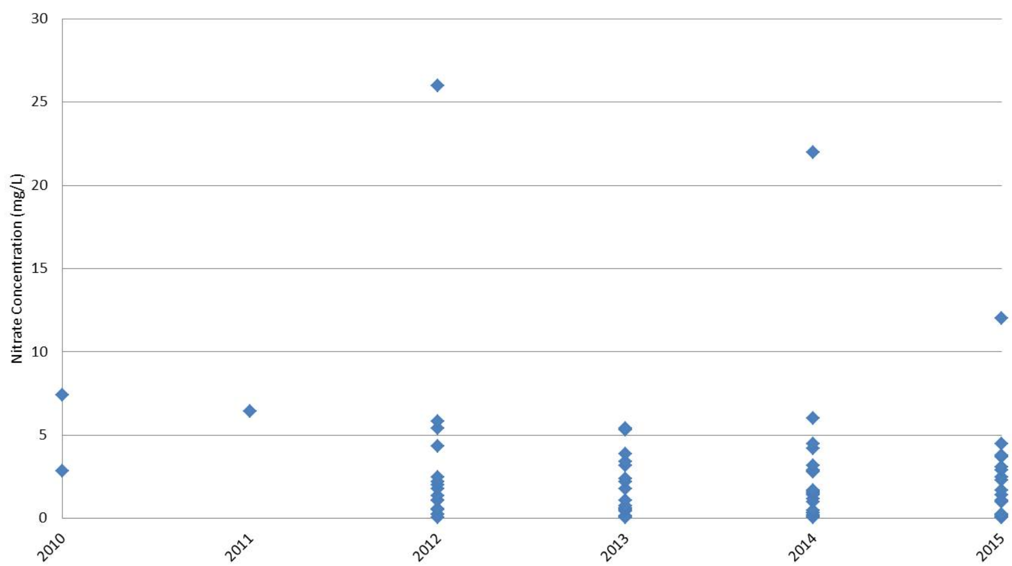

Figure 19. Ambient groundwater monitoring data for nitrate concentrations (2010-2015).

Regional groundwater quality

From 1992 to 1996, the Minnesota Pollution Control Agency conducted baseline water quality sampling and analysis of Minnesota's principal aquifers based on dividing Minnesota into six hydrogeologic regions: Northwest, Northeast, Southwest, Southeast, North Central and Twin Cities Metropolitan Regions. The Rum River Watershed lies primarily within the North Central Hydrogeologic Region, with the northern point in the Northeast Region and the southern point in the Twin Cities Metropolitan Region (Figure 20). The baseline study determined that the groundwater quality in the North Central Region is considered very good in most aquifers when compared to other areas with similar aquifers. The number of exceedances to drinking criteria for arsenic, beryllium, boron, manganese, nickel, nitrate, selenium, thallium, and vanadium ranged from one to seven, depending on the aquifer (MPCA, 1998). Nitrate was identified as the chemical of greatest concern in this hydrogeologic region, with probable anthropogenic sources contributing to the elevated concentrations. Volatile organic compounds were also detected with the most commonly detected compounds associated with fuel oils, gasoline and well disinfection (MPCA, 1998).

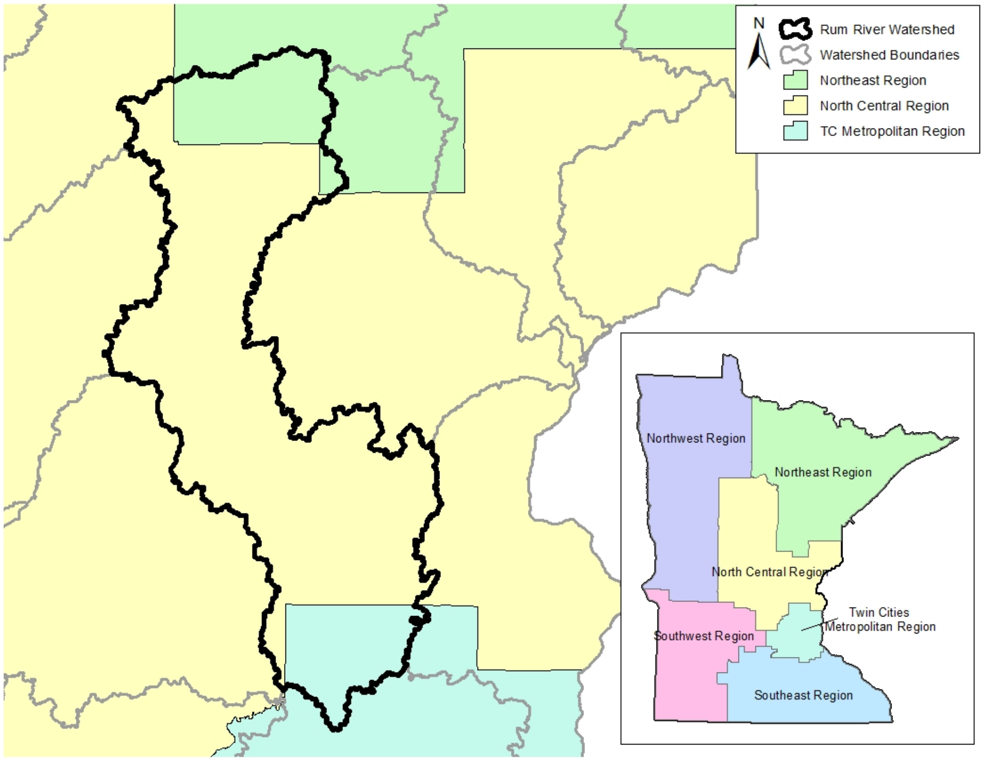

Figure 20. Rum River Watershed within the MPCA hydrogeological Region

The Minnesota Department of Agriculture (MDA) monitors pesticides and nitrate on an annual basis in groundwater across agricultural areas in the state. The MDA also separates the state into regions, which consist of ten regional water quality monitoring networks that are referred to as Pesticide Monitoring Regions (PMRs). The Rum River Watershed lies primarily within the regional water quality monitoring networks for Region 5 (PMR 5). PMR 5 is also referred to as the East Central Region.

The Monitoring and Assessment Unit (MAU) of the MDA sampled 167 sites throughout Minnesota for pesticides in groundwater in 2014. Although some wells detected up to five common detection pesticides or degradants, which include acetochlor, alachlor, atrazine, metolachlor and metribuzin, no detections exceeded drinking water standards for human consumption (MDA, 2015). Within the Rum River Watershed, the MAU sampled sites in the central area for the presence of pesticides found detections of three to four pesticides per site (Figure 21). When analyzing median trends for long term groundwater sampling for PMR 5, MAU has identified a statistically significant increasing trend in desethylatrazine while a statistically significant decreasing trend in alachlor ESA, metolachlor ESA and metalachlor OXA (MDA, 2015). All other median trend analysis results had no trend or a trend not statistically significant. Detection frequency trend analysis determined statistically significant decreasing trends for alachlor ESA, alachlor OXA, atrazine, and metolachlor ESA; all others did not exhibit trends or statistically significant trends (MDA, 2015).

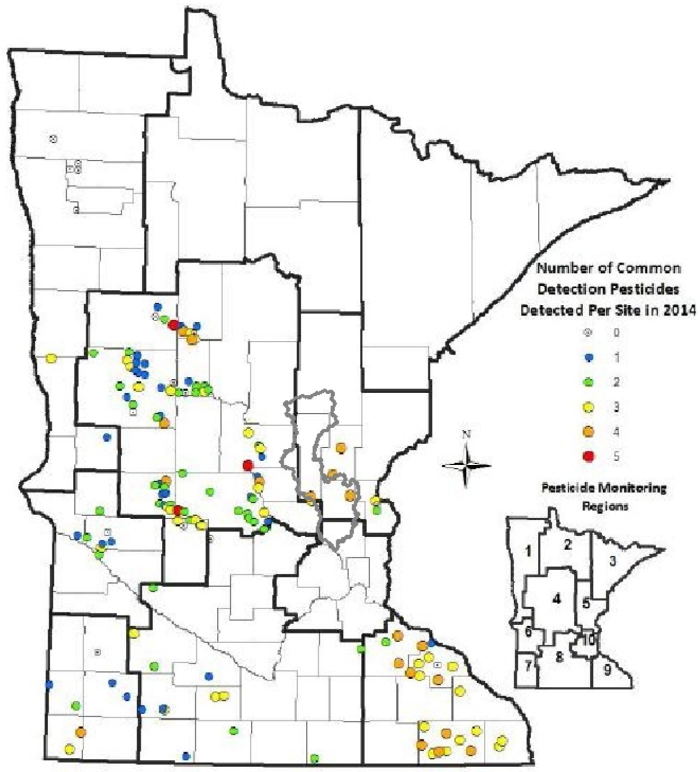

Figure 21. Pesticide detections within the Rum River Watershed (Source: MDA, 2015).

Although there are limited sampling sites specifically within the watershed, PMR 5 displayed high levels of nitrogen-nitrate detections. The 2014 Water Quality Monitoring Report determined that nitrate-nitrogen was detected in 100% of the wells sampled in PMR 5 with a median concentration of 8.27 milligrams per liter (mg/L) (MDA, 2015). Of those samples, 12% were at or below background level of 3.00 mg/L, 44% were within 3.01 and 10.00 mg/L, and 44% were above drinking water standard of 10.00 mg/L (MDA, 2015). Additionally, a MPCA report on the statewide condition of Minnesota's groundwater determined that sand and gravel aquifers have the greatest nitrate concentrations in the state, which also coincides with the location of the sites sampled by the MDA (Kroening & Ferrey, 2013).

Another source of information on groundwater quality comes from the Minnesota Department of Health (MDH). Mandatory testing for arsenic, a naturally occurring but potentially harmful contaminant for humans, of all newly constructed wells has found that 10.7% of all wells installed from 2008 to 2015 have arsenic levels above the maximum contaminant level (MCL) for drinking water of 10 micrograms per liter (MDH, 2015). MDH cannot force the private well owner to do anything to improve the water but suggests installing a water treatment system (such as specialty media, reverse osmosis systems with pre-oxidation, distillation systems), construct a new well, connect to a community public water system, or buy bottled water as methods to reduce arsenic in drinking water. If arsenic is above the MCL in public water supply wells, then MDH requires them to get water from a new source or to treat the water. In the Rum River Watershed, the majority of new wells are within the water quality standards for arsenic levels, but there are some exceedances to the MCL. When observing concentrations of arsenic by percentage of wells that exceed the MCL of 10 micrograms/liter per county, the watershed lays within counties that range from less than 5 to 10%, which is considered low. By county, the percentages of wells identified with concentrations exceeding the MCL are as follows: Aitkin (5.8%), Anoka (8.8%), Benton (0.8%), Crow Wing (4.3%), Chisago (3.5%), Isanti (2.6%), Kanabec (2.6%), Mille Lacs (0.6%), Morrison (4.1%), and Sherburne (2.5%) (Figure 22). For more information on arsenic in private wells, please refer to the Minnesota Department of Health's website: http://www.health.state.mn.us/divs/eh/wells/waterquality/arsenic.html.

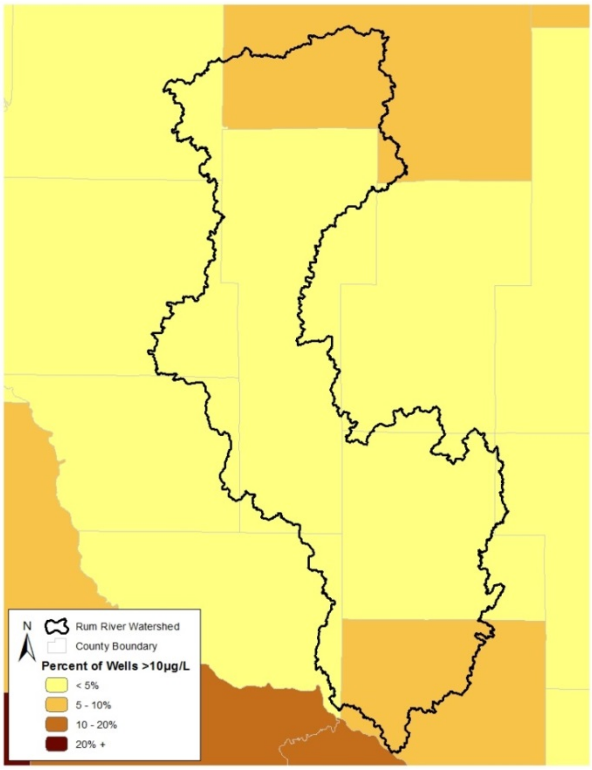

Figure 22. Percent wells with arsenic occurrence greater than the MCL for the Rum River Watershed (2008-2015) (Source: MDH, 2014)

A statewide dataset of potentially contaminated sites and facilities with environmental permits and registrations is available at the MPCA's website, through a web-based application called, "What's in My Neighborhood" (WIMN). This MPCA resource provides the public with a method to access a wide variety of environmental information about communities across the state. The data is divided into two groups. The first is potentially contaminated sites, and includes contaminated properties, formerly contaminated sites, and those that are being investigated for suspicion of being contaminated. The second category is made up of businesses that have applied for and received different types of environmental permits and registrations from the MPCA. An example of an environmental permit would be for a business acquiring a permit for a storm water or wastewater discharge, requiring it to operate within limits established by the MPCA. In the Rum River Watershed, there are currently 4,135 sites identified by WIMN: 1,597 water quality sites, 1,086 hazardous waste sites, 261 feedlots sites, 205 investigation and cleanup sites, 52 air quality sites, 22 solid waste sites, 911 tanks and leaks, and (Figure 23). For more information regarding "What's in My Neighborhood", refer to the MPCA webpage at: http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood.html.

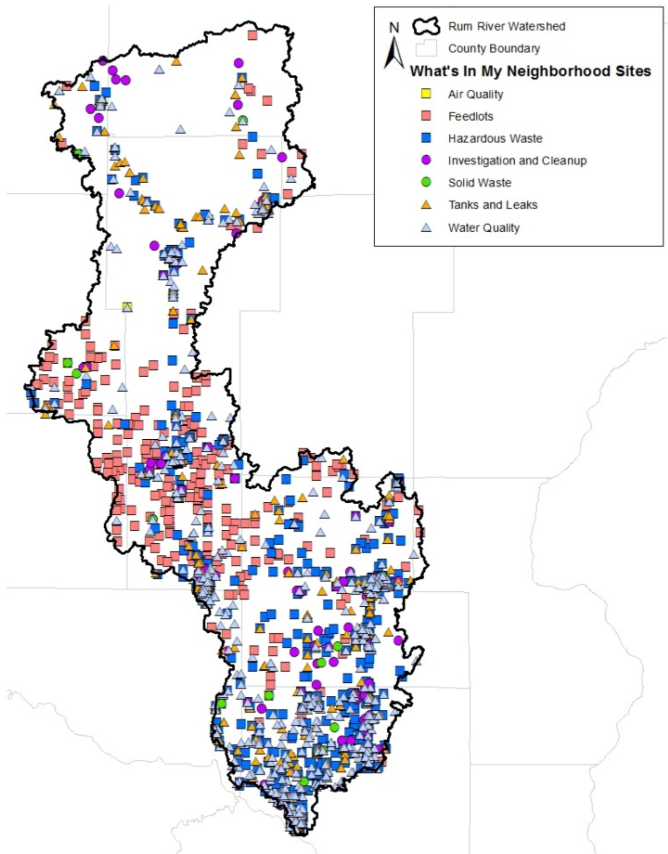

Figure 23. "What's in My Neighborhood" site programs and locations for the Rum River Watershed.

Groundwater quantity

The Department of Natural Resources permits all high capacity water withdrawals where the pumped volume exceeds 10,000 gallons per day or one million gallons per year. Permit holders are required to track water use and report back to the MNDNR yearly. The changes in withdrawal volume detailed in this groundwater report are a representation of water use and demand in the watershed and are taken into consideration when the MNDNR issues permits for water withdrawals. Other factors not discussed in this report but considered when issuing permits include: interactions between individual withdrawal locations, cumulative effects of withdrawals from individual aquifers, and potential interactions between aquifers. This holistic approach to water allocations is necessary to ensure the sustainability of Minnesota's groundwater resources.

The three largest permitted consumers of water in the state (in order) are power generation, public water supply (municipals), and irrigation (MNDNR, 2015c). According to the most recent USGS site-specific water-use data system (SWUDS), in 2013 the withdrawals within the Rum River Watershed are primarily utilized for water supply (56.6%), such as private or municipal water supply. The remaining withdrawals include: agricultural irrigation (21.9%), non-crop irrigation (10.6%), industrial processing (5.8%), special categories including pollution containment, dust control and livestock watering (4.8%), water level maintenance (0.2%), heating and cooling purposes (0.04%) and power generation (0.01%) (Figure 24). From 1994 to 2013, withdrawals associated with agricultural and non-crop irrigation have increased significantly (p=0.01), while water supply, industrial processing, special categories and power generation have not exhibited any statistically significant trends. Heating and cooling and water level maintenance have also increased significantly over this time period (p=0.001 and p=0.01, respectively), but due to the very small percentage of water withdrawn, this is not considered substantial.

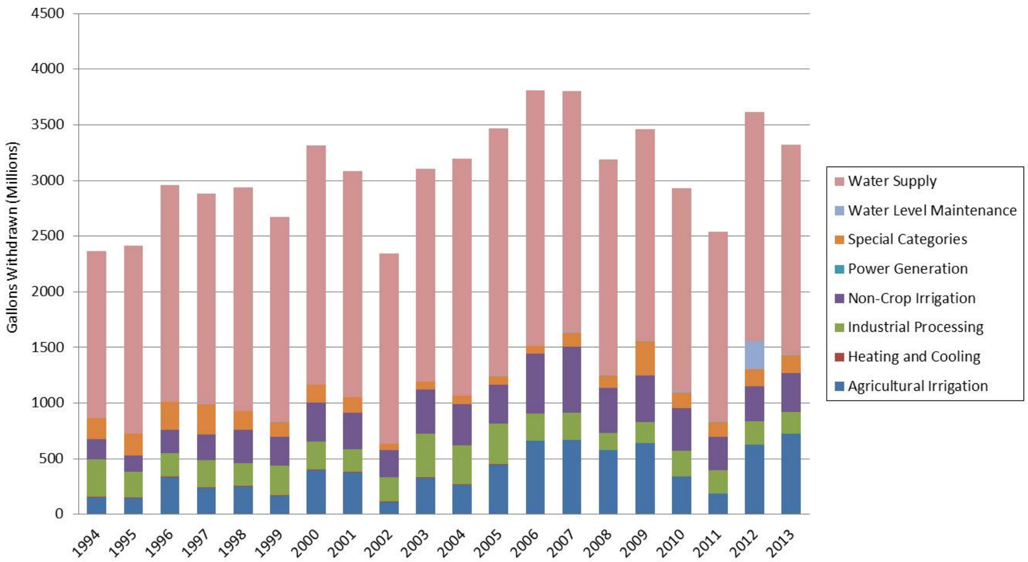

Figure 24. Groundwater and surface water permitted withdrawals by category within the Rum River Watershed (1994-2013).

Figure 25 displays total high capacity withdrawal locations within the watershed with active permit status in 2013. Permitted groundwater withdrawals are displayed below as blue triangles and surface water withdrawals as red squares. During 1994 to 2013, groundwater withdrawals within the Rum River Watershed exhibit a significant increasing withdrawal trend (p=0.05) (Figure 24), while surface water withdrawals does not exhibit a statistically significant trend (Figure 25). Water table (QWTA) withdrawals, which account for approximately 14.8 percent of all active groundwater withdrawals, do not emulate the overall groundwater withdrawal trend and has no statistically significant trend (Figure 26) compared to the decrease of surface water withdrawals (Figure 27) and quartnary (Figure 28) withdrawals over the same period.

The increase in groundwater withdrawals can be quantified further by the SWUDS data. In 1994, the number of active permits within the watershed for groundwater sources that reported withdrawal quantities was 149, pumping a reported amount of approximately 2.5 billion gallons of water. In 2013, the number of active permits for groundwater that reported withdrawal quantities was 213, withdrawing 3.3 billion gallons of water. For surface water withdrawals in 1994, the number of reported quantities by active permit holders was 17 and withdrew 89.9 million gallons, while in 2013, the number increased to 18 withdrawing 91.4 million gallons.

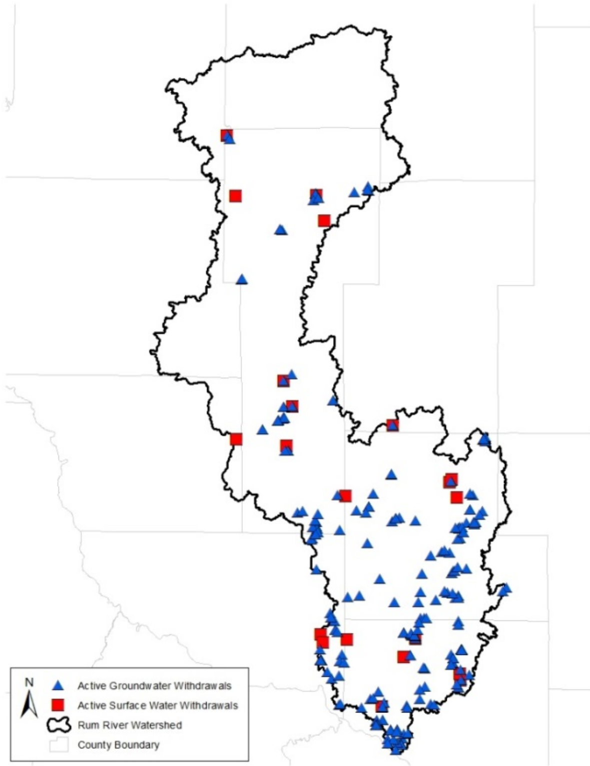

Figure 25. Locations of active status permitted high capacity withdrawals in 2013 within the Rum River Watershed.

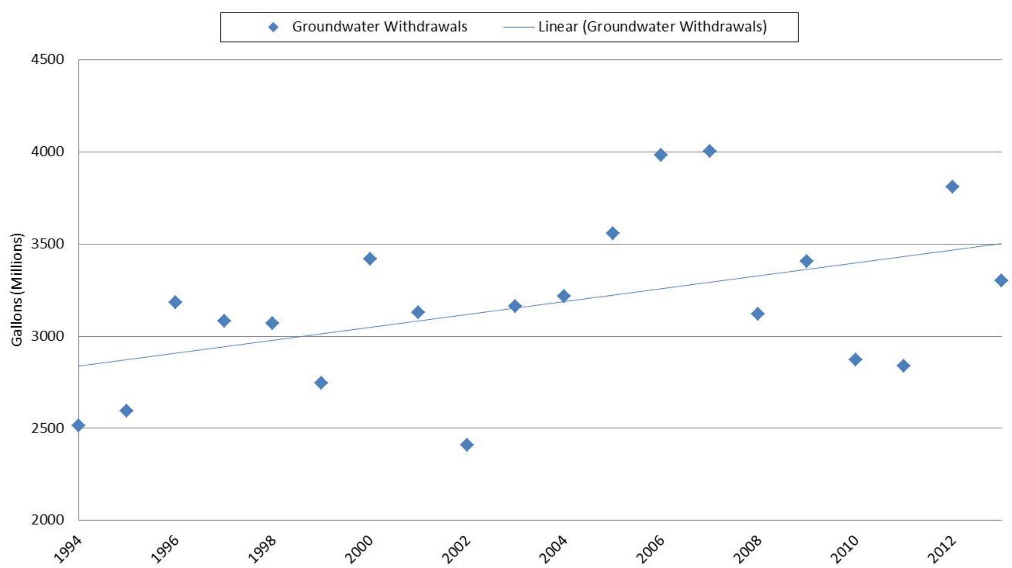

Figure 26. Total annual groundwater withdrawals in the Rum River Watershed (1994-2013).

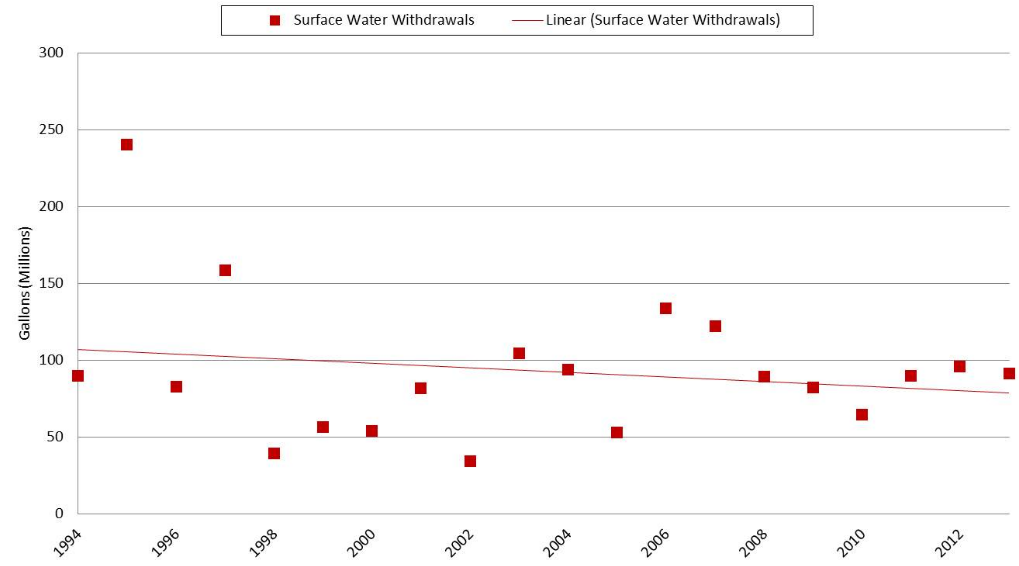

Figure 27. Total annual surface water withdrawals in the Rum River Watershed (1994-2013).

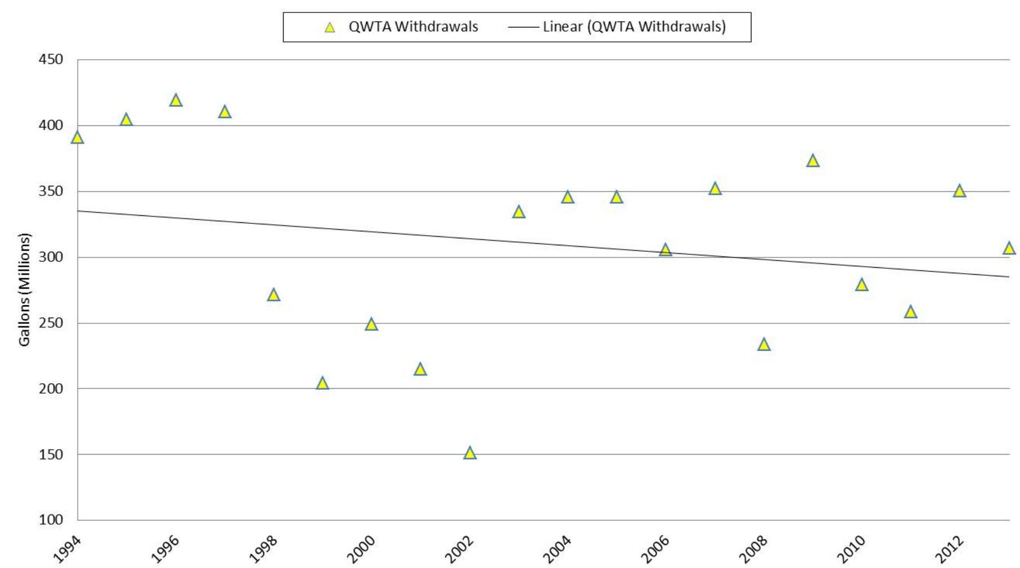

Figure 28. Total annual quaternary water table withdrawals in the Rum River Watershed (1994-2013).

Minnesota Department of Natural Resources observation wells

Monitoring wells from the MNDNR Observation Well Network track the elevation of groundwater across the state. The elevation of groundwater is measured as depth to water in feet and reflects the fluctuation of the water table as it rises and falls with seasonal variations and anthropogenic influences. To access the MNDNR Observation Well Network, please visit http://www.dnr.state.mn.us/waters/cgm/index.html.

Three of the nine MNDNR Observation Wells (48011, 02025 and 30005) within the Rum River Watershed were chosen based on data availability and geologic location as representative of depth to groundwater throughout the watershed (Figure 29). Depth to Water (DTW) was collected on a monthly basis and the average annual DTW was calculated.

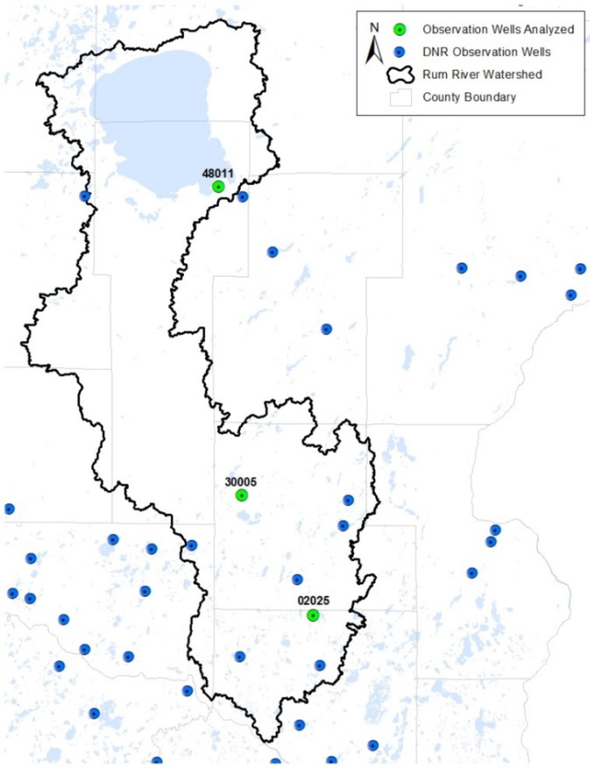

Figure 29. MNDNR quaternary water table observation well locations within the Rum River Watershed.

For observation well 48011 located near Wahkon in the northern region of the watershed (Figure 30), observation well 02025 near Bethel in the southern area of the watershed (Figure 31), and observation well 30005 near Princeton in the central region (Figure 32), there is no statistical trend in depth to groundwater on an average annual basis.

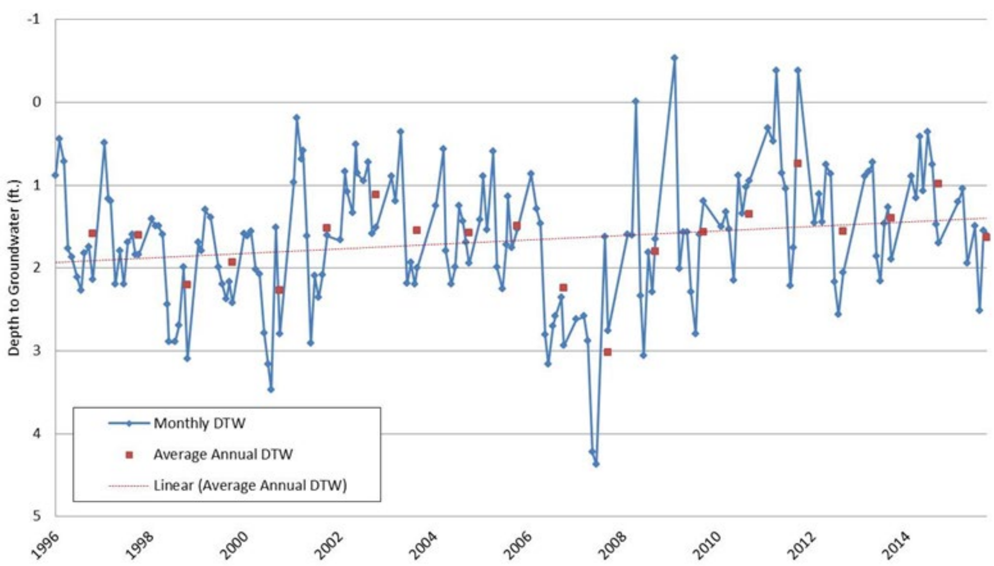

Figure 30. Depth to groundwater for observation well 48011 near Wahkon (1996-2015).

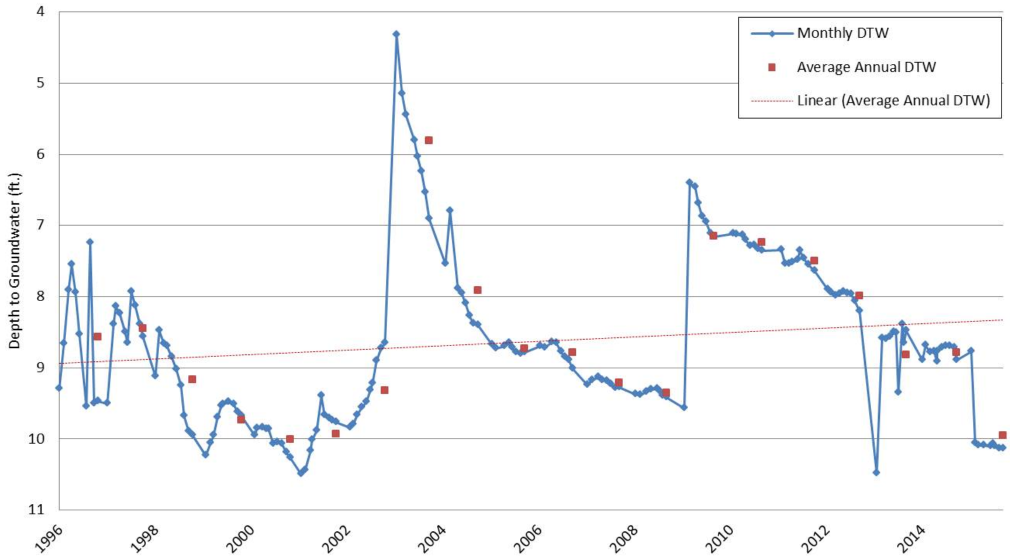

Figure 31. Depth to groundwater for observation well 02025 near Bethel (1996-2015).

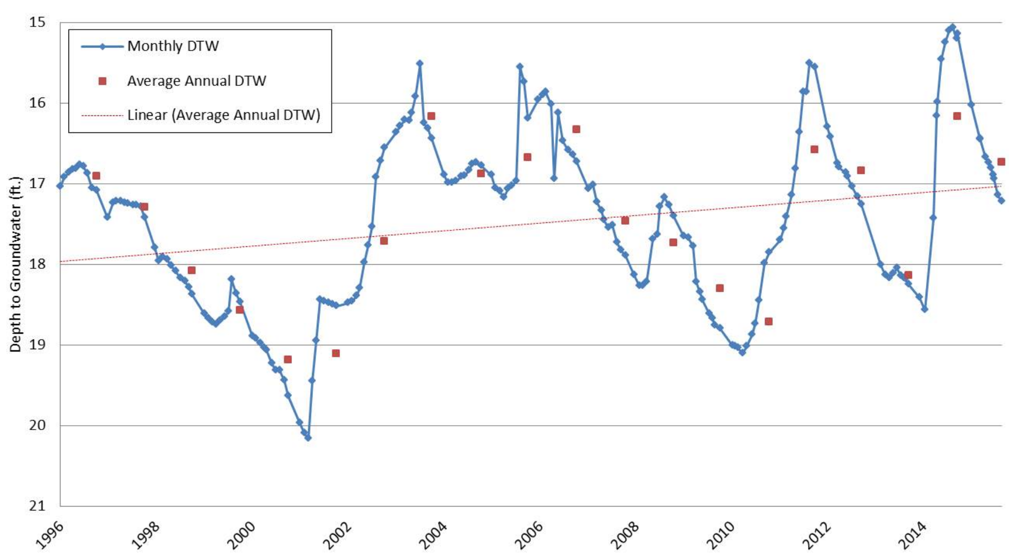

Figure 32. Depth to groundwater for observation well 30005 near Princeton (1996-2015).

Wetlands

Wetlands are a prominent feature in the Rum River Watershed. National Wetlands Inventory (NWI) data estimate 235,565 acres of wetland present in the watershed—about 23% of the watershed area (Figure 33). This coverage rate is higher than the statewide rate of 19% (Kloiber and Norris 2013). The predominant wetland type is Emergent (i.e., grass, sedge, and or forb dominated) which occupies approximately 12% of the watershed and comprises roughly half (51%) of the wetlands in the Rum River Watershed.

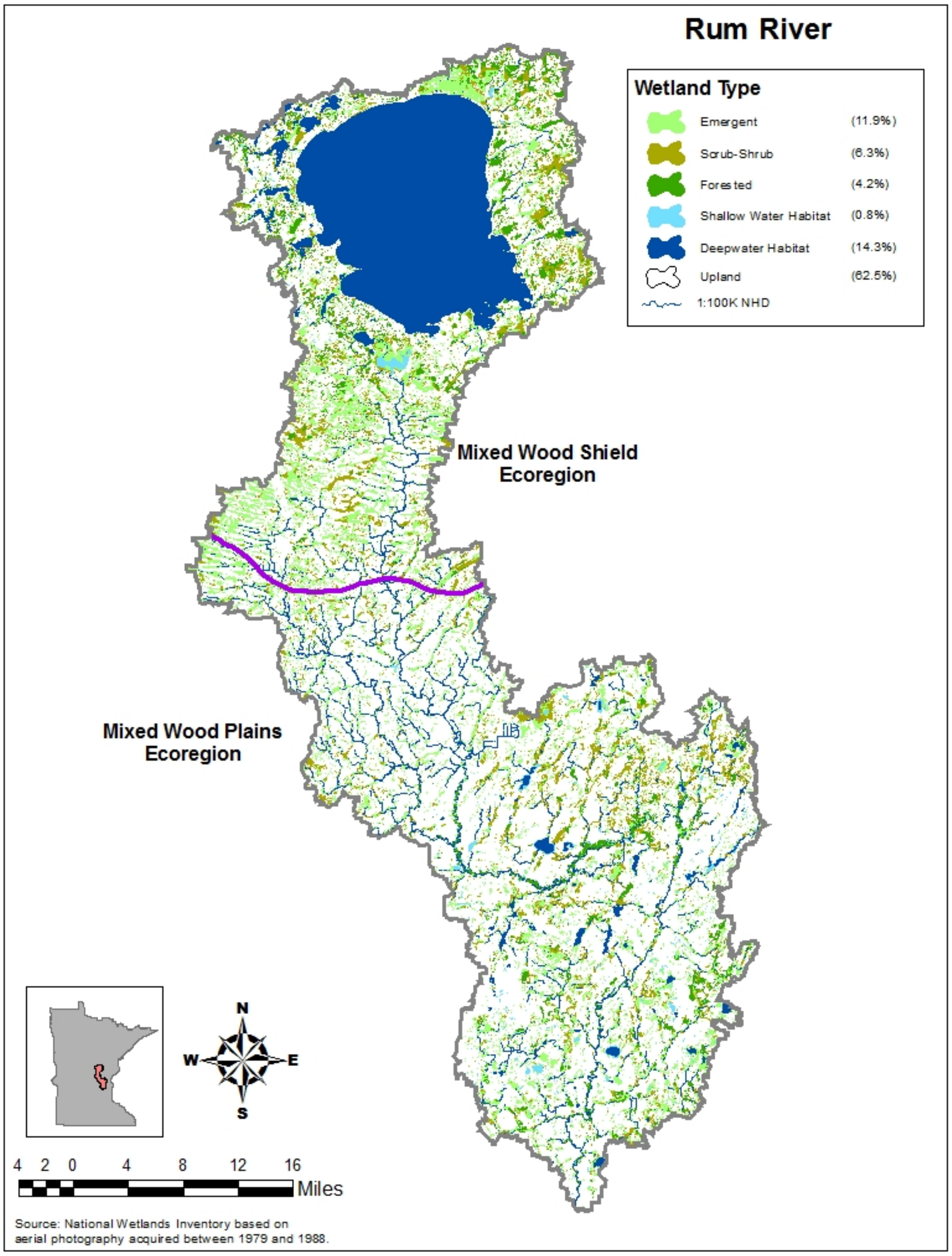

Figure 33. Wetlands and surface water in the Rum River Watershed. Wetland data are from the National Wetlands Inventory. The level II ecoregion boundary has been included (purple). The Mixed Wood Plains (i.e., central hardwood forest) ecoregion lies to the south.

Prior to European settlement, wetlands were more prevalent in the watershed. As wetland soil features typically persist after artificial drainage, soil survey data can be used to estimate historical wetland extent. Soil units mapped as Poorly and Very Poorly drained classes typically support wetlands when they are not being artificially drained. Wetland loss estimates can then be made by subtracting NWI totals (e.g., the best current estimate of wetland extent) from the Poorly and Very Poorly drained totals (e.g., the best historical estimate). Unfortunately, complete soil survey data were available for only 8 of the 14 sub-watersheds, prohibiting a reasonably accurate historical wetland extent estimate for the watershed as a whole. Sub-watershed loss estimates, however, can be made where data are available (Figure 34).

Pre-European settlement wetlands are largely intact in the Mixed Wood Shield ecoregion portion of the watershed (Figure 34). Three of the four sub-watersheds have < 25% historical wetland loss rates and the Headwaters Rum River loss rate is estimated at 26%.

Agricultural development is much more prevalent in the remainder of the watershed that corresponds to the Mixed Wood Plains ecoregion (Figure 33). Wetland drainage is typically associated with agricultural development to improve the productivity of the land. Of the four sub-watersheds occurring in this ecoregion where data are available (Figure 34), two have loss rates 25-50% and two have loss rates 50 – 75%. Sufficient soil data is unavailable for remaining sub-watersheds (Figure 34), but given the setting it is likely that these have historical wetland loss rates > 50%.

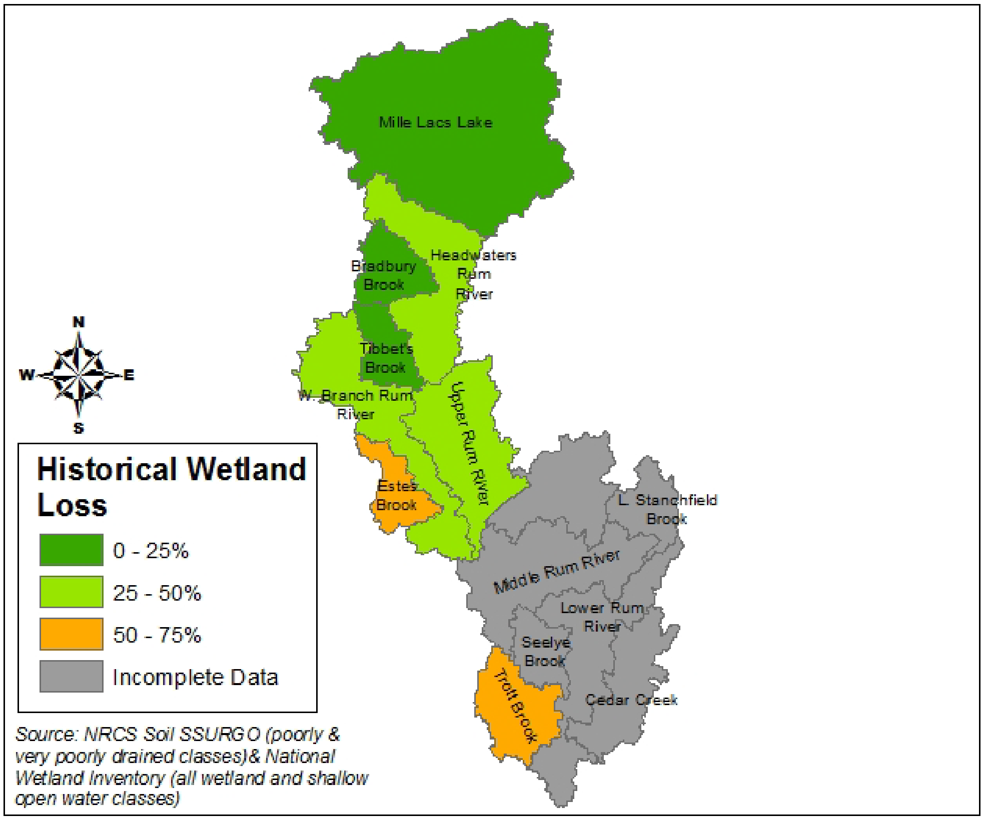

Figure 34. Historical wetland loss by sub-watershed in the Rum River Watershed.

The glacial landforms are varied in the Rum River Watershed (MNGS 1997)—leading to contrasting hydrogeorphic (HGM) wetland patterns in different portions of the watershed. The predominant landform in the northernmost portion of the watershed is an end moraine (the outer edge of a glacial advance) that formed the dam creating Mille Lacs Lake. The end moraine landform has numerous hills and basins—producing lakes and depressional wetlands. Depressional wetland hydrology may be dominated by surface flow, precipitation, and/or groundwater depending on the local setting and whether the basin has a surface water connection (Smith 1995). The Pierz drumlins lie south of the end moraine and extend to the Mixed Wood Plains ecoregion border (Figure 33). The drumlin landform consists of low-streamlined hills and swales aligned parallel to ice flow. The landscape is generally flat. With little elevation gradient for water to drain—extensive wetlands have formed in the swales and complex shallow depressions—accumulating peat. These wetlands are best described as organic flats in

HGM (Smith 1993). The predominant water exchange in organic flat wetlands is through precipitation and evaporation. As peat has low hydrologic conductivity, excess precipitations can slowly runoff via overland saturation flow along very low elevation gradients thereby forming headwater streams (Acreman and Holden 2013). The source water coming from the wetlands typically have high DOM and low DO. The small lateral streams flowing to the mainstem of the Rum River in this area have organic flat wetlands as source waters. A mosaic of ground moraine (low hills and depressions) and glacial outwash valleys (formed during glacial melt) occurs between the ecoregion border to the southern lobe in the watershed—producing larger sized depressional wetlands and linear wetland features. Many of the smaller streams here have wetlands as headwaters and/or flow through larger wetland complexes. Finally, the southern lobe of the watershed consists of an outwash plain landform (outflow delta deposits from melting glaciers) known as the Anoka sandplain. The groundwater table is very near to the surface and extensive wetlands have formed in the gentle topographic depressions (MNDNR 2000). Ditching has extended the headwaters of many of the streams in this area (e.g., Cedar Creek)—draining (or partially draining) many wetlands.

In terms of special wetland features—the MNDNR has documented numerous wild rice populations in the watershed. They are located in the general vicinity of Mille Lacs Lake and scattered throughout the southern third of the watershed. No state listed calcareous fens (an uncommon wetland that supports a number of rare plant species and are considered Outstanding Resource Value Waters) are present.

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

The MPCA currently does not monitor wetlands systematically by watershed. Alternatively, the overall status and trends of wetland quality in the state and by major ecoregion is being tracked through probabilistic monitoring. Probabilistic monitoring refers to the process of randomly selecting sites to monitor; from which, an unbiased estimate of the resource can be made. Probabilistic survey results may provide a reasonable approximation of the current wetland quality in the watershed. In addition, the MPCA conducts wetland quality monitoring at targeted locations that are associated with low gradient streams to provide supporting information for assessment and stressor identification.

Watershed-wide data collection methodology

Load monitoring

Intensive water quality sampling occurs at all WPLMN sites. Thirty-five samples per year are allocated for basin and major watershed sites and 25 samples per season (ice out through October 31) for subwatershed sites. Because correlations between concentration and flow exist for many of the monitored analytes, sampling frequency is typically greatest during periods of moderate to high flow (Figure 63). Because these relationships can also 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 flow data are coupled in the "FLUX32," pollutant load model to estimate the transport (load) of nutrients or other water quality constituents past a tributary sampling station over a given period of time. Flux uses paired concentration/flow observations to develop one or more discharge or seasonally constrained relationships to estimate daily pollutant concentrations from the daily flow record. Most WPLMN load estimates use the "Time series"calculation method in FLUX32. This method applies an "adjustment" to the regressed estimates based on adjacent sample concentrations and when sample collection frequency is high, results in the determination of more accurate daily as well as annual/seasonal pollutant loads than the regressed estimates alone. Primary output includes annual and daily pollutant loads and flow weighted mean concentrations. Loads and flow weighted mean concentrations are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate (DOP), nitrate plus nitrite nitrogen (NO_2+NO_3-N), and total Kjeldahl nitrogen (TKN).

Stream water sampling

Fourteen water chemistry stations were sampled from May thru September in 2013, and again June thru August of 2014, to provide sufficient water chemistry data to assess all components of the Aquatic Life and Recreation Use Standards. Following the IWM design, water chemistry stations were placed at the outlet of each aggregated 12 HUC subwatershed that was >40 square miles in area (purple circles and green circles/triangles in (Figure 2). A Surface Water Assessment Grant (SWAG) was awarded to the Anoka Conservation District and Mille Lacs Soil and Water Conservation District (SWCD).Water chemistry was collected at all fourteen stations, four stations by the Anoka Conservation District and 10 stations by the Mille Lacs SWCD. (See Appendix 2 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study). In the Rum River Watershed there a few cases where the intensive water chemistry station had to be relocated upstream to collect data that would better represent the stream. In the Middle Rum River Aggregated HUC-12 there are three intensive water chemistry stations. The additional 2 intensive water chemistry stations were added to get downstream water chemistry data from the Princeton and Cambridge waste water treatment facilities.

Stream flow methodology

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

Stream biological sampling

The biological monitoring component of the intensive watershed monitoring in the Rum River Watershed was completed during the summer of 2013. A total of 47 sites were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, 9 existing biological monitoring stations within the watershed were revisited in 2013. These monitoring stations were initially established as part of a random Rum River Basin wide survey in 2000, part of a 2000 survey which investigated the quality of channelized streams with intact riparian zones, or the random statewide biological monitoring survey (EMAP) in 2010. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2015 assessment was collected in 2013. A total of 37 AUIDs were sampled for biology in the Rum River

Watershed. Waterbody assessments to determine aquatic life use support were conducted for 35 AUIDs. Biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used as a basis for long term trend results in subsequent reporting cycles.

