Red Lake River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

July 2016

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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

DO Dissolved oxygen

DOP Dissolved Orthophosphate

EQuIS Environmental Quality Information System

EX Exceeds Criteria (Bacteria)

EXP Exceeds Criteria, Potential Impairment

EXS Exceeds Criteria, Potential Severe Impairment

FIBI Fish Index of Biological Integrity

FS Full Support

FWMC Flow Weighted Mean Concentration

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

IF Insufficient Information

IWM Intensive watershed monitoring

K Potassium

LRVW Limited Resource Value Water

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MDNR Minnesota Department of Natural Resources

MIBI Macroinvertebrate Index of Biological Integrity

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

MTS Meets the Standard

Nitrate-N Nitrate Plus Nitrite Nitrogen

NA Not Assessed

NHD National Hydrologic Dataset

NH3 Ammonia

NS Not Supporting

NWI National Wetlands Inventory

OP Orthophosphate

P Phosphorous

PCB Poly Chlorinated Biphenyls

RLWD Red Lake Watershed District or **RLRWD**?

RNR River Nutrient Region

SWAG Surface Water Assessment Grant

SWCD Soil and Water Conservation District

TALU Tiered Aquatic Life Uses

TKN Total Kjeldahl Nitrogen

TMDL Total Maximum Daily Load

TP Total Phosphorous

TSS Total Suspended Solids

UAA Use Attainability Analysis

USGS United States Geological Survey

WMA Wildlife Management Area

WPLMN Water Pollutant Load Monitoring Network

Executive summary

In 2012 the Minnesota Pollution Control Agency (MPCA) undertook an Intensive Watershed Monitoring (IWM) program within the Red Lake River Watershed. The primary goal of the IWM program is to describe the condition of rivers, streams, and lakes within each of Minnesota's 80 major watersheds using a comprehensive suite of indicators. Biological data from both fish and macroinvertebrate (bug) communities and water chemistry data were collected from streams and rivers and used to assess surface waters for aquatic life, as well as aquatic recreation. Near the outlet of the watershed, an analysis of mercury within fish tissue was also conducted and provided a basis for an assessment of aquatic consumption. Data was also collected and used to compute loads through the Major Watershed Load Monitoring Program. Work was completed by staff from the MPCA, citizen volunteers, and Surface Water Assessment Grant (SWAG) recipients.

Based on the data collected and used in the waterbody assessments in 2014, 10 streams were assessed as fully supporting aquatic recreation while 7 do not support aquatic recreation due to elevated bacteria levels. For aquatic life use, 15 streams were determined to be fully supporting and 13 stream reaches were found to be non-supporting. No lakes were assessed within this watershed.

Sediment sources like this are detrimental to water quality. Photo was taken just outside the watershed, west of Terrebonne. Note biologist in center of photo for scale.

The assessment results for the Red Lake River Watershed indicate that the aquatic biology is generally in good condition on the Red Lake River main-stem channel. However, both fish and macroinvertebrate communities are in poor condition on a majority of the tributaries to the main-stem river. Many of the tributaries within this watershed are ditches which were constructed for drainage purposes, or natural reaches which have been straightened (channelized) in an effort to increase drainage. Streams in the watershed as a whole are naturally low gradient systems that are not efficient at transporting large amounts of water rapidly. The effects are felt downstream. When something alters the landscape around a river's headwaters, life in lowland reaches feels the effects (Karr and Chu, 1999). Stream straightening and channelization may be short-term solutions to minimize flooding of agricultural fields, but in the long term such practices increase flow velocity of outside bends in previous meanders; the result is often severe stream bank erosion and high sediment inputs (Waters, 1995).

Introduction

Water is one of Minnesota's most abundant and precious resources. The 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 Red Lake River Watershed beginning in the summer of 2012. This report provides a summary of all water quality assessment results in the Red Lake River Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring and monitoring conducted by local government units.

I. The watershed monitoring approach

The watershed approach is a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 80 major watersheds (Figure 1). The major benefit of this approach is the integration of monitoring resources to provide a more complete and systematic assessment of water quality at a geographic scale useful for the development and implementation of effective TMDLs, project planning, effectiveness monitoring and protection strategies. The following paragraphs provide details on each of the principal monitoring components of the watershed approach. For additional information see: Watershed Approach to Condition Monitoring and Assessment (MPCA 2008) (http://www.pca.state.mn.us/publications/wq-s1-27.pdf).

Watershed Pollutant Load Monitoring Network

The Watershed Pollutant Load Monitoring Network (WPLMN) is a long-term program designed to measure and compare regional differences and long-term trends in water quality among Minnesota's major rivers including the Red, Rainy, St. Croix, Mississippi, and Minnesota, and the outlets of the major tributaries (8 digit HUC scale) draining to these rivers. Since the program's inception in 2007, the WPLMN has adopted a multi-agency monitoring design that combines site specific stream flow data from United States Geological Survey (USGS) and Minnesota Department of Natural Resources (MDNR) flow gaging stations with water quality data collected by the Metropolitan Council Environmental Services, local monitoring organizations, and the MPCA to compute pollutant loads from 201 streams and rivers 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:

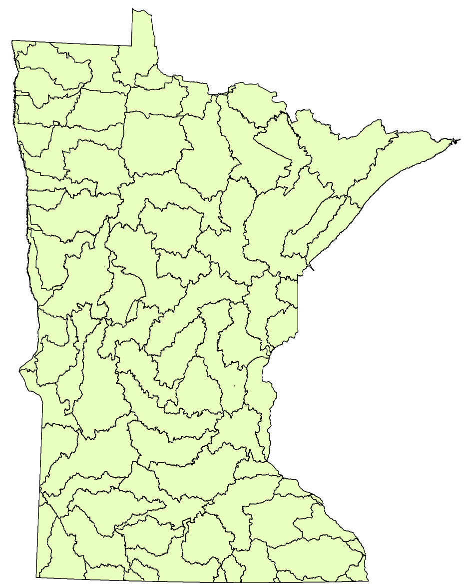

Figure 1. Major watersheds within Minnesota.

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

Major Watershed – tributaries draining to major 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.

Data are also used to assist with: 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 including a map of the sites. Watershed Pollutant Load Monitoring Network | Minnesota Pollution Control Agency

Intensive watershed monitoring

The IWM 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 monitored for at least two years 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 (Figure2). 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 (green triangle 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 12-HUC outlet (green dots in Figure 3) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Within each 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).

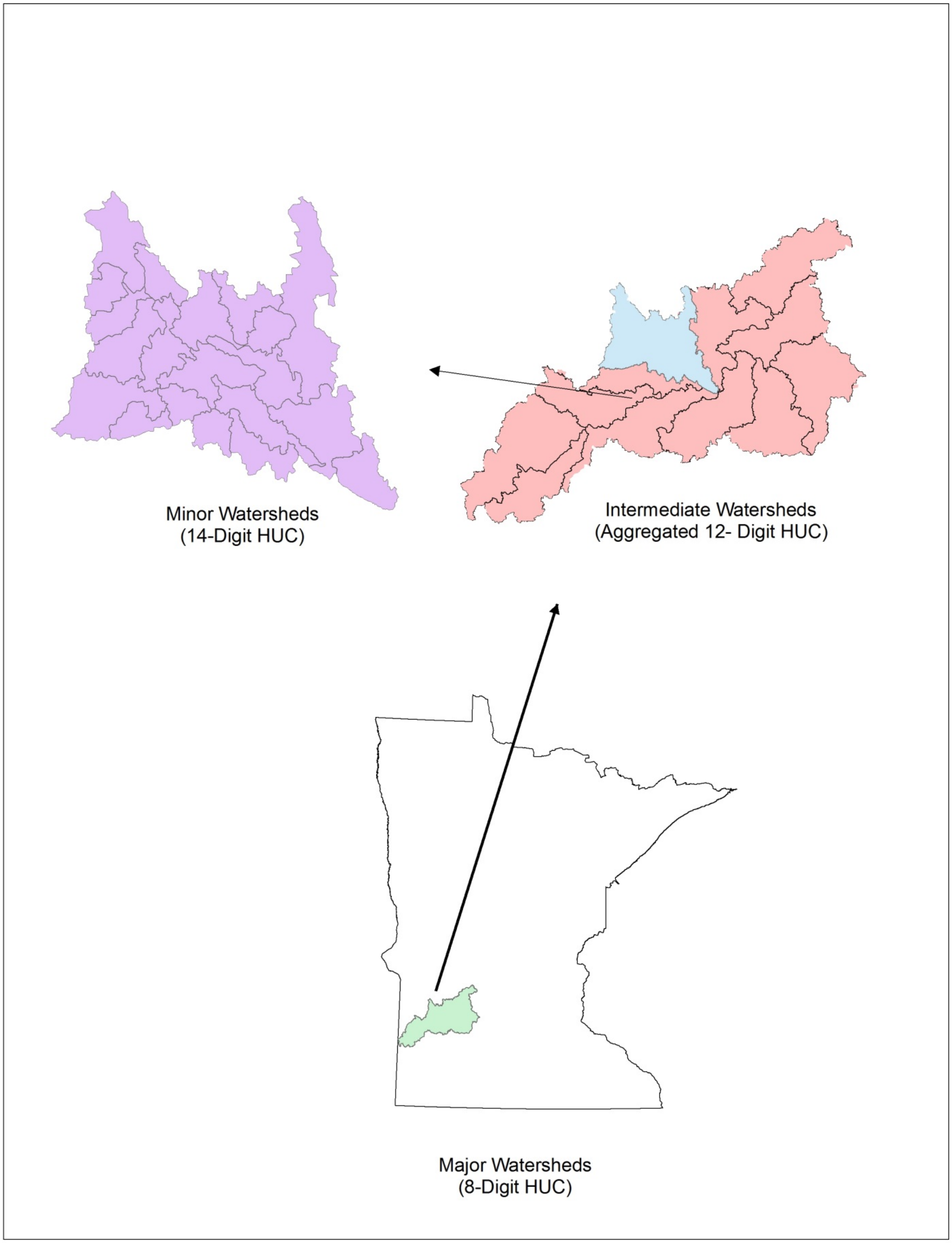

Figure 2. The intensive watershed monitoring design.

Within the IWM 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 stream sites sampled as part of the intensive monitoring effort in the Red Lake River Watershed are shown in Figure 3.

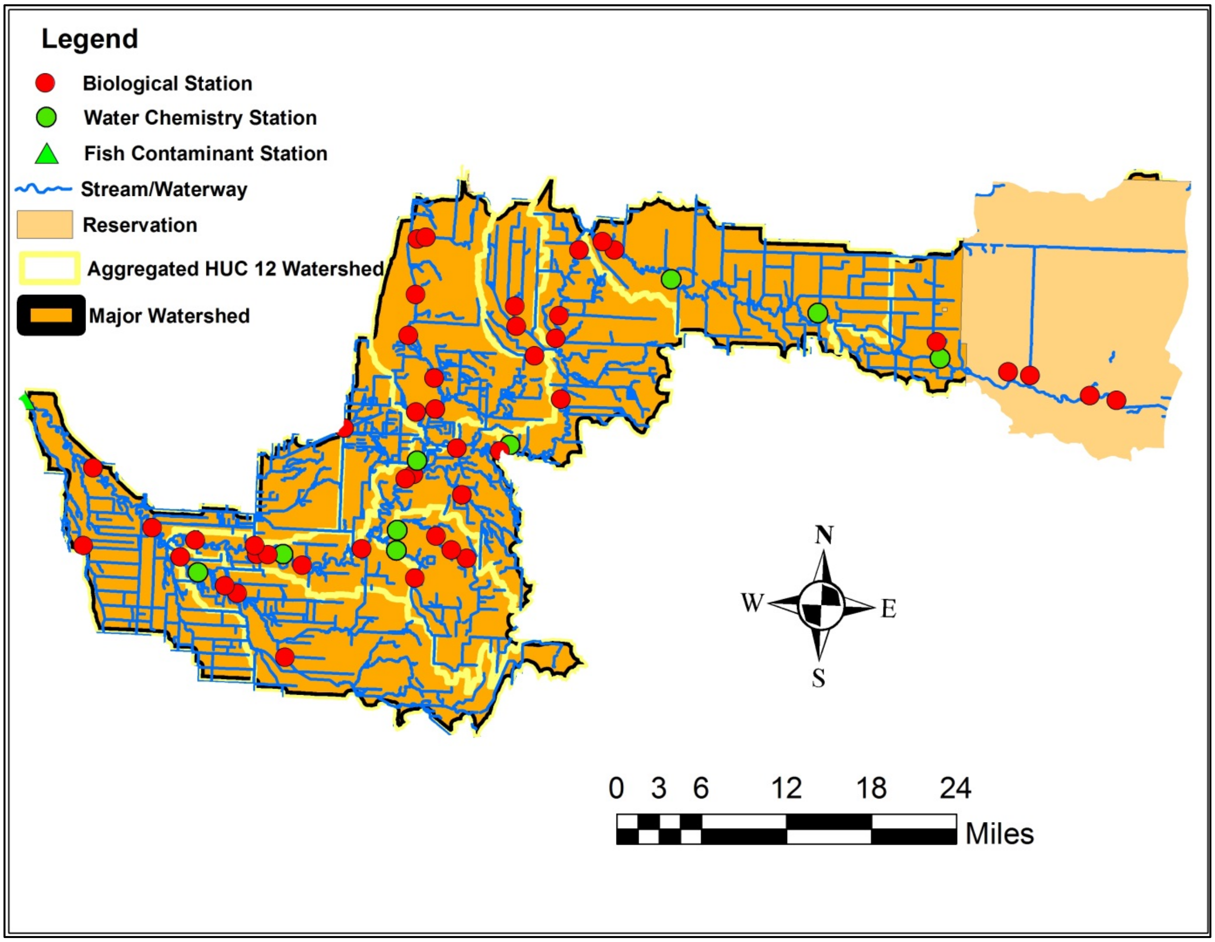

Figure 3. Intensive watershed monitoring sites for streams in the Red Lake River Watershed.

Citizen and local monitoring

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

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

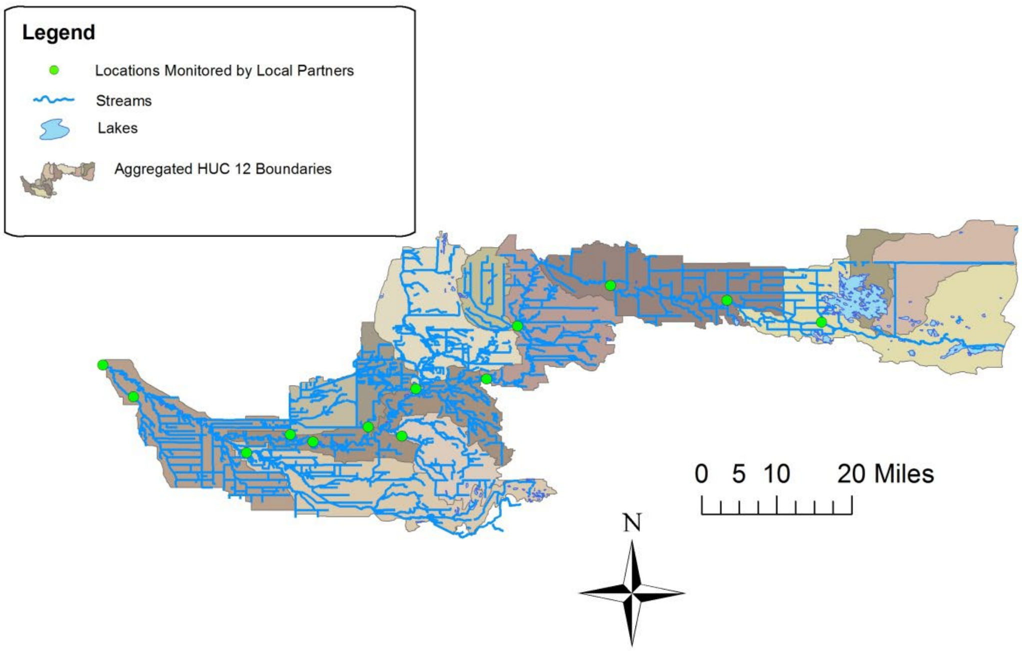

Figure 4. Monitoring locations of local groups, citizens and the MPCA lake monitoring staff in the Red Lake River Watershed.

II. Assessment methodology

The CWA requires states to report on the condition of the waters of the state every two years. This biennial report to Congress contains an updated list of surface waters that are determined to be supporting or non-supporting of their designated uses, as evaluated by the comparison of monitoring data to criteria specified by Minnesota Water Quality Standards (Minn. R. ch. 7050 2008; https://www.revisor.leg.state.mn.us/rules/?id=7050). The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment methodologies see: Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List (MPCA 2014). 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 IBIs 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 IBIs 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 bio criteria 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 (DO), un-ionized ammonia nitrogen, chloride, and suspended sediment.

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 are determined before assessment based on the attainment of the applicable biological criteria and/or an assessment of the habitat. For additional information, see: http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html).

Table 1. Table of proposed Tiered Aquatic Life Use standards.

Proposed Tiered Aquatic Life Use	Acronym	Proposed Use Class Code	Description
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.

Proposed Tiered Aquatic Life Use	**Acronym**	**Proposed Use Class Code**	**Description**
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 aquatic 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 from a lake or stream are safe to eat, and to issue recommendations regarding the frequency that fish from a particular water body can be safely consumed. For lakes, rivers and streams that are protected as a source of drinking water, the MPCA primarily measures the concentration of nitrate in the water column to assess this designated use.

A small percentage of stream miles in the state (~1% of 92,000 miles) have been individually evaluated and re-classified as a Class 7 Limited Resource Value Water (LRVW). These streams have previously demonstrated that the existing and potential aquatic community is severely limited and cannot achieve aquatic life standards either due to: 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) limited recreational opportunities (such as fishing, swimming, wading or boating) in and on the water resource. While not being protective of aquatic life, LRVWs are still protected for industrial, agricultural, navigation and other uses. Class 7 waters are also protected for aesthetic qualities (e.g., odor), secondary body contact, and groundwater for use as a potable water supply. To protect these uses, Class 7 waters have standards for bacteria, pH, DO and toxic pollutants.

Assessment units

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

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

Determining use attainment

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

The first step in the aquatic life assessment process is 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 ensure 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).

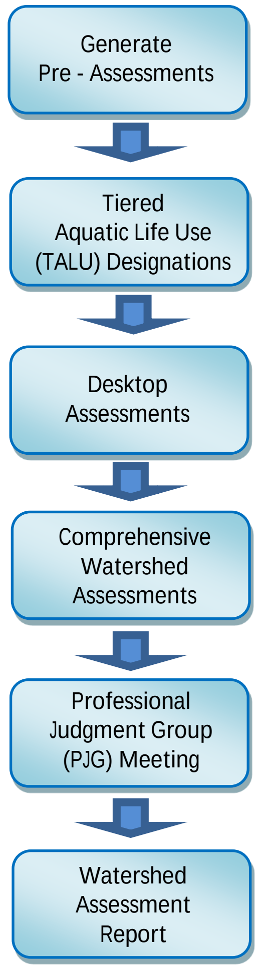

Figure 5. Flowchart of aquatic life use assessment process.

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 2014) 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 (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),may be used to revise previous use attainment decisions. 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 Environmental Quality Information System (EQuIS), MPCA's data system and are also uploaded to the US Environmental Protection Agency's data warehouse. Data for monitoring projects with federal or state funding are required to be stored in EQuIS (e.g., Clean Water Partnership, CWLA Surface Water Assessment Grants and TMDL program). Many local projects not funded by MPCA also choose to submit their data to the MPCA in an EQuIS-ready format so that the monitoring data may be utilized in the assessment process. Prior to each assessment cycle, the MPCA sends out a request for monitoring data to local entities and partner organizations.

Period of record

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

III. Watershed overview

The Red Lake River Watershed is located in the Red River Basin of northwest Minnesota. The watershed drains approximately 1,420 square miles (909,024 area acres) of land in Beltrami, Clearwater, Marshall, Pennington, Polk, and Red Lake counties. The major river within the watershed, the Red Lake River, originates from Lower Red Lake in Beltrami County. From this location the river flows westerly approximately 192 miles and receives water via numerous tributaries, many of which are partially ditched. The Clearwater River and Thief River are two of its major tributaries, each having their own HUC 8 watershed. The Red Lake River flows through the towns of Thief River Falls, Red Lake Falls, and Crookston before reaching its confluence with the Red River in East Grand Forks. Eventually this water is carried into Lake Winnipeg in Canada through the Red River.

Row crop agriculture is prevalent throughout the watershed but most notably in the flat and fertile western portion of the watershed, an area once covered historically by glacial Lake Agassiz. Decades of work to clear and drain the wetlands and prairies of the region have resulted in one of the richest agricultural regions in the country. However, conversion to agriculture has come at a considerable cost to the rivers and streams of the region. The Red Lake River is not only a major contributor of water but is also considered to be a major contributor of pollutants to the Red River (NRCS 2008). Today, over 70% of streams have been ditched to improve drainage. Sediment loading caused by erosion of both stream banks and runoff from surrounding land is a major problem. Although much of the erosion of stream banks occurs primarily during high flows, it is not limited to these times as wind is also a significant mechanism of soil loss, especially given the relatively wide open nature of this watershed. Although erosion of stream banks is a natural process that takes place under normal conditions in streams, cultural activities that affect the amplitude of discharge fluctuations can exacerbate erosion of stream banks (Waters, 1995). For the Red Lake River Watershed, the combination of minimized riparian zones and hydrological alteration (channelization and tiling) are among the most prevalent of these activities.

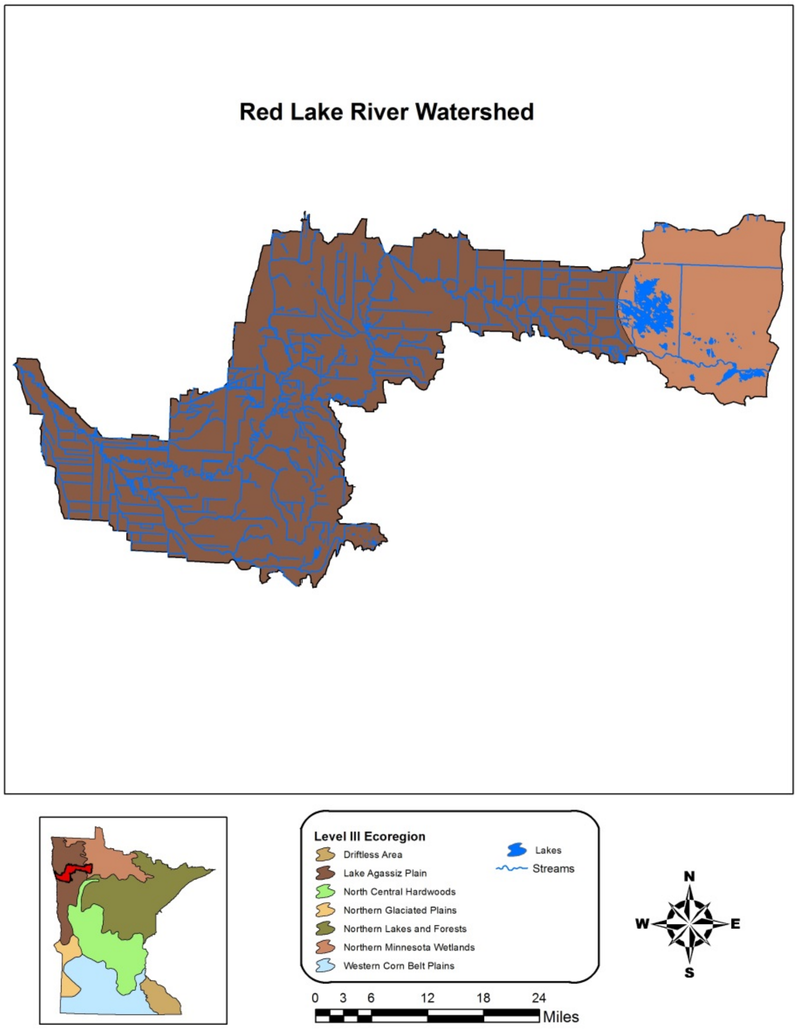

Figure 6. The Red Lake River Watershed within the Glacial Lake Agassiz Plain and Northern Minnesota Wetlands Level III ecoregions of northwest Minnesota.

Land use summary

Prior to European settlement, the Red Lake River Watershed was primarily prairie grassland. The rivers and streams are mostly low gradient with poorly defined floodplains and drainage areas. Consequently, the watershed was prone to annual flooding. The flooding brought in nutrient rich soil, making the area attractive for agricultural use. Upon settlement, the land quickly gave way to the plow resulting in the conversion from prairie to farmland throughout the watershed. This widespread conversion from prairie to farmland and some urban development leaves the area subject to even more severe and frequent flooding. Today, over 75% of the land is privately owned, with a majority of this land being used for agricultural production (approximately 67% with about 61% of this being utilized for row crop production).

The change in land use has resulted in even more severe and frequent flooding.

The far eastern portion (headwaters area) of the watershed is owned by the Red Lake Band of Chippewa (Red Lake Nation). The largely undeveloped land of the Red Lake Reservation is comprised of wetlands and forests and makes up approximately 18% of the watershed. The land was acquired by the tribe through a series of treaties beginning with the Old Crossing Treaty of 1863. Following this original treaty, the United States Federal Government made several amendments to the determination of tribal ownership boundaries. On July 6, 1889, the sovereignty of the Red Lake Band of Chippewa was established through a culmination of negotiations, and Red Lake Nation was confirmed as independent. The current ownership boundaries of the tribe are reflective of another amendment which occurred in 1905. Other than the land owned by the Red Lake Band, and that which is in private ownership, the remaining land within the Red Lake River Watershed is divided between state (approximately 3%), conservancy (approximately 3%), federal (under 1%), and miscellaneous public lands (under 1%).

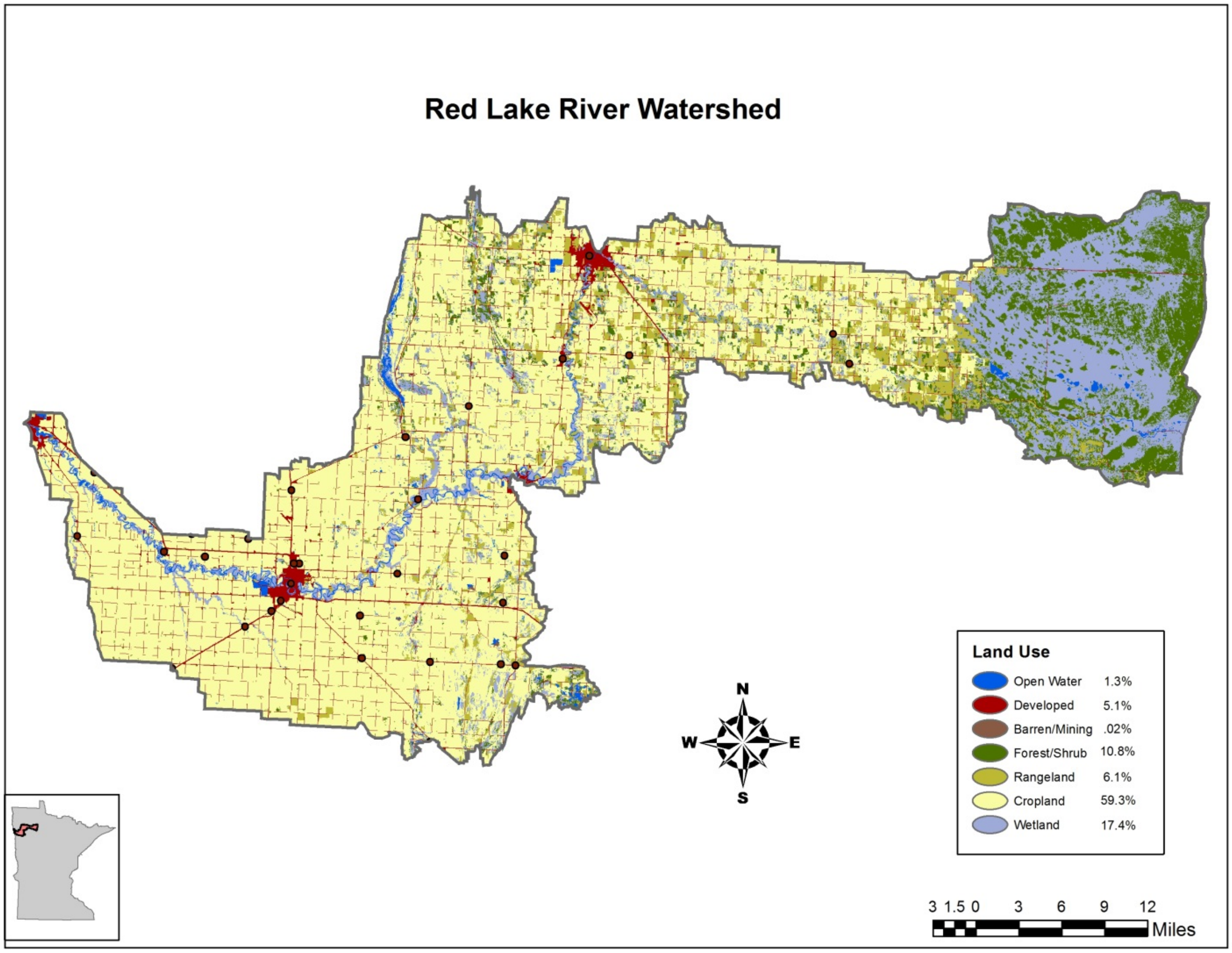

Figure 7. Land use in the Red Lake River Watershed.

Surface water hydrology

The Red Lake River Watershed includes 13 intermediate (aggregated 12-digit HUC) sized watersheds and 83 minor (14-digit HUC) sized watersheds. Major reaches/channels within the system include the Red Lake River, Kripple Creek, Gentilly River, Burnham Creek, Judicial Ditch 60, County Ditch 76, County Ditch 1, and the Black River. Typical of the Red River Basin/Lake Agassiz Plain ecoregion in general, most of the reaches within this system are relatively low gradient in nature as the area has a poorly defined floodplain. To exemplify this point, at its origin at Lower Red Lake in Clearwater County, the Red Lake River has an elevation of approximately 1,181 feet above sea level. The outlet elevation near East Grand Forks is 348 feet lower at approximately 833 feet. Since the Red Lake River flows about 192 miles from its source to its confluence with the Red River, its average gradient is only 1.8 feet/mile. Over the last few centuries, an effort has been made to increase the rate at which water is shed off the land by creating ditch networks and or straightening natural reaches in the area. Much of this ditching (channelization) occurred in the early 1900s through various state/county projects in an effort to create conditions which would better suit the agricultural land use practices of the area. In more recent years, installation of drain-tiles has become a common practice to even further increase the drainage rate of the area. Although these projects accomplish their initial goal of draining water from the upstream land more quickly, many of the streams in the watershed have become hydrologically unstable and thus prone to bank failure.

There are 12 dams within the Red Lake River Watershed. Many of them are utilized to manage water levels to increase waterfowl habitat, and a few are utilized for hydroelectric power. In 2005, the Crookston Dam which was located at river mile 53.6 upstream of the confluence with the Red River of the North was removed. The dam was originally built in 1883 to provide mill power. It was converted to generate hydropower in 1905 and ultimately retired in 1970. In 2006, a second dam constructed in 1916 approximately 10 miles upstream (river mile 62.8) was also removed. Originally built by the Red River Power Company for generation of hydroelectric power, the dam was severely damaged during a flood in 1950. Although no longer used to generate power, the dam remained in place for more than half a century. http://files.dnr.state.mn.us/eco/streamhab/reconnecting_rivers_appendix.pdf.

The removal of both dams has not only increased public safety and recreational opportunities to kayakers and anglers, but also has provided fish habitat and allow passage to access critical upstream spawning areas. Since the removal of the dams, anglers have reported catching channel catfish and sauger in the upstream portions of the watershed, areas where they had never caught these species prior. One angler reported catching a sauger near the town of Thief River Falls, the first one he has caught there in over 45 years of fishing the location.

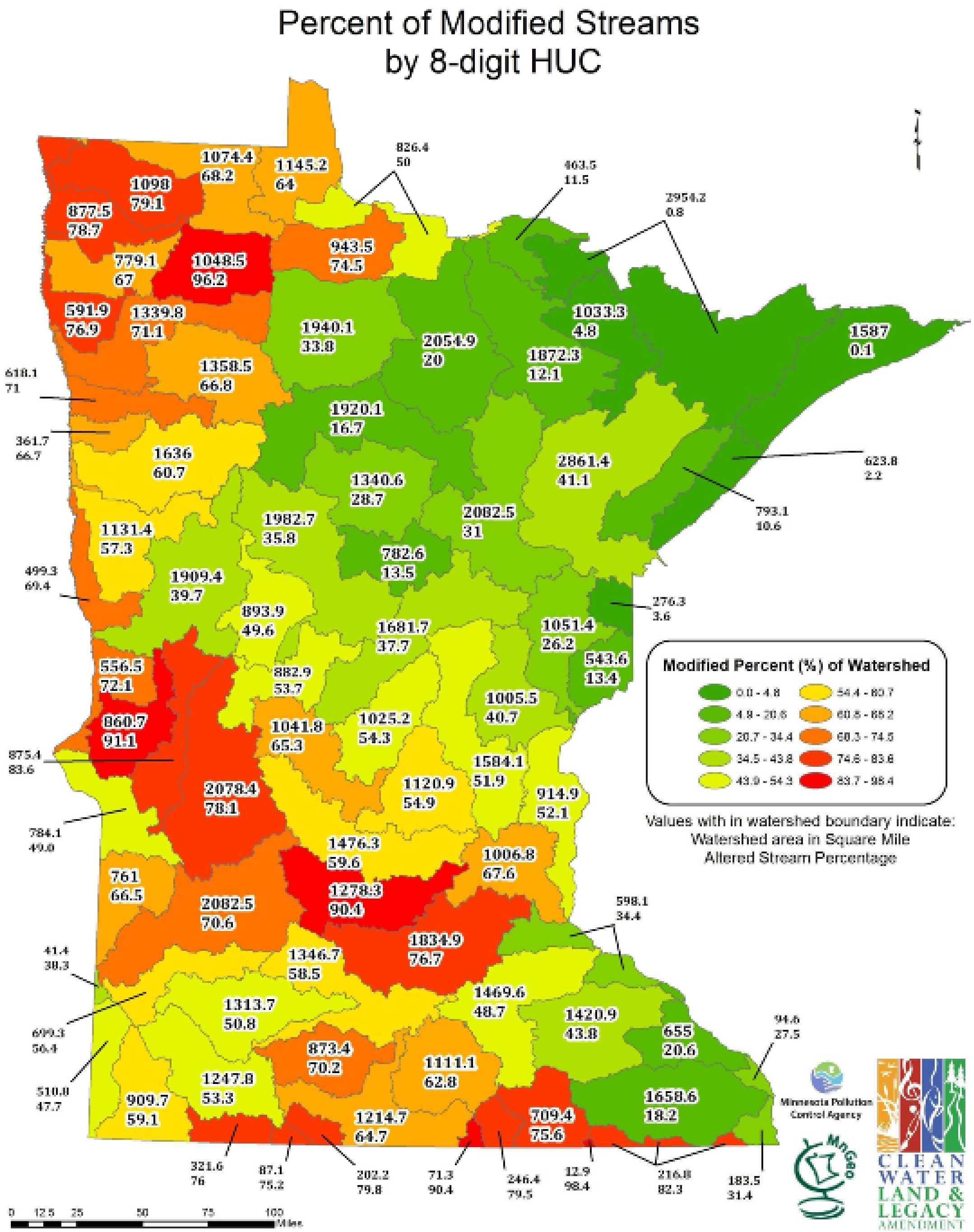

Figure 8. Map of percent modified streams by major watershed (8-HUC).

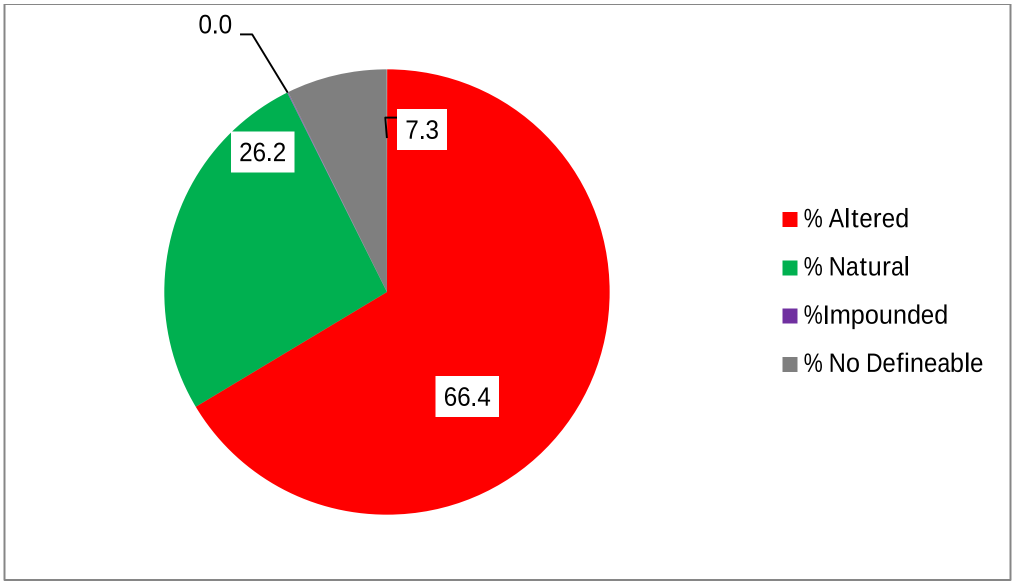

Figure 9. Comparison of natural to altered streams in the Red Lake River Watershed (percentages derived from the State-wide Altered Water Course project).

Climate and precipitation

The ecoregion has a continental climate, marked by warm summers and cold winters. The mean annual temperature for Minnesota is 4.5˚C; the mean summer temperature for the Red Lake River Watershed is 18.3˚C; and the mean winter temperature is -12.8˚ C (Minnesota State Climatologists Office, 2003).

Precipitation is the source of almost all water inputs to a watershed. Figure 10 shows two representations of precipitation for calendar year 2012. On the left is total precipitation, showing the typical pattern of increasing precipitation toward the eastern portion of the state. According to this map, the Red Lake River Watershed area received approximately 16 inches of precipitation in 2012. The display on the right shows the amount those precipitation levels departed from normal. For the Red Lake River area it shows that precipitation ranged from 6 to 10 inches below normal.

