South Fork Crow River Watershed Monitoring and Assessment Report

Minnesota Pollution Control Agency

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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

DNR Minnesota Department of Natural Resources

DOP Dissolved Orthophosphate

E Eutrophic

EQuIS Environmental Quality Information System

EX Exceeds Criteria (Bacteria)

EXP Exceeds Criteria, Potential Impairment

EXS Exceeds Criteria, Potential Severe Impairment

FS Full Support

FWMC Flow Weighted Mean Concentration

H Hypereutrophic

HUC Hydrologic Unit Code

IBI Index of Biotic Integrity

IF Insufficient Information

K Potassium

LRVW Limited Resource Value Water

M Mesotrophic

MCES Metropolitan Council Environmental Services

MDA Minnesota Department of Agriculture

MDH Minnesota Department of Health

MINLEAP Minnesota Lake Eutrophication Analysis Procedure

MPCA Minnesota Pollution Control Agency

MSHA Minnesota Stream Habitat Assessment

MTS Meets the Standard

N Nitrogen

NA Not Assessed

NHD National Hydrologic Dataset

NH3 Ammonia

Nitrate-N Nitrate Plus Nitrite Nitrogen

NS Not Supporting

NT No Trend

OP Orthophosphate

P Phosphorous

PCB Polychlorinated Biphenyls

PWI Protected Waters Inventory

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

USGS United States Geological Survey

WPLMN Water Pollutant Load Monitoring Network

Executive summary

The South Fork Crow River Watershed (HUC 07010205) drains an area of 331,206 hectares (818,428 acres) along the Upper Mississippi Basin's southern boundary with the Minnesota River Basin in central Minnesota. It spans an area from the city of Willmar on the watershed's western boundary to the Delano area on the eastern boundary, occupying portions of Kandiyohi, Renville, Meeker, McLeod, Sibley, Wright and Hennepin counties.

In 2012 the Minnesota Pollution Control Agency (MPCA) began a two year, intensive watershed monitoring (IWM) project in the South Fork Crow River Watershed. This project was designed to assess the quality of the lakes and streams in the watershed through both biological and water chemistry monitoring. MPCA biomonitoring staff evaluated fish and macroinvetebrate communities at 83 unique monitoring stations across 49 assessment reaches of stream. MPCA surface water quality staff and the Crow River Organization of Waters (CROW) completed lake and stream chemistry sampling at 12 stream locations: 11 of which were at the outlets of the major subwatersheds and an additional location on the South Fork Crow River mainstem. CROW also collected water chemistry from four lakes (Barber, Goose, Johnson and South) to assess the aquatic life and aquatic recreation potential of each lake and stream where sufficient data was available. Overall 52 lakes and 88 streams were assessed for aquatic life and/or aquatic recreation. (Where insufficient data existed, assessments were not made).

Results presented in this report indicate significantly degraded water quality and biological communities throughout the watershed. Overall, scores of biological communities in this watershed were resoundingly poor; not a single general use stream in the South Fork Crow River Watershed fully supported aquatic life for both fish and macroinvertebrates. Only six streams (<7% of assessed reaches) were determined to be supporting aquatic life for Modified Use waters (which have lower impairment thresholds than general use waters) for both fish and macroinvertebrate communities.

Fish communities throughout the South Fork Crow Watershed were characterized by a near-total lack of species that are sensitive to declines in habitat and water quality. Further, these communities were dominated by species capable of persisting in degraded and sub-marginal habitats. The five most commonly collected species of fish, both in number of sites where present and in number of individuals collected, were species that are highly tolerant of degradations to habitat and water quality: fathead minnow (present at 98% of sites), black bullhead (89%), green sunfish (87%), common carp (80%), and orangespotted sunfish (74%). These taxa are characterized by an ability to survive and even thrive in conditions that are lethal to many stream fishes: extremely high water temperatures, low dissolved oxygen, and homogenous substrates and habitats.

A similar pattern was noted among stream macroinvertebrates in the South Fork Crow River Watershed; 73% of assessed stream reaches were determined to harbor impaired macroinvertebrate communities. Of the 11 assessment units that exhibited healthy macroinvertebrate communities, only one was a designated general aquatic life use stream (Otter Creek, AUID 07010205-643).

Surface water quality in the South Fork Crow River is poor, with widespread bacterial contamination, nutrient exceedances, and dissolved oxygen issues beyond the permissible thresholds. Of 18 stream reaches with sufficient chemistry data to make an assessment, only four assessment units (22%) were determined to be supporting aquatic recreation. The remaining stream reaches that were assessed exhibited bacterial levels beyond acceptable standards.

Of the 179 lakes greater than 10 acres in this watershed, 52 had sufficient data for the assessment process. Excessive nutrient enrichment contributed to algal blooms and macrophyte growth: over 70% of these assessed lakes failed to meet aquatic recreation standards. Only four lakes (North Little Long, South Little Long, Carrie and Stahl's) were considered suitable for aquatic recreation. Biological monitoring of lakes was not performed as a part of this study; lakes were not assessed for aquatic life. Chloride values sampled in the lakes are low and do not appear to be impacting aquatic life at this time.

Chemical contaminants were examined in fish tissues from 26 lakes within this watershed. Over half (n=14) of the sampled lakes exhibited high levels of mercury and are listed as impaired for aquatic consumption. In addition to these lakes, the mainstem of the South Fork Crow River bears an impairment for high levels of mercury in fish tissues.

Groundwater quality in the South Fork Crow River Watershed is considered poor when compared to other regions with comparable aquifers. Nitrate and arsenic are contaminants of concern in this watershed; the Minnesota Department of Health (MDH) encourages well owners to test their water supply for arsenic at least once and to test for nitrate on a regular basis.

The overall area covered by wetlands in this watershed has been reduced to approximately 12% of its pre-settlement acreage. Macroinvertebrate community scores in these wetlands ranged from good to poor (76 to 42 out of 100). Wetland plant communities in the eastern portion of the watershed were considered to be in fair ecological condition, while communities in the western portion were considered poor.

The degraded water quality and biological communities in the South Fork Crow River Watershed reflect the land use, hydrologic modification, and discharge of pollutants (point and non-point) within this watershed. Changes in land use beginning in the mid-19th century have resulted in a near wholesale conversion of the landscape from tall grass prairie, wetland and forest vegetation to row crop agriculture in this watershed. Such a dramatic shift in land cover, coupled with widespread modification of stream channels and wetland complexes has had severe consequences for surface water quality. The prevalence of stream channelization and artificial drainage tiling has created an engineered surficial hydrology that does not retain water from precipitation in the same manner as an unaltered landscape; rain events result in a rapid spike in discharge volumes, while intervening periods of low precipitation result in exceptionally low flows. High discharge events destabilize and erode stream banks which generate high sediment loads and ever wider, shallower channels. The loss of riparian tree cover and rooted, perennial vegetation can greatly exacerbate these issues by further destabilizing banks and increasing water temperatures from lack of shade and cover. Streams impacted by these processes are characterized by uniform depths, homogenous fine substrates and lack of well-developed riffle-pool-run sequences; they provide little habitat for diverse and healthy aquatic communities.

The adoption of best land management practices such as an implementation of perennial vegetation buffers along stream reaches, improved control of waste runoff at livestock operations, installation of exclusion fencing to limit animal access to streams, and novel manners to mitigate nutrient loading to surface waters from fertilizer application would have profound benefits to water quality and biological communities throughout the region.

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 South Fork Crow River Watershed beginning in the summer of 2012. This report provides a summary of all water quality assessment results in the South Fork Crow River Watershed and incorporates all data available for the assessment process including watershed monitoring, volunteer monitoring and monitoring conducted by local government units.

The watershed monitoring approach

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

Pollutant Load Monitoring Network

Funded with appropriations from Minnesota's Clean Water Legacy Fund, the Watershed Pollutant Load Monitoring Network (WPLMN) is a long-term program designed to measure and compare regional differences and long-term trends in water quality among Minnesota's major rivers including the Red, Rainy, St. Croix, Mississippi, and Minnesota, and the outlets of the major tributaries (8 digit HUC scale) draining to these rivers. Since the program's inception in 2007, the WPLMN has adopted a multi-agency monitoring design that combines site specific stream flow data from United States Geological Survey (USGS) and Minnesota Department of Natural Resources (DNR) flow gaging stations with water quality data collected by the Metropolitan Council Environmental Services (MCES), local monitoring organizations, and the MPCA to compute pollutant loads from over 200 stream and river monitoring sites across Minnesota. Sites span three ranges of scale with annual loads calculated for Basin and Major Watershed sites and seasonal loads for Subwatershed sites:

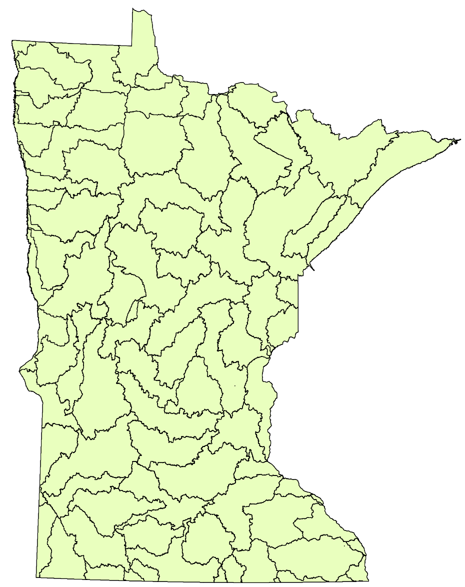

Figure 1. Major watersheds within Minnesota (8 Digit HUC).

Basin – major river mainstem 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 will also be used to assist with: TMDL studies and implementation plans; watershed modeling efforts; and watershed research projects.

More information can be found at the WPLMN website (https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring-network) including a map of the sites.

Intensive watershed monitoring

The intensive watershed monitoring strategy utilizes a nested watershed design allowing the sampling of streams within watersheds from a coarse to a fine scale. Each watershed scale is defined by a hydrologic unit code (HUC). These HUCs define watershed boundaries for water bodies within a similar geographic and hydrologic extent. The foundation of this approach is the 80 major watersheds (8-HUC) within Minnesota. Using this approach many of the smaller headwaters and tributaries to the main stem river are sampled in a systematic way so that a more holistic assessment of the watershed can be conducted and problem areas identified without monitoring every stream reach. Each major watershed is the focus of attention for at least one year within the 10-year cycle.

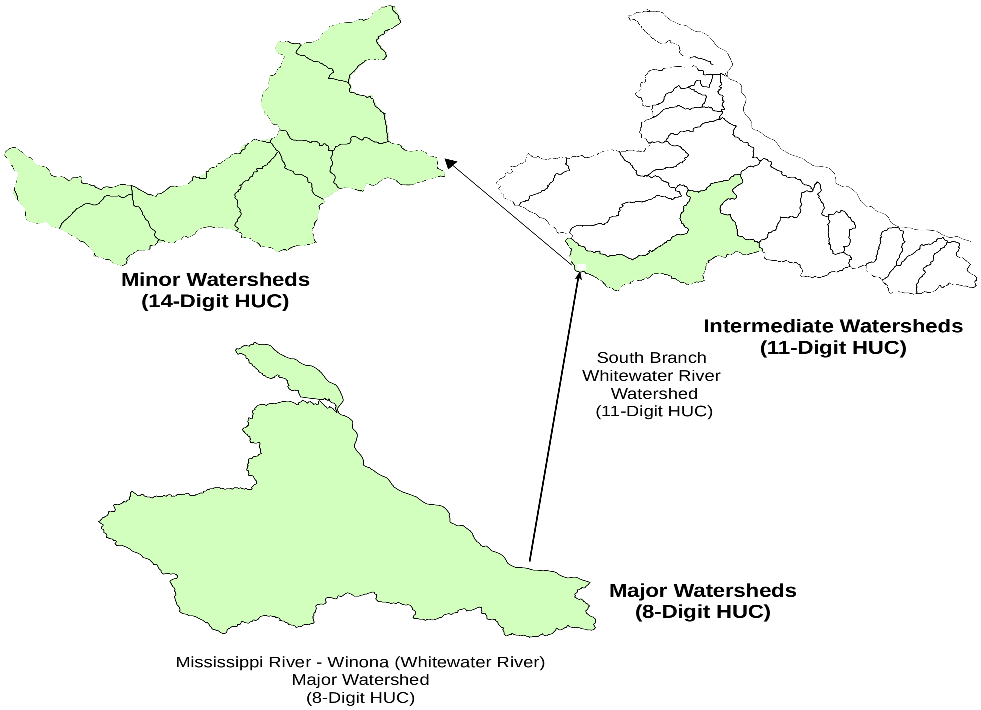

Figure 2. The intensive watershed monitoring design.

River/stream sites are selected near the outlet of each of three watershed scales, 8-HUC, 12-HUC and 14-HUC (Figure 2). Within each scale, different water uses are assessed based on the opportunity for that use (i.e., fishing, swimming, supporting aquatic life such as fish and insects). The major river watershed is represented by the 8-HUC scale. The outlet of the major 8-HUC watershed (purple dot in (Figure 3) is sampled for biology (fish and macroinvertebrates), water chemistry and fish contaminants to allow for the assessment of aquatic life, aquatic recreation and aquatic consumption use support. The 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 12-HUC, smaller watersheds (14 HUCs, typically 10-20 mi^2), are sampled at each outlet that flows into the major 12-HUC tributaries. Each of these minor subwatershed outlets is sampled for biology to assess aquatic life use support (red dots in (Figure 3).

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

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

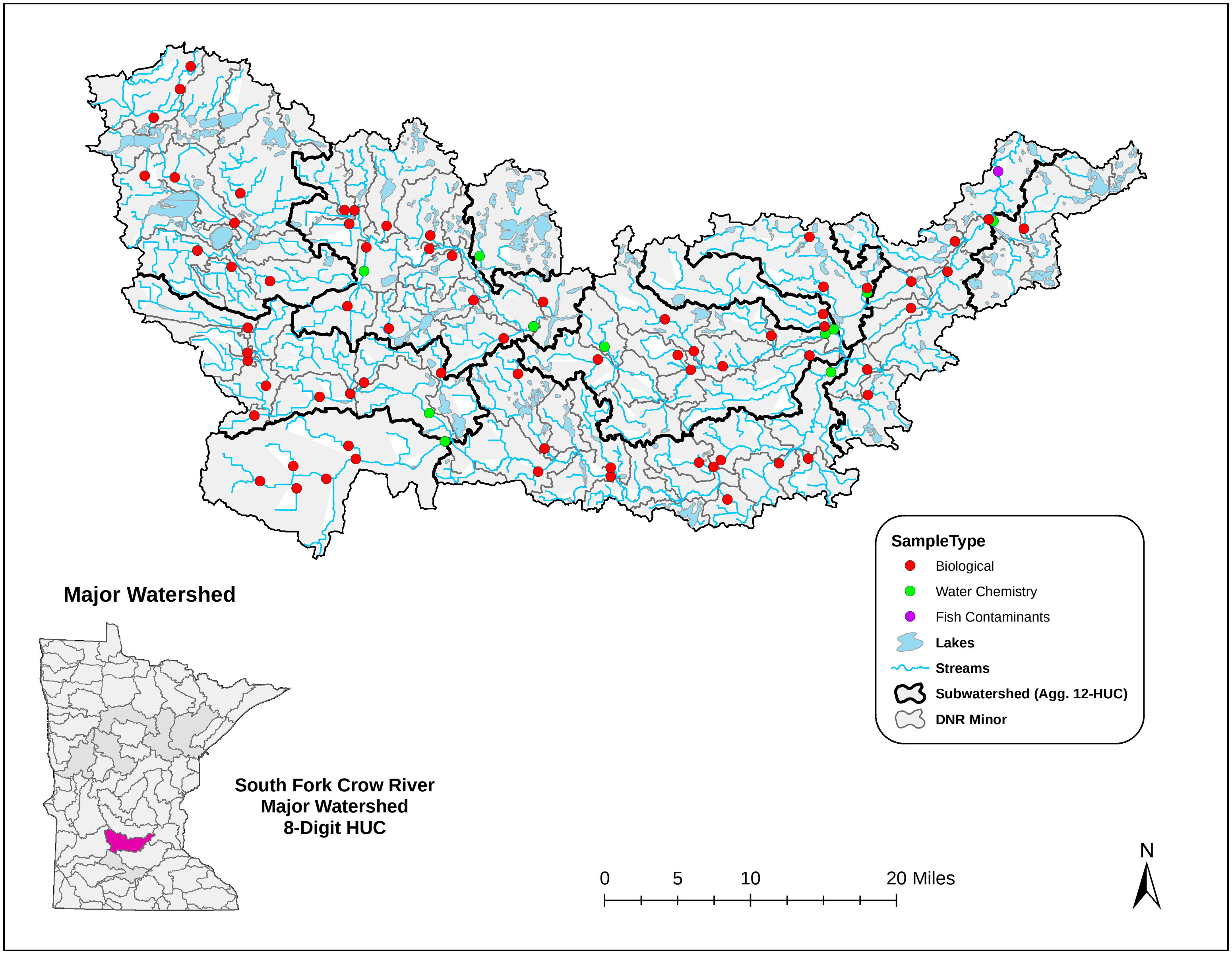

Figure 3. Intensive watershed monitoring sites for streams in the South Fork Crow River Watershed.