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

Fish contaminants

Mercury was analyzed in fish tissue samples collected from Rum River and 11 lakes in the watershed. Polychlorinated biphenyls (PCBs) were measured in fish from the river and 7 lakes. Fourteen fish species were tested for contaminants. Fish species are identified by codes that are defined by their common and scientific names (Table 68). A total of 814 fish were collected for contaminant analysis between 1978 and 2013

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

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

PCBs in fish have not been monitored as intensively as mercury in the last three decades due to monitoring completed in the 1970s and 1980s. These studies identified that high concentrations of PCBs were only a concern downstream of large urban areas in large rivers, such as the Mississippi River and in Lake Superior. This implied that it was not necessary to continue widespread frequent monitoring of smaller river systems as is done with mercury. However, limited PCB monitoring was included in the watershed sampling design to ensure that this conclusion is still accurate. Impairment assessment for PCBs in fish tissue is based on the fish consumption advisories prepared by the MDH. If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week because of

PCBs, the MPCA considers the lake or river impaired. The threshold concentration for impairment is 0.22 mg/kg PCBs and more restrictive advice is recommended for consumption (one meal per month).

Lake water sampling

MPCA sampled nine lakes in 2013 and 2014, as part of the Clean Water Legacy Surface Water Monitoring project for the purpose of enhancing the dataset for lake assessment of aquatic recreation. A Surface Water Assessment Grant (SWAG) was awarded to Aitkin county, Anoka Conservation District, Crow Wing Soil and Water Conservation District (SWCD), and Mille Lacs Soil and Water Conservation District (SWCD). The SWAG was contracted for these groups to sample thirteen lakes in the Rum River Watershed over the course of two years (2013 and 2014). There are currently 23 volunteers enrolled in the MPCA's Citizens Lake Monitoring Program (CLMP) that are conducting lake monitoring within the watershed. Sampling methods are similar among monitoring groups and are described in the document entitled "MPCA Standard Operating Procedure for Lake Water Quality" found at: http://www.pca.state.mn.us/publications/wq-s1-16.pdf. The lake water quality assessment standard requires eight observations/samples within a 10-year period for phosphorus, chlorophyll-a and Secchi depth.

Groundwater monitoring

Approximately 75% of Minnesota's population receives their drinking water from groundwater, undoubtedly indicating that clean groundwater is essential to the health of its residents. The Minnesota Pollution Control Agency's Ambient Groundwater Monitoring Program monitors trends in statewide groundwater quality by sampling for a comprehensive suite of chemicals including nutrients, metals, and volatile organic compounds. These Ambient wells represent a mix of deeper domestic wells and shallow monitoring wells. The shallow wells interact with surface waters and exhibit impacts from human activities more rapidly. Available data from federal, state and local partners are used to supplement reviews of groundwater quality in the region.

There are currently 18 MPCA Ambient Groundwater Monitoring well (17 monitoring, 1 domestic) within the Rum River Watershed. Figure 16 displays the locations of ambient groundwater wells within and around the specified watershed. Data collection ranged from 2004 to 2015; however, the majority of the wells were added in 2010. Therefore, data analysis was conducted on the current MPCA Ambient Groundwater Wells from 2010 to 2015.

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).

Individual aggregated 12-HUC subwatershed results

Aggregated 12-HUC subwatersheds

Assessment results for aquatic life and recreation use are presented for each Aggregated HUC-12 subwatershed within the Rum River Watershed. The primary objective is to portray all the full support and impairment listings within an aggregated 12-HUC subwatershed 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 aggregated HUC-12 subwatersheds contain the assessment results from the 2015 Assessment Cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2013 intensive watershed monitoring effort, but also considers available data from the last 10 years.

The proceeding pages provide an account of each aggregated HUC-12 subwatershed. Each account includes a brief description of the aggregated HUC-12 subwatershed, and summary tables of the results for each of the following: a) stream aquatic life and aquatic recreation assessments, b) stream habitat quality c) channel stability, and where applicable d) water chemistry for the aggregated HUC-12 outlet, and e) 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 aggregated HUC-12 subwatershed. A brief description of each of the summary tables is provided below.

Stream assessments

A table is provided in each section summarizing aquatic life and aquatic recreation assessments of all assessable stream reaches within the aggregated HUC-12 subwatershed (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 made during the desktop phase of the assessment process (see Figure 4). Assessment of aquatic life is derived from the analysis of biological (fish and invert IBIs), dissolved oxygen, turbidity, chloride, pH and un-ionized ammonia (NH3) 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 4.2 and Appendix 4.3. 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 aggregated HUC-12 subwatershed as well as in the Watershed-wide results and discussion section.

Stream habitat results

Habitat information documented during each fish sampling visit is provided in each aggregated HUC-12 subwatershed 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 aggregated HUC-12 subwatershed.

Stream stability results

Stream channel stability information evaluated during each invert sampling visit is provided in each aggregated HUC-12 subwatershed 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. The CCSI rates three regions of the stream channel (upper banks, lower banks, and bottom) which may provide an indication of 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 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. The final row in each table displays the average CCSI scores and a rating for the aggregated HUC-12 subwatershed.

Aggregated HUC-12 subwatershed outlet water chemistry results

These summary tables display the water chemistry results for the monitoring station representing the outlet of the aggregated HUC-12 subwatershed. 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 Rum River Watershed are compared to expectations developed by McCollor and Heiskary (1993) that were based on the 75th percentile of a long-term dataset of least impacted streams within each ecoregion.

Lake assessments

A summary of lake water quality is provided in the aggregated HUC-12 subwatershed 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 5.2.

Mille Lacs Lake Aggregated 12-HUC **HUC 0701020701-01**

The Mille Lacs Lake subwatershed is the largest subwatershed in the Rum River Watershed, draining 416 mi² of the southeast corner of Crow Wing county, the northwest corner of Mille Lacs county, and the southwest corner of Aitkin county. The Mille Lacs Lake subwatershed is dominated by Mille Lacs Lake which is the second largest lake in Minnesota. Mille Lacs Lake itself is 207 mi². There are a handful of very small tributaries that flow into Mille Lacs Lake none of which are larger than 5 mi ² so no biological sampling was conducted. Mille Lacs Lake is the origin of the Rum River which flows out of its southwest corner. Land in the watershed is primarily open water (50.7 %) and wetland (20.4 %). Developed areas in the watershed (3.2 %) are mainly limited to the shores of Mille Lacs Lake consisting of cabins, houses, and resorts. The largest communities along the lake are Garrison, Isle, and Wahkon. Outside of the small cities and he development of the shoreline there is are large forested areas (18.5 %) mostly consisting hardwoods. No intensive water chemistry was taken in the subwatershed because Mille Lacs Lake is the origin of the Rum River and the outlet of the 12 HUC is a lake and would not act like a riverine system.

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

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Eutrophication: Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-544 **Reddy Creek (Marmon Creek),** Unnamed cr to Lk Mille Lacs		0.04	WWg			IF	IF	IF	MTS	MTS			IF		IF	IF
07010207-546 **Cedar Creek (Little River),** Cedar Lk to Lk Mille Lacs		4.55	WWg			EXS	IF	MTS	MTS	MTS			IF		NS	NA
07010207-547 **Malone Creek (Thains Creek),** Anderson Lk to Lk Mille Lacs		0.98	WWg			EXS	MTS	MTS	MTS	MTS			IF		NS	FS
07010207-554 **Borden Creek,** Deer Lk to Lk Mille Lacs		1.27	WWg			EXS	MTS	MTS	MTS	MTS	IF		IF		NS	NA

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

Table 3. Lake assessments: Mille Lacs Lake Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Cedar	01-0065-00	253	E	92.7	5.5	2.4		28	1	2	FS	
Twenty	01-0085-00	128	E	100	0.9			57		0.8	IF	
Deer	01-0086-00	45	E		1.8			69		0.9	IF	
Big Pine	01-0157-00	617	M	42.2	23.8	6.4	NT	14	3.5	3.8	FS	FS
Round	01-0204-00	719	O	42	38.1	13.1	I	11	2.8	3.7	FS	FS
Whitefish	18-0001-00	710	M	61.5	18.9		I	19	6.6	3.9	FS	
Camp	18-0018-00	514	M	43.7	12.8		NT	15	8.9	2.4	FS	FS
Kenney	18-0019-00	105	M	33.3	16.8		NT	16	9.6	3.1	FS	
Borden	18-0020-00	990	M	32	25.6	6.7	I	19	7	3.	FS	FS
Miller	18-0021-00	124	M	34.8	14.6		NT	17	9.6	3.5	FS	
Smith	18-0028-00	455	M	47.2	16.5		NT	16	7.5	3.5	FS	FS
Holt	18-0029-00	167	M	58.9	8.5		NT	21	10	2.7	FS	
Barbour	18-0030-00	63	M	26.2	16.5					2.8	IF	
Scott	18-0033-00	164	M	79.2	14.3			21	6	4.1	FS	
Turtle	18-0047-00	104	M	82.1	10.1		D			2.8	IF	
Partridge	18-0048-00	183	M	62.5	12.8					3.9	IF	
Mille Lacs	48-0002-00	128167	E		10.7	8.8	I	30	7.7	3.3	FS	

Summary

Stream assessments

There are 28 stream reaches in the Mille Lacs Lake Aggregated 12-HUC. For aquatic recreation, 1 of the 28 stream reaches has been assessed. The remaining stream reaches are dominated by small tributaries directly to Lake Mille Lacs and either have insufficient information or no data. Malone Creek (Thains Creek, 07010207-547) is meeting the aquatic recreation standard. Malone Creek is less than a mile and is a tributary to Mille Lace Lake. It is predominately surrounded by wetland characteristics and some development.

For aquatic life, 3 of the 28 stream reaches have been assessed. The remaining stream reaches are heavily impacted by lake influences and either have insufficient information or no data. Reddy Creek (Marmon Creek, 07010207-544) was listed as impaired for dissolved oxygen in 2010; upon closer review, it was determined that wetland conditions are present at the sampling site and the data was not representative of stream conditions; the impairment will be removed. Cedar Creek (Little River, 07010207-546), Borden Creek (07010207-554), and Malone Creek (Thains Creek, 07010207-547) were listed as impaired for dissolved oxygen in 2010 and 2012; the current data supports the previous listings. Many of the stream reaches are surrounded by wetlands and forested areas.

Lake assessments

For aquatic recreation, 17 of the 48 lake basins >10 acres in size have been assessed (Table 3). The remaining stream reaches either have insufficient information or no data. The majority (15) of the lakes have characteristics of deep basin lakes and are considered to be mesotrophic. Round Lake is small and deep, surrounded by forest and wetland it is the only lake in the Mille Lacs Lake watershed that is oligotrophic. There are few lakes (Cedar, Twenty, Deer, and Mille Lacs) that with right conditions in the summer could experience algal blooms. There are 12 lakes that meet the water quality aquatic recreation standards. There are 11 lakes that have long term transparency records which can be calculated into a transparency trend. The majority (6) of them have no trend. A few of the lakes (Round, Whitefish, Borden, and Mille Lacs) have an increasing transparency trend. Turtle Lake has a decreasing transparency trend. Overall where lakes have enough data for an assessment those lakes are meeting the aquatic recreation standard. For aquatic life, 5 of the 48 lake basins >10 acres in size have been assessed (Table 3). The overall theme of the 5 lakes were that gillnets were dominated by northern pike and the trapnets collected mainly bluegill. The lakes also had a number of other species that were collected including cisco. Round and Smith Lake both contain cisco which would indicate an oxygen rich coldwater habitat. Borden's fish survey did not collect any cisco for the first time since 1972 (7 surveys form 1972-2008, 20 cisco collect each survey); it is possible that increased temperature and reduced oxygen concentrations at depth are occurring to reduce habitat available. Overall the 5 lakes meet the aquatic life standard. There are 11 lakes with aquatic plant surveys; all with exceptional quality plant communities. This indicates that eutrophication is not impacting the aquatic plant community.

There are many lakes that should be a priority for protection in the Mille Lacs Lake Aggregated 12-HUC. All of the following lakes are susceptible to increases of phosphorus in multiple ways. These increases could cause any of the lakes to become impaired. Mille Lac Lake (48-0002-00) has a large surface area and the phosphorus average is close the ecoregion standard. Cedar Lake (01-0065-00) is also close to the Northern Lakes and Forest ecoregion standard. Big Pine Lake (01-0157-00), Round Lake (01-0204-00), Camp Lake (18-0018-00), and Smith Lake (18-0028-00) all have larger watersheds where the land use could be changed in which an increase of phosphorus could cause impairment.

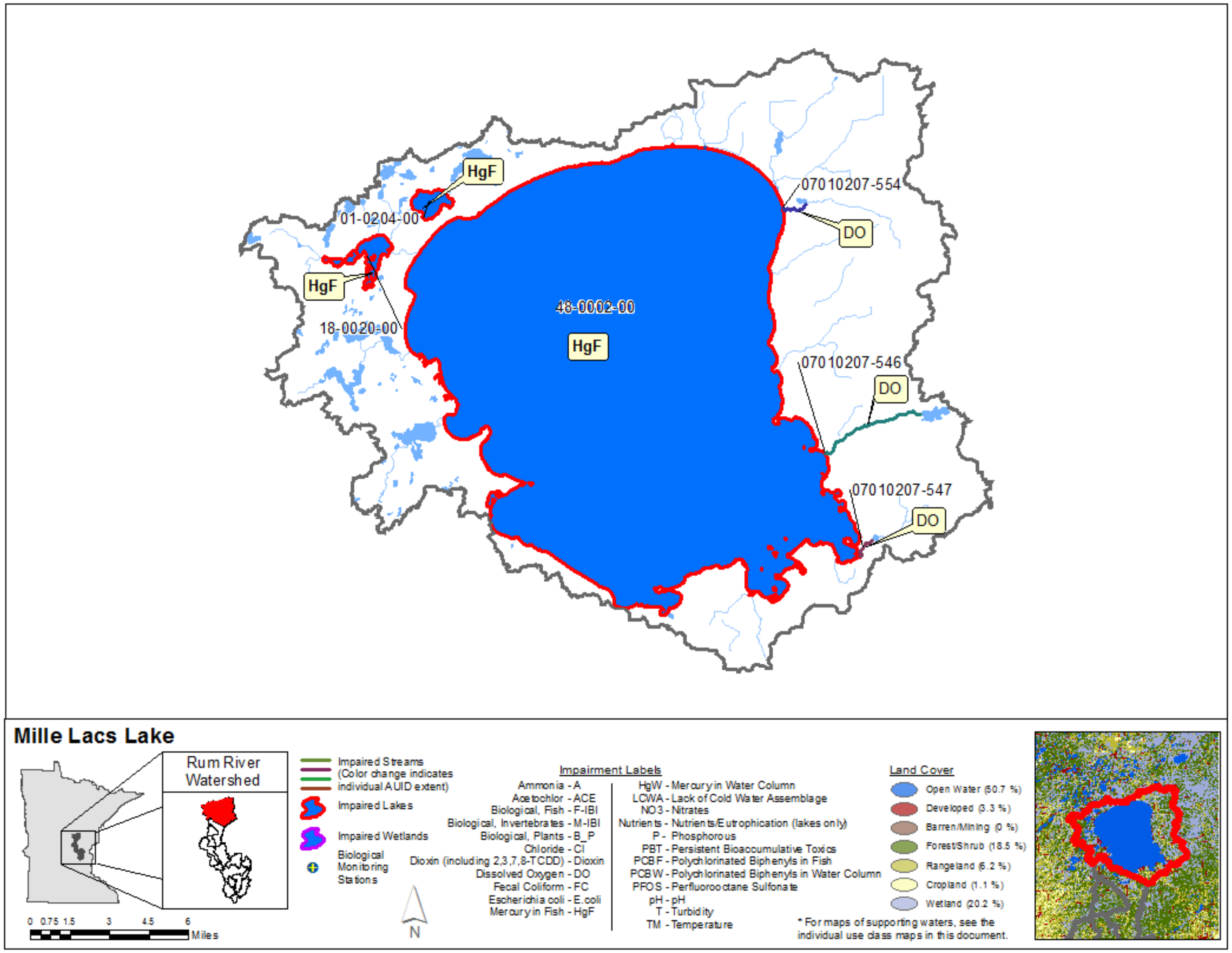

Figure 35. Currently listed impaired waters by parameter and land use characteristics in the Mille Lacs Lake Aggregated 12-HUC.

Upper Rum River Aggregated 12-HUC

HUC 0701020702-01

Upper Rum River subwatershed is a flow through watershed sandwiched between the West Branch Rum subwatershed to the west and the St. Croix Basin to the east. The watershed starts in the north where Tibbitts Brook flows into the Rum River and flows due south through the city of Milaca to the city of Princeton where the subwatershed stops at the confluence of the West Branch Rum River. The watershed encompasses 135.6 mi^2 of Mille Lac county, a sliver of the southwest corner of Kanabec county, and the very northwest corner of Isanti county. This watershed has the 2nd highest density of agricultural land use in the Rum River Watershed. Rangeland (40%) is the highest land use percentage in this subwatershed and the whole Rum River Watershed followed by cropland (23.8%). The cropland is dominated by hay and alfalfa and the row crop that is present is mainly corn which is cut as silage for the cows. Much like the rest of Upper Rum River Watershed forested areas (21.3%) make up a large portion of the land use. Normally there would not be an intensive water chemistry site in this subwatershed because it is a flow through aggregated HUC 12 watershed but the outlet of the watershed has an intensive water chemistry site to capture upstream water quality data from the Princeton wastewater treatment facility. The outlet water chemistry station is co-located with biological monitoring station 13UM045.

Table 4. Aquatic life and recreation assessments on stream reaches: Upper Rum River Aggregated 12-HUC. Reaches are organized upstream to downtstream in the table.

AUID ***Reach Name***, *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	**Eutrophication** Phosphorous	**Eutrophication** Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-510 **Rum River,** Tibbetts Bk to Bogus Bk	13UM058	22.90	WWg	MTS	MTS	MTS	MTS	MTS	MTS	IF	MTS		MTS		FS	FS
07010207-511 **Rum River,** Bogus Bk to W Br Rum R	13UM045	14.87	WWg	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS		IF		FS	FS
07010207-522 **Bogus Brook,** T38 R26W S14, north line to T38 R26W S14, south line	13UM074	1.86	7			IF				IF	IF				NA	NA

07010207-523 **Bogus Brook,** T38 R26W S23, north line to Rum R		12.64	WWg			IF	MTS	MTS	MTS	MTS	MTS		IF		IF	IMP
07010207-535 **county Ditch 4**, Unnamed ditch to Unnamed cr	13UM078	0.93	WWm	MTS	MTS	IF	IF	IF		IF	IF		IF		FS	NA
07010207-537 **Mike Drew Brook,** Unnamed cr to Unnamed cr	00UM031	2.20	WWg	MTS	MTS	IF	IF	IF		IF	IF		IF		FS	NA
07010207-567 **Vondell Brook,** Unnamed cr to Rum R	13UM049	1.47	WWg	EXS	MTS	IF	IF	IF		IF	IF		IF		IMP	NA
07010207-641 **Washburn Brook,** Unnamed ditch to Unnamed cr	13UM089	0.69	WWm	EXS		IF	IF	IF		IF	IF		IF		IMP	NA
07010207-687 **Vondell Brook**, T38 R26W S32, north line to Unnamed cr	07UM094	3.56	WWg	EXS		IF	IF	IF		IF	IF		IF		IMP	NA
07010207-689 **Chase Brook,** T38 R27W S15, north line to Rum R	13UM059	4.31	WWg	MTS	MTS	IF	IF	IF		IF	IF		IF		FS	NA

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

Table 5. Minnesota Stream Habitat Assessment (MSHA): Upper Rum River Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
4	00UM031	Mike Drew Brook	5	10.25	6.89	13.25	17.5	52.89	Fair
1	07UM094	Vondell Brook	2	7	19.4	12	25	65.4	Fair
1	13UM045	Rum River	4.25	14	17.8	15	25	76.05	Good
2	13UM049	Vondell Brook	1.25	13.25	13.1	7.5	21	56.1	Fair
1	13UM058	Rum River	3	12	26	16	30	87	Good
1	13UM059	Chase Brook	5	15	9	15	18	62	Fair
1	13UM074	Bogus Brook	5	10	13.6	8	29	65.6	Fair
1	13UM078	county Ditch 4	0	9.5	5.3	12	9	35.8	Poor
1	13UM089	Washburn Brook	0	7	4	2	1	14	Poor
Average Habitat Results: *Upper Rum River Aggregated 12-HUC*			**3.21**	**10.92**	**11.45**	**11.38**	**19.15**	**56.12**	**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 6. Channel Condition and Stability Assessment (CCSI): Upper Rum River Aggregated 12-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
2	00UM031	Mike Drew Brook	16	11	10	4	41	fairly stable
1	13UM045	Rum River	23	38	15	7	83	severely unstable
1	13UM049	Vondell Brook	14	17	15	5	51	moderately unstable
1	13UM058	Rum River	11	9	6	1	27	stable
1	13UM059	Chase Brook	8	20	20	5	53	moderately unstable
1	13UM074	Bogus Brook	25	15	19	7	66	moderately unstable
1	13UM078	county Ditch 4	9	18	24	3	54	moderately unstable
Average Stream Stability Results: *Upper Rum River Aggregated 12-HUC*			**15.14**	**18.29**	**15.57**	**4.57**	**53.57**	**moderately unstable**

Qualitative channel stability ratings

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

Table 7. Outlet water chemistry results: Upper Rum River Aggregated 12-HUC.

Station location:	Rum River, Upstream of CSAH 95, in Princeton						
STORET/EQuIS ID:	S004-409						
Station #:	13UM045						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances
Ammonia-Nitrogen	ug/L	10	0.4	6.1	2.3	40	
Dissolved Oxygen (DO)	mg/L	20	6	9.5	7.7	5	
pH		20	6.9	8.1	7.5	6.5 - 9	
Secchi Tube	100 cm	20	43	107.5	90.1	40	
Total Suspended Solids	mg/L	10	4	18	9.1	15	1
Escherichia coli (geometric mean)	MPN/100 ml	14	13.5	45.2		126	
Escherichia coli	MPN/100 ml	14	1	980	106	1260	
Chlorophyll-a, Corrected	ug/L	13	1	2.6	1.42	7	
Phosphorus	ug/L	16	27	160	65.1	50	7
Temperature, water	deg °C	20	14.8	27.2	21.5		
Hardness	mg/L	10	59.8	94.1	82.8		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Upper Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Biological impairments in the Upper Rum River subwatershed appear to be isolated to two small headwaters tributaries Vondell Brook (07010207-567 and 07010207-687) and Washburn Brook 07010207-641 are both impaired for aquatic life for fish and Bogus Brook (07010207-523) is impaired for aquatic recreation due to elevated bacteria levels.

Rum River (07010207-510, 07010207-510)

The Rum River flows south from the outlet of Tibbitts Brook to the outlet of the West Branch Rum River. The Rum River throughout the extent of its reaches within the subwatershed it is historically impaired for aquatic consumption from elevated mercury in fish tissue like every other AUID on the Rum River. The two sites sampled 13UM058 and 13UM045 scored above the threshold for both fish and invertebrates and have very good habitat score. The main stem Rum River meets the aquatic recreation standard. Overall there are low bacteria samples from the Rum River with the occasional runoff where samples can become elevated.

Bogus Brook (07010207-522, 07010207-523)

Bogus Brook flow from the city of Bock south to the Rum River near the city of Woodward Brook. One biological station 13UM074 was placed on Bogus Brook in a Class 7 segment of the stream. No biological assessment was completed because of the limited use water designation; however, the fish and macroinvertebrate scores are above the threshold. The biological site was placed toward the headwaters of the stream because the majority of the lower reaches of the stream are wetland dominated. A fair habitat score corroborates the good IBI scores. The lower reach of Bogus Brook (07010207-523) is not meeting the aquatic recreation standard. The bacteria levels are elevated throughout the summer (June – August) which indicates a constant source of bacteria to the Rum River. There are 7 established feedlots within a mile of the Bogus Brook which could be a contributor to the bacteria issues.

County Ditch 4 (07010207-535)

County Ditch 4 flow southeast from the city of Pease to the Rum River near the city of Woodward Brook. One biological station 13UM078 was placed ~1.5 mi. upstream of the outlet. County Ditch 4 has a 100% modified stream channel and the only AUID scored with a modified use designation. Both the fish and macroinvertebrate scores meet for aquatic life. Cover for fish including undercut banks, overhanging vegetation, deep pools, logs and woody debris, submergent macrophytes, and riffles make up for a poor habitat score due to a channelize reach within a heavily used agricultural area in this watershed.

Mike Drew Brook (07010207-537)

Mike Drew Brook flows southwest out of the Rum River State Forest to the Rum River just after it crosses Hwy 169 5 mi. north of Milaca. One biological station (00UM031) was sampled ~2 mi. upstream of the confluence with the Rum River. This site is slated for biological monitoring every other year (odd years) in an attempt to better understand variability of aquatic communities over time. The two macroinvertebrate and fish samples collected up to this point, in 2000 and 2013, yielded very similar IBI scores of 52 and 50, respectively for macroinvertebrates and 69 and 72, respectively for fish. Both samples for macroinvertebrates are near the general use IBI threshold of 51 for this stream class and were collected under low flow conditions while both fish samples are above the threshold and confidence interval and were collected at base flow.

Vondell Brook (07010207-567, 07010207-687)

The headwaters of Vondell Brook are in a heavily forested and wetland dominated area. It flows southwest from the city of Bock to the city of Milaca then turns southeast to 130th street and finely bends to the southwest again flowing into the Rum River near the city of Pease. 2 biological sampling stations are located on Vondell Brook. The most upstream biological sampling station (07UM094) was sampled in 2007 for fish as part of a special project looking for high quality fish and invertebrate habitat "reference ditches" to help with creating an IBI for channelized reaches. This sampling location scored below the general use threshold and within the confidence interval even though the majority of the AUID is a natural stream channel. The downstream biological station (13UM049) fish data was collected twice in 2013. The fish IBI scores are below the general use threshold and within the lower confidence interval. This station was sampled in June and then again in August. Both samples scored near the same 36 and 40 respectively. Macroinvertebrates were sampled at 13UM049 in 2013 the MIBI score is above the general use threshold and within the confidence interval. A decent IBI score considering the very low water level/little flow at the time of invert sampling. Fish habitat was lacking at both sites. The largest concern for aquatic life in Vondell Brook may be caused by low dissolved oxygen. 13UM049 had a D.O. reading of 5.36% at 9:40 and 6.99 mg/l at 18:49 and 07UM094 had a D.O. reading of 6.09 mg/l at 19:10. Overnight the D.O. may drop below 5 mg/l which is the bottom end of the D.O. standard and will have an effect on the biology of the stream. Most likely the low D.O. is a result of the wetland complex in the headwaters.

Washburn Brook (07010207-641)

Washburn Brook flows southwest from just south of the city of Bock to the Rum River northeast of Pease. Washburn Brook is 100% channelized and is scored against a modified use IBI score. Fish data collected from one biological station (13UM049) sampled in 2013. The fish IBI score below the modified use threshold and the lower confidence limit. There was limiting habitat with the lowest MSHA and one of the lowest FIBI (13) scores in the entire Rum River Watershed.

Chase Brook (07010207-689)

Chase Brook flows south from Mille Lacs CR. 11, just west of Hwy. 169, to the Rum River in Milaca. One biological station (13UM059) was sampled for both fish and macroinvertebrates in 2013. Both fish and macroinvertebrates scored above the general use threshold and within the upper confidence interval. Chase Brook has good surrounding land use and large undisturbed riparian buffer creating good fish and macroinvertebrate habitat.

Figure 36. Photograph at 10X water chemistry location

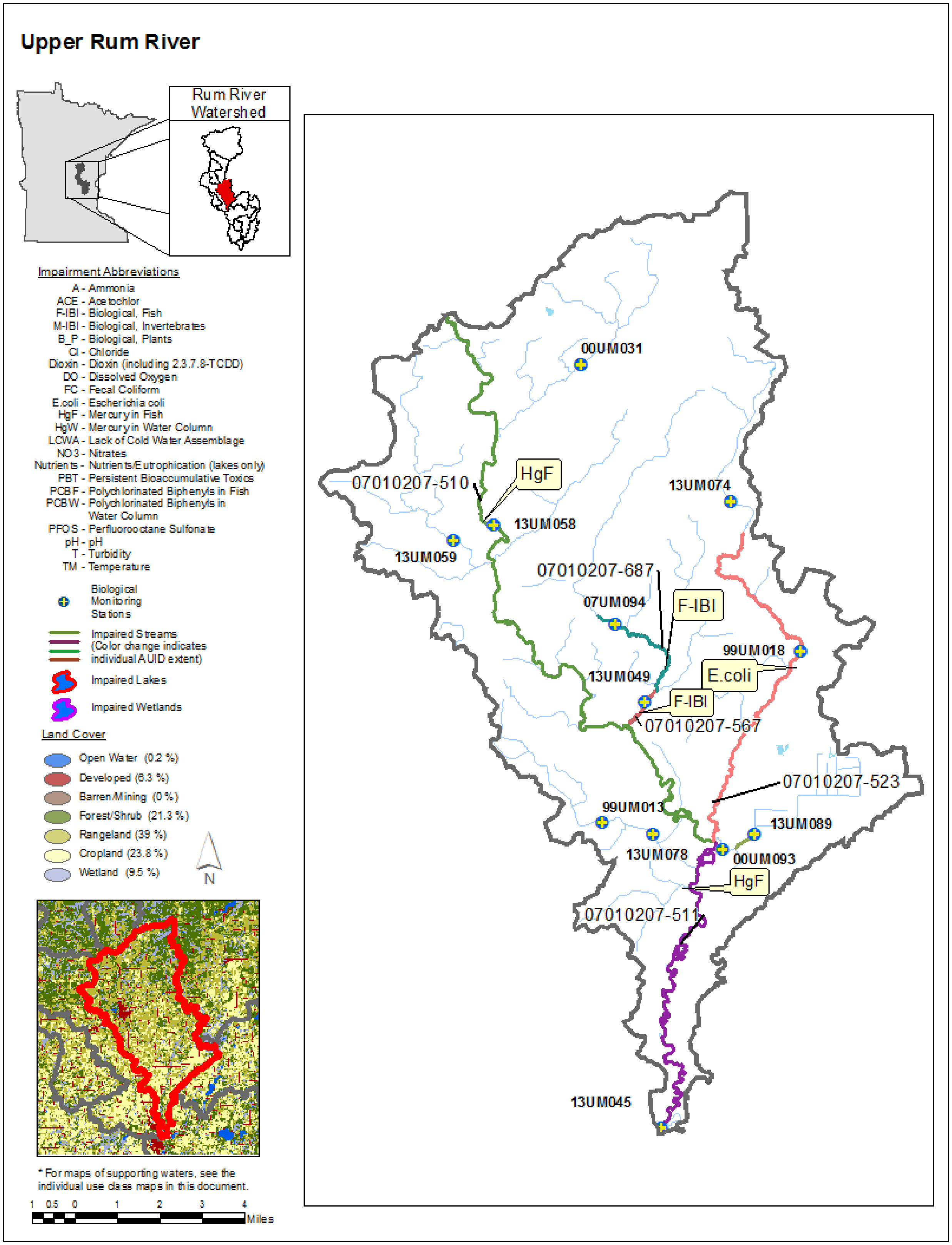

Figure 37. Currently listed impaired waters by parameter and land use characteristics in the Upper Rum River Aggregated 12-HUC.

Tibbetts Brook Aggregated 12-HUC HUC 0701020702-02

Tibbetts Brook subwatershed is the second smallest subwatershed in the Rum River Watershed encompassing 43 mi^2. The north/south Morrison and Mille Lacs county line splits the watershed in half. Tibbitts Brook flows southwest out of a large wetland complex to the Rum River near the junction of CR 16 and Highway 169. Over half of the watershed is forested (54.8%) and the wetland complex at the headwaters makes up for (20.3%) of the land use. Similar to the surrounding area in the Rum River Watershed rangeland (21.3%) is one of the predominant land uses. There are no cities in the subwatershed so developed land only accounts for (1.7%) of the land use. The intensive water chemistry station is co-located with biological station 13UM043.

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

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Response Indicator	Aquatic Life	Aquatic Rec. (Bacteria)
07010207-676 **Tibbetts Brook,** T40 R28W S25, west line to T40 R2W S36, west line	13UM088	2.79	WWm	EXS	MTS	IF	IF	IF		IF	IF		IF		IMP	NA
07010207-677 **Tibbetts Brook,** T40 R28W S35, east line to Rum R	07UM081, 13UM043	11.70	WWg	MTS	MTS *	IF	IF	IF		MTS	MTS		IF		FS*	FS

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

Table 9. Minnesota Stream Habitat Assessment (MSHA): Tibbetts Brook Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	07UM081	Tibbetts Brook	5	13	18.2	13	25	74.2	Good
2	13UM043	Tibbetts Brook	3.75	11.5	14.4	13	13	55.65	Fair
1	13UM088	Tibbetts Brook	2.5	5	8	8	4	27.5	Poor
Average Habitat Results: *Tibbetts Brook Aggregated 12-HUC*			**3.75**	**9.83**	**13.53**	**11.33**	**14**	**52.45**	**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): Tibbetts Brook Aggregated 12-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
1	13UM088	Tibbetts Brook	14	9	18	5	46	moderately unstable
1	13UM043	Tibbetts Brook	14	11	13	5	43	fairly stable
Average Stream Stability Results: *Tibbetts Aggregated 12-HUC*			**14**	**10**	**15.5**	**5**	**44.5**	**fairly stable**

Qualitative channel stability ratings

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

Table 11. Outlet water chemistry results: Tibbetts Brook Aggregated 12-HUC.

Station location:	Tibbetts Brook, at CSAH 19, 5.5 mi. NW of Milaca						
STORET/EQuIS ID:	S007-553						
Station #:	13UM043						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	0.9	7.9	4.5	40	
Dissolved Oxygen (DO)	mg/L	21	5.7	10.3	7.8	5	
pH		21	7	8.8	7.9	6.5 - 9	
Secchi Tube	100 cm	8	92	100	98.3	40	
Total Suspended Solids	mg/L	10	2	11	4.5	15	
Escherichia coli (geometric mean)	MPN/100ml	15	76.5	77.2		126	
Escherichia coli	MPN/100ml	15	16	754	149.1	1260	
Phosphorus	ug/L	10	38	128	87.3	50	9
Temperature, water	deg °C	21	15.5	30.2	22.4		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Tibbetts Brook Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Tibbitts Brook (07010207-676, 07010207-677)

Tibbitts Brook flows southeast out of a large wetland complex southeast of the city of Hillman to the Rum River near the city of Page. Fish data collected from three stations (13UM088, 07UM081, 13UM043) sampled in 2007 and 2013. The fish IBI score is below the modified use threshold and the lower confidence limit for the most upstream biological station (13UM088) sampled in 2013, while the macroinvertebrate data collected in 2013, is above the modified use threshold and the upper confidence limit. Very little fish habitat and a very poor MSHA score along with modified land use may be a contributing factor to low fish IBI scores. Fish data collected from lower two stations (07UM081, 13UM043) sampled in 2007 and 2013. 07UM081 sampled in 2007, the fish IBI score is below the general use threshold and the lower confidence limit. Fish IBI scores sampled in 2013, is above the general use threshold and the upper confidence limit. The station below the threshold was channelized stream and was purposely sample because it was modified for a special project looking for ditches throughout the state that are exceptional for aquatic life. The reach sampled was one of the only modified reaches in the entire AUID which may limit the fish assemblage even though there is a good habitat score and cover for fish and is not used toward the assessment of the AUID (-677). The macroinvertebrate IBI score (23) is well below the general use aquatic life threshold of 51 for this class. An impairment determination was made based on this information; however, the impact of the streams below normal water level on the macroinvertebrate community remained a question. This site was monitored again in 2015, to help ascertain the influence of the low water levels on the macroinvertebrate assessment. In 2015, the opposite situation occurred with high water levels present due to a beaver dam located at the downstream end of the reach. The macroinvertebrate score (59.7) was above the threshold and within the confidence interval. The site was listed with the EPA but after the resample in 2015 a correction of supporting for aquatic life is pending.

Stream assessments

There are five stream reaches in the Tibbetts Brook Aggregated 12-HUC. For aquatic recreation, 1 of the 5 stream reaches has been assessed. The remaining stream reaches either have insufficient information or no data. Tibbetts Brook (07010207-677) is meeting the aquatic recreation standard. The vast amount of forestry and intact riparian zone across the watershed is mostly likely contributing the low bacteria levels.

For aquatic life, 2 of the 5 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. Tibbetts Brook (07010207-677) has elevated levels of phosphorus; however, it is unclear if this is resulting in algae blooms or excessive vegetative growth. The headwaters and the above stream reach (07010207-676) flows through cropland which could be a contributor to the higher levels of phosphorus. It was noted that the runs and pools contained excess sediment which could also be a contributor to the high levels of phosphorus. The overall transparency (average: 98.3cm) of the Tibbetts Brook (07010207-677) is very good.

Figure 38. Photograph at 10X water chemistry location.

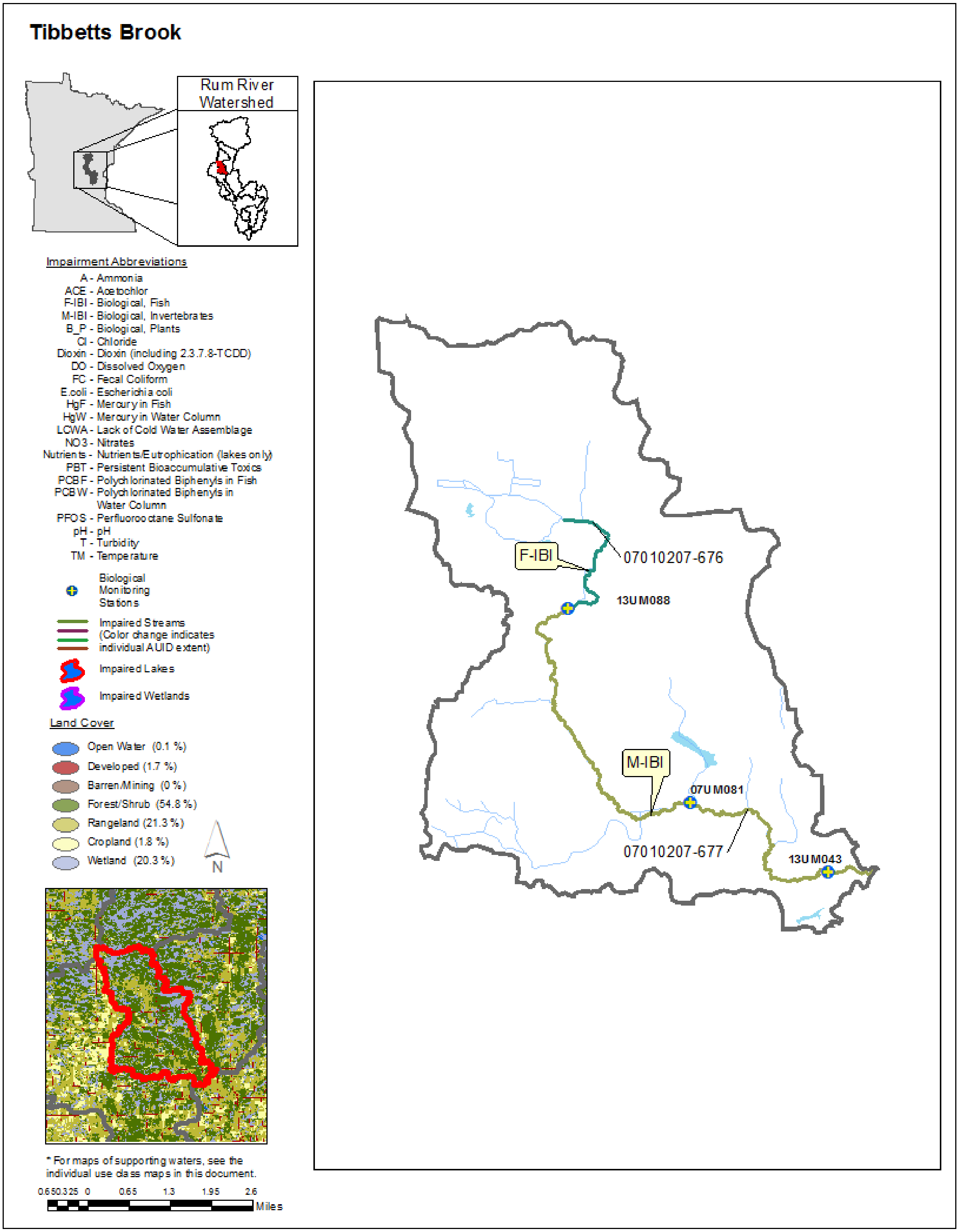

Figure 39. Currently listed impaired waters by parameter and land use characteristics in the Tibbitts Brook Aggregated 12-HUC.

Headwaters Rum River Aggregated 12-HUC HUC 0701020702-03

The Headwaters Rum River subwatershed is first subwatershed the Rum River flows through. The Rum River starts in the north at Mille Lacs Lake and flows south through Ogechie Lake then turns southeast to flow through Shakopee Lake then turns again flow south through Lake Onamia and the city of Onamia. The Rum River continues south out of Onamia and the subwatershed ends where Tibbitts Brook enters the Rum River. The subwatershed is almost completely in Mille Lacs county except ~ 1 mi^2 of the southeast corner of Crow Wing county and ~ 2 mi^2 of the northeast corner of Morrison county. Nearly 75% of the 126.9 mi^2 subwatershed has natural land uses. The largest land uses are forest (46%) and wetland (26.3%). The outlet water chemistry monitoring station was co-located with biological monitoring station 00UM032.

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

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	**Eutrophication** Phosphorous	Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-509 **Rum River,** Lk Onamia to Tibbetts Bk	00UM032, 13UM054	21.08	WWg	MTS	EXP	MTS	MTS	MTS	MTS	MTS	MTS		MTS		IF*	FS
07010207-564 **Black Brook,** Headwaters to Rum R	04UM013	2.74	WWg		MTS										FS	NA

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

Table 13. Minnesota Stream Habitat Assessment (MSHA): Headwaters Rum River Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover	Channel Morph.	MSHA Score (0-100)	MSHA Rating
2	00UM032	Rum River	5	13	25.3	13	30.5	86.8	Good
2	13UM054	Rum River	3.75	12.75	21.5	15.5	22	75.5	Good
Average Habitat Results: *Headwaters Rum River Aggregated 12-HUC*			**4.375**	**12.875**	**23.4**	**14.25**	**26.25**	**81.15**	**Good**

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

Table 14. Channel Condition and Stability Assessment (CCSI): Headwaters Rum River Aggregated 12-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
1	00UM032	Rum River	11	13	8	3	35	fairly stable
1	13UM054	Rum River	4	7	6	1	18	stable
Average Stream Stability Results: *Headwaters Rum River Aggregated 12-HUC*			**7.5**	**10**	**7**	**2**	**26.5**	**stable**

Qualitative channel stability ratings

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

Table 15. Outlet water chemistry results: Headwaters Rum River Aggregated 12-HUC.

Station location:	**Rum River, Upstream of CSAH 16, 7 mi. N of Milaca**
STORET/EQuIS ID:	**S002-955**
Station #:	**00UM032**

Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances
Ammonia-Nitrogen	ug/L	10	1.3	17.9	6.3	40	
Dissolved Oxygen (DO)	mg/L	21	6.7	10.8	8.5	5	
pH		21	6.8	8.6	7.7	6.5 - 9	
Secchi Tube	100 cm	21	92.1	107.5	103.6	40	
Total Suspended Solids	mg/L	10	2	10	5.7	15	

Escherichia coli (geometric mean)	MPN/100ml	15	8.9	3.29		126	
Escherichia coli	MPN/100ml	15	1	33	12.6	1260	
Chlorophyll-a, Corrected	ug/L	13	1	3.4	1.4	7	
Phosphorus	ug/L	16	11	67	33	50	2
Temperature, water	deg °C	21	16.8	30	23		
Hardness	mg/L	10	52.6	83.7	68.8		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Headwaters Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 16. Lake assessments: Headwaters Rum River Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Onamia	48-0009-00	1077	E		4.0			62	2.1	0.9	FS	IF
Shakopee	48-0012-00	635	E	100				39	15.6	1.6	IF	IF
Ogechie	48-0014-00	393	M		1.8			22	2.3	1.5	IF	
Unnamed	48-0019-00	18	E					32	66.1	1	IF	IF
Twelve	49-0006-00	117	E		2.6			52	17.7	1.7	NS	

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

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

Summary

Rum River (07010207-509)

The assessed Rum River AUID starts at Lake Onamia in the city of Onamia and flow south to and to the confluence of Tibbitts Brook southeast of the city of Page. Fish data collected from two biological stations sampled in 2013. The most downstream station (00UM032) scored at the general use threshold. There is a replicate sample that is expired data which is above the general use threshold and upper confidence interval. Percent tolerant taxa is higher at the most resent sample which follows the same pattern as the invertebrate sample at the station. The most upstream site (13UM054) was sampled twice in 2013 once scoring above the general use threshold and confidence interval the other sample was just below the upper confidence interval. Invert data collected from the same two stations sampled in 2013. The downstream station (00UM032) scored below the general use threshold on both QA/QC replicate samples. This same station scored a 96 (out of 100) in the year 2000. A loss of approximately 20 taxa occurred between the 2000 and 2013 samples. Habitat of sample reach is in excellent condition according to MSHA. Large numbers of a tolerant riffle beetle were collected in 2013, affecting the %Very Tolerant and Minnesota HBI metrics, but dramatic drop in other metrics as well such as Intolerant and Predator Taxa Richness. Additional monitoring occurred in the summer of 2015 given the pattern of support at other mainstem Rum stations. The MIBI score at biological station 00UM032 scored above the threshold and confidence interval following the pattern of support like all other mainstem Rum stations

The Rum River (07010207-509) has an extensive water quality dataset containing 36 samples over a four-year period. The bacteria samples are very low compared to the standard. There are a few feedlots in the watershed but there is a large riparian zone and large amounts of forestry that surround the river which can attribute to the low bacteria levels. The transparency data is very good.

Black Brook (07010207-564)

Black Brook is a 2.7 miles long stream flow in a westward direction into the Rum River just south the city of Onamia. Only one biological macroinvertebrate sample had been collected from Black Brook (04UM013) for method comparability study associated with the 2004 National Wadeable Streams Assessment. This small headwater stream had a macroinvertebrate IBI score of 61, well above the general use threshold for the northern forest streams glide-pool IBI class.

Lake assessments

For aquatic recreation, 2 of the 11 lake basins >10 acres in size have been assessed (Table 16). The remaining lakes either have insufficient information or no data. The lakes in the Headwater Rum River Aggregated 12-HUC are shallow and considered eutrophic with the exception of Ogechie Lake (48-0014-00). Ogechie Lake (48-0014-00) is connected to Mille Lacs Lake through a short 0.5 mile-stream reach. This is the start of the Rum River which flows through two more lakes, Shakopee Lake (48-0012-00) and Onamia Lake (48-0009-00), before continuing south. All three of these lakes have shallow basins and wetland like characteristics (especially Onamia Lake (48-0009-00). Onamia Lake (48-0009-00) is meeting the aquatic recreation standard. Twelve Lake (49-0006-00) is not meeting the aquatic recreation standard. It is located on the east side of cropland and the northern portion has wetland characteristics. Potential runoff and internal loading are the likely cause of the impairment. There are three lakes (Onamia: 48-0009-00, Shakopee: 48-0012-00, and Ogechie: 48-0014-00) with aquatic plant surveys; all with exceptional quality plant communities. This indicates that eutrophication is not impacting the aquatic plant community. Upstream of Onamia Lake (48-0009-00) is being restored into native wild rice habitat which could affect the water chemistry of Onamia Lake (48-0009-00). An additional drawdown is planned which could also affect Shakopee Lake (48-0012-00).

Figure 40. Photograph at 10X water chemistry location in the Headwaters Rum Aggregated 12-HUC.

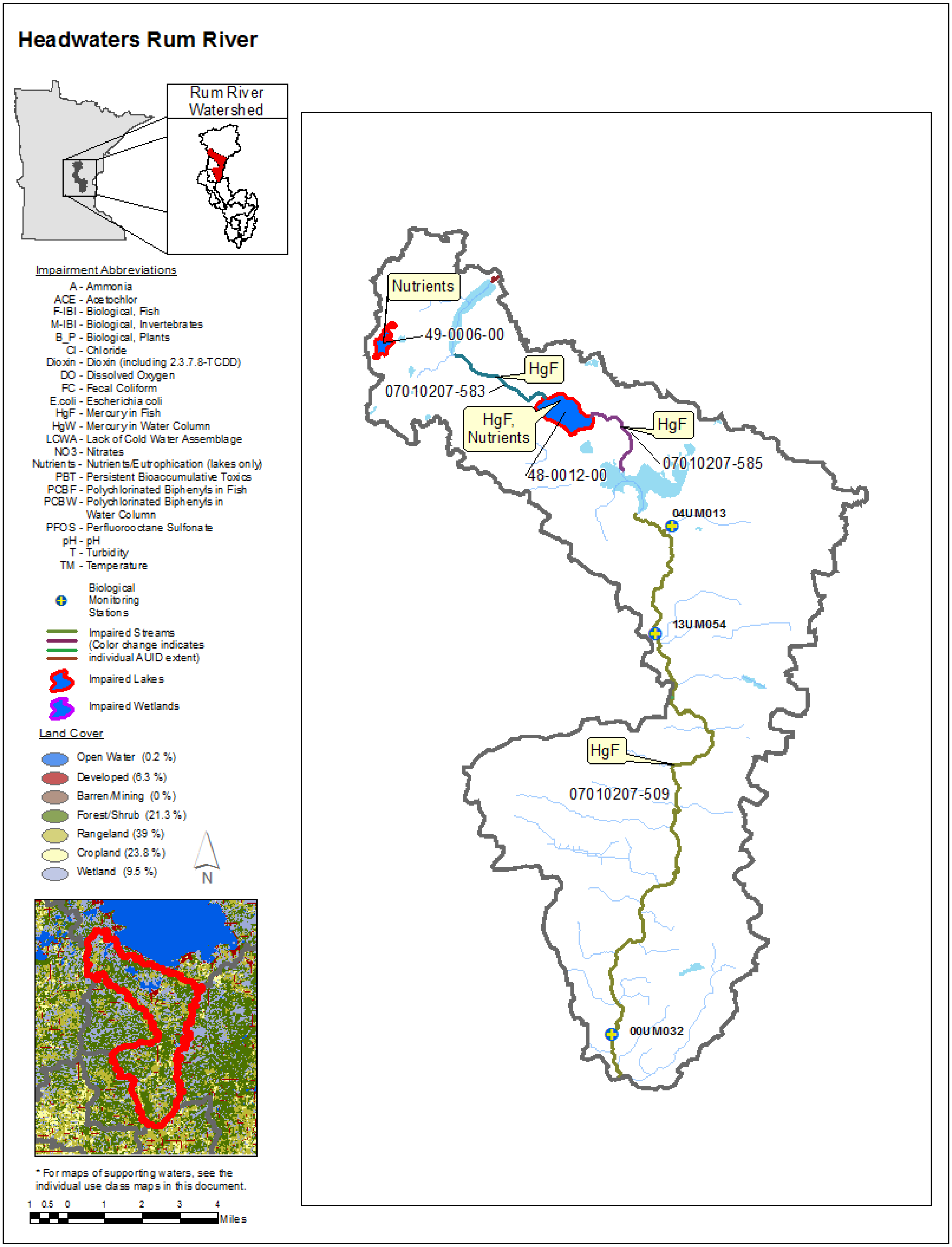

Figure 41. Currently listed impaired waters by parameter and land use characteristics in the Headwaters Rum Aggregated 12-HUC.