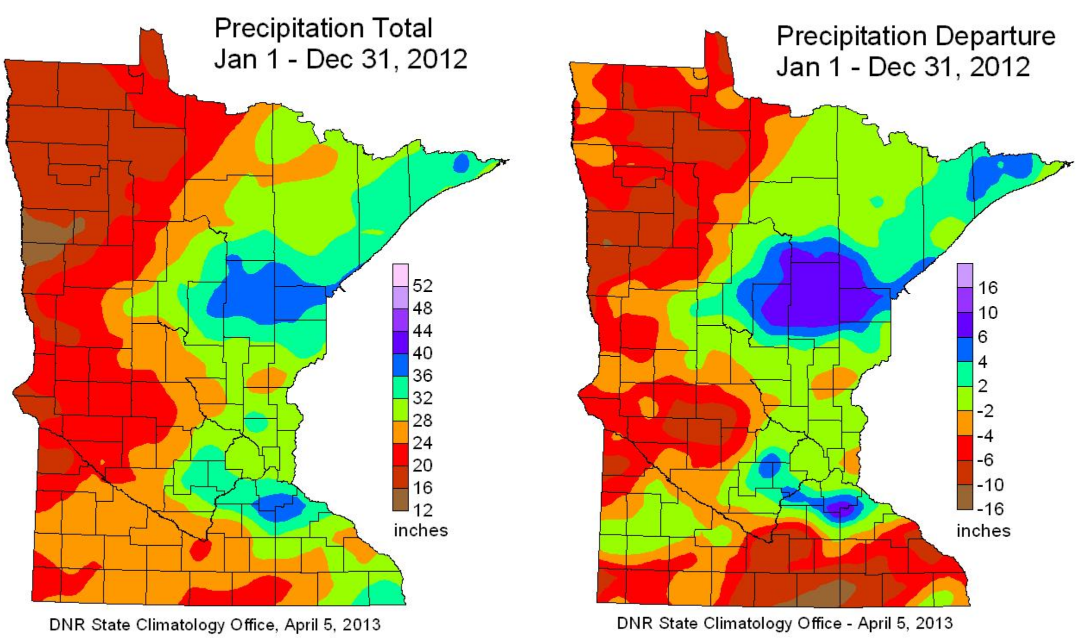

Figure 10. State-wide precipitation levels during the 2012 water year.

The Red Lake River Watershed is located in the northwest precipitation region. Figure 11 and 12 (below) display the areal average representation of precipitation in northwest Minnesota for 20 and 100 years, respectively. An areal average is a spatial average of all the precipitation data collected within a certain area presented as a single dataset. This data is taken from the Western Regional Climate Center, available on the University of Minnesota Climate website. Though rainfall can vary in intensity and time of year, rainfall totals in the northwest region display no significant trend over the last 20 years. However, precipitation in northwest Minnesota exhibits a statistically significant rising trend over the past 100 years (p=0.001). This is a strong trend and matches similar trends throughout Minnesota.

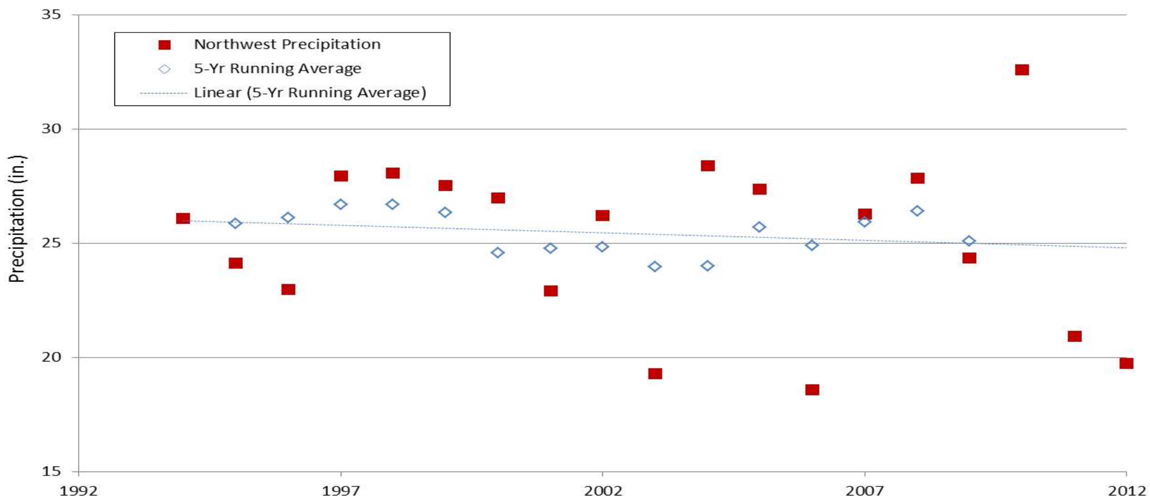

Figure 11. Precipitation trends in northwest Minnesota (1992-2012) with five year running average.

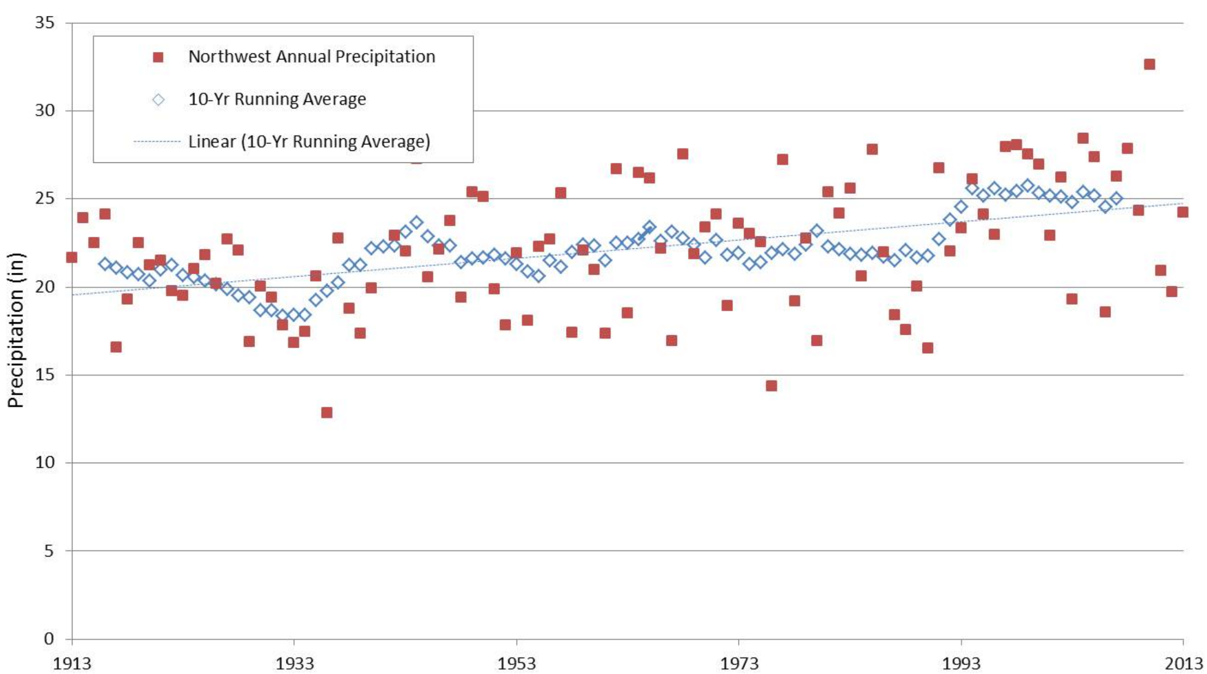

Figure 12. Precipitation trends in northwest Minnesota (1913-2013) with 10-year running average.

Hydrogeology and groundwater quality

The Red Lake River Watershed is located within the Red River of the North Basin in the Northwest Hydrogeologic Region of Minnesota (Region 3). This basin is composed of thick lacustrine sediments, averaging 150 to 300 feet deep, with up to 95 feet of silt and clay lacustrine deposits underneath left behind by Glacial Lake Agassiz (USGS, 2003). The lake was formed in the Hudson Bay drainage during the last de-glaciation, leaving behind two distinct hydrogeological features - beach ridges and the lake plain. The beach ridges are remnants of the shorelines of Glacial Lake Agassiz, and are characterized by sandy, coarse-textured deposits and disjoined aquifers. In these disconnected aquifers, water will collect and move horizontally through the ridge and form wetlands and springs at the base. The plain, known as the Lake Agassiz Plain, is composed of glacial till overlying thick lacustrine sediments and is more specifically characterized by glacially-deposited, clay-rich sediments, poorly drained organic soils, peat and open and wooded wetlands (Lorenz & Stoner, 1996). The plain is extremely flat with few lakes, making it highly prone to flooding.

The Red Lake River Watershed is also located within one of Minnesota's six groundwaterprovinces: the Western Province. This province is defined by the MDNR and described geologically as "clayey glacial drift overlying Cretaceous and Precambrian bedrock" (MDNR, 2001).

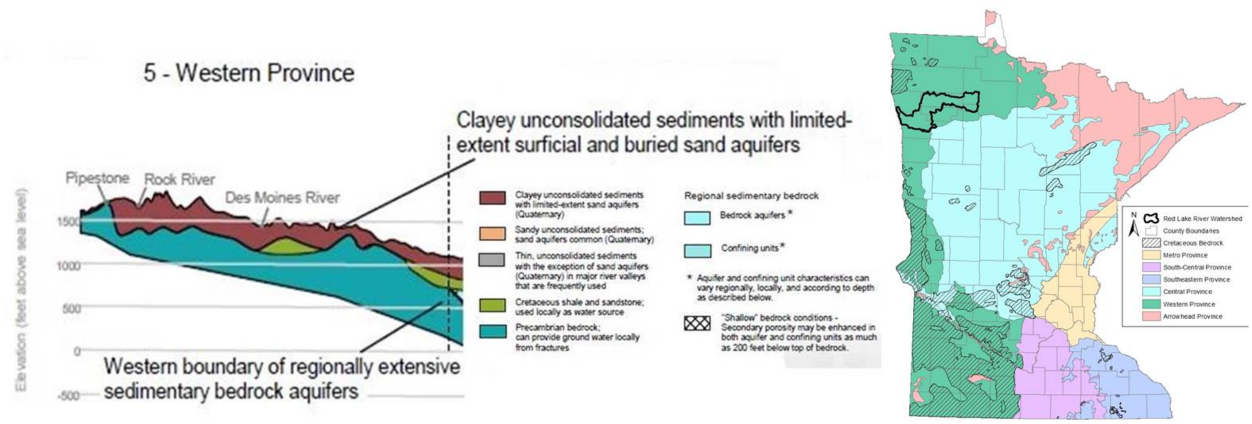

Figure 13. Western Province generalized cross section (Source: MDNR, 2001)

The lake plain aquifers are covered with thick lake deposits which are recharged primarily from an area of stagnation moraines to the east of the watershed. These areas are where glaciers "stagnated", deposited coarse-grained material, and left behind rough topography. Stagnation moraines are important for regional groundwater recharge in the entire northwestern portion of the state; they average five inches of recharge per year, but can account for up to 10 inches (MPCA, 1999).

Groundwater is available primarily through surficial sand and gravel aquifers, buried sand and gravel aquifers, and deeper cretaceous aquifers. Recharge of these aquifers is limited to areas located at topographic highs, areas with surficial sand and gravel deposits, and those along the bedrock/surficial deposit interface. Typically, recharge rates in unconfined aquifers are estimated at 20 to 25% of precipitation received, but can be less than 10% of precipitation where glacial clays or till are present (USGS, 2007). For the Red Lake River Watershed, the average annual recharge rate to surficial materials is zero to two inches per year in the western portion of the watershed, two to four inches per year in the central portion, and ranging from two to six inches per year in the eastern reaches (Figure 14).

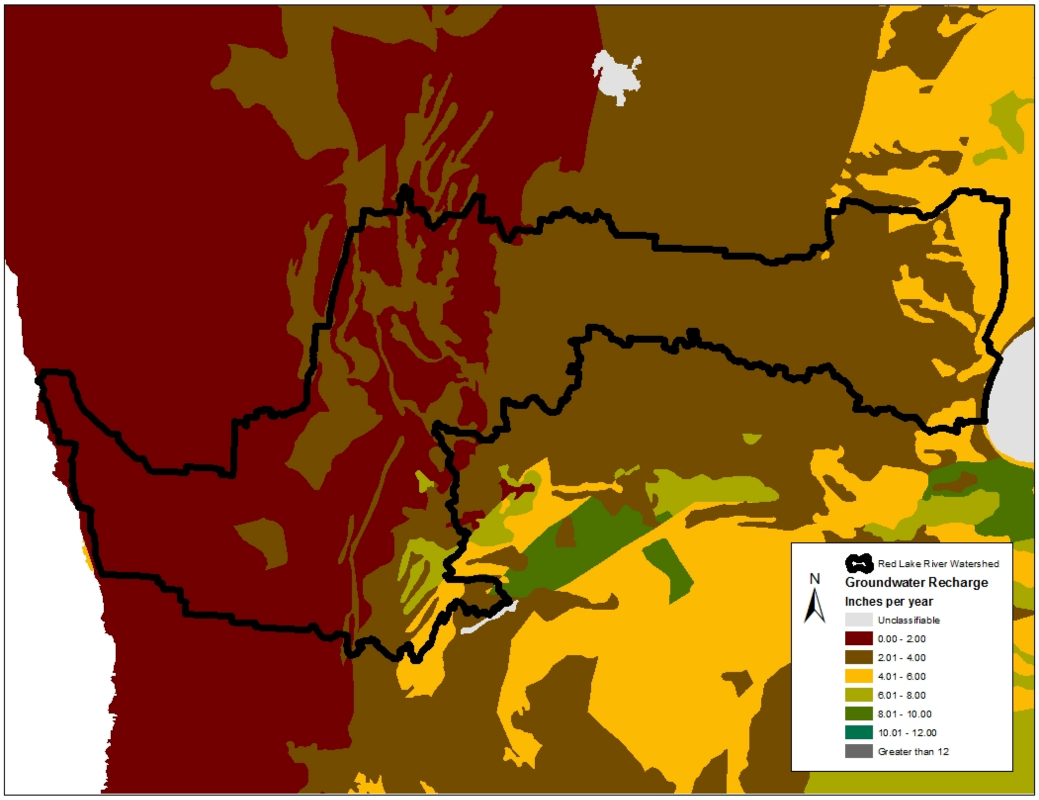

Figure 14. Average annual recharge rate to surficial materials in Red Lake River Watershed (1971-2000).

Groundwater/surface water withdrawals

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

The changes in withdrawal volume detailed in this report are a representation of water use and demand in the watershed that are taken into consideration when the MDNR issues permits for water withdrawals. Other factors not discussed in this report but considered when issuing permits include: interactions between individual withdrawal locations, cumulative effects of withdrawals from individual aquifers, and potential interactions between aquifers. This holistic approach to water allocations is necessary to ensure the sustainability of Minnesota's groundwater resources.

The three largest permitted consumers of water in the state (in order) are municipalities, industry and irrigation. The withdrawals within the Red Lake River Watershed are mostly for irrigation (major crop and non-crop) and municipal use (waterworks).

Figure 15 displays total groundwater withdrawals from the watershed from 1991-2011 as blue diamonds, with total surface water withdrawals as red squares. During this time period within the Red Lake River Watershed, groundwater withdrawals exhibit a significant rising trend (p=0.01) while surface water withdrawals exhibit no trend. However, it is relevant to notice the significant increase in surface water withdrawal beginning in 2008.

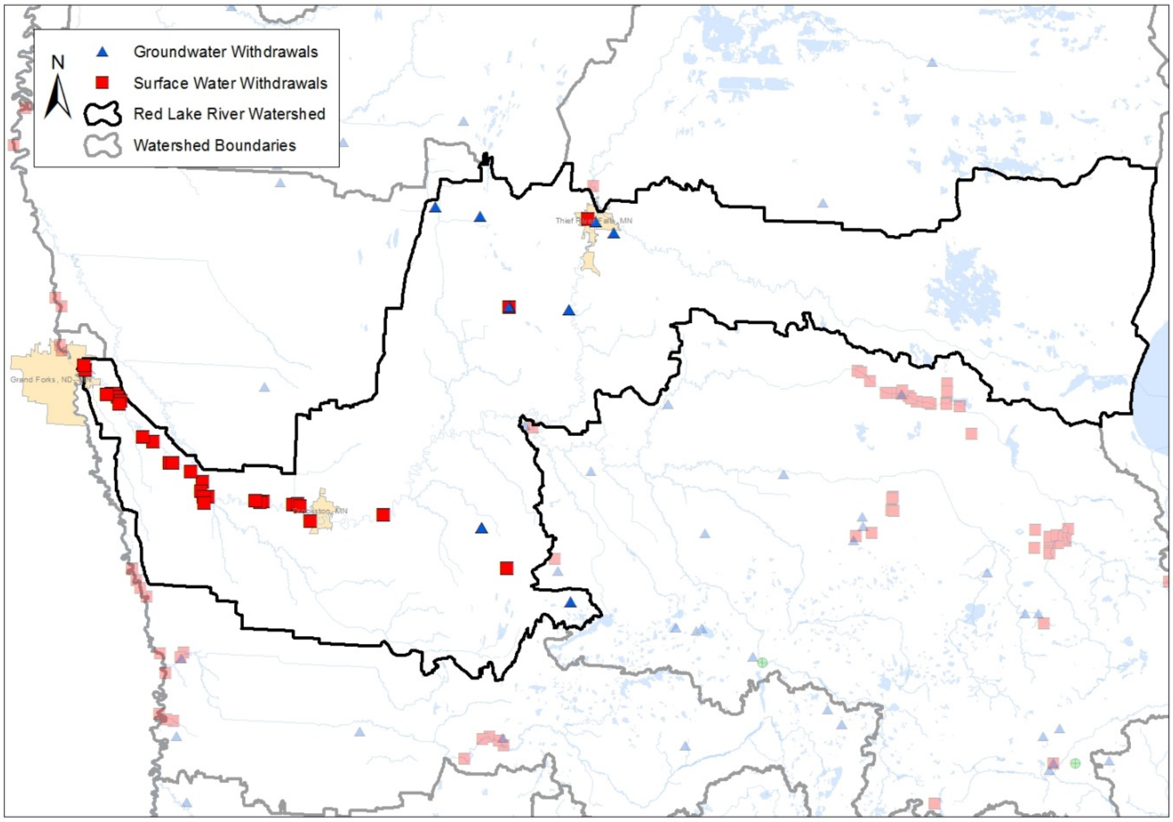

Figure 15. Locations of permitted groundwater withdrawals in the Red Lake River Watershed.

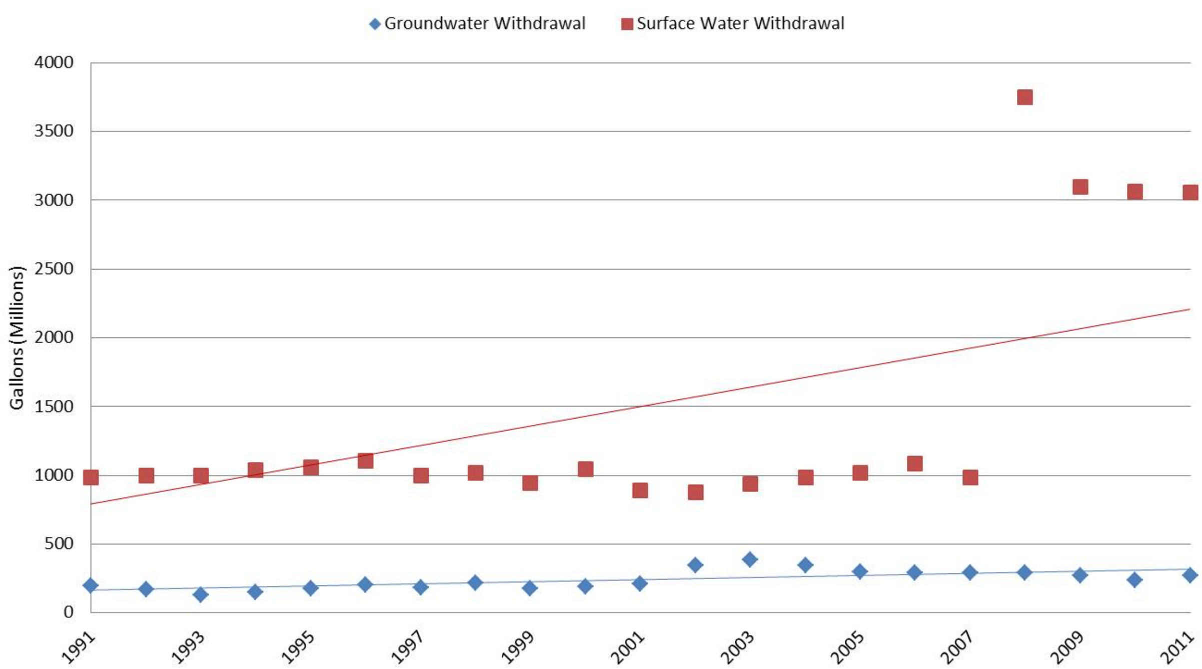

Figure 16. Total annual groundwater and surface water withdrawals in the Red Lake River Watershed (1991-2011).

Wetlands

The current wetland extent in the Red Lake River Watershed varies widely from east to west. Overall, there are 194,548 acres of wetland—or about 23% of the watershed area—according to National Wetlands Inventory (NWI) data (Figure 17). This wetland extent is slightly higher than the state wetland coverage rate of 19%; however, most of the wetlands are located in the far eastern portion of the watershed corresponding with the boundary between the Temperate Prairies and Mixed Wood Shield (i.e., northern forest) ecoregions. The predominant wetland type is Emergent wetland that has a canopy of grasses, sedges, and/or cattails.

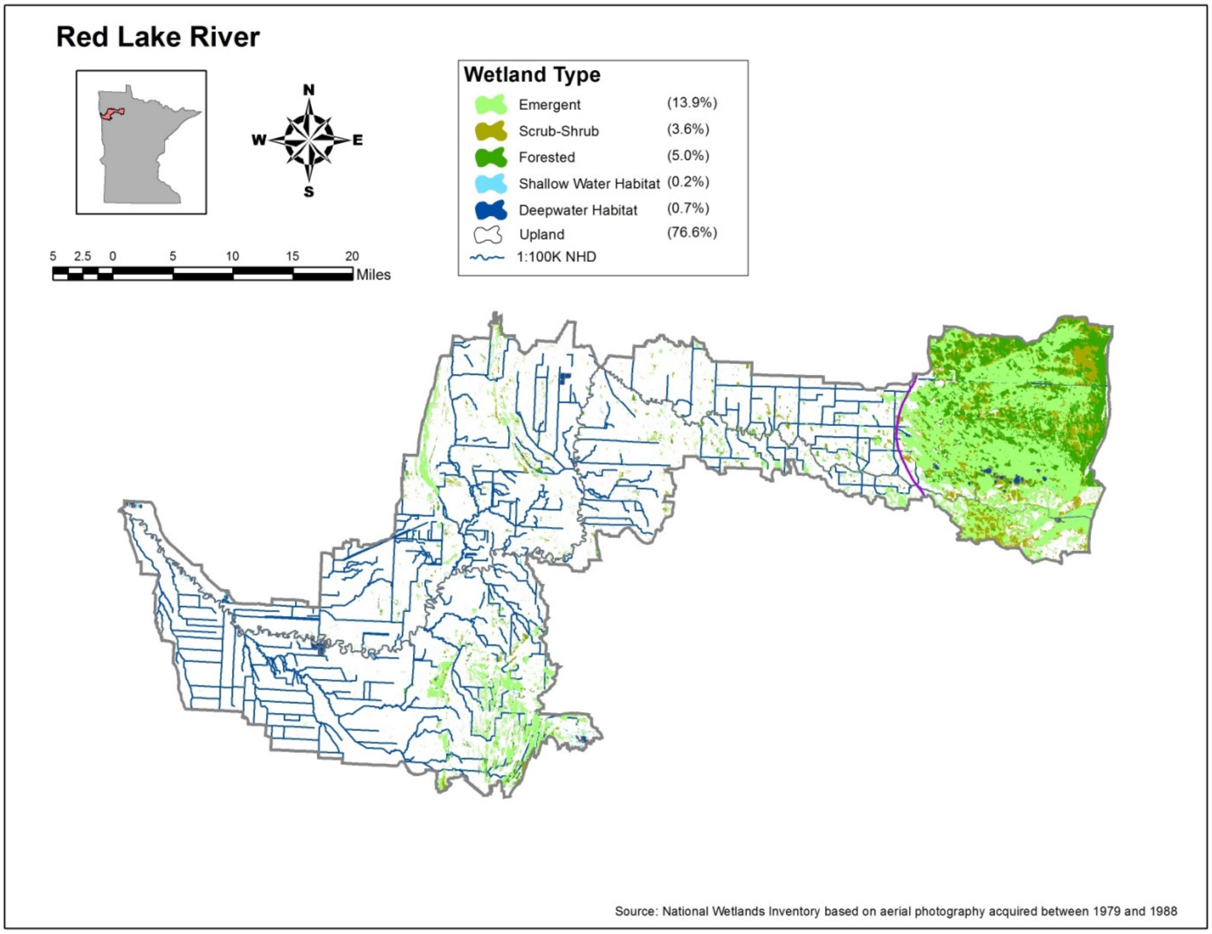

Figure 17. Wetlands and surface water in the Red Lake River Watershed. Wetland data is from the National Wetlands Inventory.

Prior to settlement, wetlands were much more prevalent and evenly distributed throughout the Red Lake River Watershed. As wetland soil features persist after artificial drainage, soil survey data can be used to estimate historical wetland extent. Mapped Poorly and Very Poorly drained soil drainage classes (which would typically support wetlands) equal 358,902 acres in the watershed—or approximately 42%. Comparing that total to the current NWI estimate reveals that approximately 54% of the historical wetland extent has been lost. Again, most of the losses have occurred in the Temperate Prairies ecoregion portion of the watershed where all of the sub-watersheds (with the exception of the Gentilly River) have lost >75% (and in many cases > 90%) of their historical wetland acreage (Figure 18).

Two glacial landforms are present in the Red Lake River Watershed (MNGS 1997) that have largely dictated the current wetland extent patterns and the kinds of hydrogeomorphically (HGM; Smith et al. 1995) functioning types that are currently (or once) present. The landform of the eastern half and far western quarter of the watershed consists of a glacial lake plain. The extremely flat landscape that remained following the drainage of Glacial Lake Agassiz had little capacity to drain surface water, promoting saturated soil conditions over expansive areas. Mineral flat HGM type wetlands formed in the glacial lake plain landform in the Temperate Prairies ecoregion portion of the watershed. These have in large part been effectively drained primarily via surface ditching to increase agricultural production. Organic flat HGM type wetlands formed in the Mixed Wood Shield ecoregion portion of the watershed where the climate is relatively wetter and cooler. The majority of these wetlands remain. The remainder of the watershed is made up of a relatively narrow band of sand and gravel glacial lake beach ridges that were formed on the shores of Glacial Lake Agassiz at various stages of lake depth. The majority of the watershed's current wetlands within the Temperate Prairies ecoregion occur amongst these beach ridges, where drainage and agriculture are less practical. There are numerous areas of groundwater discharge along the beach ridge zone. Wetlands form where water accumulates behind downstream ridges (depressional HGM type), as well as in areas on the ridge slopes where groundwater discharge saturates the soil surface and peat accumulates (slope HGM type). Calcareous fens—an uncommon wetland type with alkaline (pH > 6.7) peat that supports a number of rare plant species—form where the groundwater discharge is mineral-rich. Calcareous fens are state Outstanding Resource Value Waters (ORVW; Minn. R. ch. 7050 2008; [https://www.revisor.leg.state.mn.us/rules/?id=7050)](https://www.revisor.leg.state.mn.us/rules/?id=7050) and six occur in the watershed. Three are clustered approximately eight miles west of Thief River Falls. Two are clustered nine miles southeast of Crookston. The remaining calcareous fen is approximately eight miles northwest of Fertile.

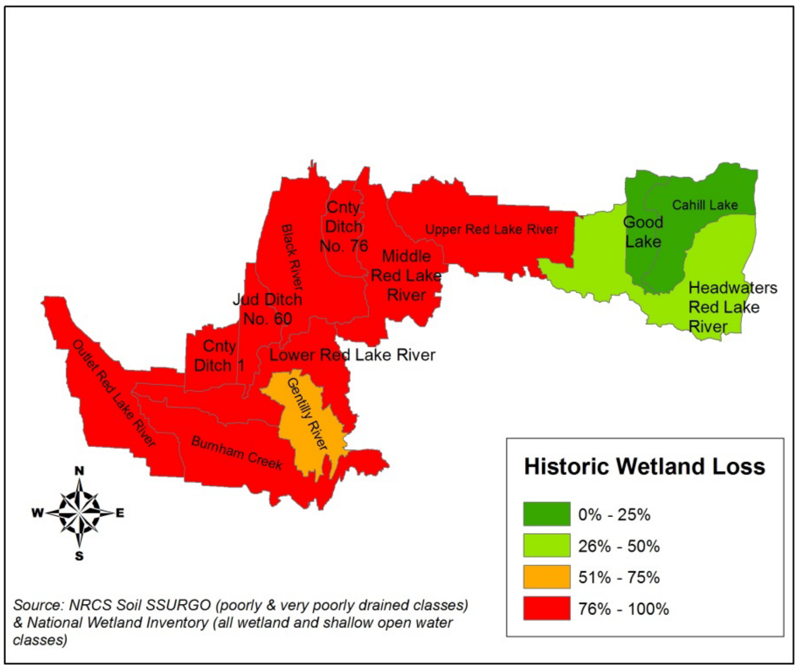

Figure 18. Historic wetland loss by sub-watershed in the Red Lake River Watershed.

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 macroinvertebrate and vegetation IBIs for depressional wetlands 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. The MPCA is in process of publishing the results for an initial baseline survey of vegetation quality for all wetland types based on the FQA (MPCA *in prep*). The overall survey results may provide a reasonable approximation of current wetland conditions in the watershed.

Wetland vegetation quality is high in Minnesota (Table 2)—with approximately 67% of the total wetland extent in exceptional-good condition. Wetlands in exceptional-good condition have had few (if any) changes in expected native vegetation composition or abundance distribution. The high rates of exceptional-good condition at the statewide scale is being driven by the large proportion of wetlands (75%) that occur in the Mixed Wood Shield ecoregion, where there have been few human impacts and condition is largely intact (Table 2). Wetlands within the Mixed Wood Shield ecoregion portion of the watershed likely have high rates of exceptional-good vegetation condition. A single wetland survey site located in this area was in exceptional condition, helping to support this generalization.

The majority of the Red Lake River Watershed, however, occurs in the Temperate Prairies ecoregion, where agriculture is the predominant land use and the vast majority of pre-settlement wetlands have been drained. Correspondingly, wetland vegetation quality in the ecoregion is largely degraded (Table 2), with 82% of wetlands having fair-poor condition. Plant communities assessed as fair-poor have had moderate to extreme changes in expected species composition and abundance distributions. These changes are associated with a broad spectrum of human impacts, such as physical and hydrological alterations that most often promote increases in the abundance of non-native plant species such as Reed canary grass and/or Narrow leaved cattail. Wetlands in poor vegetation condition often have had significant to complete replacement of native species by non-native invasive species. Given the ecoregion results, it is very likely that the vegetation quality of the wetlands in this large portion of the watershed is predominantly in a degraded state. A single wetland survey site was located in the Temperate Prairies portion of the watershed and was in fair condition due to high abundance of Reed canary grass.

Table 2. The relative proportions of wetland vegetation condition categories (Exceptional/Good/Fair/Poor) observed statewide and in the Mixed Wood Shield and Temperate Prairies ecoregions for all wetland types. Proportions are based on the total wetland extent over the geographic area.

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

IV. Watershed-wide data collection methodology

Load monitoring

Intensive water quality sampling occurs throughout the year at all WPLMN sites. Between 16 and 39 mid-stream grab samples were collected per year at the Red Lake River at Fisher, Minnesota (MDNR/MPCA ID: 63078001; EQuIS ID: S000-031; USGS ID: 05080000). 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 19). 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, originally developed by Dr. Bill Walker and recently upgraded by the U.S. Army Corp of Engineers and the MPCA to compute pollutant loads for all WPLMN monitoring sites. Flux32 allows the user to create seasonal or discharge constrained concentration/flow regression equations to estimate pollutant concentrations and loads on days when samples were not collected. Primary outputs include annual and daily pollutant loads and flow weighted mean concentrations (pollutant load/total flow volume). Loads and flow weighted mean concentrations are calculated for total suspended solids (TSS), total phosphorus (TP), dissolved orthophosphate (DOP), nitrate plus nitrite nitrogen (nitrate-N), and total Kjeldahl nitrogen (TKN).

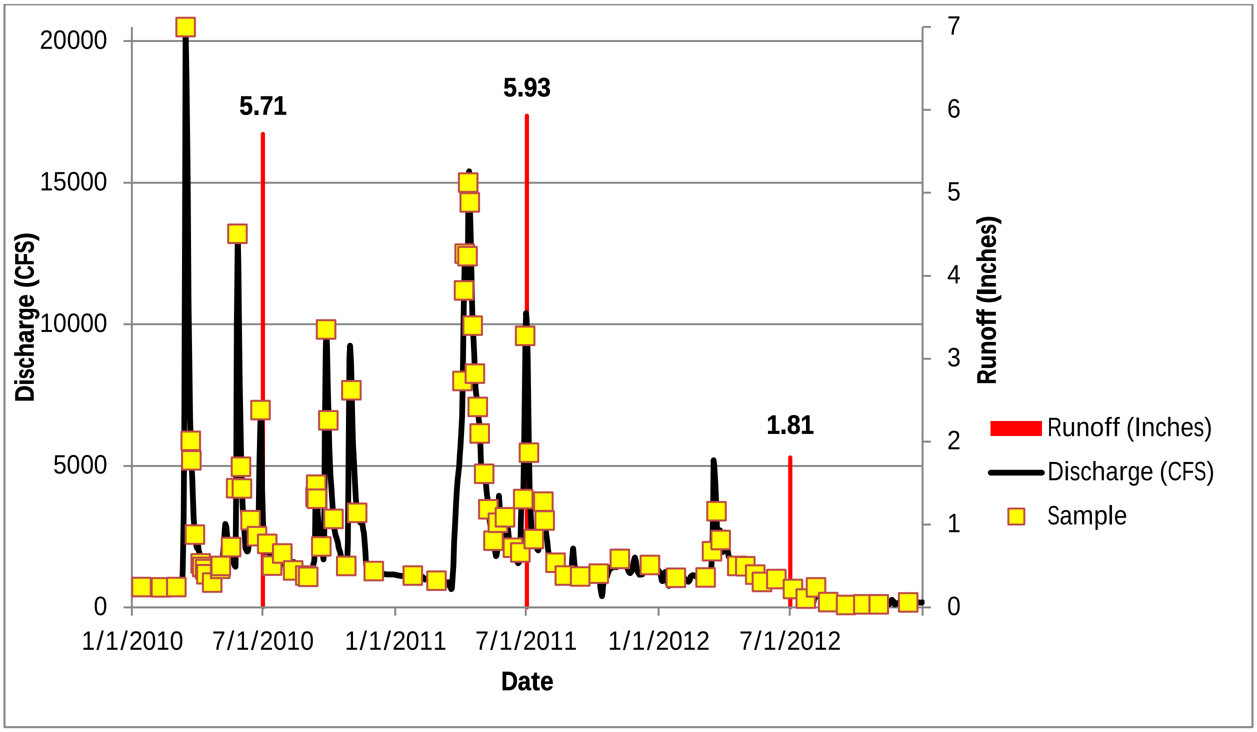

Figure 19. 2010-2012 hydrograph, sampling regime and annual runoff for the Red Lake River at Fisher, Minnesota.

Additionally, the USGS maintains real-time streamflow gaging stations across the United States. Measurements can be viewed at: USGS Current Water Data for the Nation Some USGS gages are incorporated into the WPLMN.

Stream water chemistry sampling

Fourteen water chemistry stations were sampled in 2012 and 2013, 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 (green circles in Figure 3). A SWAG was awarded to the Red Lake Watershed District (RLWD) in partnership with Pennington County SWCD and Red Lake County 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). Headwaters Red Lake River, Cahill Lake, and Good Lake Subwatersheds (aggregated 12-HUC) did not have intensive chemistry collection stations placed at their outlets; however, biological stations were placed at the outlets and assessed for aquatic life. These three subwatersheds lay partially or completely within the Red Lake Indian Reservation and their land use is dominated by a dense bog/wetland complex. Not only is access to these subwatersheds difficult due to the terrain and political boundaries, but there were no chemistry sites that would be representative of stream conditions and not influenced by the bog. The MPCA assessed the outlet of the Headwaters Red Lake River, Cahill Lake, and Good Lake Subwatersheds using biological data to assess aquatic life.

Stream biological sampling

The biological monitoring component of theIWM in the Red Lake River Watershed was completed during the summer of 2012. A total of 35 sites were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, five existing biological monitoring stations within the watershed were revisited in 2012. These monitoring stations were initially established as part of a random Red River Basin-wide survey in 2005, or as part of a 2007 survey which investigated the quality of channelized streams with intact riparian zones. A pilot effort was also conducted in 2012 within the Red Lake River Watershed where additional (biological intensification) sites were established in areas where an observed degraded aquatic community was anticipated. Although it was initially thought that these additional locations would aid in the stressor identification phase of the watershed down the line, data from these sites ended up corroborating overall conditions indicated by the standard IWM sites. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2014 assessment was collected in 2012. A total of 28 AUIDs were sampled for biology in the Red Lake River Watershed. Waterbody assessments to determine aquatic life use support were conducted for 27AUIDs. 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, IBIs, specifically fish and invertebrate IBIs, were calculated based on monitoring data collected for each of these communities. A fish and macroinvertebrate classification framework was developed to account for natural variation in community structure which is attributed to geographic region, watershed drainage area, water temperature and stream gradient. As a result, Minnesota's streams and rivers were divided into seven distinct warm water classes and two cold water classes, with each class having its own unique fish IBI and invertebrate IBI. Each IBI class uses a unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals (CIs) (For IBI classes, thresholds and CIs, see Appendix 4.1). IBI scores higher than the impairment threshold and upper CI indicate that the stream reach supports aquatic life. Contrarily, scores below the impairment threshold and lower CI indicate that the stream reach does not support aquatic life. When an IBI score falls within the upper and lower confidence limits, additional information may be considered when making the impairment decision such as the consideration of potential local and watershed stressors and additional monitoring information (e.g., water chemistry, physical habitat, observations of local land use activities). For IBI results for each individual biological monitoring station, see Appendix 4.2.

Fish contaminants

Mercury and PCBs were analyzed in fish tissue samples collected from the Red Lake River and the Red Lake River Reservoir. MPCA biomonitoring staff collected the fish from the river in 2012. MDNR fisheries staff collected all other fish.

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

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

Before 2006, mercury in fish tissue was assessed for water quality impairment based on MDH's fish consumption advisory. An advisory more restrictive than a meal per week was classified as impaired due to mercury in fish tissue. Since 2006, a waterbody has been classified as impaired due to 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 per species are required to make this assessment and only the last 10 years of data are used for statistical analysis. MPCA's Impaired Waters List includes waterways that were assessed as impaired prior to 2006 as well as more recent impairments.

PCBs in fish were intensively monitored in the 1970s and 1980s, showing high concentrations of PCBs were only a concern downstream of large urban areas in large rivers, such as the Mississippi River and in Lake Superior. Therefore, continued widespread frequent monitoring of smaller river systems was not necessary. The current watershed monitoring approach includes screening for PCBs in representative predator and forage fish collected at the pour point stations in each major watershed.

Lake water sampling

The MPCA sampled Lake Miskogineu in 2012, as part of the EPA's National Lake Assessment for the purpose of providing statistically valid regional and national estimates of the condition of lakes. Results of this study can be found at: http://www.pca.state.mn.us/index.php/view-document.html?gid=21074. There are currently no volunteers enrolled in the MPCA's CLMP that are conducting lake monitoring within the watershed.