Citizen and local monitoring

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

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

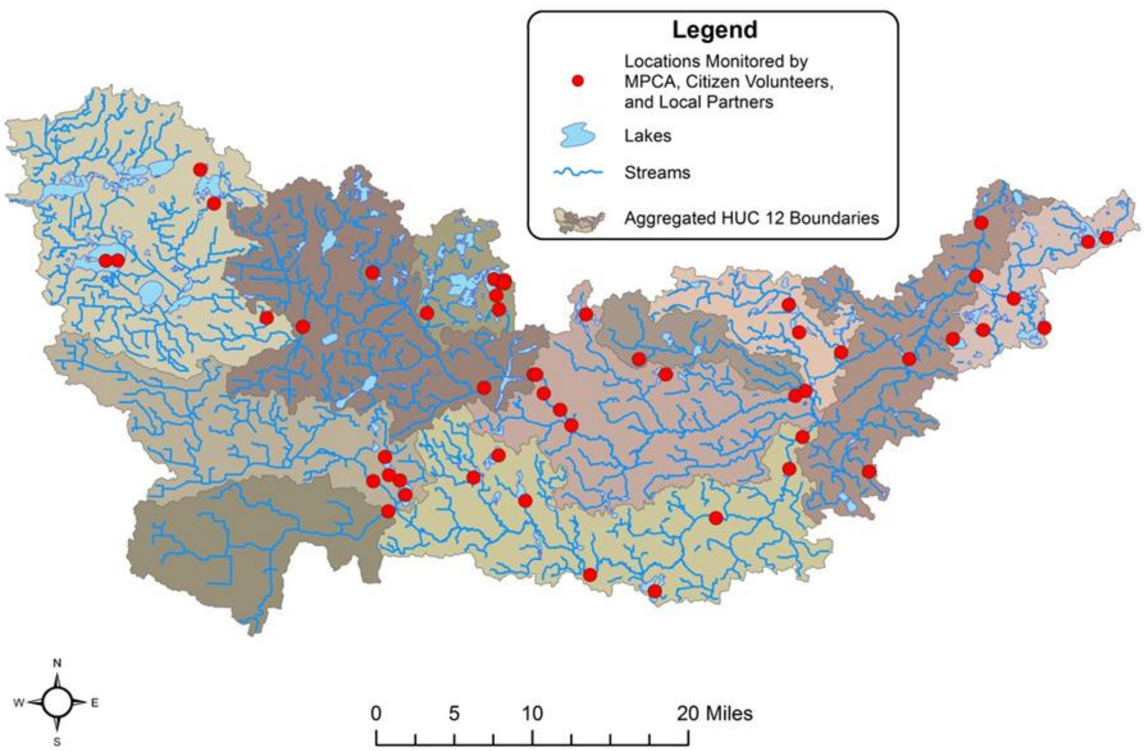

Figure 4. Monitoring locations of local groups, citizens and the MPCA lake monitoring staff in the South Fork Crow River Watershed.

Assessment methodology

The Clean Water Act requires states to report on the condition of the waters of the state every two years. This biennial report to Congress contains an updated list of surface waters that are determined to be supporting or non-supporting of their designated uses as evaluated by the comparison of monitoring data to criteria specified by Minnesota Water Quality Standards (Minn. R. Ch. 7050 2008; https://www.revisor.leg.state.mn.us/rules/?id=7050). The assessment and listing process involves dozens of MPCA staff, other state agencies and local partners. The goal of this effort is to use the best data and best science available to assess the condition of Minnesota's water resources. For a thorough review of the assessment methodologies see: Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List (MPCA 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 IBI's for fish and macroinvertebrates since these communities can respond differently to various types of pollution. Because the rivers and streams in Minnesota are physically, chemically, and biologically diverse IBI's are developed separately for different stream classes to account for this natural variation. Further interpretation of biological community data is provided by an assessment threshold or biocriteria against which an IBI score can be compared within a given stream class. In general, an IBI score above this threshold is indicative of aquatic life use support, while a score below this threshold is indicative of non-support. Additionally, chemical parameters are measured and assessed against numeric standards developed to be protective of aquatic life, including pH, dissolved oxygen, un-ionized ammonia nitrogen, chloride and total suspended solids (TSS).

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).

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 (TP), secchi depth and chlorophyll-a as indicators. Lakes that are enriched with nutrients and have abundant algal growth are eutrophic and do not support aquatic recreation.

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

A small percentage of stream miles in the state (~1 percent of 92,000 miles) have been individually evaluated and re-classified as a Class 7 limited resource value water (LRVW). These streams have previously demonstrated that the existing and potential aquatic community is severely limited and cannot achieve aquatic life standards either by: a) natural conditions as exhibited by poor water quality characteristics, lack of habitat or lack of water; b) the quality of the resource has been significantly altered by human activity and the effect is essentially irreversible; or c) there are limited recreational opportunities (such as fishing, swimming, wading or boating) in and on the water resource. While not being protective of aquatic life, LRVWs are still protected for industrial, agricultural, navigation and other uses. Class 7 waters are also protected for aesthetic qualities (e.g., odor), secondary body contact, and groundwater for use as a potable water supply. To protect these uses, Class 7 waters have standards for bacteria, pH, dissolved oxygen and toxic pollutants.

Assessment units

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

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

Determining use attainment

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

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

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

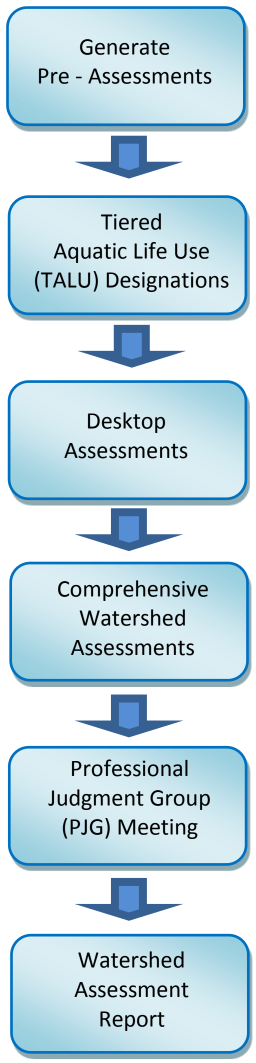

Figure 5. Flowchart of aquatic life use assessment process.

The next step in the process is a Comprehensive Watershed Assessment meeting where reviewers convene to discuss the results of their desktop assessments for each individual waterbody. Implementing a comprehensive approach to water quality assessment requires a means of organizing and evaluating information to formulate a conclusion utilizing multiple lines of evidence. Occasionally, the evidence stemming from individual parameters are not in agreement and would result in discrepant assessments if the parameters were evaluated independently. However, the overall assessment considers each piece of evidence to make a use attainment determination based on the preponderance of information available. See the *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List* (MPCA 2012) http://www.pca.state.mn.us/index.php/view-document.html?gid=8601 for guidelines and factors considered when making such determinations.

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

Data management

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

Period of record

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

Watershed overview

The South Fork Crow River Watershed (HUC 07010205) drains an area of 331,206 hectares (818,428 acres) along the Upper Mississippi Basin's southern boundary with the Minnesota River Basin in central Minnesota. It spans an area from the city of Willmar on the watershed's western boundary to the Delano area on the eastern boundary, occupying portions of Kandiyohi, Renville, Meeker, McLeod, Sibley, Wright and Hennepin counties. The watershed spans the boundary between two Minnesota ecoregions; the larger, western portion of the watershed is in the Western Corn Belt Plains and the eastern third lies within the North Central Hardwoods ecoregion (Figure 6).

This watershed is divided into eleven subwatersheds. These subwatersheds are aggregations of individual 12-digit HUC drainages, containing anywhere from one to many 12-digit HUC units. For example, the Hoff Lake and Crane Creek subwatersheds are relatively small and consist of one 12-digit HUC drainage, while the Upper South Fork Crow is somewhat larger and consists of seven aggregated 12-digit HUC units.

The South Fork Crow River Watershed falls entirely within the Iowa and Minnesota Till Prairies Major Land Resource Area (MLRA). This area is characterized by scattered lacustrine areas, flood plains, outwash and potholes with loamy, glacial till soils. Prior to landscape conversion in the 1850s, the native vegetation was predominantly tall grass prairie (NRCS 2007).

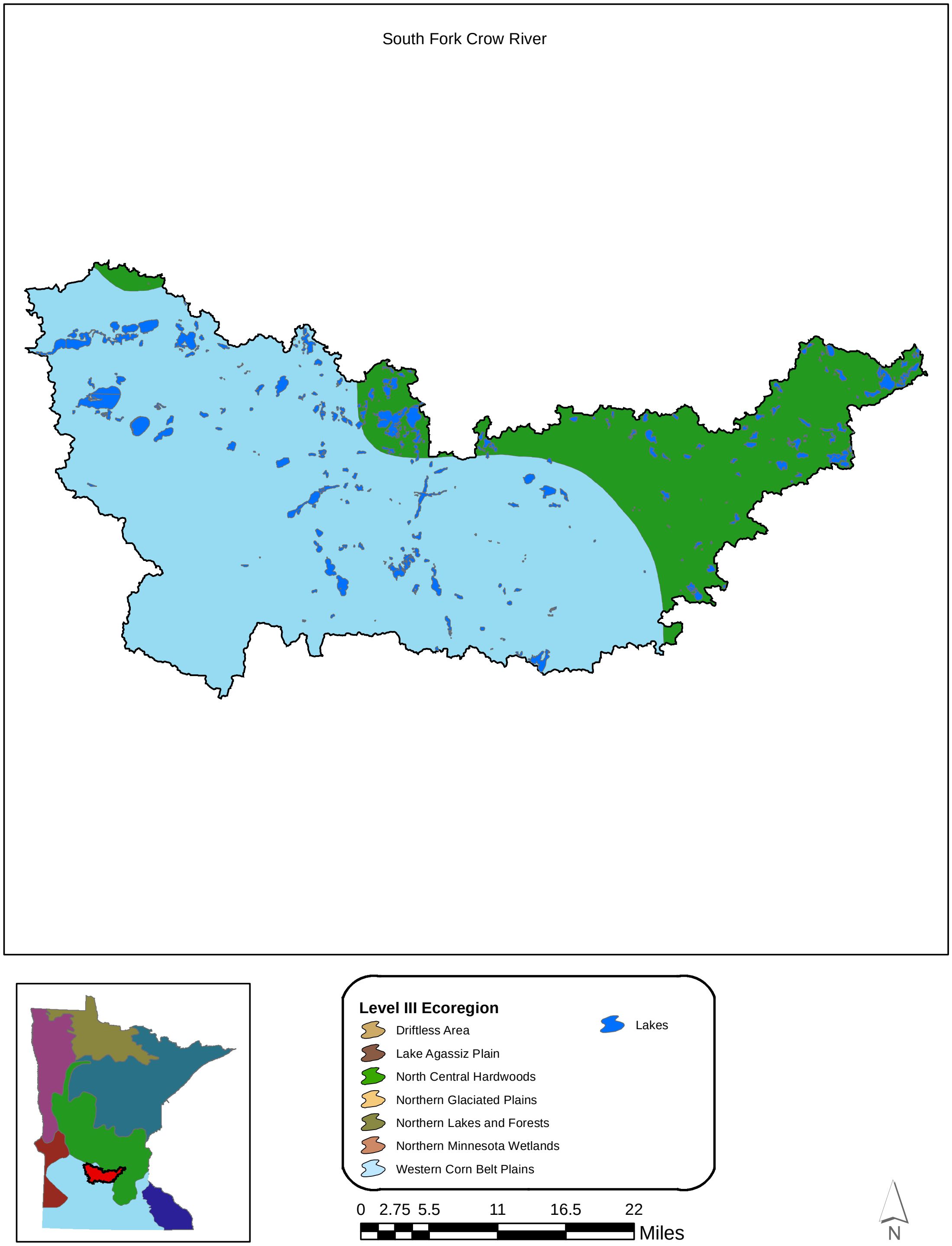

Figure 6. The South Fork Crow Watershed within the West Central Corn Belt Plains and North Central Hardwoods ecoregions of central Minnesota.

Land use summary

Lands within the South Fork Crow River Watershed were opened to non-indigenous settlement in the mid-19th century. Over the following century and a half, the landscape underwent a near wholesale conversion from native tall grass prairie vegetation to agricultural uses. To increase arable land surface, wetlands and free flowing streams were converted to networks of agricultural drainage ditches.

Today, the landscape in this watershed is dominated by agriculture, with over 70% of the land coverage dedicated to row crop farming. Rangeland is the second most prevalent land use type at just over 10%. The remaining land use types are split amongst developed lands (5.8%), forest/shrub (5%), open water (3.7%) and wetlands (2.7%).

Nearly all the land (98%) in the South Fork Crow watershed is privately owned, and the region is predominantly rural. The most sizable cities in this region are Willmar (19,680), Hutchinson (13,871), Delano (5,654) and Glencoe (5,536). The remaining towns and communities throughout the watershed have less than 5,000 inhabitants.

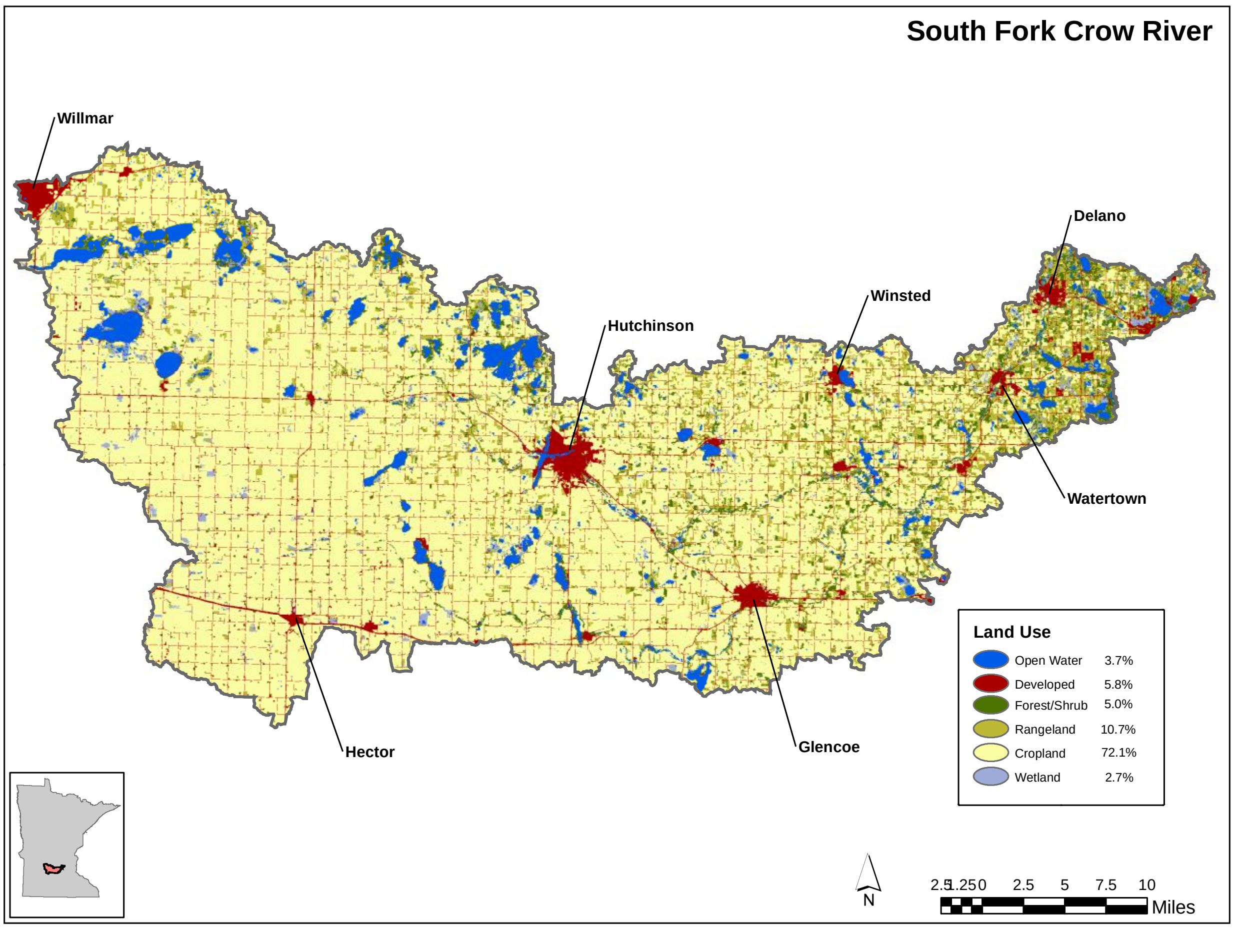

Figure 7. Land use in the South Fork Crow Watershed.