Bradbury Brook Aggregated 12-HUC — HUC 0701020702-04

Bradbury Brook subwatershed is the northern most watershed that flows into the Rum River. The watershed is mainly in Mille Lacs county but the western edge of the watershed is in Morrison county encompassing 50.6 mi^2. North Fork Bradbury Brook flows southeast and combines with the South Fork Bradbury Brook to make Bradbury Brook which flows into the Rum River ~ 5 mi. south of Onamia. Much like the rest of the northern part of the Rum River Watershed the majority of the land use is natural. The two largest land uses are forest (56.1%) and wetland (30.7%) and has the smallest amount of row crop (0.8%) in the entire watershed. The outlet water chemistry monitoring station was co-located with biological monitoring station 00UM033.

Table 17. Aquatic life and recreation assessments on stream reaches: Bradbury Brook Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Eutrophication: Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-540 **Bradbury Brook,** N Fk Bradbury Bk to Rum R	00UM033	0.93	WWg	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS		MTS		FS	IF
07010207-691 **Bradbury Brook, North Fork,** T41 R27W S13, west line to Bradbury Bk	13UM053	5	WWg		EXS	IF		IF		IF					IF	NA

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

Table 18. Minnesota Stream Habitat Assessment (MSHA): Bradbury Brook Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	00UM033	Bradbury Brook	5	14	22.5	12	27	80.5	Good
2	13UM053	Bradbury Brook, North Fork	2.875	7.25	18.225	12.5	21	61.85	Fair
Average Habitat Results: *Bradbury Brook Aggregated 12-HUC*			**3.94**	**10.63**	**20.36**	**12.25**	**24**	**71.18**	**Good**

Qualitative habitat ratings

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

Table 19. Channel Condition and Stability Assessment (CCSI): Bradbury Brook Aggregated 12-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
1	00UM033	Bradbury Brook	14	19	13	7	53	moderately unstable
1	13UM053	Bradbury Brook, North Fork	21	13	12	4	50	moderately unstable
Average Stream Stability Results: *Bradbury Brook Aggregated 12-HUC*			**17.5**	**16**	**12.5**	**5.5**	**51.5**	**moderately unstable**

Qualitative channel stability ratings

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

Table 20. Outlet water chemistry results: Bradbury Brook Aggregated 12-HUC.

Station location:	**Bradbury Brook, North Brook, Upstream of Hwy 169, 5 mi. S of Onamia**
STORET/EQuIS ID:	**S007-554**
Station #:	**00UM033**

Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances
Ammonia-Nitrogen	ug/L	10	0.3	6.7	2.9	40	
Dissolved Oxygen (DO)	mg/L	21	5.3	9.3	8.1	5	
pH		21	6.6	8.8	7.7	6.5 - 9	
Secchi Tube	100 cm	8	100	100	100	40	
Total Suspended Solids	mg/L	10	2	11	4.5	15	

Escherichia coli (geometric mean)	MPN/100ml	15	15	47.2		126	
Escherichia coli	MPN/100ml	15	2	248	79.8	1260	
Phosphorus	ug/L	10	23	112	48.9	50	2
Temperature, water	deg °C	21	15	30.2	21.8		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Bradbury Brook Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Bradbury Brook (07010207-540)

Bradbury Brook is less than one-mile long and it starts at the confluence of the North Fork and South Fork Bradbury Brook and flows east into the Rum River. Fish data was collected from one biological station (00UM033) sampled in 2000 and 2013. The FIBI score in 2000 was below the threshold but within the confidence interval the 2013, sample is above the general use threshold and within the upper confidence interval. There was very good habitat and fish cover. Macroinvertebrate monitoring has been conducted at the same biological station on three separate occasions in 2000, 2004, and 2013. The resulting IBI scores for those samples were 83, 64, and 63, respectively. While it may appear that this stream has degraded in quality, the high IBI score in 2000 is likely an artifact of how the stream was sampled at that time; a variation on the qualitative multi-habitat method that is currently being used to sample aquatic macroinvertebrates. In 2000, the sampling crew included more habitat types than would be collected using the current method and therefore collected more taxa from groups that utilize these habitats such as dragonflies and damselflies. Overall, the macroinvertebrate community of Bradbury Brook is in good health meeting general aquatic life use criteria.

Bradbury Brook is meeting the aquatic recreation standard. The transparency (average: 100cm) is very good and continuous dissolved oxygen samples were taken here which resulted in 1036 samples. The majority of the data fluctuates between 5mg/L and 7.9mg/L which indicates full support for aquatic life.

Bradbury Brook, North Fork (07010207-691)

North Fork Bradbury Brook flows southeast from a wetland and wooded dominated area west of Onamia to the confluence with the South Fork Bradbury Brook. One biological station (13UM053) was sampled in 2013. During the assessment process there were concerns about the representativeness of the macroinvertebrate data collected from 13UM053. This station was located where the stream flows through an open pasture when the majority of this stream's length has a natural riparian corridor. In addition, the water level at the time of macroinvertebrate sampling was below normal. Therefore, an additional macroinvertebrate sample was collected from this station in 2015 during normal water levels. Attempts to locate a more representative station were hampered by limited access points to the stream and difficulty in obtaining landowner permission. Results of this new monitoring effort will be considered in a follow-up assessment of this AUID.

Figure 42. Photograph at 10X water chemistry location in the Bradbury Brook Aggregated 12-HUC.

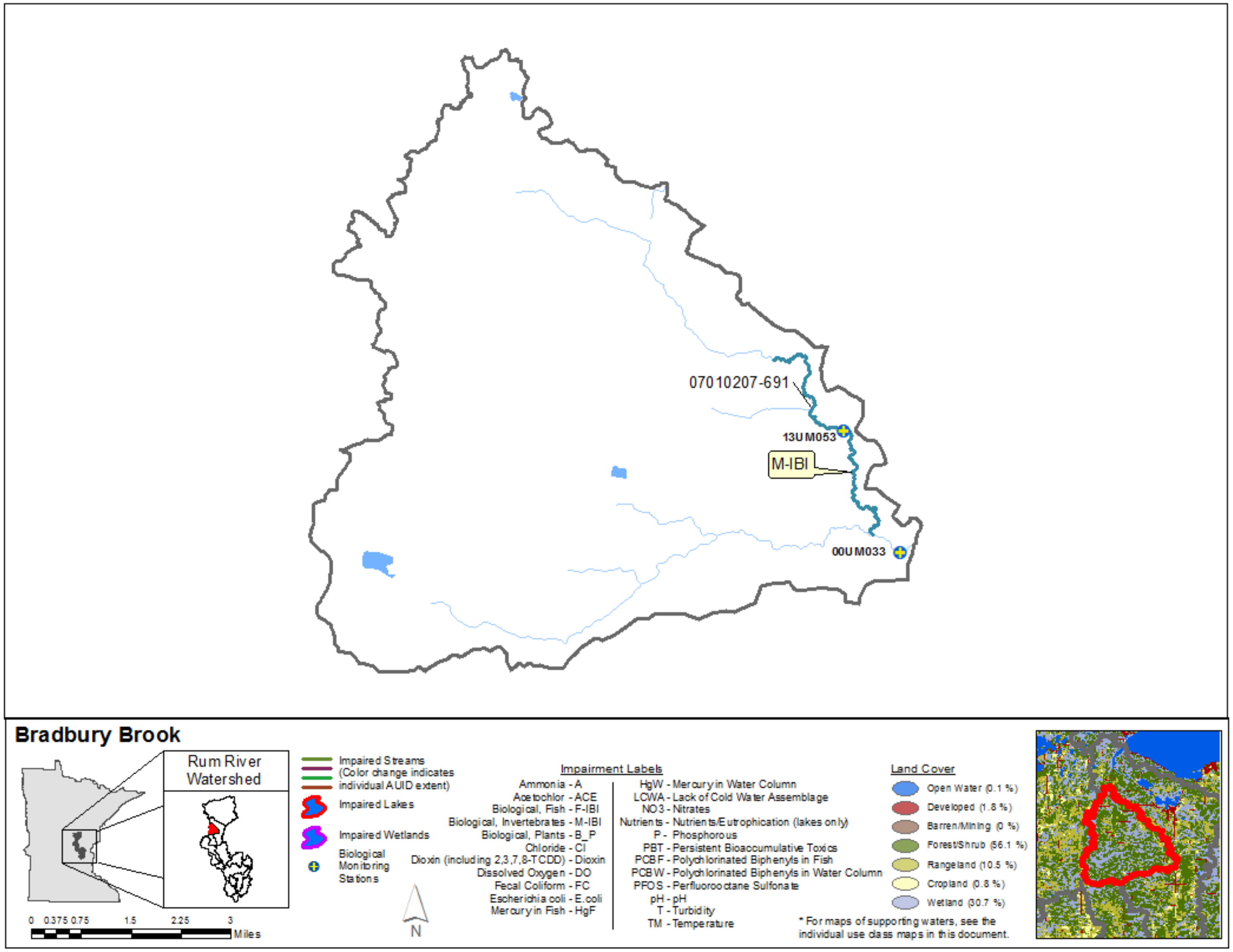

Figure 43. Currently listed impaired waters by parameter and land use characteristics in the Bradbury Brook Aggregated 12-HUC.

West Branch Rum River Aggregated 12-HUC HUC 0701020703-01

West Branch Rum River is the largest subwatershed that flows into the Rum River encompassing 141.2 mi². The headwaters are in southeast Morrison county and northeast Benton county and flow southeast through Mille Lacs county where it joins the Rum River in the city of Princeton. The West Branch Rum River subwatershed is located in the central part of the Rum River Watershed and where the land use changes from predominately natural in the north to predominately agricultural. Rangeland (31%) and cropland (26.6%) makeup over half the land use in the subwatershed. The highest density of forested area (25.3%) occurs in the northeast corner of Benton county. The outlet water chemistry monitoring station was co-located with biological monitoring station 13UM048.

Table 21. Aquatic life and recreation assessments on stream reaches: West Branch Rum River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Response Indicator	Aquatic Life	Aquatic Rec. (Bacteria)
07010207-525 **Rum River, West Branch,** Estes Bk to Rum R	13UM048	15.75	WWg	MTS	EXS	MTS	MTS	MTS	MTS	MTS	MTS		MTS		NS	NS
07010207-527 **Rum River, West Branch,** Headwaters (Unnamed lk 49-0172-00) to Estes Bk	07UM080, 13UM055, 13UM056, 13UM065	40.68	WWg	MTS	MTS	IF	IF	MTS		IF	MTS		IF		FS	NA
07010207-667 **Unnamed creek,** Headwaters to W Br Rum R	13UM075	6.55	WWg	MTS	EXS	IF	IF	IF		IF	IF		IF		NS	NA
07010207-684 **Prairie Brook,** Headwaters to -93.6682, 45.6013	13UM077	4.85	WWm	MTS		IF	IF	IF		IF	IF		IF		FS	NA

Abbreviations for Indicator Evaluations: **MTS** = Meets Standard; **EXS** = Fails Standard; **IF** = Insufficient Information
Abbreviations for Use Support Determinations: **--** = No Data, **NA** = Not Assessed, **IF** = Insufficient Information, **SUP** = Full Support (Meets Criteria); **IMP** = Impaired (Fails Standards)
Key for Cell Shading: ☐ = existing impairment, listed prior to 2014 reporting cycle; ☐ = new impairment; ☐ = full support of designated use; ☐ = insufficient information.

Abbreviations for Use Class: **WWg** = warmwater general, **WWm** = Warmwater modified, **WWe** = Warmwater exceptional, **CWg** = Coldwater general, **CWe** = Coldwater exceptional,
LRVW = limited resource value water
*Assessments were completed using proposed use classifications changes that have not yet been written into rule.

Table 22. Minnesota Steam Habitat Assessment (MSHA): West Branch Rum River Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	07UM080	Rum River, West Branch	1	7	18.6	12	22	60.6	Fair
1	10EM116	Unnamed ditch	0	11	8	6	7	32	Poor
2	13UM048	Rum River, West Branch	5	15	20.9	10	28	78.9	Good
2	13UM055	Rum River, West Branch	3.75	13.25	22.15	11.5	27.5	78.15	Good
1	13UM056	Rum River, West Branch	5	14	22	14	29	84	Good
1	13UM065	Rum River, West Branch	2.5	13	22	13	28	78.5	Good
1	13UM072	Unnamed ditch	2.5	8	13.7	10	6	40.2	Poor
2	13UM075	Unnamed creek	0.25	9.25	21.1	11	23.5	65.1	Fair
1	13UM077	Prairie Brook	0	11	10.6	15	14	50.6	Fair
1	13UM080	Stony Brook	0	5	16	11	8	40	Poor
2	15EM091	Rum River, West Branch	2.5	11.5	18.975	13	21	66.975	Good
Average Habitat Results: *West Branch Rum River Aggregated 12-HUC*			**2.045**	**10.73**	**17.64**	**11.5**	**19.45**	**61.37**	**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 23. Channel Condition and Stability Assessment (CCSI): West Branch Rum River Aggregated 12-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
1	10EM116	Unnamed ditch	15	9	13	1	38	fairly stable
1	13UM048	Rum River, West Branch	29	23	20	6	78	moderately unstable
1	13UM055	Rum River, West Branch	9	13	15	3	40	fairly stable
1	13UM056	Rum River, West Branch	9	15	10	3	37	fairly stable
1	13UM065	Rum River, West Branch	11	15	12	5	43	fairly stable
1	13UM075	Trib. to Rum River, West Branch	21	11	10	5	47	moderately unstable
1	13UM080	Stony Brook	15	13	20	5	53	moderately unstable
Average Stream Stability Results: *West Branch Rum River Aggregated 12-HUC*			**15.57**	**14.14**	**14.29**	**4**	**48**	**moderately unstable**

Qualitative channel stability ratings
= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 24. Outlet water chemistry results: West Branch Rum River Aggregated 12-HUC.

Station location:	Rum River, West Branch, at CR 102, 1 mi. W of Princeton						
STORET/EQuIS ID:	S002-953						
Station #:	13UM048						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	0.1	12.4	3.4	40	
Dissolved Oxygen (DO)	mg/L	21	5	11.7	8.1	5	
pH		21	5.3	8.6	7.5	6.5 - 9	2
Secchi Tube	100 cm	21	38	107.5	88.4	40	1
Total Suspended Solids	mg/L	10	3	11	7	15	
Escherichia coli (geometric mean)	MPN/100ml	15	77	166		126	1
Escherichia coli	MPN/100ml	15	18	1301	222.6	1260	1
Phosphorus	ug/L	10	47	171	96	100	3
Temperature, water	deg °C	21	14.6	26.7	20.5		
Hardness	mg/L	10	70.7	198	147.1		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the West Branch Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID**

Summary

Rum River, West Branch (07010207-525, 07010207-527)

The West Branch Rum River is the largest tributary to the Rum River and flows southeast from the township of Mount Morris to the Rum River in Princeton. Four biological stations were sampled (13UM055, 13UM056, 13UM065, 13UM048) in 2013, and one biological station (07UM080) was sampled in 2007 on the West Branch of the Rum River for fish. All of the fish samples in 2013, including a repeat sample of 13UM048 were above the threshold and the confidence interval. Fish habitat was abundant at all of these sites with good MSHA scores at all of the sampling locations. The lower section of the West Branch Rum River (-625), from Estes Brook to the Rum River, was determined to be impaired for aquatic life based on macroinvertebrate monitoring data. The next section of river upstream (-627) also had low macroinvertebrate IBI scores but was not listed as impaired because low water levels at two stations in 2013, precluded effective sampling of a primary habitat type (riffles) and another station (13UM065) had an IBI score above the general use threshold. The lower part of the West Branch Rum River had sufficient water at the time of macroinvertebrate monitoring, and thus it was concluded that water level was minimally impacting the IBI assessment. The macroinvertebrate community at the lower monitoring station (13UM048) had a lower percentage of EPT (mayflies, caddisflies, and stoneflies) individuals, fewer intolerant taxa, and a higher percentage of tolerant taxa relative to the next site upstream (13UM065), which was meeting the aquatic life use criteria.

There are 22 stream reaches in the West Branch Rum River Aggregated 12-HUC. For aquatic recreation, 1 of the 22 stream reaches has been assessed. The remaining stream reaches either have insufficient information or no data. The Rum River, West Branch (07010207-525) is 16 miles long and is located at the bottom of the watershed. There is an extensive bacteria dataset (37 samples) that extends over a four-year period. The geometric monthly mean exceeds the standard in June (224MPN/100ml) and August (214MPN/100ml) as well as an individual exceedance (1301MPN/100ml); resulting in an impairment for aquatic recreation use. There are 69 established feedlots in the West Branch Rum River Aggregated 12-HUC; 7 within a mile of the West Branch Rum River (07010207-525).

For aquatic life, 4 of the 22 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The West Branch Rum River (07010207-525 and 07010207-527) has very good transparency. There are pH values that drop below the standard. These exceedances occurred in June of 2013 and 2014. The pH dataset is extensive containing 109 samples over an eight-year period with the two exceedances. The dissolved oxygen dataset consistently is higher in the spring and fall and lower throughout the summer months. The phosphorus data indicates nutrients are elevated; no data exists to determine if it is resulting in excess algae or rooted vegetation in the stream.

Unnamed Creek (07010207-667)

Unnamed Creek flows east from Morrill Township to the West Branch Rum River. Fish data collected from one biological station (13UM075) sampled in 2013. The fish IBI score is above the general use threshold and the upper confidence limit. The station was sampled twice in 2013 but the first sample is not assessable due to the stream did not have time to recolonize due to a late spring and the stream was dry in the previous fall. Even with little time to recolonize the first sample taken was above the general use threshold and within the upper confidence limit. For a modified stream reach there was an abundance of fish habitat including woody debris and riffles. Invert data collected from the same biological station sampled in 2013 the invert IBI score is below the general use threshold and the lower confidence limit. Low flow may be impacting invert IBI score but, evidence of nutrient enrichment and erosion issues preclude dismissing the low score due to natural disturbance. Fish were sampled the day before invert sampling and water levels were sufficient to obtain a decent sample of headwater fish species (~300 individuals).

Prairie Brook (07010207-684)

Fish data collected on Prairie Brook from one biological station (13UM077) sampled in 2013. Fish IBI score is above the modified use threshold and within the upper confidence interval. Good cover for fish and a good riparian along the sampling site may have contributed to the good FIBI score.

Figure 44. Photograph at 10X water chemistry location in the West Branch Rum Aggregated 12-HUC.

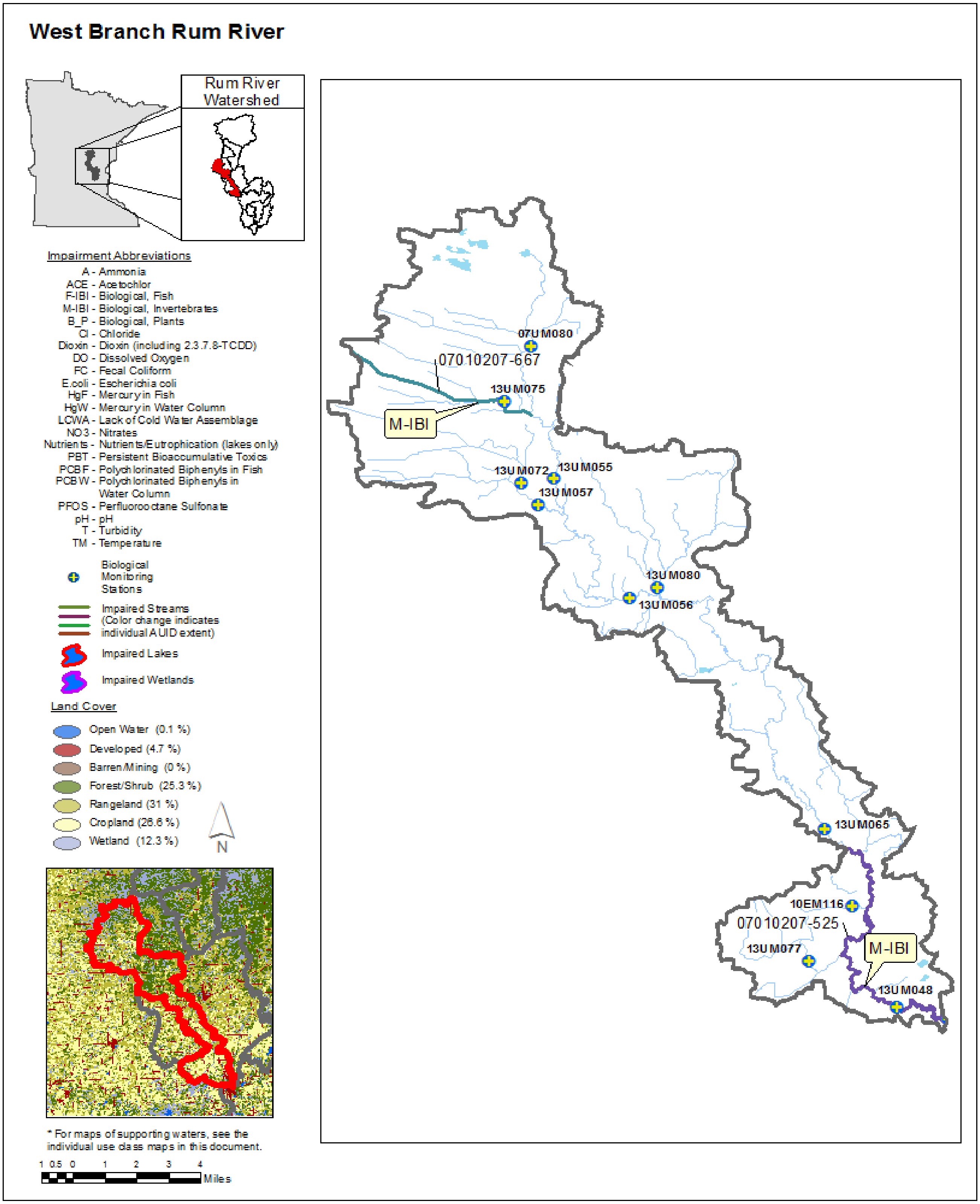

Figure 45. Currently listed impaired waters by parameter and land use characteristics in the West Branch Rum Aggregated 12-HUC.

Estes Brook Aggregated 12-HUC   HUC 0701020703-02

Estes Brook is the only subwatershed that flows into the West Branch Rum River. The headwaters of Estes Brook flow southeast out of Benton county into Mille Lacs county near the city of Estes Brook. Estes Brook's 43.6 mi^2 drainage area is predominately in agricultural production, 39.5% is cultivated as cropland while 34.2% is utilized as pasture for livestock. Only 14.2% of the watershed is forested which are focused along the stream corridors. The outlet water chemistry monitoring station was co-located with biological monitoring station 13UM042.

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

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	**Eutrophication** Phosphorous	Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-533 **Unnamed creek,** Unnamed cr to Estes Bk	13UM076	1.62	WWg	MTS	MTS	IF	IF	IF		IF	IF		IF		FS	NA
07010207-679 **Estes Brook,** -93.7502, 45.7028 to W Br Rum R	13UM042, 13UM060	13.62	WWg	MTS	EXS	IF	IF	IF		MTS	MTS		IF		NS	NS

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

Table 26. Minnesota Stream Habitat Assessment (MSHA) Estes Brook Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
2	13UM042	Estes Brook	3.13	14	12.6	9	23	61.73	Fair
1	13UM060	Estes Brook	5	11	13.6	15	24	68.6	Good
1	13UM076	Unnamed creek	5	11	12.3	12	26	66.3	Good
2	15UM100	Estes Brook	1.5	8.75	19.53	14	24	67.78	Good
Average Habitat Results: ***Estes Brook Aggregated 12-HUC***			**3.66**	**11.19**	**14.51**	**12.5**	**24.25**	**66.10**	**Good**

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

Table 27. Channel Condition and Stability Assessment (CCSI): Estes Brook Aggregated 12-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
1	13UM060	Estes Brook	28	21	24	7	80	moderately unstable
1	13UM042	Estes Brook	22	17	12	5	56	moderately unstable
1	13UM076	Unnamed creek	6	22	14	3	45	fairly stable
Average Stream Stability Results: ***Estes Brook Aggregated 12-HUC***			**18.67**	**20**	**16.67**	**5**	**60.33**	**moderately unstable**

Qualitative channel stability ratings
= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 28. Outlet water chemistry results: Estes Brook Aggregated 12-HUC.

Station location:	Estes Brook, at Davenport RD, 4.5 mi. NW of Princeton						
STORET/EQuIS ID:	S006-104						
Station #:	13UM042						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	0.9	16.1	5.9	40	
Dissolved Oxygen (DO)	mg/L	21	3.9	10.7	8	5	1
pH		21	7	9	7.5	6.5 - 9	
Secchi Tube	100 cm	21	72.4	107.5	99.6	40	
Total Suspended Solids	mg/L	10	4	10	6.2	15	
Escherichia coli (geometric mean)	MPN/100ml	15	295.3	740.8		126	2
Escherichia coli	MPN/100ml	15	6	2419	764.9	1260	2
Phosphorus	ug/L	10	42	192	103.5	100	4
Temperature, water	deg °C	21	15.4	29.2	21.9		
Hardness	mg/L	10	95.4	219	196.9		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Estes Brook Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Unnamed Creek (07010207-533)

Unnamed Creek flows into Estes Brook northwest of the city of Princeton. The stream is in a predominately agricultural area but the stream corridor near the confluence of Estes Brook is heavily wooded. One biological station (13UM076) was sampled in 2013. Both fish and macroinvertebrates have passing scores. The MSHA and CCSI scored good and fairly stable respectively which may both conducive to good FIBI and MIBI scores.

Estes Brook (07010207-679)

Estes Brook is the largest tributary to the West Branch Rum River. It flows southeast and enters the West Branch Rum River 4.5 miles northwest of the city of Princeton. Two biological stations (13UM060, 13UM042) were sampled for fish in 2013. Both biological stations scored above the threshold and the confidence interval and a repeat sample occurred at 13UM042 and had the result.

Macroinvertebrate monitoring occurred at the same two locations along Estes Brook. Based on the results of those two samples it appears that the lower part of the stream is in worse condition, triggering an impairment determination for this general aquatic life designated stream. At the lower station (13UM042) the macroinvertebrate IBI score was 43, 10 points below the threshold for this stream class. An evaluation of the habitat at this location suggests that instability of the channel (i.e., bank erosion, embedded substrates) may be contributing to the poor macroinvertebrate community, symptoms of hydrologic alteration further up in the watershed.

Stream assessments

There are five stream reaches in Estes Brook Aggregated 12-HUC. For aquatic recreation, 1 of the 5 stream reaches has been assessed. The remaining stream reaches either have insufficient information or no data. The bacteria samples are elevated throughout the dataset with some individual samples reaching as high as 2419 MPN/100mL. Both the geometric mean and the individual samples are exceeding the standard; resulting in an impairment for recreation use. There are 35 established feedlots in the Estes Brook Aggregated 12-HUC; 5 within a mile of Estes Brook (07010207-579).

For aquatic life, two of the five stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The dissolved oxygen exceeded the standard of 5 mg/L once in two years (2013 and 2014). The one exceedance (3.9 mg/L) occurred before 9 am which could indicate that the dissolved oxygen flux could be a potential stressor on aquatic life. Overall the transparency is very good in Estes Brook (07010207-579). The phosphorus is elevated in Estes Brook (07010207-579); information to determine if it was resulting in excessive algae or rooted vegetation was unavailable. Estes Brook (07010207-579) flows through predominately cropland which could be a contributor to the high phosphorus levels.

Figure 46. Photograph at 10X water chemistry location in the Estes Brook Aggregated 12-HUC.

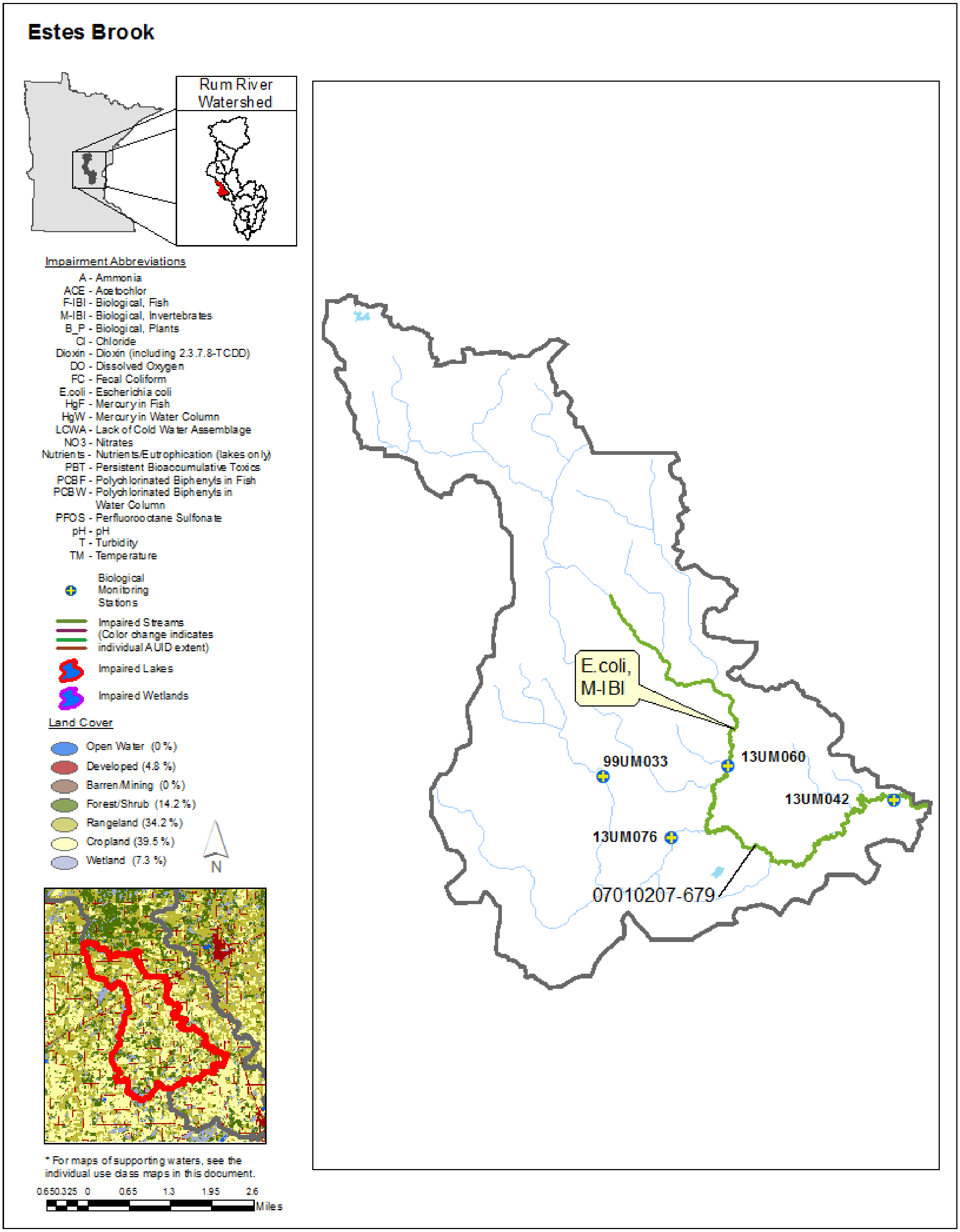

Figure 47. Currently listed impaired waters by parameter and land use characteristics in the Estes Brook Aggregated 12-HUC.

Stanchfield Creek Aggregated 12-HUC

HUC 0701020704-01

Stanchfield Creek subwatershed is bordered to the north by the St. Croix Basin, to the west and south by the Upper Rum and Middle Rum River Watersheds respectively, and to the east by Lower Stanchfield Branch subwatershed. There are two main streams that drain the 96.4 mi^2 watershed. Agricultural land use makes up the majority of the area in the watershed cropland (39.7%) and rangeland (22.8%). Forested areas (18.9%) mainly occur along the stream corridors. Stanchfield Creek has its headwaters in northwest Isanti county and a very small section of southeast Mille Lacs County. Stanchfield Creek flows east to Ties Creek which flows south out of Kanabec County. After the confluence of Ties Creek near the city of Day, Stanchfied Creek flows south to the Rum River near the city of Spring Vale. The outlet water chemistry monitoring station was co-located with biological monitoring station 13UM047.

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

				Aquatic Life Indicators:									Eutrophication			
AUID ***Reach Name*****,** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Phosphorous	Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-518 **Stanchfield Creek,** Ties Cr (Stanchfield Bk) to Rum R	13UM047	14.63	WWg	MTS	EXP	IF	MTS	MTS	MTS	MTS	MTS		EX		FS	FS
07010207-520 **Stanchfield Creek,** Headwaters (North Stanchfield Lk 30-0143-00) to Stanchfield Bk	13UM061	14.86	WWg	EXS		IF	IF	IF		IF	IF		IF		NS	NA

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

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

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

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

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

Table 30. Minnesota Stream Habitat Assessment (MSHA): Stanchfield Creek Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	13UM061	Stanchfield Creek	5	10.5	17.1	16	16	64.6	Fair
1	13UM082	Unnamed creek	0	11	9	8	14	42	Poor
1	13UM081	Ties Creek (Stanchfield Brook)	5	10.5	4	13	10	42.5	Poor
1	13UM047	Stanchfield Creek	5	12.5	13.7	16	23	70.2	Good
Average Habitat Results: *Starnchfield Creek Aggregated 12-HUC*			**3.75**	**11.13**	**10.95**	**13.25**	**15.75**	**54.83**	**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 31. Channel Condition and Stability Assessment (CCSI): Stanchfield Creek Aggregated 12-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
1	13UM047	Stanchfield Creek	12	22	8	3	45	fairly stable
Average Stream Stability Results: *Stanchfield Creek Aggregated 12-HUC*			**12**	**22**	**8**	**3**	**45**	**fairly stable**

Qualitative channel stability ratings

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

Table 32. Outlet water chemistry results: Stanchfield Creek Aggregated 12-HUC.

Station location:	Stanchfield Creek, at 357th Ave., 4 mi. NW of Cambridge						
STORET/EQuIS ID:	S004-980						
Station #:	13UM047						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	0.1	21.4	5.9	40	
Dissolved Oxygen (DO)	mg/L	20	2.9	10.1	7.5	5	1
pH		20	6.2	8.8	7.9	6.5 - 9	1
Secchi Tube	100 cm	20	100	107.5	104.9	25	
Total Suspended Solids	mg/L	10	2	9	4.5	30	
Escherichia coli (geometric mean)	MPN/100ml	14	33	41		126	
Escherichia coli	MPN/100ml	14	9	261	58.4	1260	
Phosphorus	ug/L	10	84	578	210.8	100	9
Temperature, water	deg °C	20	17	28.5	22.8		
Hardness	mg/L	10	136	206	180.4		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Stanchfield Creek Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 33. Lake assessments: Stanchfield Creek Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Lory	30-0096-00	239	E		5.2	1.8		26	29.9	1.3	IF	FS
South Stanchfield	30-0138-00	409	E	92	5.2	2.4		87	74.8	1.	NS	IF
Krone	30-0140-00	59	E					75	130	0.5		
North Stanchfield	30-0143-00	147	H	100	3.2	1.2		196	35	0.8	NS	
Unnamed	30-0162-00	36	E					72	38.5			
Lewis	33-0032-00	176	E	45.2	14.0	4.9	NT	26	13.9	2.1	FS	IF

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

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

Summary

Stanchfield Creek (07010207-518, 07010207-520)

Stanchfield Creek is a wetland dominated stream that flows south from near the city of Dalbo to the Rum River just north of the city of Cambridge. Two biological stations (13UM061, 13UM047) were sampled in 2013. Fish data from the upstream biological station scored below general use threshold and within lower confidence interval. Habitat is marginal in the stream with abundant macrophytes in the stream. The fish assemblage is dominated by intolerant species that brought down the IBI score. A low dissolved oxygen reading at 3 p.m. in a macrophyte dominated reach indicates nutrient problems. Nutrient enrichment may be threatening the biological integrity of this creek. The most downstream fish IBI score is above general use threshold and within upper confidence interval. Habitat was good in the stream with abundant wild rice in the margins of the stream. The fish assemblage was decent but lacking intolerant species which brought down the IBI score. The fish and invertebrate scores are on the edge of impairment. The natural characteristics of the stream channel were taken into consideration in the assessment of macroinvertebrate community at the Stanchfield Creek monitoring station (13UM047). Dense wetland vegetation, including wild rice, was present along the margins of the reach resulting in many macroinvertebrates typical of wetlands being present in the sample. Still, a total of 10 EPT taxa were collected, indicating that this low gradient stream was in relatively good health. Therefore, despite an IBI score that fell a few points below the general use threshold for this stream class, the macroinvertebrate community was considered to be indicative of a stream that is supporting its aquatic life designated use. Total phosphorus concentrations were elevated in this stream but were not resulting in increased productivity (i.e., eutrophication). This situation should continue to be monitored as nutrient enrichment may represent a threat to the healthy aquatic communities currently inhabiting this stream.

Stream assessments

There are 7 stream reaches in Stanchfield creek aggregated 12-HUC. For aquatic recreation, 1 of the 7 stream reaches has been assessed. The remaining stream reaches either have insufficient information or no data. Stanchfield Creek (07010207-518) has very low bacteria levels and is supporting recreational use. There are no feedlots in the immediate vicinity of the stream but some in the watershed.

For aquatic life, 2 of the 7 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The overall transparency is very good as it never drops below 100 cm in Stanchfield Creek (07010207-518). The dissolved oxygen dataset was small; a few observations dropped below the standard over the course of the dataset. Stanchfield Creek (07010207-518) has high levels of phosphorus but no response parameters to determine if excess algal growth is resulting.

Lake assessments

For aquatic recreation, 4 of the 18 lake basins >10 acres in size have been assessed (Table 33). The remaining lakes either have insufficient information or no data. The majority of the lakes are shallow and eutrophic. Lory Lake (30-0096-00) has lower levels of phosphorus compared to the response variables of chlorophyll-a and Secchi. There is insufficient information to assess Lory Lake (30-0096-00). South Stanchfield (30-0138-00) flows into North Stanchfield (30-0143-00) and both are shallow and contain very high levels of phosphorus. The shallow basins will cause some internal loading which will result in increasing phosphorus across the summer. Additionally, the surrounding landscape is predominately cropland which could also be a cause to the high levels of phosphorus. Both lakes are not meeting the aquatic recreation standard. Lewis Lake (33-0032-00) is a relatively deep lake at the top of the watershed with overall good water quality. This can be attributed to the land use which is dominated by forest and wetland.

Lory Lake (30-0096-00) and Lewis Lake (33-0032-00) both had fish surveys conducted and assessed. For both lakes, Yellow Bullhead was the dominant species in the trap nets, by biomass, and Northern Pike was the dominate species in the gill nets, by biomass. The nearshore samples were dominated by Bluegills in both lakes as well. The fish community condition of Lory Lake (30-0096-00), as measured by the Fish IBI, indicates that it is meeting the aquatic life standard. The fish community condition of Lewis Lake (33-0032-00) had insufficient information to assess for aquatic life.

Plant surveys were completed on Lory Lake (30-0096-00), South Stanchfield (30-0138-00), North Stanchfield (30-0143-00), and Lewis Lake (33-0032-00). Both Lory Lake (30-0096-00) and Lewis Lake (33-0032-00) had plant communities that were above the threshold indicating a healthy water quality to support plant communities. South Stanchfield (30-0138-00) and North Stanchfield (30-0143-00) had plant communities that were of poorer quality with scores below the threshold for both lakes.

Lewis Lake (33-0032-00) is a deep lake in the Northern Lakes and Forest ecoregion. It is a relative large watershed and the average phosphorus concentration is close to the standard. This lake should be considered high priority for protection because it can susceptible to increases of phosphorus in multiple ways (development, wetland drainage, etc.). These sources could cause any of the lakes to become impaired in this watershed.

Figure 48. Photograph at 10X water chemistry location in the Stanchfield Creek Aggregated 12-HUC.

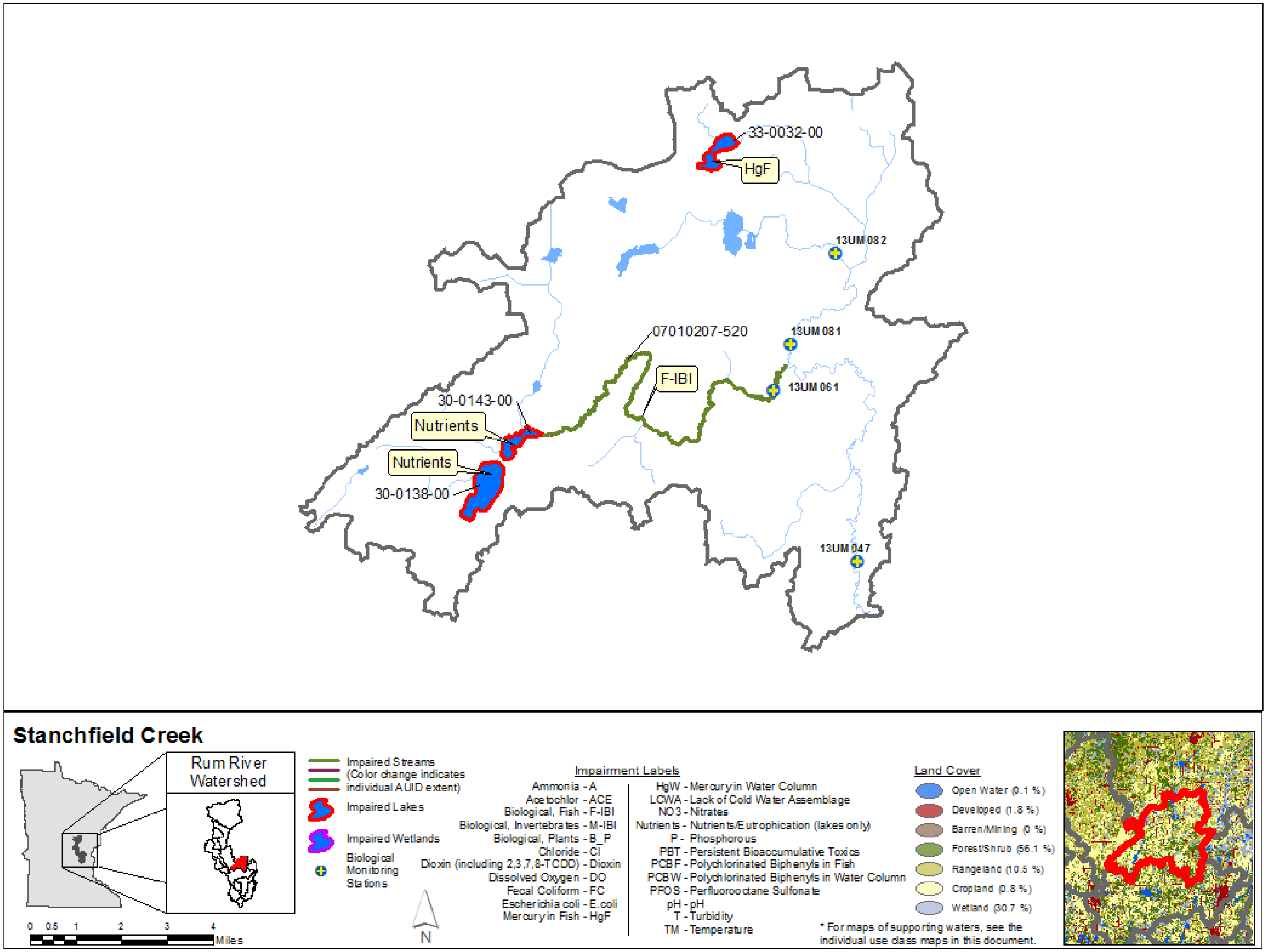

Figure 49. Currently listed impaired waters by parameter and land use characteristics in the Stanchfield Creek Aggregated 12-HUC.

Middle Rum River Aggregated 12-HUC HUC 0701020705-01

The Middle Rum River subwatershed is the largest riverine subwatershed encompassing 151.52 mi^2 of southeast Mille Lacs county, northeast Sherburne county, and central Isanti county. The Rum River flow east from Princeton to Cambridge which are two of largest cities within the Rum River Watershed. Developed land use makes up 9.5% of the subwatershed. Agricultural land use makes up the majority of the area in the watershed cropland (32.4%) and rangeland (18.7%). The outlet water chemistry monitoring station was co-located with biological monitoring station 13UM093. Two additional intensive water chemistry stations were placed in the watershed to get water chemistry data from below Princeton's wastewater treatment plant biological monitoring station 13UM093 and get upstream water chemistry data from Cambridge's wastewater treatment plant biological monitoring station 13UM046.

Table 34. Aquatic life and recreation assessments on stream reaches: Middle Rum River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Eutrophication: Response Indicator	Aquatic Life	Aquatic Rec. (Bacteria)
07010207-504 **Rum River,** Stanchfield Cr to Seelye Bk	13UM046, 13UM087, 13UM093	34.41	WWg	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS		EX		FS	FS
07010207-512 **Rum River,** W Br Rum R to Stanchfield Cr	10EM036, 13UM094	37.56	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS		MTS		FS	FS

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

Table 35. Minnesota Stream Habitat Assessment (MSHA): Middle Rum River Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
4	10EM036	Rum River	3.94	13.63	15.25	11.75	19.5	64.06	Fair
1	13UM046	Rum River	3.5	11	19.1	14	28	75.6	Good
1	13UM051	Spencer Brook	5	11	9	12	6	43	Poor
1	13UM087	Rum River	3.75	14.5	18.3	14	30	80.55	Good
1	13UM091	Unnamed creek	2.5	10	4	6	1	23.5	Poor
1	13UM093	Rum River	3.5	14	17.05	6	17	57.55	Fair
1	13UM094	Rum River	5	12	17.8	14	27	75.8	Good
Average Habitat Results: *Middle Rum River Aggregated 12-HUC*			**3.88**	**12.3**	**14.36**	**11.1**	**18.35**	**60.01**	**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 36. Channel Condition and Stability Assessment (CCSI): Middle Rum River Aggregated 12-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
1	13UM094	Rum River	21	38	13	7	79	moderately unstable
1	13UM087	Rum River	32	23	16	7	78	moderately unstable
1	10EM036	Rum River	24	28	21	5	78	moderately unstable
1	13UM046	Rum River	30	17	22	5	74	moderately unstable
1	13UM093	Rum River	29	19	15	7	70	moderately unstable
1	13UM091	Trib. to Rum River	7	10	9	1	27	stable
Average Stream Stability Results: *Middle Rum River Aggregated 12-HUC*			**23.83**	**22.5**	**16**	**5.33**	**67.67**	**moderately unstable**

Qualitative channel stability ratings

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

Table 37. Outlet water chemistry results: Middle Rum River Aggregated 12-HUC.

Station location:	Rum River, Downstream of Hwy 95, in Cambridge						
STORET/EQuIS ID:	S005-326						
Station #:	13UM046						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances
Ammonia-Nitrogen	ug/L	10	0.4	6.6	2.9	40	
Dissolved Oxygen (DO)	mg/L	20	5.2	10	7.7	5	
pH		20	6.7	8.1	7.5	6.5 - 9	
Secchi Tube	100 cm	20	61.4	107.5	93.4	40	
Total Suspended Solids	mg/L	10	4	14	7.4	15	
Escherichia coli (geometric mean)	MPN/100ml	14	11.9	20.7		126	
Escherichia coli	MPN/100ml	14	4	118	37.3	1260	
Chlorophyll-a, Corrected	ug/L	13	1	5.6	2.7	18	
Phosphorus	ug/L	16	52	178	100.6	100	7
Temperature, water	deg °C	20	15.6	27.1	21.6		
Hardness	mg/L	10	54.9	125	104.4		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Middle Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 38. Outlet water chemistry results: Middle Rum River Aggregated 12-HUC.