Groundwater quality

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

Groundwater/surface water withdrawals

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

The changes in withdrawal volume detailed in this report are a representation of water use and demand in the watershed and are taken into consideration when the MDNR issues permits for water withdrawals. Other factors not discussed in this report but considered when issuing permits include: interactions between individual withdrawal locations, cumulative effects of withdrawals from individual aquifers, and potential interactions between aquifers. This holistic approach to water allocations is necessary to ensure the sustainability of Minnesota's groundwater resources.

Groundwater quantity

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

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, Mixed Wood Plains and the Mixed Wood Shield 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. These indicators are used in a statewide survey of wetland condition where results can be summarized statewide and for each of Minnesota's three level II ecoregions (Genet 2012).

V. Individual subwatershed results

Aggregated HUC-12 subwatersheds

Assessment results for aquatic life and recreation use are presented for each aggregated HUC-12 subwatershed within the Red Lake 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 3.1). This scale provides a robust assessment of water quality condition at a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The graphics presented for each of the aggregated HUC-12 subwatersheds contain the assessment results from the 2014 Assessment Cycle as well as any impairment listings from previous assessment cycles. Discussion of assessment results focuses primarily on the 2012 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 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 subwatershed. A brief description of each of the summary tables is provided below.

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.

Stream assessments

A table is provided in each section summarizing aquatic life and aquatic recreation assessments of all assessable stream reaches within the 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); these determinations are made during the desktop phase of the assessment process (see Figure 5. Flowchart of aquatic life use assessment process.) Assessment of aquatic life is derived from the analysis of biological (fish and invertebrate IBIs), DO, turbidity, chloride, pH and un-ionized ammonia (NH_3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (Escherichia coli or fecal coliform) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community general use (2Bg); cool or warm water community modified use (2Bm); 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 3.1. 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 invertebrate 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.

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 Red Lake 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

There are a limited number of lakes in the Red Lake River Watershed. There was not sufficient information to assess lakes, so there will be no further discussion on lakes in this report.

Headwaters Red Lake River Subwatershed HUC 0902030302-02

The Headwaters Red Lake River Subwatershed drains approximately 188 square miles of Beltrami, Clearwater, and Pennington Counties. Due to its relatively large drainage area, it is one of the main contributing subwatersheds of the Red Lake River. Originating at the outlet of Lower Red Lake located in Red Lake Nation, the Red Lake River flows primarily in a westerly direction where it also receives water from County Ditch (CD) 43 in Pennington County, the other major contributor within this subwatershed.

The outlet of the Headwaters Red Lake River Subwatershed is represented by the MPCA's STORET/EQuIS station S007-234 and biological station 12RD018 (located upstream of County Road (CR) 27, 7 mi. East of River Valley), and MPCA's STORET/EQuIS station S002-077 (biological station 05RD129), just south of High Landing, Minnesota. The latter station is just downstream of the headwaters watershed, but its location best represents conditions in this watershed.

Table 3. Aquatic life and recreation assessments on stream reaches: Headwaters Red Lake River Subwatershed. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Aquatic Rec. Indicators: Bacteria	Nutrients	Aquatic Life	Aquatic Rec.
09020303-547 County Ditch 43 Unnamed ditch to Red Lake River	7.3	WWm	12RD045	Upstream of CSAH 3, 6 mi E. of River Valley.	EXS	EXS	IF	IF	-	IF	-	-	-	-	IMP	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 4. Minnesota Stream Habitat Assessment (MSHA): Headwaters Red Lake River Subwatershed.

# 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	12RD045	County Ditch 43	1.5	8	12	12	7	40.5	Poor
Average Habitat Results: *Headwaters Red Lake River Subwatershed*			1.5	8	12	12	7	40.5	**Poor**

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

Table 5. Channel Condition and Stability Assessment (CCSI): Headwaters Red Lake River Subwatershed.

# 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	12RD045	County Ditch 43	16	5	12	1	34	Fairly Stable
Average Stream Stability Results: *Headwaters Red Lake River Subwatershed*			16	5	12	1	34	**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 6. Outlet water chemistry results: Headwaters Red Lake River Subwatershed.

Station location:	**Red Lake River at CSAH 27, 7 mi E of River Valley**						
STORET/EQuIS ID:	**S007-234**						
Station #:	**12RD018**						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-nitrogen	ug/L	18	<40	680	77		
Chloride	mg/L	10	2.79	3.49	3.15	230	
Dissolved Oxygen (DO)	mg/L	36	6.58	13.16	9.67	5	
pH		36	7.54	8.87	8.33	6.5-9	
Secchi Tube[1]	100 cm	19	29.5	100.0	64.4	25	
Total suspended solids	mg/L	16	1	23	10.4	30	
Escherichia coli (geometric mean)	MPN/100ml	4	12	94	-	126	
Escherichia coli	MPN/100ml	17	3	261.3	-	1260	
Inorganic nitrogen (nitrate and nitrite)	mg/L	16	<0.03	<0.03	<0.03		
Kjeldahl nitrogen	mg/L	16	0.33	1.09	0.84		
Phosphorus	ug/L	16	20	98	39		
Specific Conductance	uS/cm	36	229	332	280		
Temperature, water	deg °C	36	10.09	29.18	20.45		
Sulfate	mg/L	10	<3.00	6.11	3.90		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at an IWM station in the Headwaters Red Lake River Subwatershed, conducted between April and October from 2012 to 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 7. Outlet water chemistry results: Headwaters Red Lake River Subwatershed.

Station location:	Red Lake River at CSAH 24, 7 mi S of Goodridge						
STORET/EQuIS ID:	S002-077						
Station #:	05RD129						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Ammonia-nitrogen	ug/L	56	<0	90	40	40	8
Chloride	mg/L	10	2.93	3.51	3.25	230	
Dissolved Oxygen (DO)	mg/L	112	5.44	13.78	9.00	5	
pH		114	6.23	8.61	8.02	6.5 - 9	1
Secchi Tube	100 cm	86	18.0	107.5	68.4	25	1
Total suspended solids	mg/L	108	<1	77	11.1	30	1
Escherichia coli (geometric mean)	MPN/100ml	7	9	42	-	126	
Escherichia coli	MPN/100ml	50	2	387	-	1260	
Chlorophyll-a, Corrected	ug/L	7	0.70	4.60	2.55		
Inorganic nitrogen (nitrate and nitrite)	mg/L	97	<0.00	0.76	0.07		
Kjeldahl nitrogen	mg/L	98	0.41	3.08	0.96		
Pheophytin-a	ug/L	7	<0.64	1.27	1.00		
Phosphorus	ug/L	98	19	189	42		
Specific Conductance	uS/cm	112	161	424	282		
Temperature, water	deg °C	112	-0.06	28.52	17.06		
Sulfate	mg/L	10	<3.0	7.4	4.1		
Hardness	mg/L	11	131	159	149.7		
Alkalinity	mg/l	2	98.8	157.0	127.9		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at an IWM station in the Upper Red Lake River Subwatershed, conducted between March and October from 2004 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The Headwaters Red Lake River Subwatershed has one assessable AUID (09020303-547), County Ditch 43. From an unnamed ditch about one mile south of Minnesota Highway 1 and three miles west of the Red Lake Reservation boundary, it flows south 7.3 miles to the Red Lake River. One biological monitoring station (12RD045) was located on CD 43 which was surveyed for fish and macroinvertebrates. A use attainability analysis (UAA) determined that this reach was channelized and habitat limited, thus qualifying for modified use IBI thresholds. The Fish Index of Biological Integrity (FIBI) score was just above this applicable threshold but the sample was dominated by very tolerant taxa and had fewer than 25 total fish from 4 species. The Macroinvertebrate Index of Biological Integrity (MIBI) score was very poor and was dominated by snails, which are tolerant of low DO and poor habitat. There was not sufficient chemistry data to suggest support for aquatic recreation or aquatic life for this reach, however, MPCA stressor ID staff deployed a sonde in August 2014 and has preliminary data for the stream. Continuous DO data from this sampling found every daily minimum to be well below the standard, with a mean of 1.09 mg/L. The combination of low MSHA scores, sonde data and biological community compositions suggest that this reach is severely impaired.

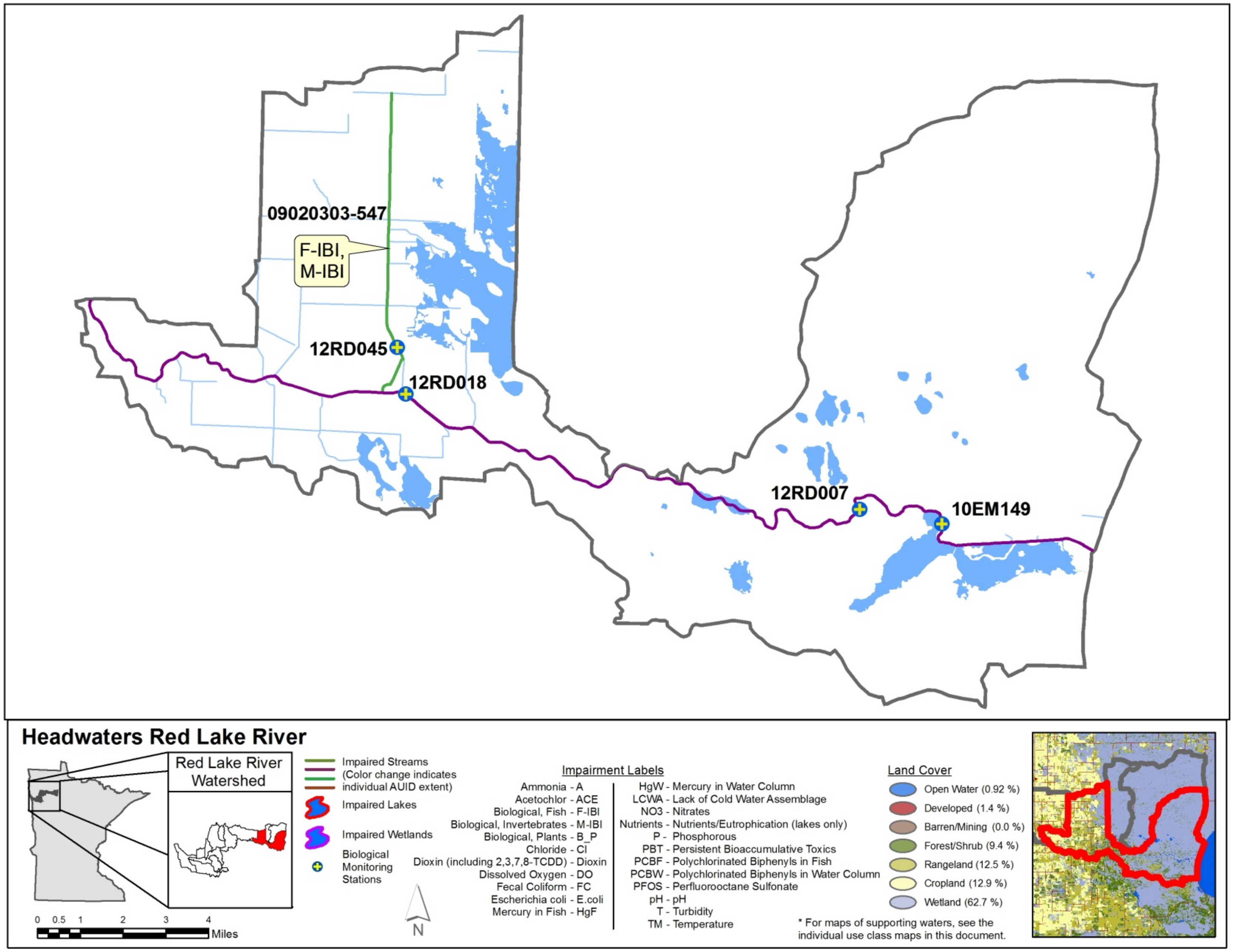

Figure 20. Currently listed impaired waters by parameter and land use characteristics in the Headwaters Red Lake River Subwatershed.

Cahill Lake Subwatershed HUC 0902030301-01

The Cahill Lake Subwatershed drains approximately 95 square miles of land and is completely within the Red Lake Nation. Including portions of Beltrami and Clearwater Counties, it is in the far northeast portion of the Red Lake River Watershed. The major tributary within this drainage is an approximately 10 mile long unnamed ditch that empties into Red Lake River from the north, approximately 3 miles east of the Pennington/Clearwater county line. In 2012, one biological station was established and sampled for both fish and macroinvertebrates on this reach in cooperation with the Red Lake Band of Chippewa. A majority of the land is in some form of a natural state with over 95% being wetland.

There are three lakes greater than 10 acres in size within the Cahill Lake Subwatershed which include: Miskogineu, Curtis, and Cahill, but these were not monitored.

Table 8. Aquatic life and recreation assessments on stream reaches: Cahill Lake Subwatershed. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Aquatic Life	Aquatic Rec.
09020303-543 Trib. To Red Lake River Unnamed ditch to Red Lake River	9.96	WWg	12RD006	Upstream of BIA 22, 21 mi. N of Clearbrook.	MTS	NA	IF	IF	-	IF	-	-	-	SUP	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 9. Minnesota Stream Habitat Assessment (MSHA): Cahill Lake Subwatershed.

# 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	12RD006	Trib. To Red Lake River	5	8	9.8	12	13	47.8	Fair
Average Habitat Results: *Cahill Lake Subwatershed*			**5**	**8**	**9.8**	**12**	**13**	**47.8**	**Fair**

Qualitative habitat ratings

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

Table 10. Channel Condition and Stability Assessment (CCSI): Cahill Lake Subwatershed.

# 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	12RD006	Trib. To Red Lake River	14	9	11	4	38	Fairly Stable
Average Stream Stability Results: *Cahill Lake Subwatershed*			**14**	**9**	**11**	**4**	**38**	**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

Summary

The Cahill Lake Subwatershed has one assessable AUID (09020303-543), a 10 mile unnamed ditch which is completely within the Red Lake Reservation. A fish survey was conducted at biological station 12RD006 on 06/13/2012. The sample had 12 species including several sensitive taxa (e.g. spottail shiner, northern red-belly dace, and finescale dace) which resulted in a very good FIBI score. Although this reach is channelized (ditched), a UAA determined that the habitat did not limit the aquatic community and therefore the general use class standards were still applicable. Macroinvertebrates were not assessed due to flow permanence issues, and there was not sufficient water chemistry data to assess this reach using water chemistry indicators.

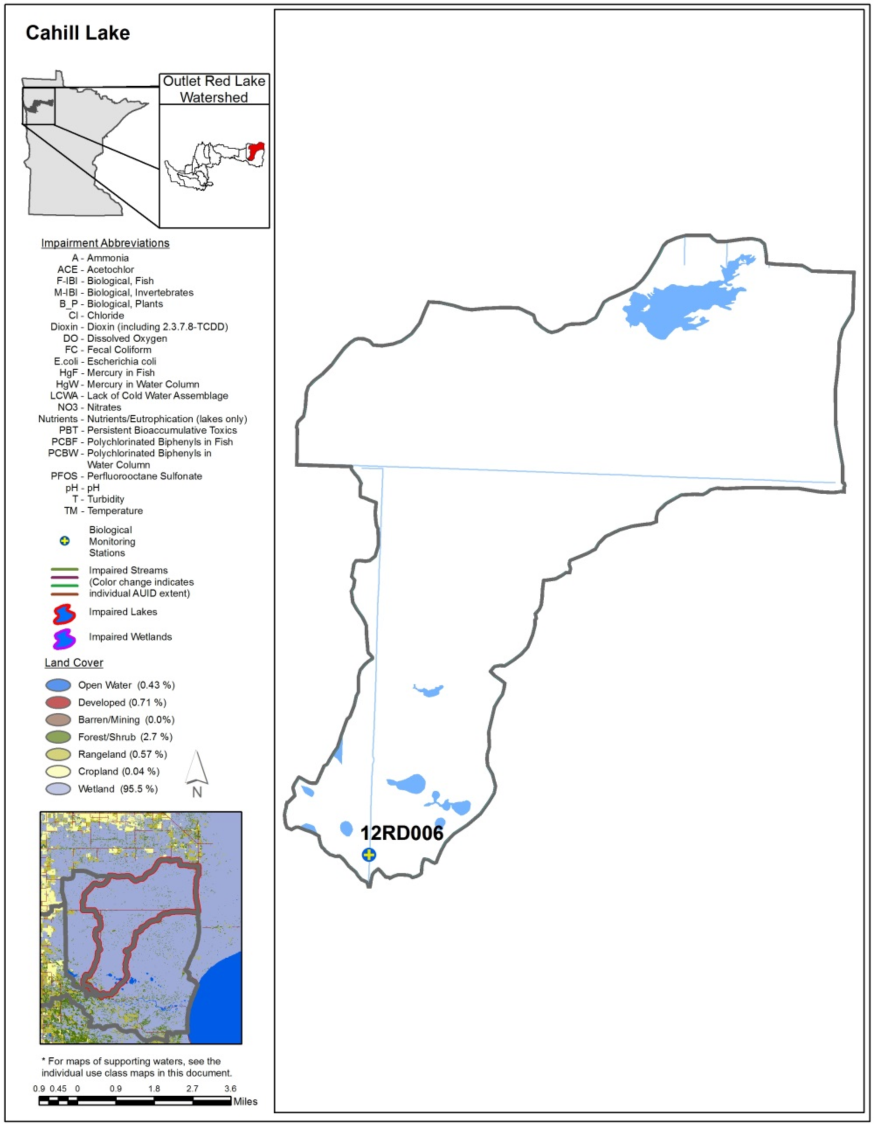

Figure 21. Currently listed impaired waters by parameter and land use characteristics in the Cahill Lake Subwatershed.

Good Lake Subwatershed HUC 0902030302-03

The Good Lake Subwatershed is located in the eastern portion of the Red Lake River Watershed and includes portions of Beltrami and Clearwater Counties. The entire subwatershed is within the Red Lake Reservation. Draining approximately 41 square miles of land, it is the smallest contributing subwatershed to the Red Lake River system. The major tributary within this area is a very small unnamed creek. In 2012, one biological station was established on this reach and sampled for fish and macroinvertebrates in cooperation with the Red Lake Band of Chippewa. Much like the Cahill Lake Subwatershed, minimal development is present and the area is over 90% wetland. There is a cooperative enhancement project occurring within this subwatershed between the Red Lake Band of Chippewa and the Red Lake River Watershed District (Good Lake Impoundment/RLWD Project 67). The project is intended to provide flood water retention and wetland habitat which should benefit waterfowl, furbearers, and other wetland species. The reservoir also provides the potential of seasonally rearing northern pike, as well as development of wild rice paddies in adjacent areas.

Table 11. Aquatic life and recreation assessments on stream reaches: Good Lake Subwatershed. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:								Aquatic Rec. Indicators:			
AUID ***Reach Name,*** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Nutrients	**Aquatic Life**	**Aquatic Rec.**
09020303-544 Trib. To Red lake River Headwaters to Red Lake River	1.25	WWg	12RD009	Upstream of BIA 19, 21 mi. NW of Clearbrook.	MTS	NA	IF	IF	-	IF	-	-	-	-	SUP	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 12. Minnesota Stream Habitat Assessment (MSHA): Good Lake Subwatershed.

# 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	12RD009	Trib. To Red Lake River	5	9	7	12	4	37	Poor
		Average Habitat Results: *Good Lake Subwatershed*	**5**	**9**	**7**	**12**	**4**	**37**	**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 13. Channel Condition and Stability Assessment (CCSI): Good Lake Subwatershed.

# 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	12RD009	Trib. To Red Lake River	7	5	22	5	39	Fairly Stable
		Average Stream Stability Results: *Good Lake Subwatershed*	**7**	**5**	**22**	**5**	**39**	**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

Summary

The Good Lake Subwatershed has one assessable AUID (09020303-544), a 1.25 mile unnamed creek within the Red Lake Reservation. A biological monitoring survey conducted within the Good Lake Subwatershed indicates the biological community to be in excellent condition. The biological monitoring station (12RD009) was sampled with assistance from the Red Lake Department of Natural Resources in June of 2012. The sample produced 14 species including sensitive taxa (e.g. weed shiner, northern red-belly dace) as well as cool water indicative species (brassy minnow). This sampling reach had the highest FIBI score of the entire watershed. A UAA determined that the habitat was not limiting the potential of this resource and therefore the general use standards would still be applicable. The excellent IBI score is indicative of the fact that much of the surrounding land has not been developed, and therefore minimal anthropogenic stressors are present. Macroinvertebrates were not assessed due to flow permanence issues and there was not sufficient water chemistry data to assess this reach using water chemistry indicators.

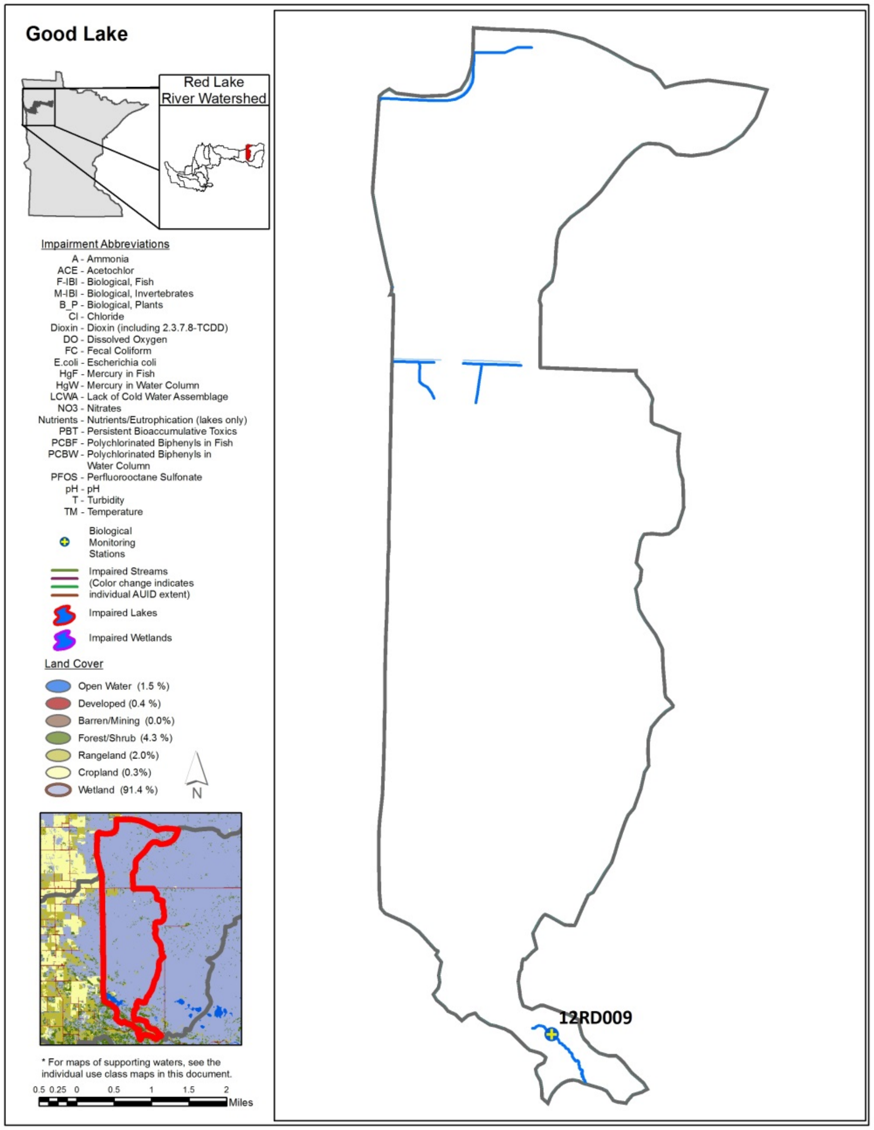

Figure 22. Currently listed impaired waters by parameter and land use characteristics in the Good Lake Subwatershed.

Upper Red Lake River Subwatershed HUC 0902030302-01

The Upper Red Lake River Subwatershed is located within Pennington County in the northeast portion of the Red Lake River Watershed. Covering approximately 158 square miles, it is one of the largest subwatersheds of the Red Lake River system. Aside from the Red Lake River main-stem, all of the reaches within this subwatershed are channelized and go dry or stop flowing during the summer. As a result, a majority of the stations that were established and sampled within this subwatershed were on the main-stem Red Lake River. There is a significant amount of agricultural land in the subwatershed that is dominated by cropland (68%), and some pasture (13%). There is also slightly more development (6%) as the city of Thief River Falls is in the far northwestern corner of this subwatershed.

The outlet of the Upper Red Lake River Subwatershed is represented by the MPCA's STORET/EQuIS station S007-063 and biological station 12RD008, located at County State Aid Highway (CSAH) 7, approximately six miles southeast of Thief River Falls.

Table 14. Aquatic life and recreation assessments on stream reaches: Upper Red Lake River Subwatershed. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Aquatic Rec. Indicators: Bacteria	Nutrients	Aquatic Life	Aquatic Rec.
09020303-508 Red Lake River Headwaters to Thief River	66.51	WWg	10EM149 12RD007 12RD018 05RD129 12RD008 05RD034 12RD104	2 mi. upstream of River Rd, 15 mi. NW of Red Lake Upstream of BIA 19, 21 mi. N of Clearbrook Upstream of CSAH 27, 7 mi. E of River Valley Downstream of CSAH 24, just S of High Landing Upstream of CSAH 7, 6 mi. E of Thief River Falls S of CR 62, 2 mi. SE of Thief River Falls 1.5 mi. upstream of Thief/Red Lake River confluence	MTS	MTS	MTS	MTS	MTS	MTS	MTS	-	MTS	-	SUP	SUP

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 15. Minnesota Stream Habitat Assessment (MSHA): Upper Red Lake River Subwatershed.

# 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	10EM149	Red Lake River	5	11	6	14	24	60	Fair
1	12RD007	Red Lake River	5	11	9	9	13	47	Fair
1	12RD018	Red Lake River	0	6.5	7	5	5	23.5	Poor
2	05RD129	Red Lake River	0	7.5	18	10	15	50.5	Fair
	05RD129	Red Lake River	0	8	16	7	15	46	Fair
2	12RD008	Red Lake River	0	8.5	18	11	17	54.5	Fair
	12RD008	Red Lake River	0	8	18	11	17	54	Fair
1	05RD034	Red Lake River	1	10.5	22	16	25	74.5	Good
1	12RD104	Red Lake River	1	10	12	11	17	51	Fair
Average Habitat Results: *Upper Red Lake River Subwatershed*			**1.3**	**9**	**14**	**10.4**	**16.4**	**51.2**	**Fair**

Qualitative habitat ratings

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

Table 16. Channel Condition and Stability Assessment (CCSI): Upper Red Lake River Subwatershed.

# 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
0	10EM149	Red Lake River	-	-	-	-	-	-
1	12RD007	Red Lake River	6	5	18	1	30	Fairly Stable
1	12RD018	Red Lake River	8	6	10	1	25	Stable
1	05RD129	Red Lake River	6	5	8	1	20	Stable
1	12RD008	Red Lake River	11	6	8	4	29	Fairly Stable
0	05RD034	Red Lake River	-	-	-	-	-	-
1	12RD104	Red Lake River	9	6	20	3	38	Fairly Stable
Average Stream Stability Results: *Upper Red Lake River Subwatershed*			**8**	**5.6**	**12.8**	**2**	**28.4**	**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 17. Outlet water chemistry results: Upper Red Lake River Subwatershed.

Station location:	Red Lake River at CSAH 7 (Smiley Bridge), 6 mi SE of Thief River Falls						
STORET/EQuIS ID:	S007-063						
Station #:	12RD008						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	17	<40	50	40	40	1
Chloride	mg/L	10	2.21	3.74	2.99	230	
Dissolved Oxygen (DO)	mg/L	42	6.22	12.86	9.10	5	
pH		42	7.05	8.90	8.18	6.5 - 9	
Secchi Tube	100 cm	20	24.0	>100.0	80.8	25	1
Total suspended solids	mg/L	20	<1	38	8.25	30	1
Escherichia coli (geometric mean)	MPN/100ml	4	12	24	-	126	
Escherichia coli	MPN/100ml	17	<1	121	-	1260	
Inorganic nitrogen (nitrate and nitrite)	mg/L	16	<0.03	<0.03	<0.03		
Kjeldahl nitrogen	mg/L	16	7.05	8.90	8.18		
Phosphorus	ug/L	16	14	62	32		
Specific Conductance	ug/L	42	221	364	291		
Temperature, water	ug/L	42	4.95	28.77	19.37		
Sulfate	uS/cm	10	<3.0	13.0	5.6		
Hardness	deg °C	11	136	159	149.9		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Upper Red lake River Subwatershed, conducted between April and October from 2012 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

This is a 66 mile reach of the main-stem of the Red Lake River that begins at the outlet of Lower Red Lake and ends at the confluence of the Thief River in Thief River Falls. The reach is currently in the process of being split into three separate reaches; however the splits are not reflected in this report.

Numerous biological surveys on this reach of the Red Lake River (09020303-508) indicate that the fish and macroinvertebrate communities are in good condition. Nine fish surveys were conducted on seven stations and six macroinvertebrate surveys were conducted at five stations along this reach.

The FIBI score in the upper, ditched section of the reach was slightly lower compared to the other stations sampled on this reach. The poor habitat appears to be limiting the biological community to some extent. (MSHA score 23.5). However, the MIBI score was good and included a few sensitive taxa such as the caddis fly, *Helicopsyche borealis*.

Sampling at 10EM149 produced a good FIBI score. Several sensitive species (e.g. weed shiner, rock bass, and spottail shiner) were observed.

The FIBI score for 12RD007 was also very good where again several sensitive taxa were sampled.

Sampling station 12RD018 also produced a good fish community. Despite the relatively good FIBI score, 12RD018 scored slightly lower compared to other stations sampled on this reach. This is most likely due to the fact that this station is located on a channelized (ditched) portion of this reach and habitat appears to be limiting the biological community to some extent (MSHA score 23.5). The macroinvertebrate sampling at 12RD018 had a strong MIBI score and had a few sensitive taxa present including a caddis fly, *Helicopsyche borealis*.

The FIBI scores from two separate visits to station 05RD129 were both good. Sensitive taxa including weed shiner and rock bass, two species of redhorse (golden and shorthead), and a number of darter species (blackside, iowa, and johnny) were found at this site. Similarly, there were two sampling visits to 12RD008 and there was good diversity including both lithophilic and sensitive fish species. MIBI scores were very good at both sites with numerous sensitive species present.

Both the initial and replicate visits to sampling station 05RD129 (which is further downstream) produced FIBI scores that were excellent, where sensitive taxa (weed shiner and rock bass) were sampled at both locations along with two species of redhorse (golden and shorthead). Darter species such as the blackside, iowa, and johnny were also identified within the samples. The two macroinvertebrate visits to 05RD129 also had strong MIBI scores with numerous sensitive taxa present.

Both the FIBI and MIBI scores decreased at the downstream end of the reach. In fact, the MIBI score was just below the applicable threshold but the low score is likely due to difficult sampling conditions and does not suggest impairment.

Previous assessments had listed this reach as impaired for low DO levels as well as mercury in fish tissue. Dissolved oxygen exceedances were more prevalent in the upstream portions of the reach where the stream has been channelized and the surrounding land is comprised of large bog/wetland complexes. Further downstream, the watershed transitions to a mixture of pasture and crops. The combination of wetland influence and stream straightening in the upper portions of the reach appears to have a negative effect on DO. Pre-9:00 AM samples had an exceedance rate of 11.5% but all of the exceedances were from upstream sites. Overall, the DO exceedance rate is low and gradually improves as the reach returns to a more natural channel downstream. Further study will need to be conducted to determine if the DO impairment can be removed.

Aquatic life standards are being met for un-ionized ammonia, pH, and chloride, as no exceedances were found during the assessment period. Sediment datasets are quite robust. The reach has very low exceedance rates for TSS and S-tube of 1.7% and 1.3%, respectively, and is thus meeting the standard. No individual or geometric monthly mean exceedances were found in E. coli samples and the reach therefore is fully supporting aquatic recreation.

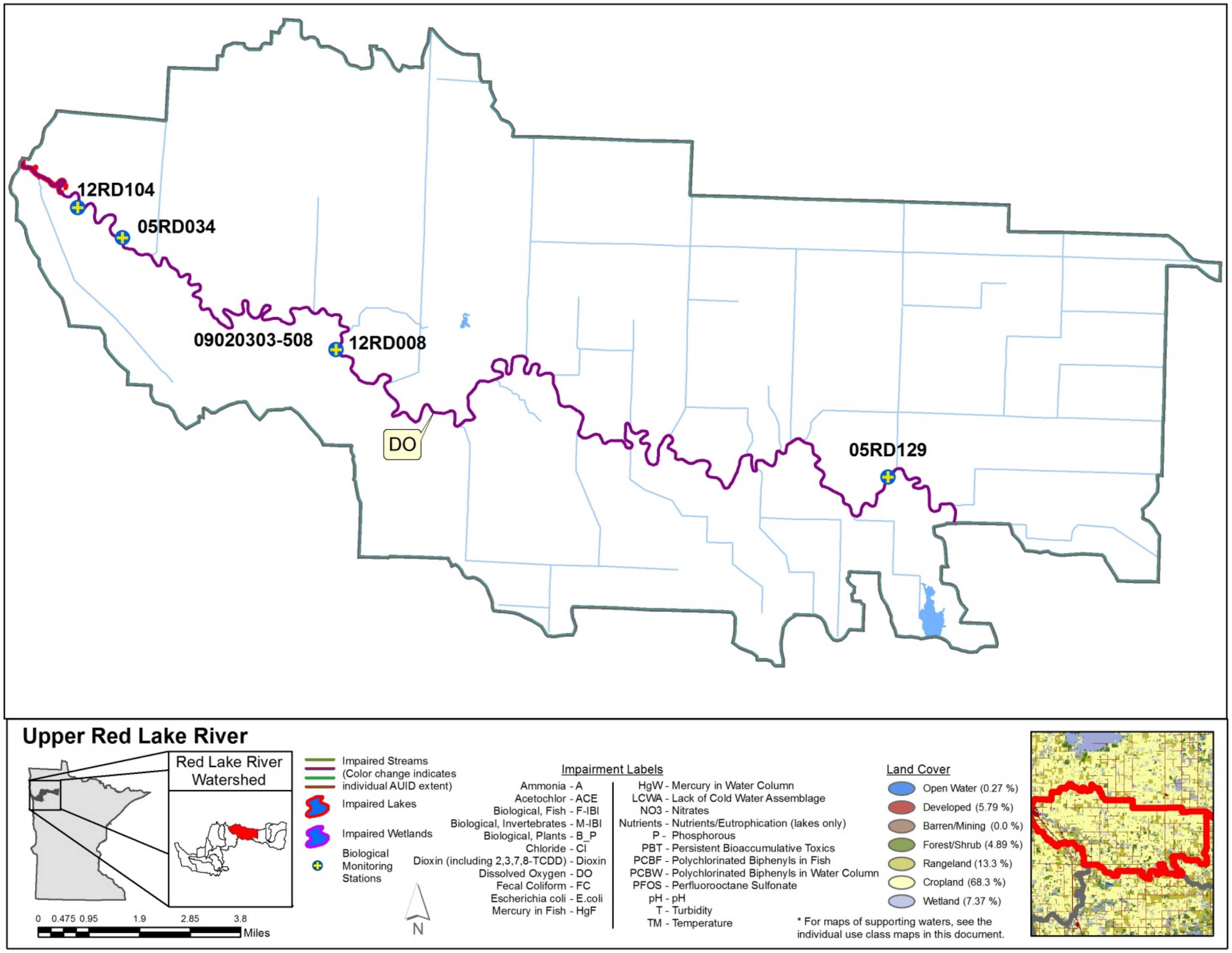

Figure 23. Currently listed impaired waters by parameter and land use characteristics in the Upper Red Lake River Subwatershed.

Middle Red Lake River Subwatershed HUC 0902030303-01

The Middle Red Lake River Subwatershed is in the central portion of the Red Lake River system, with the northern end of the area being near the town of Thief River Falls. The town of Saint Hilaire is on the far western edge. Including portions of Pennington and Red Lake counties, the subwatershed covers approximately 123 square miles and includes several channelized (ditched) tributaries to the Red Lake River. Based on the intermittent nature of these channelized reaches, no biological stations were established or sampled on them during the 2012 year; however several either existing or established stations were sampled for fish and macroinvertebrates on the Red Lake River. Land use in the area is dominated by cropland (>60%) and pasture (about 12%), with some development (10%) occurring mostly due to the presence of Thief River Falls within this area.

The outlet of the Middle Red Lake River Subwatershed is represented by the MPCA's STORET/EQuIS station S003-172 and biological station 12RD003 which are located upstream of CSAH 13, 0.5 miles Northwest of Red Lake Falls.

Table 18. Aquatic life and recreation assessments on stream reaches: Middle Red Lake River Subwatershed. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:								Aquatic Rec. Indicators:			
AUID ***Reach Name*,** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Nutrients	**Aquatic Life**	**Aquatic Rec.**
09020303-513 Red Lake River Thief River Falls Dam to County Ditch 76	13.66	WWg	05RD121 05RD171 76RD014	0.5 mi. S of Thief River Falls in City Park In between CR 74 and CR 75, 2mi. N of St Hilaire SE of St Hilaire, 0.5 mi. E of CR 3. Access from Park	MTS	MTS	MTS	MTS	-	-	-	-	-	-	SUP	NA
09020303-504 Red Lake River County Ditch 76 to Clearwater River	20.88	WWg	12RD105 12RD003	Between CR 107 and CSAH 26, 4 mi. S of St Hilaire Upstream of CSAH 13, 0.5 mi. NW of Red Lake Falls	MTS	MTS	MTS	IF	MTS	MTS	MTS	-	MTS	-	SUP	SUP

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 19. Minnesota Stream Habitat Assessment (MSHA): Middle Red Lake River Subwatershed.

# 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	05RD121	Red Lake River	1	8	24.4	15	34	82.4	Good
	05RD121	Red Lake River	2	9.5	22	12	28	73.5	Good
1	05RD171	Red Lake River	1	6	20.8	8	18	53.8	Fair
1	76RD014	Red Lake River	.5	7	20.6	16	23	67.1	Good
1	12RD105	Red Lake River	2.5	7.5	22.8	15	31	78.8	Good
1	12RD003	Red Lake River	3.25	9	15.3	9	21	57.55	Fair
Average Habitat Results: *Middle Red Lake River Subwatershed*			**1.7**	**7.8**	**20.9**	**12.5**	**25.8**	**68.9**	**Good**

Qualitative habitat ratings

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

Table 20. Channel Condition and Stability Assessment (CCSI): Middle Red Lake River Subwatershed.

# 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)	CCS Rating
1	05RD121	Red Lake River	28	9	8	3	48	Moderately Unstable
0	05RD171	Red Lake River	-	-	-	-	-	-
1	76RD014	Red Lake River	12	13	12	3	40	Fairly Stable
1	12RD105	Red Lake River	26	19	5	2	52	Moderately Unstable
2	12RD003	Red Lake River	18	8	14	3	43	Fairly Stable
	12RD003	Red Lake River	31	17	6	3	57	Moderately Unstable
Average Stream Stability Results: *Middle Red Lake River Subwatershed*			**23**	**13.2**	**9**	**2.8**	**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 21. Outlet water chemistry results: Middle Red Lake River Subwatershed.