Surface water hydrology

The South Fork Crow River flows in a predominantly west to east direction 116 miles from its headwaters at the outlet of Little Kandiyohi Lake to its confluence with the North Fork Crow River downstream of Delano. For nearly the first 30 miles from the headwaters, the South Fork Crow River is channelized; it transitions to a natural channel downstream of the town of Cosmos. The South Fork Crow River's largest tributary, Buffalo Creek, drains the southern third of this watershed. It flows roughly parallel to the mainstem of the South Fork Crow for nearly 90 miles before the two meet just downstream of Lester Prairie. Less than 13% of stream channels in this watershed retain their natural condition (Figure 9). The remaining natural stream channels in this watershed are nearly all restricted to the mainstem reaches of the South Fork Crow River and Buffalo Creek; virtually all of the first, second and third order streams in this watershed have been channelized. Two smaller tributaries, Crane Creek and Otter Creek, join the South Fork Crow River just upstream of its confluence with Buffalo Creek.

There are two dams along the South Fork Crow River. The dam in the city of Hutchinson was built in 1857 to create a reservoir for milling and recreation purposes. The old dam was removed and replaced with a series of rock rapids in 2007-2008. Although the new dam design is no longer a complete barrier to fish passage, it still creates a sizable impoundment upstream of the structure. The second dam is located in Watertown. At three feet in height, the river is not considered to be impounded by this structure. In addition to these dams, there are numerous small dams and control structures at lake outlets throughout the watershed.

There are 179 lakes with surface areas greater than 10 acres in the South Fork Crow watershed, including three larger lakes with over 1,500 acres: Cedar Lake, Big Kandiyohi, and Lake Wakanda.

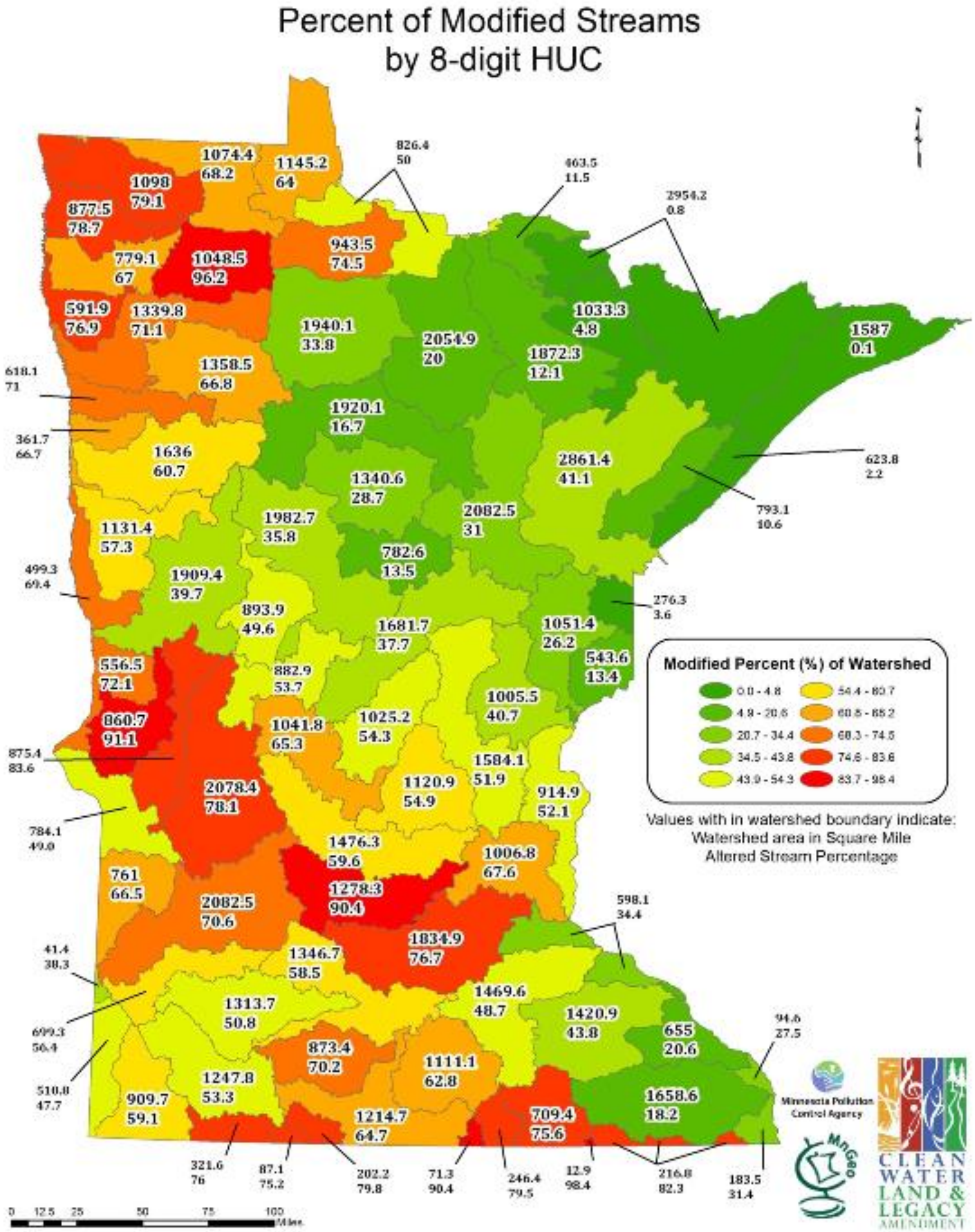

Figure 8. Map of percent modified streams by major watershed (8-HUC).

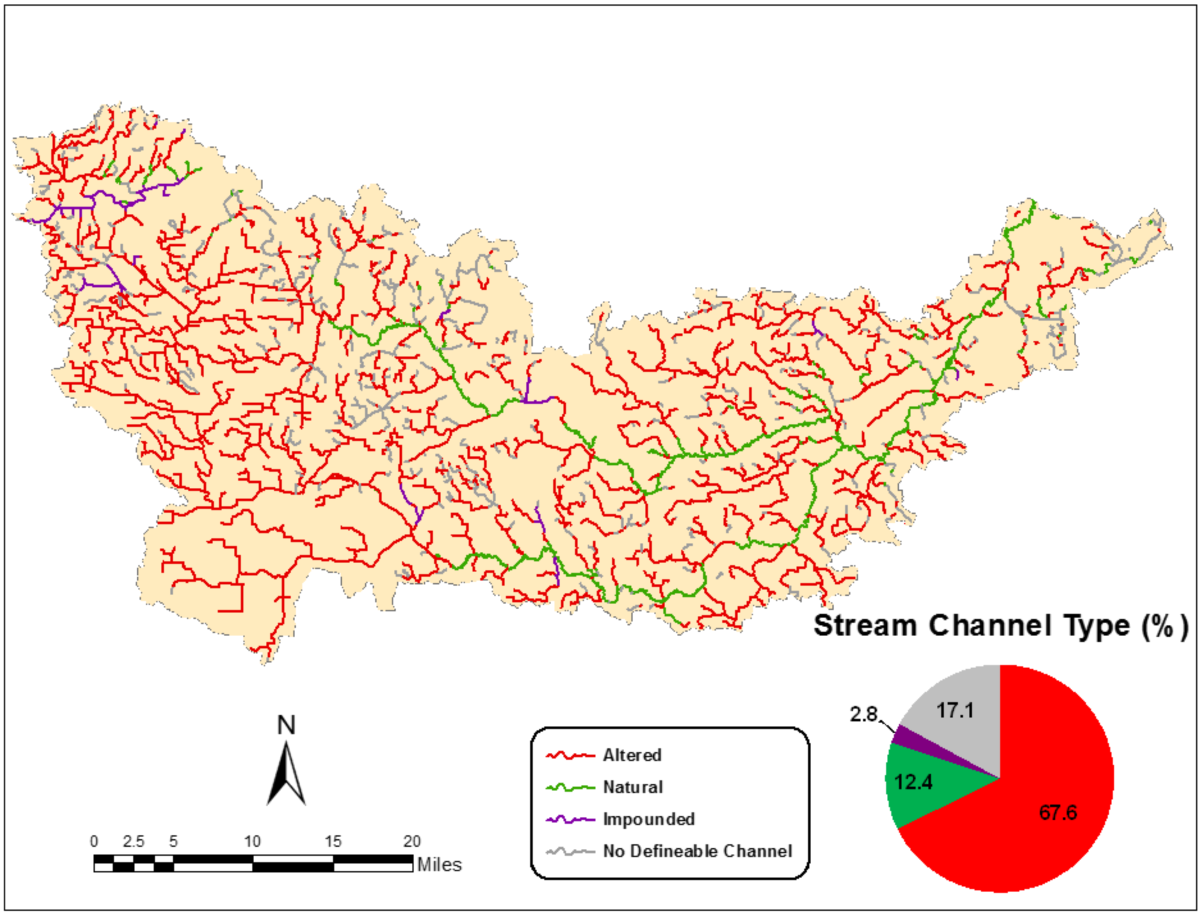

Figure 9. Comparison of natural to altered streams in the South Fork Crow River Watershed (percentages derived from the state-wide Altered Water Course project).

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 South Fork Crow River Watershed is 18.8˚C; and the mean winter temperature is -9.4˚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 South Fork Crow River Watershed area received 24 to 32 inches of precipitation in 2012. The display on the right shows the amount those precipitation levels departed from normal. For the South Fork Crow River area it shows that precipitation ranged from two inches below normal to four inches above normal.

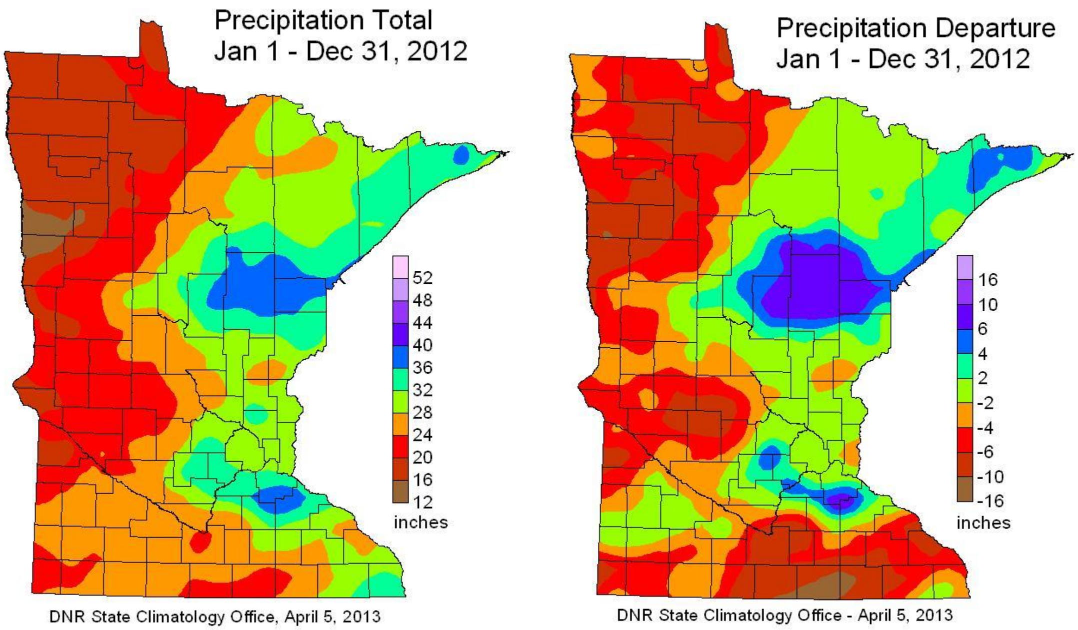

Figure 10. State-wide precipitation levels during the 2012 water year.

The South Fork Crow River Watershed is located in the central precipitation region. Figure 11 and Figure 12 display the areal average representation of precipitation in central Minnesota for 20 and 100 years, respectively. An areal average is a spatial average of all the precipitation data collected within a certain area presented as a single dataset. This data is taken from the Western Regional Climate Center, available as a link off of the University of Minnesota Climate website. Though rainfall can vary in intensity and time of year, rainfall totals in the central region display no significant trend over the last 20 years. However, precipitation in central 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.

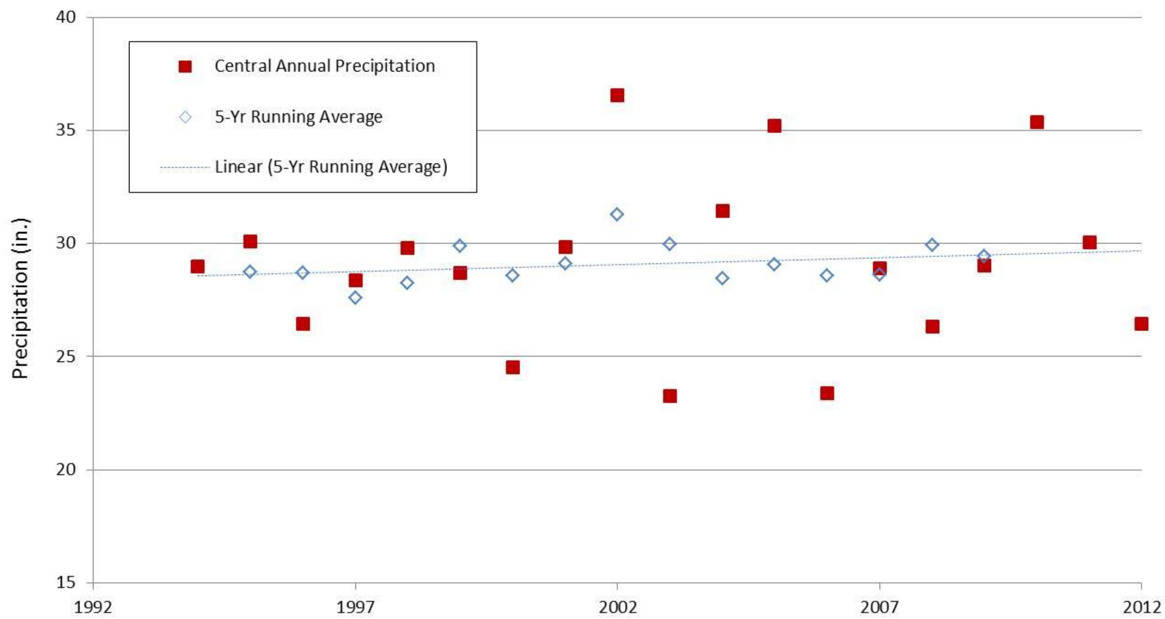

Figure 11. Precipitation trends in Central Minnesota (1992-2012) with five-year running average.

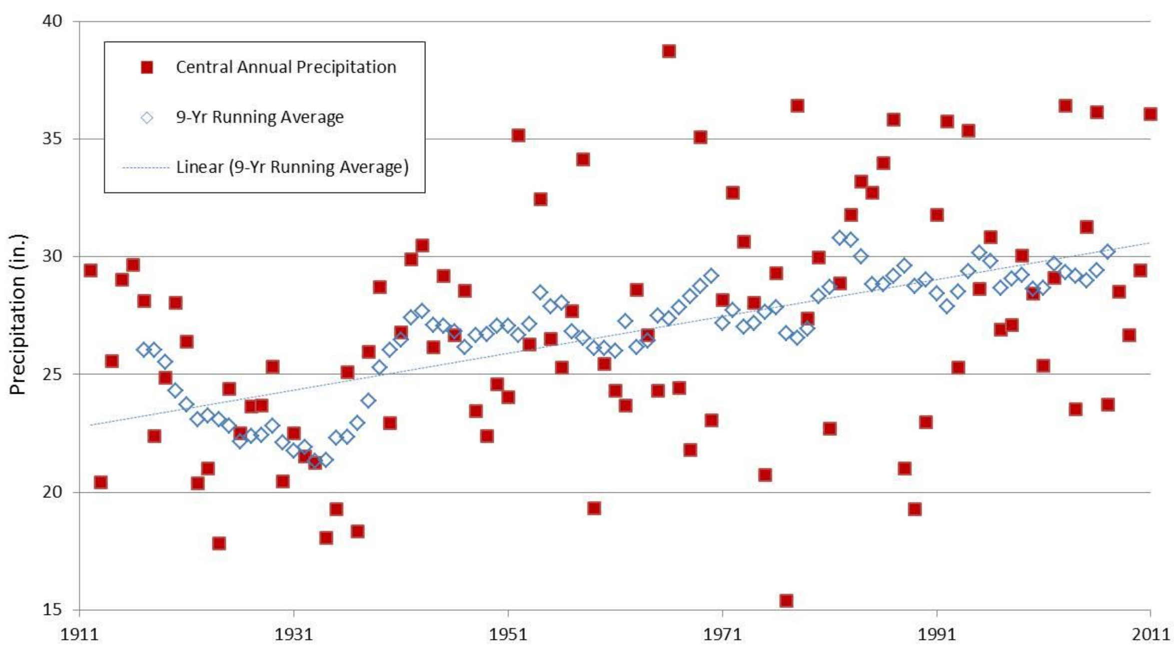

Figure 12. Precipitation trends in Central Minnesota (1911-2011) with nine-year running average.