Station location:	Rum River, 10920 313th Ave, 2.5 mi. SE of Princeton						
STORET/EQuIS ID:	S007-551						
Station #:	13UM094						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances
Ammonia-Nitrogen	ug/L	10	0.6	5.3	2.4	40	
Dissolved Oxygen (DO)	mg/L	20	5.1	9.4	7.7	5	
pH		20	6.8	8.4	7.5	6.5 - 9	
Secchi Tube	100 cm	7	55	100	79.1	40	
Total Suspended Solids	mg/L	10	4	17	10.2	15	1
Escherichia coli (geometric mean)	MPN/100ml	14	23.4	52.1		126	
Escherichia coli	MPN/100ml	14	1	697	94.7	1260	
Chlorophyll-a, Corrected	ug/L	13	1	2.6	1.4	18	
Phosphorus	ug/L	16	29	550	109.7	100	5
Temperature, water	deg °C	20	14.5	27.5	21.4		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Middle Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 39. Outlet water chemistry results: Middle Rum River Aggregated 12-HUC.

Station location:	Rum River, West of Oak Cir., 1.5 mi. S of Cambridge						
STORET/EQuIS ID:	S007-552						
Station #:	13UM093						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances
Ammonia-Nitrogen	ug/L	10	0.9	6.8	3.2	40	
Dissolved Oxygen (DO)	mg/L	20	5	9.9	7.5	5	
pH		20	6.9	8	7.5	6.5 - 9	
Secchi Tube	100 cm	7	80	100	95.1	40	

Total Suspended Solids	mg/L	10	3	12	6.9	15	
Escherichia coli (geometric mean)	MPN/100 ml	14	19.5	21.5		126	
Escherichia coli	MPN/100 ml	14	10	86	26.5	1260	
Chlorophyll-a, Corrected	ug/L	13	1.1	6.7	2.9	18	
Phosphorus	ug/L	16	80	210	119.4	100	7
Temperature, water	deg °C	20	15.6	27.1	21.6		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.
****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Middle Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 40. Lake assessments: Middle Rum River Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Elizabeth	30-0083-00	268	M		1.5			15	1.6	2	FS	
Blue (NorthBay)	30-0107-01	47	E		3.2	1.5	NT			1.4	IF	IF
Blue (South Bay)	30-0107-02	247	M		9.4	4.6	NT	24	38.3	1.7	IF	IF
Tennyson	30-0113-00	112	H		0.5			107	4.8	0.9	NS	
Baxter	30-0114-00	77	H	100	3.0			104	24.2	1.1	NS	
Spectacle	30-0135-00	249	M	65.6	15.7	3.7	I	19	3	4.2	FS	FS
Green	30-0136-00	822	E	45	8.5		NT	52	30.2	1.7	NS	NS
Silver	48-0004-00	143	H		1.4			198	135	0.5		
Sandy	71-0040-00	59	M	67	12.5	4.3	NT	14	3	4.8	FS	

Abbreviations:
D -- Decreasing/Declining Trend
I -- Increasing/Improving Trends
NT – No Trend
H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O - Oligotrophic
FS – Full Support
NS – Non-Support
IF – Insufficient Information

Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use

Summary

Rum River (07010207-504, 07010207-512)

The Rum River in the Middle Rum River subwatershed flows east from the city of Princeton to Cambridge where it turns south and flows out of the subwatershed. These are the two largest cities that are completely within the watershed and both have sewage treatment facility that the effluent flows into the Rum River. Both AUIDs that make up the mainstem Rum River in this subwatershed are supporting for aquatic life just like all of the other mainstem AUIDs on the Rum River indicating that both cities are adequately treating its waste water. In addition, fair to good MSHA scores with an abundance of fish and macroinvertebrate habitat were found.

Unnamed Creek (07010207-668)

One other stream was assessed using fish and macroinvertebrate community data. This stream had a macroinvertebrate IBI score of 42, well above the modified use threshold for this stream class and a fish IBI score below the threshold and confidence limit. However, the final aquatic life use assessment for this Unnamed Creek (-668) was "Not Assessed" due to the unique circumstances of this water body. Connected to the Rum River at two locations, upstream of the State Highway 47 bridge near West Point and at the State Highway 95 bridge near Walbo (Figure 50), Unnamed Creek functions as an overflow channel during flood events, providing significant floodwater storage that is slowly released over an extended period of time (FEMA 2003). As such, the watershed assessment team felt that is was inappropriate to assess this water body as a stream given the periodic nature of measurable flow through this channel, functioning more like wetland the majority of the time. Restoration of drained and partially drained wetlands in this area would increase floodwater storage capacity and benefit the stability of the river channel as well as riparian landowners further downstream during flood events.

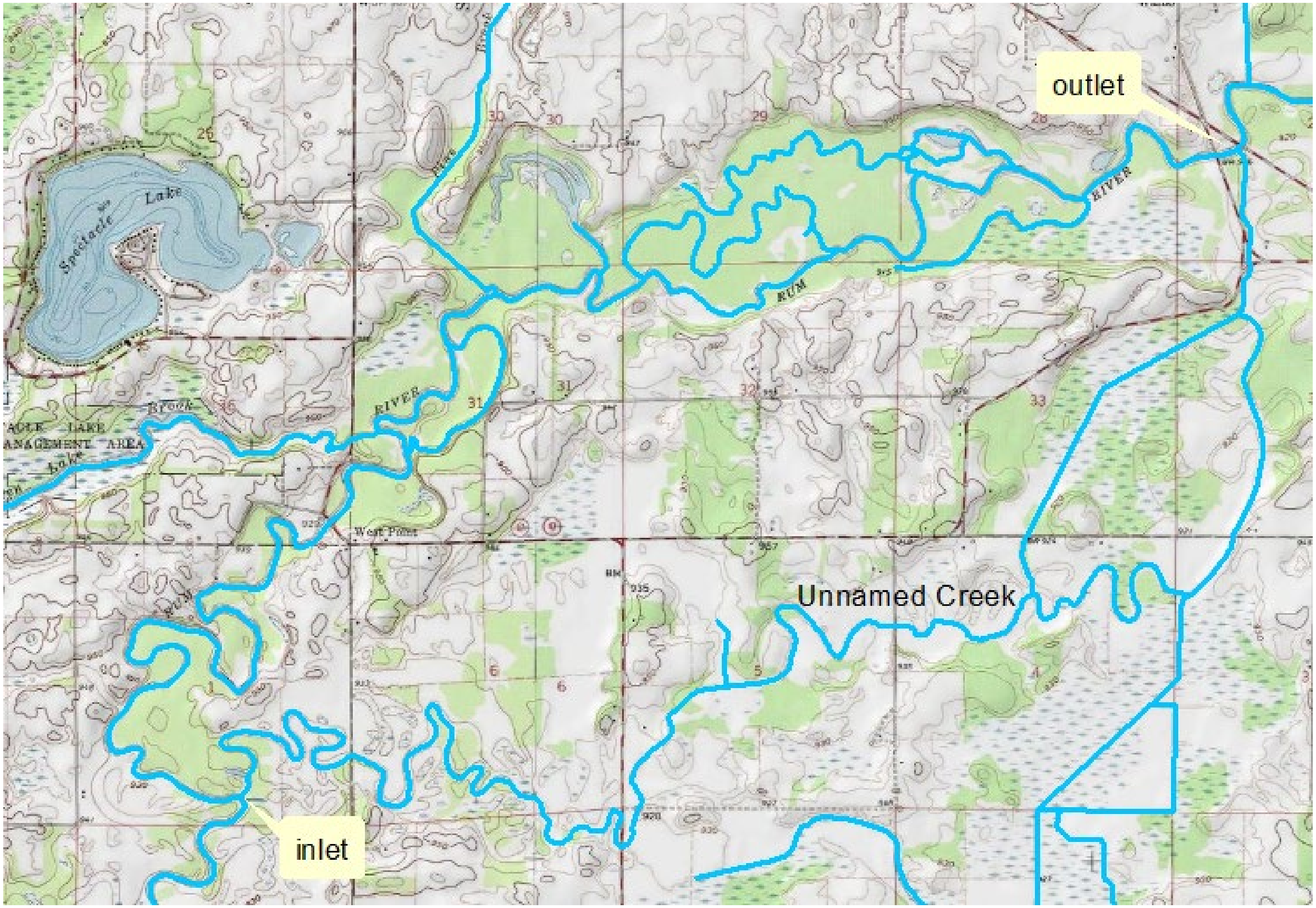

Figure 50. Map of Unnamed Creek showing the inlet and outlet of this natural diversion channel of the Rum River.

Stream assessments

There are 18 stream reaches in Middle Rum River Aggregated 12-HUC. For aquatic recreation, 2 of the 18 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The Rum River (070102070-504 and 07010207-512) stretches 72 miles and flows through a few wetlands. The riparian zone mainly consists of forest and grasses. Both of these AUIDs have low bacteria levels. There are 20 established feedlots in the watershed and only 4 of them within a mile of the stream. Both reaches are meeting the aquatic recreation standard.

For aquatic life, 2 of the 18 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The Rum River (070102070-504 and 07010207-512) has good transparency throughout. There are a few occasions where transparency falls below the standard. The total suspended solids are also very low which corresponds with the transparency values. Even though the river's riparian zone mainly consists of forest and grasses, the phosphorus levels are elevated. The aerial photo of the watershed can be described as dominantly cropland. Overall, the water chemistry in the Rum River is meeting the aquatic life standard.

Lake assessments

For aquatic recreation, 6 of the 32 lake basins >10 acres in size have been assessed (Table 40). The remaining lakes either have insufficient information or no data. The Middle Rum River Aggregated 12-HUC contains many different types of lakes from hypereutrophic to mesotrophic, shallow to deep, and small to large basins. All of the lakes are in the North Central Hardwood Forest ecoregion. Spectacle Lake (30-0135-00) and Sandy Lake (71-0040-00) are deep lakes and Elizabeth Lake (30-0083-00) is shallow. They all have a small watershed to lake ratio which helps reduce the runoff input. Spectacle (30-0135-00) has an increasing transparency trend of 0.06 to 1.52 feet per decade. All three lakes are considered mesotrophic and are all meeting the aquatic recreation standard. On the other end of the spectrum there is Tennyson Lake (30-0113-00), Baxter Lake (30-0114-00), and Green Lake (30-0136-00). All of them have large watershed to lake ratios which increases the runoff to the lake. Baxter Lake (30-0114-00) flows into Tennyson Lake (30-0113-00) and both are shallow which would allow for internal loading to occur. Both Tennyson Lake (30-0113-00) and Baxter Lake (30-0114-00) are hypereutrophic and Green Lake (30-0136-00) is eutrophic. Green Lake (30-0136-00) is already listed for aquatic recreation since 2008. All of them are not meeting the aquatic recreation standard. Blue Lake (North Bay: 30-0107-01) is shallow and eutrophic. Blue Lake (South Bay: 30-0107-02) is deep and mesotrophic. The phosphorus levels in Blue Lake (South Bay: 30-0107-02) are low but the chlorophyll-a levels are considerably higher than expected. This would indicate that Blue Lake (South Bay: 30-0107-02) has the potential for periodic algal blooms in mid to late summer. Overall the water chemistry data is insufficient to make an assessment.

For aquatic life, 4 of the 32 lake basins >10 acres in size have been assessed (Table 40). Yellow Bullhead and Northern Pike were the dominate species collected in trap nets and gill nets for all the sampled lakes. The nearshore samples indicate a strong Bluegill population in the lakes as well. Spectacle Lake (30-0135-00) has a relatively diverse fish population. It was noted by the MNDNR fisheries staff that characteristics of the shoreline made it difficult to use the shoreline trap nets and the results were not fully representative of the lake. Overall the fish survey portrayed a healthy fish community which is meeting the aquatic life standard. Green Lake (30-0136-00) is impaired for aquatic recreation and this poor water quality is reflected in the fish surveys and lack of complex of nearshore habitat. Bowfin was the most abundant fish collected in the trap nets and Sunfish dominated the nearshore survey. Green Lake (30-0136-00) is not meeting the aquatic life standard. Blue Lake (30-0107-01 and -02) was surveyed in 2013 and the trap nets consisted of mainly Yellow Bullhead and Common Carp. Northern Pike and

Walleye were sampled and accounted for the majority of the gill net biomass followed by Yellow Bullhead and White Sucker. The nearshore survey was dominated by Bluegill. The two most dominant species, by biomass, in the trap nets were yellow bullhead and common carp. Fish community condition, as measured by the Fish IBI, in Blue Lake (30-0107-01 and -02) provided insufficient information to assess aquatic life. However, Blue Lake (30-0107-01 and -02) is vulnerable to become impaired due to the low fish IBI scores, a large contributing watershed with moderately high disturbance and poor shoreline habitat.

There were 5 of the 32 lake basins >10 acres in size where an aquatic vegetation survey was conducted. Elizabeth Lake (30-0083-00), Blue Lake (30-0107-01 and -02), Spectacle Lake (30-0135-00), and Sandy Lake (71-0040-00) all scored above the threshold during the aquatic plant survey. Green Lake (30-0136-00) scored below the threshold. Spectacle Lake (30-0135-00) lake also has a healthy fish community; both biological communities indicate the lake is meeting the aquatic life standard Green Lake (30-0136-00) is not supporting aquatic recreation or aquatic life and the plant community also indicates that poor water quality that exists in the lake.

There are a few lakes that should be a priority for protection in the Middle Rum River Aggregated 12-HUC. Elizabeth Lake (30-0083-00), Blue Lake (30-0107-01, -02), and Spectacle Lake (30-0135-00) have large watersheds compared to the lakes size and Blue Lake (30-0107-01, -02) has an average phosphorus concentration that is close the standard. Steps should be taken to protect these waters to prevent them from becoming impaired.

Figure 51. Photographs at 10X water chemistry locations in the Middle Rum River Aggregated 12-HUC.

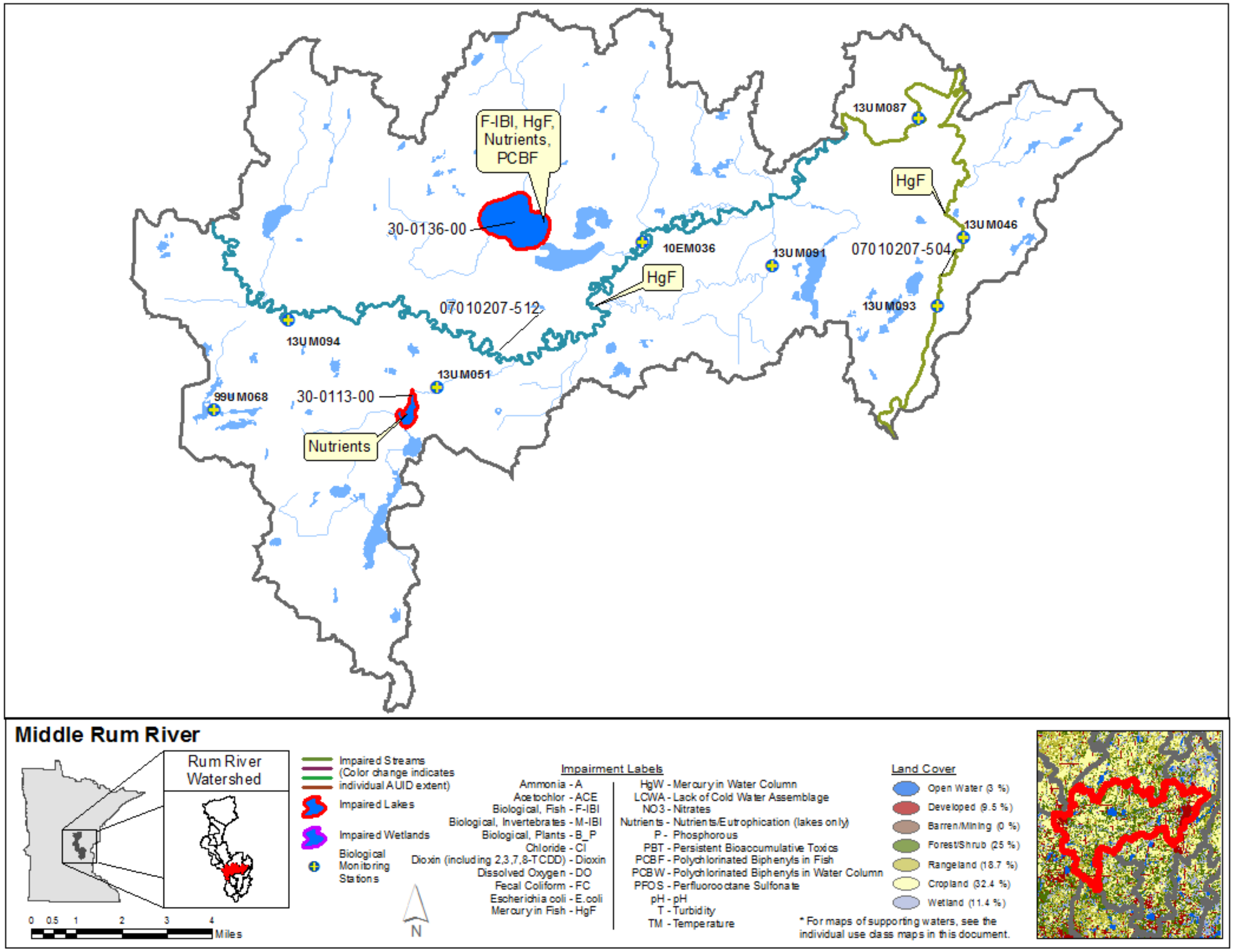

Figure 52. Currently listed impaired waters by parameter and land use characteristics in the Middle Rum River Aggregated 12-HUC.

Lower Stanchfield Branch Aggregated 12-HUC — HUC 0701020705-02

The majority of Lower Stanchfield Branch subwatershed is in northeast Isanti county but a small area of southeast Kanabec county and northwest Chisago county make up the headwaters. Lower Stanchfield is the fourth smallest subwatershed draining 46.8 mi^2. The watershed is borders the St. Croix basin to the north and east. The city of Stanchfield is the largest city in the watershed but just downstream of the outlet into the Rum River is the city of Cambridge. The watershed is one of the more wetland dominated (24.1%) subwatersheds the only land use that is more abundant is cropland (35.7%). No outlet water chemistry monitoring station was placed in this watershed because of the abundance of wetlands near the outlet.

Table 41. Aquatic life and recreation assessments on stream reaches: Lower Stanchfield Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID **_Reach Name_**, _Reach Description_	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Eutrophication: Response Indicator	Aquatic Life	Aquatic Rec. (Bacteria)
07010207-515 **Lower Stanchfield Branch,** T37 R23W S27, north line to Little Stanchfield Lk	13UM063	5.42	WWg	NA	MTS	IF	IF	IF		IF	IF		IF		FS	NA

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

Table 42. Minnesota Stream Habitat Assessment (MSHA): Lower Stanchfield Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	13UM063	Lower Stanchfield Branch	5	15	10.3	14	16	60.3	Fair
1	13UM068	Lower Stanchfield Branch	4	12	3	5	4	28	Poor
Average Habitat Results: *Lower Stanchfield Aggregated 12-HUC*			**4.5**	**13.5**	**6.65**	**9.5**	**10**	**44.15**	**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): Lower Stanchfield Aggregated 12-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
1	13UM068	Lower Stanchfield Branch	29	13	17	1	60	moderately unstable
1	13UM063	Lower Stanchfield Branch	16	25	14	3	58	moderately unstable
Average Stream Stability Results: *Lower Stanchfield Aggregated 12-HUC*			**22.5**	**19**	**15.5**	**2**	**59**	**moderately unstable**

Qualitative channel stability ratings

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

Table 44. Lake assessments: Lower Stanchfield Branch Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Little Stanchfield	30-0044-00	164	H		3.7	1.5		103	43	1	NS	FS
Long	30-0056-00	125	E	100	2.6			29	2.2	2.3	FS	
Section	30-0060-00	125	O					10	4.8	1.1	IF	

Abbreviations:
D -- Decreasing/Declining Trend
I -- Increasing/Improving Trends
NT – No Trend
H – Hypereutrophic
E – Eutrophic
M – Mesotrophic
O - Oligotrophic
FS – Full Support
NS – Non-Support
IF – Insufficient Information

Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use

Summary

Lower Stanchfield (07010207-515)

Lower Stanchfield Branch flow south from the city of Braham to the Rum River just north of the city of Cambridge. Fish data was collected from one biological station (13UM063) sampled in 2013. Fish IBI score is below the general use threshold and within lower confidence interval. The initial fish sample had less than 25 fish at the beginning of the index period after a late spring in a stream that had gone dry the summer before. Other sites in this area experienced this same result of low fish numbers and poor IBI scores with early samples but when repeated later in the summer, they had passing IBI score. This fish sample was not assessable due to the fish did not have proper amount of time to recolonize the stream. More sampling could help confirm the good macroinvertebrate scores taken under good conditions. The biological monitoring station on Lower Stanchfield Branch (13UM063) was along a section of the stream that flowed through areas of dense speckled alder growth. Despite having wetland characteristics, this station had a macroinvertebrate IBI score of 56, well above the general use threshold for the Southern Forests Glide-Pool stream IBI class. A MNDNR regulated aquatic invasive species, the Chinese Mystery Snail (*Cipangopaludina chinensis*), was collected at this site which suggests that a lake or wetland upstream is infested. This is the only station in the watershed where this species has been collected to date.

Lake assessments

For aquatic recreation, 2 of the 14 lake basins >10 acres in size have been assessed (Table 44). The remaining lakes either have insufficient information or no data. Little Stanchfield Lake (30-0044-00) is a shallow basin lake that is considered hypereutrophic and is not supporting aquatic recreation use. The size (164 acres) and direction of the lake paired with minimal wind obstruction results in a considerably large fetch. The large fetch and shallow depth is a likely contributor to the high levels of phosphorus due to sediment resuspension forces. Long Lake (30-0056-00) is also a shallow basin that is considered eutrophic. The lake is 1.2 miles long and surrounded by cropland, forest, and wetlands. Long Lake (30-0056-00) is at the top of the watershed and has a small contributing watershed. The overall water chemistry is very good and meeting the aquatic recreation standard considering the shallow basin, land cover types, and large fetch. Section Lake (30-0060-00) is a small lake with minimal data (1 sample point) but lake is surrounded by forest and wetland which is contributing to the low levels of phosphorus and chlorophyll-a. There is not enough data to make an assessment.

For aquatic life, 1 of the 14 lake basins >10 acres in size have been assessed (Table 44). Little Stanchfield Lake (30-0044-00) has a relatively diverse fish population compared to similar lakes in the watershed. Bowfin was the most abundant fish surveyed in the trap nets. Northern Pike were the dominate species surveyed in the gill nets and Bluegill dominated the nearshore sampling. Both Bowfin and White Sucker comprised a significant amount of the gill net survey. Overall the fish community is meeting the aquatic life standard.

Little Stanchfield Lake (30-0044-00) and Long Lake (30-0056-00) had aquatic plant surveys conducted in 2013. Little Stanchfield Lake has taxa richness is above an impairment threshold identified for similar lakes in the ecoregion, but when based on FQI, the aquatic plant community is below the threshold identified for similar lakes in the ecoregion. The Long Lake (30-0056-00) plant survey is above the plant IBI threshold.

Long Lake (30-0056-00) should be a high priority for protection. The lake is shallow and additions of phosphorus could lead to internal loading.

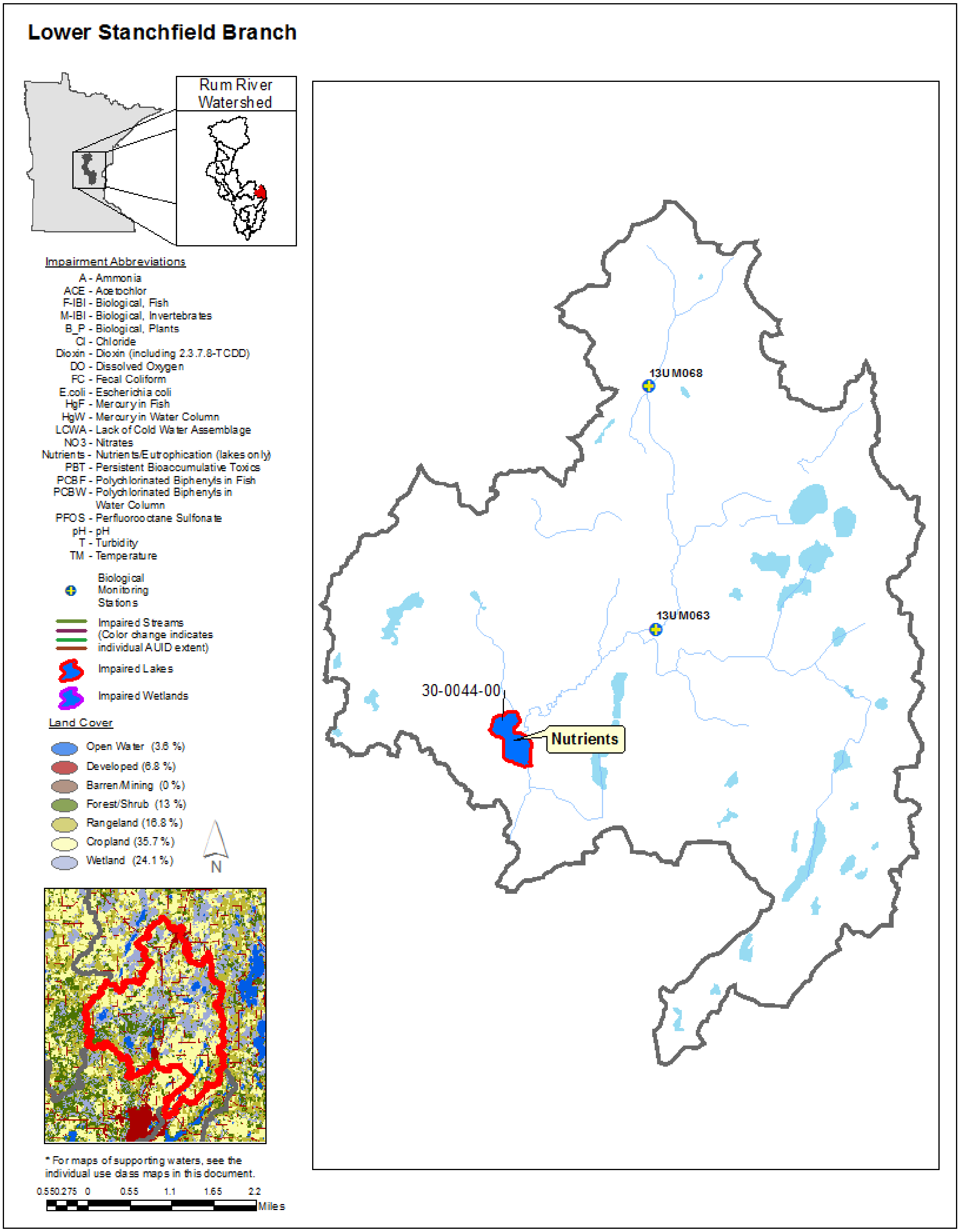

Figure 53. Currently listed impaired waters by parameter and land use characteristics in the Lower Stanchfield Aggregated 12-HUC.

Cedar Creek Aggregated 12-HUC HUC 0701020706-01

Cedar Creek is the southeast most subwatershed bordered to the east by the St. Croix Basin and to the south by the Mississippi River Twin Cities subwatershed. The headwaters start in southeast Isanti county and flow southwest into Anoka county draining 84.1 mi2. Even though this is the 3rd most developed subwatershed (10.9%) natural areas are still abundant in the headwaters, forest (22.5%) and wetlands (18.6%). The outlet water chemistry monitoring station was co-located with biological monitoring station 00UM101.

Table 45. Aquatic life and recreation assessments on stream reaches: Cedar Creek Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

				Aquatic Life Indicators:												
													Eutrophication			
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Phosphorous	Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-521 **Cedar Creek,** Headwaters to Rum R	00UM101, 13UM064, 13UM084	28.55	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS		MTS		FS	NS
07010207-575 **Crooked Brook,** CD 28 to Cedar Cr	13UM067	2.32	WWg	MTS	MTS	IF	IF	IF		IF	IF		IF		NS	NA
07010207-682 **Mahoney Brook,** T33 R24W S34, south line to Cedar Cr	00UM102	1.24	WWg	EXS	MTS	IF	IF	IF		IF	IF		IF		NS	NA

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

Table 46. Minnesota Stream Habitat Assessment (MSHA): Cedar Creek Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
1	00UM101	Cedar Creek	3.5	10.5	14	8	13	49	Fair
3	00UM102	Mahoney Brook	3.08	9.83	10	12.67	18	53.58	Fair
1	13UM064	Cedar Creek	3.5	12	15	8	20	58.5	Fair
1	13UM067	Crooked Brook	4.5	11	8.25	13	21	57.75	Fair
1	13UM070	Unnamed ditch (Branch 3 Lateral 2)	1.75	9.5	4	1	7	23.25	Poor
1	13UM071	county Ditch 28	3.75	10	9	6	7	35.75	Poor
2	13UM084	Cedar Creek	5	10.5	6.5	15	10.5	47.5	Fair
Average Habitat Results: *Cedar Creek Aggregated 12-HUC*			**3.58**	**10.48**	**9.54**	**9.1**	**13.79**	**46.48**	**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 47. Channel Condition and Stability Assessment (CCSI): Cedar Creek Aggregated 12-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
1	00UM101	Cedar Creek	30	29	32	11	102	severely unstable
1	13UM071	county Ditch 28	31	17	26	3	77	moderately unstable
1	13UM070	Unnamed ditch	27	15	30	3	75	moderately unstable
1	00UM102	Mahoney Brook	20	25	21	3	69	moderately unstable
1	13UM067	Crooked Brook	21	25	10	3	59	moderately unstable
1	13UM064	Cedar Creek	12	13	22	3	50	moderately unstable
1	13UM084	Cedar Creek	23	15	8	3	49	moderately unstable
Average Stream Stability Results: *Cedar Creek Aggregated 12-HUC*			**23.43**	**19.86**	**21.29**	**4.14**	**68.71**	**moderately unstable**

Qualitative channel stability ratings

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

Table 48. Outlet water chemistry results: Cedar Creek Aggregated 12-HUC.

Station location:	Cedar Creek, at CSAH 9, 5 mi. NE of Ramsey						
STORET/EQuIS ID:	S003-203						
Station #:	00UM101						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	2.3	21.3	8.9	40	
Chloride	mg/L	10	17.1	32.4	25.8	230	
Dissolved Oxygen (DO)	mg/L	21	4.5	10.4	7.3	5	3
pH		21	7.4	8.6	7.9	6.5 - 9	
Secchi Tube	100 cm	21	61	100	91.2	25	
Total Suspended Solids	mg/L	15	2	26	10.2	30	
Escherichia coli (geometric mean)	MPN/100ml	14	201.7	235.8		126	2
Escherichia coli	MPN/100ml	14	1	547	230.6	1260	
Phosphorus	ug/L	15	43	239	129.7	100	8
Temperature, water	deg °C	21	4.9	24.7	17.6		
Hardness	mg/L	10	125	211	179.4		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Cedar Creek Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 49. Lake assessments: Cedar Creek Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Minard	02-0067-00	127	E		2.1			88.63	1.79	1.09	FS	

Abbreviations:
D -- Decreasing/Declining Trend
I -- Increasing/Improving Trends
NT – No Trend

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

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

Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use

Summary

Cedar Creek (07010207-521)

Cedar Creek stretches 28.5 miles from the headwaters to the Rum River (07010207-502) in the city of Andover, MN. The stream drains 84 square miles and travels through multiple wetlands, forested areas, suburban areas, and cropland. Cedar Creek flows south from Athens WMA to the city of Cedar then turns west and flows into the Rum River 2 miles northeast of the city of Ramsey. Three biological stations (13UM084, 13UM084, 00UM101) along Cedar Creek were monitored for fish and macroinvertebrates in 2013; however, the data at the uppermost station (13UM084) was not assessed due to extremely low water levels during the macroinvertebrate sampling visit. The next station downstream (13UM064) had a macroinvertebrate IBI score slightly below the general use threshold and the fish score was above the threshold. The available habitat types at this station were limited to aquatic vegetation and overhanging vegetation with a predominantly sand substrate. The furthest downstream station (00UM101) scored a 64 in 2000 and 47 in 2013 for macroinvertebrates, limited evidence that the biological condition of this stream may have degraded over this time span. Notably, three stonefly genera (*Acroneuria*, *Taeniopteryx*, and *Paragnetina*) that were collected in the 2000 sample, a total of 26 individuals, were not present in the 2013 sample from this station. Fish at this site scored below general use threshold and within lower confidence interval. Sparse habitat along with a sand barren bottom is the major problem with this site. There is little disturbance up stream of the site and the two up-stream sites score well enough to use the weight of evidence approach to call this AUID fully supporting for aquatic life. In order to prevent this stream from becoming impaired in future rounds of IWM, Cedar Creek should be the beneficiary of watershed protection strategies in the intervening years between assessments.

The bacteria's individual samples are not exceeding the individual standard but the geometric mean standard is exceeding the standard in June (230 MPN/100mL) and July (202 MPN/100mL) indicating that the reach is not supporting aquatic recreation use. There are only 2 established feedlots in the Cedar Creek Aggregated 12-HUC; 1 within a 0.5 miles of Cedar Creek (07010207-521). For aquatic life, 1 of the 22 stream reaches has been assessed. The remaining stream reaches either have insufficient information or no data. Cedar Creek (07010207-521) has an extensive dataset. There are 58 dissolved oxygen samples that extend over a seven-year period. All of the exceedances occur immediately downstream of wetlands and were excluded from the assessment dataset as they were not representing stream conditions. There is a large dissolved oxygen fluctuation ranging from 5.0mg/L to 14.7mg/L. The large fluctuation in the dissolved oxygen could be a stressor on the aquatic life. There are high levels of phosphorus present in the stream but the response variables (chlorophyll-a, BOD 5, and DO flux) show no exceedances. The stream is meeting the river eutrophication standard.

Crooked Brook (07010207-575)

Crooked Brook has its headwaters in a heavily wetland and agricultural area to the west to an urban dominated area where it turns north at Viking Boulevard and flow into the Rum River in the city of East Bethel. One biological station (13UM067) was sampled for fish and macroinvertebrates in 2013 but was not assessed because it is located on a Class 7 limited resource AUID. Both fish and macroinvertebrate scores are above the threshold and within the confidence interval. The fair MSHA score includes good instream fish and macroinvertebrate in the form of aquatic vegetation habitat and a wide riparian help overcome an existing dissolved oxygen impairment from a previous assessment.

Mahoney Brook (07010207-682)

Mahony Brook consists mainly of a modified stream channel flowing through an agricultural landscape. One biological station (00UM102) was sampled in 2000, 2013, and 2015, for fish and in 2013 and 2015, for macroinvertebrates. The expired fish IBI score (61.8) for 2000, was above the threshold and confidence interval but the 2013 FIBI score (24.8) is below the threshold and confidence interval. While the macroinvertebrate score (52.7) in 2013, was above the threshold and within the confidence interval. Because of the big drop in FIBI score from 2000 to 2013, with little surrounding land use change and a good MIBI score a decision was made to do an additional biological sampling in 2015. The MIBI score dropped from 52.7 in 2013 to 43.9 in 2015, but stayed above modified threshold while the FIBI score rose from 24.8 in 2013 to 31.5 in 2015, but stayed below threshold confirming the not supporting determination aquatic life designation.

Lake assessments

For aquatic recreation, 1 of the 16 lake basins >10 acres in size have been assessed (Table 49). The remaining lakes either have insufficient information or no data. Minard lake (02-0067-00) is small (127 aces) and shallow (2.1 m). It is in the North Central Hardwood Forest ecoregion and considered eutrophic. Minard Lake (02-0067-00) is surrounded by subdivisions and a large wetland on the north side of the lake. Outside of the immediate boundary of the lake is cropland. The contributing watershed to Minard Lake (02-0067-00) is relatively small and the large wetland on the north end is contributing to the good water quality. Minard Lake (02-0067-00) is meeting the aquatic recreation standard.

Figure 54. Photograph at 10X water chemistry location in the Cedar Creek Aggregated 12-HUC.

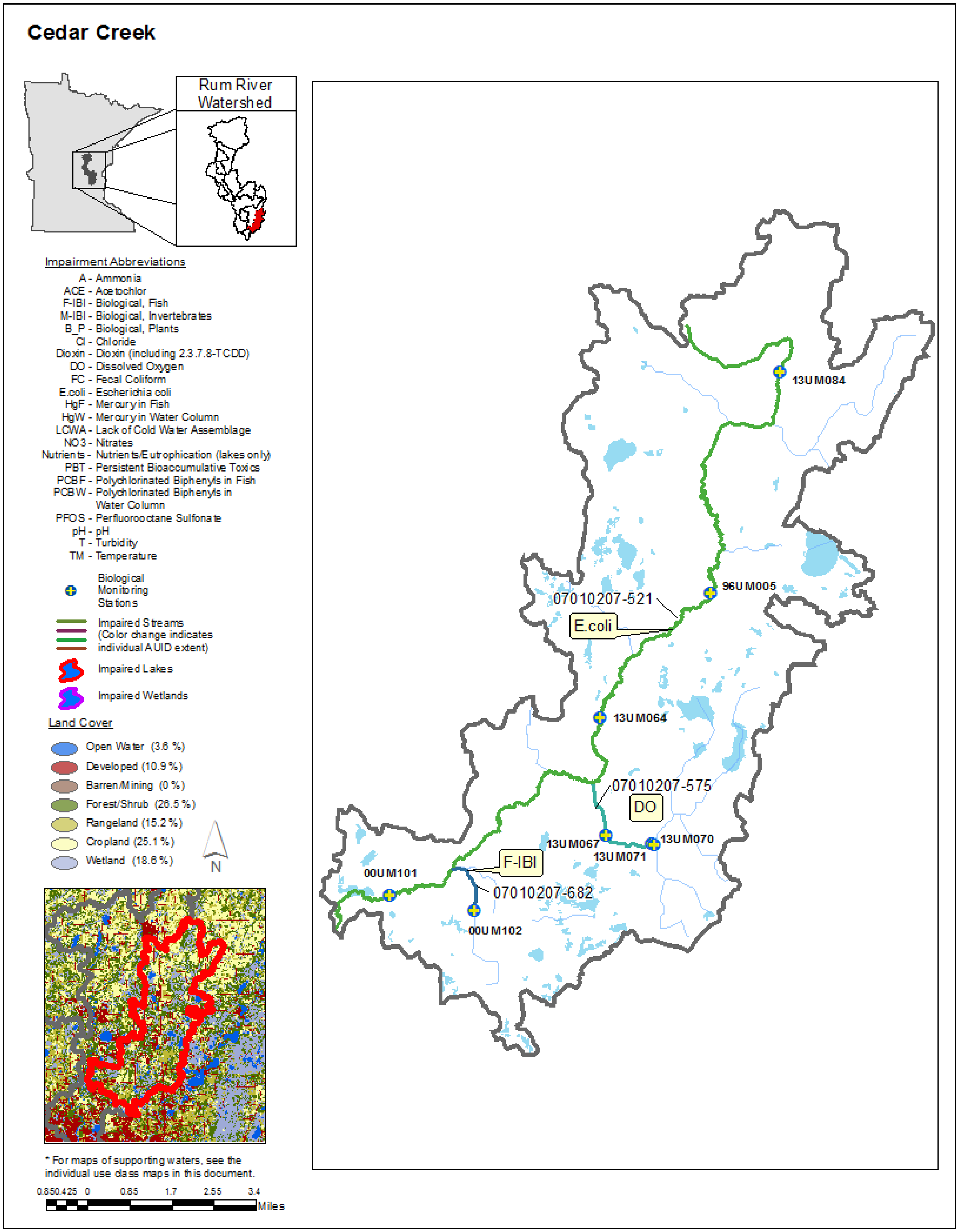

Figure 55. Currently listed impaired waters by parameter and land use characteristics in the Cedar Creek Aggregated 12-HUC.

Lower Rum River Aggregated 12-HUC — HUC 0701020707-01

The Lower Rum River is the most downstream section of the Rum River. The subwatershed starts in Isanti county the north just downstream of the city of Cambridge and flow south to Anoka county to the Mississippi River in the city of Anoka. The dam near the outlet of the river makes a reservoir of deeper and slower water then the rest of the Rum River for ~2 mi upstream of the dam. The lower section of the Rum River is the most populated area in the entire Rum River Watershed. Developed land (19.9%) is the 3rd most abundant land use behind cropland (25.9%) and forest (22.5%). The outlet water chemistry monitoring station and fish tissue collection was co-located with biological monitoring station 13UM040 which is located upstream of the impounded water in a riverine area.

Table 50. Aquatic life and recreation assessments on stream reaches: Lower Rum River Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Eutrophication: Response Indicator	Aquatic Life	Aquatic Rec. (Bacteria)
07010207-502 **Rum River,** Cedar Cr to Trott Bk	13UM062	3.52	WWg	MTS	MTS	IF	MTS	MTS	MTS	MTS	NA		IF		FS	NA
07010207-503 **Rum River,** Seelye Bk to Cedar Cr	10EM100	6.79	WWg	MTS	MTS	IF	IF	IF		IF	IF		IF		FS	NA
07010207-504 **Rum River,** Stanchfield Cr to Seelye Bk	13UM069, 00UM066	34.41	WWg	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS		IF		FS	NA
07010207-592 **Isanti Brook,** Florence Lk outlet to Rum R	13UM052	4.93	WWg	EXS	EXS	IF	IF	IF		IF	IF		IF		NS	NA
07010207-665 **Rum River,** Anoka Dam to Madison/Rice St in Anoka		0.32	WWg			IF	MTS	IF	MTS	MTS	MTS		NA		IF	FS
07010207-666 **Rum River** Trott Bk to Anoka Dam	13UM040	8.85	WWg	MTS	NA	IF	MTS	MTS	MTS	MTS	MTS		NA		FS	FS

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

Table 51. Minnesota Stream Habitat Assessment (MSHA): Lower Rum River Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
4	10EM100	Rum River	3.25	12.63	20.46	13.5	26	75.84	Good
1	13UM040	Rum River	3.5	15	9	11	17	55.5	Fair
1	00UM066	Rum River	3.5	14	24	16	34	91.5	Good
1	13UM069	Rum River	5	15	9	14	17	60	Fair
1	13UM052	Isanti Brook	1.5	11	10.2	15	28	65.7	Fair
1	13UM062	Rum River	5	14.5	19.8	12	19	70.3	Good
Average Habitat Results: ***Lower Rum River Aggregated 12-HUC***			**3.63**	**13.69**	**15.41**	**13.58**	**23.5**	**69.81**	**Good**

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

Table 52. Channel Condition and Stability Assessment (CCSI): Lower Rum River Aggregated 12-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
1	13UM069	Rum River	26	26	30	7	89	severely unstable
1	13UM062	Rum River	11	15	15	3	44	fairly stable
1	10EM100	Rum River	6	13	16	3	38	fairly stable
1	00UM066	Rum River	15	9	11	3	38	fairly stable
1	13UM052	Isanti Brook	8	11	6	1	26	stable
Average Stream Stability Results: ***Lower Rum River Aggregated 12-HUC***			**13.2**	**14.8**	**15.6**	**3.4**	**47**	**fairly stable**

Qualitative channel stability ratings
= stable: CCSI < 27 = fairly stable: 27 < CCSI < 45 = moderately unstable: 45 < CCSI < 80 = severely unstable: 80 < CCSI < 115 = extremely unstable: CCSI > 115

Table 53. Outlet water chemistry results: Lower Rum River Aggregated 12-HUC.

Station location:	Rum River, at Pier in Park on SW side where Bunker L Blvd and Rum						
STORET/EQuIS ID:	S007-555						
Station #:	13UM040						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	3.1	35	14.6	40	
Chloride	mg/L	10	6.2	16	12.8	230	
Dissolved Oxygen (DO)	mg/L	19	5.1	15.5	8.1	5	
pH		19	7.5	8.7	8.1	6.5 - 9	
Secchi Tube	100 cm	19	62	100	90	40	
Total Suspended Solids	mg/L	10	2	16	7.7	15	1
Escherichia coli (geometric mean)	MPN/100ml	14	42.9	74.4		126	
Escherichia coli	MPN/100ml	14	28	172	57.3	1260	
Chlorophyll-a, Corrected	ug/L	13	1	6.3	3	18	
Phosphorus	ug/L	16	71	183	123.1	100	11
Temperature, water	deg °C	19	13.4	28.2	21		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Lower Rum River Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 54. Lake assessments: Lower Rum River Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Round	02-0089-00	263	E		4.6		NT	31	7.9	2.9	FS	
George	02-0091-00	480	E	79	9.8	2.4	D	28	8.1	2.1	FS	IF
Sand Shore	02-0102-00	38	E				NT			1.9	IF	
Grass	02-0113-00	35	M					14	5.8	1.3	FS	
Skogman	30-0022-00	223	E	59.6	11.0	4.0	NT	43	20.1	1.5	NS	FS
Florence	30-0035-00	130	M		7.9	2.1	I	16	7.6	1.9	FS	FS

Elms	30-0036-00	53	E	81.1	7.9		I			2	IF	
Fannie	30-0043-00	356	E	84.1	10.1	2.4	NT	46	25.2	1.6	NS	FS
Marget	30-0070-00	49	E					33	9.02			
Long	30-0072-00	363	H	100	3.4	1.5	NT	119	48.7	0.5	NS	FS
Francis	30-0080-00	256	H	100	2.6		NT	106	108.6	0.4	NS	NS
German	30-0100-00	345	E					29	1.3	1.2	FS	

Abbreviations: D -- Decreasing/Declining Trend; I -- Increasing/Improving Trends; NT – No Trend

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

FS – Full Support; **NS** – Non-Support; I**F** – Insufficient Information

Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use

Summary

Rum River (07010207-502, 07010207-503, 07010207-504, 07010207-665, 07010207-666)

The Rum River in this subwatershed flows south from where Isanti Brook flow in, just south of the city of Cambridge, to the Mississippi River in the city of Anoka. This section of the Rum is the most urban section of the river where many houses dot the banks and the river flows through city centers like the city of Anoka. A dam in the city of Anoka near the confluence of the Mississippi River creates a reservoir that stretches ~4.5 miles. Even though the increase anthropogenic effects because of the increased population density in this section of river all of the fish and macroinvertebrate scores indicate full support for aquatic life based on the 5 biological stations placed on the Rum River in this subwatershed. The overall MSHA scores are the second highest on the mainstem Rum River in this subwatershed right behind the Headwaters Rum River subwatershed which is in a very natural area.

There are 20 stream reaches in Lower Rum River Aggregated 12-HUC. For aquatic recreation, 2 of the 20 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The Rum River (07010207-665 and -666) is located on the southern half of the watershed. The river stretches nine miles from Trott Brook until it leaves the watershed. The Rum River (07010207-665 and -666) has 351 bacteria samples taken from 2005 to 2014. There are only three individual exceedances in the dataset. This section of the Rum River (07010207-665 and -666) is meeting the aquatic recreation standard.

For aquatic life, 4 of the 20 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. The main stem Rum River (07010207-502, -503, and -666) is meeting the aquatic life standard. The Rum River (07010207-502 and -503) has limited water chemistry datasets. Both of the datasets have minimal exceedances for all parameters. Phosphorus is elevated in each reach but there are limited response variables (Chlorophyll-a and BOD) to make an assessment. The Rum River (07010207-666) has the more complete dataset on the Rum River in this watershed. This section of the Rum River is located on the southern half of the watershed and collectively drains the entire Rum River Watershed before it flows into the Mississippi River in Anoka, Minnesota. There is a dam at the end of the reach before it exits into the Mississippi River. There are higher levels of unionized ammonia sampled in this section of the Rum River but the samples do not exceed the standard. There is a 10-year dataset for chloride with 160 samples. None of them are exceeding the standard. The dissolved oxygen data is meeting the standard but there are not enough samples before 9 a.m. to determine if the standard is met. The total suspended solids and Secchi tube data is meeting the standard. The Rum River (07010207-504) continues in this aggregated 12-HUC but that was assessed in the Middle Rum River aggregated 12-HUC. Overall the Rum River is meeting the aquatic life standard.

Isanti Brook (07010207-592)

Isanti Brook flows southwest from just east of the city of Cambridge to the Rum River in the city of Isanti. Fish and macroinvertebrate data collected from one biological station (13UM052) sampled in 2013. Fish IBI score is below the general use threshold and within the lower confidence interval. The stream has good habitat and in stream cover for fish but is lacking coarse substrate and is dominated by tolerant species. A significant amount of agriculture upstream of the station may be a source of increased nutrients. The macroinvertebrate IBI score was 34, well below the general use threshold for this class of stream, resulting in an aquatic life impairment determination for this general use stream.

Lake assessments

For aquatic recreation, 9 of the 27 lake basins >10 acres in size have been assessed (Table 54). The remaining lakes either have insufficient information or no data. All of the lakes are less than 500 acres and majority of them are considered eutrophic. Round Lake (02-0089-00), George Lake (02-0091-00), and German Lake (30-0100-00) are very similar. They all are considered eutrophic with relative small contributing watersheds. They are all surrounded by forest and wetland with some development mixed in. George Lake (02-0091-00) does have a declining transparency trend but all of these lakes are meeting the aquatic recreation standard. Grass Lake (02-0113-00) and Florence Lake (30-0035-00) are both considered mesotrophic. Grass Lake (02-0113-00) is surrounded by wetland and forested areas. There are large croplands that drain into Grass Lake (02-0113-00). Florence Lake (30-0035-00) is located off of Highway 65 in the town of Cambridge, Minnesota. It is surrounded by development, some vegetation, and has a control structure on its outlet. It also receives water from Fannie Lake (30-0043-00) which is impaired for aquatic recreation. Before the water from Fannie Lake (30-0043-00) reaches Florence Lake (30-0035-00) it travels through a wetland and Elms Lake (30-0036-00). Elms Lake (30-0036-00) is 7.9 meters (26 feet) deep which could serve as a settling area for phosphorus that comes from Fannie Lake (30-0043-00). There is a limited dataset for Elms Lake (30-0036-00) which is why it is not assessed. The low levels of phosphorus and chlorophyll-a in both Grass Lake (02-0113-00) and Florence Lake (30-0035-00) are supporting recreation use. Skogman Lake (30-0022-00) and Fannie Lake (30-0043-00) are both considered eutrophic. Long Lake (30-0072-00) and Francis Lake (30-0080-00) are both considered hypereutrophic. All of these lakes are relatively the same size and have development on their shorelines. Skogman Lake (30-0022-00) flows into Fannie Lake (30-0043-00) which contributes to the poor water quality that already exists. All the lakes have contributing surface water from cropland in their watersheds. Skogman Lake (30-0022-00), Fannie Lake (30-0043-00), and Francis Lake (30-0080-00) all are previously impaired for aquatic recreation. The newest data supports the previous listings. Long Lake (30-0072-00) will be added to the impaired waters listing as it is not meeting the aquatic recreation standard.