Station location:	**Red Lake River at CSAH 13 (Sportsman's Bridge), 1 mi W of Red Lake Falls**						
STORET/EQuIS ID:	**S003-172**						
Station #:	**12RD003**						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	44	10	460	60	40	8
Chloride	mg/L	9	2.66	6.39	3.95	230	
Dissolved Oxygen (DO)	mg/L	89	5.17	14.10	8.87	5	
pH		92	7.04	9.02	8.10	6.5 - 9	1
Secchi Tube	100 cm	66	4.5	>100.0	49.4	25	20
Total suspended solids	mg/L	87	2	302	36.38	30	24
Escherichia coli (geometric mean)	MPN/100ml	6	3	134	-	126	1
Escherichia coli	MPN/100ml	55	3	1553	-	1260	1
Inorganic nitrogen (nitrate and nitrite)	mg/L	81	<0.02	1.00	0.11		
Kjeldahl nitrogen	mg/L	81	<0.30	1.98	1.02		
Phosphorus	ug/L	81	24	525	81		
Specific Conductance	uS/cm	93	163	753	394		
Temperature, water	deg °C	93	2.38	26.90	18.13		
Sulfate	mg/L	9	12.9	34.0	20.9		
Hardness	mg/L	9	147	182	163.3		
Alkalinity	mg/L	6	126.0	145.0	136.5		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Middle Red Lake River Subwatershed, conducted between March and October from 2004 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Fish and macroinvertebrate surveys conducted in the upper portions of the Middle Red Lake River Subwatershed indicate good biological condition. Four fish visits at three monitoring stations (05RD121, 05RD171, and 76RD014) were conducted on the Red Lake River (09020303-513) between 2005 and 2012.

Both the initial and replicate visits (2006 and 2012) to station 05RD121 had FIBI scores that were very good. Both of the samples had good taxa richness (21 and 26 species) including several sensitive species (e.g. stonecat, smallmouth bass, spottail shiner, rock bass, weed shiner, and burbot) and lithophilic spawning species (e.g. johnny darter and blackside darter). MIBI scores were all supporting and two samples were exceptional. Numerous intolerant and cool-water taxa were sampled at all three visits.

Station 05RD171 (sampled in 2006) had good FIBI scores, taxa diversity (20 species), and several sensitive taxa (e.g. smallmouth bass, rock bass, stonecat, and spottail shiner). The MIBI score was exceptional, the highest of any in the Red Lake River Watershed.

Station 76RD014 had an exceptional FIBI score. Several sensitive taxa (e.g. rock bass, silver lamprey, and lamprey ammocete) were sampled including three species of redhorse (shorthead, golden, and silver). MIBI scores were also good.

Two monitoring stations (12RD003 and 12RD105) were established on the lower portion of the Red Lake River (09020303-504) in this subwatershed. Station 12RD003 had a good FIBI score. The fish community was diverse with good numbers of late maturing individuals such as quillback, channel catfish, and yellow perch. The station was sampled for macroinvertebrates in 2012 and 2013. In 2012 riffle/rock substrates were not sampled resulting in a low MIBI score. Riffle/Rock is home to many sensitive EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa. The inclusion of riffle/rock substrate in the 2013 sample resulted in an exceptional MIBI score. Thirteen additional EPT taxa were collected in the sample, significantly improving the MIBI and corroborating the FIBI. Station 12RD105 had an exceptional FIBI score. The sample included 16 species of fish, many sensitive taxa and several lithophillic spawners. The MIBI score was good, with high species richness and two intolerant taxa.

The Middle Red Lake River aggregated HUC-12 watershed has water quality data available from five AUIDs; three are on the mainstem reach of the Red Lake River, and the other two are on CD 21 and CD 70. The Red Lake River portion of the subwatershed is about 35 miles long. It originates from the confluence of the Thief River and flows southward through the Red Lake River Reservoir, through the town of St. Hilaire, and outlets at the confluence with the Clearwater River in Red Lake Falls. All Red Lake River reaches were previously listed as not supporting aquatic consumption due to mercury in fish tissue. CD 70 is 2.03 miles long and originates west of Thief River Falls and flows east to the Red Lake River. CD 70 is also the outlet from a retention pond and NPDES permittee. CD 21 is 1.52 miles long and flows west to the Red Lake River, approximately 2 miles north of St. Hilaire.

Stream segment (09020303-509) encompasses the Red Lake River Reservoir and a hydroelectric dam. Sedimentation in this reservoir has been a recurring issue and has required dredging and drawdowns. TSS analysis yielded no exceedances and one S-tube value was below the standard over the 11-year assessment period. Low exceedance rates were also found for pH and DO during the assessment period. There is a lack of pre-9:00 AM DO samples, so there is not sufficient information to determine full support for aquatic life. No individual or geometric monthly mean exceedances were found in E. coli samples and the reach therefore is fully supporting aquatic recreation.

The following downstream reach (09020303-513) is the Red Lake River from the Thief River Falls dam to St. Hilaire (13.66 miles). There was only one exceedance found in DO during the assessment period. A large number of these DO samples were taken before 9:00AM. DO is not adversely affecting the aquatic life in this reach. The reach has a low amount of exceedance rates for both TSS and S-tube, with large data sets available over the assessment window. Sediment does not appear to be affecting aquatic life. This information suggests full support for this reach based on chemistry data. This reach had no bacteria samples available to assess for aquatic recreation.

The next reach (09020303-504) of the Red Lake River, flows from St. Hilaire to the confluence with the Clearwater River (20.88mi) and is the outlet of the Middle Red Lake River Subwatershed. Along with an impairment for mercury in fish tissue, this reach is currently listed for turbidity as well. TSS and S-tube exceeded the standard, when looking at all data collected over the assessment period. However, if event-based samples are removed from the data set, TSS and S-tube would only have 3.0% and 8.6% exceedance rates, respectively. Chemistry sites are all near the end of this reach. More sites should be established along this reach and more systematic sampling conducted to confirm if sediment is affecting aquatic life and confirms the current turbidity impairment. Over the 10-year sampling period, only two pH exceedances were found in a rather robust dataset. Aquatic life standards are being met for un-ionized ammonia, chloride, and DO, as no exceedances were found during the assessment period. There was one individual and one geometric monthly mean exceedance of the E. coli standard, both occurring in June. The elevated E. coli levels are short in duration, perhaps attributed to swallows nesting under bridges during June, and do not suggest an impairment for aquatic recreation.

County Ditch 70 (09020303-902) is a LRVW. However, warm water standards are being met for un-ionized ammonia, pH, and DO, as no exceedances were found during the assessment period. There were three individual E. coli exceedances, but the exceedance rate was low so the standard is being met.

County Ditch 21 (09020303-541) has a small watershed and the stream channel is not very deep or wide. This stream is heavily vegetated and “little to no flow” has often been observed in field notes. A few high ammonia-nitrogen values drove the unionized ammonia above the standard and could be attributed to congregations of birds in the stream or low flow conditions. Dissolved oxygen exceedances were observed in 39.1% samples and as low as 2.00 mg/L. However since many of these samples were taken during stagnant conditions, further monitoring will need to be conducted to see if DO is limiting aquatic life. Chloride and pH values had no exceedances. There were single exceedances for both TSS and S-tube of 41 mg/L and 12.7 cm, respectively. Data indicates that sediment is not affecting aquatic life. Individual E. coli samples exceeded the standard in 24% of cases. All of these exceedances were above the detection limit of 2420 MPN/100 mL but like the DO samples, many were taken during no-flow conditions. This reach therefore lacks sufficient information to assess for recreation. There was also one geometric monthly mean exceedance for E. coli.

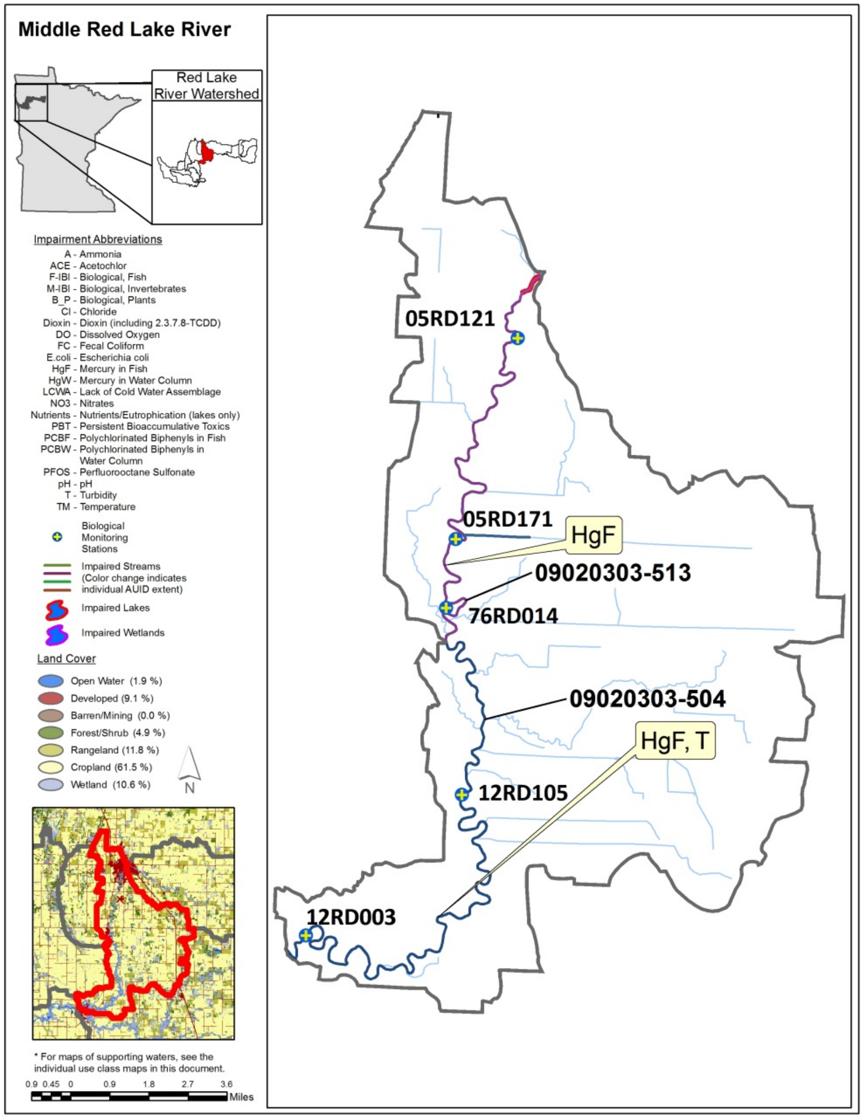

Figure 24. Currently listed impaired waters by parameter and land use characteristics in the Middle Red Lake River Subwatershed.

County Ditch 76 Subwatershed HUC 0902030303-02

The CD 76 Subwatershed is in the central portion of the Red Lake River drainage and is entirely within Pennington County. Covering just over 40 square miles, it is one of the smaller subwatersheds of the Red Lake River system. Streams in the subwatershed are almost all channelized; the largest is CD 76. Land use within the area is dominated by cropland (70%) with the remaining use being divided equally between developed, forest, pasture, and wetland (roughly 7% each). As a result of the 2012 drought few biological stations were established and or sampled within this subwatershed.

The outlet of the CD 76 Subwatershed is represented by the MPCA's STORET/EQuIS station S005-683, located upstream of Highway 32, one mile south of Saint Hilaire.

Table 22. Aquatic life and recreation assessments on stream reaches: County Ditch 76 Subwatershed. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:								Aquatic Rec. Indicators:			
AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Nutrients	Aquatic Life	Aquatic Rec.
09020303-545 Unnamed Ditch Unnamed ditch to unnamed creek	1.32	WWm	12RD039	Downstream of CR 57, 2.5 mi. NW of St. Hilaire	EXS	MTS	IF	-	-	IF	-	-	-	-	IMP	NA
09020303-505 Pennington County Ditch 76 Headwaters to Red Lake River	10.72	WWm	07RD021	Upstream of CR 3, 4 mi. NE of St. Hilaire	MTS	MTS	IF	MTS	MTS	MTS	MTS	-	EXS	-	SUP	IMP
09020303-548 County Ditch 76 County Ditch 76 to Unnamed ditch	1.16	WWm	12RD049	Adjacent to CR 54, 1.5 mi. SW of St. Hilaire	NA	-	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 23. Minnesota Stream Habitat Assessment (MSHA): County Ditch 76 Subwatershed.

# 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	12RD039	Unnamed Ditch	3	8	18	12	14	55	Fair
1	07RD021	Pennington County Ditch 76	1	9.5	12	13	10	45.5	Fair
1	12RD049	County Ditch 76	0	6	3	9	1	19	Poor
Average Habitat Results: *County Ditch 76 Subwatershed*			**1.3**	**7.8**	**11**	**11.3**	**8.3**	**39.8**	**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 24. Channel Condition and Stability Assessment (CCSI): County Ditch 76 Subwatershed.

# 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	12RD039	Unnamed Ditch	20	8	12	3	43	Fairly Stable
0	07RD021	Pennington County Ditch 76	-	-	-	-	-	-
0	12RD049	County Ditch 76	-	-	-	-	-	-
Average Stream Stability Results: *County Ditch No. 76 Subwatershed*			**20**	**8**	**12**	**3**	**43**	**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 25. Outlet water chemistry results: County Ditch 76 Subwatershed.

Station location:	County Ditch 76 at MN 32, 0.5 mi S of St. Hilaire						
STORET/EQuIS ID:	S005-683						
Station #:	NA						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	36	<40	440	60	40	9
Chloride	mg/L	30	4.60	18.80	11.78	230	
Dissolved Oxygen (DO)	mg/L	60	3.31	12.85	8.95	5	1
pH		60	7.73	9.03	8.12	6.5 - 9	1
Secchi Tube	100 cm	43	6.4	>100.0	76.1	25	1
Total suspended solids	mg/L	33	<1	99	7.8	30	2
Escherichia coli (geometric mean)	MPN/100ml	6	47	264	-	126	2
Escherichia coli	MPN/100ml	44	4.1	2420	-	1260	1
Chlorophyll-a, Corrected	ug/L	10	1.00	28.00	4.69		
Inorganic nitrogen (nitrate and nitrite)	mg/L	33	<0.02	1.55	0.11		
Kjeldahl nitrogen	mg/L	33	0.53	2.18	1.13		
Phosphorus	ug/L	33	19	175	65		
Specific Conductance	uS/cm	59	55	766	492		
Temperature, water	deg °C	60	0.25	28.48	18.34		
Sulfate	mg/L	10	6.7	43.6	23.4		
Hardness	mg/L	10	130	346	229.9		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the County Ditch 76 Subwatershed, conducted between April and October from 2009 to 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The CD 76 aggregated HUC-12 watershed has biological and water quality data available from three stream reaches - the main-stem of Pennington CD 76 (09020303-505), and two smaller ditches (09020303-545 and 09020303-548). Pennington CD 76 is approximately 11 mi long; it originates about 7 miles west of Thief River Falls and flows southwest to the Red Lake River just south of St. Hilaire. All monitored reaches have been modified and straightened to accommodate drainage. A UAA concluded that the modified use criteria were applicable for all three monitoring reaches based on the fact that they are all channelized and the habitat appears to be limiting the potential to support aquatic life. The land use in this subwatershed is cropland and pasture with interspersed deciduous forest and wetlands.

Pennington CD 76 (09020303-505) was surveyed for fish at biological station 07RD021; five species were observed and the community was dominated by tolerant taxa (e.g. central mudminnow, fathead minnow, and black bullhead), however a sensitive species (Northern redbelly dace) was also observed. The 07RD021 macroinvertebrate sample was comprised primarily of *Hyalella*, with a few caddisflies and beetles present. Both the MIBI and FIBI scored above the modified threshold. TSS and S-Tube samples taken from the reach indicate that sediment parameters are not a significant problem. Of the two TSS exceedances, one sample was 99mg/L and the other was just over the standard at 31 mg/L. There was one S-Tube exceedance of 6.4 cm, all other measurements met the standard. There were only two DO exceedances over five years of sampling but many values approached the standard. Continuous DO data collected by the RLWD in 2013 indicated that 59.2% of the daily minimum exceeded the standard suggesting that DO is a likely stressor and follow-up sampling should be conducted. Only one pH exceedance and no exceedances for un-ionized ammonia and chloride were found, suggesting that these aquatic life standards are being met. There was one E. coli individual exceedance and two monthly geometric mean exceedances. The geometric means in July and October were 264/100mL and 196/100mL, respectively. Both of these are well above the geometric mean monthly standard and indicate that the reach is impaired for aquatic recreation.

Station 12RD039 on Unnamed Ditch (09020303-545) was sampled for fish in June of 2012 and only two species (brook stickleback and central mudminnow) were observed. Both of these taxa are considered tolerant, indicating an impairment of fish for this reach. The MIBI indicated support for aquatic life based on macroinvertebrates. These conflicting IBI scores are likely a function of DO fluctuations, generally a bad thing for sensitive aquatic life. The macroinvertebrates collected were primarily tolerant to low DO conditions, however there was high species richness resulting in a passing MIBI.

MPCA stressor ID staff deployed a sonde downstream of the CR 57 road crossing in late July to early August 2014. Dissolved oxygen daily minimums exceeded the standard every day of the two week deployment, with a mean value of 1.80 mg/L. However, it should be noted that this continuous monitoring was collected following a rain event.

Station 12RD049 on CD 76 (09020303-548) was surveyed for fish in mid-July of 2012. Very few individuals (<25) and only two tolerant species (central mudminnow and northern pike) were collected. The data was not assessed because of low flow conditions at the time the sample was collected. There was not a macroinvertebrate sample collected due to low water levels. Macroinvertebrates were not sampled for the same reason.

The CD 76 subwatershed is highly influenced by human alterations. County Ditch 76 (09020303-505) had a larger drainage area and better habitat leading to better fish IBI scores. The smaller channelized streams (09020303-545 and 09020303-548) had smaller drainage areas and were more heavily influenced by flow impermanence and DO flux, typically causing more stress on aquatic life.

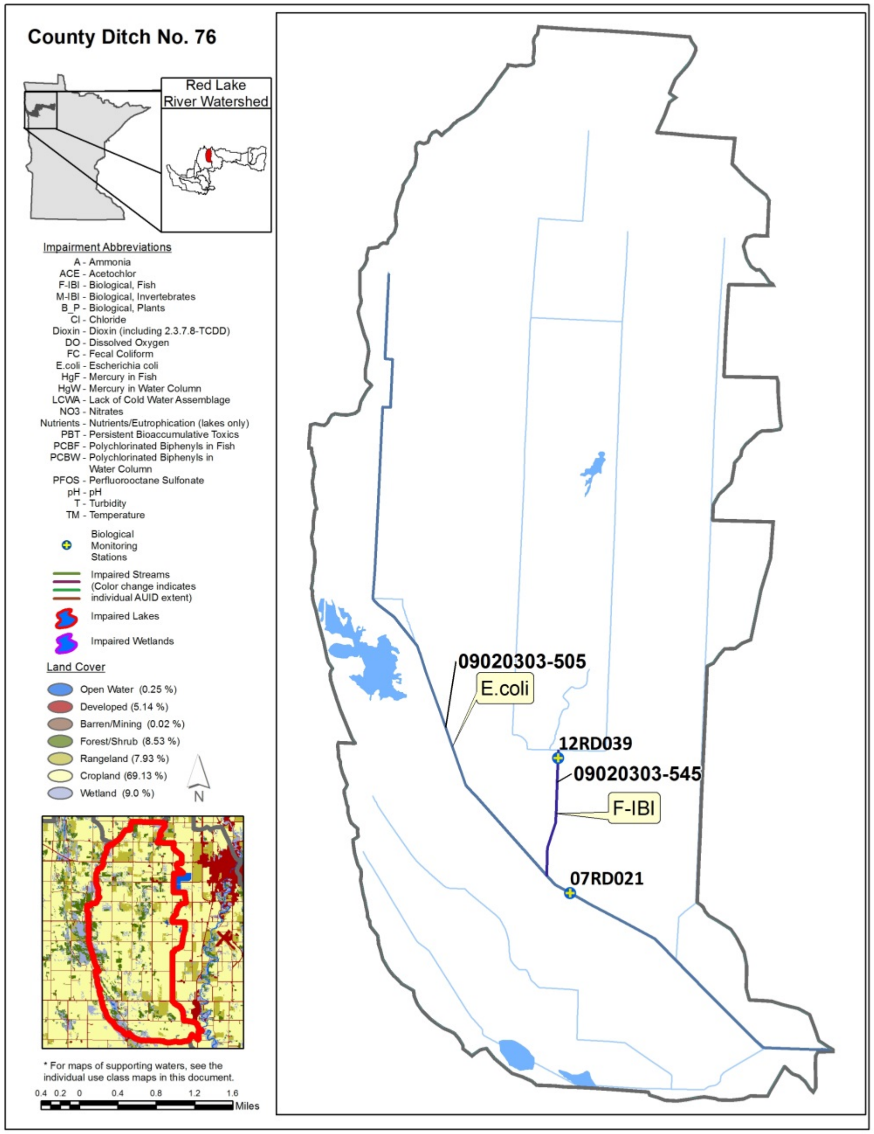

Figure 25. Currently listed impaired waters by parameter and land use characteristics in the County Ditch No. 76 Subwatershed.

Black River Subwatershed

HUC 0902030304-01

The Black River Subwatershed is located in the west central portion of the Red Lake River Watershed. Draining approximately 145 square miles, it is one of the larger subwatersheds and includes portions of Pennington, Red Lake, and Polk counties. Reaches include the Black and Little Black River, along with several ditches. Land use is dominated by cropland (75%) with slightly more wetland area (11%) than in other areas of the watershed. The remaining land is divided between open water, pasture, and development.

The outlet of the Black River Subwatershed is represented by the MPCA's STORET/EQuIS station S002-132 and biological station 12RD002, located upstream of CR 18, one mile north of Huot.

Table 26. Aquatic life and recreation assessments on stream reaches: Black River Subwatershed. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:								Aquatic Rec. Indicators:			
AUID ***Reach Name*****,** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Nutrients	**Aquatic Life**	**Aquatic Rec.**
09020303-557 Black River Headwaters to 48.0146, -96.4328	15.82	WWm	07RD022 10EM176 12RD014	Upstream of CR 67, 10 mi. W of Thief River Falls Adjacent to Unnamed St, 11 mi. W of Thief River Falls Downstream of CR 58, 7 mi. S of Carpenters Corner	MTS	MTS	IF	-	-	MTS	MTS	-	-	-	SUP	SUP
09020303-558 Black River 48.0146, -96.4328 to Little Black River	14.21	WWg	05RD122 12RD102	Upstream of CR 55, 5 mi. NW of Wylie Downstream of CSAH 13, about 3mi. E of Dorothy	EXS	EXS	EX	-	-	MTS	MTS	-	IF	-	IMP	IF
09020303-529 Black River Little Black River to Red Lake River	8.45	WWg	12RD002	Upstream of CSAH 18, 1 mi. N of Huot.	MTS	MTS	MTS	MTS	MTS	MTS	MTS	-	EXS	-	SUP	IMP
09020303-528 Little Black River Unnamed Ditch to Black River	2.17	WWg	12RD024	Downstream of CR 102, 1 mi. E of Dorothy.	EXS	-	IF	-	-	IF	-	-	-	-	IMP	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 27. Minnesota Stream Habitat Assessment (MSHA): Black River Subwatershed.

# 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	07RD022	Black River	0	9	18	9	18	54	Fair
1	10EM176	Black River	1.25	9	16	7	18	51.25	Fair
1	12RD014	Black River	0	8.5	9	2	7	26.5	Poor
1	05RD122	Black River	5	9	18	11	18	61	Fair
1	12RD024	Little Black River	0	8	12	10	25	55	Fair
1	12RD102	Black River	1	5	14	17	19	56	Fair
2	12RD002	Black River	5	10	14.6	14	27	70.6	Good
-	12RD002	Black River	5	9	18.4	13	20	65.4	Fair
Average Habitat Results: *Black River Subwatershed*			**2.16**	**8.44**	**15**	**10.38**	**19**	**54.98**	**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 28. Channel Condition and Stability Assessment (CCSI): Black River Subwatershed.

# 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
0	07RD022	Black River	-	-	-	-	-	-
0	10EM176	Black River	-	-	-	-	-	-
1	12RD014	Black River	13	10	15	3	41	Fairly Stable
0	05RD122	Black River	-	-	-	-	-	-
	12RD024	Little Black River	-	-	-	-	-	-
1	12RD102	Black River	26	38	17	3	84	Severely Unstable
2	12RD002	Black River	17	15	11	3	46	Moderately Unstable
-	12RD002	Black River	27	25	13	4	69	Moderately Unstable
Average Stream Stability Results: *Black River Subwatershed*			**20.75**	**22**	**14**	**3.25**	**60**	**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 29. Outlet water chemistry results: Black River Subwatershed.

Station location:	Black River at CSAH 18, 6 mi W of Red Lake Falls						
STORET/EQuIS ID:	S002-132						
Station #:	12RD002						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	59	30	730	70	40	23
Chloride	mg/L	8	9.70	11.60	10.86	230	
Dissolved Oxygen (DO)	mg/L	146	3.51	14.48	9.24	5	6
pH		147	5.77	8.71	7.93	6.5 - 9	1
Secchi Tube	100 cm	59	4.0	107.5	40.6	10	5
Total suspended solids	mg/L	56	2	272.5	25.5	65	4
Escherichia coli (geometric mean)	MPN/100ml	7	3	241	-	126	
Escherichia coli	MPN/100ml	73	<1	4884	-	1260	4
Inorganic nitrogen (nitrate and nitrite)	mg/L	66	<0.02	5.55	0.44		
Kjeldahl nitrogen	mg/L	66	0.64	5.29	1.28		
Phosphorus	ug/L	66	26	789	160		
Specific Conductance	uS/cm	148	149	890	524		
Temperature, water	deg °C	152	0.15	27.78	16.09		
Sulfate	mg/L	8	36.2	70.5	50.2		
Hardness	mg/L	8	212	260	235.6		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 65 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Black River Subwatershed, conducted between March and November from 2004 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The headwaters of the Black River begins about seven miles west of Thief River Falls, and winds generally southwest, ending just south of Pennington CSAH 3. This 18.52 mile long reach (09020303-557) has largely been straightened and ditched. A UAA determined that the reach is habitat limited and therefore meet the modified use criteria. The reach was surveyed at three stations for fish and two stations for macroinvertebrates. IBI scores for both fish and macroinvertebrates decreased in an upstream to downstream direction ranging from 51 at the upstream site to 27 at the downstream site for fish and 42 to 23 for macroinvertebrates. The MSHA scores also showed the same pattern. In spite of the decreasing IBI scores, all sites met their applicable IBI thresholds and supported aquatic life. Similarly, TSS, S-Tube, un-ionized ammonia, and pH value readings generally met standards. The reach is currently listed as impaired due to high turbidity, but the newer assessment information suggests that the reach should be considered for a delisting. Dissolved oxygen is also impaired from a previous listing. There was only one DO exceedance in the dataset used for the current assessment but the range of DO observations was large, from 4.40 to 25.90 mg/L. Because there were only a few early morning DO samples, no assessment decision was made. There were no individual or geometric monthly mean exceedances in E. coli samples, so the reach full supports aquatic recreation.

The next downstream reach (09020303-558) of the Black River has a natural channel. This 14.21 mile reach flows south and ends at the confluence with the Little Black River. It was sampled at two stations for both fish and one for macroinvertebrates. The upstream biological station (05RD122) was sampled in 2006 for fish. The sample was dominated by tolerant fathead minnows and the FIBI was poor. Fish and macroinvertebrate samples from the downstream site on this reach (12RD102) were dominated by tolerant taxa, and both IBIs were also poor. This reach is currently listed as impaired due to problems with levels of DO and turbidity, although sediment data from this assessment suggests turbidity should be delisted. One S-tube exceedance was found over 10 years of sampling and there were no TSS exceedances over 11 years. There was one pH exceedance and no un-ionized exceedances during the 10-year assessment period. MPCA stressor ID staff collected continuous DO data on this reach in 2014 and found 4 of 15 daily minimums were below the standard. The mean daily minimum was 5.68 mg/L and lowest value 3.94 mg/L. Dissolved oxygen concentrations from the grab samples exceeded the standard in 19.1% of the time. Consequently, the reach does not support aquatic life due to low DO levels. The reach also does not support aquatic recreation based on four exceedances of the individual E. coli standard and an exceedance of the July geometric mean standard.

The lowest reach on the Black River (09020303-529) from the confluence of the Little Black River to the Red Lake River flows southward for 8.45 mi. The reach appears to recover somewhat biologically. FIBI scores during two separate visits indicated support for aquatic life. Low exceedance rates were found for TSS and S-tube of 8.8% and 7.0% respectively. The reach is currently listed as impaired due to turbidity, but should be considered for delisting based on the new data. There were no chloride or un-ionized ammonia exceedances and only one pH exceedance in the 10 year sampling period. Dissolved oxygen samples exceeded the standard in 5.6% of cases and most of the exceedances were only slightly below the standard. Somewhat contrary to the grab sample data, a continuous sonde deployed by the RLWD in 2012 indicated that DO levels were worse than the grab samples would suggest. Data from the sonde had 40 exceedances of the standard, with individual readings as low as 1.23 mg/L, and many samples between 2 to 3 mg/L. However, low flow conditions in 2012 and impoundments within the reach likely contributed to the low DO readings. Because of the somewhat conflicting results between the data from the sondes and grab samples, the biological data was assumed to be the stronger indicator and the reach was considered to fully support aquatic life. E. coli levels exceeded the geometric monthly mean twice and there were four individual samples above the standard indicating that the reach does not support aquatic recreation.

The Little Black River is split into two AUIDs. The first reach (09020303-527) originates in the Pembina WMA and flows southeast for 3.14 miles. This reach represents the channelized portion of the Little Black River. The stream chemistry station is on the outlet of a wetland and not representative of stream conditions. Therefore, the data was not used to assess aquatic life. Therefore, the data was not used to assess aquatic life. However, there was sufficient E. coli data collected by the MPCA and RLWD to assess aquatic recreation. E. coli levels in this reach exceeded the July geometric mean and therefore the reach does not supporting aquatic recreation.

The downstream reach (09020303-528) of the Little Black River returns to a natural channel and flows southeast for 2.17 miles to the confluence with the Black River. There is an on-channel impoundment near the downstream end of this reach that is a barrier to fish migration. Water chemistry data is limited on this reach, but there has been continuous sonde data collected by MPCA stressor ID staff. The sonde data showed that daily minimums were below the standard during the entire two week deployment, with a mean value of 2.94 mg/L and a low value of 2.05 mg/L. Based on this recent information, the DO concentrations in this reach appear to be stressing aquatic life. The RLWD has taken E. coli samples in this reach but there was not enough data to make an assessment for aquatic recreation. Four of the E. coli samples taken in 2014 were above 1,000 MPN/100mL, suggesting that more data should be collected so that an assessment can be made during the next assessment period.

Browns Creek includes two AUIDs. The first assessed segment of this stream (09020303-540) is 2.87 miles long, flows from east to west, and ends at Red Lake CSAH 9. Un-ionized ammonia and pH were within the standard for this reach. No exceedances were observed in TSS samples over three years of sampling. Dissolved oxygen samples yielded only one exceedance. Based on chemistry data alone, aquatic life does not appear to be stressed. Biology was not assessed on this reach, so there is not sufficient information to assess for aquatic life condition.

The second Browns Creek reach (09020303-539) continues westward to the confluence with the Black River and is 1.36 miles long. The stream is prone to no-flow conditions and dries up often mid- to late-summer. This reach has a very limited dataset, and there is not enough information to assess aquatic life or recreation.

The Black River Subwatershed is highly influenced by human stressors. The upstream, channelized reaches are in relatively good condition but the downstream natural reaches are heavily influenced by agricultural activities within the watershed and are considered impaired for aquatic life. Dissolved oxygen appears to be a primary stressor in these reaches as indicated by direct measurement of DO and the dominance of fish and macroinvertebrates that are tolerant of low DO conditions.

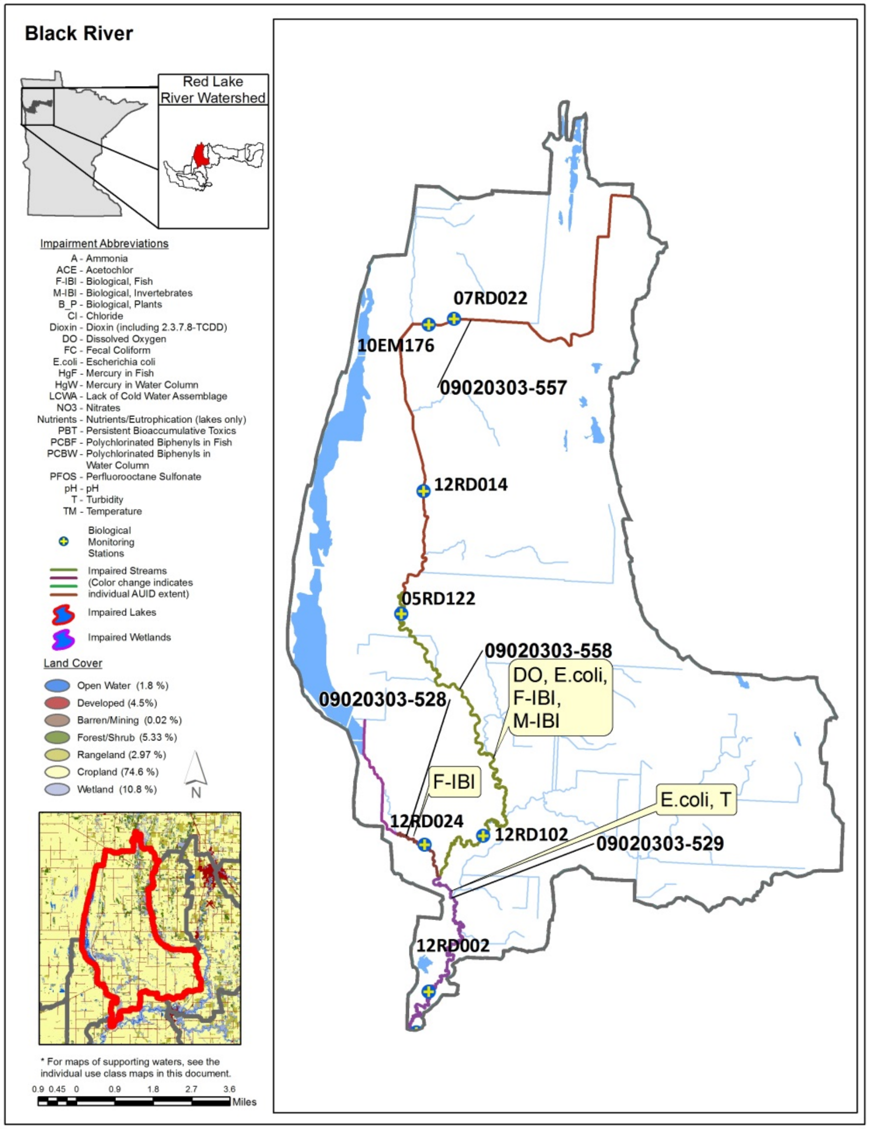

Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Black River Subwatershed.

Lower Red Lake River Subwatershed HUC 0902030305-01

The Lower Red Lake River Subwatershed covers an area of roughly 114 square miles and includes portions of Red Lake and Polk counties. Located in the southeastern portion of the watershed, the primary land uses of the area are agricultural, mostly cropland (70%), and wetland (12%). The town of Crookston is located in the west-central portion of this area comprising much of the land that is classified as developed (9%). Streams in the subwatershed include the mainstem of the Red Lake River and numerous tributaries. The temporally variable nature of flow in many of the tributary ditches limited the monitoring locations, primarily to the main-stem river.

The water chemistry of the Black River Subwatershed is represented by the MPCA's STORET/EQuIS station S002-080 and biological station 94RD513, located downstream of Woodland Avenue in Crookston.

Table 30. Aquatic life and recreation assessments on stream reaches: Lower Red Lake River Subwatershed. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name***, *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	**Aquatic Life Indicators:**								**Aquatic Rec. Indicators:**		**Aquatic Life**	**Aquatic Rec.**
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Nutrients		
09020303-510 Red Lake River Clearwater River to Cyr Creek	8.2	WWg	12RD113 10EM048	1.5 mi. downstream of Red Lake Falls Adjacent to unnamed road, 3.5 mi. NW of RLF	MTS	MTS	IF	IF	-	IF	-	-	-	-	SUP	NA
09020303-556 Cyr Creek CR 14 to Red Lake River	8.99	WWg	12RD023	Upstream of CR 110, 4 mi. SW of Red Lake Falls	EXS	-	IF	-	IF	MTS	MTS	-	EXS	-	IMP	IMP
09020303-511 Red Lake River Cyr Creek to Black River	4.64	WWg	05RD057	Just E of CR 104, ¼ mi. NE of Huot	MTS	MTS	IF	-	-	IF	-	-	-	-	SUP	NA
09020303-502 Red Lake River Black River to Gentilly River	9.91	WWg	12RD015	Upstream of CSAH 3 in Huot	MTS	MTS	MTS	-	-	MTS	MTS	-	MTS	-	SUP	SUP
09020303-512 Red Lake River Gentilly River to County Ditch 99	11.71	WWg	12RD013	Downstream of CSAH 11, 5.5 mi. E of Crookston	MTS	MTS	IF	IF	-	MTS	IF	-	IF	-	SUP	NA
09020303-506 Red Lake River County Ditch 99 to Burnham Creek	25.05	WWg	12RD108 94RD513 12RD004 05RD080 12RD112 12RD103	1 mi. upstream of Crookston Downstream of Woodland Ave. in Crookston Downstream of Hwy 75, 0.5 mi W of Crookston 1.5 mi. W of Crookston, downstream of ALT. 75 1.5 mi. downstream of Crookston 1 mi. S of Ross	MTS	MTS	MTS	EXS	MTS	MTS	MTS	-	MTS	-	SUP	SUP

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 31. Minnesota Stream Habitat Assessment (MSHA): Lower Red Lake River Subwatershed.

# 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	12RD113	Red Lake River	5	6	22	14	23	70	Good
1	10EM048	Red Lake River	2.5	13.5	19.8	14	29	78.8	Good
1	12RD023	Cyr Creek	5	10	16.9	12	30	73.9	Good
1	05RD057	Red Lake River	2.5	9	20.7	9	23	64.2	Fair
1	12RD015	Red Lake River	3	7	17.6	11	19	57.6	Fair
1	12RD013	Red Lake River	0	8	15.9	9	18	50.9	Fair
1	12RD108	Red Lake River	0	7.5	13.3	5	14	39.8	Poor
1	94RD513	Red Lake River	2	7	22	10	20	61	Fair
1	12RD004	Red Lake River	1.25	9	20.6	8	23	61.85	Fair
1	05RD080	Red Lake River	2.5	8	18.4	13	30	71.9	Good
1	12RD112	Red Lake River	2.5	7	16.4	6	19	50.9	Fair
2	12RD103	Red Lake River	2.5	7	9.9	6	18	43.4	Poor
	12RD103	Red Lake River	2.5	8.5	10.2	6	16	43.2	Poor
Average Habitat Results: *Lower Red Lake River Subwatershed*			**2.4**	**8.3**	**17.2**	**9.5**	**21.7**	**59**	**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 32. Channel Condition and Stability Assessment (CCSI): Lower Red Lake River Subwatershed.