Hydrogeology and groundwater quality

The South Fork Crow River Watershed is located in the eastern reaches of the Southwest hydrogeologic region (Region 4). The watershed is within the Upper Mississippi River Basin and was formed primarily by the advancement and retreating of the Des Moines Lobe, leaving quaternary deposits ranging from a few feet to several hundred feet (MPCA, 1998). The sand and gravel outwash deposits contribute to the groundwater source for this area of Minnesota.

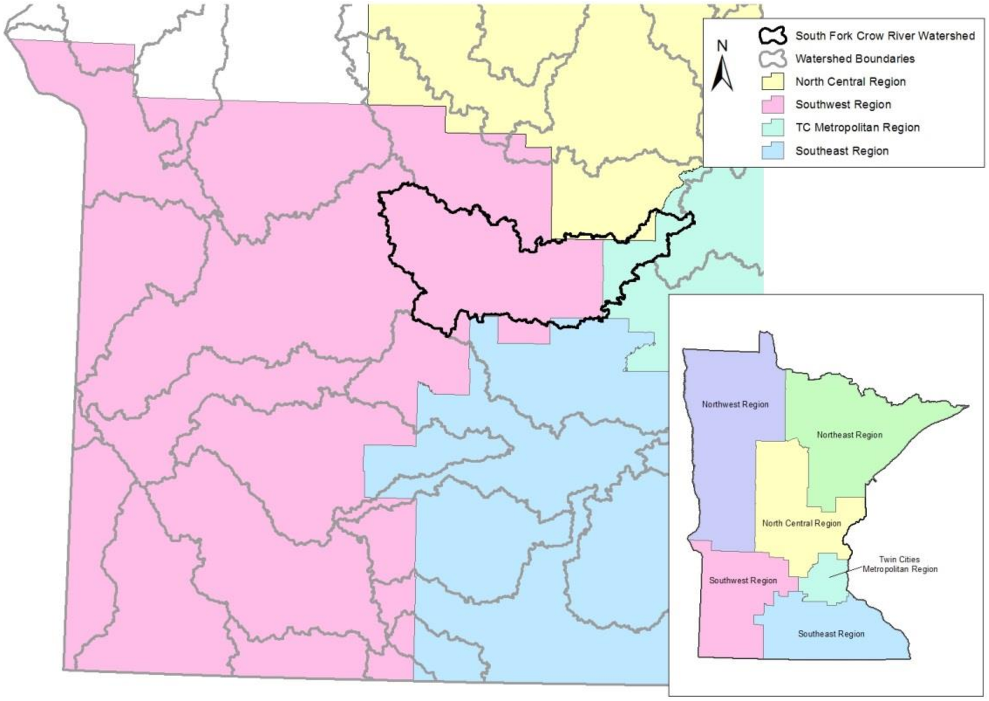

Figure 13. South Fork Crow River Watershed within the hydrogeologic regions

This region contains four main types of aquifer to include buried sand and gravel, and surficial sand and gravel aquifers, Precambrian aquifers, and Cretaceous aquifers. These four aquifers are vital as a groundwater sources. The buried sand and gravel aquifers include the Quaternary Buried Artesian Aquifer (QBAA), the Quaternary Buried Unconfined Aquifer (QBUA), and the Quaternary Buried Undifferentiated Aquifer (QBUU). It is from these aquifers that the majority of wells in this region of Minnesota yield its greatest groundwater source (MPCA, 1998). Another important source of groundwater is the surficial sand and gravel aquifers, which consist of well-sorted outwash deposits left behind from the Des Moines lobe. Two main aquifers that are included in this category are the Quaternary Water Table Aquifer (QWTA) and the Quaternary Undifferentiated Unconfined Aquifer (QUUU).

Cretaceous bedrock accounts for approximately 80% of Southwest hydrogeologic region and are only absent where Precambrian bedrock surfaces. Deposits include interbedded shale, siltstone and sandstone that can range from 300 to 500 feet. The Precambrian bedrock underlies the entire Southwest region, making it the oldest, lowermost bedrock type in this region. The Precambrian aquifers include the Sioux Quartzite and Crystaline aquifers, which are nearly impermeable and very few wells withdraw from this layer. In addition, the South Fork Crow River Watershed contains Cretaceous bedrock in the southwestern area of the watershed. This bedrock is located beneath glacial drift but above older bedrock. These areas consist of sandstone layers interbedded with thick layers of shale and are used locally as water sources (DNR, 2001).

The South Fork Crow River Watershed falls within four of Minnesota's six Ground Water Provinces: the Western, Central, Metro and South-Central Provinces. The majority of the watershed lies within the Western Province which is characterized by "clayey glacial drift overlying Cretaceous and Precambrian bedrock. Glacial drift and Cretaceous bedrock contain limited extent sand and sandstone aquifers, respectively" (DNR, 2001). The eastern portion of the watershed is within the South-Central Province which is characterized by "thick clayey glacial drift with limited extent sand aquifers overlying Paleozoic sandstone, limestone, and dolostone aquifers" (DNR, 2001).

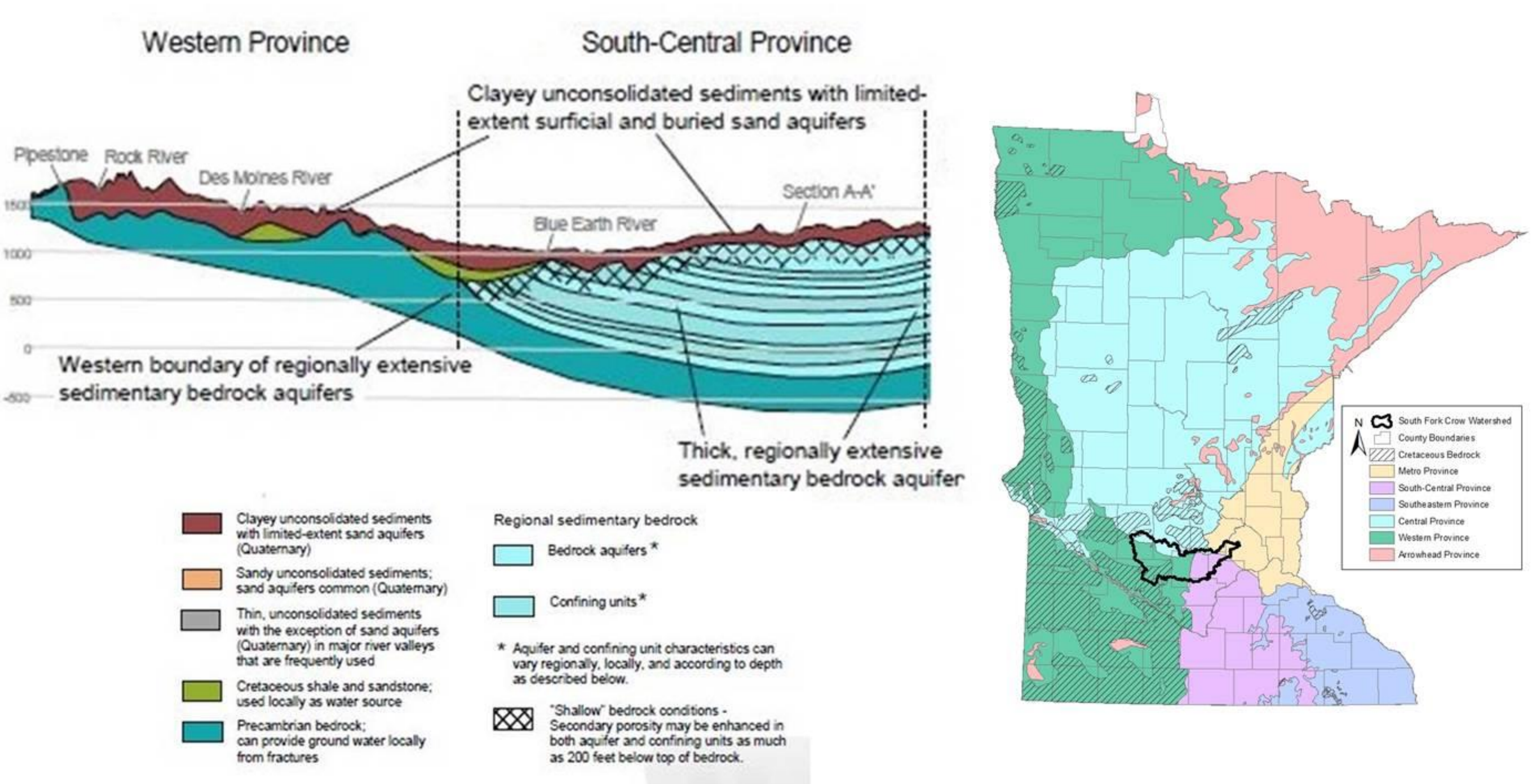

Figure 14. West Province Generalized Cross Section (Source: DNR, 2001)

Recharge of these aquifers is important and limited to areas located at topographic highs, those 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 South Fork Crow River Watershed, the average annual recharge rate to surficial materials is four to six per year with some regions recharging at a rate of two to four inches per year (Figure 15).

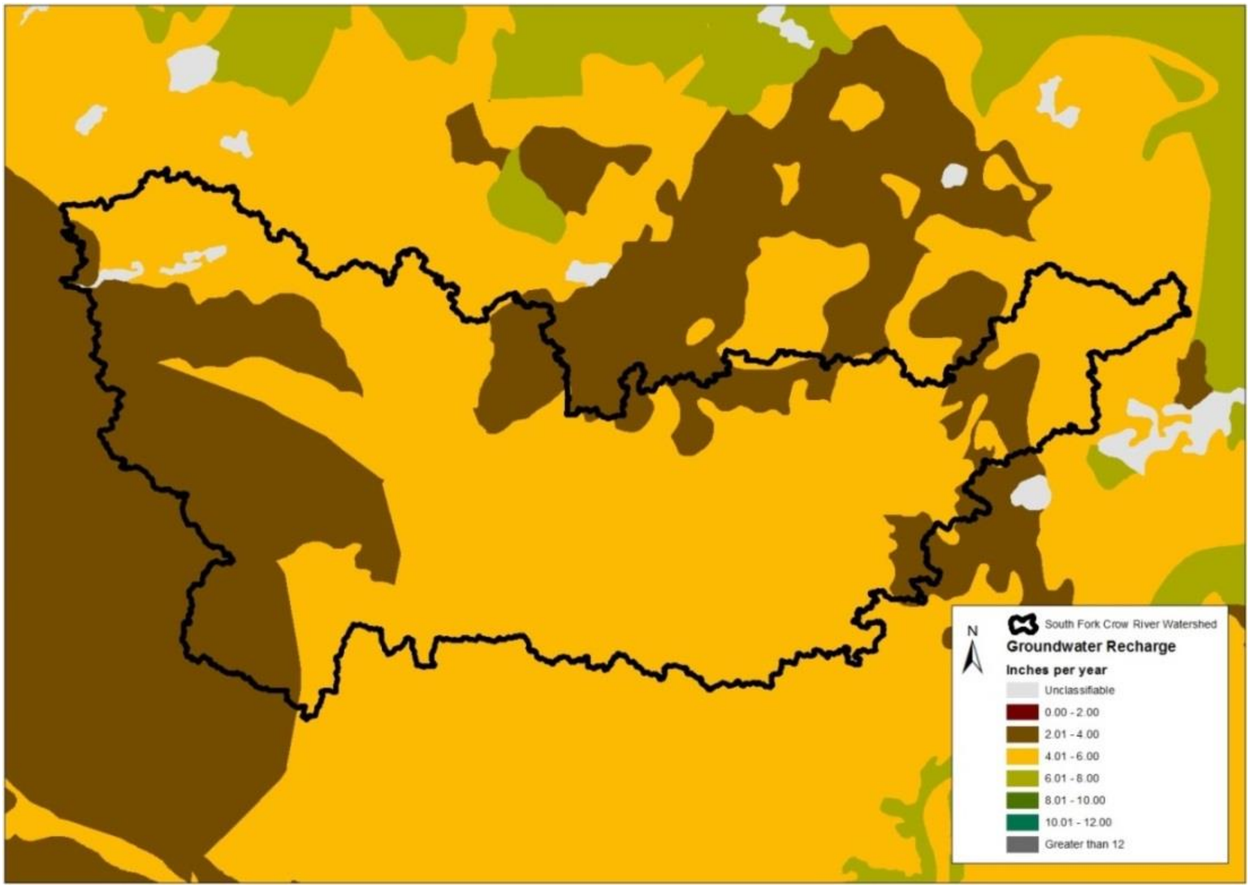

Figure 15. Average Annual Recharge Rate to Surficial Materials in South Fork Crow River Watershed (1971-2000).

Wetlands

At present, there are approximately 82,000 acres of wetlands in the South Fork Crow River Watershed, roughly equivalent to 10% of its total area. Emergent vegetation and shallow open water wetlands are well-distributed across watershed and represent the most common wetland types (Figure 16). Scrub-shrub wetlands and forested wetlands are present in the watershed, primarily concentrated in the eastern part of the watershed that lies within the Mixed Wood Plains ecoregion. It should be noted that these estimates represent a snapshot of the location, type, and extent of wetlands occurring in the early 1980s—when aerial imagery was acquired to develop National Wetlands Inventory (NWI) maps in this part of the state. Updated NWI maps are currently available for the eastern region of the watershed (Hennepin, Carver and Wright County), part of a recent update for the East-Central region of Minnesota based on 2010 and 2011 aerial imagery.

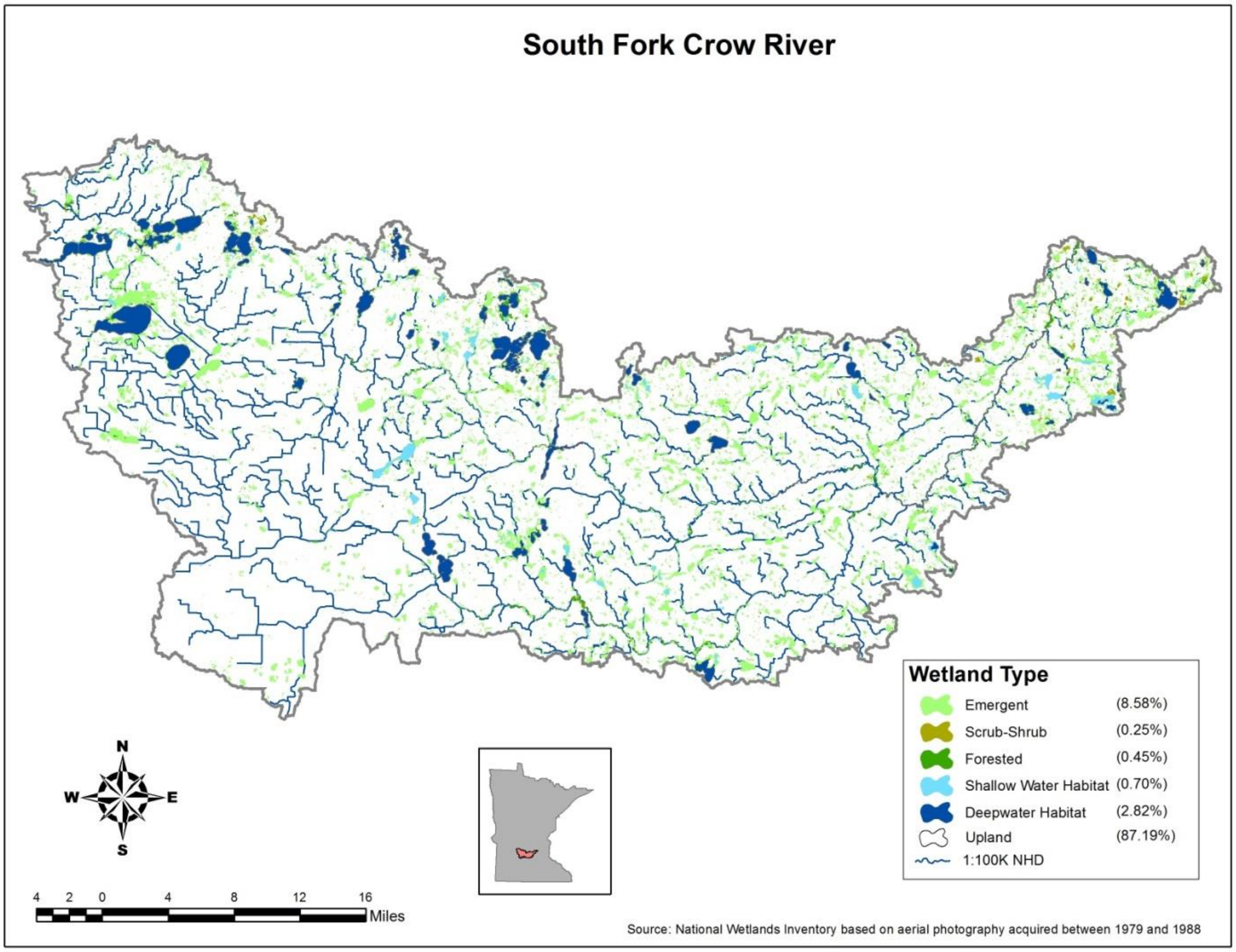

Figure 16. Wetland types and their distribution across the South Fork Crow River Watershed.