For aquatic life, 6 of the 27 lake basin >10 acres in size have been assessed (Table6). The remaining lakes had no data. A common occurrence among the assess lakes (George Lake: 02-0091-00, Skogman Lake: 30-0022-00, Florence Lake: 30-0035-00, Fannie Lake: 30-0043-00, and Long Lake: 30-0072-00) were dominated by gill net collections of Northern Pike. Bluegill was the most abundant fish surveyed in the nearshore and trap net assessment except on Skogman Lake (30-0022-00) and Long Lake (30-0072-00). Skogman Lake (30-0022-00) surveyed a large Bowfin population in the trap nets. Long Lake (30-0072-00) surveyed a large Northern pike population in the trap net surveys. It was noted by the MNDNR fisheries survey team that Skogman Lake (30-0022-00) and Fannie Lake (30-0043-00) had a low fish density population and Skogman Lake (30-0022-00) had an abundant Yellow Bullhead population. George Lake (02-0091-00) is considered a vulnerable body of water due to the overall fish diversity and abundance. All of these lakes, with the exception of George Lake (02-0091-00) are meeting the aquatic life standard. Francis Lake (30-0080-00) has a relatively low diversity fish community compared to similar lakes in the area. The trap nets mainly consisted of Northern Pike and White Sucker. The gill net was comprised of White Sucker and Black Crappie and the nearshore survey was dominated by Yellow Perch. The proportions of centrarchids in the trap net indicate degraded water quality and nearshore habitat.

There were seven plant assessments surveyed in the Lower Rum River Aggregated 12-HUC. Skogman Lake (30-0022-00), Florence Lake (30-0035-00), Fannie Lake (30-0043-00), Long Lake (30-0072-00), and German Lake (30-0100-00) all were above the threshold for plant IBI. These lakes have a healthy plant community. George Lake (02-0091-00) has an exceptional plant community. Francis Lake (30-0080-00) is below the impairment threshold identified for similar lakes in the ecoregion.

There are a few lakes that should be a priority for protection in the Lower Rum River Aggregated 12-HUC. All of the following lakes are susceptible to increases of phosphorus in multiple ways. These increases could cause any of the lakes to become impaired. George Lake (02-0091-00) and German Lake (30-0100-00) have large watersheds compared to their lake size. George Lake (02-0091-00) also has strong evidence for declining lake transparency trend.

Figure 56. Photograph at 10X water chemistry location in the Lower Rum River Aggregated 12-HUC.

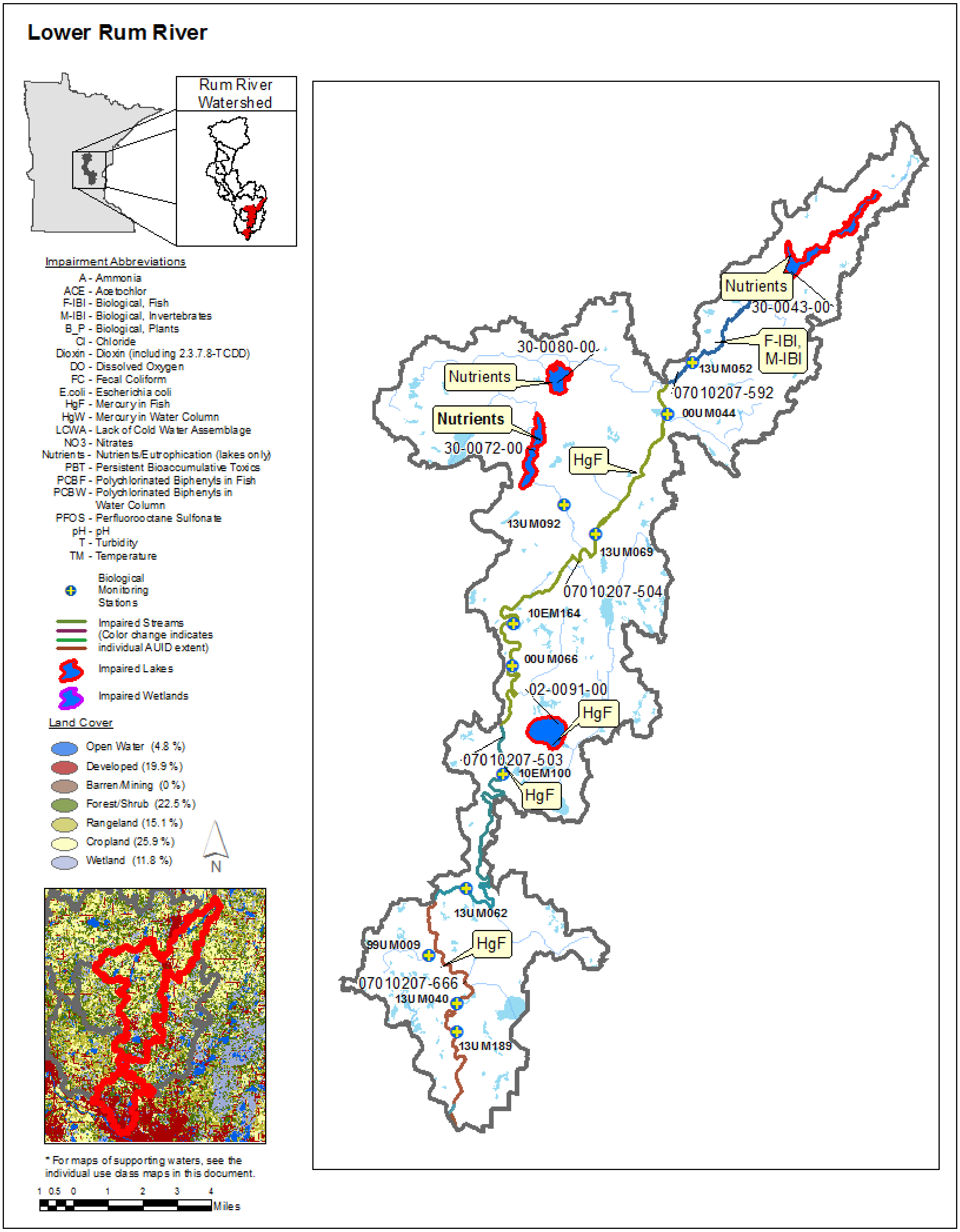

Figure 57. Currently listed impaired waters by parameter and land use characteristics in the Lower Rum River Aggregated 12-HUC.

Trott Brook Aggregated 12-HUC HUC 0701020707-02

The headwaters of Trott Brook subwatershed are in southeast Sherburne county which flow southeast into Anoka county before entering into the Rum River near the city of Ramsey draining 73.8 mi^2. The subwatershed has two main streams Trott Brook makes up the southern half of the watershed and Ford Brook the north. They converge ~ 1 mile west from the outlet into the Rum River. The headwaters area to the west are dominated by agricultural land use with cropland (17.3%) and rangeland (34%) making up half of the land use for the entire subwatershed. The northwest corner of Anoka County is dominated by forest helping he watershed to have forest (21.2%) be an abundant land use. As Trott Brook comes closer to the Rum River developed areas (12.6%) mainly housing developments become more prevalent. The outlet water chemistry monitoring station was co-located with biological monitoring station 13UM044.

Table 55. Aquatic life and recreation assessments on stream reaches: Trott Brook Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	Eutrophication: Phosphorous	Response Indicator	Aquatic Life	Aquatic Rec. (Bacteria)
07010207-587 **Unnamed ditch,** Unnamed ditch to Goose Lk	13UM066	1.09	WWm	MTS	MTS	IF	IF	IF		IF	IF		IF		FS	NA
07010207-680 **Trott Brook,** CD 51 to Rum R	13UM044	4.43	WWg	EXS	EXS	EXS	MTS	MTS	MTS	MTS	MTS		EX		NS	IF

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

Table 56. Minnesota Stream Habitat Assessment (MSHA): Trott Brook Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
3	13UM044	Trott Brook	2.83	10.5	11.53	13	17	54.87	Fair
1	13UM066	Unnamed ditch	2.5	10	9	14	2	37.5	Poor
Average Habitat Results: ***Trott Brook Aggregated 12-HUC***			**2.67**	**10.25**	**10.27**	**13.5**	**9.5**	**46.18**	**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 57. Channel Condition and Stability Assessment (CCSI): Trott Brook Aggregated 12-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
1	13UM066	Trib. to Goose Lake	18	10	28	3	59	moderately unstable
1	13UM044	Trott Brook	4	7	24	3	38	fairly stable
Average Stream Stability Results: ***Trott Brook Aggregated 12-HUC***			**11**	**8.5**	**26**	**3**	**48.5**	**moderately unstable**

Qualitative channel stability ratings

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

Table 58. Outlet water chemistry results: Trott Brook Aggregated 12-HUC.

Station location:	Trott Brook, Downstream of HWY 47, 1.5 mi. NE of Ramsey						
STORET/EQuIS ID:	S003-176						
Station #:	13UM044						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	1.4	7.7	3.8	40	
Chloride	mg/L	10	14.2	32.4	24.6	230	
Dissolved Oxygen (DO)	mg/L	19	2	8.2	5.3	5	7
pH		19	7.1	8.6	7.7	6.5 - 9	
Secchi Tube	100 cm	19	92	100	99.6	25	
Total Suspended Solids	mg/L	10	2	24	7.5	30	
Escherichia coli (geometric mean)	MPN/100ml	14	36.4	153.6		126	1
Escherichia coli	MPN/100ml	14	8	225	79.7	1260	
Chlorophyll-a, Corrected	ug/L	5	1	3.2	1.8	18	
Phosphorus	ug/L	15	55	173	107.9	100	8
Temperature, water	deg °C	19	12.1	25	18.3		
Hardness	mg/L	10	155	250	217		

Table 59. Lake assessments: Trott Brook Aggregated 12-HUC.

Name	MNDNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Rogers	02-0104-00	41	E				I	59	19.7	1.1	NS	
Pickerel	02-0130-00	239	M		1.5		I	24	7.4	1.4	FS	IF
East Twin	02-0133-00	76	M		20.1	4.0	NT	22	5.2	3.7	FS	IF
West Hunter	71-0022-00	112	E	100	1.8			66	19.3	1.3	NS	
East Hunter	71-0023-00	112	E	100	2.1			73	31.5	1.6	NS	

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

Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated us

Summary

Unnamed Ditch (07010207-587)

Unnamed Ditch flows east from near the city of Mitchell Corner through Goose Lake then south to Trott Brook near the city of Ramsey. Fish and macroinvertebrate data collected from one station (13UM066) sampled in the headwaters above Goose Lake and were sampled in 2013. Fish IBI score is above the modified use threshold and within the upper confidence interval. There is poor habitat for fish other than an abundance of submergent macrophytes. Even with a low MSHA score, the fish scored above the modified use threshold. Invert data collected from the same biological station sampled in 2013. Invert IBI score is above the modified use threshold and within the confidence interval. Stagnant conditions occurred at the time of sampling yet IBI score meets modified criteria. Sample predominantly comprised of wetland invertebrate taxa with decent taxa richness.

Trott Brook (07010207-680)

Trott Brook flows south from near the city of Mitchell Corner to the city of Dayton then turns east and flows into the Rum River just north of the city of Ramsey. Fish data collected from two biological stations (00UM067, 13UM044) sampled in 2000, (expired) and 2013. The stations are in close proximity but sampled 13 years apart. The 2000 fish sample has an IBI score above the threshold and within the upper confidence limit, while the 2013 sample is below the general use threshold. For the amount of fish habitat in the stream with overhanging vegetation and submergent macrophytes there was fewer number of fishes that would be expected and was dominated by tolerant species. There has been a great deal of land development upstream of the station in the form of a housing development which happened after the 2000, sample. This type of change to the watershed could make the difference between the passing score in 2000 and the lower score in 2013.The macroinvertebrate community in Trott Brook appears to be exhibiting signs of stress associated with nutrient enrichment and/or hydrologic fluctuations. Many of the macroinvertebrates that were collected at this station are also frequently collected in wetland habitats. However, the relative contribution of this stream's channel geomorphology to this condition is uncertain at this time. The lower portion (~6 miles) of Trott Brook flows within a glacially derived "tunnel valley" (as described on page 1), and thus is in close association with riparian wetlands throughout this stretch. While this no doubt contributes to a low dissolved oxygen condition, this reach and Mike Drew Brook (-537) in the Upper Rum River subwatershed provides a good example of how these types of streams can attain general use biocriteria in the absence of significant human disturbance.

There are 8 stream reaches in Trott Brook Aggregated 12-HUC. For aquatic recreation, 1 of the 8 stream reaches has been assessed. The remaining stream reaches either have insufficient information or no data. The bacteria samples were collected over a two-year period and some of the samples were associated with heavy rain events; while there are elevated concentrations of bacteria in the stream there is not enough data to assess for aquatic recreation.

Stream assessments

For aquatic life, 3 of the 8 stream reaches have been assessed. The remaining stream reaches either have insufficient information or no data. Trott Brook (07010207-680) stretches 4.4 miles in the south of the watershed before it empties into the Rum River (07010207-666). It is mainly surrounded by wetland and cropland. The dissolved oxygen in this stream can fluctuate significantly; data shows concentrations ranging from 6 mg/L to 11 mg/L over the course of a day. There are high levels of phosphorus in the stream and it was noted that there was large amount of filamentous algae growth. Trott Brook (07010207-680) is not meeting the standard for aquatic life based on the dissolved oxygen impairment.

Lake assessments

For aquatic recreation, 5 of the 21 lake basins >10 acres in size have been assessed (Table 59). The remaining lakes either have insufficient information or no data. Rogers Lake (02-0104-00), West Hunter Lake (71-0022-00), and East Hunter Lake (71-0023-00) are all considered eutrophic and are not meeting the aquatic recreation standard. Rogers Lake (02-0104-00) is located in the southern portion of the watershed and was previously listed in 2006. It is surrounded by development and wetland like characteristics. The shallow basin could cause internal sediment resuspension loading issues. Rogers Lake (02-0104-00) does have a statically increasing transparency trend. West Hunter (71-0022-00) and East Hunter Lake (71-0023-00) are located in the northern portion of the watershed and are connected through multiple channels. Both of the lake basins are shallow and not protected from wind causing the waterbodies to mix; internal loading could be a potential issue for recycling phosphorus. The contributing watershed consists of development and cropland. Aerial photos show severe blooms that occur in each of the lake basins since 2011. Pickerel Lake (02-0130-00) and East Twin Lake (02-0133-00) are considered mesotrophic and both are meeting the aquatic recreation standard. They are located in the middle of the Trott Brook Aggregated 12-HUC with small contributing watershed. Each of their watersheds is mainly forest and wetland characteristics. Pickerel Lake (02-0130-00) has a shallow basin and in the spring and fall resuspension of phosphorus is being mixed into the water column which could cause a bloom but overall the water chemistry is in good condition.

A recent fish survey was conducted on East Twin Lake (02-0133-00) where Northern Pike dominated the gill nets and Bluegill was predominantly surveyed in the tap nets. The low effort nearshore survey and lack of data caused there to not be enough information to make an assessment for aquatic life. West Hunter Lake (71-0022-00), East Hunter Lake (71-0023-00), Pickerel Lake (02-0130-00), and East Twin Lake (02-0133-00) all had recent plant surveys. They were all above the plant impairment threshold identified for similar lakes in the ecoregion.

Figure 58. Photograph at 10X water chemistry location in the Trott Brook Aggregated 12-HUC.

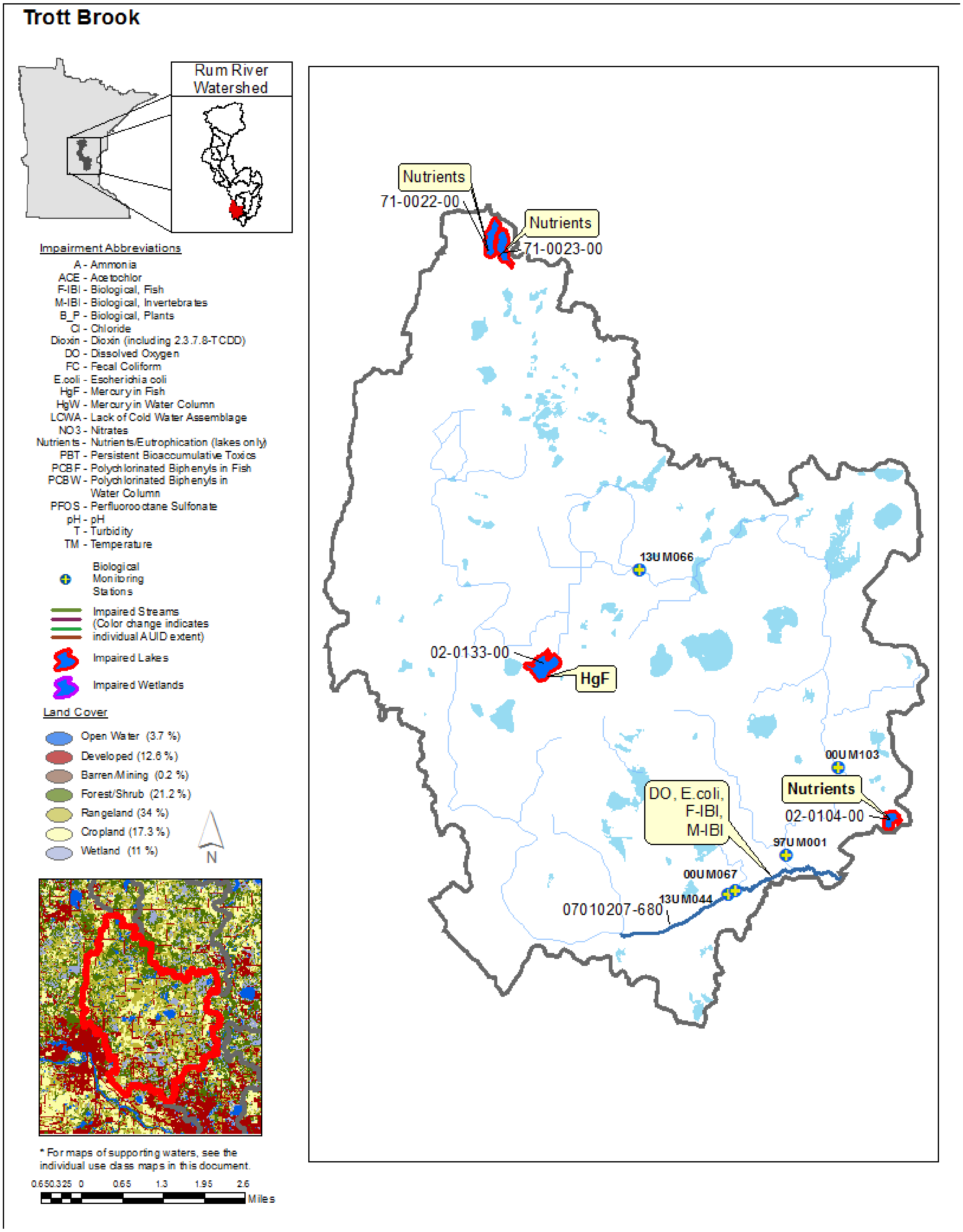

Figure 59. Currently listed impaired waters by parameter and land use characteristics in the Trott Brook Aggregated 12-HUC.

Seelye Brook Aggregated 12-HUC HUC 0701020707-03

Seelye Brook is the only subwatershed that is only bordered by other watersheds in the Rum River Watershed. The headwaters are in southwest Isanti county just south of the city of Spencer Brook. Seelye Brook flows southeast into Anoka county and enters the Rum River just south of St. Francis. The upper two-thirds of the watershed is split between natural areas with forest (29.5%) and wetland (14.8%) and agricultural land use of rangeland (25.4%) and cropland (22.9%). The most downstream area of the watershed is the city of St. Francis which accounts for the largest density of the developed land use (6.7%). The outlet water chemistry monitoring station was co-located with biological monitoring station 00UM104.

Table 60. Aquatic life and recreation assessments on stream reaches: Seelye Brook Aggregated 12-HUC. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	Pesticides ***	**Eutrophication** Phosphorous	Response Indicator	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010207-528 **Seelye Brook,** Headwaters to Rum R	00UM104, 13UM079	12.4	WWg	IF*	IF*	IF	MTS	MTS	MTS	MTS	MTS		IF		IF*	NS

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

Table 61. Minnesota Stream Habitat Assessment (MSHA): Seelye Brook Aggregated 12-HUC.

# Visits	Biological Station ID	Reach Name	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover (0-17)	Channel Morph. (0-36)	MSHA Score (0-100)	MSHA Rating
3	00UM104	Seelye Brook	3	11	10.87	12	20	56.87	Fair
3	13UM079	Seelye Brook	3.42	13.67	10.93	10	12.33	50.35	Fair
Average Habitat Results: *Seelye Brook Aggregated 12-HUC*			**3.21**	**12.33**	**10.9**	**11**	**16.17**	**53.61**	**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 62. Channel Condition and Stability Assessment (CCSI): Seelye Brook Aggregated 12-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
2	00UM104	Seelye Brook	10	15.5	22	4	51.5	moderately unstable
1	13UM079	Seelye Brook	13	29	30	5	77	moderately unstable
1	13UM079	Seelye Brook	7	15	15	3	40	fairly stable
Average Stream Stability Results: *Seelye Brook Aggregated 12-HUC*			**10**	**19.83**	**22.33**	**4**	**56.17**	**moderately unstable**

Qualitative channel stability ratings

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

Table 63. Outlet water chemistry results: Seelye Brook Aggregated 12-HUC.

Station location:	Seelye Brook, Upstream of Rum River Blvd, 1 mi. S of Saint Francis						
STORET/EQuIS ID:	S003-204						
Station #:	00UM104						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-Nitrogen	ug/L	10	2.2	19.3	7.2	40	
Chloride	mg/L	10	8.6	58.7	31.5	230	
Dissolved Oxygen (DO)	mg/L	21	3	14.2	7.8	5	3
pH		21	7.2	8.8	7.9	6.5 - 9	
Secchi Tube	100 cm	21	87	100	98.6	25	
Total Suspended Solids	mg/L	15	2	14	4.3	30	
Escherichia coli (geometric mean)	MPN/100ml	14	127.4	279.8		126	2
Escherichia coli	MPN/100ml	14	30	613	210.6	1260	
Phosphorus	ug/L	15	40	211	129.9	100	12
Temperature, water	deg °C	21	5	23.1	17.5		
Hardness	mg/L	10	119	224	179.5		

1Secchi Tube standards are surrogate standards derived from the total suspended solids.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Seelye Brook Aggregated 12-HUC, a component of the IWM work conducted between May and September from 2013 and 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Seelye Brook (07010207-528)

Seelye flows south from Crooked Road WMA to the Rum River near Lake George. Fish data collected from two biological stations (13UM079, 00UM104) sampled in 2013. A long term biological monitoring station is located on Seelye Brook (13UM079); however, this effort was not initiated until 2013 so there isn't yet an extensive data to inform the assessment of this stream. Two stations will be monitored every other year (odd years) in the lower part of this subwatershed: the station that is downstream of the St. Francis WWTP discharge to Seelye Brook and one that is upstream of this point source. The downstream station (00UM104) had a macroinvertebrate IBI score of 70, one of the highest scores in the watershed and well above the general use criteria. The fish IBI scores at this station have decreased from the 2000, sample to the 2013, sample. The upstream station (13UM079) did not score as well (58), but was still above the general use threshold for this class. These results are somewhat surprising given recent violations of permitted effluent limits (including in 2013) at the discharge point for nitrate, BOD (biological oxygen demand), phosphorus, total suspended solids, and ammonia. However, the upstream station seemed to have been impacted more by the abnormally dry conditions the region experienced in late summer of 2013. In August, flow had dramatically decreased at the upper station compared to when the station was visited in May while the lower station did not exhibit a dramatic change in flow. This stream will continue to be monitored to better understand the relative impact of the WWTP (if any) compared to natural disturbance (e.g., drought, floods) on aquatic communities in Seelye Brook. Currently, Seelye Brook (-528) is listed as "insufficient information" for the aquatic life assessment until additional biological monitoring data can be evaluated to determine whether or not the fish community is impaired. The fish IBI score at the upstream site (13UM079) is below the general use threshold and the lower confidence limit. There was limiting habitat at the site and low flow conditions. 13UM079 was 7m wider in the spring when the stream was looked at for sampling. With higher flow there would be much more habitat for fish and additional monitoring was recommended. The downstream station fish IBI score is above the threshold and within the upper confidence interval. Habitat at this site was much better which reflects in the IBI score. Fish and macroinvertebrate biological samples occurred in 2015 at base flow conditions and at the upstream biological site (13UM079). Both fish and macroinvertebrates scored above the threshold. Fish scored above the threshold and within the confidence interval and macroinvertebrates scored above the threshold and the confidence interval. With the new data a full supporting for aquatic life designation is proposed for the Seelye Brook AUID (-528).

Stream assessments

There is one stream reach in Seelye Brook Aggregated 12-HUC and it was assess for aquatic recreation. Seelye Brook (07010207-528) flows 12.4 miles from the northeast of the watershed until it exists into the Rum River (07010207-503). The stream reach travels through wetlands, forest, cropland and some development. There are high levels of bacteria that were collected in 2013 and 2014. The contributing watershed is large and contains six established feedlots. Some of the feedlots reside very close to flowlines which could be a contributing factor to the high bacteria levels. Overall the stream is impaired for bacteria and is not meeting the aquatic recreation standard.

For aquatic life, Seelye Brook contains higher levels of phosphorus but the response variable data is inconclusive. The total suspended solids are low compared to the standard and the transparency data is very good for the amount of water that flows in the stream reach. The dissolved oxygen dataset is small and there are some exceedances but there is not enough data to complete an assessment.

Figure 60. Photograph at 10X water chemistry location in the Seelye Brook Aggregated 12-HUC.

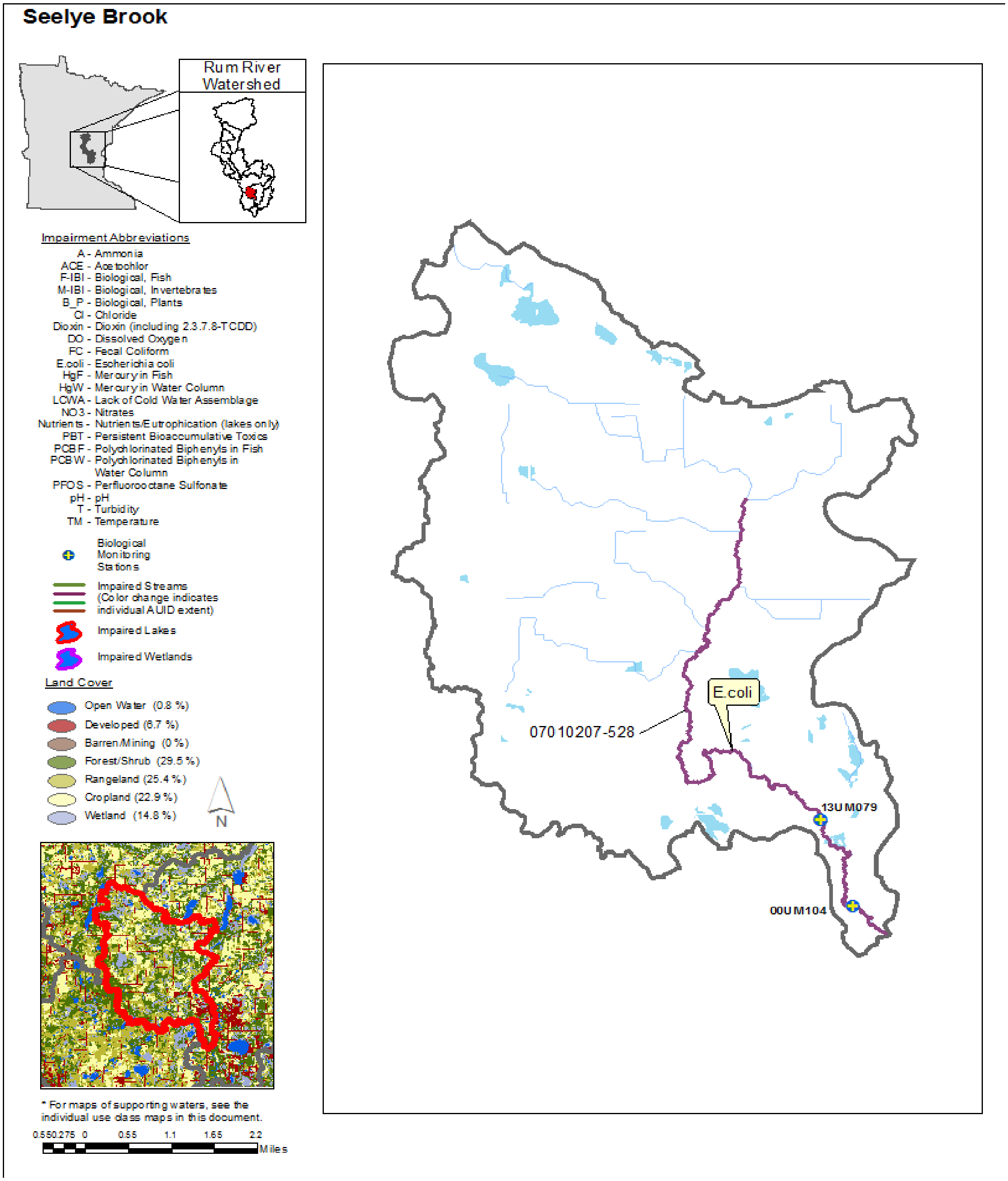

Figure 61. Currently listed impaired waters by parameter and land use characteristics in the Seelye Brook Aggregated 12-HUC.

Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the Rum River, grouped by sample type. Summaries are provided for load monitoring data results near the mouth of the river, 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. Additionally, groundwater monitoring results and long-term monitoring trends are included where applicable.

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

Pollutant Load Monitoring

The Rum River is monitored in downtown Anoka. 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) (MPCA 2010a), each with unique nutrient standards. Of the state's three RNR's (North, Central, South), the Rum River's load monitoring station is located within the Central RNR. Annual FWMCs were calculated and compared for years 2009-2013, (Figure 64, Figure 65, and Figure 66) and compared to the RNR standards (only TP and TSS draft standards are available for the North RNR). It should be noted that while a FWMC exceeding given water quality standard is generally a good indicator the water body is out of compliance with the River Nutrient Region 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 (MPCA 2010a), over the most recent 10-year period and not based on comparisons with FWMCs. 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 either "non-point" as well as "point", or end of pipe, sources such as industrial or waste water treatment plants. Major "non-point" sources of phosphorus include dissolved phosphorus from fertilizers and phosphorus adsorbed to and transported with sediment during runoff.

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

N concentrations tending 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. In many cases, it is a combination of climatic factors from which the pollutant loads are derived.

Total Suspended Solids (TSS)

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

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

Currently, the State of Minnesota's TSS standards are moving from the "development phase" into the "approval phase" and must be considered to be draft standards until complete approval. Within the Central RNR, the TSS draft standard is 30 mg/L (MPCA 2010c), when greater than 10% of the individual samples exceed the draft standard, the river is out of compliance. Calculations from 2009 through 2013, show 0, 1, 0, 4 and 0 percent of the individual TSS samples exceeded the 30 mg/L draft standard, respectively. In addition, none of the computed FWMCs for the five sampling years exceeded the 30 mg/L draft standard (Figure 64). The few samples exceeding the standard were collected during high flow conditions. Although the data may not reflect long-term trends, both TSS FWMCs and annual loads did not show consistent trends from 2008 through 2013. (Figure 64 and Table 64). Because of the strong correlation that often exists between pollutant loads and annual runoff volume, variations in loads may be due strictly to differences in annual runoff volume (Figure 63).

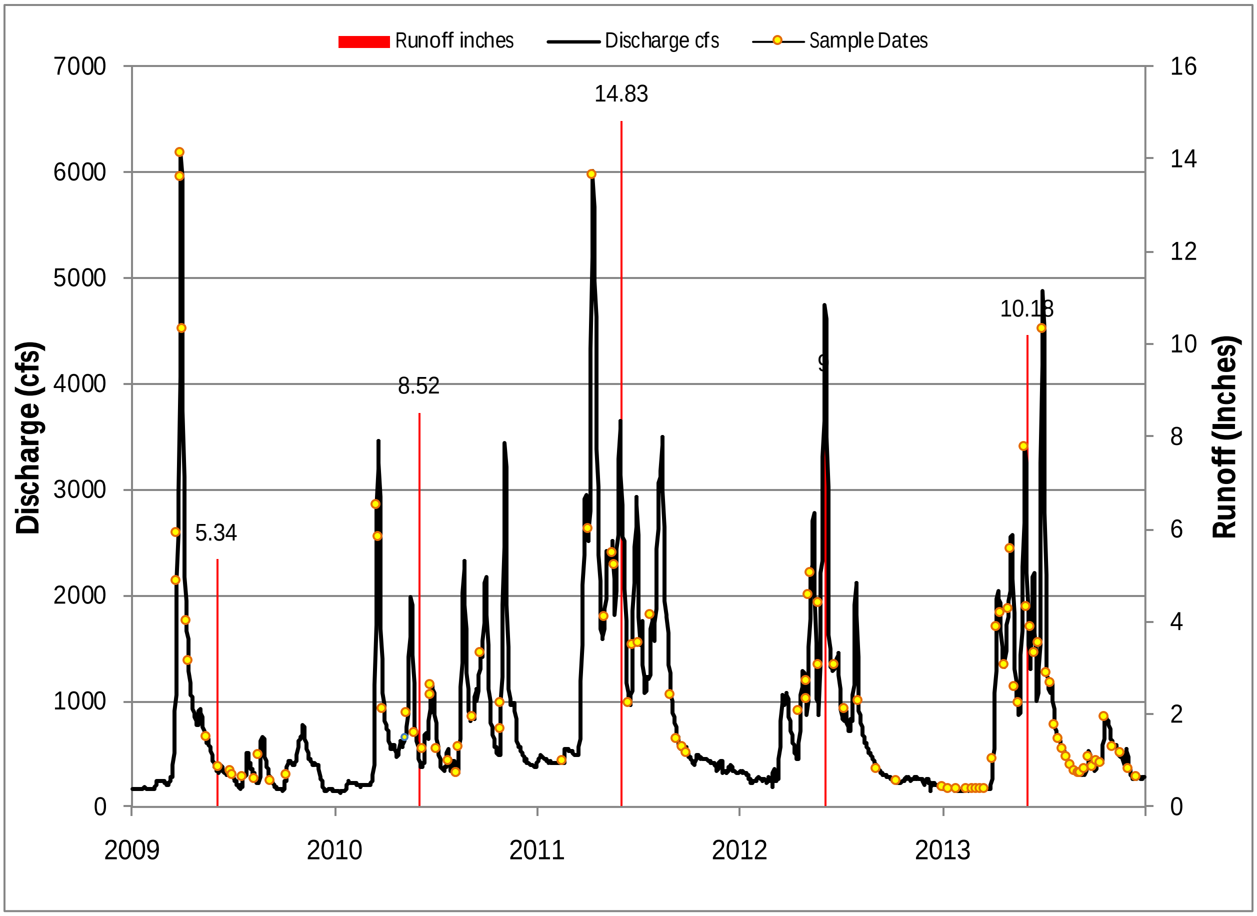

Figure 62. Annual discharge compared to runoff in the Rum River Watershed

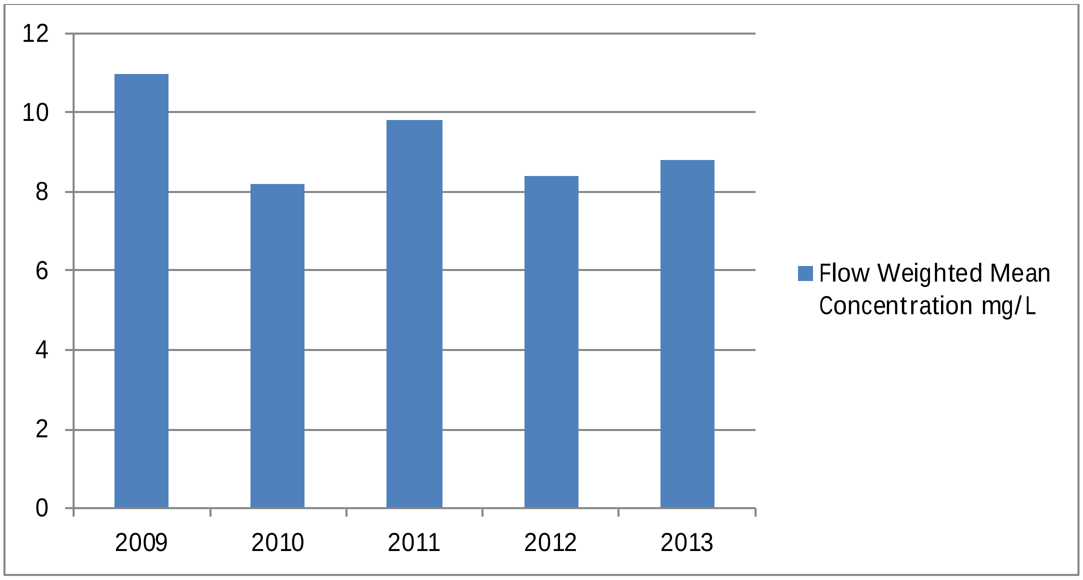

Figure 63. Flow Weighted Mean Total Suspended concentrations for the Rum River 2009 through 2013.

Table 64. Annual pollutant loads in Kilograms per year by parameter calculated for the Rum River Watershed.

Year	Total Suspended Solids	Total Phosphorus	Nitrate Nitrite N	Total Kjeldahl N	Ortho Phosphorus
2009	5219924	30514	174649	387301	30514
2010	6284496	87938	322016	831322	45574
2011	13052030	155150	507542	1196614	78910
2012	6792122	76373	314609	722444	47174
2013	8055077	108312	397356	828094	56728

Total Phosphorus (TP)

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

TP standards for Minnesota's rivers are also in the final approval phase and must be considered draft standards until approved. Within the Central RNR, the TP draft standard is 100 ug/L as a summer average. Summer average violations of one or more "response" variables (pH, biological oxygen demand (BOD), dissolved oxygen flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. Concentrations from 2009 through 2013, show that 40, 25, 30 and 25% of the individual TP samples exceeded the 0.1 mg/L draft standard, respectively. Observation of Figure 64 shows that four of the five FWMCs from 2009 to 2013, exceed the draft standard. At this site, TP concentrations are highest at high flows and at different times of the year.

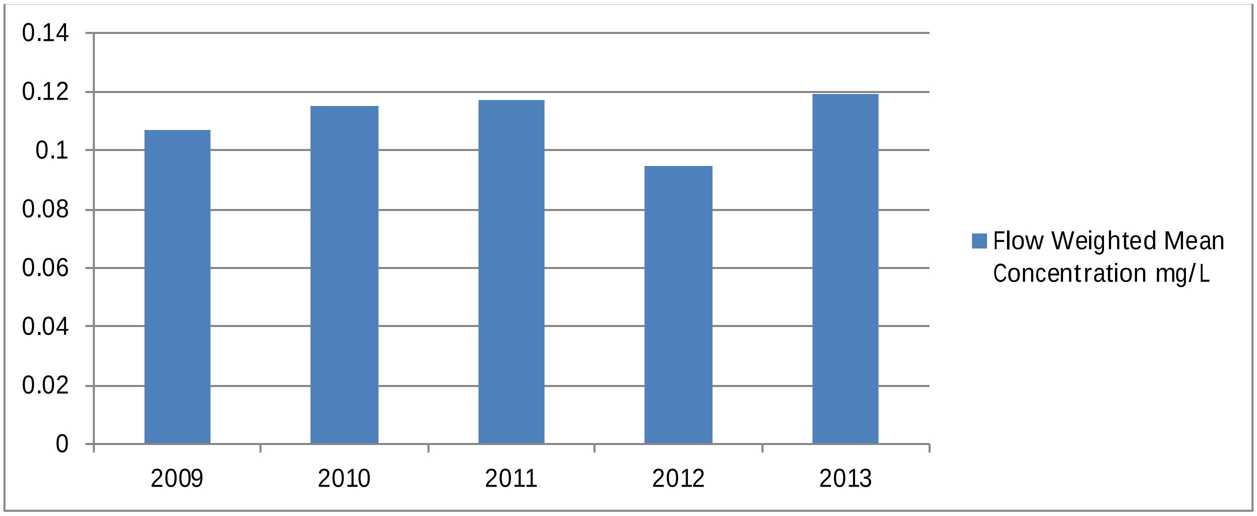

Figure 64. Total Phosphorus (TP) flow weighted mean concentrations for the Rum River.

Dissolved Orthophosphate (DOP)

DOP is a water soluble form of phosphorus that is readily available to algae (bioavailable) (MPCA and MSUM 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. The 2009 through 2013 FWMC ratio of DOP to TP shows that about 50% of TP is in the orthophosphate form. Figure 66 indicates DOP FWMC showed little variation from year to year.

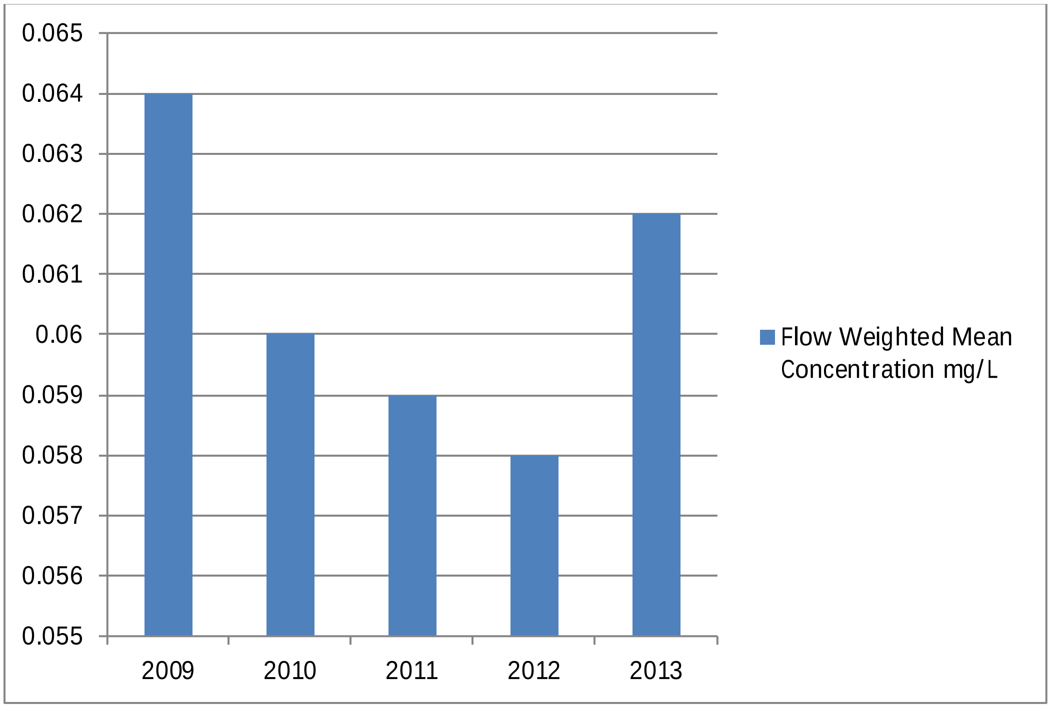

Figure 65. Dissolved Orthophosphate (DOP) flow weighted mean concentrations for the Rum River.

Nitrate plus Nitrite - Nitrogen

Nitrate and nitrite-nitrogen are inorganic forms of nitrogen present within the environment that are formed through the oxidation of ammonia-nitrogen by nitrifying bacteria (nitrification). Ammonia-nitrogen is found in fertilizers, septic systems, and animal waste. Once converted from ammonia-nitrogen to nitrate and nitrite-nitrogen, they too, like phosphorus, can stimulate excessive levels of some algae species in streams (MPCA 2010b). Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrite-N to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen, with nitrite-nitrogen typically making up a small proportion of the combined total concentration. These and other forms of nitrogen exist naturally in aquatic environments; however concentrations can vary drastically depending on season, biological activity, and anthropogenic inputs.

Nitrate- N can also be a common toxicant to aquatic organisms in Minnesota's surface waters, with invertebrates appearing to be the most sensitive to nitrate toxicity. Draft nitrate-N standards have been proposed (2012) for the protection of aquatic life in lakes and streams. The draft acute value (maximum standard) for all Class 2 surface waters is 41 mg/L nitrate-N for a one-day duration, and the draft chronic value for Class 2B (warm water) surface waters is 4.9 mg/L nitrate-N for a 4-day duration. In addition, a draft chronic value of 3.1 mg/L nitrate-N (4-day duration) was determined for protection of Class 2A (cold water) surface waters (MPCA, Aquatic Life Water Quality Standards Technical Support Document for Nitrate, Nov 2010).

Nitrate-N FWMCs from [2009] through [2013] for the Rum River Watershed were .37,.42, .38, .39 and .44 mg/L, respectively (Figure 67) Calculations of the Rum River's annual nitrate-N loads show little relationship to the annual runoff volume over the five-year sampling period (Figure 63).

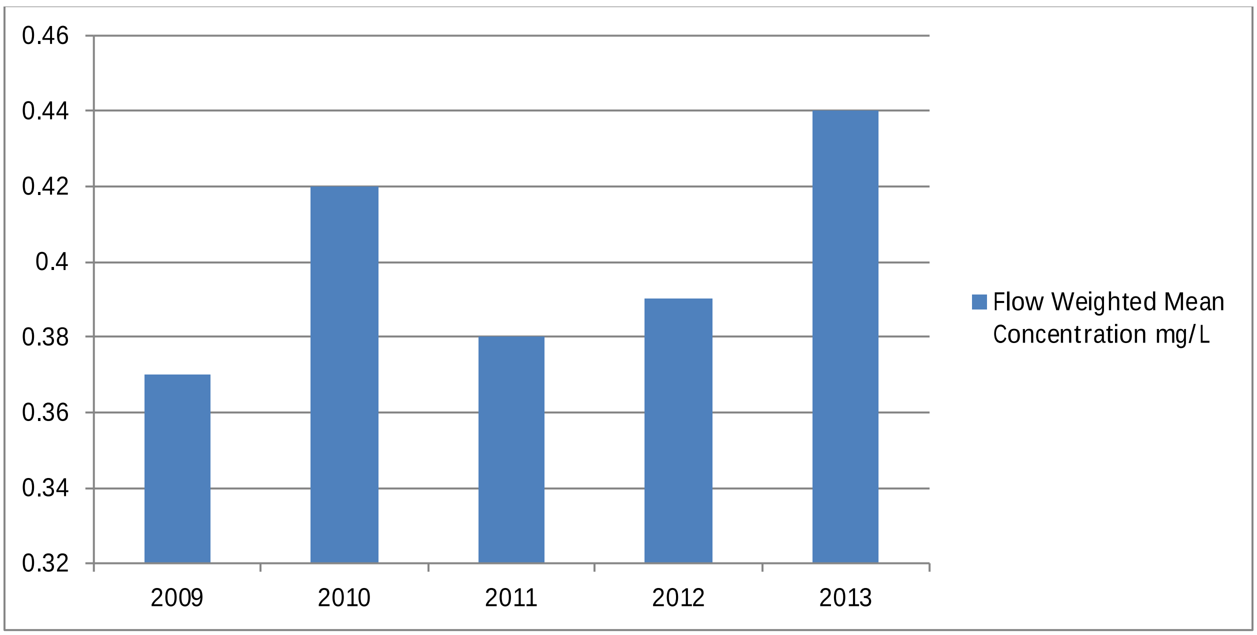

Figure 66. Nitrate and Nitrite Flow Weighted Mean Concentrations 2009 through 2013 for the Rum River.

Stream water quality

Fifty-eight of the 177 total stream AUIDs were assessed (Table 66). Of the assessed streams, 19 streams were considered to be fully supporting of aquatic life and 10 streams were fully supporting of aquatic recreation. 6 AUIDs were not assessed due to their classification as limited resource waters.

Throughout the watersheds, 21 AUIDs are non-supporting for aquatic life and/or recreation. Of those AUIDs, 16 are non-supporting for aquatic life and 5 are non-supporting for aquatic recreation. All of the remaining stream reaches either had insufficient data for no data to assess.

Table 65. Assessment summary for stream water quality in the Rum River Watershed.