# 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	12RD113	Red Lake River	22	16	7	3	48	Moderately Unstable
0	10EM048	Red Lake River	-	-	-	-	-	-
0	12RD023	Cyr Creek	-	-	-	-	-	-
0	05RD057	Red Lake River	-	-	-	-	-	-
1	12RD015	Red Lake River	16	23	15	4	58	Moderately Unstable
2	12RD013	Red Lake River	13	13	1	3	40	Fairly Stable
	12RD013	Red Lake River	34	23	18	4	79	Moderately Unstable
2	12RD108	Red Lake River	10	11	13	3	37	Fairly Stable
	12RD108	Red Lake River	24	20	12	3	59	Moderately Unstable
0	94RD513	Red Lake River	-	-	-	-	-	-
1	12RD004	Red Lake River	29	18	11	3	61	Moderately Unstable
0	05RD080	Red Lake River	-	-	-	-	-	-
	12RD112	Red Lake River	29	18	11	3	61	Moderately Unstable
0	12RD103	Red Lake River	-	-	-	-	-	-
	Average Stream Stability Results: *Lower Red Lake River Subwatershed*		**29**	**18**	**11**	**3**	**61**	**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 33. Outlet water chemistry results: Lower Red Lake River Subwatershed.

Station location:	Red Lake River at Woodland Ave (Sampson Bridge), in Crookston						
STORET/EQuIS ID:	S002-080						
Station #:	94RD513						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	53	<0	440	60	40	13
Chloride	mg/L	11	<0.00	9.98	5.57	230	
Dissolved Oxygen (DO)	mg/L	104	6.97	14.00	9.39	5	
pH		109	5.20	8.65	8.15	6.5 - 9	1
Secchi Tube	100 cm	66	6.4	86.0	28.4	25	34
Total suspended solids	mg/L	50	2	438	48.1	30	23
Escherichia coli (geometric mean)	MPN/100ml	7	4	51	-	126	
Escherichia coli	MPN/100ml	52	<1	980	-	1260	
Inorganic nitrogen (nitrate and nitrite)	mg/L	mg/L	51	<0.00	1.35	0.12	
Kjeldahl nitrogen	mg/L	mg/L	52	0.39	2.30	1.00	
Phosphorus	ug/L	ug/L	52	27	399	88	
Specific Conductance	uS/cm	uS/cm	109	191	658	408	
Temperature, water	deg °C	deg °C	109	3.24	27.77	17.27	
Sulfate	mg/L	mg/L	10	15.7	82.7	33.3	
Hardness	mg/L	mg/L	10	164	216	190.7	
Alkalinity	mg/L	mg/L	2	111	219	165	

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Lower Red Lake River Subwatershed, conducted between April and November from 2004 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The Lower Red Lake River Subwatershed has water quality and/or biological data available from seven stream reaches, including five reaches on the main-stem Red Lake River and reaches on Cyr Creek. Land use in the subwatershed is primarily cropland with the exception of a few pastures in the upper portions of the subwatershed. Fish and macroinvertebrate communities on all five Red Lake River reaches supported aquatic life in spite of decreasing MSHA scores longitudinally from upstream to downstream. MSHA scores ranged from over 70 in the upper reaches of this subwatershed to the lower 40s near the mouth. All reaches of the Red Lake River in this subwatershed are currently listed as not supporting aquatic consumption due to mercury in fish tissue.

The 8.16 mile upstream reach (09020303-510) flows westward from the confluence with the Clearwater River in Red Lake Falls to the confluence with Cyr Creek. This reach was sampled for fish and macroinvertebrates at two stations (12RD113 and 10EM048). Several sensitive species were present in the samples resulting in good FIBI and MIBI scores. The good IBI scores correlate with good MSHA scores for the reach, suggesting that good habitat and land use is allowing sensitive taxa to survive. A limited number of water chemistry samples were taken on this reach, so there is not sufficient information to suggest support for aquatic life or aquatic recreation.

Fish and macroinvertebrate communities on the mainstem Red Lake River from the confluence of the Black River to CD 99 (09020303-502 and 09020303-512) continued to perform well. In fact, 12RD013 just downstream of CSAH 11, east of Crookston had the second highest FIBI score in the subwatershed (FIBI=83) and one of the higher MIBI scores (MIBI=57). Both reaches have existing turbidity impairments but data from the current assessment period were either inconclusive (e.g. 09020303-502) or suggest that the existing turbidity impairment should be reconsidered (e.g. 09020303-512). All other water chemistry data collected from these reaches indicates support for aquatic life. The upper reach fully supported aquatic recreation and the lower reach did not have enough data to make an aquatic recreation assessment.

The most downstream reach (09020303-506) of the Red Lake River, from CD 99 to the confluence with Burnham Creek, continued to perform well biologically in spite of generally decreasing MSHA scores. A poor macroinvertebrate sample collected in 2012 from 12RD108 lacked representation from all available habitat types resulting in a poor MIBI score. Another sample collected in 2013 was a much better representation of the available habitats at the site. Consequently, macroinvertebrate community in the second sample was numerically dominated by several sensitive mayfly species and the MIBI score was substantially better. The fish communities at all sites within the reach were fairly diverse ranging from poor to excellent. Silver chub, a sensitive and somewhat rare large river species was collected just west of Crookston (12RD004). All water chemistry variables indicated support for aquatic life with the exception of turbidity where TSS and S-tube samples exceeded the standard numerous times, confirming the existing turbidity standard. The TSS data set was robust and included both event-based sampling and systematic sampling. No individual or geometric monthly mean exceedances were found in E. coli samples.

Cyr Creek from CSAH 14 to its confluence with the Red Lake River (09020303-556) is 8.99 mile long un-channelized stream reach. The creek often experiences low to no flow conditions and has gone dry during drought periods. The FIBI score from 12RD023 was 7, which is well below the impairment threshold of 42. Most of the water quality readings met standards but DO readings from two sonde deployments suggest that DO is often significantly below the 5.0 mg/L standard. The Red Lake River Watershed District deployed a sonde in May through August of 2013 and found that 45.1% of all daily values exceeded the standard. In August, 2014 a sonde deployed by MPCA stressor ID staff exceeded the standard 100% of the time. The mean daily minimum value during the 2 week deployment period was 1.24 mg/L, and the highest recorded value was only 4.93 mg/L. E. coli samples often exceeded both the individual and geometric mean standards indicating that this reach does not support aquatic recreation.

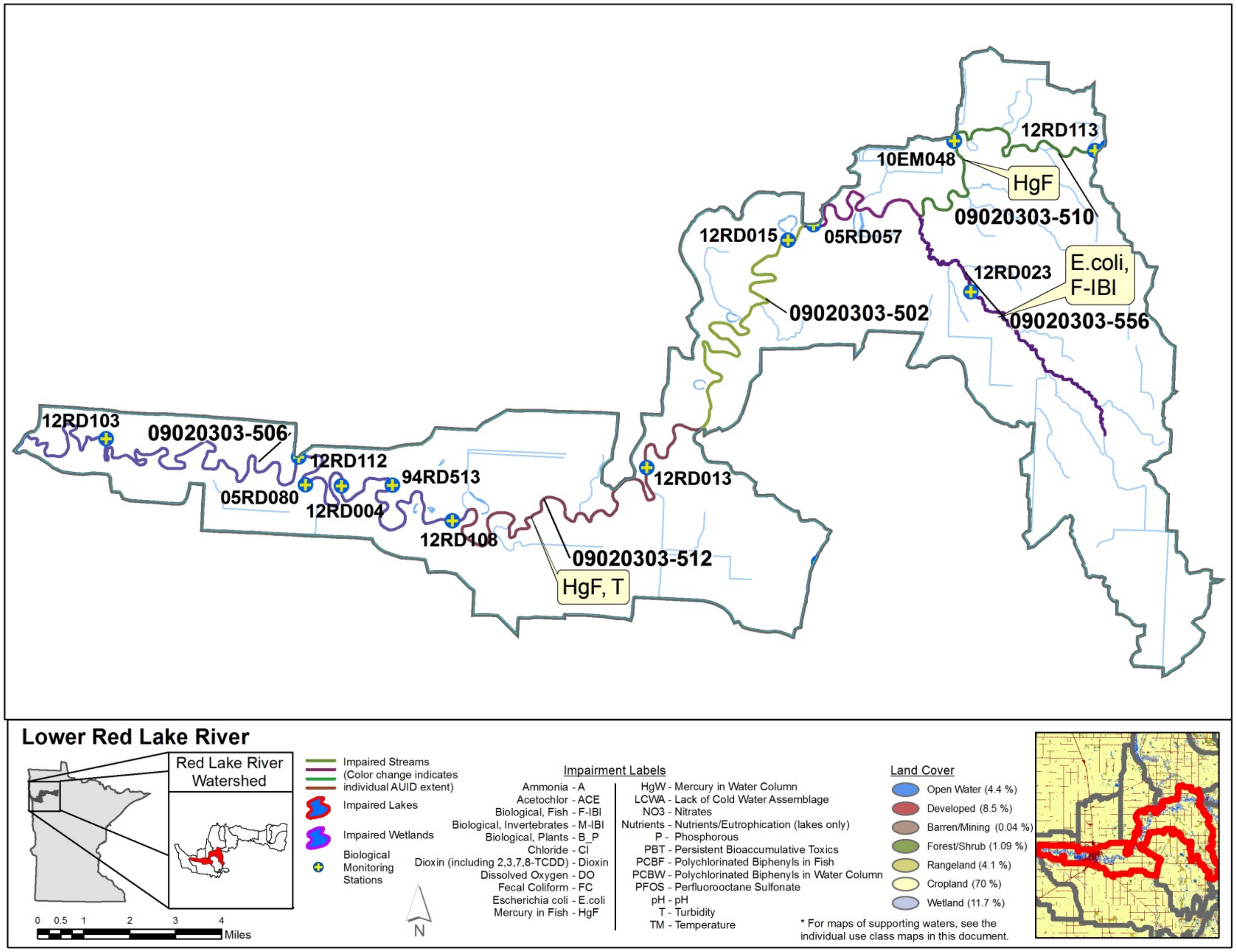

Figure 27. Currently listed impaired waters by parameter and land use characteristics in the Lower Red Lake River Subwatershed.

Judicial Ditch 60 Subwatershed HUC 0902030305-03

The Judicial Ditch 60 Subwatershed is located in the west-central portion of the RLWD. Covering approximately 43 miles, it is one of the smaller subwatersheds of the Red Lake River, and includes portions of Polk, Pennington, and Red Lake counties. The tributaries which make up this drainage include a network of ditches and natural stream reaches which have been channelized. The largest reach is Judicial Ditch (JD) 60. JD 60 enters the Red Lake River approximately 5 miles west of the town of Gentilly. Land use in the area is primarily utilized for agricultural purposes with a majority (85%) classified as cropland. Due to the temporally variable nature of the ditches in this system, no biological stations were established or sampled within this subwatershed. The outlet water chemistry from the JD 60 Subwatershed is represented by MPCA's EQuIS Station S007-062, which is located at 250th Street NW, approximately 3.5 miles west of Gentilly.

Table 34. Aquatic life and recreation assessments on stream reaches: Judicial Ditch 60 Subwatershed. Reaches are organized upstream to downstream in the table.

AUID *Reach Name*, *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Aquatic Rec. Indicators: Bacteria	Nutrients	Aquatic Life	Aquatic Rec.
09020303-546 Judicial Ditch 60 County Ditch 147 to Unnamed Ditch	2.67	WWm	-		NA	-	IF	-	-	IF	-	-	-	-	IF	NA
09020303-542 Judicial Ditch 60 Lateral Ditch 4 to Red lake River	1.87	WWg	-		-	-	EXS	MTS	MTS	IF	MTS	-	IF	-	IMP	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 35. Outlet water chemistry results: Judicial Ditch 60 Subwatershed.

Station location:	Judicial Ditch 60 at 250th St NW, 3.5 mi W of Gentilly						
STORET/EQuIS ID:	S007-062						
Station #:	N/A						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-nitrogen	ug/L	14	<40	610	160	40	7
Chloride	mg/L	10	9.87	24.00	14.84	230	
Dissolved Oxygen (DO)	mg/L	34	3.46	19.35	9.01	5	4
pH		33	7.28	9.81	8.15	6.5 - 9	5
Secchi Tube[1]	100 cm	19	19.0	>100.0	89.2	10	
Total suspended solids	mg/L	14	1	10	3.9	65	
Escherichia coli (geometric mean)	MPN/100ml	5	8	68	-	126	
Escherichia coli	MPN/100ml	18	8	1120	-	1260	
Inorganic nitrogen (nitrate and nitrite)	mg/L	14	<0.03	0.27	0.07		
Kjeldahl nitrogen	mg/L	14	1.24	2.30	1.60		
Phosphorus	ug/L	13	36	517	254		
Specific Conductance	uS/cm	34	206	957	579		
Temperature, water	deg °C	34	8.76	28.15	18.84		
Sulfate	mg/L	10	11.2	222.0	68.7		
Hardness	mg/L	10	200	448	299.7		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 65 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Judicial Ditch 60 Subwatershed, conducted between April and October from 2012 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The Judicial Ditch 60 aggregated HUC-12 watershed has two assessable stream reaches, both along JD 60. These reaches have been completely modified and straightened. The upstream-most reach (09020303-546) begins at CD 147 and flows south to Polk County Road 252 for 2.39 miles. There was insufficient data to make an assessment of aquatic life or aquatic recreation in this reach. The Parnell impoundment, located within this reach, may at times split the flow of JD 60 between the Red Lake River and Grand Marais Creek Watersheds. Local groups have suggested changing the designation of both steam reaches in this subwatershed to limited value use waters due to the intermittent nature of the flow regime as the reach may become stagnant or go dry during periods of low rainfall

The other assessed reach (09020303-542) of JD 60 begins at Lateral Ditch 4 and ends at the confluence with the Red Lake River and is 1.87 miles long. No exceedances were found for TSS, S-tube, chloride, and un-ionized ammonia. Dissolved oxygen samples had exceedance rates of 13.8%, though the exceedances were just slightly below the standard. The DO span varied greatly, ranging from 3.50 to 19.40, which may suggest high primary productivity in this reach. There was a 15.2% pH exceedance rate during the assessment period, also suggesting that productivity is high. The RLWD deployed a sonde on this reach and found that 91.7% of all daily minimum DO values were below the standard, and many were below 2.0 mg/L. The evidence as a whole suggests that the reach is impaired for aquatic life due to low DO. No E. coli exceedances were found, however the dataset was not large enough to determine support for aquatic recreation.

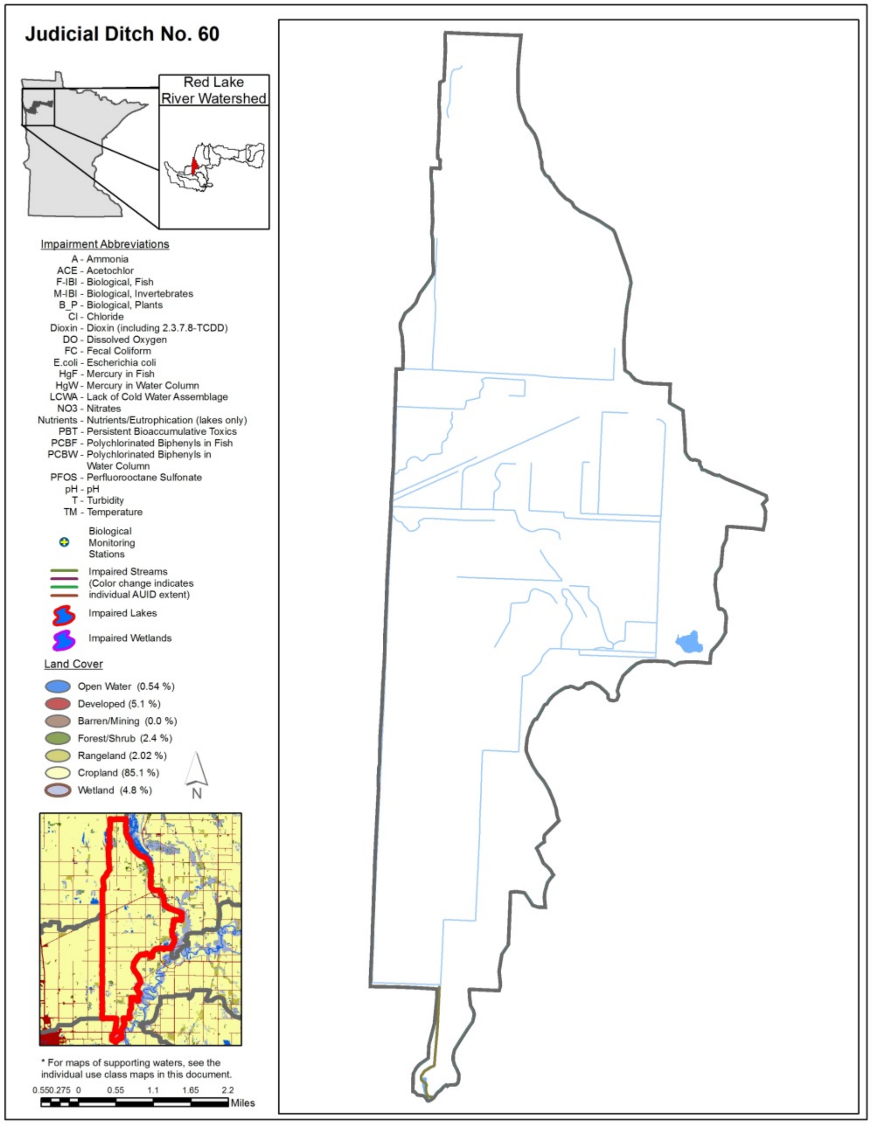

Figure 28. Currently listed impaired waters by parameter and land use characteristics in the Judicial Ditch 60 Subwatershed.

Gentilly River Subwatershed HUC 0902030305-04

The Gentilly River Subwatershed covers an area of approximately 67 miles and includes portions of Red Lake and Polk counties. Surface water movement through this system is in a primarily northwest direction. Several small ditches as well as Kripple Creek flow into the Gentilly River. The Gentilly River empties into the Red Lake River just west of the confluence of Kripple Creek, approximately 6 miles east of Crookston. The area is primarily utilized for agricultural purposes; over 80% of the land is cropland. The remaining land use is equally divided between pasture, developed, and wetland. Numerous beaver impoundments within this subwatershed are known to impact flow patterns and water temperature.

The outlet of the Gentilly River Subwatershed is represented by the MPCA's STORET/EQuIS stations SOO4-835 and S007-060 and biological stations 12RD022 and 12RD021. The stations are located upstream of 180th Ave SW, 1.5 miles NE of Gentilly and upstream of CR 18, 1 mile north of Huot, respectively.

Table 36. Aquatic life and recreation assessments on stream reaches: Gentilly River Subwatershed. Reaches are organized upstream to downstream in the table

AUID *Reach Name*, Reach Description	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Aquatic Rec. Indicators: Bacteria	Nutrients	Aquatic Life	Aquatic Rec.
09020303-526 *Kripple Creek (County Ditch 66)* Unnamed ditch to Unnamed creek	5.91	WWg	07RD006 12RD044	Downstream of Hwy 50, 3 mi. NW of Marcoux Downstream of CSAH 53, 4 mi. E of Gentilly	EXS	EXS	IF	-	-	IF	-	-	-	-	IMP	NA
09020303-525 *Kripple Creek* Unnamed Creek to Gentilly River	9.28	WWg	05RD077 12RD022	Upstream of 250th Ave, 3 mi. NE of Gentilly Upstream of 180th Ave SW, 1.5 mi. NE of Gentilly	EXS	EXS	IF	-	MTS	MTS	MTS	-	EX	-	IMP	IMP
09020303-554 *Gentilly River* County Ditch 140 to Red Lake River	8.51	WWg	12RD043 12RD021	Upstream of Hwy 2, 2.5 mi. SE of Gentilly Upstream of 180th Ave SW, 0.5 mi. SE of Gentilly	EXS	EXS	IF	-	MTS	MTS	MTS	-	EX	-	IMP	IMP

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

Table 37. Minnesota Stream Habitat Assessment (MSHA): Gentilly River Subwatershed.

# 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	07RD006	Kripple Creek (County Ditch 66)	1	7.5	16	13	21	58.5	Fair
1	12RD044	Kripple Creek (County Ditch 66)	3	9.5	12.1	12	29	65.6	Fair
1	05RD077	Kripple Creek	3	9	16	7	14	49	Fair
1	12RD022	Kripple Creek	0	11.5	18.6	14	22	66.1	Good
1	12RD043	Gentilly River	4	9.5	13.2	13	17	56.7	Fair
1	12RD021	Gentilly River	0	7	13.8	17	17	54.8	Fair
Average Habitat Results: *Gentilly River Subwatershed*			**1.8**	**9**	**14.95**	**12.7**	**20**	**58.45**	**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 38. Channel Condition and Stability Assessment (CCSI): Gentilly River Subwatershed.

# 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
0	07RD006	Kripple Creek (County Ditch 66)	-	-	-	-	-	-
1	12RD044	Kripple Creek (County Ditch 66)	16	25	9	3	53	Moderately Unstable
0	05RD077	Kripple Creek	-	-	-	-	-	-
0	12RD022	Kripple Creek	-	-	-	-	-	-
1	12RD043	Gentilly River	10	14	16	3	43	Fairly Stable
1	12RD021	Gentilly River	14	16	16	3	49	Moderately Unstable
Average Stream Stability Results: *Gentilly River Subwatershed*			**13.3**	**18.3**	**13.6**	**3**	**48.3**	**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 39. Outlet water chemistry results: Gentilly River Subwatershed.

Station location:	Kripple Creek at 80th St SW, near Gentilly						
STORET/EQuIS ID:	S004-835						
Station #:	12RD022						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-nitrogen	ug/L	37	<0	300	60		
Chloride	mg/L	18	3.57	18.20	8.01	230	
Dissolved Oxygen (DO)	mg/L	114	5.85	13.88	9.49	5	
pH		111	7.49	9.65	7.95	6.5 - 9	1
Secchi Tube[1]	100 cm	54	5.0	>100.0	68.1	10	2
Total suspended solids	mg/L	80	<1	210	15.9	65	4
Escherichia coli (geometric mean)	MPN/100ml	7	4	515	-	126	
Escherichia coli	MPN/100ml	53	2	>2420	-	1260	6
Inorganic nitrogen (nitrate and nitrite)	mg/L	74	<0.02	4.13	0.22		
Kjeldahl nitrogen	mg/L	62	<0.30	2.30	0.88		
Phosphorus	ug/L	74	<5	895	177		
Specific Conductance	uS/cm	114	204	919	621		
Temperature, water	deg °C	113	-0.12	25.54	15.91		
Sulfate	mg/L	10	47.3	918.0	149.2		
Hardness	mg/L	10	251	340	290.4		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 65 mg/L.

****Data found in the table above was compiled using the results from data collected at an IWM station in the Gentilly River Subwatershed, conducted between March and October from 2008 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Table 40. Outlet water chemistry results: Gentilly River Subwatershed.

Station location:	Gentilly River at 180th Ave SW, 0.5 mi SE of Gentilly						
STORET/EQuIS ID:	S007-060						
Station #:	12RD021						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances**
Ammonia-nitrogen	ug/L	13	<40	230	60		
Chloride	mg/L	10	2.95	9.48	5.05	230	
Dissolved Oxygen (DO)	mg/L	31	2.75	11.88	7.90	5	4
pH		31	7.32	8.15	7.69	6.5 - 9	
Secchi Tube[1]	100 cm	19	>100.0	>100.0	>100.0	10	
Total suspended solids	mg/L	14	<1	7	3.9	65	
Escherichia coli (geometric mean)	MPN/100ml	7	5	219	-	126	
Escherichia coli	MPN/100ml	19	4	921	-	1260	
Inorganic nitrogen (nitrate and nitrite)	mg/L	13	<0.03	<0.03	<0.03		
Kjeldahl nitrogen	mg/L	13	<0.30	0.84	0.49		
Phosphorus	ug/L	13	24	136	68		
Specific Conductance	uS/cm	31	510	798	605		
Temperature, water	deg °C	31	9.31	22.94	17.89		
Sulfate	mg/L	10	29.9	131.0	48.7		
Hardness	mg/L	10	217	342	276.9		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 65 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Gentilly River Subwatershed, conducted between May and September from 2012 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

Six biological monitoring stations were sampled on three stream reaches between 2005 and 2012. All three assessed stream reaches were impaired for fish and macroinvertebrates indicating that aquatic communities are not doing well within this subwatershed.

Kripple Creek (09020303-526) is a mostly altered and straightened portion of the stream. This reach is more known by locals as County Ditch (CD) 66. The reach originates in the Glacial Ridge NWR and flows northwest 5.91 miles, ending just north of Polk CSAH 53 at the confluence with an unnamed stream. Fish and macroinvertebrate communities were sampled at two stations (07RD006 and 12RD044). Both stations were dominated by tolerant and or pioneering fish and macroinvertebrate species resulting in poor FIBI and MIBI scores. There was insufficient water chemistry information to assess for aquatic life and aquatic recreation on this reach. However, a sonde deployed at the downstream end of this reach in August 2014, showed no DO exceedances. The daily minimum DO mean was 6.55 mg/L with the lowest reading being 5.59 mg/L. The sonde data suggests that DO is not limiting the aquatic life in this section of Kripple Creek. Restorations are currently taking place within the NWR that may help to improve the water quality.

Further downstream, Kripple Creek (09020303-525) continues to flow westward 9.28 miles from the unnamed stream to its confluence with the Gentilly River, just northwest of the town of Gentilly. Two biological monitoring stations are on this reach. The upstream station (05RD077) is impaired based on the FIBI and MIBI and the downstream station (12RD022) is impaired based on the FIBI. All IBI scores were well below their applicable thresholds. The downstream station (12RD022) was not sampled for macroinvertebrates due to a lack of flowing water. There were either no or very few exceedances for S-tube and TSS, un-ionized ammonia, chloride, DO and pH. The RLWD has done continuous DO monitoring on this reach in 2012 and 2013. In 2012, 60.3% of daily minimum values exceeded the 5.0 mg/L standard but in 2013 only 3.0% of the values exceeded the standard. Upstream restorations could be benefiting the DO concentrations for this reach. The varying results between yearly sonde deployments suggest that additional monitoring should be conducted. Also, there were not enough pre-9:00 AM samples taken to determine aquatic life support based on the grab samples. The reach does not support aquatic recreation. Bacteria samples exceeded the geometric monthly mean four times and there were six individual exceedances during the assessment period

The assessed reach of the Gentilly River (09020303-554) begins at the confluence with CD 140 and ends at the confluence with the Red Lake River. Fish and macroinvertebrate communities were sampled on this reach at two stations (12RD043 and 12RD021). The fish community at 12RD043 was comprised mainly of tolerant and or pioneer species (e.g. central mudminnow, brook stickleback, and fathead minnow) resulting in a poor FIBI score. The fish community further downstream (12RD021) was in better condition. The presence of darter species (johnny and blackside) as well as rock bass helped to improve the score at this site. The FIBI score for the downstream site was right at the applicable threshold. Macroinvertebrate taxa at both stations were low and numerically dominated by tolerant taxa. A dam downstream of CR 11 crossing may, at least in part contribute to the low FIBI scores. However, DO levels within the reach may also stress aquatic life. The RLWD deployed a Sonde within this reach in 2012. 58.5% of the minimum daily values were below the standard. The water chemistry results from the grab samples were all within acceptable levels including the DO concentrations. The contradictory DO information suggests that more early morning DO samples need to be taken to determine if a DO problem exists. There were three monthly geometric mean exceedances for E. coli and one individual exceedance, so aquatic recreation is not supported.

County Ditch 140 (09020303-524) is primarily an altered watercourse and originates in the NWR and winds west then north to the confluence with the Gentilly River, just south of US Highway 2. Aquatic life and aquatic recreation were not assessed in this reach due to a lack of data. However, a sonde deployed just downstream of this reach in August of 2014, indicated that the 5.0 mg/L standard was exceeded in 10 of 14 daily minimums. The mean DO concentration during the sonde deployment was 4.57 mg/L and the minimum value was 2.75 mg/L. This information suggests that DO is stressing the aquatic life in this reach and follow-up monitoring should be conducted.

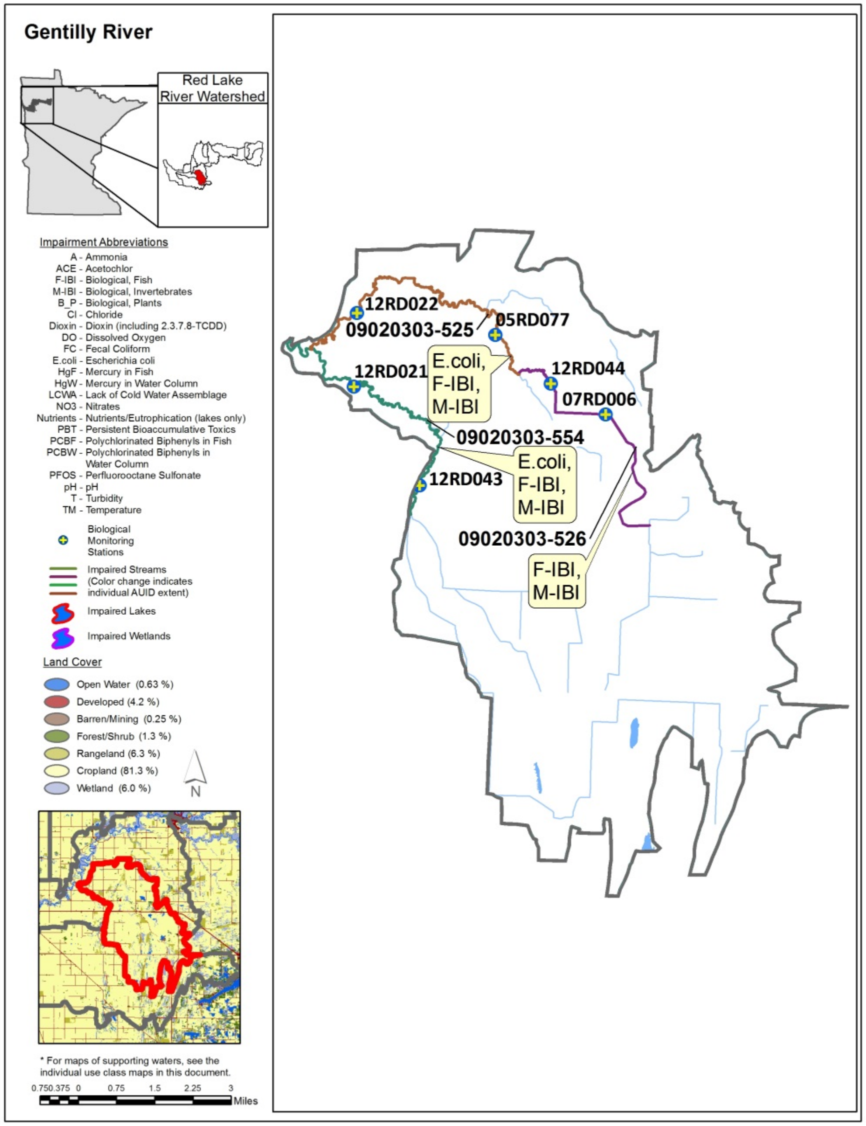

Figure 29. Currently listed impaired waters by parameter and land use characteristics in the Gentilly River Subwatershed.

County Ditch 1 Subwatershed HUC 0902030305-02

The County Ditch 1 Subwatershed is located within Polk County, in the southwest portion of the Red Lake River Watershed. Covering just over 40 square miles, it is the smallest subwatershed of the Red Lake River system. Land is primarily utilized for agriculture and is dominated by cropland (90%). Streams in this watershed are almost all channelized and intermittent. No biological stations were sampled in this watershed due to low flow conditions experienced in 2012.

The outlet water chemistry of the County Ditch 1 Subwatershed is represented by MPCA's STORET/EQuIS station S007-059, located at CSAH 61, 2 miles west of Crookston.

Table 41. Outlet water chemistry results: County Ditch 1 Subwatershed.

Station location:	**County Ditch 1 at CSAH 61, 2 mi W of Crookston**						
STORET/EQuIS ID:	**S007-059**						
Station #:	**N/A**						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	7	<40	<40	<40		
Chloride	mg/L	4	30.80	40.30	36.33	230	
Dissolved Oxygen (DO)	mg/L	22	4.28	16.48	10.48	5	1
pH		22	7.53	8.30	8.02	6.5 - 9	
Secchi Tube	100 cm	12	5.3	>100.0	52.4	10	1
Total suspended solids	mg/L	7	5	29	14.9	65	
Escherichia coli (geometric mean)	MPN/100ml	3	6	81	-	126	
Escherichia coli	MPN/100ml	10	1	1986	-	1260	
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	7	<0.03	<0.03	<0.03		
Kjeldahl nitrogen	mg/L	7	1.14	1.95	1.45		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	6	62	85	73		
Specific Conductance	uS/cm	21	187	1341	895		
Temperature, water	deg °C	22	2.43	27.67	19.13		
Sulfate	mg/L	4	246.0	269.0	257.5		
Hardness	mg/L	5	220	561	454.4		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 65 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the County Ditch 1 Subwatershed, a component of the IWM work conducted between April and July from 2012 to 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The County Ditch Subwatershed has one assessable AUID (09020303-536) and covers a two mile segment of CD 1 from CD 60 to the confluence with the Red Lake River. The majority of the land in this watershed is utilized for agricultural cropland. Water chemistry samples taken during the assessment period were limited but resulted in no exceedances for un-ionized ammonia, pH, and chloride and a single DO exceedance. For TSS and S-tube samples, the desired numbers of samples were not collected during the assessment period. However, there were no TSS exceedances and only one S-tube exceedance of 5.3 cm. There were no early morning DO samples and only two years of data collection, so there was insufficient information to suggest aquatic life support. There was only one individual E. coli sample above the standard, but the dataset was too small to determine support for aquatic recreation.

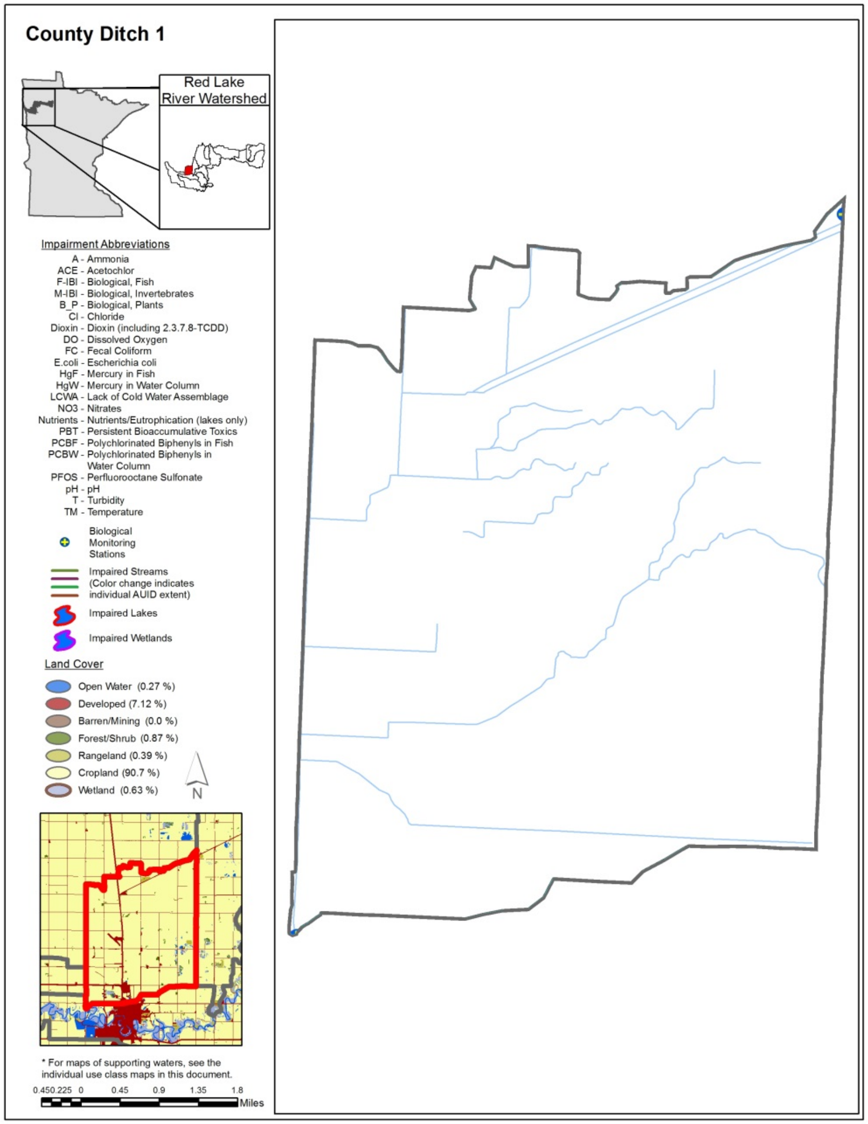

Figure 30. Currently listed impaired waters by parameter and land use characteristics in the County Ditch 1 Subwatershed.

Burnham Creek Subwatershed HUC 0902030306-01

The Burnham Creek Subwatershed is located in the southwest portion of the RLWD and covers roughly 150 square miles. The main stream in the subwatershed, Burnham Creek, flows primarily in a northwest direction. It has been channelized along much of its length but there are still some natural sections of the creek remaining. Several ditches enter into Burnham Creek prior to its confluence with the Red Lake River, approximately 6 miles west of the town of Crookston. The lower stretch of Burnham Creek from CD 15 to the Red Lake River was listed in 2008 as impaired for aquatic life based on turbidity standards. The stream experiences heavy beaver activity and therefore the water levels fluctuate based on the number and magnitude of impoundments (beaver dams) present at any given time. Land use within this area is dominated by cropland (84%), with the remaining land divided evenly among developed land, forest, pasture, and wetlands.

The outlet water chemistry of the Burnham Creek Subwatershed is represented by MPCA's STORET/EQuIS station S007-058 and biological station 12RD001.

Table 42. Aquatic life and recreation assessments on stream reaches: Burnham Creek Subwatershed. Reaches are organized upstream to downstream in the table.

AUID ***Reach Name,*** *Reach Description*	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Aquatic Rec. Indicators: Bacteria	Nutrients	Aquatic Life	Aquatic Rec.
09020303-551 Burnham Creek CD 106 to Polk CD 15	7.36	WWm	12RD030	Upstream of 240th Ave SW, 5 mi. NW of Greenview	EXS	EXS	IF	-	-	IF	IF	-	IF	-	IMP	NA
09020303-515 Burnham Creek Polk CD 15 to Red Lake R	20.52	WWg	12RD032 12RD115 12RD001 10EM112	Downstream of CR 217, 0.5 mi. N of Girard Upstream of 300th Ave SW, 4 mi. SW of Crookston Upstream of 320th Ave SW, 5 mi. W of Crookston. Upstream of 170th Ave SW, 7.5 mi. W of Crookston	EXS	EXS	MTS	MTS	MTS	MTS	MTS	-	MTS	-	IMP	SUP

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 43. Minnesota Stream Habitat Assessment (MSHA): Burnham Creek Subwatershed.

# 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	12RD030	Burnham Creek	1.5	7	12	5	7	32.5	Poor
2	12RD032	Burnham Creek	4	8.5	7	16	14	49.5	Fair
	12RD032	Burnham Creek	3	8	10.4	15	22	58.4	Fair
1	12RD115	Burnham Creek	0	8	15.6	12	20	55.6	Fair
1	12RD001	Burnham Creek	2.5	11.5	7	16	16	53	Fair
1	10EM112	Burnham Creek	0	13	7	10	14	44	Poor
Average Habitat Results: *Burnham Creek Subwatershed*			**1.8**	**9.3**	**9.8**	**12.3**	**15.5**	**48.8**	**Fair**

Qualitative habitat ratings

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

Table 44. Channel Condition and Stability Assessment (CCSI): Burnham Creek Subwatershed.