Soil data can be used to estimate the extent of historic or pre-settlement wetlands and serve as a baseline for comparing current wetland acreage. The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database, based on a summation of map units classified as "poorly drained" or "very poorly drained", provides an estimate of approximately 456,000 acres of wetlands (~56% of watershed area) occurring in the South Fork Crow River Watershed prior to European settlement (Soil Survey Staff, NRCS 2013). The current wetland area estimate for the watershed, based on 1980s National Wetlands Inventory data, is about 82,000 acres. A comparison of these two time periods (i.e., pre-settlement vs. early 1980s) yields an estimate of 82% wetland loss for the watershed. Wetland loss is not uniformly distributed with the greatest rates of loss occurring in the headwaters and middle portions of the watershed (Figure 17).

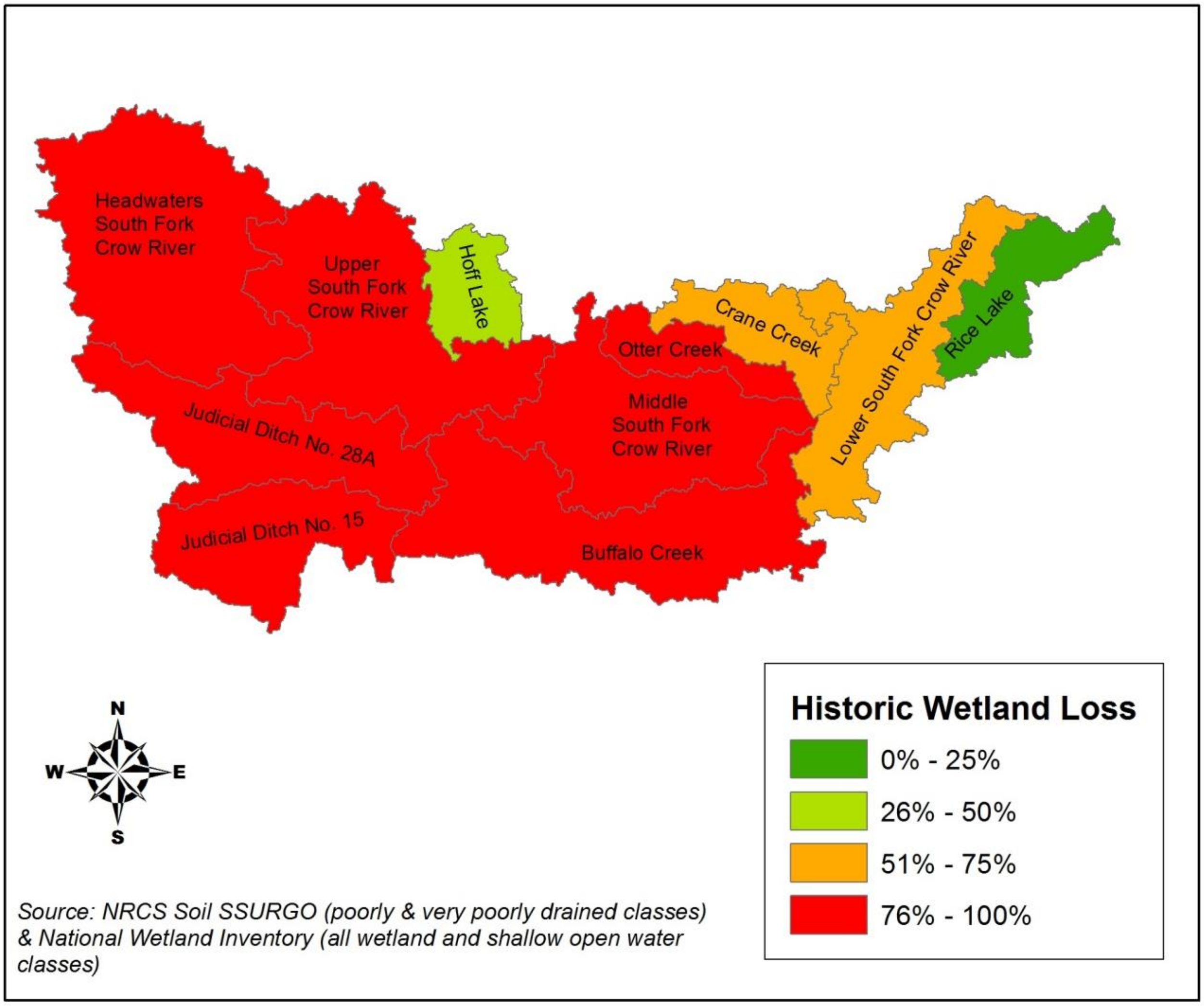

Figure 17. Estimated historic wetland loss in each subwatershed based on a comparison of "poorly drained" and "very poorly drained" soil types (SSURGO database) to wetland extent in the early 1980s (NWI).

Watershed-wide data collection methodology

Load monitoring

Intensive water quality sampling occurs throughout the year at all WPLMN sites. Between 27 and 46 mid-stream grab samples were collected per year at the South Fork Crow River on Bridge Avenue in Delano, Minnesota (DNR/MPCA ID: 19001001; EQuIS ID: S001-255). 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 18). 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 discharge data are coupled in the "FLUX32", pollutant load model, originally developed by Dr. Bill Walker and recently upgraded by the U.S. Army Corp of Engineers and the MPCA. FLUX32 allows the user to create seasonal or discharge constrained concentration/flow regression equations to estimate pollutant concentrations and loads on days when samples were not collected. Primary outputs include annual and daily pollutant loads and flow weighted mean concentrations (pollutant load/total flow volume). Loads and flow weighted mean concentrations are calculated for TSS, total phosphorus (TP), dissolved orthophosphate (DOP), and nitrate plus nitrite nitrogen ($NO_3 + NO_2$-N).

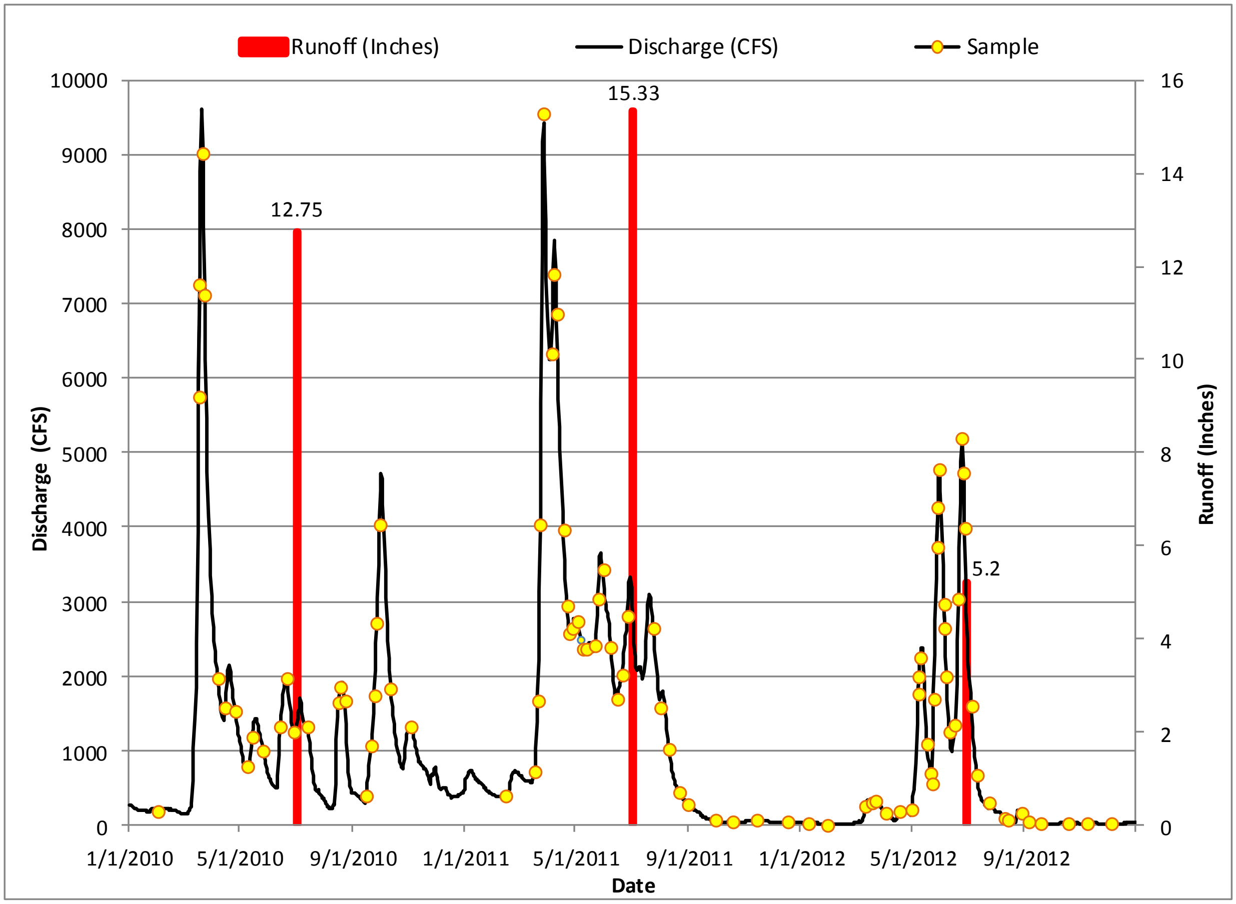

Figure 18. Hydrograph and annual runoff for the South Fork Crow River at Delano from 2010-2012.

Stream water sampling

Twelve water chemistry stations were sampled from May through September in 2012, and again June through August/September of 2013, to provide sufficient water chemistry data to assess the Aquatic Life and Recreation Use Standards. Following the IWM design, water chemistry stations were placed at the outlet of each subwatershed that was >40 square miles in area (Figure 3). A Surface Water Assessment Grant (SWAG) was awarded to the Crow River Organization of Waters (CROW) to assist the MPCA with collecting water chemistry samples at locations throughout the South Fork Crow Watershed. (See Appendix 2 for locations of stream water chemistry monitoring sites. See Appendix 1 for definitions of stream chemistry analytes monitored in this study). One of the chemistry stations was placed too close to a lake outlet and was not assessed due to the lake influence that occurred throughout sampling.

Stream flow methodology

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

Stream biological sampling

The biological monitoring component of the intensive watershed monitoring in the South Fork Crow River Watershed was completed during the summer of 2012. A total of 72 sites were newly established across the watershed and sampled. These sites were located near the outlets of most minor HUC-14 watersheds. In addition, 19 existing biological monitoring stations within the watershed were revisited in 2012. These monitoring stations were initially established as part of a random Upper Mississippi River Basin wide survey in 1999 and 2000, or as part of a 2007 survey which investigated the quality of channelized streams with intact riparian zones. While data from the last 10 years contributed to the watershed assessments, the majority of data utilized for the 2014 assessment was collected in 2012. A total of 57 AUIDs were sampled for biology in the South Fork Crow River Watershed. Waterbody assessments to determine aquatic life use support were conducted for 49 AUIDs. Biological information that was not used in the assessment process will be crucial to the stressor identification process and will also be used as a basis for long term trend results in subsequent reporting cycles.

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

Fish contaminants

Mercury was analyzed in fish tissue samples collected from the South Fork Crow River and 26 lakes. Polychlorinated biphenyls (PCBs) were measured in fish from the river and 14 lakes. MPCA biomonitoring staff collected the fish from the South Fork Crow River in 2012. Minnesota DNR fisheries staff collected all other fish.

In addition, fish from seven lakes were tested for perfluorochemicals (PFCs) between 2007 and 2010. PFCs became a contaminant of emerging concern in 2004 when high concentrations were measured in fish from the Mississippi River. Extensive statewide monitoring of lakes and rivers for PFCs in fish was continued through 2010. After 2010, more focused monitoring for PFCs continued in known contaminated waters, such as the Mississippi River, several lakes in the Twin Cities Metropolitan Area, and some reservoirs in the Duluth area.

Captured fish were wrapped in aluminum foil and kept 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. For PFCs, whole fish were shipped to AXYS Analytical Services Ltd in Sidney, British Columbia, Canada. AXYS did the fish measurements and processing before analyzing the tissue samples for 13 PFCs. The PFC that primarily bioaccumulates in fish and is a known health concern for human consumption is perfluorooctane sulfonate (PFOS).

The Impaired Waters List is submitted every even year to the U.S. EPA for the agencies approval. MPCA has included waters impaired for contaminants in fish on the Impaired Waters List since 1998. Impairment assessment for PCBs and PFOS in fish tissue is based on the fish consumption advisories prepared by the MDH. If the consumption advice is to restrict consumption of a particular fish species to less than a meal per week because of PCBs or PFOS, the MPCA considers the lake or river impaired. The threshold concentration for impairment (consumption advice of one meal per month) is an average fillet concentration of 0.22 mg/kg for PCBs and 0.200 mg/kg (200 ppb) for PFOS.

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 for mercury in fish tissue. Since 2006, a waterbody has been classified as impaired for mercury in fish tissue if ten percent of the fish samples (measured as the 90th percentile) exceed 0.2 mg/kg of mercury, which is one of Minnesota's water quality standards for mercury. At least five fish samples per species are required to make this assessment and only the last 10 years of data are used for statistical analysis. MPCA's Impaired Waters 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

Sampling methods are similar among monitoring groups and are described in the document entitled "MPCA Standard Operating Procedure for Lake Water Quality" found at http://www.pca.state.mn.us/publications/wq-s1-16.pdf. The lake water quality assessment standard requires eight observations/samples within a 10-year period for phosphorus, chlorophyll-a and Secchi depth. A Surface Water Assessment Grant (SWAG) was awarded to the CROW to collect chemistry data on four lakes (Barber, Goose, Johnson and South). The MPCA collected chemistry data from 11 lakes. Both were done over a two-year period.

Remote sensing

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

Groundwater monitoring

Groundwater quality

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

Groundwater quantity

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

There are no DNR Observation Wells in the South Fork Crow River Watershed at this time.

Groundwater/Surface water withdrawals

The Department of Natural Resources 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 DNR yearly. Information on the program and the program database are found at: http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html.

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 DNR 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.

Wetland monitoring

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

Individual subwatershed results

Aggregated HUC-12 subwatersheds

Assessment results for aquatic life and recreation use are presented for each subwatershed within the South Fork Crow River. The primary objective is to portray all the full support and impairment listings within a subwatershed resulting from the complex and multi-step assessment and listing process. (A summary table of assessment results for the entire 8-HUC watershed including aquatic consumption, and drinking water assessments [where applicable] is included in Appendix 3). This scale provides a robust assessment of water quality condition at a practical size for the development, management, and implementation of effective TMDLs and protection strategies. The graphics presented for each of the 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 ten years.

The proceeding pages provide an account of each 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 subwatershed 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.

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); determinations made during the desktop phase of the assessment process (see Figure 5). Assessment of aquatic life is derived from the analysis of biological (fish and invert IBIs), dissolved oxygen, turbidity, chloride, pH and un-ionized ammonia (NH3) data, while the assessment of aquatic recreation in streams is based solely on bacteria (*Escherichia coli* or fecal coliform) data. Included in each table is the specific aquatic life use classification for each stream reach: cold water community (2A); cool or warm water community (2B); or indigenous aquatic community (2C). 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 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 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 subwatershed.

Stream stability results

Stream channel stability information evaluated during each invert sampling visit is provided in each 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 subwatershed.

Subwatershed outlet water chemistry results

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

Lake assessments

A summary of lake water quality is provided in the aggregated HUC-12 subwatershed sections where available data exists. For lakes with sufficient data, basic modeling was completed. Assessment results for all lakes in the watershed are available in Appendix 3.2. Lake models and corresponding morphometric inputs can be found in Appendix 5.