				Supporting		Non-supporting			
Watershed	**Area (acres)**	**# Total AUIDs**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**#Aquatic Recreation**	**Insufficient Data**	**# Delistings**
Rum River **HUC 8**	1,013,794	**177**	**39**	**19**	**10**	**16**	**5**	**24**	
0701020701-01	266,384	28	3		1	3		10	
0701020702-01	86,803	25	9	5	2	3	1	1	
0701020702-02	27,516	5	2		1	2			
0701020702-03	81,223	14	2	1	1			3	
0701020702-04	32,409	5	1	1				2	
0701020703-01	90,372	22	4	2		2	1	1	
0701020703-02	27,904	5	2	1		1	1		
0701020704-01	61,671	7	2	1	1	1		1	
0701020705-01	96,794	18	2	2	2			1	
0701020705-02	29,949	6	1	1					
0701020706-01	53,827	16	3	1		2	1		
0701020707-01	85,784	17	5	3	2	1		2	
0701020707-02	47,231	8	2	1		1		2	
0701020707-03	25,928	1	1				1	1	

Biological monitoring

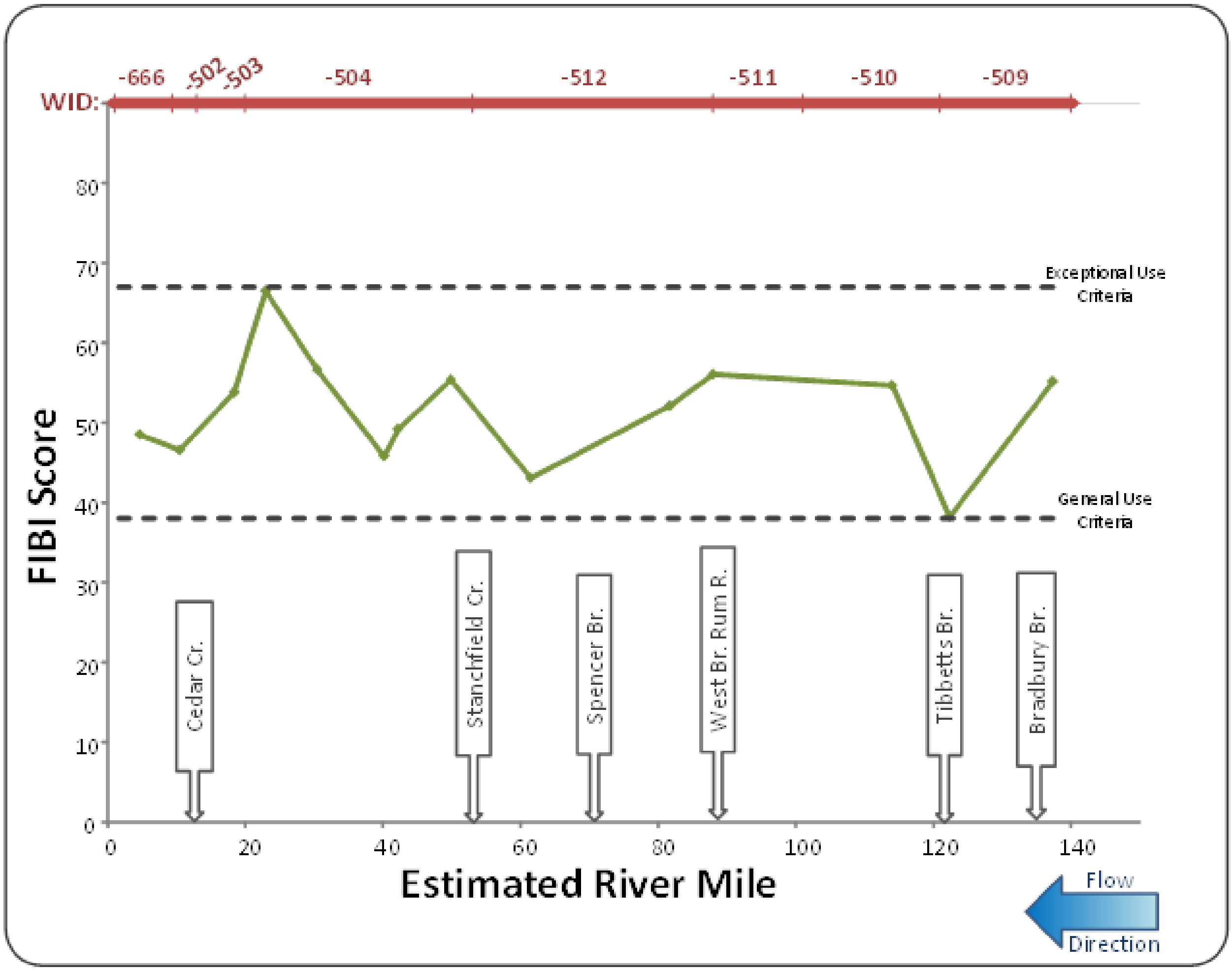

Figure 67. Fish IBI scores on the mainstem Rum River and the major tributaries to the river.

Fish index of biological integrity (FIBI) scores at monitoring stations along the Rum River sampled in 2013. Corresponding waterbody identifications (WIDs), the river segments used in the assessment process, are provided along the top margin of the graph (Figure 68).

All of the stations along the river meet general use aquatic life criteria with MFIBI scores stay somewhat consistent as you move downstream (Figure 68). There are a few dips in the graph but never below the general use threshold.

The highest scoring site at 07010207-503 scored just below the exceptional use threshold but did not quite reach the level so that AUID will continue to be assessed using the general aquatic life use criteria.

Biological monitoring: Fish

The condition of fish stream communities in the Rum River Watershed reflects the land use, hydrologic modification, and discharge of pollutants (point and non-point) upstream of each monitoring location. Out of the 32 stream and river assessment units where fish data was assessed, 8 (25%) were determined to have impaired fish communities (2 modified use, 6 general use). Of the 24 (75%) assessment units that exhibited healthy fish communities, 22 were designated general aquatic life use streams. Two assessment units were either deemed 'not assessable' or have assessments that are pending additional data collection. The assessment of fish community data in the Rum River Watershed required the application of four distinct fish IBIs: Northern Rivers IBI; Northern Streams IBI; Northern Headwaters IBI; and Low Gradient IBI. Having options in terms of which IBI to use for assessing fish communities, depending on the size of the drainage area and the gradient of the stream, allows natural variability to be somewhat accounted for and therefore increases the resolution of the anthropogenic or human disturbance "signal" provided by IBI results.

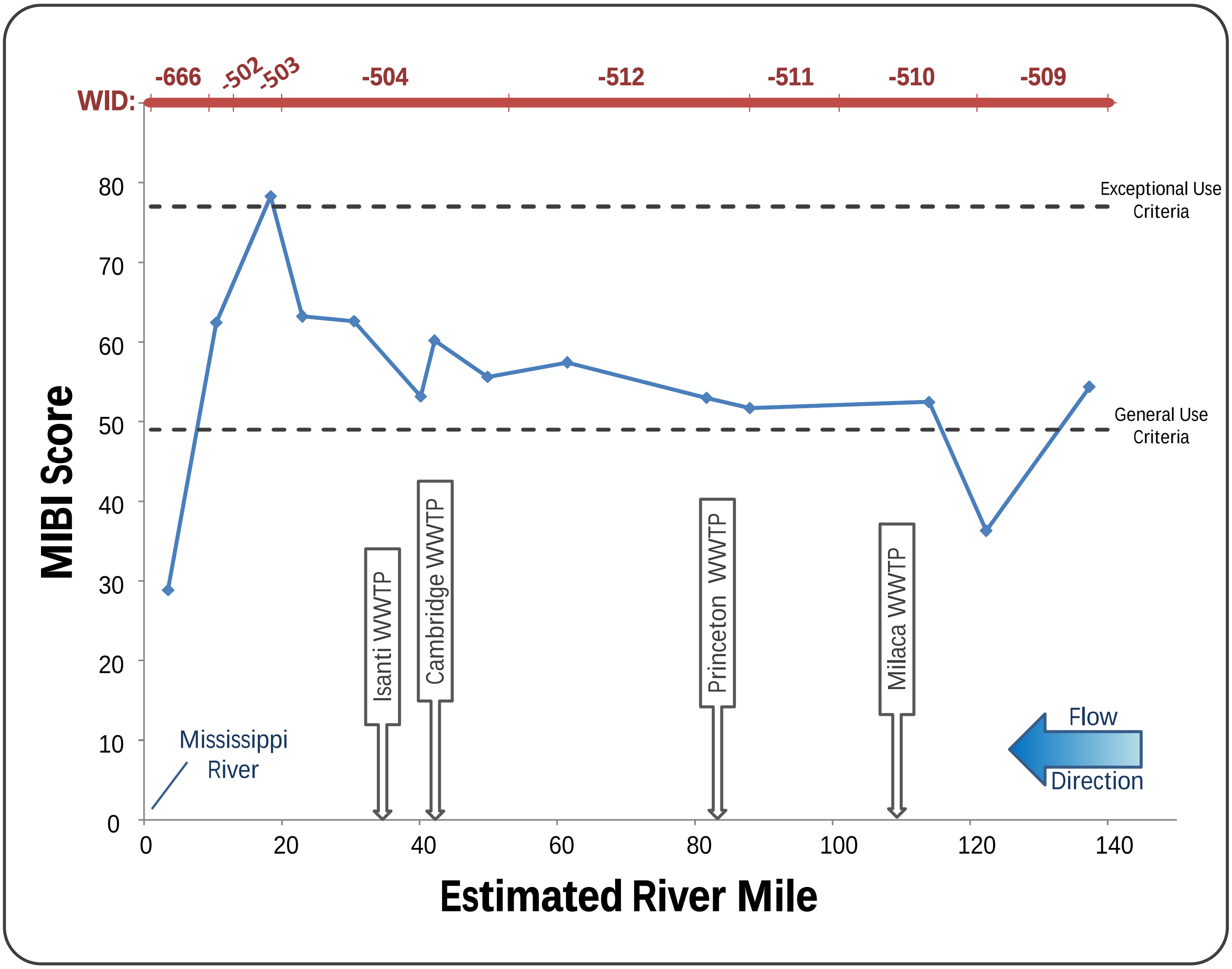

Figure 68. Macroinvertebrate IBI scores on the mainstem Rum River compared to the wastewater treatment outputs.

Aquatic macroinvertebrate index of biological integrity (MIBI) scores at monitoring stations along the Rum River sampled in 2013. Corresponding waterbody identifications (WIDs), the river segments used in the assessment process, are provided along the top margin of the graph.

Even though the southern portion of the Rum River occurs within the Prairie Forests River macroinvertebrate IBI region, the entire river has been classified as a Northern Forest River for monitoring and assessment purposes. Most of the stations along the river meet general use aquatic life criteria with MIBI scores exhibiting a somewhat increasing trend as you move downstream (Figure 69). A dip in this pattern was observed just downstream of the Cambridge wastewater treatment plant (WWTP), the largest facility along the river, where the aquatic macroinvertebrate community was dominated by filter-feeding organisms including net-spinning caddisflies, freshwater sponge, brachycentrid caddisflies, and bryozoan colonies. However, this site is not impaired.

The station at river mile 3.5 was the lowest scoring site along the Rum River in 2013 (Figure 69). This site was deemed 'not-assessable' due to the Anoka Dam located just downstream. The river is still being impounded at the monitoring station, affecting macroinvertebrate community composition with a combination of lentic (lake) and lotic (river) taxa present. Development of biological criteria for modified (e.g., impounded) rivers is anticipated in the future at which time such monitoring stations will be assessed. The only other site that failed to meet general use criteria, 00UM032, is located in the upper part of the watershed. Additional monitoring was conducted in 2015 to re-evaluate the condition of this station as it had a macroinvertebrate IBI score of 96 in 2000, but scored a 43 and 30 based on two samples collected in 2013. Results of this monitoring are forthcoming and will be considered in a follow-up assessment of this WID. This station also exhibited a poor fish community in 2013, with a fish IBI score of 38, the lowest scoring Rum river station that year.

The Rum River is listed on MNDNR's Infested Waters List for zebra mussel (*Dreissena polymorpha*) which is primarily due to its connection to Mille Lacs Lake. Biological monitoring crews did not collect or observe zebra mussels at any sampling station in the watershed in 2013. On the other hand, the rusty crayfish (*Orconectes rusticus*), another aquatic invasive species was collected and observed at numerous locations throughout the watershed.

Biological monitoring: Macroinvertebrates

The condition of macroinvertebrate stream communities in the Rum River Watershed reflects the land use, hydrologic modification, and discharge of pollutants (point and non-point) upstream of each monitoring location. Out of the 32 stream and river assessment units where macroinvertebrate data was assessed, 6 (19%) were determined to have impaired aquatic macroinvertebrate communities (0 modified use, 6 general use). Of the 22 (69%) assessment units that exhibited healthy macroinvertebrate communities, nineteen were designated general aquatic life use streams. Four (12%) assessment units were either deemed 'not assessable' or have assessments that are pending additional data collection. The assessment of macroinvertebrate community data in the Rum River Watershed required the application of four distinct macroinvertebrate IBIs: Southern Forest Streams (Glide/Pool Habitat) IBI; Northern Forest Streams (Glide/Pool Habitat) IBI; Northern Forest Streams (Riffle/Run Habitat) IBI; and Northern Forest Rivers IBI. Having options in terms of which IBI to use for assessing macroinvertebrate communities, depending on characteristics of the monitoring station, allows natural variability to be somewhat accounted for and therefore increases the resolution of the anthropogenic or human disturbance "signal" provided by IBI results.

Overall, a total of 243 genera in 85 families of macroinvertebrates were collected in the Rum River Watershed based on 68 qualitative multi-habitat samples collected primarily in 2013. The most commonly collected macroinvertebrates in the watershed included: midges in the genera Polypedilum and Thienemannimyia; fingernail clams; amphipods in the genus Hyalella; mayflies in the genera Caenis and Baetis; water mites (Acari); and blackflies in the genus Simulium. A total of 186 macroinvertebrate genera were collected from low gradient (glide/pool) streams, the most common of which were: midges in the genera Polypedilum and Thienemannimyia; mayflies in the genus Caenis; fingernail clams; amphipods in the genus Hyalella; and the snail genus Physa. In high gradient (riffle/run habitat) streams 150 macroinvertebrate genera were collected, the most common of which were: midges Thienemannimyia and Cricotopus; snails in the genus Physa; mayflies in the genus Caenis; and water mites (Acari). A total of 167 genera were collected from the Rum River mainstem where the drainage area was large enough (> 500 mi^2) to be evaluated using the Northern Forest Rivers IBI (13 stations). Mayflies in the genera Baetis, Tricorythodes, and Maccaffertium; midges in the genera Polypedilum and Crocotopus; caddisflies in the genus Cheumatopsyche; blackflies in the genus Simulium; riffle beetles in the genus Stenelmis; and stoneflies in the genus Pteronarcys were collected most frequently at Rum River biological monitoring stations.

Lake water quality

The Rum River Watershed contains 197 lakes that are greater than ten acres. The assessable lakes were limited to 41 lakes. The biological data was supporting the aquatic life standard on 12 lakes; only 2 were not supporting (Francis Lake: 30-0080-00 and Green Lake: 30-0136-00). For aquatic recreation, 26 out of 40 lakes were meeting the standard. Skogman Lake (30-0022-00), Fannie Lake (30-0043-00), and Green Lake (30-0136-00) were listed for aquatic recreation impairment in 2008 and the current data supports that listing. Rogers Lake (02-0104-00) and Francis Lake (30-0080-00) were also listed for aquatic recreation impairment in 2006 and 2002; the current data also supports those impairments. There was insufficient information on 23 lakes for aquatic life or aquatic recreation.

Table 66. Assessment summary for lake water chemistry in the Rum River Watershed.

			Supporting		Non-supporting			
Watershed	**Area (acres)**	**Lakes >10 Acres**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
Rum River HUC 8	1,013,794	197	12	26	2	14	23	
0701020701-01	266,384	48	5	12			5	
0701020702-01	86,803	0						
0701020702-02	27,516	0						
0701020702-03	81,223	11		1		1	4	
0701020702-04	32,409	2						
0701020703-01	90,372	1						
0701020703-02	27,904	0						
0701020704-01	61,671	18	1	1		2	3	
0701020705-01	96,794	32	1	3	1	3	4	
0701020705-02	29,949	14	1	1		1	1	
0701020706-01	53,827	16		1				
0701020707-01	85,784	28	4	5	1	4	4	
0701020707-02	47,231	21		2		3	2	
0701020707-03	25,928	6						

Remote sensing

Remote sensing data was used to describe lake transparency in areas where water chemistry data has not been collected or were difficult to access. With remote sensing data, comparisons can be made at the state and watershed scale. Remote sensing provides insight into water quality by estimating transparency values for lakes void of TP, Chl-a, or Secchi data. Satellite imagery is used with Secchi transparency measurements to form a relationship that allows for predictions of transparency values across the state. This provides a snap shot of lake transparency during the time of satellite pass over.

Currently, remote sensing data has been analyzed on approximately a five-year basis from 1975 to 2008, with seven years of remote sensing data available. At this frequency the data allows for a simple average lake transparency value to be calculated at the state or watershed scale. Comparisons of lake transparencies may also be made between individual lakes during any single year. This data does not allow for trends analysis due to the small number of remote sensing data points available at this time.

Remote sensing data was used to describe lake transparencies on 51 lakes without water chemistry data in the Rum River Watershed. The Rum River Watershed crosses over two ecoregions; Northern Lakes and Forest and North Central Hardwood Forest. There are 18 lakes within the Northern Lakes and Forest and 33 lakes within the North Central Hardwood Forest. Thirteen lakes had estimated transparencies greater than the Northern Lakes and Forest Ecoregion Eutrophication Standard of 2.0 m. Five lakes had estimates of transparencies that fell below the 2.0 m eutrophication standard. There is a deep (>1.4 m) and shallow (>1.0 m) transparency standard for the North Central Hardwood Forest Ecoregion. Twenty lakes had estimated transparencies greater than the North Central Hardwood Forest Ecoregion Eutrophication Standard of 1.4 m. Thirteen lakes had estimates of transparencies that fell below the 1.4 m eutrophication standard; seven of these lakes are above the shallow eutrophication standard (1.0 m). These lakes may warrant further investigation into water quality conditions. However, confounding variables must be examined as well, such as lake depth and color, which may impact the remote sensing data. Overall, transparencies look to be in good to excellent condition for the majority of lakes without water chemistry data. Lakes with excellent remote sensing lake transparency data may be considered candidates for protection strategies given their exceptional condition.

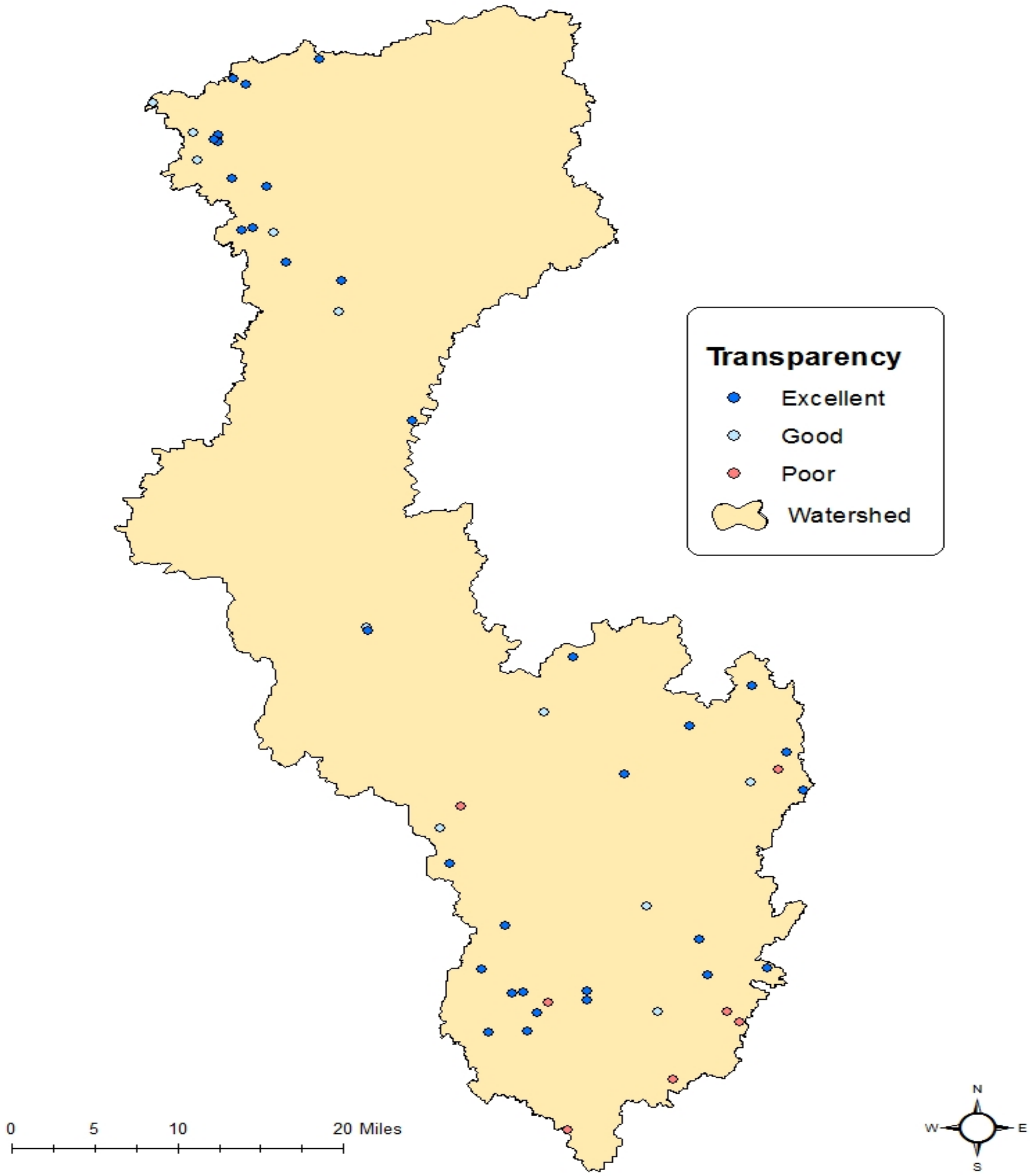

Figure 69. Remote sensing water quality in the Rum River Watershed.

Fish contaminant results

Mercury was analyzed in fish tissue samples collected from Rum River and 11 lakes in the watershed Polychlorinated biphenyls (PCBs) were measured in fish from the river and seven lakes. Fourteen fish species were tested for contaminants. Fish species are identified by codes that are defined by their common and scientific names. (Table 67). A total of 814 fish were collected for contaminant analysis between 1978 and 2013.

Contaminant concentrations are summarized by waterway, fish species, and year (Table 68). "Total Fish" indicates the total number of fish analyzed and "N" indicates the number of samples. The number of fish exceeds the number of samples when fish are combined into a composite sample. This was typically done for panfish, such as bluegill sunfish (BGS) and yellow perch (YP). "Anat." refers to the sample anatomy. Since 1989, most of the samples have been skin-on fillets (FILSK) or for fish without scales (catfish and bullheads), skin-off fillets (FILET). Occasionally whole fish (WHORG) are analyzed.

The Rum River and nine of the lakes are listed as impaired for mercury in fish tissue (MPCA's 2014 draft Impaired Waters List). They are identified in Table 68. with a red asterisk (*). None of the waters in this watershed are listed as impaired for PCBs in fish tissue. All of the impaired waterways, except Lewis Lake (33003200), are covered under the Statewide Mercury TMDL and do not need additional TMDLs for mercury in fish tissue.

Most of the PCB concentrations in fish tissue were near or below the reporting limit (0.01 - 0.05 mg/kg). The highest PCB concentration was 0.24 mg/kg in a walleye collected from the Rum River in 1978, and was a whole fish (WHORG). The next highest PCB concentration was in carp from the Rum River collected in 1985. The most recent analysis of PCBs in fish from the Rum River were less than the 0.025 mg/kg reporting limit.

Perfluorooctane sulfonate (PFOS) concentration was measured in µg/kg (ppb), which is 1000 times lower units than mercury and PCBs. The impairment threshold is the threshold for a meal per month fish consumption advisory: 200 µg/kg. All measured PFOS concentrations in fish from the Rum River Watershed were below the reporting limit (~5 µg/kg).

Overall, mercury remains the dominant fish contaminant in the watershed. The Fish Contaminant Monitoring Program will continue to retest the fish from impaired waters to assess if mercury levels are changing.

Table 67. Fish species codes, common names, and scientific names

Species	Common name	Scientific name
BGS	Bluegill sunfish	*Lepomis macrochirus*
BKB	Black bullhead	*Ameiurus melas*
BKS	Black crappie	*Pomoxis nigromaculatis*
BUR	Burbot (Eelpout)	*Lota lota*
C	Carp	*Cyprinus carpio*
CIS	Cisco (Lake herring)	*Coregonus artedi*
HSF	Hybrid sunfish	
LMB	Largemouth bass	*Micropterus salmoides*
NP	Northern pike	*Esox lucius*
SMB	Smallmouth bass	*Micropterus dolomieue*
WE	Walleye	*Sander vitreus*
WSU	White sucker	*Catostomus commersoni*
YEB	Yellow bullhead	*Ameiurus natalis*
YP	Yellow perch	*Perca flavescens*

Table 68. Summary statistics of fish length, mercury, and PCBs, by waterway-species-year.

									Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)		
MAJOR WATERSHED	HUC8	AUID	WATERWAY	SPECIES	YEAR	ANAT.	NO. FISH	N	Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	< RL
Rum River	07010207	07010207-506, -583, -585, -509, -510, -511, -512, -504, -503, -502, -666, -665, -556*	RM 0.6, AT ANOKA	C	1978	PLUG	10	2	22.0	20.8	23.1	0.285	0.260	0.310	2	0.05	0.06				
						WHORG	10	2	22.0	20.8	23.1	0.155	0.140	0.170	2	0.075	0.09				
				SMB	1978	WHORG	3	1	9.8	9.8	9.8	0.200	0.200	0.200	1	0.09	0.09				
				WE	1978	PLUG	1	1	26.0	26.0	26.0	0.960	0.960	0.960	1	0.04	0.04				
						WHORG	1	1	26.0	26.0	26.0	0.550	0.550	0.550	1	0.24	0.24				
			1.5 MI N OF ANOKA	SMB	2013	FILSK	9	9	15.0	10.2	19.5	0.352	0.212	0.606	2	0.025	0.025	Y			
				SRH	2013	FILSK	5	5	21.7	20.8	22.3	0.387	0.287	0.506	2	0.025	0.025	Y			
			RM 12-13, AT ANDOVER, M-63	NP	2012	FILSK	2	2	18.9	18.2	19.6	0.344	0.318	0.370							
				SMB	2012	FILSK	6	6	14.6	9.9	18.8	0.434	0.219	0.646							
				WE	2012	FILSK	4	4	15.4	12.0	19.0	0.428	0.328	0.529							
				WSU	2012	FILSK	1	1	14.4	14.4	14.4	0.248	0.248	0.248							
			RM 18, HWY 24 AT ST. FRANCIS	C	1985	FILSK	5	1	21.0	21.0	21.0	0.160	0.160	0.160	1	0.2	0.2				
			M-63, RM 55-56, AT CAMBRIDGE	C	2012	FILSK	2	1	26.5	26.5	26.5	0.239	0.239	0.239							
				NP	2012	FILSK	3	3	19.1	17.0	22.2	0.302	0.248	0.385							
				SMB	2012	FILSK	5	5	12.6	9.8	16.4	0.291	0.211	0.484							
			RM 090	NP	2009	FILSK	2	2	21.1	18.6	23.5	0.275	0.238	0.311	2	0.025	0.025	Y			
			RM 118	NP	2009	FILSK	1	1	17.0	17.0	17.0	0.171	0.171	0.171							
			RM 83-137, ONAMIA TO PRINCETON	WE	1992	FILSK	5	2	14.2	11.5	16.8	0.370	0.240	0.500	1	0.026	0.026				
		01015700	BIG PINE	BGS	2007	FILSK	3	1	6.9	6.9	6.9	0.034	0.034	0.034					1	1.0	Y
				BKS	2007	FILSK	7	1	9.1	9.1	9.1	0.086	0.086	0.086							
				HSF	2007	FILSK	3	1	7.1	7.1	7.1	0.054	0.054	0.054							
		01020400	ROUND*	BKS	1993	FILSK	10	1	8.7	8.7	8.7	0.100	0.100	0.100							
					2003	FILSK	7	1	9.5	9.5	9.5	0.195	0.195	0.195							
					2013	FILSK	5	1	8.7	8.7	8.7	0.230	0.230	0.230							
				C	1993	FILSK	8	3	23.7	20.0	27.2	0.113	0.100	0.120	3	0.023	0.031				

MAJOR WATERSHED	HUC8	AUID	WATERWAY	SPECIES	YEAR	ANAT.	NO. FISH	N	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)		
									Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	< RL
					2003	FILSK	5	1	19.3	19.3	19.3	0.109	0.109	0.109	1	0.01	0.01	Y			
				CIS	2003	FILSK	2	1	13.8	13.8	13.8	0.163	0.163	0.163							
					2013	FILSK	1	1	17.4	17.4	17.4	0.053	0.053	0.053							
				NP	1993	FILSK	17	4	25.5	19.0	33.2	0.463	0.150	0.690	2	0.0225	0.035	Y			
					2003	FILSK	5	5	23.6	19.0	28.5	0.394	0.241	0.521							
					2013	FILSK	7	7	20.7	16.5	26.2	0.361	0.252	0.521							
				SMB	1993	FILSK	12	2	14.7	13.6	15.7	0.130	0.100	0.160	1	0.016	0.016				
					2003	FILSK	4	4	14.3	9.8	19.2	0.263	0.176	0.338							
				WE	1993	FILSK	18	4	21.3	16.4	25.7	0.573	0.180	0.970	3	0.0707	0.1				
					2003	FILSK	5	5	19.9	13.9	26.8	0.538	0.247	0.896							
					2013	FILSK	1	1	20.5	20.5	20.5	0.611	0.611	0.611							
		02004200	COON*	BGS	2003	FILSK	10	1	6.1	6.1	6.1	0.068	0.068	0.068							
					2009	FILSK	10	2	6.1	6.0	6.1								2	4.9	Y
				BKB	2009	FILSK	8	1	9.0	9.0	9.0	0.029	0.029	0.029					1	4.4	Y
				NP	1983	FILSK	5	1	20.6	20.6	20.6	0.190	0.190	0.190	1	0.05	0.05	Y			
					2003	FILSK	5	5	24.7	20.2	32.0	0.165	0.092	0.238							
					2009	FILSK	8	8	25.4	22.8	28.0								8	5.0	Y
				WSU	1983	FILSK	4	1	16.1	16.1	16.1	0.030	0.030	0.030	1	0.05	0.05	Y			
				YEB	2003	FILET	9	1	8.2	8.2	8.2	0.118	0.118	0.118							
		02009100	GEORGE*	BGS	1993	FILSK	10	1	6.1	6.1	6.1	0.082	0.082	0.082							
					2008	FILSK	12	1	6.5	6.5	6.5	0.064	0.064	0.064							
				LMB	1993	FILSK	4	1	11.5	11.5	11.5	0.160	0.160	0.160							
				NP	1993	FILSK	25	5	21.6	14.2	28.7	0.237	0.073	0.420	1	0.01	0.01	Y			
					2008	FILSK	5	5	22.2	18.5	26.1	0.246	0.199	0.349							
				YEB	1993	FILET	7	1	9.9	9.9	9.9	0.170	0.170	0.170							
					2008	FILET	10	1	11.4	11.4	11.4	0.212	0.212	0.212							
		02013300	EAST TWIN*	BGS	2004	FILSK	11	1	6.0	6.0	6.0	0.098	0.098	0.098							

MAJOR WATERSHED	HUC8	AUID	WATERWAY	SPECIES	YEAR	ANAT.	NO. FISH	N	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)		
									Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	< RL
				BKB	2004	FILET	8	1	9.6	9.6	9.6	0.065	0.065	0.065							
				NP	2004	FILSK	6	6	23.1	16.5	28.4	0.245	0.163	0.317							
		18002000	BORDEN*	BGS	2003	FILSK	8	1	6.9	6.9	6.9	0.081	0.081	0.081							
				BKS	2003	FILSK	5	1	9.5	9.5	9.5	0.097	0.097	0.097							
					2014	FILSK	10	1	8.2	8.2	8.2	0.090	0.090	0.090							
				CIS	2003	FILSK	3	1	16.2	16.2	16.2	0.145	0.145	0.145							
				LMB	2003	FILSK	5	5	11.8	9.5	13.6	0.284	0.241	0.334							
				NP	2003	FILSK	5	5	23.7	18.4	28.9	0.310	0.210	0.371							
					2014	FILSK	8	8	22.3	18.5	25.4	0.358	0.287	0.438							
				SMB	2003	FILSK	3	3	16.9	16.3	17.9	0.459	0.441	0.472							
				WE	2003	FILSK	5	5	21.6	20.3	23.6	0.785	0.450	1.291							
		30008000	FRANCIS	BKS	1993	FILSK	8	1	10.7	10.7	10.7	0.036	0.036	0.036							
				C	1993	FILSK	13	3	21.6	14.2	26.4	0.074	0.036	0.140	3	0.016	0.028	Y			
				NP	1993	FILSK	4	3	27.0	22.9	31.2	0.103	0.043	0.170	1	0.01	0.01	Y			
		30013600	GREEN*	BKB	2012	FILET	5	1	12.1	12.1	12.1	0.033	0.033	0.033							
				BKS	1992	FILSK	8	1	8.2	8.2	8.2	0.081	0.081	0.081							
					2012	FILSK	10	2	8.4	8.2	8.5	0.065	0.058	0.071							
				C	1992	FILSK	10	2	19.8	18.9	20.7	0.055	0.038	0.071	2	0.0585	0.071				
				NP	1992	FILSK	15	4	24.8	19.5	30.3	0.173	0.140	0.220	1	0.16	0.16				
				WE	1992	FILSK	15	4	19.9	13.3	25.3	0.350	0.140	0.500	1	0.28	0.28				
					2012	FILSK	6	6	18.2	13.1	25.1	0.224	0.141	0.361							
		33003200	LEWIS**	BGS	1996	FILSK	10	1	5.9	5.9	5.9	0.300	0.300	0.300							
				C	1996	FILSK	1	1	23.2	23.2	23.2	0.260	0.260	0.260	1	0.01	0.01				
				NP	1996	FILSK	20	4	22.3	17.7	27.6	0.300	0.090	0.780	1	0.01	0.01	Y			
				WSU	1996	FILSK	1	1	17.4	17.4	17.4	0.020	0.020	0.020							
		48000200	MILLE LACS*	BKS	2012	FILSK	10	2	9.0	7.8	10.2	0.088	0.074	0.101							
				BUR	1997	FILET	8	2	19.3	16.7	21.8	0.074	0.068	0.079	2	0.01	0.01	Y			

									Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)		
MAJOR WATERSHED	HUC8	AUID	WATERWAY	SPECIES	YEAR	ANAT.	NO. FISH	N	Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	< RL
				C	1990	FILSK	3	2	24.3	23.5	25.1	0.073	0.069	0.076	2	0.031	0.038				
				CIS	1997	FILSK	8	1	12.3	12.3	12.3	0.031	0.031	0.031	1	0.01	0.01	Y			
					2003	FILSK	4	1	14.2	14.2	14.2	0.039	0.039	0.039	1	0.01	0.01	Y			
				HSF	2007	FILSK	4	1	8.2	8.2	8.2	0.054	0.054	0.054					1	0.9	Y
				NP	1985	FILSK	12	4	23.1	18.9	25.4	0.128	0.110	0.160	4	0.05	0.05	Y			
					1990	FILSK	10	3	23.5	19.7	26.6	0.063	0.025	0.100	3	0.0123	0.017	Y			
					1997	FILSK	10	10	29.1	21.7	35.3	0.168	0.097	0.320	2	0.01	0.01	Y			
					2003	FILSK	5	5	28.7	20.3	33.7	0.124	0.050	0.172							
					2008	FILSK	22	22	24.6	15.1	38.3	0.141	0.011	0.607							
				SMB	2007	FILSK	6	6	15.3	11.8	17.6	0.124	0.066	0.173							
				WE	1985	FILSK	20	6	20.7	14.6	27.0	0.197	0.120	0.330	6	0.05	0.05	Y			
					1990	FILSK	20	4	19.2	12.1	25.9	0.148	0.073	0.220	4	0.01	0.01	Y			
					1997	FILSK	10	10	17.8	11.9	25.7	0.114	0.050	0.200	2	0.01	0.01	Y			
					2003	FILSK	5	5	20.5	17.5	22.1	0.216	0.099	0.388							
					2010	FILSK	5	5	18.7	17.1	20.1								5	4.9	Y
					2012	FILSK	40	8	17.8	11.6	24.5	0.171	0.081	0.562							
				WSU	1997	FILSK	7	1	16.6	16.6	16.6	0.029	0.029	0.029	1	0.01	0.01	Y			
				YP	1990	FILSK	10	1	9.5	9.5	9.5	0.047	0.047	0.047	1	0.01	0.01	Y			
					1997	FILSK	10	1	10.0	10.0	10.0	0.067	0.067	0.067	1	0.01	0.01	Y			
					2003	FILSK	9	1	10.5	10.5	10.5	0.076	0.076	0.076							
					2010	FILSK	5	5	9.3	8.3	10.2								5	4.8	Y
		48001200	SHAKOPEE*	BGS	2013	FILSK	8	2	7.5	6.5	8.5	0.081	0.059	0.102							
				BKS	1995	FILSK	10	1	10.1	10.1	10.1	0.070	0.070	0.070							
				NP	1995	FILSK	15	6	24.3	14.9	35.4	0.179	0.086	0.370	2	0.01	0.01	Y			
					2013	FILSK	8	8	18.9	15.8	21.2	0.230	0.178	0.272							
				WE	1995	FILSK	4	2	13.7	12.1	15.3	0.103	0.055	0.150							

MAJOR WATERSHED	HUC8	AUID	WATERWAY	SPECIES	YEAR	ANAT.	NO. FISH	N	Length (in)			Mercury (mg/kg)			PCBs (mg/kg)				PFOS (µg/kg)		
									Mean	Min	Max	Mean	Min	Max	N	Mean	Max	< RL	N	Mean	< RL
					2013	FILSK	2	2	20.1	19.5	20.6	0.230	0.209	0.251							
				WSU	1995	FILSK	5	1	17.3	17.3	17.3	0.076	0.076	0.076							

*** Impaired for mercury in fish tissue as of 2014 Draft Impaired Waters List; categorized as EPA Class 4a for waters covered by the Statewide Mercury TMDL.**

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

1 **Species codes are defined in Table FC1**
2 Anatomy codes: FILSK – edible fillet, skin-on; FILET—edible fillet, skin-off; PLUG—dorsal muscle piece, without skin; WHORG—whole organism

Wetland condition

Table 69. Macroinvertebrate condition of depressional wetlands according by number of wetland basins (Genet 2012).

Condition Category	Statewide	Mixed Wood Shield	Mixed Wood Plains	Temperate Prairies
Good	47%	60%	44%	33%
Fair	33%	29%	40%	20%
Poor	20%	12%	15%	47%

Overall wetland quality is generally high in Minnesota—both in terms of macroinvertebrates in depressional wetlands Table 69) and vegetation in all wetland types (Table 70). Wetlands in exceptional or good condition have had few (if any) changes in the expected native composition or the abundance distribution. However, wetland quality varies widely in different parts of the state. For macroinvertebrates in depressional wetlands (Table 69), the rate of good condition is greatest in the Mixed Wood Shield ecoregion (where there have been few wetland impacts), moderate in the Mixed Wood Plains ecoregion, and lowest in the Temperate Prairies ecoregion (where most of the land has been developed for agriculture). For vegetation quality in all wetland types (Table 70), > 80% of the wetland acreage in the Mixed Wood Shield is in exceptional-good condition. The exact opposite is true in both the Mixed Wood Plains and Temperate Prairies ecoregions—where > 80% of the wetland extent is in fair or poor condition (i.e., moderate changes in native composition and structure to complete replacement by non-native invasive species).

Table 70. Vegetation condition of all wetlands by extent (MPCA 2015).

Condition Category	Statewide	Mixed Wood Shield	Mixed Wood Plains	Temperate Prairies
Exceptional	49%	64%	6%	7%
Good	18%	20%	12%	11%
Fair	23%	16%	42%	40%
Poor	10%		40%	42%

As approximately 75% of Minnesota's wetlands occur in the Mixed Wood Shield ecoregion, the high levels of good to exceptional condition found there largely masks the widespread degraded vegetation condition found in remainder of the state.

The Rum River Watershed is roughly split in half by ecoregion, with the northern portion in the Mixed Wood Shield and southern in the Mixed Wood Plains (Figure 75). As such, wetland quality of both macroinvertebrates in depressional wetlands is expected to be better (to substantially better for vegetation) in the northern compared to the southern portion Table 69 and Table 70.

Macroinvertebrates have been monitored at nine depressional wetlands in the watershed—only two of which were located in the Mixed Wood Shield ecoregion (Figure 75). In terms of condition category: 67% were good, 22% fair, and 11% poor which is similar to the rates observed in the Mixed Wood Shield ecoregion (Table 69). It should be noted, however, that this is a small sample size and may not be representative of the depressional wetlands in the watershed.

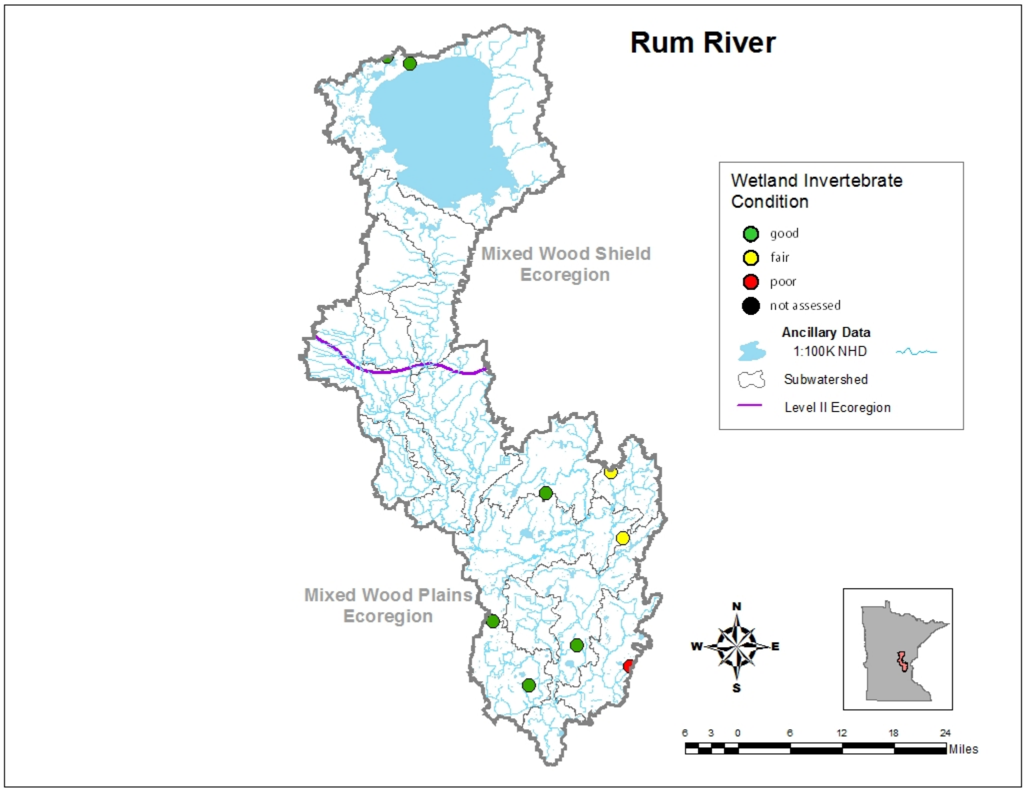

Figure 70. Depressional wetland macroinvertebrate monitoring results in the Rum River Watershed.

Vegetation has been monitored at 14 wetlands sites in the watershed, covering a variety of wetland types. Four of the sites were from our probabilistic survey (MPCA 2015) with the remainder completed for low gradient stream support monitoring. All sites were located in the Mixed Wood Plains ecoregion portion of the watershed. In terms of condition category: 19% were good, 50% fair, and 31% poor—which is approximately the condition category rates for the broader Mixed Wood Plains ecoregion (Figure 76). Again, this is a small sample size, not a random sample, and not evenly distributed throughout the watershed. It is expected that the wetlands located in the Mixed Wood Shield ecoregion portion of the watershed likely have higher rates of good to exceptional vegetation condition.

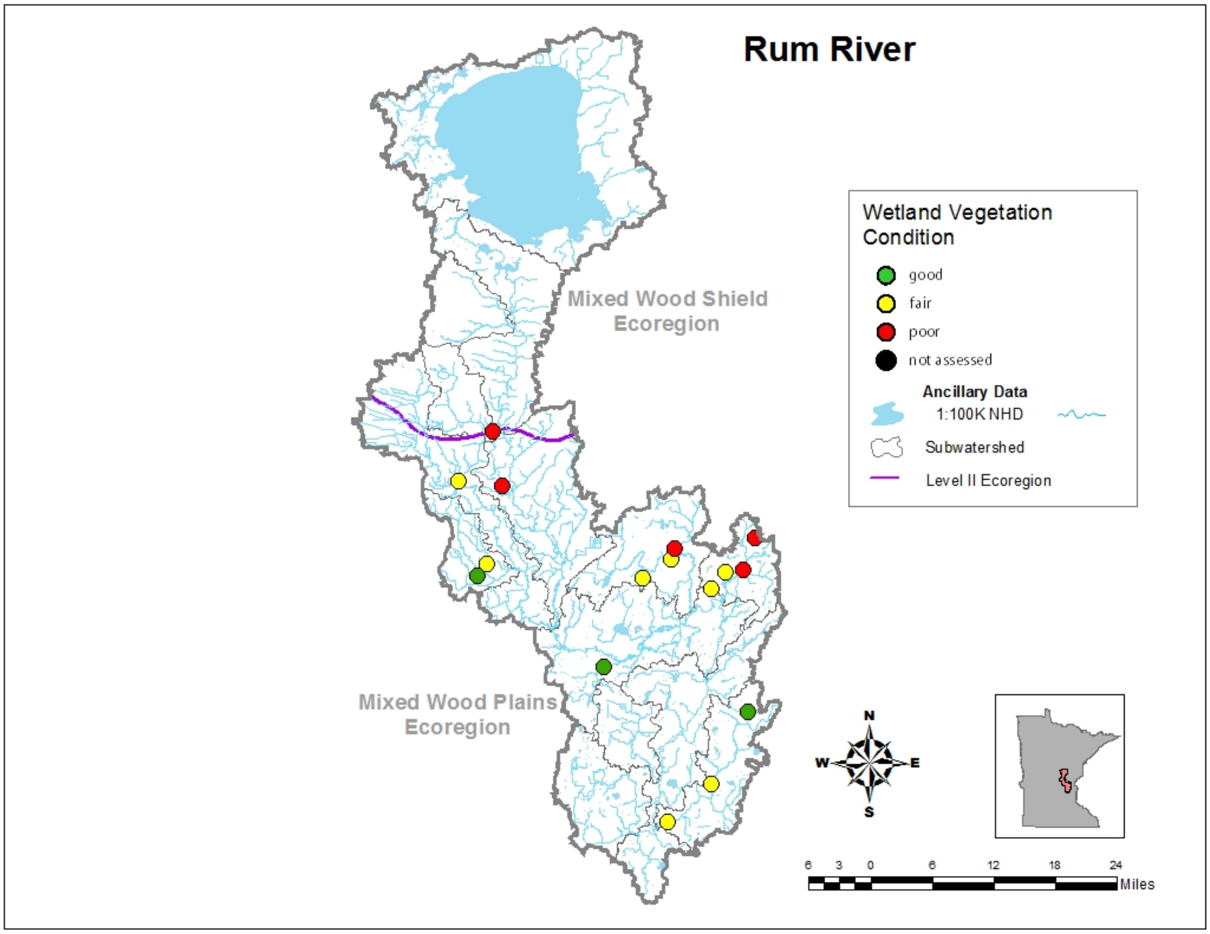

Figure 71. Wetland vegetation monitoring results in the Rum River Watershed.

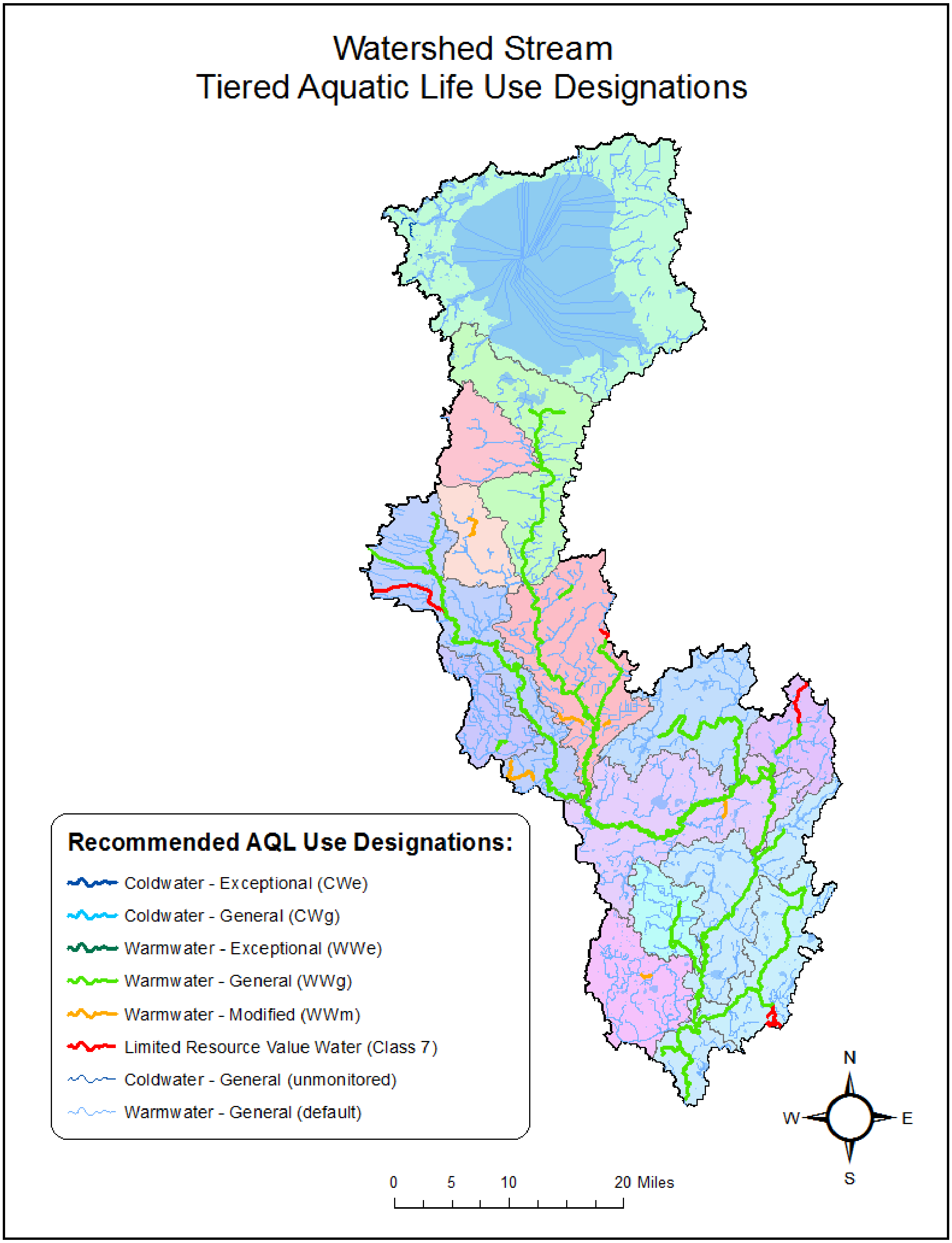

Figure 72. Stream Tiered Aquatic Life Use Designations in the Rum River Watershed.