# 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	12RD030	Burnham Creek	18	7	18	1	44	Fairly Stable
0	12RD032	Burnham Creek	-	-	-	-	-	-
0	12RD115	Burnham Creek	-	-	-	-	-	-
1	12RD001	Burnham Creek	23	5	11	1	40	Fairly Stable
0	10EM112	Burnham Creek	-	-	-	-	-	-
Average Stream Stability Results: *Burnham Creek Subwatershed*			**20.5**	**6**	**14.5**	**1**	**42**	**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 45. Outlet water chemistry results: Burnham Creek Subwatershed.

Station location:	Burnham Creek at 320th Ave SW, 5 mi W of Crookston						
STORET/EQuIS ID:	S007-058						
Station #:	12RD001						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	22	<40	340	60		
Chloride	mg/L	10	11.90	20.90	17.58	230	
Dissolved Oxygen (DO)	mg/L	37	5.89	12.72	8.40	5	
pH		37	7.47	9.76	8.17	6.5 - 9	1
Secchi Tube	100 cm	18	18.0	>100.0	88.4	10	
Total suspended solids	mg/L	25	<1	400	31.9	65	2
Escherichia coli (geometric mean)	MPN/100ml	7	8	108	-	126	
Escherichia coli	MPN/100ml	25	<1	649	-	1260	
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	20	<0.03	0.72	0.09		
Kjeldahl nitrogen	mg/L	21	1.07	3.12	1.46		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	21	82	703	264		
Specific Conductance	uS/cm	37	383	826	655		
Temperature, water	deg °C	37	7.25	26.69	19.03		
Sulfate	mg/L	10	65.7	139.0	101.8		
Hardness	mg/L	10	247	438	325.1		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 65 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Burnham Creek Subwatershed, conducted between March and October from 2004 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

The upstream reach of Burnham Creek (09020303-551) was sampled for fish and macroinvertebrates upstream of 240th Avenue SW (12RD030). Fish and macroinvertebrate communities and the stream habitat in this reach are in very poor condition. The reach has been ditched and has been designated as a modified use stream. Both FIBI and MIBI scores were poor and dominated by tolerant taxa. There was insufficient information to assess aquatic life and aquatic recreation support based on water chemistry.

The next downstream reach on Burnham Creek (09020303-552) is a 7.36 mile long ditched segment that flows northwesterly through mostly cropland. There were no biological monitoring sites on the reach and an insufficient number of samples to assess aquatic life and aquatic recreation support. However, a sonde deployed within the reach in July of 2014, found no DO exceedances. The mean daily minimum DO value was 6.42 mg/L, and lowest recorded value was 5.96 mg/L. The sonde data suggests that DO is not limiting the aquatic life in this reach.

Further downstream, Burnham Creek (09020303-515) returns to a more natural channel. Four sites were sampled for fish and two were sampled for macroinvertebrates in this lower reach. FIBI and MIBI scores at all of the sites were poor and indicated impairment. Two of the sites that were sampled for fish (12RD115 and 10EM112) were not sampled for macroinvertebrates because they were stagnant/dry. Flow permanence and beaver activity are two potential stressors in this reach. Low flows reduce available habitats and may cause drops in DO. Beaver activity has the potential to alter flow, warm stream temperature, and block fish passage. Water chemistry samples taken during the assessment period resulted in no exceedances for un-ionized ammonia and chloride and a low exceedance rate for pH, DO and TSS. The TSS and S-tube datasets were quite large. However, some of the TSS exceedances occurred during a large rain event in May 2013 and may not be representative of normal stream conditions. The existing turbidity impairment on this reach should be reevaluated based on the results of this assessment. A number of sonde deployments in 2012 and 2014 contradict the DO low exceedance rate from the grab samples. A sonde deployed by the RLWD in 2012 indicated that 38.8% of DO daily minimum values were below the standard, the lowest value being 2.34 mg/L. A sonde deployed by MPCA in 2014 at 10EM112 indicated that 8 of 16 daily minimum values were below and the standard with a low of 3.56 mg/L. A third sonde deployed by MPCA 0.5 miles from the mouth of Burnham Creek had only one reading that was slightly below the standard (4.95mg/L). The recovery in DO near the mouth corresponded with the highest FIBI score in Burnham Creek, at the downstream most biological monitoring site (10EM112). Additional DO measurements, including pre-9:00 AM samples and additional sonde deployments are necessary to determine if low DO levels are responsible for the poor IBI scores in Burnham Creek. A large E. coli dataset indicated that Burnham Creek supports aquatic recreation.

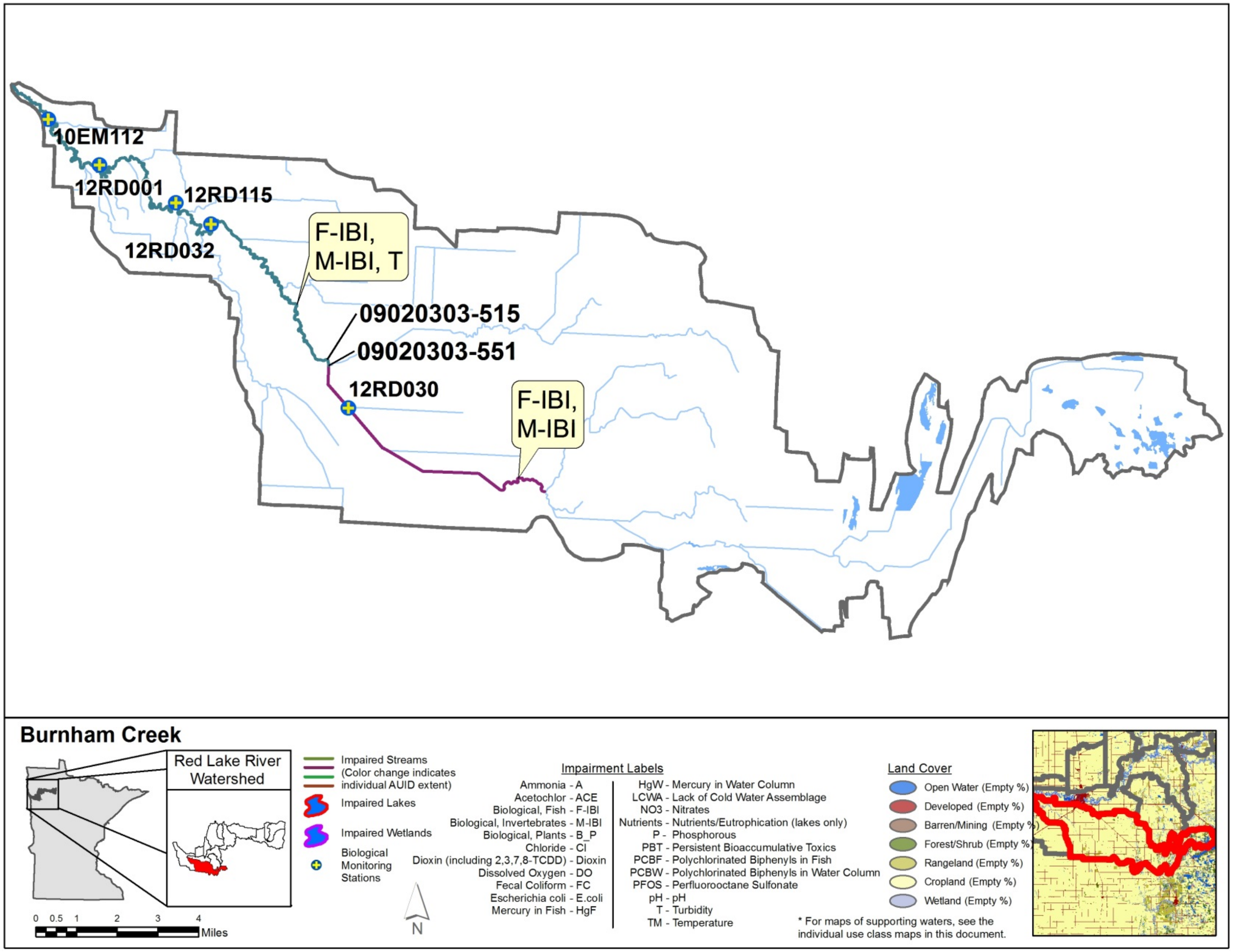

Figure 31. Currently listed impaired waters by parameter and land use characteristics in the Burnham Creek Subwatershed.

Outlet Red Lake River Subwatershed HUC 0902030307-01

The Outlet Red Lake River Subwatershed is located in the far western portion of the watershed, and includes the confluence of the Red Lake River with the Red River of the North in East Grand Forks. The area drains approximately 131 square miles of land and is in Polk County. Streams in the watershed include the main-stem Red Lake River and numerous channelized tributaries and ditches. Like most of the watershed, the area is primarily cropland (85%). The remaining land use is divided between developed (8%), wetland (4%), and open water (2%). Cities included within this subwatershed are Fisher and East Grand Forks.

The outlet of this subwatershed is represented by MPCA's STORET/EQUIS station S002-963 and biological station 12RD010, located upstream of 2nd Avenue NE, in East Grand Forks.

Table 46. Aquatic life and recreation assessments on stream reaches: Outlet Red Lake River Subwatershed. Reaches are organized upstream to downstream in the table.

					Aquatic Life Indicators:								Aquatic Rec. Indicators:			
AUID ***Reach Name*,** *Reach Description*	**Reach Length (miles)**	**Use Class**	**Biological Station ID**	**Location of Biological Station**	Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH_3	Pesticides	Bacteria	Nutrients	**Aquatic Life**	**Aquatic Rec.**
09020303-501 Red Lake River Burnham Cr to Unnamed Cr	30.83	WWg	76RD023 12RD110	Upstream of CSAH 15, 0.5 mi. W of Fisher 3.7 mi. upstream of Hwy 220, 3 mi. NW of Bygland	MTS	MTS	MTS	EXS	MTS	MTS	MTS	-	-	-	SUP	SUP
09020303-549 RLWD Ditch 12 Headwaters to CD 115.	7.27	WWm	10EM160	Downstream of Hwy 220, 5 mi. SW of Fisher	EXS	EXS	IF	IF	-	IF	-	-	-	-	NA	NA
09020303-550 Unnamed creek CD 115 to Red Lake River	11.39	WWg	-	--	-	-	EXS	MTS	MTS	MTS	MTS	-	MTS	-	IMP	SUP
09020303-503 Red Lake River Unnamed Creek to Red River	1.87	WWg	12RD010	Upstream of 2nd Ave NE, in East Grand Forks	MTS	-	MTS	EXS	MTS	MTS	MTS	-	MTS	-	SUP	SUP

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 47. Minnesota Stream Habitat Assessment (MSHA): Outlet Red Lake River Subwatershed.

# 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	76RD023	Red Lake River	1	6	15.8	6	18	46.8	Fair
1	12RD110	Red Lake River	1.25	5	7	6	11	30.25	Poor
1	10EM160	Unnamed Creek	0	6	10	8	10	34	Poor
1	12RD010	Red Lake River	1.25	5	7	6	11	30.25	Poor
Average Habitat Results: *Outlet Red Lake River Subwatershed*			**0.88**	**5.5**	**9.95**	**6.5**	**12.5**	**35.3**	**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 48. Channel Condition and Stability Assessment (CCSI): Outlet Red Lake River Subwatershed.

# 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	76RD023	Red Lake River	20	16	14	5	55	Moderately Unstable
1	12RD110	Red Lake River	21	19	12	3	55	Moderately Unstable
0	10EM160	Unnamed Creek	-	-	-	-	-	-
1	12RD010	Red Lake River	21	19	12	3	55	Moderately Unstable
Average Stream Stability Results: *Outlet Red Lake River Subwatershed*			**20.6**	**18**	**12.6**	**3.7**	**55**	**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 49. Outlet water chemistry results: Outlet Red Lake River Subwatershed.

Station location:	Red lake River at 2nd Ave NE (Murray Bridge), in East Grand Forks						
STORET/EQuIS ID:	S002-963						
Station #:	12RD010						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Ammonia-nitrogen	ug/L	53	<0	430	60		
Chloride	mg/L	11	<0.00	17.60	8.45	230	
Dissolved Oxygen (DO)	mg/L	92	6.10	13.16	8.78	5	
pH		97	6.46	9.10	8.13	6.5 - 9	2
Secchi Tube	100 cm	56	5.9	39.0	17.4	25	52
Total suspended solids	mg/L	63	9	408	77.0	30	54
Escherichia coli (geometric mean)	MPN/100ml	7	2	33	-		
Escherichia coli	MPN/100ml	52	<1	387	-	1260	
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	50	<0.00	1.48	0.11		
Kjeldahl nitrogen	mg/L	51	<0.30	2.60	1.06		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	51	15	427	104		
Specific Conductance	uS/cm	97	189	578	413		
Temperature, water	deg °C	97	0.43	28.92	17.47		
Sulfate	mg/L	10	17.7	64.6	38.2		
Hardness	mg/L	10	155	242	193.2		

[1]Secchi Tube standards are surrogate standards derived from the total suspended solids standard of 30 mg/L.

****Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Outlet Red Lake River Subwatershed, conducted between January and November from 2004 to 2014. This specific data does not necessarily reflect all data that was used to assess the AUID.**

Summary

There were four assessed reaches in the Outlet Red Lake River aggregated HUC-12. Biological monitoring was conducted at four sites on three of the reaches between 2007 and 2012. The biological monitoring results were generally good even though the stations sampled had some of the poorest habitat scores within the watershed. Water chemistry results were variable. Turbidity and DO levels are of the most concern. This subwatershed is within the Agassiz Lake Plain Ecoregion, which is fairly flat in topography and has fertile soils. As a result, a majority of this area has been converted to cropland.

The upper portion of the mainstem Red Lake River between Burnham Creek and Unnamed creek (09020303-501) was sampled at two locations (76RD023 and 12RD110) in 2012. MIBI and FIBI scores were well above their respective impairment thresholds for both assemblages at both sites. Both communities were diverse and contained numerous sensitive species. The water chemistry dataset was large; including both event based sampling and systematic sampling events. TSS and S-tube samples resulted in 229 and 221 exceedances respectively and confirm the existing turbidity impairment. Un-ionized ammonia, chloride, pH, and DO were all meeting aquatic life standards. Individual E. coli samples and the geometric monthly means were within acceptable levels indicating that the reach supports aquatic recreation.

RLWD Ditch 12 (Heartsville Coulee) (09020303-549) was surveyed for fish at one station (10EM160) in 2010. Few fish species were sampled from this station and all fish species sampled were tolerant of pollution resulting in a FIBI score of 0. The reach was not assessed because ongoing work to improve the stream channel occurred just prior to the biological survey. There was insufficient information to assess the reach based on water chemistry. However, a sonde was deployed by MPCA at the downstream end of the reach in July 2014. All daily minimum values were violated the DO standard. The mean DO concentration was 0.50 mg/l with a range of 0.00 to 21.49 mg/L. It is likely that the low and highly variable DO levels in this reach pose a threat to aquatic life

There was one biological monitoring station (12RD010) on the lowest reach of the mainstem Red Lake River (09020303-503) The FIBI score was good, reflecting the presence of several sensitive species and game species (e.g. smallmouth bass, walleye, mooneye, rock bass, and spottail shiner). The reach is currently impaired due to turbidity and mercury in fish tissue. The TSS and S-tube datasets resulted in 64 exceedances, confirming the existing turbidity impairment. Un-ionized ammonia, chloride, pH, and DO were all meeting aquatic life standards. The reach also supports aquatic recreation as there were no individual or geometric monthly mean exceedances for E. coli.

A large dataset was available to assess Unnamed creek (09020303-550) from CD115 and to the confluence with the Red Lake River. Un-ionized ammonia, chloride, pH, TSS and S-Tube readings all met aquatic life standards. However, DO exceeded the standard in 73.5% of cases. Flows in this reach have been known to be intermittent, which could explain the high exceedance rate. The RLWD deployed a sonde on this reach in 2012. During the 120 day deployment all values exceeded the standard. Based on the DO data, the reach does not support aquatic life. There were no individual or geometric monthly mean exceedances of the E. coli standard, so the reach fully supports aquatic recreation.

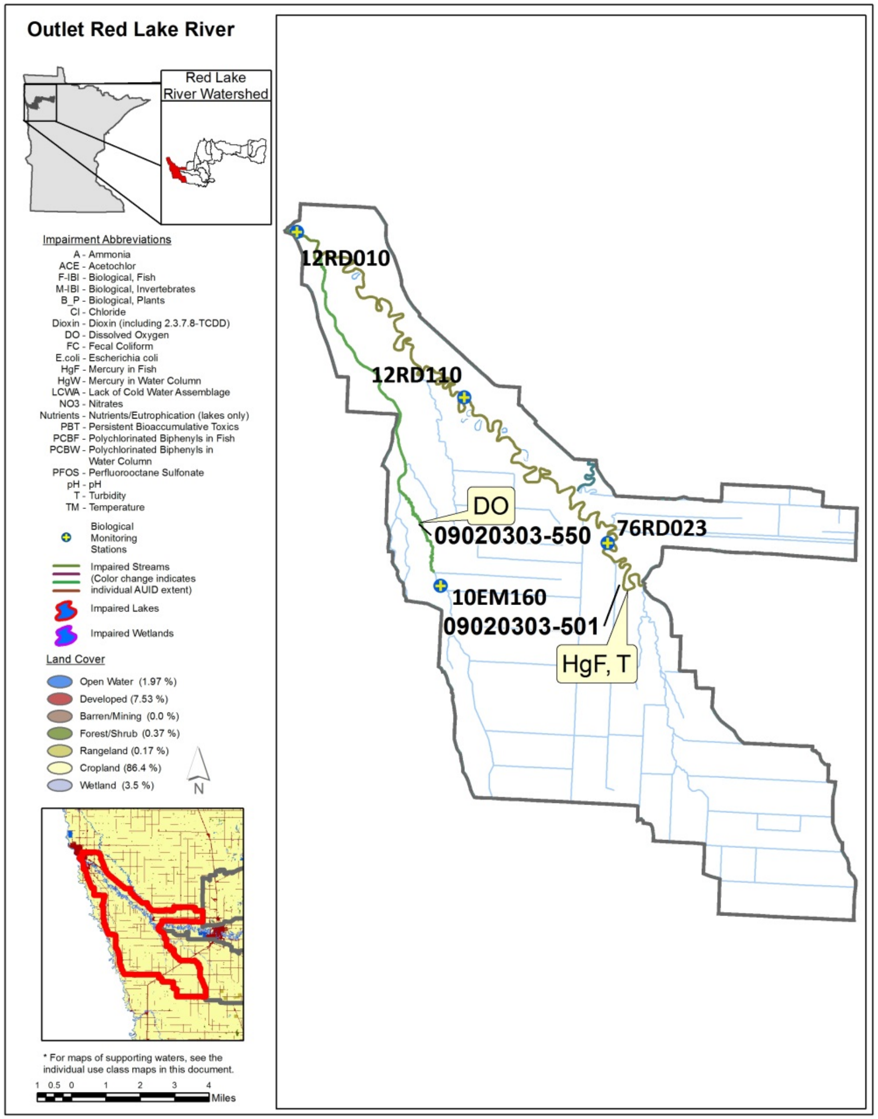

Figure 32. Currently listed impaired waters by parameter and land use characteristics in the Outlet Red Lake River Subwatershed.

VI. Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the Red Lake River Watershed, grouped by sample type. Summaries are provided for load monitoring data results near the mouth of the river, for 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 Red Lake River Watershed.

Pollutant load monitoring

The Red Lake River is monitored on CSAH Highway 15 near Fisher, Minnesota, approximately 13 miles above the confluence with the Red River of the North (Red Lake River near Fischer, CSAH 15; USGS ID 05080000; Hydstra ID E630378001). Many years of water quality data from throughout Minnesota combined with the previous analysis of Minnesota's ecoregion patterns, resulted in the development of three "River Nutrient Regions" (RNR), each with unique nutrient standards (MPCA, 2008). Of the state's three RNRs (North, Central, South), the Red Lake River's monitoring station is located within the South RNR.

Annual flow weighted mean concentrations (FWMCs) were calculated for years 2010-2012 (Figures 33-36) and compared to the RNR standards (only TP and TSS standards are available for the South RNR). It should be noted that while a FWMC exceeding water quality standard is generally a good indicator that the water body is out of compliance with the RNR standard, the rule does not always hold true. Waters of the state are listed as impaired based on the percentage of individual samples exceeding the numeric standard, generally 10% and greater, over the most recent 10 year period and not based on comparisons with FWMCs (MPCA, 2014). 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 ($NO_3 + NO_2$-N) are regarded as "non-point" source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess 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 conditions (frozen/unfrozen, saturation level, etc.) 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 when compared to 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 flow, shallow and deep groundwater, and subsurface drainage tile. Runoff pathways, discharge levels, total flow volume and other factors determine the type and levels of pollutants transported to receiving waters and help explain between-storm and temporal differences in FWMCs and loads. During years when high intensity rain events provide the greatest proportion of total annual runoff, concentrations of TSS and TP tend to be higher and DOP and $NO_3 + NO_2$-N concentrations tend to be lower. In contrast, during years with high snow melt runoff and less intense rainfall events, TSS levels tend to be lower while TP, DOP, $NO_3 + NO_2$-N levels tend to be elevated.

Total suspended solids

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

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

Minnesota's water quality standards for river eutrophication and total suspended solids were adopted into Minn. R. ch. 7050 in 2014 and approved by the EPA in January 2015. Within the South RNR, a river is considered impaired when greater than 10% of the individual samples exceed the TSS standard of 65 mg/L. (MPCA, 2011). From 2010 through 2012, 56, 63, and 44%of the samples from the Red Lake River at Fisher exceeded the 65 mg/L standard, respectively. Table 50 displays total annual loads and shows the lowest TSS load occurred in 2012, a year with less than half the runoff when compared to 2010 and 2011. Because pollutant loads are the product of concentration and volume, years with lesser runoff volume tend to have lower pollutant loads unless concentrations are elevated.

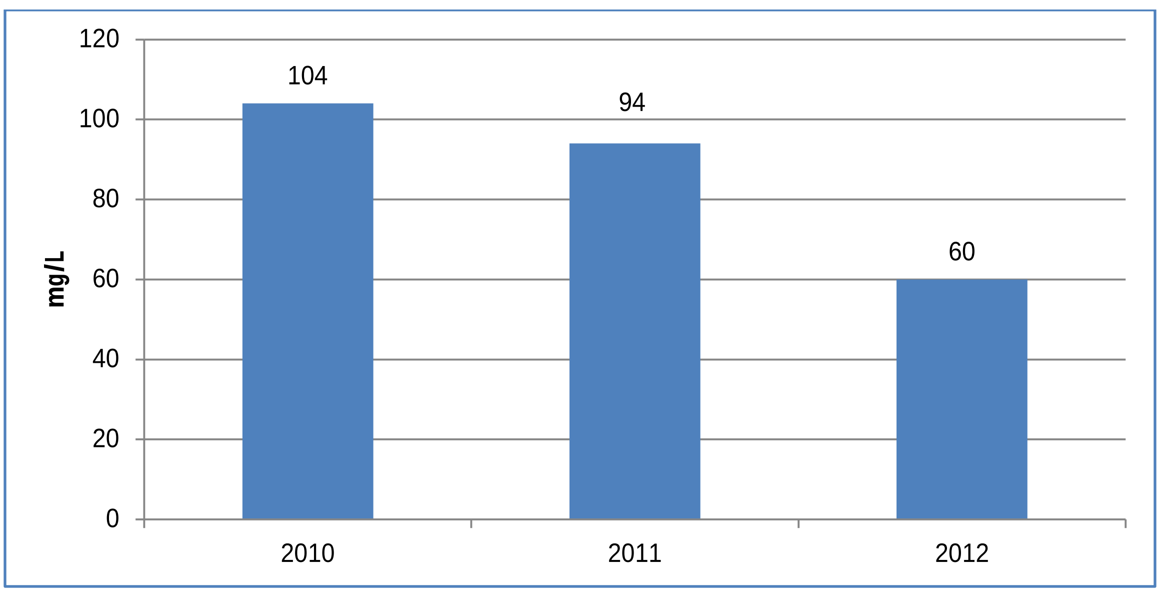

Figure 33. Total Suspended Solids (TSS) flow weighted mean concentrations in the Red Lake River.

Table 50. Annual pollutant loads by parameter calculated for the Red Lake River at Fisher.

	2010	2011	2012
Parameter	**Mass (kg)**	**Mass (kg)**	**Mass (kg)**
Total Suspended Solids	222,348,300	207,189,700	40,152,240
Total Phosphorus	361,021	262,555	58,215
Dissolved Orthophosphate	169,245	78,396	25,831
Nitrate + Nitrite Nitrogen	1,023,785	1,019,631	137,185

Total phosphorus

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

Within the South RNR, the TP standard is 0.150 mg/L as a summer average (June through September). Summer average violations of one or more "response" variables (pH, biological oxygen demand, DO flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. A comparison of the data collected during the summer averaging period, show TP exceedances occurred 59, 33, and 9% of the time, respectively. Although there were exceedances of the standard, only 2010 had summer averages greater than the standard (0.187 mg/L). Figure 34 illustrates the 2010 TP FWMC also exceeded the standard, albeit this includes all data throughout the year (not just summer values). Table 50 shows annual loads which exhibit similar traits similar to TSS.

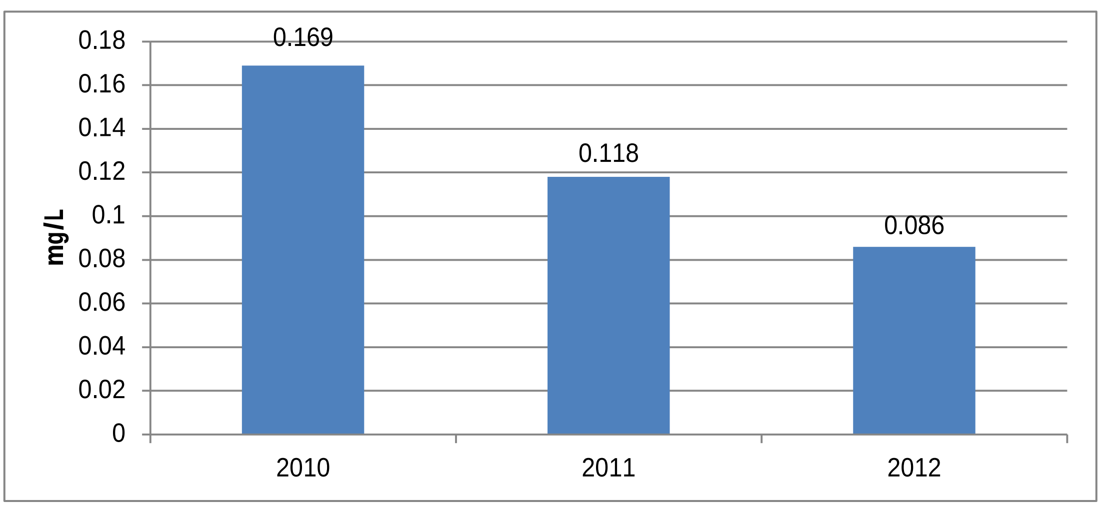

Figure 34. Total phosphorus flow weighted mean concentrations for the Red Lake River at Fisher.

Dissolved orthophosphate

Dissolved orthophosphate (DOP) is a water soluble form of phosphorus that is readily available for plant uptake (MPCA and MSUM, 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from wastewater treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. Computation of FWMC DOP to TP ratio from the three years was between 47, 30, and 44% respectively. Table 50 shows similar trends between years as seen with TP. This is not uncommon due to the relationship between DOP and TP. Interestingly, Figure 35 shows similar FWMCs in 2011 and 2012. This can occur when higher concentrations occur at the higher flows. The highest DOP concentrations at elevated flows in 2012 were twice the highest DOP concentrations at elevated flows in 2011.

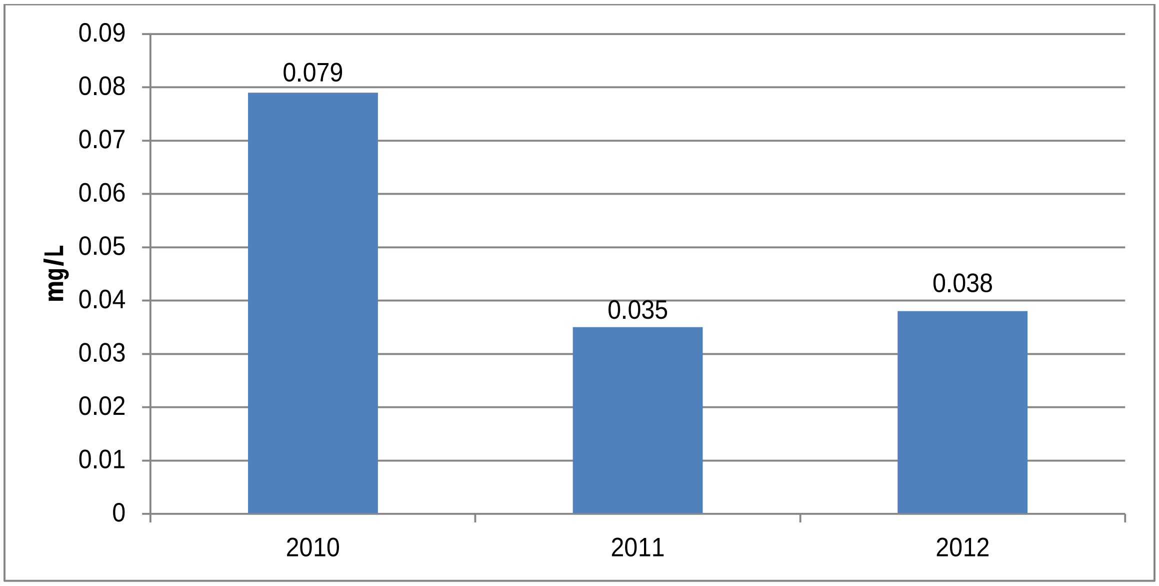

Figure 35. Dissolved orthophosphate flow weighted mean concentrations for the Red Lake River at Fisher.

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, 2013). Because nitrate and nitrite-nitrogen are water soluble, transport to surface waters is enhanced through agricultural drainage. The ability of nitrate plus nitrite nitrogen (nitrite-N) to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis ofnitrate-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.

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

Figure 36 shows the $NO_3 + NO_2$-N FWMCs over the three-year period for the Red Lake River at Fisher monitoring site. The FWMC for all three years were below the draft acute Class 2 and draft chronic Class 2B nitrate-N standards. Between 2010 and 2012, there were no exceedances of the draft acute Class 2 standard and no exceedances of the draft chronic Class 2B 4-day duration standard. Table 50 displays the annual loads which decreased over the three year period which corresponds to the decrease in FWMCs.

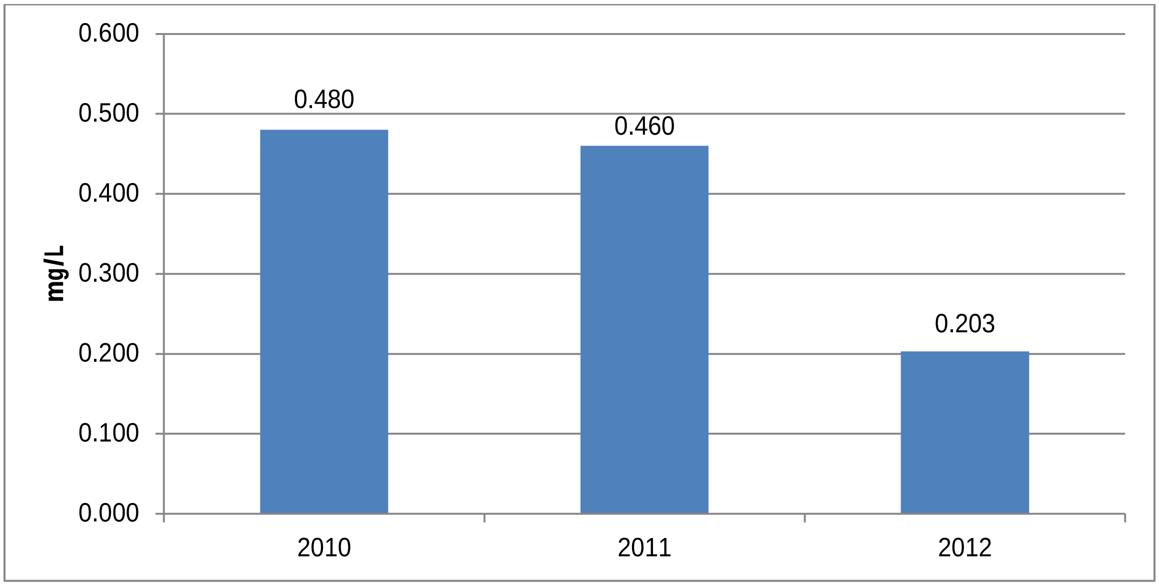

Figure 36. Nitrate + Nitrite Nitrogen flow weighted mean concentrations for the Red Lake River at Fisher, Minnesota

Stream water quality

Water chemistry data was available for 39 of the 52 stream reaches in the Red Lake River Watershed. Of the 31 assessable stream reaches, 26 had bacteria data available. Twenty-nine stream segments had sufficient data to assess aquatic life and 18 were assessed for aquatic recreation. Fifteen streams fully supported aquatic life and 10 streams fully supported aquatic recreation. One reach (09020303-902) was not assessed due its classification as limited resource water. Throughout the watershed, 14 streams do not support aquatic life and 7 do not support aquatic recreation.

Table 51. Assessment summary for stream water quality in the Red Lake River Watershed.

				Supporting		Non-supporting				
Watershed	Area (acres)	# Total AUIDs	# Assessed AUIDs	# Aquatic Life	# Aquatic Recreation	# Aquatic Life	# Aquatic Recreation	Insufficient Data	Not Assessed (lacking critieria)	# Delistings
09020303 **HUC 8**	**857496**	**56**	**31**	**15**	**10**	**14**	**7**	**7 AL, 7 AR**	**4 AL, 15 AR**	**5**
0902030302-02	120476	3	2	1	0	1	0	0 AL, 0 AR	1 AL, 2 AR	
0902030301-01	60808	1	1	1	0	0	0	0 AL, 0 AR	0 AL, 1 AR	
0902030302-03	26521	1	1	1	0	0	0	0 AL, 0 AR	0 AL, 1 AR	
0902030302-01	101166	2	2	2	1	0	0	0 AL, 0 AR	0 AL, 1 AR	
0902030303-01	78529	6	5	3	2	1	2	1 AL, 0 AR	1 AL, 2 AR	
0902030303-02	26590	3	1	0	0	1	0	1 AL, 0 AR	0 AL, 2 AR	
0902030304-01	92708	7	5	2	1	2	3	2 AL, 2 AR	1 AL, 1 AR	3
0902030305-01	73281	8	8	5	2	3	2	0 AL, 3 AR	0 AL, 1 AR	1
0902030305-03	27713	2	1	0	0	1	0	0AL, 0 AR	1 AL, 2 AR	
0902030305-04	43328	6	2	0	0	2	1	1 AL, 0 AR	3 AL, 5 AR	
0902030305-02	26794	5	1	0	0	0	0	1 AL, 1 AR	4 AL, 4 AR	
0902030306-01	95807	6	2	0	1	2	0	1 AL, 2 AR	3 AL, 3 AR	1
0902030307-01	83778	6	3	2	3	1	0	0 AL, 0 AR	3 AL, 3 AR	

Fish contaminant results

Fourteen fish species from the Red Lake River and the Red Lake Reservoir were tested for contaminants. A total of 163 fish were tested between 1978 and 2012. Fish species are identified by codes that are defined by their common and scientific names in Table 52.

Table 53 summarizes contaminant concentrations by waterway, fish species, and year. “No. 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). Since 1989, most of the samples have been skin-on fillets (FILSK) or for fish without scales (catfish and bullheads), skin-off fillets (FILET).

All 11 reaches of the Red Lake River were listed as impaired due to mercury in fish in 1998 (Table 53). The Red Lake River Reservoir was specifically listed in 2012 as impaired due to mercury in fish.

From all tested fish in the Red Lake River Watershed, the highest mercury concentration was 8.85 mg/kg in a sauger collected from below the Thief River Falls dam in 2011.

Most of the PCB concentrations in fish tissue from the lakes were below the reporting limit. The highest PCB concentration was 0.6 mg/kg in a common carp and next highest 0.42 mg/kg in a quillback, both collected from the river below the dam in 1978. The two carp tested for PCBs in 2012 were < 0.025 mg/kg and 0.089 mg/kg, indicating a substantial drop in PCB concentrations.

Overall, the fish contaminant results shows PCBs have not been at levels of concern in the Red Lake River Watershed in the last two decades, whereas the mercury concentrations in fish tissue have remained relatively high in the river.

Table 52. Fish species codes, common names, and scientific names

Species	Common Name	Scientific Name
BKS	Black crappie	*Pomoxis nigromaculatis*
C	Common Carp	*Cyprinus carpio*
CHC	Channel catfish	*Ictalurus punctatus*
GE	Goldeye	*Hiodon alosoides*
GRH	Golden redhorse	*Moxostoma erythrurum*
NP	Northern pike	*Esox Lucius*
QUB	Quillback	*Carpiodes cyprinus*
RKB	Rock bass	*Ambloplites rupestris*
SAG	Sauger	*Sander canadensis*
SMB	Smallmouth bass	*Micropterus dolomieu*
SRD	Shorthead redhorse	*Moxostoma macrolepidotum*
WE	Walleye	*Sander vitreus*
WSU	White sucker	*Catostomus commersoni*
YP	Yellow perch	*Perca flavescens*

Table 53. Summary statistics of mercury and PCBs, by waterway-species-year.

Waterway		AUID	Species	Year	Anatomy	No. Fish	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)		
							Mean	Min	Max	N	Mean	Min	Max	N	Min	Max
Red Lake River*	RL-above TRF Dam	09020303 -508, -509	BKS	1992	FILSK	5	6.5			1	0.130					
			WE	1992	FILSK	6	14.6	13.8	15.4	2	0.315	0.300	0.330	1	< 0.01	
			WSU	1992	FILSK	10	14.1	11.2	17	2	0.186	0.072	0.300	1	< 0.01	
	RL-below TRF Dam	09020303 -513, -504, -510, -511, -502, -512, -506, -501, -503	BKS	1993	FILSK	8	8.9			1	0.180					
			C	1978	PLUG	2	19.4			1	0.210			1	0.6	
					WHORG	2	19.4			1	0.070			1	0.02	
				2012	FILSK	5	18.0	14.3	21	5	0.162	0.099	0.248	2	<0.025	0.089
			CHC	1978	WHORG	2	12			1	0.060			1	0.18	
				1979	WHORG	5	9.9			1	0.070					
				2011	FILET	8	17.4	13	25.2	8	0.188	0.153	0.317	2	<0.025	0.035
				2012	FILET	1	15.8			1	0.198			1	<0.025	
			GE	2011	FILSK	3	13.4			1	0.399					
			GRH	2011	FILSK	5	12.6			1	0.409					
			NP	2011	FILSK	1	17			1	0.388					
			QUB	1978	PLUG	5	17.3			1	0.290			1	0.42	
					WHORG	5	17.3			1	0.170			1	0.3	
				1979	WHORG	5	17.2			1	0.270					
			RKB	2011	FILSK	9	7.85	7.4	8.3	2	0.261	0.225	0.297			
			SAG	2011	FILSK	3	12.7	12	13.3	3	0.739	0.662	0.849			
			SMB	1993	FILSK	10	13.2	11.3	15.1	2	0.335	0.230	0.440	2	0.018	0.045
			SRD	1978	WHORG	2	13.3			1	0.120			1	0.29	
				2011	FILSK	1	15.3			1	0.332					
			WE	1993	FILSK	21	18.7	11.9	23.7	4	0.573	0.300	0.760	4	< 0.01	0.03
				2011	FILSK	5	14.6	12.5	18.4	5	0.366	0.258	0.461			
Red Lake River Reservoir**		57005100 (includes river AUID -509)	NP	2009	FILSK	8	20.1	15.5	31.8	8	0.320	0.200	0.782			
			RKB	2009	FILSK	10	6.8			1	0.135					
			WE	2009	FILSK	6	18.1	13.7	26.3	6	0.310	0.188	0.755			
			WSU	2009	FILSK	5	17.3			1	0.179					
			YP	2009	FILSK	5	8.8			1	0.121					

Groundwater monitoring

Groundwater quality

The Red Lake River Watershed has three types of aquifers: Cretaceous, buried sand and gravel, and surficial sand and gravel aquifers. A baseline study conducted by the MPCA found that the median concentrations of most chemicals in the sand and gravel aquifers in this region were slightly higher, while iron and sulfate were much higher, than concentrations in similar aquifers statewide (MPCA, 1999).