Headwaters South Fork Crow River Subwatershed

The Headwaters South Fork Crow Subwatershed contains the upstream-most reaches of the South Fork Crow River. It occupies the southeast quarter of Kandiyohi County and is comprised of the South Fork of the Crow River and its tributaries which flow in a southeasterly direction from the Willmar area to the confluence with Judicial Ditch Number 29. At 217 square miles, it is the largest of the subwatersheds in the South Fork Crow River and contains five large lakes: Lillian, Big Kandiyohi, Elizabeth, Wakanda and Minnetaga.

Table 1. Aquatic life and recreation assessments on stream reaches: Headwaters South Fork Crow Subwatershed.

				Aquatic Life Indicators:									
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-541, County Ditch 23A, T119 R35W S23, west line to Wagonga Lk	12UM012	5.88	LRVW	NA	NA	NA				NA			
07010205-592, Unnamed ditch, Headwaters to S Fk Crow R	10EM147	1.75	WWm	NA	NA	NA	NA	NA		NA		IF	
07010205-607, Big Kandiyohi Channel, Wagonga Lk to Unnamed lk (34-0440-00)	12UM004	3.80	WWm	MTS	MTS	NA	NA			NA		SUP	
07010205-608, State Ditch Branch 2, Unnamed ditch to Unnamed ditch	12UM005	4.58	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-610, County Ditch 24A, Unnamed ditch to Unnamed ditch	12UM013	3.56	WWm	EXS		NA	NA			NA		IMP	
07010205-612, Unnamed ditch, CD 51 to S Fk Crow R	12UM019	1.26	WWm	MTS	MTS	NA	NA			NA		SUP	
07010205-650, Unnamed ditch, Unnamed cr to -94.939 45.1036	12UM062	2.96	LRVW	NA	NA	NA				NA		NA	

07010205-658, Crow River, South Fork, Headwaters to 145th St	00UM048** 00UM053, 12UM018, 12UM042, 12UM058**	25.35	WWm	EXS	MTS	IF	EXS	EXS	MTS	MTS	MTS	IMP	IMP
07010205-557, Unnamed ditch, Unnamed lk (34-0440-00) to Big Kandiyohi Lk		0.39	WWg					MTS				IF	
07010205-556, County Ditch 24A, Unnamed ditch to S Fk Crow R		3	WWg					MTS				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.

** These sites are in the Upper South Fork Crow Subwatershed, but are presented here with the rest of the sites on this AUID (-658), which crosses the subwatershed boundary between the Headwaters SFC, and the Upper SFC.

Table 2. Minnesota Stream Habitat Assessment (MSHA): Headwaters South Fork Crow 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	10EM147	Unnamed ditch	0	12	3	0	1	16	poor
1	12UM062	Trib. to Crow River, South Fork	0	6	8	5	13	32	poor
1	12UM005	Unnamed ditch/State Ditch Branch 2	0	7.5	6	5	10	28.5	poor
1	12UM019	Trib. to Crow River, South Fork	0	11	4	9	7	31	poor
1	12UM013	County Ditch 24A	0	7	7	5	10	29	poor
1	12UM012	County Ditch 23A	0	7.5	8	7	6	28.5	poor
1	12UM042	Crow River, South Fork	0	7	7	4	7	25	poor
1	12UM004	Big Kandiyohi Channel	0	5.5	6	6	7	24.5	poor
1	12UM018	Crow River, South Fork	0	8	3	4	10	25	poor
1	00UM048	Crow River, South Fork	0	8	8	3	7	26	poor
Average Habitat Results: *Headwaters South Fork Crow River Subwatershed*			**0**	**8**	**6**	**4.8**	**7.8**	**26.6**	**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 3. Channel Condition and Stability Assessment (CCSI): Headwaters South Fork Crow 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	10EM147	Unnamed ditch	24	7	11	3	45	fairly stable
1	12UM062	Trib. to Crow River, South Fork	31	21	22	3	77	moderately unstable
1	12UM005	Unnamed ditch/State Ditch Branch 2	31	15	17	3	66	moderately unstable
1	12UM019	Trib. to Crow River, South Fork	31	13	19	5	68	moderately unstable
1	12UM013	County Ditch 24A	31	15	17	5	68	moderately unstable
1	12UM012	County Ditch 23A	33	15	19	5	72	moderately unstable
1	12UM042	Crow River, South Fork	31	15	19	5	70	moderately unstable
1	12UM004	Big Kandiyohi Channel	33	19	19	3	74	moderately unstable
1	12UM018	Crow River, South Fork	--	--	--	--	--	--
1	00UM048	Crow River, South Fork	33	15	22	3	73	moderately unstable
Average Stream Stability Results:		***Headwaters South Fork Crow River Subwatershed***	**30.9**	**15**	**18.3**	**3.8**	**68.1**	**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 4. Outlet water chemistry results: Headwaters South Fork Crow River Subwatershed.

Station location:	South Fork Crow River on MN-7, .5 mi E of Cosmos						
STORET/EQuIS ID:	S002-015						
Station #:	00UM053						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	40	1.9	11	5.8		
Chloride	mg/L	8	16.4	26.3	22.3	230	
Dissolved Oxygen (DO)	mg/L	19	4.27	14.64	8.56	5	2
pH		19	7.39	8.89	8.36	6.5 - 9	
Secchi Tube	100 cm	17	11	>100	30	10	
Total suspended solids	mg/L	8	18	115	57	65	2
Escherichia coli (geometric mean)	MPN/100ml	15	317.5	437.8		126	3
Escherichia coli	MPN/100ml	15	62	2613	528	1260	1
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	5.21	1.15		
Kjeldahl nitrogen	mg/L	6	1.82	2.99	2.39		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	146	436	252		
Specific Conductance	uS/cm	19	487	794	664		
Temperature, water	deg °C	19	16.03	28.29	23.24		
Sulfate	mg/L	8	76	121	95		
Hardness	mg/L	8	195	338	294		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Headwaters South Fork Crow River Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Table 5. Lake assessments: Headwaters South Fork Crow Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Johnson	34-0012-00	101	H					210	66	0.4	NS	NA
Mud	34-0021-00	67	H					131		0.5	IF	NA
Elizabeth (Main Lake)	34-0022-02	1018	H	100	2.7	1.2		89	23	0.6	IF	IF
Carrie	34-0032-00	88	M	23	7.9	3.0	I	18	6	1.4	FS	IF
Ella	34-0033-00	149	H	100	3.7	1.3		74	37	0.6	IF	IF
Lillian	34-0072-00	1071	H	100	2.4	0.7		87	49	1.3	NS	IF
Minnetaga	34-0076-00	771	H	97	2.7	*1.1		264	32	0.4	NS	IF
Big Kandiyohi	34-0086-00	2591	E	54	5.5	3.7	NT	147	20	1.1	NS	IF
Little Kandiyohi	34-0096-00	669	H					303	152	0.3	NS	IF
Eleanor	34-0097-00	167	H		1.4			152		0.3	IF	NA
Kasota	34-0105-00	434	H					384	168	0.2	NS	NA
Wakanda (Main Basin)	34-0169-03	1555	H	95	4.6	2.1	NT	190	121	0.4	NS	IF
Thompson	47-0159-00	222	H	100	2.4	*1.1		111	36	1.1	NS	IF

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

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

* Mean depth was derived from aerial and topographic maps

Biological monitoring

Biological monitoring in the Headwaters South Fork Crow occurred in stream reaches that are proposed to be designated as modified aquatic life use. Only 3% of stream reaches remain in a natural, non-channelized state in this subwatershed. Despite water levels being abnormally low in August of 2012, all sampled reaches of the South Fork Crow mainstem (-658) in this subwatershed met the modified macroinvertebrate IBI criteria. One sampling station on the mainstem could not be sampled due to extremely low water with virtually no productive habitat to sample. In 2006, the South Fork Crow River from the headwaters to the Hutchinson Dam was listed as impaired for macroinvertebrates under the now retired 07010205-540 assessment unit. However, due to the proposed modified use designation and the associated change in criteria, this stretch of the river is now meeting aquatic life goals appropriate for channelized streams. A correction to the 303d Impaired Waters list to remove the 2006 macroinvertebrate impairment is being pursued. In contrast to macroinvertebrate data from this assessment unit (-658), fish sample stations were characterized by IBI scores that fell well below the modified use threshold, with only one station scoring within the lower confidence interval; this reach of stream is not meeting aquatic life goals for fish in a channelized system.

Fish and macroinvertebrate communities in State Ditch Branch 2 (-608) scored within the confidence interval of the impairment threshold, but were not considered to be supporting aquatic life for either group. This site scored poorly on the Minnesota Stream Habitat Assessment (MSHA) with deeply silted substrate and exhibited signs of severe nutrient enrichment at both visits. The aquatic macroinvertebrate community at the monitoring station (12UM005) was largely comprised of taxa commonly found in wetlands - highly mobile, air-breathers, or those that have other adaptations for surviving periods of low dissolved oxygen. State Ditch Branch 2 is the only other water course in this subwatershed that was deemed impaired for aquatic macroinvertebrates.

County ditch 24A (-610) scored within the lower confidence interval of the modified use threshold. However, due to a fish assemblage dominated by tolerant species, poor habitat ratings, and dense algal growth, this reach is not considered to be meeting aquatic life standards for a stream in this class.

Wetlands monitoring

In this subwatershed the MPCA has established a long term wetland monitoring site within the 255 acre U.S. Fish and Wildlife Service Lake Charlotte Waterfowl Production Area (WPA). A 23 acre depressional wetland basin occurs in this WPA and has been monitored by the MPCA since 2002 approximately every two years. Well-buffered on the southern and southeastern shores with native vegetation, this wetland is in relatively good biological condition. The wetland macroinvertebrate IBI score has consistently been in the 60-70 range and likely reflects the relatively low pollutant concentrations in this wetland. In June, when the majority of water chemistry sampling has occurred, chloride concentrations have been below 4 mg/L, total Kjeldahl nitrogen has been below 2.5 mg/L, nitrate + nitrite concentrations have been below the analysis detection limit of 0.05 mg/L, and total phosphorus has typically been below 50 µg/L. However, the wetland plant community is not in as good of health as the macroinvertebrates with IBI scores ranging from 23 to 51, indicative of poor wetland quality. As is the case for many wetlands across Minnesota, the wetland plant community in Lake Charlotte WPA is likely suffering from impacts that occurred many years ago, a phenomenon referred to as legacy impacts. Reviews of historical aerial imagery revealed that portions of this wetland basin had been used for hay production and possibly pasture during dry years of the early to mid-part of the last century. Such impacts could’ve easily allowed invasive species to establish and flourish in this wetland. The non-native, invasive narrowleaf cattail (*Typha angustifolia*) is well established in this wetland and its dominance of the emergent plant community is likely contributing to the low plant IBI scores observed here.

Water quality monitoring

The Headwaters South Fork Crow subwatershed is split into 23 AUIDs one of which contains enough chemistry data for assessment. The South Fork Crow River flows 25 miles into the Upper South Fork Crow River subwatershed crossing through one lake (Dog Lake, 34-0003-00). Dissolved oxygen is a possible stressor for fish and invertebrates in the South Fork Crow River. Phosphorus concentrations are elevated in this watershed; paired with the large range in oxygen concentrations, this may be indicative of an eutrophication stress to aquatic life. Aquatic recreation was determined to be impaired based on the multiple exceedances of bacteria. The downstream AUID is also impaired due to bacteria. A previous turbidity impairment on the South Fork Crow River is confirmed by the recent TSS and Secchi tube data.

Thirteen of the thirty-nine lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 5). The majority of the lakes in the Headwaters South Fork Crow River subwatershed are shallow. Elizabeth Lake is located south of the town of Atwater and the values observed are right at the Western Corn Belt Plains standards. Because the lake is shallow and turbid, the chlorophyll-*a* results are lower than expected given the elevated phosphorus values. The turbid conditions would also cause the Secchi to represent a low value. Elizabeth will require further sampling for an assessment to be made. Ella Lake is located just north of Elizabeth Lake and is very productive with lower than expected phosphorus values. Because phosphorus is the limiting factor for Ella Lake another year of sampling is needed to determine the aquatic recreation decision. Lillian Lake is located in the town of Lake Lillian, Minnesota and it has reoccurring *Aphanizomenon* blooms. These colonial blooms allow considerable light through the water column resulting in higher than expected transparency measurements. The phosphorus values are below the standard but some of the data is low bias due to a lab analysis problem. If the low bias values are removed, then Lillian Lake does exceed the standard for aquatic recreation. Carrie Lake is a highlight of Headwaters South Fork Crow River subwatershed, located next to Elizabeth and Ella. Carrie Lake is part of the Sustaining Lakes in a Changing Environment (SLICE) Program; a long-term, collaborative monitoring effort that is being led by DNR. The program is designed to understand and predict the consequences of land use and climate change on lake habitats. The MPCA and DNR completed an extensive report in July 2012 on Carrie Lake which raised a concern that the connection to Elizabeth Lake would allow passage of common carp; high numbers of common carp can deter the establishment of macrophyte beds and cause increases in turbidity. To view the report go to: http://www.pca.state.mn.us/index.php/view-document.html?gid=18631. Carrie Lake's water quality is in good condition, far below the Western Corn Belt Plains impairment standards. The smaller lakeshed, a deeper basin for the area, and the surrounding land use dominated by wetland and forest is a large contributor to the good water quality observed in this lake.

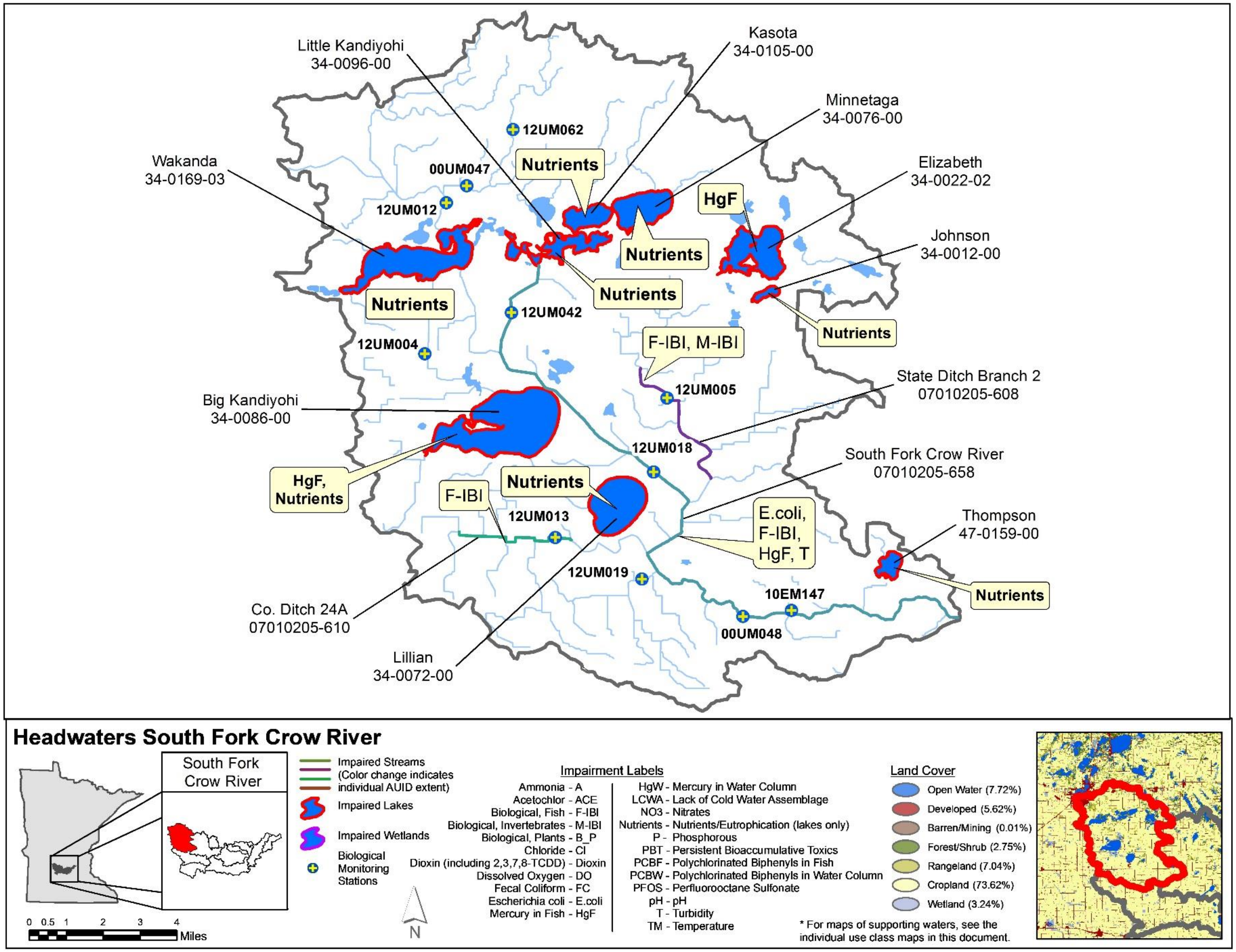

Figure 19. Currently listed impaired waters by parameter and land use characteristics in the Headwaters South Fork Crow Subwatershed.