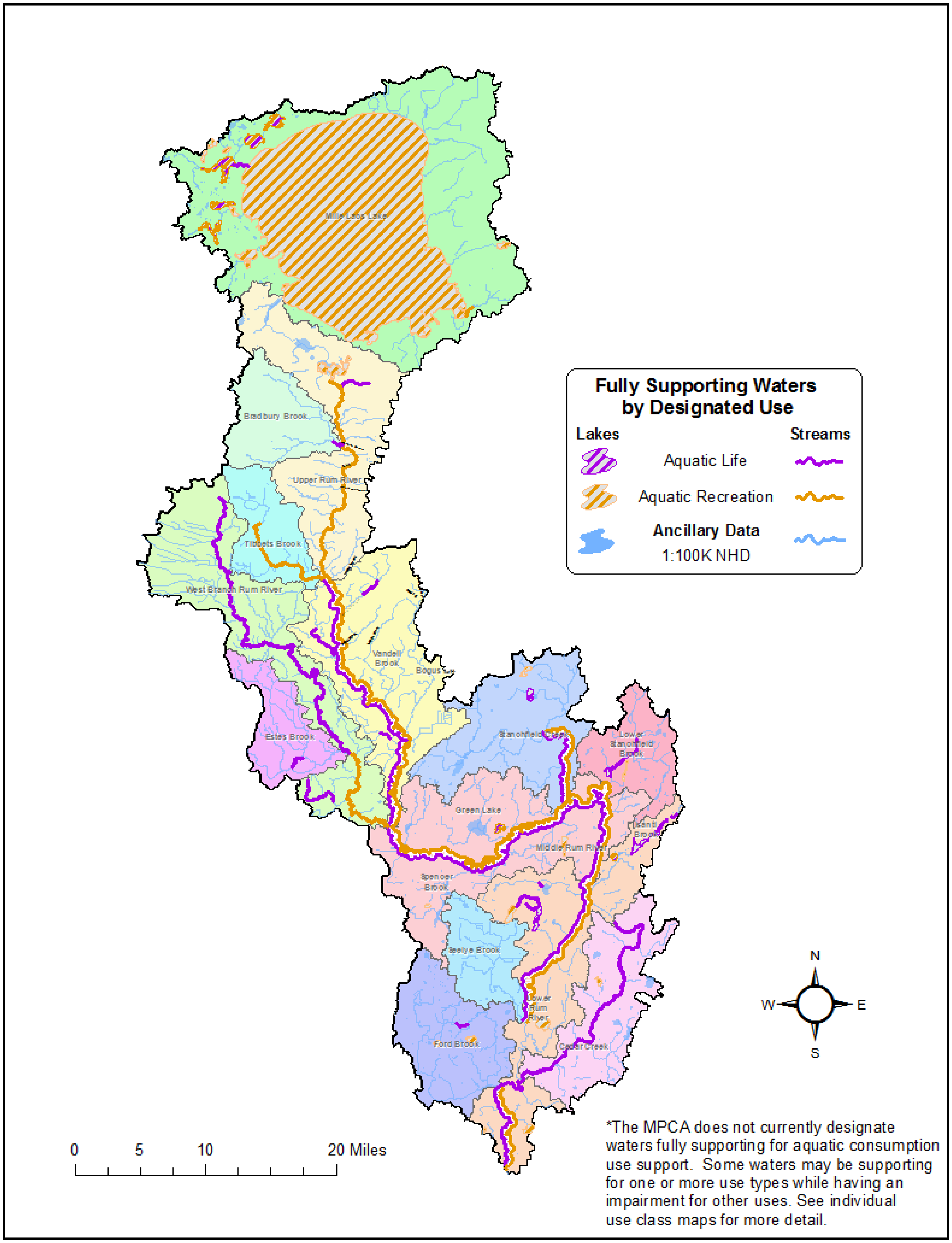

Figure 73. Fully supporting waters by designated use in the Rum River Watershed.

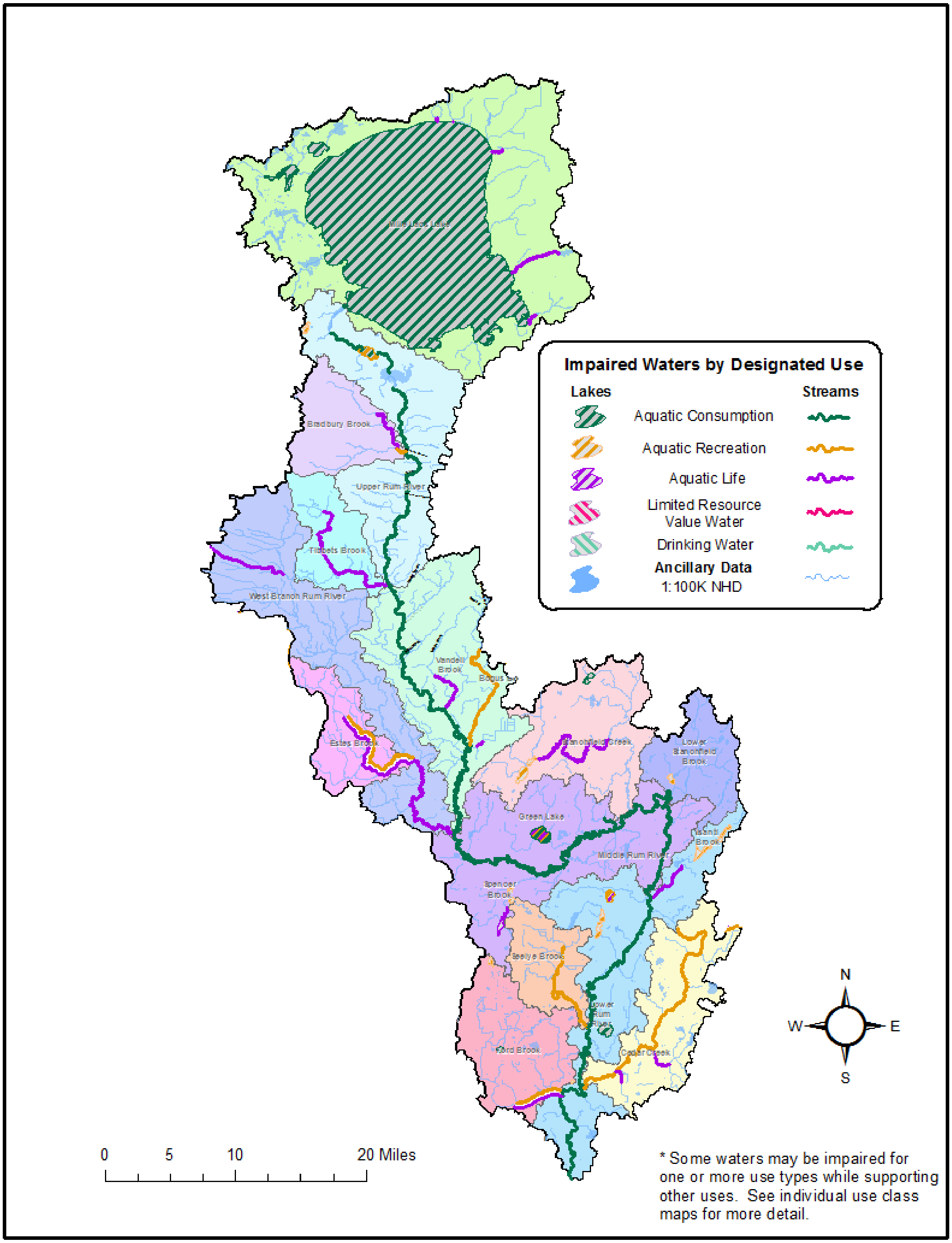

Figure 74. Impaired waters by designated use in the Rum River.

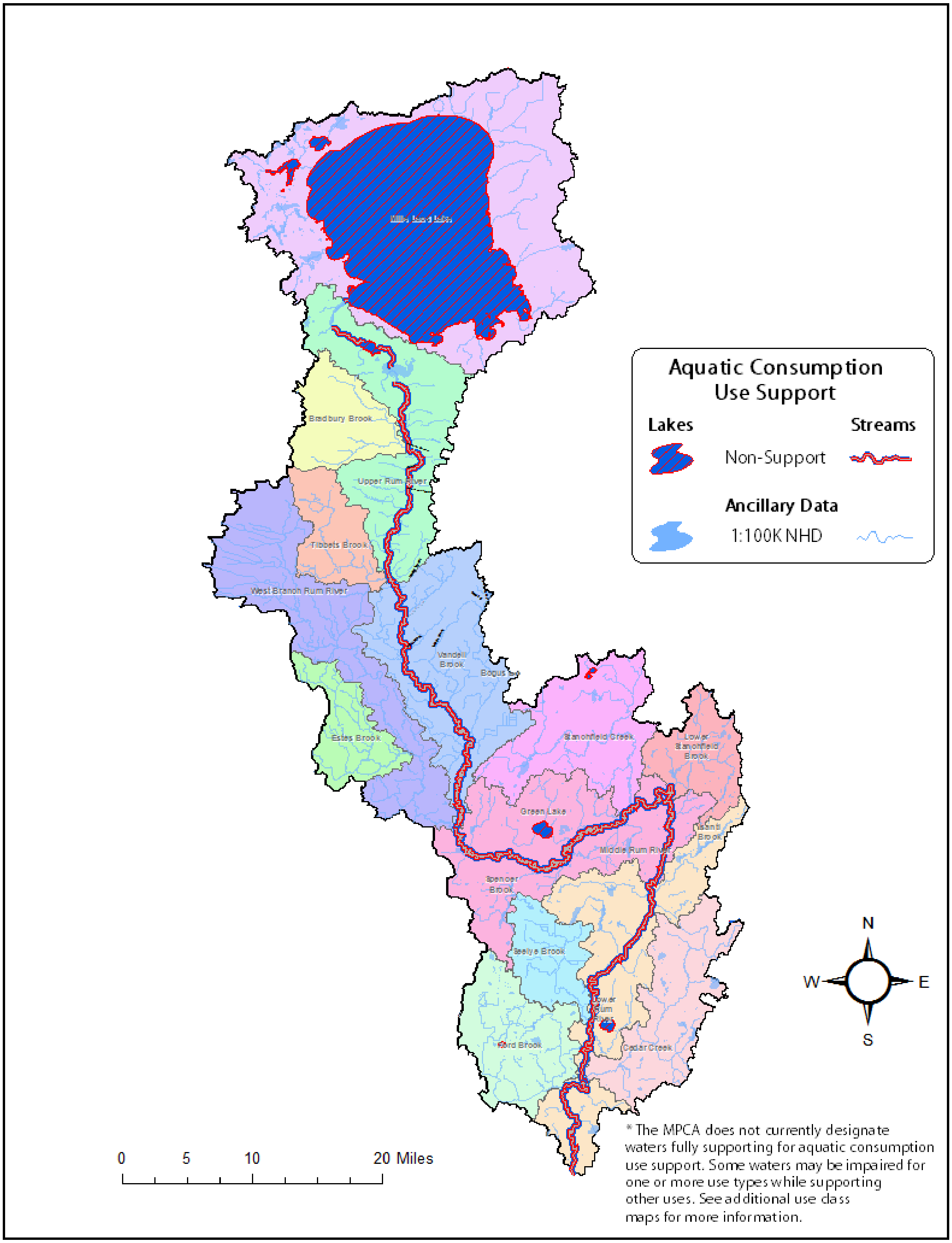

Figure 75. Aquatic consumption use support in the Rum River Watershed.

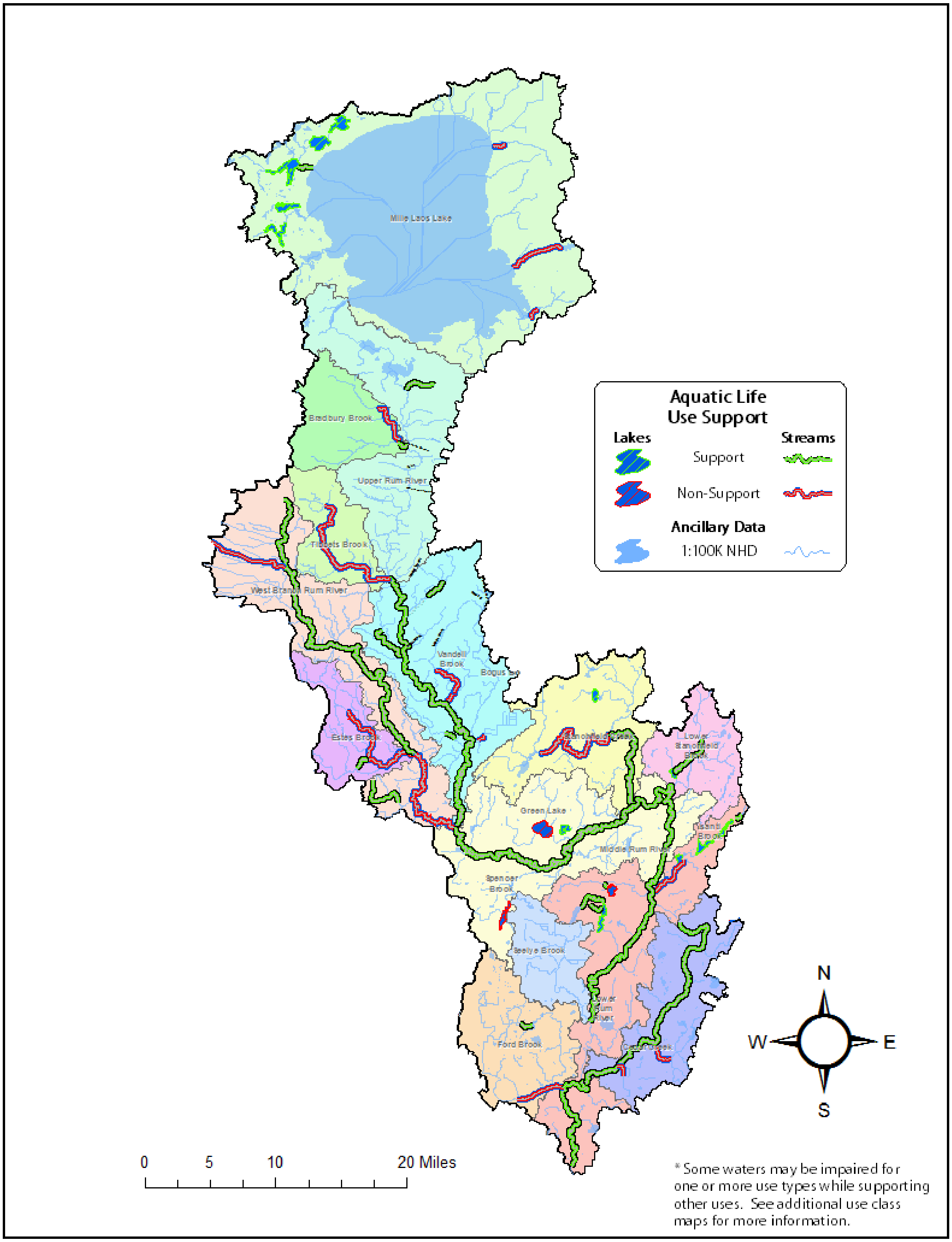

Figure 76. Aquatic life use support in the Rum River Watershed.

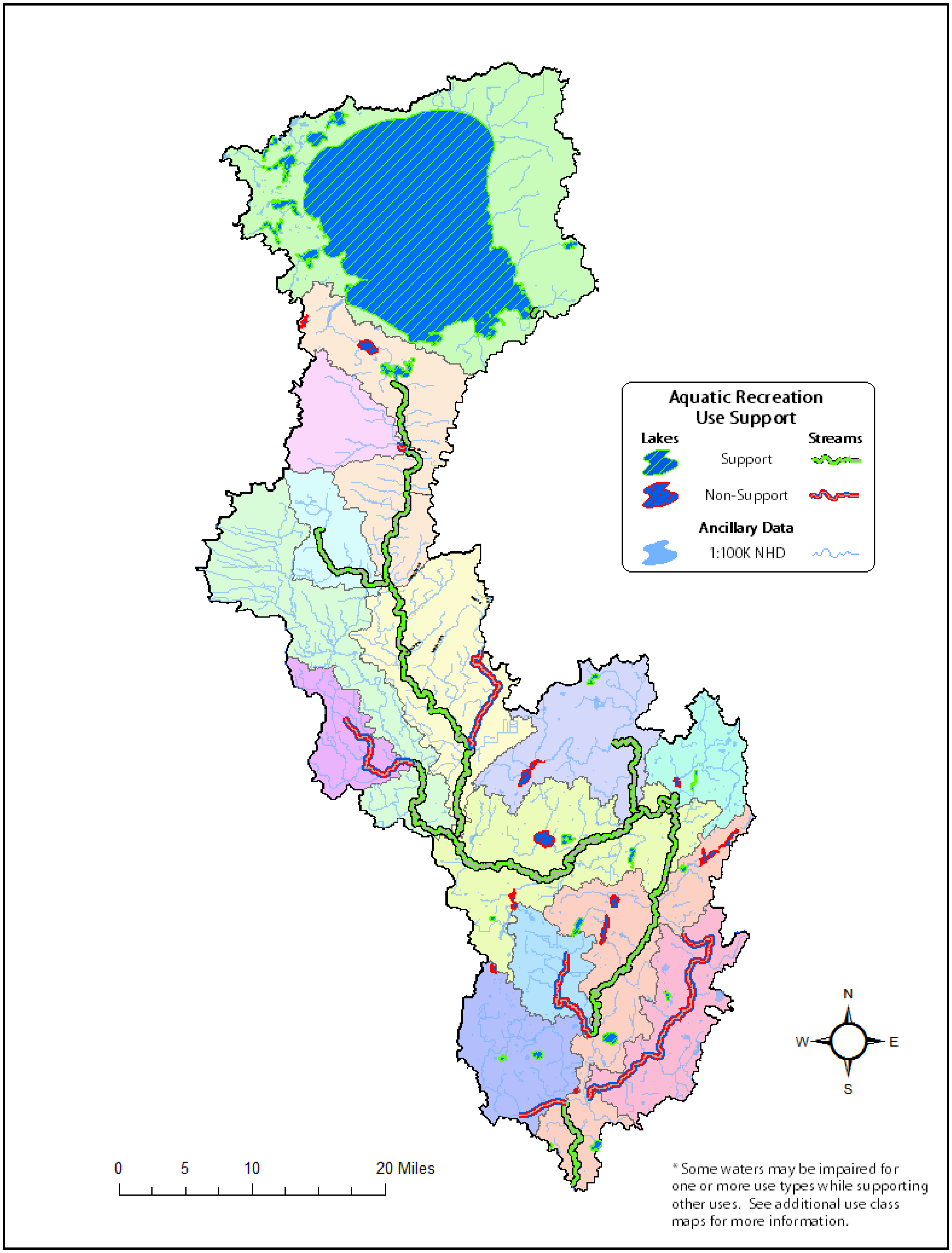

Figure 77. Aquatic recreation use support in the Rum River Watershed.

Pollutant trends for the Rum River Watershed

Water quality trends at long-term monitoring stations

Water chemistry data was analyzed for trends (Table 71) for the long term period of record (1953-2010) and near term period of record (1995-2010). There were significant increases in nitrite/nitrates and Chloride during the long term period of record for both stations and additionally for the long term period for both locations. Conversely, there were significant decreases in total suspended solids, total phosphorus, ammonia, and biological oxygen demand for the long term period of record while there was no trend with the near term period except for the Pleasant St. location which had a significant decrease in biological oxygen demand.

Table 71. Trends in the [Watershed Name] Watershed.

	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Ammonia	Biochemical Oxygen Demand	Chloride
Rum River at Bridge on CSAH-5, 0.5 Mi W of Isanti (period of record 1955 - 2010)						
overall trend	**decrease**	**decrease**	**increase**	**decrease**	**decrease**	**Increase**
estimated average annual change	-1.6%	-0.9%	1.1%	-4.4%	-2.4%	2.6%
estimated total change	**-58%**	**-37%**	**44%**	**-77%**	**-75%**	303%
(1995 – 2010) trend	**no trend**	**no trend**	**no trend**	**no trend**	**no trend**	**little data**
Estimated average annual change						
Estimated total change						
median concentrations first 10 years	23	0.2	0.1	0.1	6	4
median concentrations most recent 10 years	14	0.1	0.2	<0.05	2	12
Rum River at Bridge on Pleasant St in Anoka (period of record 1953 - 2010)						
overall trend (1953–2010)	**decrease**	**decrease**	**increase**	**No Trend**	**decrease**	**Increase**
average annual change	-2.2%	-1.5%	0.6%		-1.8%	3.5
total change	**-72%**	**-51%**	**22%**		**-65%**	606%
recent trend (1995 – 2009)	**no trend**	**no trend**	**no trend**	**no trend**	**decrease**	**little data**
average annual change					-3.3%	
total change					-43%	
median concentrations first 10 years	24	0.2	0.1	<0.02	4	5
median concentrations most recent 10 years	8	0.1	0.1	<0.05	2	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.

Summaries and recommendations

The Rum River Watershed is the gateway from the southern and western agricultural region of Minnesota to the hardwood forests of north and northeastern Minnesota. The Rum River Watershed has three distinct regions in regards to land use. The most northern 1/3 is dominated by wetland and forests, the middle third is dominated by agricultural land use, and the lower third is the most populated and the most urban. Because of these three distinct zones in the watershed there are complex issues for each landuse type.

The northern 1/3 is the most pristine section of the watershed. There are very few channelized streams and typically there are extensive buffers along the Rum River and its tributaries. The northern portion is nearly void of agriculture and is dominated by forest and wetland. The streams tend to be rockier and higher gradient then the rest of the watershed. There is only one biological impairment in this 1/3 of the watershed on Tibbitts Brook and it is for fish. The same AUID is passing for macroinvertebrates. It coincides with one of the few channelized stream sections and has very limiting habitat unlike the surrounding streams in the northern 1/3 of the Rum watershed. Best management practices should be followed to maintain this mostly pristine section of the watershed. The buffers are a key piece in keeping the banks intact which will minimize erosion.

The middle 1/3 of the watershed is dominated by agriculture. The highest percentage of modified streams is in this area of the watershed mainly due to the agricultural practices. This section still has a significant amount of forest and wetlands but they are greatly diminished land use percent compared to the upper Rum River Watershed. Agricultural land use is wide spread and is predominately cattle pasture and crops used in propagation of cattle. The agricultural fields are predominately in hay or alfalfa and the row crops that are planted are often corn used as silage for cattle feed. The increase presence of cattle and their proximity to the streams may be the cause for the two bacteria impairments within the middle part of the watershed. The streams in this area also become lower gradient in areas because of the fast moving streams under the glaciers that created wetlands, lakes and low gradient stream in their wake (tunnel valleys). These low gradient streams often have lower dissolved oxygen and depauperate fish and invertebrate communities. There is a transition in this 1/3 of the watershed where the Rum River becomes predominately sandy and the gradient becomes lower and the water is slower moving. Turbidity tends not to be a problem in the whole of the watershed due to the rocky and sandy nature of the soil with very little fine substrate but animal trampling can cause course substrates to be cover in sand reducing aquatic habitat. Having good buffers along agricultural fields and limiting cattle access to streams will help with excess sedimentation and increased bacteria loads.

The lowest 1/3 of the watershed urban development increases yet agricultures is still a significant landuse. Wetlands and forested areas become less numerous. Before the Rum River before it flows over a dam and into the Mississippi River it flows through downtown Anoka. Urban issues such as landscaping to the edge of streams, chloride from roads, and stormwater runoff can degrade the river. All of the same agricultural influences as the center 1/3 of the watershed also occur here including 3 bacteria impairments. Sand is the predominate substrate in many of the streams which is from a combination of bank erosion and that the soils in this region are very sandy. The anthropogenic effects on the lower third of the watershed are visible. An example of this is stations that were sampled 10 to 15 years ago in less developed areas along Trott Brook had passing biological scores for both fish and macroinvertebrates. Housing developments and urbanization occurred along the stream and now fish and invertebrates are impaired along with dissolved oxygen impairment.

Wetlands are a prominent feature in the Rum River Watershed representing about 23% of the watershed. Pre-European settlement wetlands are largely intact in the Mixed Wood Shield ecoregion portion of the watershed. Three of the four sub-watersheds have < 25% historical wetland loss rates and the Headwaters Rum River loss rate is estimated at 26%. Agricultural development is much more prevalent in the remainder of the watershed that corresponds to the Mixed Wood Plains ecoregion. Wetland drainage is typically associated with agricultural development to improve the productivity of the land. Of the four sub-watersheds occurring in this ecoregion where data are available, two have loss rates 25-50% and two have loss rates 50 – 75%. Sufficient soil data is unavailable for remaining sub-watersheds, but given the setting it is likely that these have historical wetland loss rates > 50%.

Mercury was analyzed in fish tissue samples collected from Rum River and 11 lakes in the watershed. Polychlorinated biphenyls (PCBs) were measured in fish from the river and 7 lakes. Polychlorinated biphenyls (PCBs) and perfluorooctane sulfonate (PFOS) were present in fish tissues but were generally below the reporting limit. Eight of the 11 lakes and the mainstem of the Rum River were found to have levels of mercury that were above the permissible threshold and were listed as impaired.

One of the principle concerns for the Rum River Watershed is groundwater protection, for both quality and quantity. As population and development grows, demands on irrigation and water supply increase. Groundwater withdrawals have increased by 75 percent over the last 20 years, partly due to the rising demand for agriculture, which has statistically increased the demand for irrigation ($p=0.01$). In addition, it is estimated that the development pressure is moderate to considerable in some parts of the watershed where land is converted from farms, timberland and lakeshore into home development (USDA NRCS). This increase in development is also seen with an increase in municipal water supply, which has significantly increased ($p=0.001$) from 1994 to 2013.

Although fluctuations due to seasonal variations have occurred, no long term changes have been observed and there is no statistical evidence of groundwater table drawdown from MNDNR observation wells at this time. This may be due to a higher rate of potential groundwater recharge to surficial materials throughout the watershed. However, if water usage continues to increase at its current rate, the probability of the water table being drawn downwards also increases. It is for this reason that the MNDNR permits and monitors water use and the rising demand suggests that the Department take precautions when granting future high capacity water use (appropriation) permits.

Groundwater quality is based on the sensitivity of the aquifers and the effects of naturally occurring and anthropogenic constituents found in the water. Special consideration should be practiced in areas of high groundwater contamination susceptibility, which is primarily associated with glacial sand and gravel aquifers in the southern portion of the watershed. Overall, the groundwater quality of the watershed appears to be healthy, despite the exceedances of chemicals and contaminants of interest and concern. The primary contaminant of concern was nitrate followed by chloride. Nitrate was detected in 100 percent of MDA's wells, with 44 percent above the drinking water standard. Chloride is a concern, due to highly developed land use within the southern part of the watershed. Chloride and nitrate were detected at a frequency of 93.9 and 95.2% of MPCA ambient wells, respectively. Chloride exceeded the secondary MCL in ten instances and nitrate exceeded the MCL in three instances.

Additional and continued monitoring will increase the understanding of the health of the watershed and its groundwater resources and aid in identifying the extent of the issues present and risk associated. Increased localized monitoring efforts will help accurately define the risks and extent of any issues within the watershed. Adoption of best management practices will benefit both surface and groundwater. These practices, such as planting cover crops, replacing aging septic systems, and controlling feedlot runoff and chemical application, will help prevent and mitigate negative impacts in the future.

Overall the Rum River Watershed biological scores well in comparison to the southern and western watersheds in Minnesota. It however the biology does not score as well as most of the northern and northeastern watersheds. The Rum River spans the agricultural regions of Minnesota to the hardwood and coniferous forests of northern Minnesota. Great care should be taken in the northern third of the watershed to protect the undisturbed areas and reducing human impact on the streams. The widespread agricultural practices in the southern 2/3 of the watershed could be reexamined to reduce surface runoff from cropland and livestock areas. Changes in surface water runoff could result in a decrease in nutrient and bacteria levels. Sustainable urbanization will help with allowing for buffers along streams and green spaces to help lower the amount of impervious surfaces. This watershed is a perfect example of the difference between natural, agricultural, and urban streams. More than half of the streams are supporting (19) than not supporting (21) after the correction for three of the sites that were listed as impaired or insufficient information are delisted or added to supporting due to additional biological sampling. The same is true for bacteria impairments with the twice as many AUIDs are supporting (10) as not supporting (5). Cooperation between landowner and local government is essential for the success in protecting and restoration for this valuable piece of Minnesota.

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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 (NH3) - Ammonia is present in aquatic systems mainly as the dissociated ion NH4+, which is rapidly taken up by phytoplankton and other aquatic plants for growth. Ammonia is an excretory product of aquatic animals. As it comes in contact with water, ammonia dissociates into NH4+ ions and -OH ions (ammonium hydroxide). If pH levels increase, the ammonium hydroxide becomes toxic to both plants and animals.

Appendix 2.1-Intensive watershed monitoring water chemistry stations in the Rum River Watershed

Biological Station ID	STORET/ EQuIS ID	Waterbody Name	Location	12-digit HUC
13UM044	S003-176	Trott Brook	Downstream of Hwy 47, 1.5 mi. NE of Ramsey	0701020707-02
00UM101	S003-203	Cedar Creek	At CSAH 9, 5 mi. NE of Ramsey	0701020706-01
00UM104	S003-204	Seelye Brook	Upstream of Rum River Blvd, 1 mi. S of Saint Francis	0701020707-03
13UM040	S007-555	Rum River	SW side of Bunker L Blvd and Rum R Intersect, 1.5 mi. N of Anoka	0701020707-01
13UM048	S002-953	Rum River, West Branch	At CR 102, 1 mi. W of Princeton	0701020703-01
00UM032	S002-955	Rum River	Upstream of CSAH 16, 7 mi. N of Milaca	0701020702-03
13UM045	S004-409	Rum River	Upstream of CSAH 95, in Princeton	0701020702-01
13UM047	S004-980	Stanchfield Creek	At 357th Ave., 4 mi. NW of Cambridge	0701020704-01
13UM046	S005-326	Rum River	Downstream of Hwy 95, in Cambridge	0701020705-01
13UM042	S006-104	Estes Brook	At Davenport Rd, 4.5 mi. NW of Princeton	0701020703-02
13UM094	S007-551	Rum River	10920 313th Ave, 2.5 mi. SE of Princeton	0701020705-01
13UM093	S007-552	Rum River	West of Oak Cir., 1.5 mi. S of Cambridge	0701020705-01
13UM043	S007-553	Tibbetts Brook	At CSAH 19, 5.5 mi. NW of Milaca	0701020702-02
00UM033	S007-554	Bradbury Brook, North Brook	Upstream of Hwy 169, 5 mi. S of Onamia	0701020702-04

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

AUID	Biological Station ID	Waterbody Name	Biological Station Location	County	Aggregated 12-digit HUC
07010207-537	00UM031	Mike Drew Brook	5 mi. N of Milaca, downstream of culvert on 200th St.	Mille Lacs	0701020702-01
07010207-509	00UM032,	Rum River	8 mi. N of Milaca @ C.R. 16 bridge	Mille Lacs	0701020702-03
07010207-509	13UM054	Rum River	Downstream of CR 103, 3 mil S of Onamia	Mille Lacs	0701020702-03
07010207-540	00UM033	Bradbury Brook	Upstream of Hwy 69, 5 mi. S of Onamia	Mille Lacs	0701020702-04
07010207-504	00UM066	Rum River	Downstream of C.R. 24 in St. Francis	Anoka	0701020705-01
07010207-504	10EM164	Rum River	0.5 mi. W of Rum River Blvd, 1 mi. N of Saint Francis	Anoka	0701020705-01
07010207-504	13UM046	Rum River	Downstream of 2nd Ave, in Cambridge	Anoka	0701020705-01
07010207-504	13UM069	Rum River	Downstream of CSAH 8, 3 mi. SW of Isanti	Anoka	0701020705-01
07010207-504	13UM087	Rum River	Upstream of CR 14, 3 mi. NW of Cambridge	Anoka	0701020705-01
07010207-504	13UM093	Rum River	West of Oak Cir., 1.5 mi. S of Cambridge	Anoka	0701020705-01
07010207-521	00UM101	Cedar Creek	Upstream of Round Lake Blvd (Anoka CR 9) in Oak Grove	Anoka	0701020706-01
07010207-521	13UM064	Cedar Creek	Downstream of CR 86, 1 mi. N of East Bethel	Anoka	0701020706-01
07010207-521	13UM084	Cedar Creek	Downstream of CSAH 9, 3.5 mi. SE of Isanti	Anoka	0701020706-01
07010207-682	00UM102	Mahoney Brook	Anoka CR 58 in Oak Grove	Anoka	0701020706-01
07010207-527	07UM080	Rum River, West Branch	Downstream of CR 34, 6 mi. N of Rum River	Benton	0701020703-01
07010207-527	13UM055	Rum River, West Branch	Upstream of 48th St, 5 mi. E of Ramey	Benton	0701020703-01
07010207-527	13UM056	Rum River, West Branch	Upstream of CSAH 9, 5 mi. W of Milaca	Benton	0701020703-01
07010207-527	13UM065	Rum River, West Branch	Upstream of CSAH 12, 4.5 mi. S of Milaca	Benton	0701020703-01
07010207-677	07UM081	Tibbetts Brook	Upstream of 160th St, 8.5 mi. NW of Millaca	Mille Lacs	0701020702-02
07010207-677	13UM043	Tibbetts Brook	Downstream of CSAH 19, 5.5 mi. NW of Milaca	Mille Lacs	0701020702-02
07010207-687	07UM094	Vondell Brook	Upstream of CR 144, 2 mi. E of Milaca	Mille Lacs	0701020702-01
07010207-512	10EM036	Rum River	0.75 mi. downstream of Hwy 47, 7 mi. W of Cambridge	Isanti	0701020705-01

07010207-512	13UM094	Rum River	North of 313th Ave., 2.5 mi. SE of Princeton	Isanti	0701020705-01
07010207-503	10EM100	Rum River	Adjacent to Vintage Dr, 5 mi. W of East Bethel	Anoka	0701020707-01
07010207-625	10EM116	Unnamed ditch	Upstream of CR 149, 4 mi. NW of Princeton	Mille Lacs	0701020703-01
07010207-666	13UM040	Rum River	Upstream of Bunker Lake Blvd NW, 1.5 mi. N of Anoka	Anoka	0701020707-01
07010207-679	13UM042	Estes Brook	Upstream of Davenport Rd, 4.5 mi. NW of Princeton	Mille Lacs	0701020703-02
07010207-679	13UM060	Estes Brook	Upstream of CSAH 12, 4.5 mi. S of Foreston	Mille Lacs	0701020703-02
07010207-680	13UM044	Trott Brook	Downstream of Nowthan Blvd., 1.5 mi. N of Ramsey	Anoka	0701020707-02
07010207-528	13UM044	Trott Brook	upstream of Anoka CR7 | Adjacent to field road in St. Francis	Anoka	0701020707-03
07010207-511	13UM045	Rum River	Upstream of Hwy 95, in Princeton	Mille Lacs	0701020702-01
07010207-518	13UM047	Stanchfield Creek	Upstream of 357th Ave., 4 mi. NW of Cambridge	Isanti	0701020704-01
07010207-525	13UM048	Rum River, West Branch	Downstream of CR 102, 1 mi. W of Princeton	Mille Lacs	0701020703-01
07010207-567	13UM049	Vondell Brook	Upstream of 120th St, 3.5 mi. SE of Milaca	Mille Lacs	0701020702-01
07010207-611	13UM051	Spencer Brook	Upstream of CSAH 5, 6 mi. SE of Princeton	Isanti	0701020705-01
07010207-592	13UM052	Isanti Brook	Upstream of Jackson St NE, 1 mi. N of Isanti	Isanti	0701020707-01
07010207-691	13UM053	Bradbury Brook, North Fork	Downstream of 130th Ave, 2.5 mi. S of Onamie	Mille Lacs	0701020702-04
07010207-510	13UM058	Rum River	Upstream of CSAH 9, 1 mi. N of Milaca	Mille Lacs	0701020702-01
07010207-689	13UM059	Chase Brook	Upstream of CR 112, 1.5 mi. NW of Milaca	Mille Lacs	0701020702-01
07010207-520	13UM061	Stanchfield Creek	Upstream of CSAH 3, 7 mi. NW of Cambridge	Isanti	0701020704-01
07010207-502	13UM062	Rum River	Upstream of Roanoke St, 2.5 mi. NE of Ramsey	Anoka	0701020707-01
07010207-515	13UM063	Lower Stanchfield Branch	Downstream of Hwy 65, 4.5 mi. N of Cambridge	Isanti	0701020705-02
07010207-587	13UM066	Unnamed ditch	Upstream of CSAH 5, 5 mi. NE of Elk River	Anoka	0701020707-02
07010207-575	13UM067	Crooked Brook	Downstream of Viking Blvd NW, .5 mi. S of East Bethel	Anoka	0701020706-01
07010207-550	13UM068	Lower Stanchfield Branch	Upstream of CR 46, 2 mi. SW of Braham	Isanti	0701020705-02
07010207-902	13UM070	Unnamed ditch (Branch 3 Lateral 2)	Adjacent to W side of Hwy 65, 1.5 mi. S of East Bethel	Anoka	0701020706-01
07010207-574	13UM071	county Ditch 28	Adjacent to E side of Hwy 65, 1.5 mi. S of East Bethel	Anoka	0701020706-01
07010207-577	13UM072	Unnamed ditch	Downstream of CR 245, 11.5 mi. N of Milaca	Benton	0701020703-01
07010207-522	13UM074	Bogus Brook	Downstream of Hwy 23, .5 mi. E of Bock	Mille Lacs	0701020702-01

07010207-667	13UM075	Unnamed creek	Downstream of 380th Ave, 13 mi. NW of Milaca	Morrison	0701020703-01
07010207-533	13UM076	Unnamed creek	Upstream of Cedar Rd, 7.5 mi. NW of Princeton	Mille Lacs	0701020703-02
07010207-684	13UM077	Prairie Brook	Downstream of 40th St, 4 mi. NW of Princeton	Mille Lacs	0701020703-01
07010207-535	13UM078	county Ditch 4	Downstream of CSAH 12, 6 mi. SE of Milaca	Mille Lacs	0701020702-01
07010207-622	13UM080	Stony Brook	Upstream of CR 54, 4 mi. SE of Rum River	Benton	0701020703-01
07010207-674	13UM081	Ties Creek (Stanchfield Brook)	Downstream of 397th Ave, 6 mi. W of Stanchfield Center	Isanti	0701020704-01
07010207-693	13UM082	Unnamed creek	Downstream of CSAH 4, 6.5 mi. W of Braham	Isanti	0701020704-01
07010207-676	13UM088	Tibbetts Brook	Upstream of 103rd St, 8 mi. N of Rum River	Morrison	0701020702-02
07010207-641	13UM089	Washburn Brook	Upstream of 90th St., 2 mi. E of Woidward Brook	Mille Lacs	0701020702-01
07010207-668	13UM091	Unnamed creek	Downstream of 325th Ave., 4.5 mi. W of Cambridge	Isanti	0701020705-01

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

AUID DESCRIPTIONS		USES						Aquatic Life Indicators:									
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water	303d listed impairments 2014	Fish	Macroinvertebrates	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	AmmoniaNH3	Phosphorous	Chlorophyl A
Aggregated HUC 12: 0701020701-01 (Mille Lacs Lake)																	
07010207-544, Reddy Creek (Marmon Creek), Unnamed cr to Lk Mille Lacs	0.04	W Wg	IF	IF						EX	IF	IF	MTS	MTS		IF	
07010207-546, Cedar Creek (Little River), Cedar Lk to Lk Mille Lacs	4.55	W Wg	NS	NA						EX	IF	MTS	MTS	MTS		EX	IF
07010207-547, Malone Creek (Thains Creek), Anderson Lk to Lk Mille Lacs	0.98	W Wg	NS	FS						EX	MTS	MTS	MTS	MTS		IF	
07010207-549, Unnamed creek, Headwaters to Lk Mille Lacs	2.25	W Wg	IF	NA						IF	EX	EX	MTS	MTS		IF	
07010207-553, Seventeen Creek, Headwaters to Lk Mille Lacs	5.06	W Wg	IF	NA						IF	IF	EX	MTS	MTS		IF	
07010207-554, Borden Creek, Deer Lk to Lk Mille Lacs	1.27	W Wg	NS	NA						EX	MTS	MTS	MTS	MTS	IF	EX	IF
07010207-558, Unnamed creek (Seastade Creek), Unnamed cr to Lk Mille Lacs	0.35	W Wg	IF	NA						EX	MTS	EX	MTS	MTS		IF	
07010207-559, Peterson Creek, Unnamed cr to Lk Mille Lacs	2.37	W Wg	IF	NA						IF	MTS	MTS	MTS	MTS		IF	
07010207-607, Unnamed creek, Smith Lk to Unnamed cr	0.45	W Wg	IF	NA						EX	MTS	Incomplete		MTS		MTS	
Aggregated HUC 12: 0701020702-02 (Tibbetts Brook)																	
07010207-510, Rum River, Tibbetts Bk to Bogus Bk	22.90	W Wg	FS	FS				MTS	MTS	MTS	MTS	MTS	MTS	IF	MTS	MTS	MTS
07010207-511, Rum River, Bogus Bk to W Br Rum R	14.87	W Wg	FS	FS				MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS	EX	MTS
07010207-522, Bogus Brook, T38 R26W S14, north line to T38 R26W S14, south line	1.86	7	NA	NA						IF				IF	IF		
07010207-523, Bogus Brook, T38 R26W S23, north line to Rum R	12.64	W Wg	IF	NS			Escherichia coli			EX	MTS	MTS	MTS	MTS	MTS	EX	MTS

07010207-534, county Ditch 4, Unnamed cr to Unnamed ditch	1.72	WWm	Incomplete	NA														
07010207-535, county Ditch 4, Unnamed ditch to Unnamed cr	0.93	WWm	FS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
07010207-537, Mike Drew Brook, Unnamed cr to Unnamed cr	2.20	WWg	FS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
07010207-567, Vondell Brook, Unnamed cr to Rum R	1.47	WWg	NS	NA			Fishes bioassessments		EXP	MTS	IF	IF	IF		IF	IF	IF	
07010207-595, Washburn Brook, Unnamed cr to Rum R	0.85	WWg	Incomplete	NA														
07010207-641, Washburn Brook, Unnamed ditch to Unnamed cr	0.69	WWm	NS	NA			Fishes bioassessments		EXS		IF	IF	IF		IF	IF	IF	
07010207-687, Vondell Brook, T38 R26W S32, north line to Unnamed cr	3.56	WWg	NS	NA			Fishes bioassessments		EXP		IF	IF	IF		IF	IF	IF	
07010207-689, Chase Brook, T38 R27W S15, north line to Rum R	4.31	WWg	FS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
Aggregated HUC 12: 0701020702-03 (Headwaters Rum River)																		
07010207-506, Rum River, Headwaters (Lk Mille Lacs 48-0002-00) to Ogechie Lk	0.48	WWg	Incomplete	Incomplete							IF	MTS	NA	MTS	MTS		IF	
07010207-509, Rum River, Lk Onamia to Tibbetts Bk	21.08	WWg	IF	FS					MTS	EXP	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS
07010207-564, Black Brook, Headwaters to Rum R	2.74	WWg	FS	NA						MTS								
07010207-583, Rum River, Ogechie Lk to Shakopee Lk	3.06	WWg	IF	NA									MTS					
Aggregated HUC 12: 0701020702-04 (Bradbury Brook)																		
07010207-540, Bradbury Brook, N Fk Bradbury Bk to Rum R	0.93	WWg	FS	IF					MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS
07010207-691, Bradbury Brook, North Fork, T41 R27W S13, west line to Bradbury Bk	5	WWg	IF	NA						EXS	IF		IF		IF			

Aggregated HUC 12: 0701020703-01 (West Branch Rum)

07010207-525, Rum River, West Branch, Estes Bk to Rum R	15.75	WWg	NS	NS			Aquatic macroinvertebrate bioassessments, Escherichia coli		MTS	EXP	MTS	MTS	MTS	MTS	MTS	MTS	MTS	
07010207-527, Rum River, West Branch, Headwaters (Unnamed lk 49-0172-00) to Estes Bk	40.68	WWg	FS	NA					MTS	MTS	IF	IF	MTS		IF	MTS	IF	IF
07010207-577, Unnamed ditch, Unnamed ditch to W Br Rum R	4.90	7	NA	NA							IF				IF	IF		
07010207-622, Stony Brook, Unnamed cr to West Br Rum R	0.67	WWg	IF	NA							IF		IF		IF			
07010207-625, Unnamed ditch, Headwaters to W Br Rum R	2.23	WWg	Incomplete	NA							NA	NA	NA		NA	NA	NA	
07010207-667, Unnamed creek, Headwaters to W Br Rum R	6.55	WWg	NS	NA			Aquatic macroinvertebrate bioassessments		MTS	EXP	IF	IF	IF		IF	IF	IF	
07010207-684, Prairie Brook, Headwaters to -93.6682, 45.6013	4.85	WWm	FS	NA					MTS		IF	IF	IF		IF	IF	IF	

Aggregated HUC 12: 0701020703-02 (Estes Brook)

07010207-531, Unnamed creek, Unnamed cr to Unnamed cr	3.59	WWg	Incomplete	NA														
07010207-533, Unnamed creek, Unnamed cr to Estes Bk	1.62	WWg	FS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
07010207-679, Estes Brook, -93.7502, 45.7028 to W Br Rum R	13.62	WWg	NS	NS			Aquatic macroinvertebrate bioassessments, Escher		MTS	EXP	IF	IF	IF		MTS	MTS	IF	

							ichia coli											
Aggregated HUC 12: 0701020704-01 (Stanchfield Creek)																		
07010207-518, Stanchfield Creek, Ties Cr (Stanchfield Bk) to Rum R	14.63	WWg	FS	FS					MTS	EXP	IF	MTS	MTS	MTS	MTS	MTS	EX	MTS
07010207-520, Stanchfield Creek, Headwaters (North Stanchfield Lk 30-0143-00) to Stanchfield Bk	14.86	WWg	NS	NA			Fishes bioassessments		EXP		IF	IF	IF		IF	IF	IF	
07010207-674, Ties Creek (Stanchfield Brook), Unnamed cr to Stanchfield Cr	4.50	WWg	Incomplete	NA					EXP		NA	NA	NA		NA	NA	NA	
07010207-693, Unnamed creek, T37 R24W S10, north line to Ties Cr	0.68	WWg	IF	NA					NA		IF	IF	IF		IF	IF	IF	
Aggregated HUC 12: 0701020705-01 (Middle Rum River)																		
07010207-504, Rum River, Stanchfield Cr to Seelye Bk	34.41	WWg	FS	FS					MTS	MTS	MTS	MTS	MTS	MTS	MTS	MTS	EX	MTS
07010207-512, Rum River, W Br Rum R to Stanchfield Cr	37.56	WWg	FS	FS					MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	MTS	MTS
07010207-611, Spencer Brook, Tennyson Lk to Rum R	3.14	WWg	IF	NA							IF	IF	IF		IF	IF	IF	
07010207-668, Unnamed creek, Unnamed creek to Rum R	1.79	WWm	Incomplete	NA					NA	NA	IF	IF	IF		IF	IF	IF	
Aggregated HUC 12: 0701020705-02 (Lower Stanchfield)																		
07010207-515, Lower Stanchfield Branch, T37 R23W S27, north line to Little Stanchfield Lk	5.42	WWg	FS	NA					NA	MTS	IF	IF	IF		IF	IF	IF	
07010207-550, Lower Stanchfield Branch, Unnamed ditch to T37 R23W S22, south line	3.42	7	NA	NA							IF				IF	IF		
Aggregated HUC 12: 0701020706-01 (Cedar Creek)																		
07010207-521, Cedar Creek, Headwaters to Rum R	28.55	WWg	FS	NS			Escherichia coli		MTS	MTS	IF	MTS	MTS	MTS	MTS	MTS	MTS	MTS
07010207-574, county Ditch 28, Headwaters to Crooked Bk	2.88	7	NA	NA							MTS				MTS	MTS		
07010207-575, Crooked Brook, CD 28 to Cedar Cr	2.32	WWg	NS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
07010207-624, Unnamed creek, Headwaters to Cedar Cr	1.48	WWg	Incom	NA									NA					

			plete															
07010207-682, Mahoney Brook, T33 R24W S34, south line to Cedar Cr	1.24	WWg	NS	NA			Fishes bioassessments		EXS	MTS	IF	IF	IF		IF	IF	IF	
07010207-902, Unnamed ditch (Branch 3 Lateral 2), Headwaters to Crooked Bk	1.33	7	NA	NA							IF				IF	IF		
Aggregated HUC 12: 0701020707-01 (Lower Rum)																		
07010207-502, Rum River, Cedar Cr to Trott Bk	3.52	WWg	FS	NA					MTS	MTS	IF	MTS	MTS	MTS	MTS	NA	IF	
07010207-503, Rum River, Seelye Bk to Cedar Cr	6.79	WWg	FS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
07010207-561, county Ditch 15, Headwaters to Rum R	4.37	WWg	IF	NA									MTS					
07010207-579, Unnamed creek, Headwaters to Rum R	2.83	WWg	Incomplete	NA														
07010207-592, Isanti Brook, Florence Lk outlet to Rum R	4.93	WWg	NS	NA			Aquatic macroinvertebrate bioassessments, Fishes bioassessments		EXP	EXP	IF	IF	IF		IF	IF	IF	
07010207-665, Rum River, Anoka Dam to Madison/Rice St in Anoka	0.32	WWg	IF	FS							IF	MTS	IF	MTS	MTS	MTS	EX	MTS
07010207-666, Rum River, Trott Bk to Anoka Dam	8.85	WWg	FS	FS					MTS	NA	IF	MTS	MTS	MTS	MTS	MTS	EX	MTS
Aggregated HUC 12: 0701020707-02 (Trott Brook)																		
07010207-587, Unnamed ditch, Unnamed ditch to Goose Lk	1.09	WWm	FS	NA					MTS	MTS	IF	IF	IF		IF	IF	IF	
07010207-672, Ford Brook, Cleary Rd NW to Trott Bk	7.36	WWg	IF	NA							IF	IF	IF	MTS	MTS		IF	
07010207-680, Trott Brook, CD 51 to Rum R	4.43	WWg	NS	IF			Aquatic macroinvertebrate bioass		EXP	EXP	EX	MTS	MTS	MTS	MTS	MTS	EX	IF

							essments, Dissolved oxygen, Fishes bioassessments											
Aggregated HUC 12: 0701020707-03 (Seelye Brook)																		
07010207-680, Trott Brook, CD 51 to Rum R	4.43	WWg	NS	IF			Escherichia coli		EXP	EXP	EX	MTS	MTS	MTS	MTS	MTS	EX	

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets standards or ecoregion expectations (MT/MTS), Potential Exceedence (EXP), Exceeds standards or ecoregion expectations (EX/EXS).