The results of this study identified exceedances of drinking water criteria in the three different aquifers found in the region. The study also identified that there are two factors that control water quality: the presence of Cretaceous Bedrock and location. While water quality in Cretaceous bedrock is typically poor, the location can dictate higher levels of contamination, such as higher arsenic concentrations in buried sand and gravel aquifers along stagnation moraines.

There are currently no MPCA ambient groundwater monitoring wells within the Red Lake River Watershed. Figure 37 displays the locations of the wells in the surrounding area of the specified watershed.

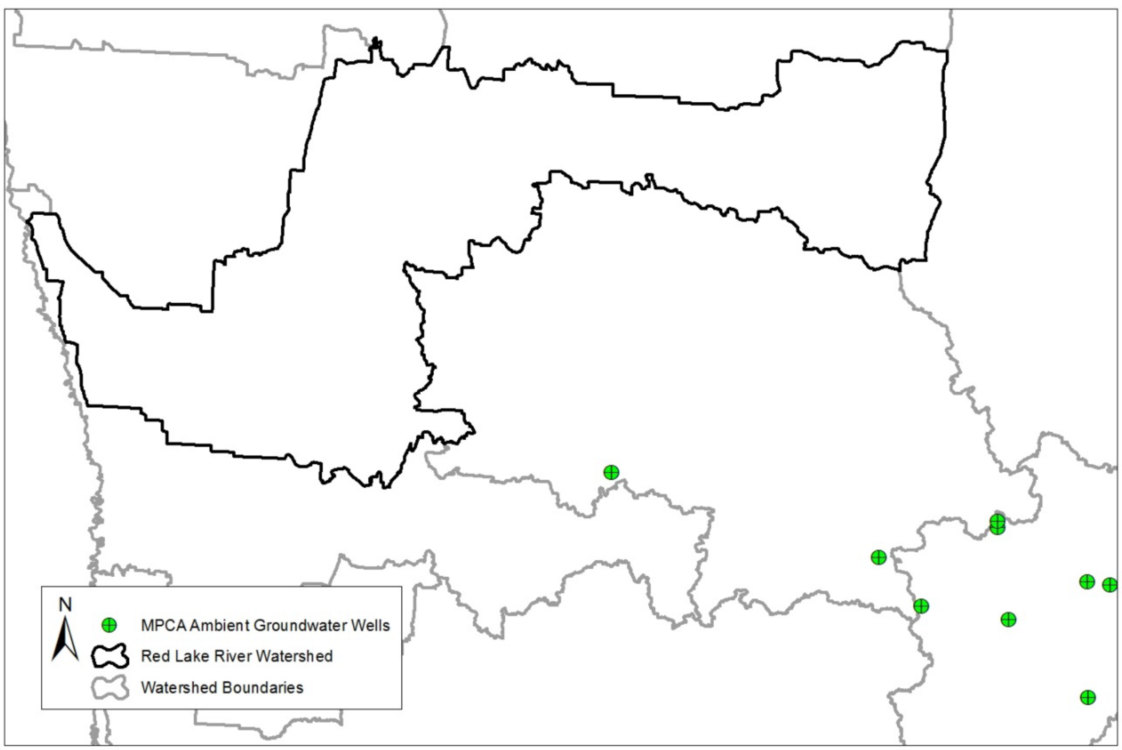

Figure 37. MPCA ambient groundwater monitoring well locations around the Red Lake River Watershed.

The Minnesota Department of Agriculture (MDA) monitors pesticides and nitrate on an annual basis in groundwater across agricultural areas in the state. The Red Lake River Watershed lies within MDA's Pesticide Monitoring Region 1 (PMR 1), also referred to as the Northwest Red River region. According to the MDA's Water Quality Monitoring Report, there were no pesticides detected in 2013 (MDA, 2014). However, nitrates were detected in 57% of the samples collected from PMR 1 with a median concentration of 0.08 milligrams per liter (mg/L). Of those samples, 36% were at or below background level of 3 mg/L, 7% were within 3.01 to 10.00 mg/L, and 14% were above the drinking water standard of 10.00 mg/L (MDA, 2014).

Another source of information on groundwater quality comes from the MDH. Mandatory testing for arsenic of all newly constructed wells statewide has found that 10.4%of all wells installed from 2008 to 2013 have arsenic levels above 10 micrograms per liter, the MCL for drinking (MDH). In northwest Minnesota, the majority of new wells are within the water quality standards for arsenic levels, but there are some exceedances (Figure 38).

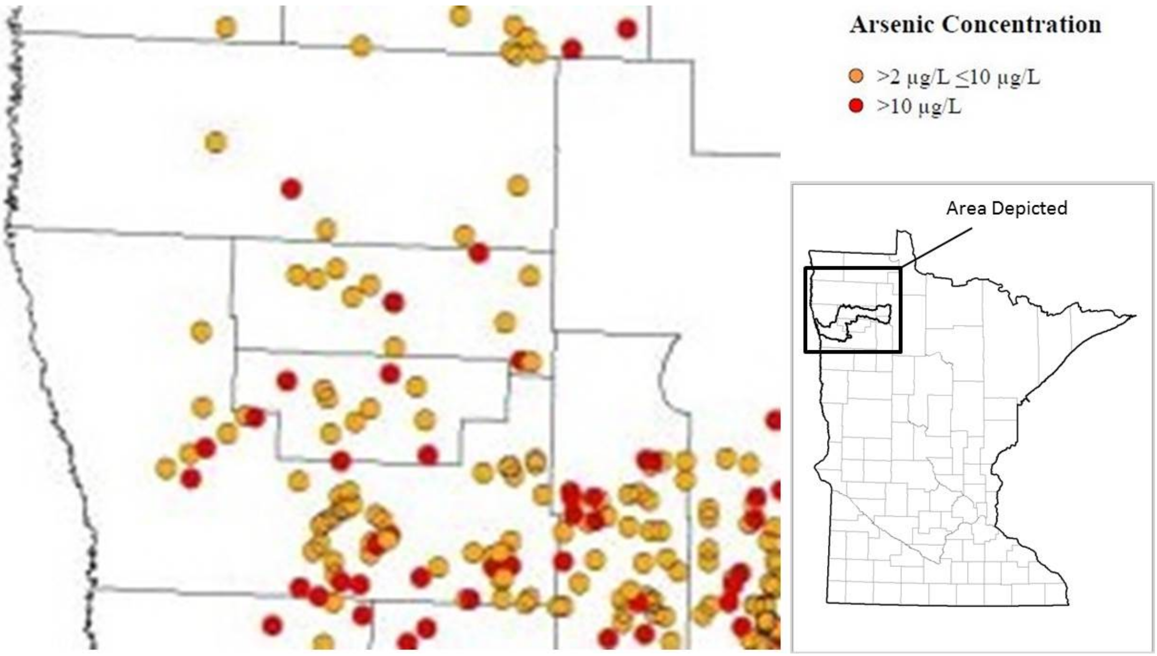

Figure 38. Arsenic occurrence in new wells in northwest Minnesota (2008-2012) (Source:MDH, 2012)

Groundwater quantity

Monitoring wells from the MDNR 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.

One MDNR Observation Well (60001) located in the Red Lake River Watershed was chosen based on data availability and geologic location within the watershed. The observation well does not exhibit a statistically significant trend in groundwater elevation change.

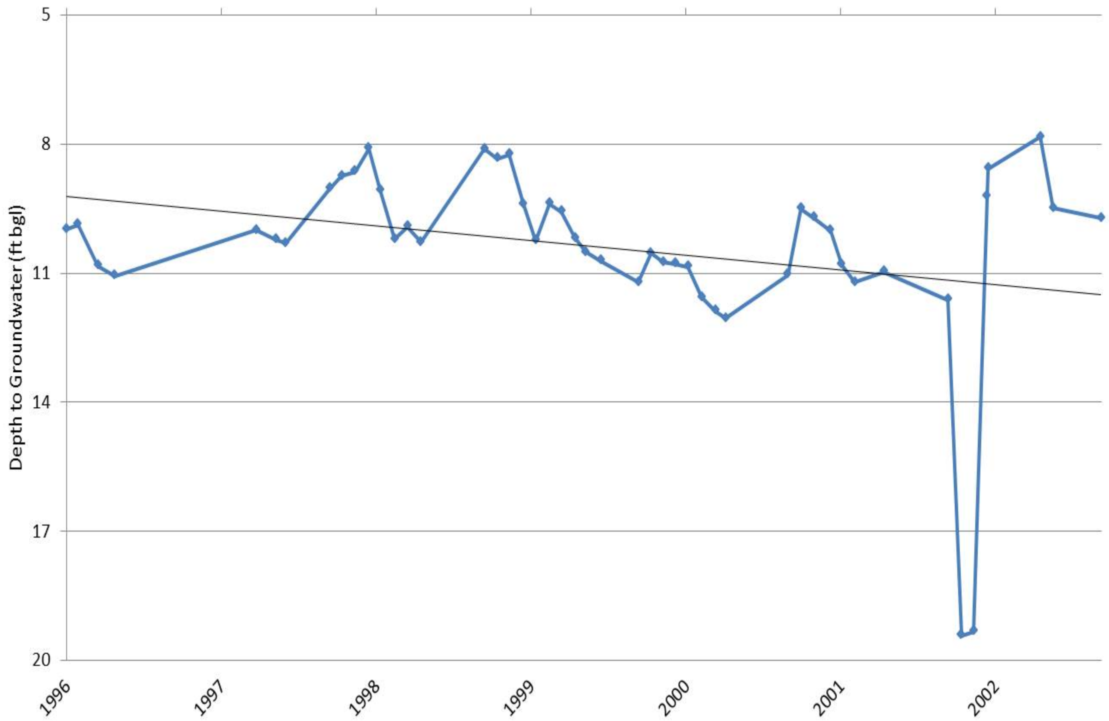

Figure 39. Observation well 60001, located in the eastern part of the Red Lake River Watershed Maple Bay, Minnesota (1996-2003).

Stream flow

Stream flow for the Red Lake River and Clearwater River, a major tributary to the Red Lake River, was analyzed for annual mean discharge and summer monthly mean discharge (July and August). Figure 39 is a display of the annual mean discharge for the Clearwater River at Red Lake Falls, Minnesota from 1993 to 2013. The data shows that although stream flow appears to be decreasing, there is no statistically significant trend. Figure 40 displays July and August mean flows for the last 20 years for the same water body. The data for July and August show a decreasing flow trend with July monthly means displaying a slightly greater statistical trend (July p= 0.01, August p=0.05). The same trends for both annual and summer monthly mean discharge can be seen in the Red Lake River near Crookston, Minnesota during the same time period (Figure 41 and 42). By way of comparison, summer month flows have declined at a statistically significant rate at a majority of streams selected randomly for a study of statewide trends.

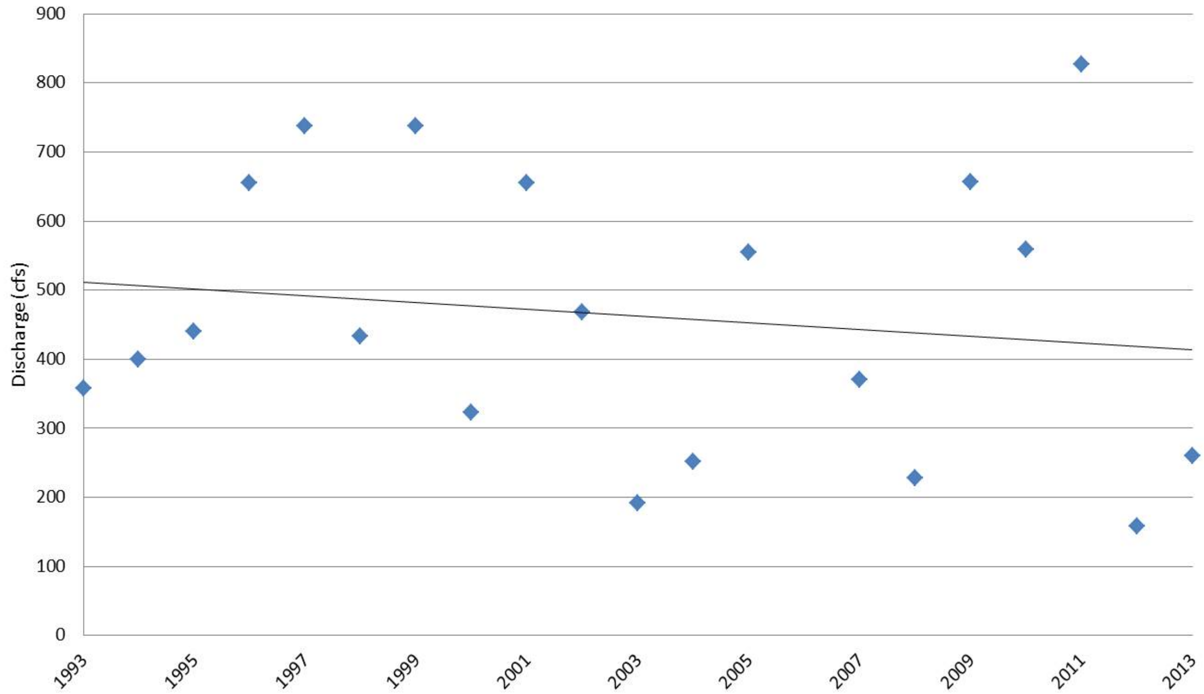

Figure 40. Annual mean discharge for Clearwater River at Red Lake Falls, Minnesota (1993-2013).

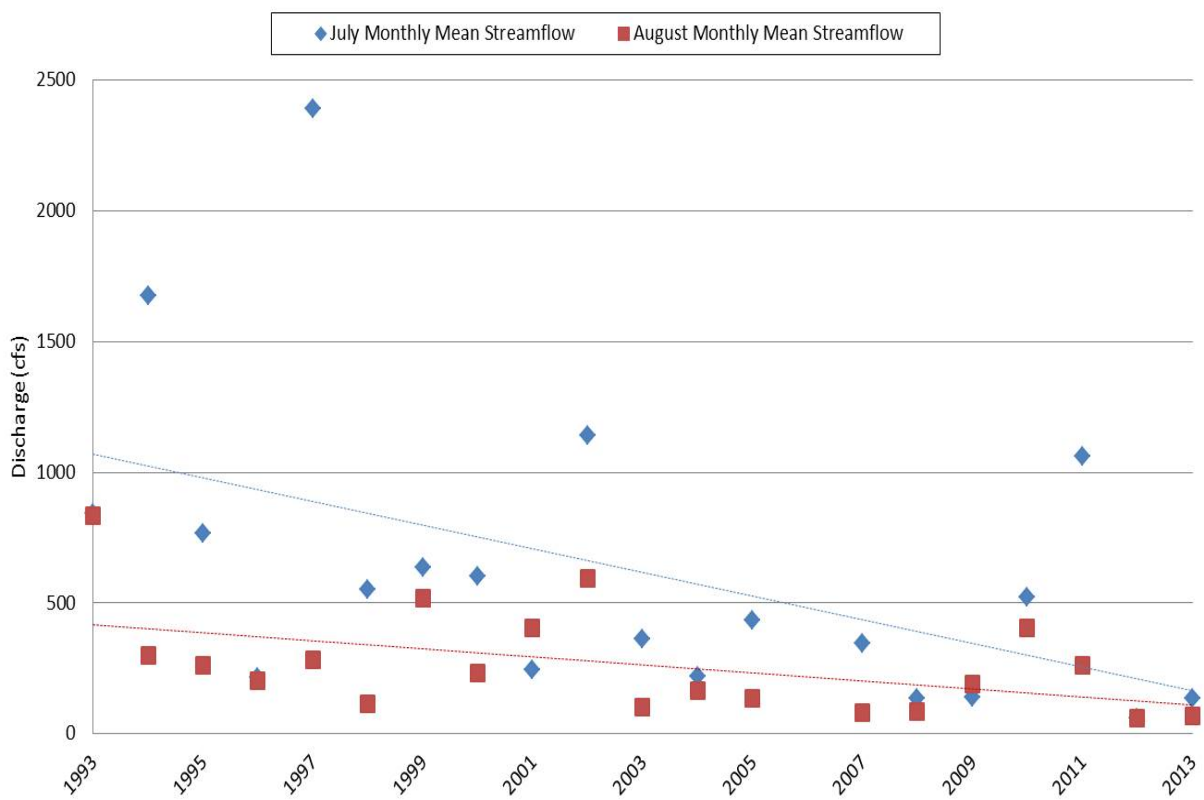

Figure 41. Mean monthly discharge measurements for July and August flows for the Clearwater River at Red Lake Falls, Minnesota (1993-2013).

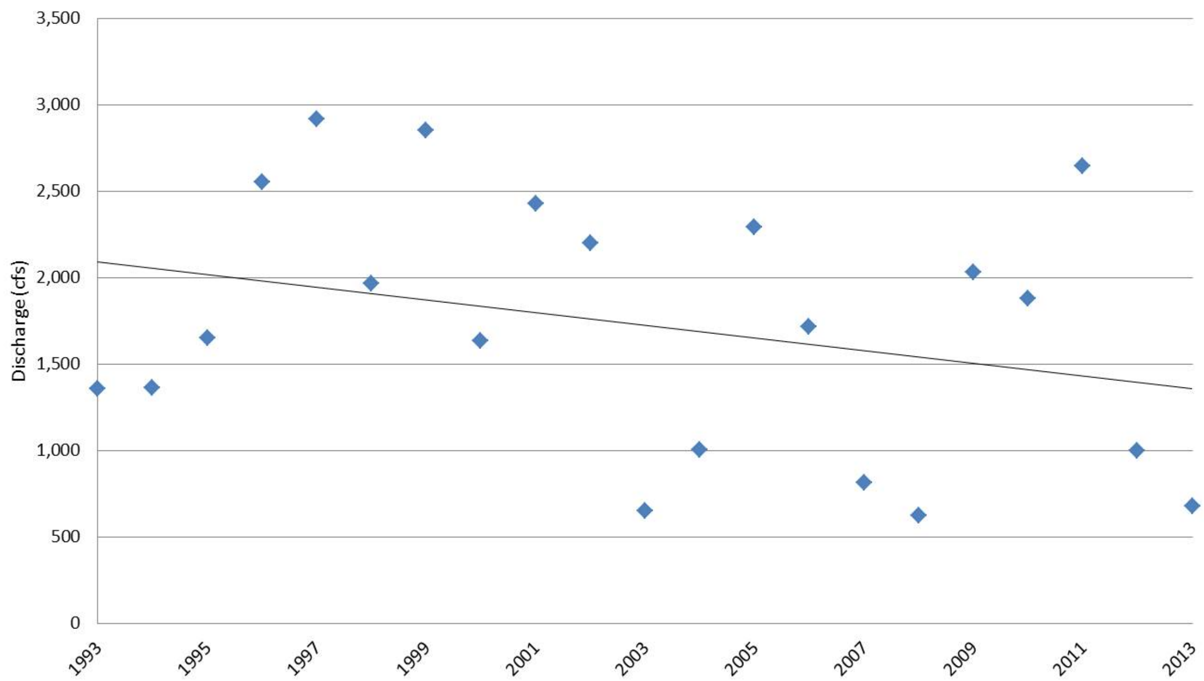

Figure 42. Annual mean discharge for Red Lake River at Crookston, Minnesota (1993-2013).

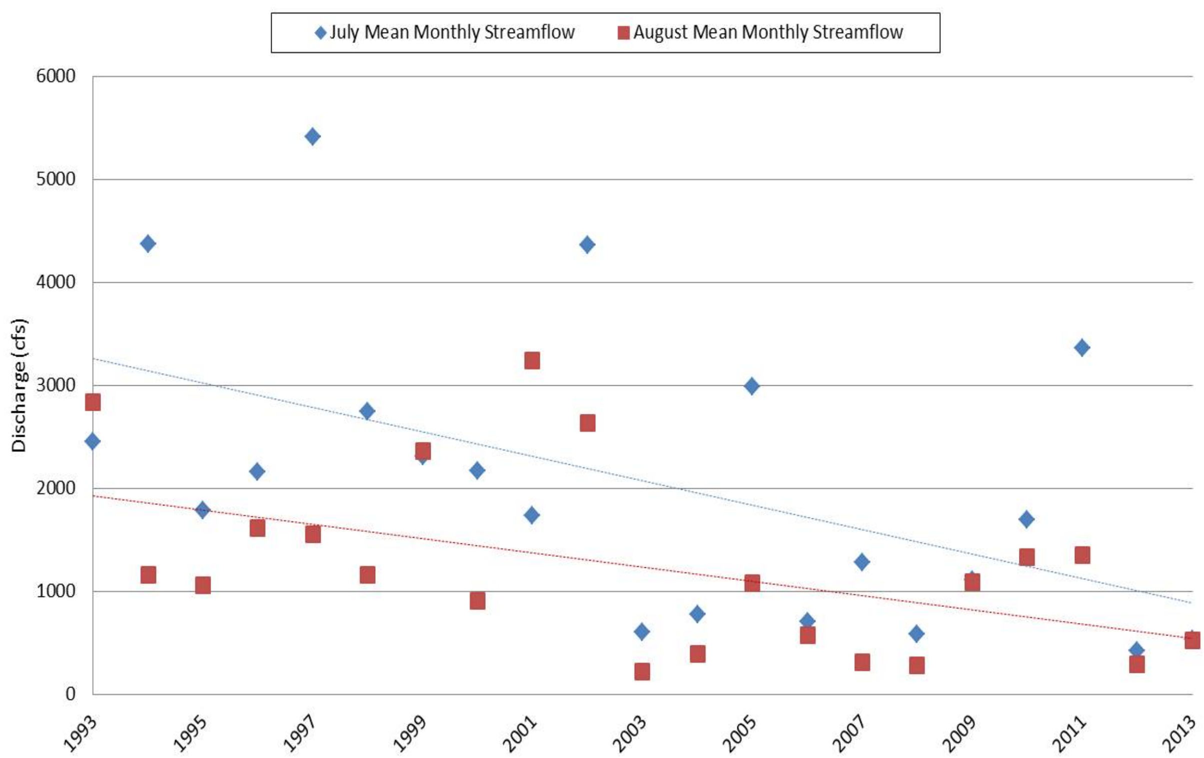

Figure 43. Mean monthly discharge measurements for July and August flows for the Red Lake River at Crookston, Minnesota (1993-2013).

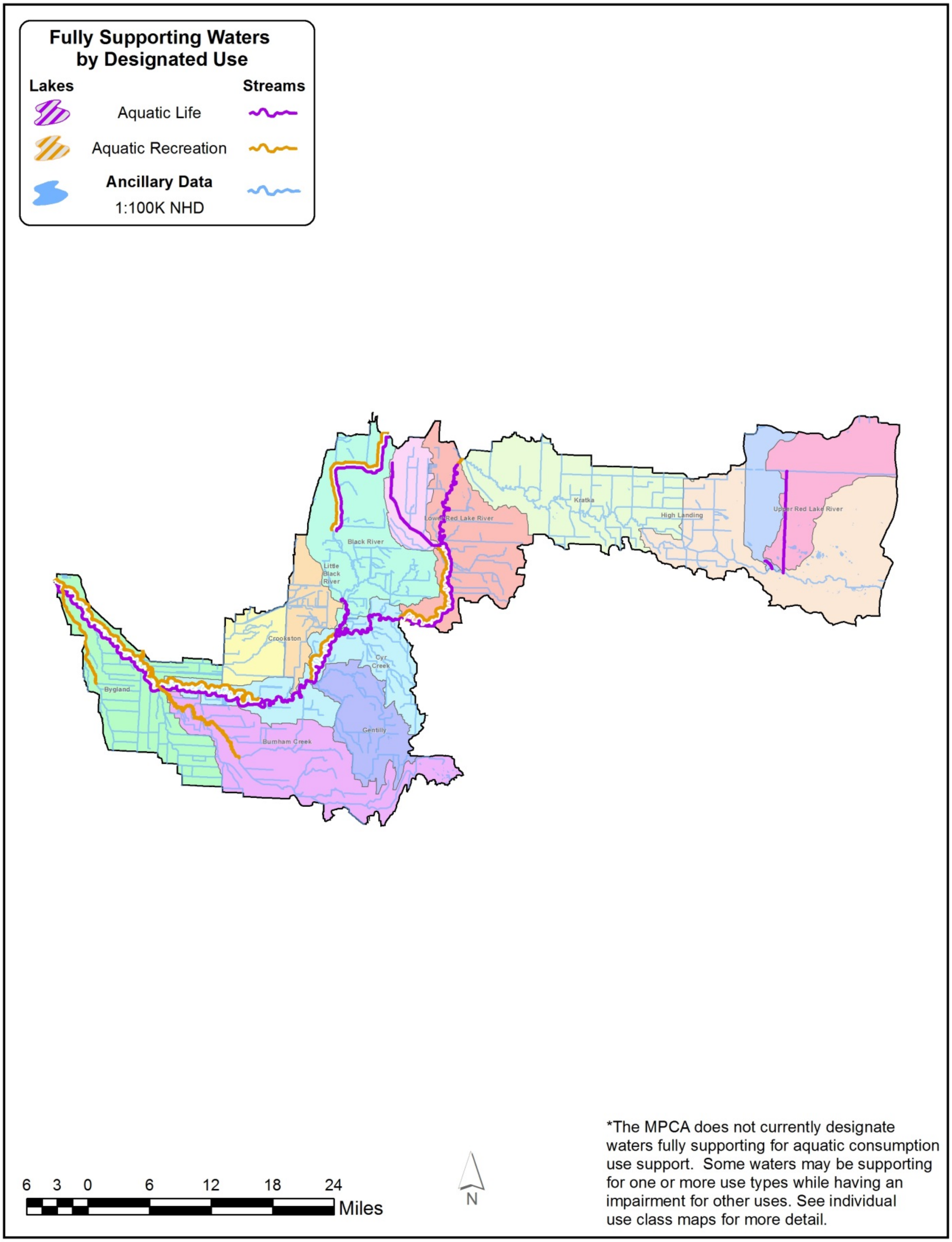

Figure 44. Fully supporting waters by designated use in the Red Lake River Watershed.

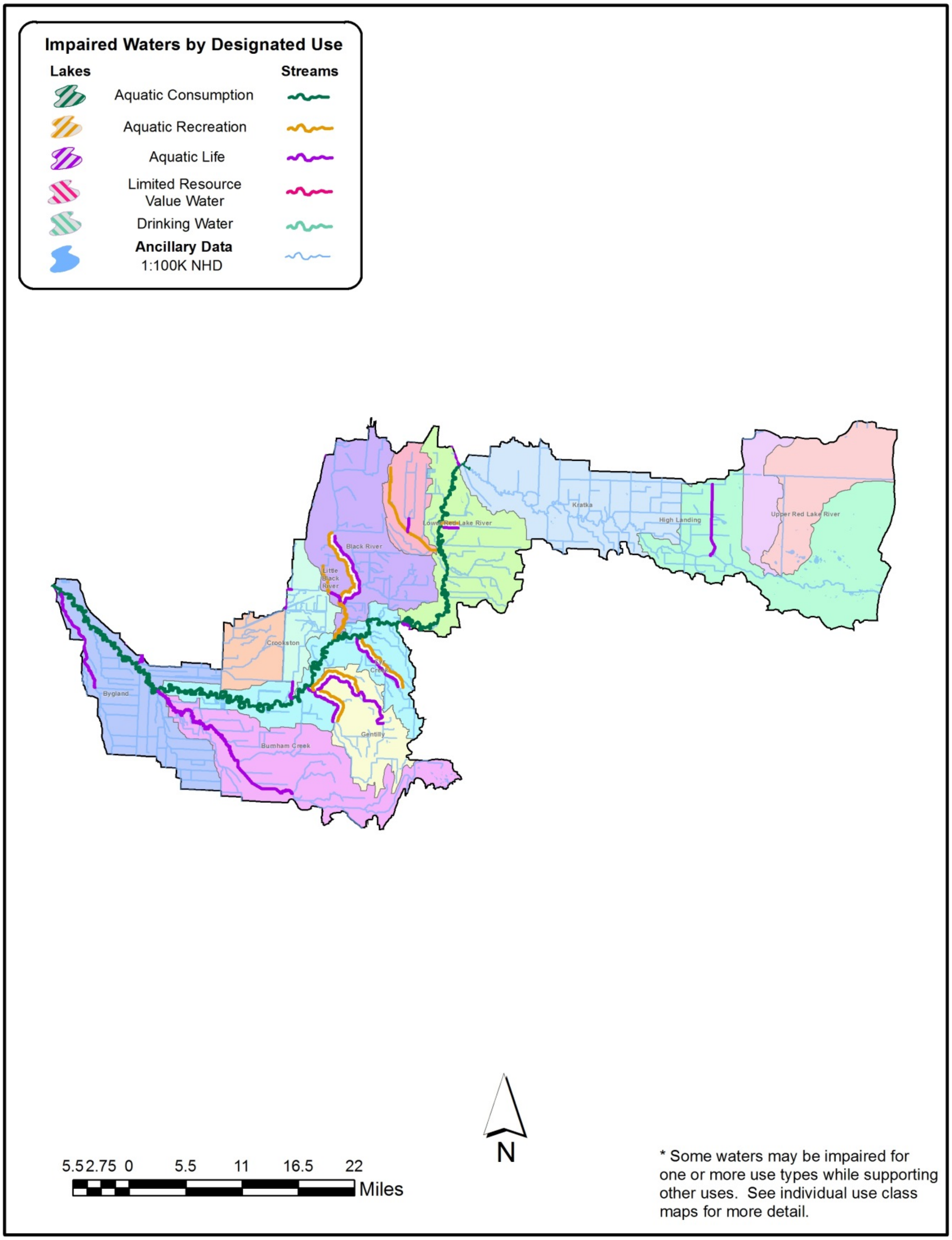

Figure 45. Impaired waters by designated use in the Red Lake River Watershed.

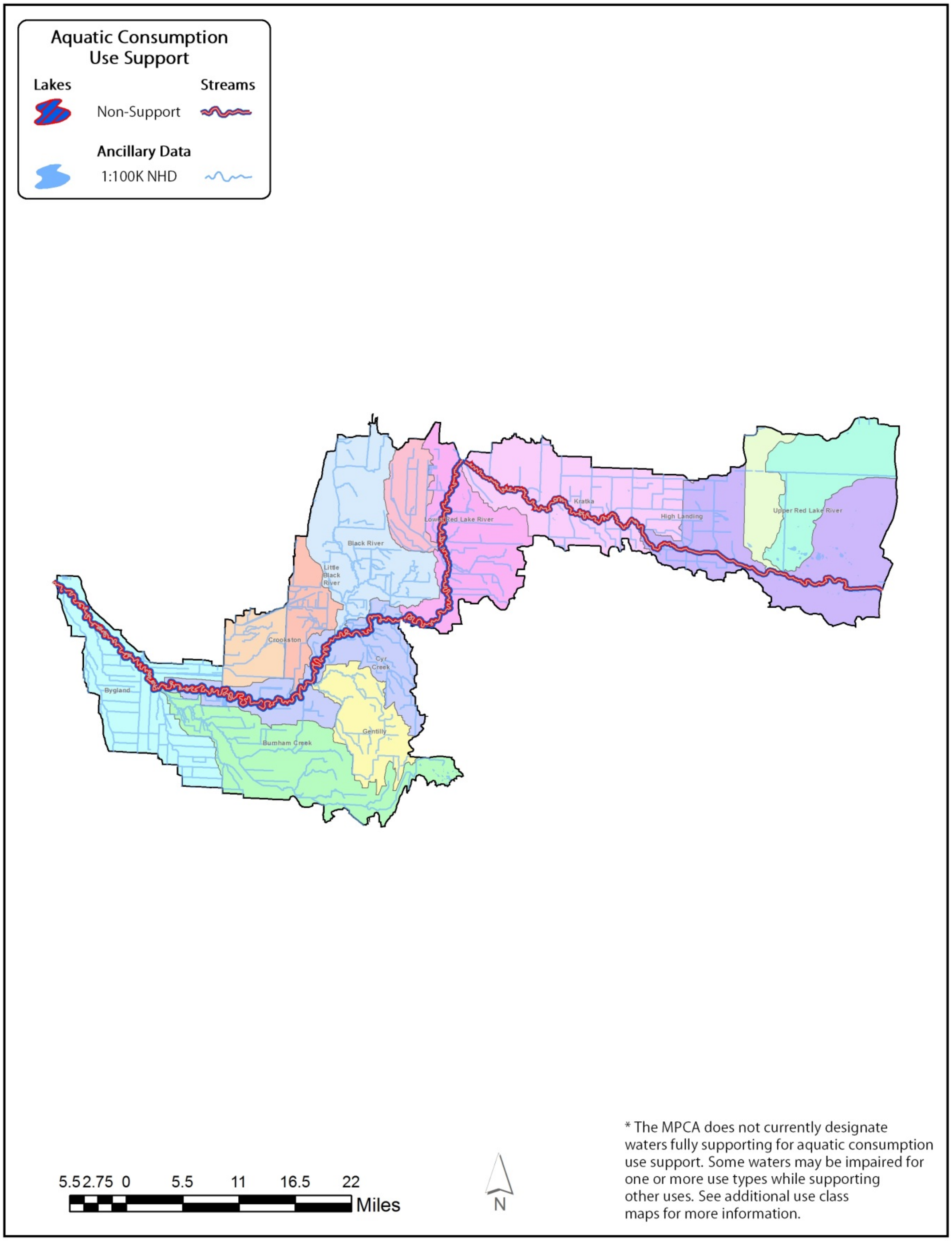

Figure 46. Aquatic consumption use support in the Red Lake River Watershed.

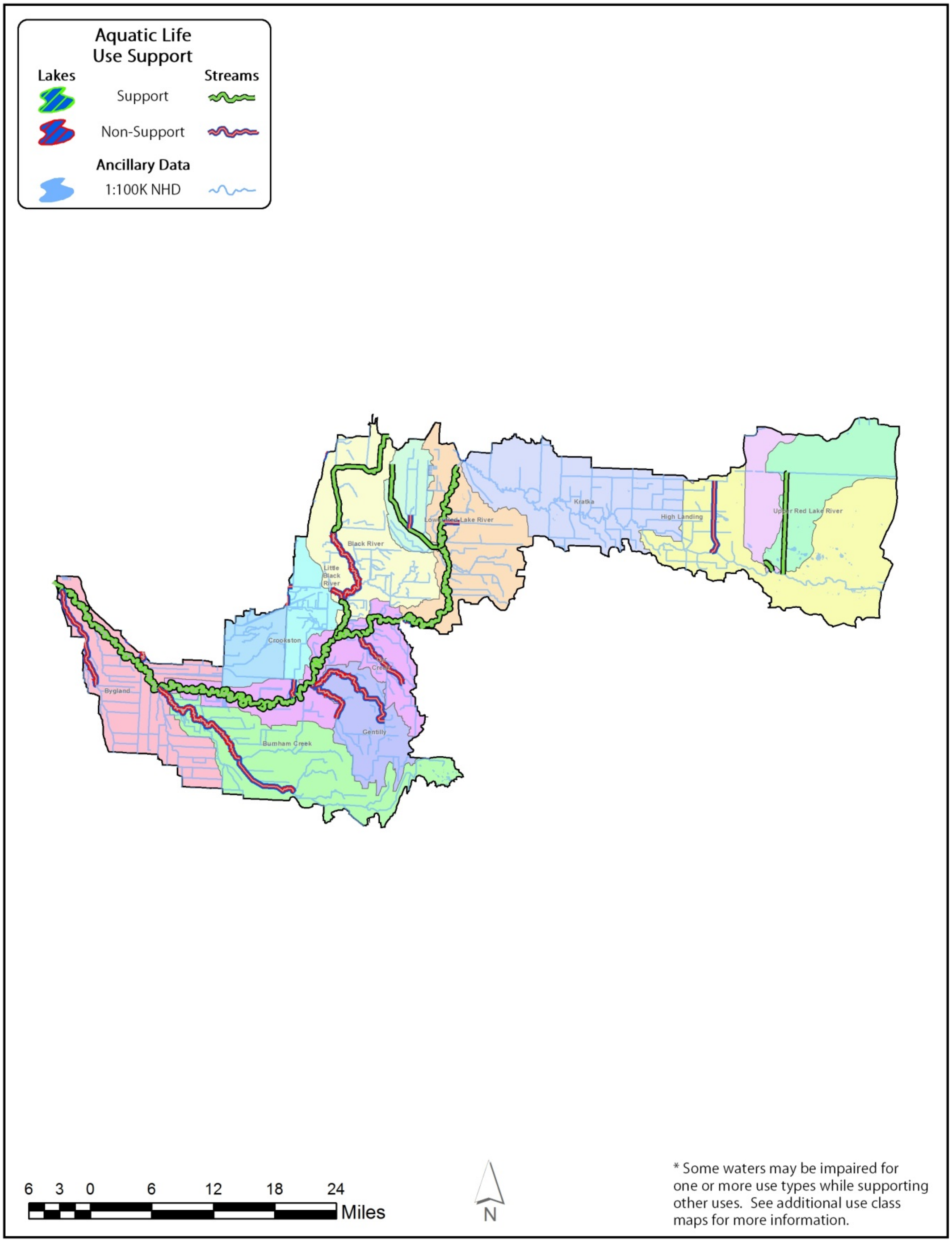

Figure 47. Aquatic life use support in the Red Lake River Watershed.