Judicial Ditch No. 28A Subwatershed

The Judicial Ditch Number 28A subwatershed is comprised of the headwaters of Buffalo Creek and its tributaries, which flow in an easterly direction from the Blomkest area to the confluence with Judicial Ditch 15, northeast of the town of Buffalo Lake. The subwatershed occupies approximately 127 square miles of northeastern Renville County. Lake Preston and Lake Allie are the only sizable lakes within this subwatershed.

Table 6. Aquatic life and recreation assessments on stream reaches: JD 28A Subwatershed.

				Aquatic Life Indicators:									
AUID ***Reach Name*,** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-502, Buffalo Creek, Headwaters to JD 15	01UM003, 01UM004, 07UM103, 12UM006	35.58	WWm	EXS	EXS	IF	MTS	MTS	MTS	MTS	MTS	IMP	IMP
07010205-504, Judicial Ditch 67, Headwaters to Buffalo Cr	01UM005	5.54	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-528, County Ditch 4, Unnamed ditch to Buffalo Cr	00UM050	2.76	WWg	EXP	EXS	NA	NA			NA		IMP	
07010205-625, Judicial Ditch 9, Headwaters to Buffalo Cr	12UM051	7.10	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-630, Unnamed ditch, Headwaters to Buffalo Cr	12UM059	4.02	WWm	EXS	EXP	NA	NA			NA		IMP	
07010205-631, County Ditch 7A, Unnamed cr to Buffalo Cr	12UM067	4.33	WWm	EXP	EXP	NA	NA			NA		IMP	
07010205-568, Unnamed creek, Preston Lk to JD 28A (Buffalo Cr)		0.49	WWg			NA	MTS	MTS	NA	NA	NA	IF	
07010205-566, Unnamed creek, Lk Allie to Preston Lk		0.21	WWg				IF	MTS				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 7. Minnesota Stream Habitat Assessment (MSHA): Judicial Ditch No. 28A Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover	Channel Morph.	MSHA Score (0-100)	MSHA Rating
1	12UM059	Trib. to Buffalo Creek	channelized	0	8	8	1	7	24	poor
1	01UM005	Judicial Ditch 67	channelized	0	6	4	1	7	18	poor
1	12UM051	Judicial Ditch 9	channelized	0	7	3	12	7	29	poor
1	12UM067	County Ditch 7A	channelized	0	7.5	8.8	1	7	24.3	poor
1	01UM003	Buffalo Creek	channelized	0	9	4	5	4	22	poor
2	00UM050	County Ditch 4	channelized	0	7	18.2	7	19.5	51.7	fair
2	01UM004	Buffalo Creek	channelized	0	5.8	14.9	5	11.5	40.1	poor
2	07UM103	Buffalo Creek	channelized	0	9	12	7.5	13.5	42	poor
1	12UM006	Buffalo Creek	channelized	0	4.5	18.1	7	15	44.6	poor
Average Habitat Results: *Judicial Ditch 28A Subwatershed*				**0**	**7.1**	**10.1**	**5.2**	**10.2**	**32.9**	**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 8. Channel Condition and Stability Assessment (CCSI) Judicial Ditch No. 28A 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	12UM059	Trib. to Buffalo Creek	26	11	26	5	68	moderately unstable
1	01UM005	Judicial Ditch 67	28	9	26	7	70	moderately unstable
1	12UM051	Judicial Ditch 9	26	13	16	5	60	moderately unstable
1	12UM067	County Ditch 7A	28	13	24	5	70	moderately unstable
1	01UM003	Buffalo Creek	26	11	16	7	60	moderately unstable
2	00UM050	County Ditch 4	20	15	12	5	52	moderately unstable
2	01UM004	Buffalo Creek	31	11	27	7	76	moderately unstable
2	07UM103	Buffalo Creek	28	11	16	5	60	moderately unstable
1	12UM006	Buffalo Creek	22	15	15	5	57	moderately unstable
Average Stream Stability Results: *Judicial Ditch 28A Subwatershed*			**26.1**	**12.1**	**19.8**	**5.7**	**63.7**	**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 > 11

Table 9. Outlet water chemistry results: Judicial Ditch No. 28A Subwatershed.

Station location:	Buffalo Creek, Headwaters to JD 15						
STORET/EQuIS ID:	S002-017						
Station #:	12UM006						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	11	1.9	8.4	4.9	40	
Chloride	mg/L	11	18.3	33.6	21.6	230	
Dissolved Oxygen (DO)	mg/L	22	3.68	15.54	10.27	5	1
pH		22	7.4	8.54	8.19	6.5 - 9	
Secchi Tube	100 cm	20	7	>100	46	10	2
Total suspended solids	mg/L	11	11	54	27	65	
Escherichia coli (geometric mean)	MPN/100ml	15	29.2	264.7		126	4
Escherichia coli	MPN/100ml	15	28.8	1046.2	252.64	1260	0
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	11	<0.03	13.9	3.9		
Kjeldahl nitrogen	mg/L	9	0.84	3.4	1.3		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	11	43	356	109		
Specific Conductance	uS/cm	22	430	963	825		
Temperature, water	deg °C	22	15.5	29.1	22.8		
Sulfate	mg/L	11	32.8	190	148		
Hardness	mg/L	11	253	1025	448		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Judicial Ditch No. 28A Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Table 10. Lake assessments: Judicial Ditch No. 28A Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Preston	65-0002-00	659	H	100	3.0	1.8	NT	123	43	0.7	NS	IF
Allie	65-0006-00	504	H	100	3.7	2.3	NT	252	12	0.9	IF	IF

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

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

* Mean depth was derived from aerial and topographic maps

Biological monitoring

The headwaters of Buffalo Creek (-502) runs the length of this subwatershed and it is fed by several ditches that flow into it along the way. A total of nine biological stations were monitored in this subwatershed: four stations along the mainstem the headwaters of Buffalo Creek, and one station each on five tributary assessment reaches.

The headwaters of Buffalo Creek (-502) has been on the 303d Impaired Waters List since 2006 based on an assessment of aquatic macroinvertebrate and fish data that were collected in 2000 and 2001. These original biological assessments were made under general use criteria. This section of stream is being proposed to be designated as a modified aquatic life use water based on habitat limitations imposed by stream channelization. IWM provided an opportunity to re-evaluate this section of the creek considering its newly proposed designation. The 2012 data set indicated that the condition of the macroinvertebrate and fish communities has remained largely unchanged and that the previous impairment determination still stands despite the change to a modified aquatic life use which has lower impairment thresholds. A longitudinal examination of the five stations monitored in 2012 revealed a pattern of increasing macroinvertebrate IBI scores heading downstream; the lowest stations on this assessment unit (07UM103 and 12UM006) meet modified use criteria. This pattern was not observed with the fish data in that the only two samples to pass the modified use impairment threshold were at one of the upstream stations (01UM003). Of the remaining four visits across three monitoring stations, all of them were below the impairment threshold, two of which fell within the lower confidence interval. These data from intensive watershed monitoring confirm the fish impairments established in 2001-2002.

Biological monitoring on four ditches that flow into Buffalo Creek found fish and macroinverebrate communities that scored below impairment thresholds for modified use waters. Habitat scores were poor (<25) at all of these stations. County Ditch 4 (-528), the only assessment unit evaluated under general use criteria, had habitat characteristics that suggested the potential to meet these thresholds. In 2012 the MSHA score for this reach was approximately 50 due to a variety of beneficial habitat attributes: varied coarse substrates, light embeddedness of coarse substrates, light bank erosion, and a variety of depths. However, the fish and macroinvertebrate IBI scores fell below the general use impairment threshold, suggesting that altered water quality (as opposed to habitat quality) may be acting as the primary stressor at this site. Despite sampling riffle habitat with adequate flow in this reach, only a few tolerant mayflies and caddisflies were collected of the various EPT (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly]) taxa that would be expected to dwell in this area of the stream.

Water quality monitoring

Judicial Ditch No. 28A is split into eleven AUIDs one of which contains enough chemistry data for assessment. Buffalo Creek stretches 35 miles from the headwaters of the watershed (five miles south of Big Kandiyohi Lake) through the Buffalo Creek subwatershed. It passes through a historical lake bed named Fox Lake. Buffalo Creek was determined to be not supporting for aquatic recreation (i.e. bacteria) which confirms the 2008 impaired waters listing for fecal coliform. July shows multiple samples that exceed the labs ability to determine a result (>2400 MPN/100ml) and June through September all show high levels of bacteria. Aquatic life could be impacted by the high dissolved oxygen flux and nutrient issues that are occurring in the Buffalo Creek.

Two of the four lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 10). Preston and Allie are both shallow and 100% littoral. Preston is considered not supporting for aquatic recreation due to excess nutrients. Preston Lake does have an outlet located on the southwest side of the lake which drains into Buffalo Creek. Allie Lake is north of Preston Lake and through a low area it drains into Preston Lake. Allie Lake is very nutrient rich and through photo evidence it shows yearly production of an *Aphanizomenon* bloom (blooms of this sort are characterized by an abundance of small pieces of green matter that resemble grass clippings suspended in the water column). There are sediment issues in the lake with moderate to severe shoreline erosion. In the summer of 2014, the inlet and public access were cleared of sediment due to build up over time. The water chemistry shows high levels of phosphorus. Secchi depth is just above the standard and is responding to the high nutrient levels. Chlorophyll-*a* should be showing a response to the high levels of phosphorus but that is not the case. A water quality report from Allie Lake in 2005 shows very similar results. That report states that there is no definite reason for the low levels of chlorophyll-*a* but a possible explanation could include the excessive growth of macrophytes. This may serve to inhibit the algal growth or increase zooplankton populations that feed on the algae.

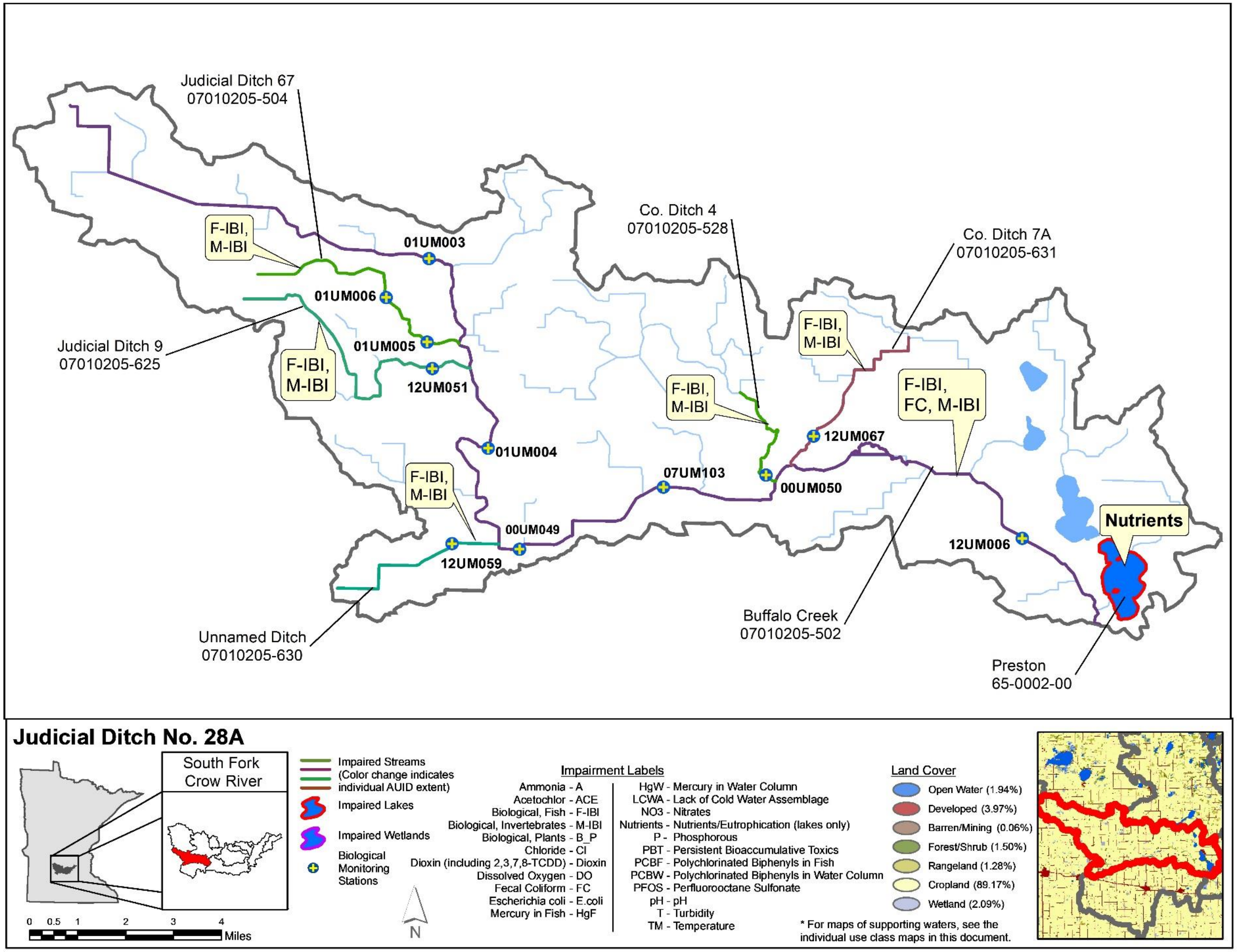

Figure 20. Currently listed impaired waters by parameter and land use characteristics in the Judicial Ditch No. 28A Subwatershed.

Judicial Ditch No. 15 Subwatershed

The Judicial Ditch No. 15 Subwatershed occupies approximately 100 square miles of east-central Renville County. The ditch and its tributaries flow in an easterly direction from the Bird Island area, through the towns of Hector and Buffalo Lake to its confluence with Buffalo Creek approximately four miles northwest of the town of Stewart. There are no sizable lakes in this subwatershed.

Table 11. Aquatic life and recreation assessments on stream reaches: JD 15 Subwatershed.

AUID ***Reach Name,*** *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-509, Judicial Ditch 15, Headwaters to T115 R32W S31, east line	12UM060	9.16	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-513, Judicial Ditch 15, T115 R32W S32, west line to Buffalo Cr	00UM051, 12UM052, 12UM055	11.27	LRVW	NA	NA	IF				MTS	MTS	NA	IMP
07010205-626, Judicial Ditch 15 branch, Headwaters to JD 15 main stem	12UM053	3.63	WWm	EXS		NA	NA			NA		IMP	
07010205-627, Judicial Ditch 15 branch, Headwaters to JD 15 main stem	12UM054	4.05	WWm	EXS		NA	NA			NA		IMP	
07010205-628, Judicial DItch 15 branch, Headwaters to JD 15 main stem	12UM056	8.88	WWm	EXS	EXS	NA	NA			NA		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 12. Minnesota Stream Habitat Assessment (MSHA): Judicial Ditch No. 15 Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	Land Use (0-5)	Riparian (0-15)	Substrate (0-27)	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
1	12UM053	Trib. to Judicial Ditch 15	channelized	0	6	6	0	7	19	poor
2	12UM054	Trib. to Judicial Ditch 15	channelized	0	6	3	4	5.5	18.5	poor
1	12UM056	Trib. to Judicial Ditch 15	channelized	0	7	4	5	7	23	poor
1	12UM060	Judicial Ditch 15	channelized	0	5	4	1	7	17	poor
1	12UM055	Judicial Ditch 15	channelized	0	7	9	9	10	35	poor
1	12UM052	Judicial Ditch 15	channelized	0	7	18	7	11	43	poor
1	00UM051	Judicial Ditch 15	channelized	0	7	18.1	5	11	41.1	poor
Average Habitat Results: *Judicial Ditch 15 Subwatershed*				**0**	**6.6**	**10.6**	**5.4**	**9.2**	**31.8**	**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 13. Channel Condition and Stability Assessment (CCSI): Judicial Ditch 15 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	12UM053	Trib. to Judicial Ditch 15	--	--	--	--	--	--
2	12UM054	Trib. to Judicial Ditch 15	29	9	28	5	71	moderately unstable
1	12UM056	Trib. to Judicial Ditch 15	26	11	16	5	58	moderately unstable
1	12UM060	Judicial Ditch 15	26	11	32	5	74	moderately unstable
1	12UM055	Judicial Ditch 15	26	11	28	5	70	moderately unstable
1	12UM052	Judicial Ditch 15	28	11	15	5	59	moderately unstable
1	00UM051	Judicial Ditch 15	28	13	13	5	59	moderately unstable
Average Stream Stability Results: *Judicial Ditch 15 Subwatershed*			**27.2**	**11**	**22**	**5**	**65.1**	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 14. Outlet water chemistry results: Judicial Ditch No. 15 Subwatershed.