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

Appendix 3.2 - Assessment results for lakes in the Rum River Watershed

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (ha)	Max Depth (m)	Watershed Area (ha)	% Littoral	Mean depth (m)	Support Status AQR	Support Status AQL
01-0065-00	Cedar	Aitkin	0701020701-01	NLF	102	5	470	92.7	2	FS	
01-0085-00	Twenty	Aitkin	0701020701-01	NLF	52	1		100		IF	
01-0086-00	Deer	Aitkin	0701020701-01	NLF	18	2				IF	
01-0157-00	Big Pine	Aitkin	0701020701-01	NLF	250	24	948	42.2	6	FS	FS
01-0158-00	Gregg	Aitkin	0701020701-01	NLF	13						
01-0204-00	Round	Aitkin	0701020701-01	NLF	291	38	1671	42	13	FS	FS
01-0228-00	Unnamed	Aitkin	0701020701-01	NLF	8						
02-0057-00	Neds	Anoka	0701020706-01	NCHF	72						
02-0059-00	Deer	Anoka	0701020706-01	NCHF	68						
02-0060-00	Mud	Anoka	0701020706-01	NCHF	15						
02-0061-00	Unnamed	Anoka	0701020706-01	NCHF	4						
02-0065-00	Fish	Anoka	0701020706-01	NCHF	135						
02-0067-00	Minard	Anoka	0701020706-01	NCHF	51	2				FS	
02-0069-00	Unnamed	Anoka	0701020706-01	NCHF	6						
02-0070-00	Coopers	Anoka	0701020706-01	NCHF	17						
02-0085-00	Ward	Anoka	0701020706-01	NCHF	15						
02-0088-00	Leman	Anoka	0701020706-01	NCHF	5						
02-0089-00	Round	Anoka	0701020707-01	NCHF	106	5				FS	
02-0091-00	George	Anoka	0701020707-01	NCHF	194	10	748	79	2	FS	IF

02-0092-00	Grass	Anoka	0701020707-01	NCHF							
02-0096-00	Hickey	Anoka	0701020707-01	NCHF							
02-0097-00	Mud	Anoka	0701020707-01	NCHF							
02-0098-00	Swan	Anoka	0701020706-01	NCHF	16						
02-0101-00	Unnamed	Anoka	0701020707-01	NCHF							
02-0102-00	Sand Shore	Anoka	0701020707-01	NCHF	15					IF	
02-0104-00	Rogers	Anoka	0701020707-02	NCHF	17					NS	
02-0105-00	Mud	Anoka	0701020707-02	NCHF	32						
02-0106-00	Norris	Anoka	0701020707-02	NCHF	22						
02-0113-00	Grass	Anoka	0701020707-01	NCHF	14					FS	IF
02-0114-01	Unnamed	Anoka	0701020707-01	NCHF							
02-0114-02	Unnamed (south portion)	Anoka	0701020707-01	NCHF							
02-0120-00	Unnamed	Anoka	0701020707-03	NCHF	6						
02-0122-00	Burns	Anoka	0701020707-02	NCHF	37						
02-0124-00	Unnamed	Anoka	0701020707-02	NCHF	6						
02-0127-00	Goose	Anoka	0701020707-02	NCHF	26						
02-0128-00	Pinnaker	Anoka	0701020707-02	NCHF	15						
02-0130-00	Pickerel	Anoka	0701020707-02	NCHF	97	2				FS	IF
02-0131-00	Bear	Anoka	0701020707-02	NCHF	9						
02-0133-00	East Twin	Anoka	0701020707-02	NCHF	31	20	168		4	FS	IF
02-0135-00	Bass	Anoka	0701020707-02	NCHF	33						

02-0136-00	Benjamin	Anoka	0701020707-02	NCHF	16						
02-0138-00	McCann	Anoka	0701020707-02	NCHF	35						
02-0143-00	Unnamed	Anoka	0701020707-02	NCHF	9						
02-0154-00	Unnamed	Anoka	0701020706-01	NCHF	4						
02-0161-00	Unnamed	Anoka	0701020706-01	NCHF	9						
02-0170-00	Unnamed	Anoka	0701020706-01	NCHF	6						
02-0234-00	Unnamed	Anoka	0701020707-03	NCHF	34						
02-0236-00	Unnamed	Anoka	0701020707-03	NCHF	5						
02-0298-00	Unnamed	Anoka	0701020707-02	NCHF	7						
02-0610-00	Unnamed (Dehns Pond)	Anoka	0701020707-01	NCHF							
02-0738-00	Unnamed (Smith)	Anoka	0701020707-01	NCHF							
02-0772-00	Bethel Pond	Anoka	0701020706-01	NCHF	5						
13-0076-00	Jonason	Chisago	0701020707-01	NCHF							
13-0077-00	Unnamed	Chisago	0701020707-01	NCHF							
18-0001-00	Whitefish	Crow Wing	0701020701-01	NLF	287	19		61.5		FS	
18-0003-00	Unnamed (Conrad)	Crow Wing	0701020701-01	NLF	14						
18-0004-00	Jennison	Crow Wing	0701020701-01	NLF	10						
18-0005-00	Bullhead	Crow Wing	0701020701-01	NLF	5						
18-0006-00	Crooked	Crow Wing	0701020701-01	NLF	12						
18-0007-00	Kutil	Crow Wing	0701020701-01	NLF	8						
18-0012-00	Unnamed	Crow Wing	0701020701-01	NLF	11						

18-0013-00	Unnamed	Crow Wing	0701020701-01	NLF	11						
18-0015-00	Dewing	Crow Wing	0701020701-01	NLF	7						
18-0018-00	Camp	Crow Wing	0701020701-01	NLF	208	13		43.7		FS	FS
18-0019-00	Kenney	Crow Wing	0701020701-01	NLF	42	17		33.3		FS	
18-0020-00	Borden	Crow Wing	0701020701-01	NLF	401	26	6819	32	7	FS	FS
18-0021-00	Miller	Crow Wing	0701020701-01	NLF	50	15		34.8		FS	
18-0022-00	Maple	Crow Wing	0701020701-01	NLF	8						
18-0024-00	Williams	Crow Wing	0701020701-01	NLF	18						
18-0025-00	Chandler	Crow Wing	0701020701-01	NLF	9						
18-0026-00	Bassett	Crow Wing	0701020701-01	NLF	14						
18-0027-00	Sunfish	Crow Wing	0701020701-01	NLF	6						
18-0028-00	Smith	Crow Wing	0701020701-01	NLF	184	16		47.2		FS	FS
18-0029-00	Holt	Crow Wing	0701020701-01	NLF	68	9		58.9		FS	
18-0030-00	Barbour	Crow Wing	0701020701-01	NLF	25	16		26.2		IF	
18-0031-00	Long	Crow Wing	0701020701-01	NLF	30						
18-0032-00	Round	Crow Wing	0701020701-01	NLF	26						
18-0033-00	Scott	Crow Wing	0701020701-01	NLF	66	14		79.2		FS	
18-0047-00	Turtle	Crow Wing	0701020701-01	NLF	42	10		82.1		IF	
18-0048-00	Partridge	Crow Wing	0701020701-01	NLF	74	13		62.5		IF	
18-0054-00	Mud	Crow Wing	0701020701-01	NLF	10						
18-0055-00	Unnamed	Crow Wing	0701020701-01	NLF	24						
18-0095-00	Chrysler	Crow Wing	0701020701-01	NLF	42						

18-0423-00	Unnamed	Crow Wing	0701020701-01	NLF	5						
18-0424-00	Unnamed	Crow Wing	0701020701-01	NLF	5						
18-0480-00	Unnamed	Crow Wing	0701020701-01	NLF	8						
18-0664-00	Unnamed	Crow Wing	0701020701-01	NLF	9						
18-0696-00	Mud	Crow Wing	0701020701-01	NLF	4						
30-0020-00	Krans	Isanti	0701020705-02	NCHF	14						
30-0021-00	Classon	Isanti	0701020705-02	NCHF	9						
30-0022-00	Skogman	Isanti	0701020707-01	NCHF	90	11	1394	59.6	4	NS	FS
30-0023-00	Linderman	Isanti	0701020705-02	NCHF	25						
30-0027-00	Stratton	Isanti	0701020706-01	NCHF	65						
30-0031-00	Unnamed	Isanti	0701020707-01	NCHF							
30-0033-00	Mud	Isanti	0701020707-01	NCHF							
30-0034-00	Unnamed	Isanti	0701020707-01	NCHF							
30-0035-00	Florence	Isanti	0701020707-01	NCHF	53	8	3462		2	FS	FS
30-0036-00	Elms	Isanti	0701020707-01	NCHF	21	8		81.1		IF	
30-0037-00	Unnamed	Isanti	0701020705-01	NCHF	35						
30-0039-00	Unnamed	Isanti	0701020707-01	NCHF							
30-0043-00	Fannie	Isanti	0701020707-01	NCHF	144	10	2457	84.1	2	NS	FS
30-0044-00	Little Stanchfield	Isanti	0701020705-02	NCHF	66	4	11156		2	NS	FS
30-0045-00	Erickson	Isanti	0701020705-02	NCHF	6						
30-0046-00	Twin	Isanti	0701020705-02	NCHF	4						

30-0047-00	Long	Isanti	0701020705-02	NCHF	42						
30-0048-00	Rum	Isanti	0701020705-01	NCHF	10						
30-0050-00	Dollar	Isanti	0701020705-02	NCHF	12						
30-0052-00	Bloomgren	Isanti	0701020705-02	NCHF	7						
30-0054-00	Brobergs	Isanti	0701020705-01	NCHF	8						
30-0055-01	Unnamed (NE Portion)	Isanti	0701020705-01	NCHF	12						
30-0055-02	Unnamed (Cambridge West)	Isanti	0701020705-01	NCHF	10						
30-0056-00	Long	Isanti	0701020705-02	NCHF	51	3		100		FS	
30-0060-00	Section	Isanti	0701020705-02	NCHF	51					IF	IF
30-0061-00	Trollin	Isanti	0701020705-02	NCHF	29						
30-0062-00	Adams	Isanti	0701020705-02	NCHF	4						
30-0065-00	Mud	Isanti	0701020705-02	NCHF	33						
30-0070-00	Marget	Isanti	0701020707-01	NCHF	20						
30-0072-00	Long	Isanti	0701020707-01	NCHF	147	3	3003	100	2	NS	FS
30-0073-00	Unnamed	Isanti	0701020705-01	NCHF	10						
30-0080-00	Francis	Isanti	0701020707-01	NCHF	104	3		100		NS	NS
30-0083-00	Elizabeth	Isanti	0701020705-01	NCHF	108	2				FS	
30-0084-00	Line	Isanti	0701020705-01	NCHF	8						
30-0088-00	Williams	Isanti	0701020705-01	NCHF	11						
30-0091-00	Walbo	Isanti	0701020705-01	NCHF	21						

30-0094-00	Olson Impoundment	Isanti	0701020705-01	NCHF	7						
30-0096-00	Lory	Isanti	0701020704-01	NCHF	97	5	1674		2	IF	FS
30-0100-00	German	Isanti	0701020707-01	NCHF	140					FS	
30-0101-00	Unnamed	Isanti	0701020705-01	NCHF	25						
30-0104-00	Stony	Isanti	0701020705-01	NCHF	13						
30-0106-00	Mud	Isanti	0701020707-03	NCHF	38						
30-0107-00	Blue	Isanti	0701020705-01	NCHF	106						
30-0107-01	Blue (North Bay)	Isanti	0701020705-01	NCHF	19	3	2915		2	IF	IF
30-0107-02	Blue (South Bay)	Isanti	0701020705-01	NCHF	100	3	2777		5	IF	IF
30-0111-00	Boomer	Isanti	0701020705-01	NCHF	12						
30-0112-00	Unnamed	Isanti	0701020705-01	NCHF	4						
30-0113-00	Tennyson	Isanti	0701020705-01	NCHF	45					NS	
30-0114-00	Baxter	Isanti	0701020705-01	NCHF	31	3		100		NS	
30-0116-00	Unnamed	Isanti	0701020707-03	NCHF	8						
30-0117-00	Mud	Isanti	0701020707-03	NCHF	34	1					
30-0123-00	Unnamed	Isanti	0701020704-01	NCHF	65						
30-0124-00	Gunnik	Isanti	0701020704-01	NCHF	21						
30-0125-00	Leasure Heath	Isanti	0701020704-01	NCHF	13						
30-0128-00	Snyder	Isanti	0701020705-01	NCHF	5						
30-0129-00	Radke	Isanti	0701020704-01	NCHF	5						
30-0130-00	Sandy	Isanti	0701020704-01	NCHF	8						

30-0131-00	Bear	Isanti	0701020705-01	NCHF	6						
30-0135-00	Spectacle	Isanti	0701020705-01	NCHF	101	16	343	65.6	4	FS	FS
30-0136-00	Green	Isanti	0701020705-01	NCHF	333	9		45		NS	NS
30-0137-00	Rasmussen	Isanti	0701020705-01	NCHF	5						
30-0138-00	South Stanchfield	Isanti	0701020704-01	NCHF	166	5	2702	92	2	NS	IF
30-0139-00	West	Isanti	0701020704-01	NCHF	58						
30-0140-00	Krone	Isanti	0701020704-01	NCHF	24						
30-0141-00	Matson	Isanti	0701020704-01	NCHF	6						
30-0142-00	Grass	Isanti	0701020704-01	NCHF	10						
30-0143-00	North Stanchfield	Isanti	0701020704-01	NCHF	59	3	6580	100	1	NS	
30-0144-00	Lindgren	Isanti	0701020704-01	NCHF	21						
30-0155-00	Unnamed	Isanti	0701020707-01	NCHF							
30-0160-00	Unnamed	Isanti	0701020705-01	NCHF	5						
30-0162-00	Unnamed	Isanti	0701020704-01	NCHF	15						
30-0192-00	Unnamed	Isanti	0701020705-01	NCHF	4						
30-0223-00	Boetcher	Isanti	0701020707-01	NCHF							
30-0243-00	Unnamed (Krone Bog)	Isanti	0701020704-01	NCHF	35						
33-0032-00	Lewis	Kanabec	0701020704-01	NCHF	71	14	647	45.2	5	FS	IF
33-0041-00	Ogilvie	Kanabec	0701020704-01	NCHF	23						
48-0001-00	Anderson	Mille Lacs	0701020701-01	NLF	13						
48-0002-00	Mille Lacs	Mille Lacs	0701020701-01	NLF	51867	11	109345		9	FS	

48-0003-00	Fog	Mille Lacs	0701020703-01	NCHF	15							
48-0004-00	Silver	Mille Lacs	0701020705-01	NCHF	58	1						
48-0006-00	Mud	Mille Lacs	0701020704-01	NCHF	7							
48-0008-00	Unnamed	Mille Lacs	0701020702-03	NLF	2							
48-0009-00	Onamia	Mille Lacs	0701020702-03	NLF	436	4					FS	IF
48-0011-00	Black Bass	Mille Lacs	0701020702-03	NLF	5							
48-0012-00	Shakopee	Mille Lacs	0701020702-03	NLF	257			100			IF	IF
48-0013-00	Warren	Mille Lacs	0701020702-03	NLF	10							
48-0014-00	Ogechie	Mille Lacs	0701020702-03	NLF	159	2					IF	
48-0015-00	Brown	Mille Lacs	0701020701-01	NLF	12							
48-0016-00	Bass	Mille Lacs	0701020701-01	NLF	5							
48-0017-00	Bass	Mille Lacs	0701020701-01	NLF	4							
48-0018-00	Bass	Mille Lacs	0701020701-01	NLF	11							
48-0019-00	Unnamed	Mille Lacs	0701020702-03	NLF	7						IF	IF
48-0022-00	Unnamed	Mille Lacs	0701020702-03	NLF	2							
48-0025-00	Wright	Mille Lacs	0701020702-03	NLF	2							
48-0026-00	Unnamed	Mille Lacs	0701020702-03	NLF	3							
48-0027-00	Unnamed	Mille Lacs	0701020702-04	NLF	5							
48-0028-00	Unnamed	Mille Lacs	0701020701-01	NLF	9							
48-0064-00	Girth	Mille Lacs	0701020705-01	NCHF	4							
49-0002-00	Unnamed	Morrison	0701020702-04	NLF	30							
49-0006-00	Twelve	Morrison	0701020702-03	NLF	47	3					NS	

71-0001-00	Twin	Sherburne	0701020707-02	NCHF	16						
71-0022-00	West Hunter	Sherburne	0701020707-02	NCHF	45	2		100		NS	
71-0023-00	East Hunter	Sherburne	0701020707-02	NCHF	45	2		100		NS	
71-0027-00	Unnamed	Sherburne	0701020707-02	NCHF	11						
71-0029-00	Stone	Sherburne	0701020707-02	NCHF	14						
71-0036-00	Long Pond	Sherburne	0701020705-01	NCHF	16						
71-0038-00	Unnamed	Sherburne	0701020705-01	NCHF	4						
71-0040-00	Sandy	Sherburne	0701020705-01	NCHF	24	12	89	67	4	FS	
71-0238-00	Unnamed	Sherburne	0701020707-02	NCHF	7						

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

Key for Cell Shading: = existing impairment, listed prior to 2016 reporting cycle; = new impairment; = full support of designated use.

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

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
Aggregated HUC 12: 0701020702-01 (Upper Rum River)							
07010207-687	07UM094	Vondell Brook	8.68	6	42	35.81	6/26/07
07010207-537	00UM031	Mike Drew Brook	10.70	7	42	72.25	6/17/13
07010207-567	13UM049	Vondell Brook	21.50	6	42	36.09	6/17/13
07010207-689	13UM059	Chase Brook	8.76	7	42	50.34	6/18/13
07010207-535	13UM078	county Ditch 4	21.25	7	15	36.13	6/18/13
07010207-641	13UM089	Washburn Brook	7.69	7	15	13.14	6/18/13
07010207-522	13UM074	Bogus Brook	7.40	6	42	51.89	6/19/13
07010207-537	00UM031	Mike Drew Brook	10.70	7	42	17.82	8/13/13

07010207-567	13UM049	Vondell Brook	21.50	6	42	39.84	8/13/13
07010207-510	13UM058	Rum River	660.38	4	38	54.68	8/14/13
07010207-511	13UM045	Rum River	772.70	4	38	56.09	8/26/13
07010207-537	00UM031	Mike Drew Brook	10.70	7	42	49.75	6/24/15
Aggregated HUC 12: 0701020702-02 (Tibbetts Brook)							
07010207-677	07UM081	Tibbetts Brook	30.30	6	42	23.40	6/27/07
07010207-677	13UM043	Tibbetts Brook	42.66	6	42	59.75	6/18/13
07010207-676	13UM088	Tibbetts Brook	16.06	7	15	9.21	8/14/13
Aggregated HUC 12: 0701020702-03 (Headwaters Rum River)							
07010207-509	13UM054	Rum River	475.51	5	47	56.21	7/24/13
07010207-509	00UM032	Rum River	570.00	4	38	38.24	7/25/13
07010207-509	13UM054	Rum River	475.51	5	47	54.10	8/14/13
Aggregated HUC 12: 0701020702-04 (Bradbury Brook)							
07010207-540	00UM033	Bradbury Brook	50.47	5	47	55.83	07010207-540
07010207-691	13UM053	Bradbury Brook, North Fork	30.76	6	42	21.25	07010207-691
Aggregated HUC 12: 0701020703-01 (West Branch Rum)							
07010207-527	07UM080	Rum River, West Branch	18.20	6	42	51.89	6/27/07
07010207-625	10EM116	Unnamed ditch	1.85	7	42	1.67	9/13/10
07010207-667	13UM075	Unnamed creek	6.78	6	42	48.83	6/18/13
07010207-684	13UM077	Prairie Brook	5.19	6	23	29.88	6/18/13
07010207-527	13UM055	Rum River, West Branch	39.41	6	42	16.72	6/19/13
07010207-577	13UM072	Unnamed ditch	9.91	6	42	0.11	6/19/13
07010207-525	13UM048	Rum River, West Branch	182.95	5	47	56.20	7/22/13
07010207-527	13UM055	Rum River, West Branch	39.41	6	42	80.35	7/23/13
07010207-527	13UM056	Rum River, West Branch	65.26	5	47	58.84	7/23/13
07010207-527	13UM065	Rum River, West Branch	105.37	5	47	47.27	7/23/13
07010207-667	13UM075	Unnamed creek	6.78	6	42	60.95	8/12/13
07010207-525	13UM048	Rum River, West Branch	182.95	5	47	73.77	8/12/13
07010207-527	15EM091	Rum River, West Branch	103.56	5	47	47.92	7/23/15
Aggregated HUC 12: 0701020703-02 (Estes Brook)							

07010207-679	13UM060	Estes Brook	19.67	6	42	45.96	6/17/13
07010207-679	13UM042	Estes Brook	43.11	7	42	69.61	6/18/13
07010207-533	13UM076	Unnamed creek	13.43	7	42	62.94	6/19/13
07010207-679	13UM042	Estes Brook	43.11	7	42	66.40	8/15/13
07010207-679	15UM100	Estes Brook	10.56	6	42	53.03	7/1/15
Aggregated HUC 12: 0701020704-01 (Stanchfield Creek)							
07010207-520	13UM061	Stanchfield Creek	47.94	7	42	35.52	6/18/13
07010207-693	13UM082	Unnamed creek	10.82	6	42	0.15	6/19/13
07010207-674	13UM081	Ties Creek (Stanchfield Brook)	28.64	7	42	40.35	8/13/13
07010207-518	13UM047	Stanchfield Creek	93.61	5	47	47.01	8/13/13
Aggregated HUC 12: 0701020705-01 (Middle Rum River)							
07010207-504	10EM164	Rum River	1333.89	4	38	72.88	8/4/10
07010207-512	10EM036	Rum River	1051.34	4	38	48.13	8/5/10
07010207-611	13UM051	Spencer Brook	21.97	7	42	35.48	6/18/13
07010207-668	13UM091	Unnamed creek	8.00	7	42	0.16	6/19/13
07010207-504	00UM066	Rum River	1325.61	4	38	66.52	8/13/13
07010207-512	13UM094	Rum River	982.00	4	38	52.14	8/27/13
07010207-504	13UM093	Rum River	1246.71	4	38	45.82	8/27/13
07010207-504	13UM046	Rum River	1242.91	4	38	49.17	8/28/13
07010207-512	10EM036	Rum River	1051.34	4	38	43.11	8/29/13
07010207-504	13UM069	Rum River	1305.58	4	38	56.62	9/11/13
07010207-504	13UM087	Rum River	1184.87	4	38	55.40	9/12/13
07010207-512	15EM107	Rum River	981.72	4	38	55.48	8/26/15
07010207-512	10EM036	Rum River	1051.34	4	38	50.13	9/3/15
Aggregated HUC 12: 0701020705-02 (Lower Stanchfield)							
07010207-515	13UM063	Lower Stanchfield Branch	12.01	6	42	27.51	6/19/13
07010207-550	13UM068	Lower Stanchfield Branch	3.58	6	42	38.62	6/19/13
Aggregated HUC 12: 0701020706-01 (Cedar Creek)							
07010207-521	13UM084	Cedar Creek	7.68	7	42	53.71	6/19/13
07010207-521	13UM064	Cedar Creek	44.34	7	42	44.89	6/20/13

07010207-574	13UM071	county Ditch 28	2.69	6	42	22.00	6/20/13
07010207-902	13UM070	Unnamed ditch (Branch 3 Lateral 2)	13.02	6	42	19.44	6/20/13
07010207-682	00UM102	Mahoney Brook	8.04	6	42	24.84	6/20/13
07010207-521	00UM101	Cedar Creek	81.64	5		45.20	7/24/13
07010207-521	13UM084	Cedar Creek	7.68	7	42	36.09	8/14/13
07010207-575	13UM067	Crooked Brook	15.88	6	42	55.07	8/15/13
07010207-682	00UM102	Mahoney Brook	8.04	6	42	31.50	7/1/15
Aggregated HUC 12: 0701020707-01 (Lower Rum)							
07010207-503	10EM100	Rum River	1396.01	4	38	62.94	8/4/10
07010207-592	13UM052	Isanti Brook	18.99	7	42	38.18	6/19/13
07010207-503	10EM100	Rum River	1396.01	4	38	52.54	8/28/13
07010207-666	13UM040	Rum River	1575.11	4	38	48.52	9/9/13
07010207-502	13UM062	Rum River	1489.09	4	38	46.59	9/12/13
07010207-503	10EM100	Rum River	1396.01	4	38	58.49	9/1/15
Aggregated HUC 12: 0701020707-02 (Trott Brook)							
07010207-680	13UM044	Trott Brook	28.90	6	42	35.04	6/20/13
07010207-587	13UM066	Unnamed ditch	14.72	6	23	34.23	8/15/13
07010207-680	13UM044	Trott Brook	28.90	6	42	33.18	7/1/15
07010207-681	15UM101	Trott Brook	15.78	6	42	20.75	7/1/15
Aggregated HUC 12: 0701020707-03 (Seelye Brook)							
07010207-528	00UM104	Seelye Brook	40.03	6	42	46.76	7/24/13
07010207-528	13UM079	Seelye Brook	38.07	6	42	24.59	8/12/13
07010207-528	00UM104	Seelye Brook	40.03	6	42	36.71	6/24/15
07010207-528	13UM079	Seelye Brook	38.07	6	42	45.30	6/25/15

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

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Invert Class	Threshold	MIBI	Visit Date
Aggregated HUC 12: 0701020702-01 (Upper Rum River)							
07010207-511	13UM045	Rum River	772.70	1	49	60.58	05-Oct-04
07010207-537	00UM031	Mike Drew Brook	10.70	4	51	63.49	05-Oct-04
07010207-510	13UM058	Rum River	660.38	1	49	7.87	18-Aug-10
07010207-522	13UM074	Bogus Brook	7.40	4	51	52.44	15-Sep-11
07010207-510	13UM058	Rum River	660.38	1	49	55.03	23-Sep-11
07010207-689	13UM059	Chase Brook	8.76	4	51	62.37	23-Sep-11
07010207-567	13UM049	Vondell Brook	21.50	4	51	11.56	05-Aug-13
07010207-535	13UM078	county Ditch 4	21.25	4	M	41.00	05-Aug-13
Aggregated HUC 12: 0701020702-02 (Tibbetts Brook)							
07010207-676	13UM088	Tibbetts Brook	16.06	4	M	49.54	05-Aug-13
07010207-677	13UM043	Tibbetts Brook	42.66	4	51	52.68	05-Aug-13
Aggregated HUC 12: 0701020702-03 (Headwaters Rum River)							
07010207-564	04UM013	Black Brook	5.96	4	51	53.30	05-Aug-13
07010207-509	13UM054	Rum River	475.51	3		63.20	05-Aug-13
07010207-509	00UM032	Rum River	570.00	1	49	29.98	06-Aug-13
07010207-509	00UM032	Rum River	570.00	1	49	33.85	06-Aug-13
Aggregated HUC 12: 0701020702-04 (Bradbury Brook)							
07010207-540	00UM033	Bradbury Brook	50.47	3	53	46.93	06-Aug-13
07010207-691	13UM053	Bradbury Brook, North Fork	30.76	3	53	55.59	06-Aug-13
07010207-540	00UM033	Bradbury Brook	50.47	3	53	57.40	06-Aug-13
Aggregated HUC 12: 0701020703-01 (West Branch Rum)							
07010207-625	10EM116	Unnamed ditch	1.85	4	51	60.17	06-Aug-13
07010207-622	13UM080	Stony Brook	19.55	3	53	21.27	07-Aug-13
07010207-667	13UM075	Unnamed creek	6.78	3	53	42.00	07-Aug-13
07010207-527	13UM055	Rum River, West Branch	39.41	3	53	51.67	07-Aug-13
07010207-527	13UM056	Rum River, West Branch	65.26	3	53	52.95	07-Aug-13
07010207-527	13UM065	Rum River, West Branch	105.37	3	53	56.32	07-Aug-13

07010207-525	13UM048	Rum River, West Branch	182.95	5	37	46.59	08-Aug-13
Aggregated HUC 12: 0701020703-02 (Estes Brook)							
07010207-679	13UM042	Estes Brook	43.11	3	53	53.14	08-Aug-13
07010207-679	13UM060	Estes Brook	19.67	4	51	57.53	08-Aug-13
07010207-533	13UM076	Unnamed creek	13.43	4	51	62.59	08-Aug-13
Aggregated HUC 12: 0701020704-01 (Stanchfield Creek)							
07010207-518	13UM047	Stanchfield Creek	93.61	4	51	65.29	08-Aug-13
Aggregated HUC 12: 0701020705-01 (Middle Rum River)							
07010207-512	10EM036	Rum River	1051.34	1	49	70.41	08-Aug-13
07010207-504	10EM164	Rum River	1333.89	1	49	40.23	12-Aug-13
07010207-504	00UM066	Rum River	1325.61	1	49	52.65	12-Aug-13
07010207-504	13UM087	Rum River	1184.87	1	49	54.34	12-Aug-13
07010207-512	10EM036	Rum River	1051.34	1	49	63.22	12-Aug-13
07010207-504	13UM046	Rum River	1242.91	1	49	22.78	13-Aug-13
07010207-668	13UM091	Unnamed creek	8.00	6	43	30.03	13-Aug-13
07010207-512	13UM094	Rum River	982.00	1	49	32.06	13-Aug-13
07010207-504	13UM093	Rum River	1246.71	1	49	34.54	13-Aug-13
07010207-504	13UM069	Rum River	1305.58	1	49	42.26	13-Aug-13
Aggregated HUC 12: 0701020705-02 (Lower Stanchfield)							
07010207-550	13UM068	Lower Stanchfield Branch	3.58	4	51	42.51	13-Aug-13
07010207-515	13UM063	Lower Stanchfield Branch	12.01	6	43	47.03	13-Aug-13
Aggregated HUC 12: 0701020706-01 (Cedar Creek)							
07010207-902	13UM070	Unnamed ditch (Branch 3 Lateral 2)	13.02	6	43	49.75	13-Aug-13
07010207-521	13UM064	Cedar Creek	44.34	6	43	43.27	14-Aug-13
07010207-574	13UM071	county Ditch 28	2.69	6	43	49.74	14-Aug-13
07010207-682	00UM102	Mahoney Brook	8.04	6	43	50.42	14-Aug-13
07010207-575	13UM067	Crooked Brook	15.88	6	43	53.23	14-Aug-13
07010207-521	13UM084	Cedar Creek	7.68	6	43	54.22	14-Aug-13
07010207-521	00UM101	Cedar Creek	81.64	6	43	55.19	14-Aug-13
Aggregated HUC 12: 0701020707-01 (Lower Rum)							
07010207-503	10EM100	Rum River	1396.01	1	49	58.16	14-Aug-13

07010207-592	13UM052	Isanti Brook	18.99	6	43	63.48	14-Aug-13
07010207-666	13UM189	Rum River	1578.99	1	49	34.77	19-Aug-13
07010207-502	13UM062	Rum River	1489.09	1	49	34.93	19-Aug-13
07010207-503	10EM100	Rum River	1396.01	1	49	42.37	19-Aug-13
Aggregated HUC 12: 0701020707-02 (Trott Brook)							
07010207-587	13UM066	Unnamed ditch	14.72	6	30	44.40	20-Aug-13
07010207-680	13UM044	Trott Brook	28.90	6	43	46.47	20-Aug-13
Aggregated HUC 12: 0701020707-03 (Seelye Brook)							
07010207-528	13UM079	Seelye Brook	38.07	6	43	28.84	21-Aug-13
07010207-528	13UM079	Seelye Brook	38.07	6	43	62.40	22-Aug-13
07010207-528	00UM104	Seelye Brook	40.03	6	43	78.27	22-Aug-13

Appendix 5.1 - 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 5.2 - MINLEAP model estimates of phosphorus loads for lakes in the Rum River Watershed

Lake ID	Lake Name	Obs TP (µg/L)	MINLEAP TP (µg/L)	Obs Chl-a (µg/L)	MINLEAP Chl-a (µg/L)	Obs Secchi (m)	MINLEAP Secchi (m)	Avg. TP Inflow (µg/L)	TP Load (kg/yr)	Background TP (µg/L)	%P Retention	Outflow (hm3/yr)	Residence Time (yrs)	Areal Load (m/yr)	Trophic Status
01-0065-00	Cedar	28	25	1	7	2.0	2.4	59	72	27.5	58	1.21	1.7	1.19	E
01-0157-00	Big Pine	14	16	4	4	3.8	3.6	60	151	18.9	74	2.51	6	1	M
01-0204-00	Round	11	13	3	3	3.7	4.2	58	243	15.8	77	4.22	9	1.45	O
02-0091-00	George	28	41	8	15	2.1	1.6	193	202	28	79	1.05	3.7	.54	M
02-0133-00	East Twin	22	34	5	11	3.7	1.9	180	41	26.8	81	.23	5.3	.75	M
18-0020-00	Borden	19	23	7	6	3	2.6	54	876	20.8	58	16.2	1.7	4.04	M
30-0022-00	Skogman	43	47	21	18	1.5	1.4	160	295	23.1	70	1.85	2	2.05	E
30-0035-00	Florence	16	87	8	45	1.9	0.8	151	682	26.8	42	4.52	0.2	8.59	M
30-0043-00	Fannie	46	62	25	28	1.6	1.1	159	516	29.5	61	3.25	0.9	2.26	E
30-0044-00	Little Stanchfield	103	104	43	58	1	0.7	149	2166	31.5	30	14.53	0.1	21.89	H
30-0072-00	Long	119	66	49	30	0.5	1.1	157	622	17.4	58	3.96	0.7	2.7	H
30-0096-00	Lory	26	63	30	28	1.3	1.1	159	351	24.5	61	2.21	0.9	2.29	E
30-0107-01	Blue (North Bay)	44	102	11	57	1.4	0.7	149	567	24.5	32	3.8	0.1	19.96	E
30-0107-02	Blue (South Bay)	24	53	38	22	1.7	1.3	155	564	22.5	66	3.65	1.4	3.65	M
30-0135-00	Spectacle	19	29	3	9	4.2	2.1	198	96	28	85	.49	8.3	.48	M
30-0138-00	South Stanchfield	87	62	75	27	1	1.1	159	570	29.7	61	3.58	0.9	2.16	E
30-0143-00	North Stanchfield	196	109	35	62	0.8	0.7	150	1284	25.6	27	8.58	0.1	14.42	H
33-0032-00	Lewis	26	36	14	12	2.1	1.8	168	146	21.6	78	.87	4.1	1.22	E
48-0002-00	Mille Lacs	30	11	8	2	3.3	4.7	65	20858	19.8	82	318.92	14.6	0.61	E
71-0040-00	Sandy	14	30	3	10	4.8	2	194	24	29.2	84	.13	7.6	0.53	M

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

Appendix 6 – Fish species found during biological monitoring surveys

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Big mouth shiner	18	128
Black bullhead	21	232
Black crappie	12	73
Blacknose dace	40	532
Blacknose shiner	8	15
Bluegill	27	124
Bluntnose minnow	36	354
Bowfin	2	2
Brassy minnow	21	61
Brook stickleback	32	736
Brown bullhead	1	1
Burbot	11	15
Central mudminnow	73	3185
Central stoneroller	23	461
Common carp	13	46
Common shiner	63	3935
Creek chub	53	3103
Fathead minnow	26	218
Finescale dace	5	12
Gen: redhorses	3	9
Golden shiner	10	11
Greater redhorse	19	51
Green sunfish	30	171
Hornyhead chub	36	1487
Hybrid minnow	1	1
Hybrid sunfish	8	10
Iowa darter	9	15

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Johnny darter	65	2794
Largemouth bass	26	137
Logperch	31	728
Longnose dace	19	724
Mimic shiner	6	36
Mottled sculpin	1	1
Northern pike	57	335
Northern redbelly dace	25	364
Pearl dace	21	858
Pumpkinseed	9	69
Rockbass	45	316
Sand shiner	8	76
Shorthead redhorse	25	328
Silver redhorse	15	69
Smallmouth bass	38	2273
Spottail shiner	26	897
Tadpole madtom	33	124
Troutperch	2	8
Walleye	18	54
White sucker	75	2463
Yellow bullhead	8	43
Yellow perch	32	687

Appendix 7 –Macroinvertebrate species found during biological monitoring surveys

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Ablabesmyia	50	296
Acari	57	213
Acentrella	5	65
Acentrella parvula	9	33
Acentrella turbida	9	27
Acerpenna	23	166
Acerpenna pygmaea	5	24
Acilius	1	present
Acricotopus	3	8
Acroneuria	10	13
Acroneuria abnormis	4	10
Acroneuria lycorias	7	21
Aeshna	7	3
Aeshna umbrosa	1	present
Aeshnidae	13	16
Agabus	2	1
Agnetina	6	19
Amnicola	5	24
Amphipoda	1	17
Anacaena	7	13
Anafroptilum	5	6
Anax	3	1
Anax junius	2	2
Ancyronyx variegatus	20	49
Anisoptera	3	6
Anopheles	14	53
Anthopotamus	7	18

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Antocha	2	2
Argia	5	7
Asellus	3	36
Atherix	10	37
Atherix variegata	1	present
Atrichopogon	8	27
Aulodrilus	1	1
Baetidae	21	198
Baetis	31	308
Baetis brunneicolor	14	173
Baetis flavistriga	15	348
Baetis intercalaris	23	310
Baetis tricaudatus	1	1
Baetisca	2	3
Belostoma	8	10
Belostoma flumineum	30	21
Berosus	3	5
Bezzia	2	3
Bezzia/Palpomyia	3	4
Bivalvia	1	3
Boyeria	4	2
Boyeria vinosa	11	14
Brachycentridae	2	2
Brachycentrus	2	1
Brachycentrus numerosus	22	558
Branchiobdellida	2	3
Brillia	21	57
Caecidotea	15	127
Caenis	19	277

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Caenis diminuta	29	426
Caenis hilaris	18	92
Callibaetis	3	15
Calopterygidae	25	282
Calopteryx	30	272
Calopteryx aequabilis	17	55
Calopteryx maculata	2	3
Cambaridae	7	4
Cambarus	2	present
Campeloma	8	9
Capniidae	2	16
Cardiocladius	5	11
Ceraclea	8	8
Ceratopogonidae	4	5
Ceratopogoninae	14	20
Ceratopsyche	15	156
Ceratopsyche alhedra	1	35
Ceratopsyche bronta	6	64
Ceratopsyche morosa	8	90
Ceratopsyche slossonae	2	8
Cheumatopsyche	54	705
Chimarra	13	101
Chimarra obscura	1	44
Chironomidae	1	2
Chironomini	20	158
Chironomus	6	16
Chloroperlidae	1	2
Chrysops	1	1
Cipangopaludina	1	present

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Cladopelma	2	3
Cladotanytarsus	10	20
Clinotanypus	2	3
Coenagrionidae	27	99
Conchapelopia	8	12
Corduliidae	7	9
Corixidae	17	62
Corydalus	1	present
Corynoneura	24	101
Crambidae	1	1
Cricotopus	52	418
Cryptochironomus	19	23
Cryptotendipes	2	2
Culicidae	8	15
Cymbiodyta	1	present
Cyphon	1	6
Dasyhelea	1	3
Decapoda	1	present
Demicryptochironomus	2	2
Desmopachria convexa	2	2
Dicranota	4	7
Dicrotendipes	25	133
Dineutus	5	4
Dixa	1	1
Dixella	4	5
Dixidae	1	1
Dolophilodes distinctus	1	13
Doncricotopus bicaudatus	3	11
Dubiraphia	52	758

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Dytiscidae	11	26
Elmidae	6	10
Empididae	19	24
Enallagma	3	18
Enchytraeus	2	3
Endochironomus	12	33
Ephemera	1	1
Ephemerellidae	3	3
Ephoron	3	4
Ephoron album	1	1
Ephydridae	25	58
Epitheca canis	1	0
Eukiefferiella	6	16
Eurylophella	2	15
Fallceon	1	1
Ferrissia	33	418
Forcipomyiinae	1	1
Fossaria	5	8
Fridericia	4	4
Gammarus	7	134
Gastropoda	2	3
Gerridae	3	3
Glyphopsyche irrorata	1	1
Glyptotendipes	2	5
Gomphidae	4	7
Gomphus	1	0
Gyraulus	14	116
Gyrinus	7	12
Haliplidae	4	7

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Haliplus	25	74
Helichus	6	13
Helicopsyche	2	55
Helicopsyche borealis	2	11
Helisoma	5	13
Helisoma anceps	1	2
Helius	2	12
Helopelopia	1	1
Helophorus	1	1
Hemerodromia	46	194
Heptagenia	10	54
Heptageniidae	27	268
Hesperocorixa	5	5
Hetaerina	1	5
Heterocloeon	3	17
Hexagenia	1	present
Hexatoma	5	9
Hirudinea	25	74
Hyalella	60	1359
Hyalella azteca	1	56
Hydaticus	1	1
Hydatophylax	4	68
Hydraena	14	36
Hydrobiidae	17	242
Hydrochus	2	2
Hydrometra	2	2
Hydrophilidae	10	16
Hydropsyche	21	184
Hydropsyche betteni	19	170

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Hydropsyche bidens	1	3
Hydropsyche incommoda	5	15
Hydropsyche phalerata	1	1
Hydropsyche placoda	2	6
Hydropsyche simulans	13	200
Hydropsychidae	52	568
Hydroptila	21	53
Hydroptilidae	7	14
Hydrozoa	2	3
Hygrotus	4	5
Ilybius	1	present
Ischnura	1	22
Isonychia	22	98
Isonychia bicolor	1	2
Isonychia rufa	1	2
Iswaeon	15	86
Kiefferulus	1	1
Kribiodorum perpulchra	1	1
Kribiodorum perpulchrum	2	2
Labiobaetis	4	15
Labiobaetis dardanus	2	8
Labiobaetis frondalis	9	45
Labiobaetis propinquus	33	580
Labrundinia	36	188
Laccophilus	1	1
Larsia	3	6
Lepidostoma	2	14
Leptoceridae	23	78
Leptophlebia	1	21

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Leptophlebiidae	17	152
Lethocerus	3	1
Leucotrichia pictipes	1	1
Leucrocuta	13	145
Libellulidae	2	1
Limnephilidae	10	19
Limnephilus	1	3
Limnophyes	8	10
Liodessus	11	48
Lopescladius	4	11
Lymnaea stagnalis	1	present
Lymnaeidae	10	33
Lype diversa	1	1
Maccaffertium	41	455
Maccaffertium exiguum	4	8
Maccaffertium mexicanum	4	6
Maccaffertium modestum	1	6
Maccaffertium terminatum	6	29
Maccaffertium vicarium	9	32
Macromia illinoiensis	1	present
Macronychus glabratus	33	221
Macrostemum	2	4
Macrostemum zebratum	2	2
Mayatrichia ayama	6	12
Mesovelia	1	2
Metrobates	1	1
Micrasema	5	18
Micrasema rusticum	2	2
Micropsectra	15	124

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Microtendipes	30	78
Microvelia	2	2
Mystacides	3	12
Naididae	1	1
Nais	7	10
Nanocladius	12	18
Natarsia	1	1
Nectopsyche	10	42
Nectopsyche diarina	10	20
Nectopsyche exquisita	1	2
Nemata	6	7
Nemotaulius	1	1
Neoperla	1	6
Neophylax	1	1
Neophylax concinnus	1	1
Neophylax fuscus	1	3
Neoplasta	1	1
Neoplea	6	52
Neoplea striola	18	153
Neoporus	3	3
Neostempellina reissi	5	9
Neotrichia	1	1
Neureclipsis	9	106
Neurocordulia	1	present
Nilotanypus	5	8
Nilothauma	3	3
Notonecta	4	4
Notonectidae	1	1
Nymphula	1	1

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Ochrotrichia	1	3
Odontomyia	1	1
Odontomyia /Hedriodiscus	2	2
Oecetis	12	23
Oecetis avara	4	8
Oecetis furva	6	15
Oecetis testacea	7	19
Oligochaeta	36	328
Ophiogomphus	3	2
Optioservus	24	211
Orconectes	45	51
Orconectes rusticus	1	2
Orthocladiinae	20	67
Orthocladius	21	79
Ostracoda	1	15
Oxyethira	6	77
Palmacorixa	1	1
Paracapnia	1	5
Parachironomus	2	1
Paracladopelma	4	6
Paracloeodes minutus	4	4
Paracymus	1	1
Paragnetina	5	7
Paragnetina media	13	77
Parakiefferiella	6	8
Paralauterborniella nigrohalterale	4	8
Paraleptophlebia	5	62
Paramerina	18	57
Parametriocnemus	15	37

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Paraphaenocladius	3	4
Paraponyx	4	4
Parapoynx	2	3
Paratanytarsus	37	287
Paratendipes	14	36
Peltodytes	7	13
Pentaneura	11	24
Pericoma / Telmatoscopus	1	1
Perlesta	3	5
Perlidae	13	46
Perlinella	1	2
Perlodidae	1	10
Phaenopsectra	41	128
Philopotamidae	3	7
Phryganeidae	3	5
Physa	41	669
Physella	8	72
Physidae	2	2
Pisidiidae	60	378
Planorbella	9	19
Planorbidae	9	23
Planorbula armigera	1	13
Plauditus	9	100
Polycentropodidae	11	21
Polycentropus	2	4
Polypedilum	73	1558
Potamyia	1	7
Potamyia flava	1	1
Procladius	22	88

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Procloeon	22	108
Promenetus exacuous	1	4
Protoptila	10	66
Psectrocladius	2	3
Pseudocentroptiloides usa	1	2
Pseudochironomus	1	1
Pseudocloeon	4	24
Pseudocloeon propinquum	1	1
Psychomyia flavida	5	11
Pteronarcys	22	51
Ptilostomis	14	33
Pycnopsyche	12	13
Pyralidae	2	15
Quistadrilus multisetosus	1	1
Ranatra	6	5
Rhagovelia	4	13
Rheocricotopus	33	114
Rheosmittia	2	2
Rheotanytarsus	56	697
Rheumatobates	2	3
Robackia	2	2
Saetheria	2	4
Sciomyzidae	2	2
Scirtes	2	3
Scirtidae	1	1
Sepedon	1	1
Serratella	3	13
Sialis	4	9
Sigara	6	9

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Sigara grossolineata	1	present
Simuliidae	2	3
Simulium	57	957
Sisyra	3	5
Smittia	1	1
Somatochlora	2	1
Somatochlora minor	1	present
Somatochlora walshii	1	3
Sperchopsis tessellata	1	1
Spirosperma	1	3
Stagnicola	9	23
Stempellina	4	22
Stempellinella	22	56
Stenacron	22	84
Stenelmis	42	521
Stenochironomus	40	99
Stenonema	7	134
Stenonema femoratum	4	7
Stictochironomus	8	11
Stictotarsus	1	4
Stratiomyidae	3	3
Sublettea coffmani	2	2
Tabanidae	5	5
Tabanus	1	present
Taeniopterygidae	1	4
Taeniopteryx	6	66
Tanypodinae	26	80
Tanypus	2	2
Tanytarsini	29	120

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Tanytarsus	48	500
Teloganopsis deficiens	2	3
Thienemanniella	31	93
Thienemannimyia	1	1
Thienemannimyia Gr.	70	446
Tipula	5	5
Tipulidae	1	1
Trepaxonemata	1	1
Triaenodes	19	49
Tribelos	7	11
Trichocorixa	2	2
Trichoptera	3	3
Tricorythodes	22	203
Tropisternus	8	3
Tubificinae	7	10
Turbellaria	15	36
Tvetenia	14	58
Valvata	2	190
Veliidae	2	2
Xenochironomus xenolabis	7	9
Xylotopus par	3	3
Zavrelimyia	5	23