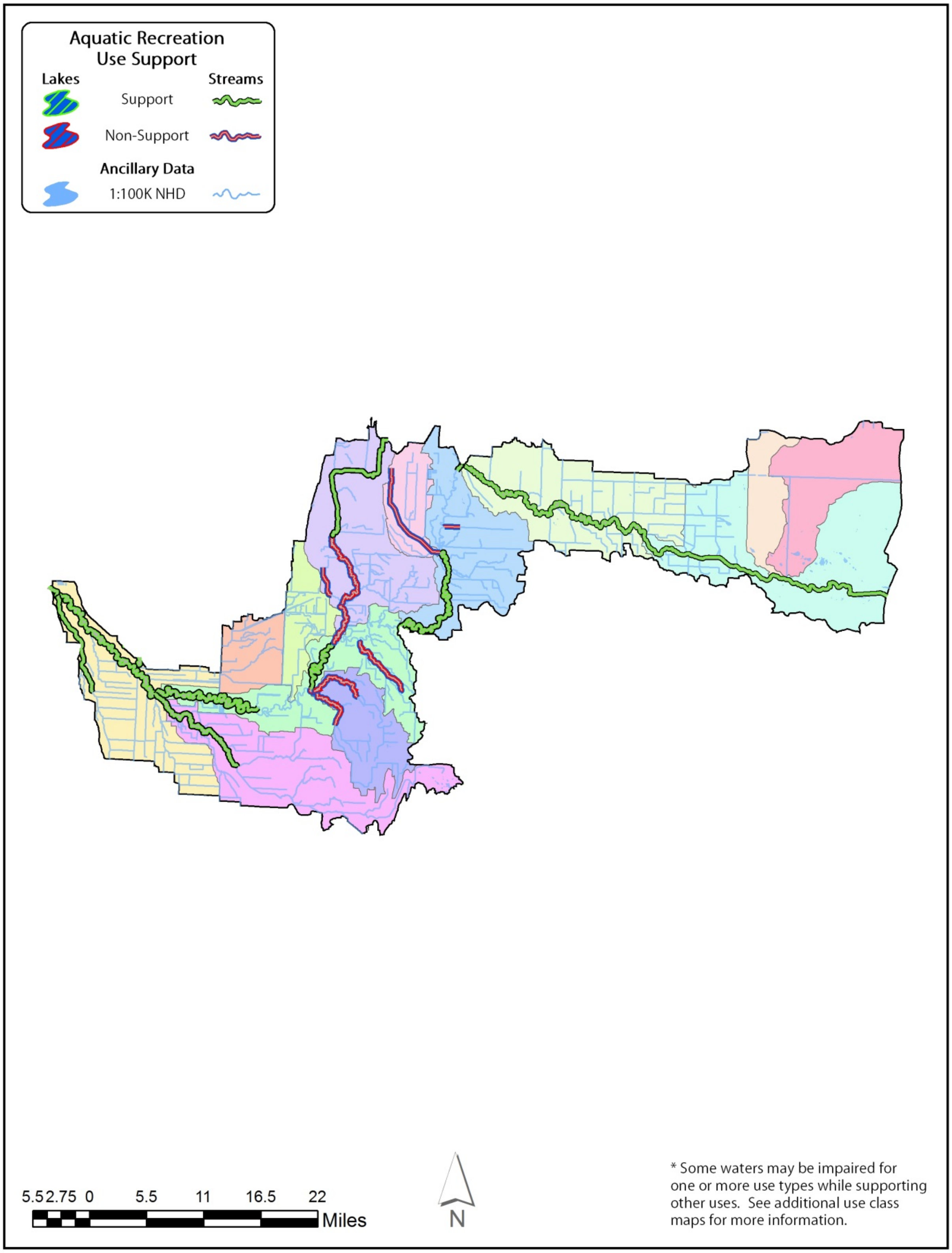

Figure 48. Aquatic recreation use support in the Red Lake River Watershed.

Pollutant trends for the Red Lake River Watershed

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

Table 54. Trends in the Red Lake River Watershed.

	Total Suspended Solids	Total Phosphorus	Nitrite/Nitrate	Ammonia	Biochemical Oxygen Demand	Chloride
Red Lake River- At Bridge on CSAH 15 at Fisher (S000-031)(RL-23) (Period of record 1955-2010)						
overall trend (1955-2010)	No trend	Decrease	Increase	No trend	Decrease	Increase
average annual change		-0.8 %	1.8 %		-1.7 %	1.7 %
total change		**-36%**	**63 %**		**-62 %**	156 %
recent trend (1995 – 2010)	No trend	No trend	No trend	No trend	No trend	No trend
average annual change						
total change						
median concentrations first 10 years	94	0.2	0.02	0.08	4	3
median concentrations most recent 10 years	79	0.2	0.11	<0.05	2	7
Red Lake River- Downstream of MN-220 Bridge in East Grand Forks (S000-013)(RL-0.2) (Period of record 1953-2010)						
overall trend (1953-2010)	No trend	Decrease	Increase	Decrease	Decrease	Increase
average annual change		-1.4 %	1.1 %	-4.9 %	-1.7 %	0.0 %
total change		**-51 %**	**47 %**	**-80%**	**-62 %**	0.0 %
recent trend (1995 – 2010)	No trend	No trend	No trend	No trend	No trend	No trend
average annual change						
total change						
median concentrations first 10 years	84	0.2	0.04	0.12	3	6
median concentrations most recent 10 years	98	0.2	0.13	<0.05	1	7

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

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

Water clarity trends at citizen monitoring sites

Currently, there is one CSMP volunteer in the watershed. Important to note though, the River Watch Citizen Monitoring Program (in partnership with IWI) is conducted throughout the Red River Basin. This citizen program has water chemistry data available from streams, ditches, lakes, and impoundments within the Red Lake River Watershed. Information on these sites can be found at: http://riverwatch.wq.io/.

Table 55. Water clarity trends at citizen monitoring sites in the Red Lake River Watershed.

Red Lake River HUC 09020303	Citizen Stream Monitoring Program
number of sites w/ increasing trend	0
number of sites w/ decreasing trend	0
number of sites w/ no trend	1

VII. Summaries and recommendations

The Red Lake River Watershed is agriculturally dominated, with 61% of the land uses for row crop production. To accommodate these agricultural practices, approximately 72% of the watersheds stream miles have been straightened or are ditches. The extensive hydrological modification is a plausible explanation for the lack of coarse substrate in many streams throughout the watershed. Coarse substrates in highly altered systems are often buried under fine sediments as erosion rates increase. High levels of TSS and poor Secchi Tube transparency readings corroborate this, as sediment concentrations increase in the lower portions of the watershed. Coarse substrates are vital for fish communities, particularly, lithophilic fish species which require coarse substrates to spawn and are more commonly the most sensitive species to sedimentation. A similar sensitivity to sedimentation is often observed in the macroinvertebrate community. Of the 28 sites that had coarse substrate present, only one scored below the MIBI threshold value. In contrast, of the sites without any coarse substrate present 7 of 11 scored below the MIBI threshold scores.

None of the sites on the Red Lake River main-stem had impaired fish or macroinvertebrates. The problem areas identified by the FIBI and MIBI scores in the watershed were primarily in the tributaries where agricultural practices have a more pronounced impact due to the streams' smaller relative size. Stream modification and or channelization are also more prevalent within these tributary reaches. The temporally variable nature of many of these reaches is exacerbated by the ditching practices and makes them more prone to becoming stagnant or going dry during later summer periods. This may result in higher water temperatures, lower DO concentrations, and increased daily DO fluctuation. It's important to note that DO impairments were common in these highly modified reaches. All of these conditions are known stressors to aquatic life communities. It is imperative to address these issues because they have the potential to significantly degrade the Red Lake River mainstem fish and macroinvertebrate populations. The watershed as a whole was dominated by tolerant macroinvertebrate taxa, such as *Physa, Hyalella, Polypedilum, Tricorythodes,* and *Coenagrionidae,* suggesting that there has been water quality degradation system-wide. Pockets of more sensitive taxa were observed in fragments of the Red Lake River mainstem where habitat has remained more intact. These same characteristics were also observed within the sampled populations of fish as tolerant species such as fathead minnow and brook stickleback seemed to dominate the tributary (more disturbed) reaches. For the main-stem Red Lake River and reaches with minimal disturbance, more sensitive taxa such as various darter and dace species were observed. In particular, one of the best observed fish communities which resulted in a very high FIBI score came from a sample on the Red Lake Reservation where riparian land use is minimal to non-existent. Areas with seemingly higher land alteration and disturbance typically resulted in low IBI scores. With restoration efforts, it is likely that many of these streams could be recolonized by more diverse fish and macroinvertebrate communities due to their proximity to viable source populations. In addition, farmers are strongly encouraged to increase riparian buffer zones and utilize crop rotation practices as this should help minimize erosion (sediment input) and decrease nutrient input from various agricultural fertilizer applications.

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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 - Intensive watershed monitoring water chemistry stations in the Red Lake River Watershed

Biological Station ID	STORET/ EQuIS ID	Waterbody Name	Location	12-digit HUC
12RD018	S007-234	Red Lake River	At CR 27, 7 mi. E of River Valley	0902030302-02
05RD129	S002-077	Red Lake River	At CSAH 24, S of High Landing	0902030302-02
12RD008	S007-063	Red Lake River	At CSAH 7, 6 mi. SE of Thief River Falls.	0902030302-01
12RD003	S003-172	Red Lake River	At CSAH 13, 0.5 mi. NW of Red Lake Falls	0902030303-01
	S005-683	County Ditch 76	At Hwy 32, 1 mi S of Saint Hilaire	0902030303-02
12RD002	S002-132	Black River	At CSAH 18, 1 mi. N of Huot	0902030304-01
94RD513	S002-080	Red Lake River	At Woodland Ave (Sampson Bridge), in Crookston	0902030305-01
	S007-062	Judicial Ditch 60	At 250th St, 3.5 mi. W of Gentilly	0902030305-03
12RD022	S004-835	Kripple Creek	At 180th Ave SW, 1.5 mi. NE of Gentilly	0902030305-04
12RD021	S007-060	Gentilly River	At 180th Ave SW, 0.5 mi. SE of Gentilly	0902030305-04
	S007-059	County Ditch 1	At CSAH 61, 2 miles W of Crookston	0902030305-02
12RD001	S007-058	Burnham Creek	At 320th Ave, 5 mi W of Crookston	0902030306-01
	S007-061	Heartsville Coulee	At 210th St, 4.5 mi SE of East Grand Forks	0902030307-01
12RD010	S002-963	Red Lake River	At 2nd Ave NE, in East Grand Forks	0902030307-01

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

AUID DESCRIPTIONS				USES							WATER QUALITY STANDARDS									
											Aquatic Life Indicators:								Aquatic Rec. 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 YEAR		Fish	Macroinvertebrates	Dissolved Oxygen	Turbidity	Chloride	pH	NH3	Pesticides	Bacteria	Nutrients
HUC 12: 0902030302-02 (Headwaters Red Lake River)																				
09020303-547	County Ditch 43	Unnamed ditch to Red Lake River	7.3	2B,3C	IMP	NA	-	-			IMP	IMP	IF	IF	-	IF	-	-	-	-
HUC 12: 0902030301-01 (Cahill Lake)																				
09020303-543	Trib. To Red Lake River	Unnamed ditch to Red Lake River	9.96	2B,3C	SUP	NA	-	-			SUP	NA	IF	IF	-	IF	-	-	-	-
HUC 12: 0902030302-03 (Good Lake)																				
09020303-544	Trib. To Red Lake River	Headwaters to Red Lake River	1.25	2Bg,3C	SUP	NA	-	-			SUP	NA	IF	IF	-	IF	-	-	-	-
HUC 12: 0902030302-01 (Upper Red Lake River)																				
09020303-508	Red Lake River	Headwaters to Thief River	66.51	1C,2Bd, 3C	IMP	SUP	IMP	-	1998		SUP	SUP	IF	SUP	SUP	SUP	SUP	-	SUP	-
HUC 12: 0902030303-01 (Middle Red Lake River)																				
09020303-513	Red Lake River	Thief River Falls Dam to CD 76	13.66	1C,2Bd, 3C	SUP	NA	IMP	-	1998		SUP	SUP	SUP	SUP	-	-	-	-	-	-
09020303-504	Red Lake River	CD 76 to Clearwater River.	20.88	1C,2Bd, 3C	SUP	SUP	-	-	1998		SUP	SUP	SUP	-	SUP	SUP	SUP	-	SUP	-
HUC 12: 0902030303-02 (County Ditch No. 76)																				
09020303-545	Unnamed Ditch	Unnamed ditch to unnamed creek	1.32	2B,3C	IMP	NA	-	-	-		IMP	SUP	IF	-	-	IF	-	-	-	-
09020303-505	Pennington County Ditch 76	Headwaters to Red Lake River	10.72	2B,3C	SUP	IMP	-	-			SUP	SUP	IF	-	SUP	SUP	SUP	-	IMP	-
09020303-548	County Ditch 76	County Ditch 76 to Unnamed ditch	1.16	2B,3C	NA	NA	-	-			NA	-	IF	-	-	IF	-	-	-	-

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.

AUID DESCRIPTIONS				USES							WATER QUALITY STANDARDS: Aquatic Life Indicators:								Aquatic Rec. 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 YEAR		Fish	Macroinvertebrates	Dissolved Oxygen	Turbidity	Chloride	pH	NH3	Pesticides	Bacteria	Nutrients
HUC 12: 0902030304-01 (Black River)																				
09020303-557	Black River	Headwaters to 48.0146,-96.4328	15.82	2Bm,3C	SUP	SUP	-	-	-		SUP	SUP	IF	-	-	SUP	SUP	-	-	-
09020303-558	Black River	48.0146,-96.4328 to black River	14.21	2Bg,3C	IMP	IF	-	-	-		IMP	IMP	IMP	-	-	SUP	SUP	-	IF	-
09020303-529	Black River	Little Black River to Red Lake River	8.45	2Bg,3C	SUP	IMP	-	-	2008		SUP	SUP	SUP	SUP	SUP	SUP	SUP	-	IMP	-
09020303-528	Little Black River	Unnamed ditch to Black River	2.17	2Bg,3C	IMP	IF	-	-	-		IMP	-	IF	-	-	IF	-	-	-	-
HUC 12: 0902030305-01 (Lower Red Lake River)																				
09020303-510	Red Lake River	Clearwater River to Cyr Creek	8.2	1C,2Bd, 3C	SUP	NA	-	-	1998		SUP	SUP	IF	-	-	IF	-	-	-	-
09020303-556	Cyr Creek	CR 14 to Red Lake River	8.99	2Bg,3C	IMP	IMP	-	-			IMP	-	IF	-	IF	SUP	SUP	-	IMP	-
09020303-511	Red Lake River	Cyr Creek to Black River	4.64	1C,2bd, 3C	SUP	NA	-	-	1998		SUP	SUP	IF	-	-	IF	-	-	-	-
09020303-502	Red Lake River	Black River to Gentilly River	9.91	1C,2Bd, 3C	SUP	SUP		-	1998		SUP	SUP	-	-	-	SUP	SUP	-	SUP	-
09020303-512	Red Lake River	Gentilly River to County Ditch 99	11.71	1C,2Bd, 3C	SUP	NA	-	-	1998		SUP	SUP	IF	-	-	SUP	IF	-	IF	-
09020303-506	Red Lake River	County Ditch 99 to Burnham Creek	25.05	1C,2Bg, 3C	SUP	SUP	-	-	1998		SUP	SUP	SUP	-	SUP	SUP	SUP	-	SUP	-
HUC 12: 0902030305-03 (Judicial Ditch No. 60)																				
09020303-546	Judicial Ditch 60	County Ditch 147 to Unnamed Ditch	2.67	2B,3C	IF	NA	-	-			-	-	IF	-	-	-	-	-	-	-
09020303-542	Judicial Ditch 60	Lateral Ditch 4 to Red Lake River	1.87	2Bg,3C	IF	IF	-	-	-		-	-	IF	SUP	SUP	IF	SUP	-	IF	IF
HUC 12: 0902030305-04 (Gentilly River)																				
09020303-526	Kripple Creek	Unnamed ditch to Unnamed creek	5.91	2Bg,3C	IMP	NA	-	-	-		IMP	IMP	IF	-	-	IF	-	-	-	-
09020303-525	Kripple Creek	Unnamed Creek to Gentilly River	9.28	2Bg,3C	IMP	IMP	-	-	-		IMP	IMP	SUP	-	SUP	SUP	SUP	-	IMP	-
09020303-554	Gentilly River	County Ditch 140 to Red Lake River	8.51	2Bg,3C	IMP	IMP	-	-	-		IMP	IMP	IF	-	SUP	SUP	-	-	IMP	-

***HUC 12:* 0902030305-02 (County Ditch No. 1)**																				
***HUC 12:* 0902030306-01 (Burnham Creek)**																				
09020303-551	Burnham Creek	CD 106 to Polk CD 15	7.36	2Bg,3C	IMP	NA	-	-	-		IMP	IMP	IF	-	-	IF	IF	-	IF	-
09020303-515	Burnham Creek	Polk CD 15 to Red Lake River	20.52	2Bg,3C	IMP	SUP	-	-	2008		IMP	IMP	SUP	-	SUP	SUP	SUP	-	SUP	-

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.

AUID DESCRIPTIONS				**USES**							**WATER QUALITY STANDARDS**									
											Aquatic Life Indicators:								**Aquatic Rec. 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 YEAR**		**Fish**	**Macroinvertebrates**	**Dissolved Oxygen**	**Turbidity**	**Chloride**	**pH**	**NH3**	**Pesticides**	**Bacteria**	**Nutrients**
***HUC 12:* 0902030307-01 (Outlet Red Lake River)**																				
09020303-501	Red Lake River	Burnham Creek to Unnamed Creek	30.83	1C,2Bdg, 3C	SUP	SUP	-	-	1998		SUP	SUP	SUP	-	SUP	SUP	SUP	-	-	-
09020303-549	RLWD Ditch 12	Headwaters to CD 115	7.27	2Bm,3C	NA	NA	-	-	-		NA	NA	IF	-	-	IF	-	-	-	-
09020303-550	Unnamed Creek	CD115 to Red Lake River	11.39	2Bg,3C	IMP	SUP	-	-	-		-	-	IMP	SUP	SUP	SUP	SUP	-	SUP	-
09020303-503	Red Lake River	Unnamed Creek to Red River	1.87	1C,2Bdg, 3C	SUP	SUP	-	-	1998		SUP	-	SUP		SUP	SUP	SUP	-	SUP	-

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 4.1 - Minnesota statewide IBI thresholds and confidence limits

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

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

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
HUC 12: 0902030302-02 (Headwaters Red Lake River)							
09020303-547	12RD045	County Ditch 43	24.04	7	15	18.2	06/19/2015
HUC 12: 0902030301-01 (Cahill Lake)							
09020303-543	12RD006	Trib. To Red Lake River	91.03	5	47	48.4	06/13/2012
HUC 12: 0902030302-03 (Good Lake)							
09020303-544	12RD009	Trib. To Red Lake River	40.34	7	42	81.9	06/13/2012
HUC 12: 0902030302-01 (Upper Red Lake River)							
09020303-508	10EM149	Red Lake River	1,980.53	4	38	58.8	09/21/2011
09020303-508	12RD007	Red Lake River	2,028.63	4	38	60.7	06/28/2012
09020303-508	12RD018	Red Lake River	2,203.54	4	38	48	06/27/2012
09020303-508	05RD129	Red Lake River	2,301.25	4	38	59.4	08/24/2006
09020303-508	05RD129	Red Lake River	2,301.25	4	38	56.6	07/31/2012
09020303-508	12RD008	Red Lake River	2375.70	4	38	67.4	07/30/2012
09020303-508	12RD008	Red Lake River	2375.70	4	38	74.6	09/13/2012
09020303-508	05RD034	Red Lake River	2,413.66	4	38	63.1	08/29/2006
09020303-508	12RD104	Red Lake River	2,415.38	4	38	44.3	07/24/2012
HUC 12: 0902030303-01 (Middle Red Lake River)							
09020303-513	05RD121	Red Lake River	3,483.85	4	38	61.2	08/30/2006
09020303-513	05RD121	Red Lake River	3,483.85	4	38	64.4	08/01/2012
09020303-513	05RD171	Red Lake River	3,510.91	4	38	57.8	07/25/2006
09020303-513	76RD014	Red Lake River	3,512.16	4	38	65.9	06/27/2012
09020303-504	12RD105	Red Lake River	3,610.98	4	38	71.3	08/02/2012
09020303-504	12RD003	Red Lake River	3,635.41	4	38	50.3	06/25/2012
HUC 12: 0902030303-02 (County Ditch No. 76)							
09020303-545	12RD039	Unnamed Ditch	11.72	6	23	0	06/18/2012
09020303-505 Mod	07RD021	Pennington County Ditch 76	24.17	7	15	32.2	08/09/2007

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
HUC 12: 0902030304-01 (Black River)							
09020303-557	07RD022	Black River	13.55	6	23	50.9	08/08/2007
09020303-557	10EM176	Black River	15.04	6	23	38.4	06/30/2010
09020303-557	12RD014	Black River	37.91	6	23	26.8	07/16/2012
09020303-558	05RD122	Black River	56.36	5	47	25	06/21/2006
09020303-558	12RD102	Black River	108.93	5	47	35.3	06/12/2012
09020303-529	12RD002	Black River	144.10	5	47	45.7	06/13/2012
09020303-529	12RD002	Black River	144.10	5	47	53.8	08/07/2013
09020303-528	12RD024	Little Black River	23.37	6	42	24.1	06/12/2012
HUC 12: 0902030305-01 (Lower Red Lake River)							
09020303-510	12RD113	Red Lake River	4,995.17	4	38	73.8	07/18/2012
09020303-510	10EM048	Red Lake River	5,002.80	4	38	65.2	09/14/2011
09020303-556	12RD023	Cyr Creek	19.23	6	42	7.3	06/12/2012
09020303-511	05RD057	Red Lake River	5,044.81	4	38	61.4	08/22/2006
09020303-502	12RD015	Red Lake River	5,190.44	4	38	58.5	07/31/2012
09020303-512	12RD013	Red Lake River	5,274.63	1	49	83.2	08/14/2012
09020303-506	12RD108	Red Lake River	5,347.92	1	49	80.7	07/26/2012
09020303-506	94RD513	Red Lake River	5,351.35	1	49	45.9	08/15/2012
09020303-506	12RD004	Red Lake River	5,352.62	1	49	64.8	06/26/2012
09020303-506	05RD080	Red Lake River	5,354.59	1	49	73	09/08/2006
09020303-506	12RD112	Red Lake River	5,355.14	1	49	90	07/25/2012
09020303-506	12RD103	Red Lake River	5,405.84	1	49	78.1	08/15/2012
09020303-506	12RD103	Red Lake River	5,405.84	1	49	72.1	09/12/2012
HUC 12: 0902030305-03 (Judicial Ditch No. 60)							
No Assessable Fish Data							
HUC 12: 0902030305-04 (Gentilly River)							
09020303-526	07RD006	Kripple Creek	15.31	6	42	34.6	08/08/2007
09020303-526	12RD044	Kripple Creek	16.24	6	42	33.2	06/12/2012
09020303-525	05RD077	Kripple Creek	22.84	6	42	21.1	06/21/2005
09020303-525	12RD022	Kripple Creek	32.05	2	50	40.5	06/14/2012
09020303-554	12RD043	Gentilly River	26.67	6	42	34	06/12/2012
09020303-554	12RD021	Gentilly River	34.10	2	50	49.8	06/12/2012

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi^2	Fish Class	Threshold	FIBI	Visit Date
HUC 12: 0902030305-02 (County Ditch 1)							
No Assessable Fish Data							
HUC 12: 0902030306-01 (Burnham Creek)							
09020303-551	12RD030	Burnham Creek	71.88	2	35	12.5	06/11/2012
09020303-515	12RD032	Burnham Creek	117.77	2	50	0	06/12/2012
09020303-515	12RD032	Burnham Creek	117.77	2	50	25	06/19/2013
09020303-515	12RD115	Burnham Creek	132.86	2	50	0	06/13/2012
09020303-515	12RD001	Burnham Creek	143.81	2	50	0	06/11/2012
09020303-515	10EM112	Burnham Creek	149.00	2	50	58.4	07/13/2010
HUC 12: 0902030307-01 (Outlet Red Lake River)							
09020303-501	76RD023	Red Lake River	5,597.39	1	49	55.2	08/14/2012
09020303-501	12RD110	Red Lake River	5,625.54	1	49	71.7	06/26/2012
09020303-503	12RD010	Red Lake River	5,686.19	1	49	61.2	07/25/2012

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
0902030302-02 (Headwaters Red Lake River)							
09020303-547	12RD045	County Ditch 43	24.04	7	41	11.24	8/7/2012
0902030302-01 (Upper Red Lake River)							
09020303-508	12RD018	Red Lake River	2,203.54	2	31	57.4	8/7/2012
09020303-508	05RD129	Red Lake River	2,301.25	2	31	42.8	8/16/2006
09020303-508	05RD129	Red Lake River	2,301.25	2	31	41.8	8/7/2012
09020303-508	12RD008	Red Lake River	2,375.70	2	31	46.7	7/30/2012
09020303-508	05RD034	Red Lake River	2,413.66	2	31	61.6	8/24/2005
09020303-508	12RD104	Red Lake River	2,415.38	2	31	33.5	8/8/2012
0902030303-01 (Middle Red Lake River)							
09020303-504	12RD003	Red Lake River	3635.41	2	31	28.44	8/6/2012
09020303-504	12RD105	Red Lake River	3610.98	2	31	42.99	8/2/2012
09020303-504	12RD003	Red Lake River	3635.41	2	31	68.77	9/25/2013
09020303-513	05RD121	Red Lake River	3483.85	2	31	73.56	9/21/2005
09020303-513	05RD121	Red Lake River	3483.85	2	31	77.98	8/7/2012
09020303-513	05RD121	Red Lake River	3483.85	2	31	53.28	8/1/2012
09020303-513	05RD171	Red Lake River	3510.91	2	31	82.57	9/28/2005
09020303-513	76RD014	Red Lake River	3512.16	2	31	43.18	8/6/2012
0902030303-02 (County Ditch No. 76)							
09020303-545	12RD039	Unnamed ditch	11.72	7	41	35.79	8/6/2013
09020303-505	07RD021	Pennington County Ditch 76	24.17	7	41	36.04	8/13/2007
0902030304-01 (Black River)							
09020303-557	10EM176	Black River	15.04	7	41	42.43	9/2/2010
09020303-557	12RD014	Black River	37.91	7	41	22.58	8/6/2013
09020303-558	12RD102	Black River	108.93	5	37	23.14	7/31/2012

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Invert Class	Threshold	MIBI	Visit Date
0902030305-01 (Lower Red Lake River)							
09020303-510	10EM048	Red Lake River	5002.8	2	31	52.98	9/14/2011
09020303-510	12RD113	Red Lake River	4995.17	2	31	57.1	7/31/2012
09020303-511	05RD057	Red Lake River	5044.81	2	31	66.09	9/28/2005
09020303-502	12RD015	Red Lake River	5190.44	2	31	49.72	7/31/2012
09020303-512	12RD013	Red Lake River	5274.63	2	31	57.17	8/14/2012
09020303-512	12RD013	Red Lake River	5274.63	2	31	56.55	8/6/2013
09020303-506	05RD080	Red Lake River	5354.59	2	31	43.06	9/13/2005
09020303-506	12RD004	Red Lake River	5352.62	2	31	58.94	8/8/2012
09020303-506	12RD103	Red Lake River	5405.84	2	31	51.83	8/15/2012
09020303-506	12RD108	Red Lake River	5347.92	2	31	16.97	8/8/2012
09020303-506	12RD112	Red Lake River	5355.14	2	31	37.37	8/8/2012
09020303-506	94RD513	Red Lake River	5351.35	2	31	46.12	8/15/2012
09020303-506	12RD108	Red Lake River	5347.92	2	31	49.3	8/7/2013
0902030305-04 (Gentilly River)							
09020303-526	07RD006	Kripple Creek (County Ditch 66)	15.31	7	41	15.11	8/15/2007
09020303-526	12RD044	Kripple Creek (County Ditch 66)	16.24	7	41	36.86	7/31/2012
09020303-525	05RD077	Kripple Creek	22.84	7	41	34.29	8/24/2005
0902030306-01 (Burnham Creek)							
09020303-515	10EM112	Burnham Creek	149	7	41	17.74	9/20/2010
09020303-515	10EM112	Burnham Creek	149	7	41	28.41	9/20/2010
09020303-515	12RD001	Burnham Creek	143.81	7	41	29.39	8/8/2012
0902030307-01 (Outlet Red Lake River)							
09020303-501	76RD023	Red Lake River	5597.39	2	31	58.94	8/14/2012
09020303-501	12RD110	Red Lake River	5625.54	2	31	46.38	8/15/2012

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 6 – Fish species found during biological monitoring surveys

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
white sucker	40	1279
common shiner	30	2040
rock bass	29	601
shorthead redhorse	29	239
blackside darter	29	1488
fathead minnow	26	2082
johnny darter	26	414
central mudminnow	26	931
golden redhorse	25	389
emerald shiner	24	1170
northern pike	23	118
creek chub	22	1219
silver redhorse	21	392
spotfin shiner	20	746
brook stickleback	19	1274
spottail shiner	19	498
walleye	18	69
smallmouth bass	17	1127
yellow perch	17	565
hornyhead chub	16	605
quillback	15	115
common carp	14	125
channel catfish	14	134
northern redbelly dace	13	1487

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
freshwater drum	11	32
goldeye	11	57
trout-perch	11	90
sauger	11	16
weed shiner	10	78
stonecat	9	52
sand shiner	9	337
mooneye	8	16
bigmouth shiner	7	106
bluntnose minnow	7	53
black bullhead	6	9
black crappie	6	19
tadpole madtom	6	23
finescale dace	6	600
burbot	5	5
chestnut lamprey	5	12
longnose dace	5	30
carmine shiner	4	298
silver chub	4	14
bluegill	4	48
lamprey ammocoete	4	5
young of the year redhorse	4	158
blacknose shiner	3	47
Iowa darter	3	77
blacknose dace	3	56
silver lamprey	2	3
pearl dace	2	62
golden shiner	2	9
bigmouth buffalo	2	8
pumpkinseed	2	4
brown bullhead	2	5
lake sturgeon	1	2
blackchin shiner	1	8
mimic shiner	1	25
brassy minnow	1	1
river darter	1	4
Young of the year sucker	1	17
largemouth bass	1	1
banded killifish	1	1

Appendix 7 – Macroinvertebrate species found during biological monitoring surveys

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
ACARI		
Acari	27	146
AMPHIPODA		
Hyalella	30	847
BRANCHIOBDELLIDA		
Branchiobdellida	1	11
COLEOPTERA		
Acilius	2	2
Anacaena	5	16
Berosus	6	16
Colymbetes	1	1
Desmopachria	1	1
Desmopachria convexa	2	2
Dubiraphia	31	247
Dytiscidae	7	12
Dytiscus	2	2
Elmidae	5	8
Enochrus	1	1
Gyrinus	10	29
Haliplidae	1	1
Haliplus	19	172
Helichus	3	5
Helophorus	2	2
Hydraena	8	13
Hydrobius	1	1
Hydrochus	2	7
Hydrophilidae	3	5
Hygrotus	1	1
Laccobius	1	2
Laccophilus	3	7
Liodessus	16	79

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Macronychus	1	1
Macronychus glabratus	10	207
Neoporus	2	2
Ochthebius	5	12
Optioservus	5	6
Paracymus	2	2
Peltodytes	15	33
Stenelmis	28	149
Tropisternus	4	4
DECAPODA		
Cambaridae	1	1
Orconectes	17	36
DIPTERA		
Ablabesmyia	34	131
Acricotopus	7	34
Anopheles	3	6
Antocha	3	5
Atherix	12	32
Atrichopogon	4	19
Axarus	1	11
Bezzia/Palpomyia	4	28
Brillia	2	9
Ceratopogonidae	9	29
Ceratopogoninae	10	17
Chaoborus	2	4
Chironomini	19	26
Chironomus	13	84
Chrysops	1	1
Cladopelma	3	3
Cladotanytarsus	7	11
Clinotanypus	2	2
Conchapelopia	1	1
Corynoneura	14	44
Cricotopus	26	98
Cryptochironomus	11	18
Cryptotendipes	5	15
Culex	1	3
Culicidae	5	6
Dasyhelea	8	46
Demicryptochironomus	1	1

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Dicranota	2	2
Dicrotendipes	28	371
Dolichopodidae	1	1
Doncricotopus bicaudatus	1	1
Empididae	2	2
Endochironomus	9	119
Ephydridae	17	45
Eukiefferiella	2	3
Forcipomyia	1	1
Glyptotendipes	4	6
Hemerodromia	9	13
Hexatoma	1	1
Kribiodorum perpulchrum	2	2
Labrundinia	21	56
Limnophyes	4	6
Limonia	1	6
Lopescladius	2	6
Micropsectra	5	12
Microtendipes	12	52
Nanocladius	6	15
Nilotanypus	6	12
Nilothauma	6	16
Odontomyia	2	2
Odontomyia /Hedriodiscus	3	4
Orthocladiinae	10	14
Orthocladius	5	94
Parachironomus	7	28
Paracladopelma	1	2
Parakiefferiella	4	7
Paralauterborniella	1	1
Paralauterborniella nigrohalterale	6	20
Paramerina	8	24
Paratanytarsus	15	111
Paratendipes	3	8
Pentaneura	6	30
Phaenopsectra	12	20
Polypedilum	39	749
Potthastia	4	5
Procladius	14	57
Psectrocladius	5	5

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Psectrotanypus	1	1
Pseudochironomus	6	14
Rheocricotopus	3	5
Rheotanytarsus	20	160
Sciomyzidae	1	1
Simuliidae	3	9
Simulium	27	424
Stempellinella	6	11
Stenochironomus	8	26
Stictochironomus	1	3
Tanypodinae	17	31
Tanytarsini	14	26
Tanytarsus	28	188
Thienemanniella	6	7
Thienemannimyia	1	13
Thienemannimyia Gr.	34	200
Thienemannimyia senata	7	8
Tipula	8	16
Tipulidae	2	2
Tribelos	7	9
Tvetenia	11	31
Xenochironomus xenolabis	3	3
Zavreliella marmorata	1	4
EPHEMEROPTERA		
Acentrella	2	20
Acentrella parvula	6	43
Acentrella parvula	3	19
Acentrella turbida	1	2
Acerpenna	13	138
Acerpenna pygmaea	5	10
Anafroptilum	9	35
Anthopotamus myops	2	16
Baetidae	18	77
Baetis	7	46
Baetis intercalaris	13	125
Baetisca	4	7
Baetisca lacustris	1	2
Caenis	15	252
Caenis youngi	3	38
Caenis diminuta	10	105

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Caenis hilaris	7	44
Callibaetis	7	37
Ephemerellidae	1	2
Ephoron album	1	1
Heptagenia	4	17
Heptageniidae	12	111
Hexagenia	4	12
Hexagenia limbata	1	12
Isonychia	10	54
Iswaeon	10	67
Labiobaetis	2	4
Labiobaetis dardanus	6	91
Labiobaetis propinquus	8	88
Leptophlebia	5	165
Leptophlebiidae	6	93
Leucrocuta	2	15
Maccaffertium	17	148
Maccaffertium exiguum	6	14
Maccaffertium mediopunctatum	2	15
Maccaffertium mexicanum	1	1
Maccaffertium terminatum	3	15
Nixe	1	1
Paracloeodes	1	9
Paracloeodes minutus	5	19
Paraleptophlebia	2	39
Plauditus	13	172
Procloeon	13	54
Pseudocloeon	7	280
Pseudocloeon propinquum	1	6
Rhithrogena	1	2
Sparbarus	1	1
Sparbarus marculatus	1	2
Stenacron	14	56
Stenonema	6	58
Tricorythodes	33	677
GASTROPODA		
Amnicola	3	36
Campeloma	3	9
Campeloma decisum	1	1
Ferrissia	15	72

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Fossaria	4	16
Gyraulus	9	127
Helisoma anceps	3	5
Hydrobiidae	14	191
Laevapex fuscus	1	1
Lymnaeidae	4	16
Physa	38	912
Planorbella	7	47
Planorbidae	7	153
Pseudosuccinea	1	8
Stagnicola	6	29
Valvata	3	168
HEMIPTERA		
Belostoma	7	12
Belostoma flumineum	5	8
Belostomatidae	2	4
Callicorixa	2	6
Corixidae	22	407
Hebridae	1	1
Hesperocorixa	3	4
Lethocerus	3	4
Mesovelia	1	1
Microvelia	1	1
Neoplea	2	4
Neoplea striola	14	36
Notonecta	6	20
Palmacorixa	4	9
Ranatra	6	12
Sigara	15	205
Trepobates	1	1
Trichocorixa	8	44
Veliidae	1	1
HIRUDINEA		
Hirudinea	12	27
HYDROZOA		
Hydra	1	1
Hydrozoa	2	9
LEPIDOPTERA		
Crambidae	3	6
Paraponyx	3	3

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Parapoynx	5	5
MEGALOPTERA		
Chauliodes	3	3
Corydalidae	1	1
Sialis	2	2
NEMATODA		
Nematoda	2	2
ODONATA		
Aeshna	6	7
Aeshna umbrosa	1	3
Aeshnidae	1	1
Anax	2	7
Anax junius	4	4
Anisoptera	3	4
Argia	3	11
Boyeria	1	1
Boyeria vinosa	1	1
Calopterygidae	4	8
Calopteryx	8	26
Calopteryx aequabilis	3	7
Coenagrionidae	32	634
Enallagma	8	78
Gomphidae	3	3
Gomphus	3	3
Gomphus fraternus	1	1
Hetaerina	5	15
Hetaerina americana	1	1
Ischnura	1	2
Libellula	1	1
Libellulidae	5	7
Ophiogomphus	2	2
Ophiogomphus carolus	3	3
Ophiogomphus rupinsulensis	1	1
Somatochlora	2	3
Stylurus	2	2
OLIGOCHAETA		
Oligochaeta	37	463
PLECOPTERA		
Acroneuria	3	3
Acroneuria abnormis	6	12

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Agnetina	3	3
Paragnetina	1	1
Paragnetina media	2	2
Perlidae	4	5
Pteronarcys	5	7
Taeniopteryx	2	7
TRICHOPTERA		
Brachycentrus numerosus	7	59
Ceraclea	2	4
Ceratopsyche	13	72
Ceratopsyche alhedra	1	1
Ceratopsyche bronta	2	8
Ceratopsyche morosa	5	33
Cheumatopsyche	15	62
Chimarra	6	72
Glossosomatidae	3	3
Helicopsyche	2	6
Helicopsyche borealis	11	38
Hydropsyche	15	109
Hydropsyche incommoda	1	1
Hydropsyche phalerata	5	34
Hydropsyche placoda	1	3
Hydropsyche simulans	4	36
Hydropsychidae	13	101
Hydroptila	14	198
Hydroptilidae	14	33
Lepidostoma	4	6
Leptoceridae	10	36
Leptocerus americanus	1	2
Limnephilidae	5	66
Mayatrichia ayama	4	7
Micrasema	2	2
Micrasema rusticum	2	5
Nectopsyche	10	42
Nectopsyche candida	7	37
Nectopsyche diarina	4	10
Nectopsyche exquisita	3	39
Neotrichia	1	1
Neureclipsis	9	63
Nyctiophylax	3	7

Taxonomic Name	Quantity of Stations Where Present	Quantity of Individuals Collected
Ochrotrichia	6	29
Oecetis	7	17
Oecetis avara	13	40
Oecetis furva	1	1
Oecetis testacea	2	3
Philopotamidae	2	5
Phryganeidae	2	3
Polycentropodidae	11	16
Polycentropus	3	11
Protoptila	8	218
Psychomyia	1	1
Ptilostomis	3	8
Pycnopsyche	3	5
Triaenodes	1	2
Trichoptera	2	2
TUBELLARIA		
Turbellaria	13	53
VENEROIDA		
Pisidiidae	22	86

*