Station location:	Judicial Ditch 15, 2 mi W of CSAH-20, 3.5 mi NE of Buffalo Lake						
STORET/EQuIS ID:	S002-016						
Station #:	00UM051						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Un-ionized Ammonia	ug/L	10	1.7	20	6	40	
Chloride	mg/L	8	22.1	73.7	38.8	230	
Dissolved Oxygen (DO)	mg/L	19	0.8	18.03	9.3	5	4
pH		19	7.43	8.71	8.16	6.5 - 9	
Secchi Tube	100 cm	17	6	>100	47	10	1
Total suspended solids	mg/L	8	11	40	22	65	
***Escherichia coli* (geometric mean)**	MPN/100ml	15	122.3	633.9		126	1
Escherichia coli	MPN/100ml	15	33.1	>2419.6	579.6	1260	2
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	18.5	6		
Kjeldahl nitrogen	mg/L	6	1.08	1.84	1.32		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	73	931	312		
Specific Conductance	uS/cm	19	525	1875	141		
Temperature, water	deg °C	19	14.87	28.57	22.73		
Sulfate	mg/L	8	82	170	141		
Hardness	mg/L	8	255	557	373		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Judicial Ditch No. 15 Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Biological monitoring

This subwatershed consists of Judicial Ditch 15 and several channelized streams that flow into it; there are no natural reaches of stream in this entire watershed. A large section of Judicial Ditch No. 15 is designated as a Class 7 limited resource value water (LRVW), which are not assessed for aquatic life.

Macroinvertebrates and fishes were monitored and assessed at a location on Judicial Ditch 15 (-509) upstream of the LRVW designated reach, and on a tributary to Judicial Ditch No. 15 (-628). Both channelized streams failed to support aquatic life of fish and macroinvertebrates and exhibited evidence of excess nutrients (i.e., extensive, choking algal and macrophyte growth), and a poor habitat assessment score (17). The macroinvertebrate samples collected at these sites were dominated by tolerant taxa and scrapers (i.e., organisms that feed by scraping algae and bacteria from various surfaces). The fish samples consisted of relatively few individuals of species that are very tolerant to degraded water quality

Fishes were monitored on two additional tributaries (-626,-627) that were not sampled for macroinvertebrates due to low flows late in the sample season. Fish samples on these reaches fell at or below the impairment threshold for modified use. Fish communities at these sites were simple, consisting of less than 10 species of relatively tolerant forms. Habitat scores were poor and excessive nutrient enrichment was evident from choking algal growth and dissolved oxygen ranging widely from 0.8 to 18.0 mg/l.

Water quality monitoring

Judicial Ditch No. 15 is split into six AUIDs one of which contains enough chemistry data for assessment. Judicial Ditch 15 was determined to not support aquatic recreation (i.e. bacteria) which supports the previous listing from 2010. Phosphorus concentrations were high along this reach and dissolved oxygen had a large range, with several samples that exceeded the standard. Oxygen levels may be stressing aquatic life, and the range in values noted may be indicative of an eutrophication problem.

There are no lakes in the Judicial Ditch No. 15 subwatershed.

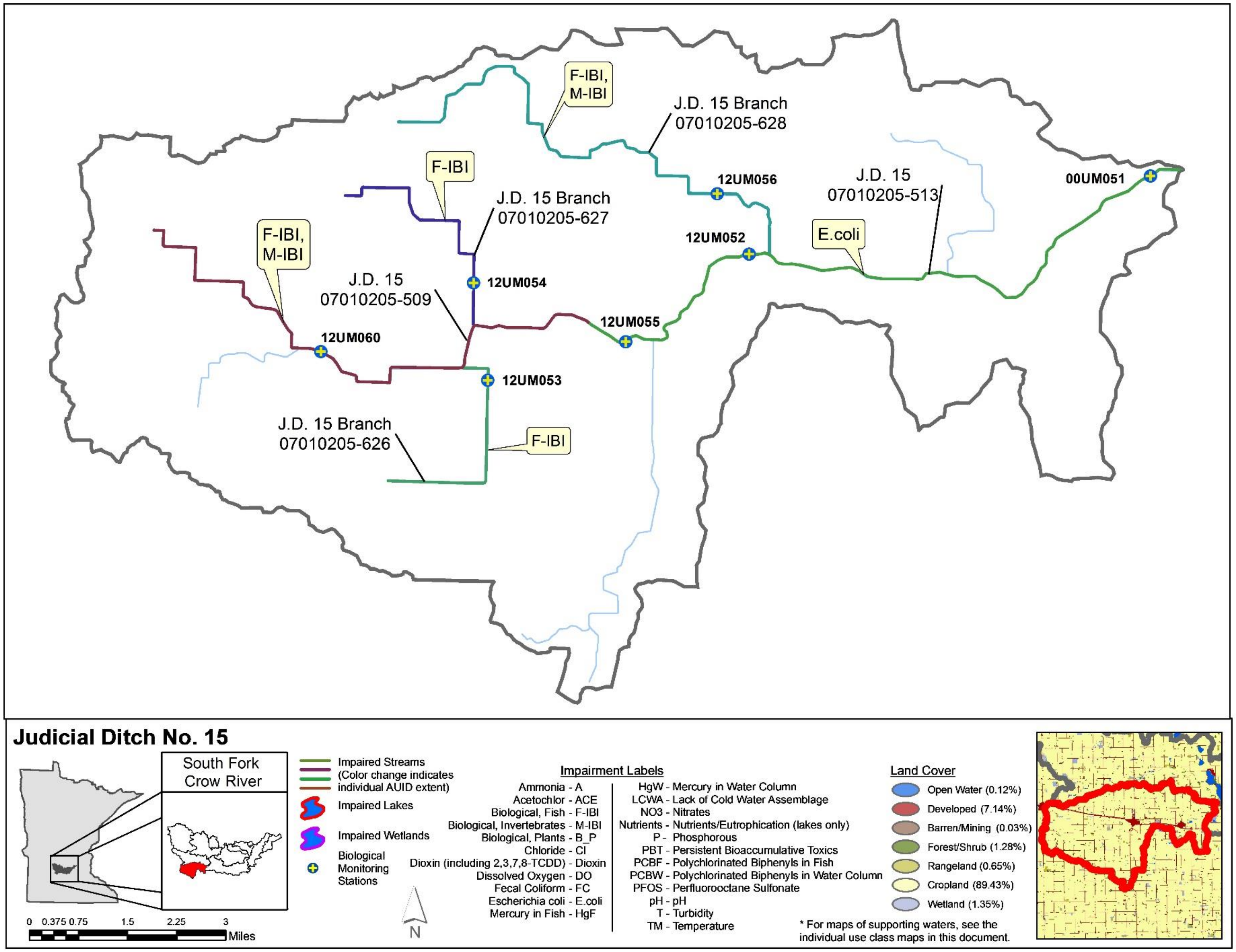

Figure 21. Currently listed impaired waters by parameter and land use characteristics in the Judicial Ditch No. 15 Subwatershed.

Upper South Fork Crow River Subwatershed

The Upper South Fork Crow River subwatershed occupies 188 square miles along the shared borders of Meeker, Renville and McCloud Counties. The South Fork Crow River enters the subwatershed just south of the town of Cosmos and flows in a southeasterly direction to the dam in Hutchinson, picking up several tributaries along the way: King Creek, Belle Creek, and numerous county ditches. The Upper South Fork Crow River subwatershed contains three sizable lakes: Otter, King and Boon.

Table 15. Aquatic life and recreation assessments on stream reaches: Upper South Fork Crow River Subwatershed.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators: Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-506, Judicial Ditch 29, Headwaters to S Fk Crow R	00UM054	4.60	WWm	MTS	MTS	NA	NA			NA		SUP	
07010205-533, Unnamed creek, Unnamed cr to Unnamed cr	12UM025	1.86	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-549, Belle Creek, Headwaters to JD 18	12UM003	1.55	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-550, Judicial Ditch 18, Belle Cr to S Fk Crow R	04UM012, 12UM021	2.81	WWm	EXS	MTS	NA	NA			NA		IMP	
07010205-609, County DItch 18, Headwaters to S Fk Crow R	12UM011	5.76	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-613, King Creek, T118 R32W S36, north line to S Fk Crow R	12UM020	3.11	WWm	EXS	MTS	NA	NA			NA		IMP	
07010205-620, Judicial Ditch 1, Unnamed cr to S Fk Crow R	12UM038	2.70	WWm	MTS	MTS	NA	NA			NA		SUP	
07010205-621, Unnamed creek, Unnamed cr to S Fk Crow R	12UM039	1.74	WWm	MTS	EXS	NA	NA			NA		IMP	

07010205-623, Unnamed creek, Unnamed cr to JD 18	12UM044	2.88	WWg	EXS	EXS	NA	NA			NA		IMP	
07010205-659, Crow River, South Fork, 145th St to Hutchinson Dam	12UM045, 99UM070	25.56	WWg	EXS	EXS	IF	EX	MT S	MTS	MTS	MTS	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 16. Minnesota Stream Habitat Assessment (MSHA): Upper South Fork Crow River Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	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	12UM011	County Ditch 18	channelized	0	10	2	1	1	14	poor
1	12UM003	Belle Creek	channelized	0	6	10.1	5	8	29.1	poor
1	12UM044	Trib. to Judicial Ditch 18	channelized	0	7	18	12	15	52	poor
1	00UM054	Judicial Ditch 29	channelized	0	7	4	1	1	13	poor
1	12UM038	Judicial Ditch 1	channelized	0	6	16	3	17	42	poor
1	12UM039	Trib. to Crow River, South Fork	channelized	0	6.5	4	0	1	11.5	poor
1	12UM025	Trib. to Crow River, South Fork	channelized	0	6.5	9	2	1	18.5	poor
1	12UM020	King Creek	channelized	0	6	4	2	1	13	poor
1	12UM021	Judicial Ditch 18	channelized	0	7	13	5	7	32	poor
1	00UM053	Crow River, South Fork	channelized	0	10	17.3	7	15	49.3	fair
1	12UM058	Crow River, South Fork	channelized	0	7	8.4	6	4	25.4	poor
1	12UM045	Crow River, South Fork	natural	2.5	10	16.7	6	18	53.2	fair
2	99UM070	Crow River, South Fork	natural	1.3	9.5	21.5	12.5	21.5	66.2	fair
Average Habitat Results: *Upper South Fork Crow River Subwatershed*				**0.3**	**7.6**	**11.1**	**4.8**	**8.5**	**32.2**	**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 17. Channel Condition and Stability Assessment (CCSI): Upper South Fork Crow 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	12UM011	County Ditch 18	31	17		13	3	64	moderately unstable
1	12UM003	Belle Creek	40	31		28	11	110	severely unstable
1	12UM044	Trib. to Judicial Ditch 18	33	18		16	3	70	moderately unstable
1	00UM054	Judicial Ditch 29	35	19		22	5	81	severely unstable
1	12UM038	Judicial Ditch 1	36	23		24	7	90	severely unstable
1	12UM039	Trib. to Crow River, South Fork	33	17		21	7	78	moderately unstable
1	12UM025	Trib. to Crow River, South Fork	34	17		22	7	80	moderately unstable
1	12UM020	King Creek	31	15		22	5	73	moderately unstable

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)		Substrate (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
1	12UM021	Judicial Ditch 18	33	17		17	5	72	moderately unstable
1	00UM053	Crow River, South Fork	33	17		24	5	79	moderately unstable
1	12UM058	Crow River, South Fork	22	16		21	5	64	moderately unstable
1	12UM045	Crow River, South Fork	20	38		22	7	87	severely unstable
2	99UM070	Crow River, South Fork	25	25		19	5	74	moderately unstable
Average Stream Stability Results: ***Upper South Fork Crow River Subwatershed***			**31.2**	**20.8**		**20.8**	**5.8**	**78.6**	**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 18. Outlet water chemistry results: Upper South Fork Crow Subwatershed.

Station location:	South Fork Crow River on CR-59, one mi W of Otter lake, three mi W Hutchinson						
STORET/EQuIS ID:	S002-014						
Station #:	99UM070						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	9	1.4	7.5	4.4	40	
Chloride	mg/L	8	14.6	21.6	18.3	230	
Dissolved Oxygen (DO)	mg/L	18	4.33	11.17	8.53	5	2
pH		18	7.39	8.69	8.25	6.5 - 9	
Secchi Tube	100 cm	16	13	>100	37	10	
Total suspended solids	mg/L	8	9	73	36	65	2
Escherichia coli (geometric mean)	MPN/100ml	15	129.4	358.5		126	3
Escherichia coli	MPN/100ml	15	27.5	1553.1	306.3	1260	1
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	5.13	1.13		
Kjeldahl nitrogen	mg/L	6	1.59	2.58	2		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	91	286	189		
Specific Conductance	uS/cm	18	366	691	551		
Temperature, water	deg °C	18	15.84	27.38	22.89		
Sulfate	mg/L	8	32	56	44		
Hardness	mg/L	8	225	297	261		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Upper South Fork Crow River Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Table 19. Lake assessments: Upper South Fork Crow Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Otter (Main Basin)	43-0085-01	352			1.4	0.8	NT	350	95	0.4	NS	IF
Goose	47-0127-00	121		100	3.7	*1.8		399	99	0.9	NS	NA
Star	47-0129-00	536		100	4.1	2.3	D	73	48	0.4	IF	IF
Boon	65-0013-00	745		100	1.8	*0.9		174	109	0.3	NS	IF

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

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

* Mean depth was derived from aerial and topographic maps

Biological monitoring

In the Upper South Fork Crow Subwatershed, the South Fork Crow River transitions from a modified aquatic life use to a general use and maintains that designation throughout the remainder of its extent downstream. This section of the mainstem (-659) was originally listed as impaired in 2006 based on an assessment of aquatic macroinvertebrates and fish communities. Fish and macroinvertebrate samples collected in 2012 from this stretch of river confirm the original aquatic life use impairment. Although habitat scores were somewhat better along this un-channelized reach of stream, three fish community samples at two stations on this assessment unit fell below the general use threshold and were listed as impaired; macroinvertebrates and E. coli are impairments on this AUID as well. Virtually all other reaches of stream in this subwatershed are channelized, modified use waters. Fish and macroinvertebrates were sampled at 12 stations in 10 AUIDs within the Upper South Fork Crow Subwatershed. Of these, two AUIDs (-620, -506) fully support aquatic life for a modified use stream for both fishes and macroinvertebrates, although both scored poorly on the MSHA. An unnamed creek (-621) met the modified use threshold for fishes, but failed to meet the standard for macroinvertebrates; the habitat scored poorly, and severe nutrient issues were evidenced by choking macrophytes, abundant duckweed and filamentous algae. The fish community was somewhat more diverse (15 spp.) relative to other sites in this subwatershed and included more sensitive species such as Iowa darter and walleye. One channelized stream (-623) was evaluated under general use criteria and exhibited relatively decent habitat for an altered watercourse, indicating that general use attainment is possible. The fact that this creek did not meet the general use biocriteria for either fish or macroinvertebrates suggests that stressors unrelated to habitat modification are impacting the biological integrity of this stream.

Of the remaining modified use streams in this subwatershed, there was a mix of sites that met modified use macroinvertebrate IBI criteria and sites that did not. For example, Judicial Ditch 1 (-620) had a macroinvertebrate IBI score that almost met general use criteria with several mayfly and caddisfly taxa present in the sample. Relatively stable cobble, gravel, and sand substrates as well as channel morphology likely contributed this channelized stream attaining the modified aquatic life use. Meanwhile, Unnamed Creek (-533) had a macroinvertebrate IBI score of less than 10 failing to meet the modified use threshold of 22. Unlike Judicial Ditch 1, this stream had very poor habitat characteristics according to the MSHA, including a silt substrate, no depth variability or channel sinuosity, and cover limited to overhanging vegetation and submerged aquatic vegetation.

Water quality monitoring

Upper South Fork Crow (659) is split into 18 AUIDs one of which contains enough chemistry data for assessment. The South Fork Crow River from 145th street to the Hutchinson Dam travels 26 miles and is not meeting the aquatic recreation standard due to the high levels of bacteria. The South Fork Crow River (658) upstream of this AUIDs shows a large flux in dissolved oxygen and in some cases drops below the five mg/L standard. The upstream AUID is also impaired for bacteria and shows a potential stressor based on low levels of dissolved oxygen. The South Fork Crow River flows through Otter Lake which is previously impaired for aquatic recreation (2010) and has very high levels of phosphorus. There are also three major drainage areas that feed into the South Fork Crow River as it flows downstream to Otter Lake.

Four of the thirty-six lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 19). All of the lakes in the Upper South Fork Crow River Subwatershed are shallow and in the Western Corn Belt Plains ecoregion. All of the lakes are impaired for aquatic recreation with the exception of Star Lake, which did not have sufficient monitoring for an assessment to be made.

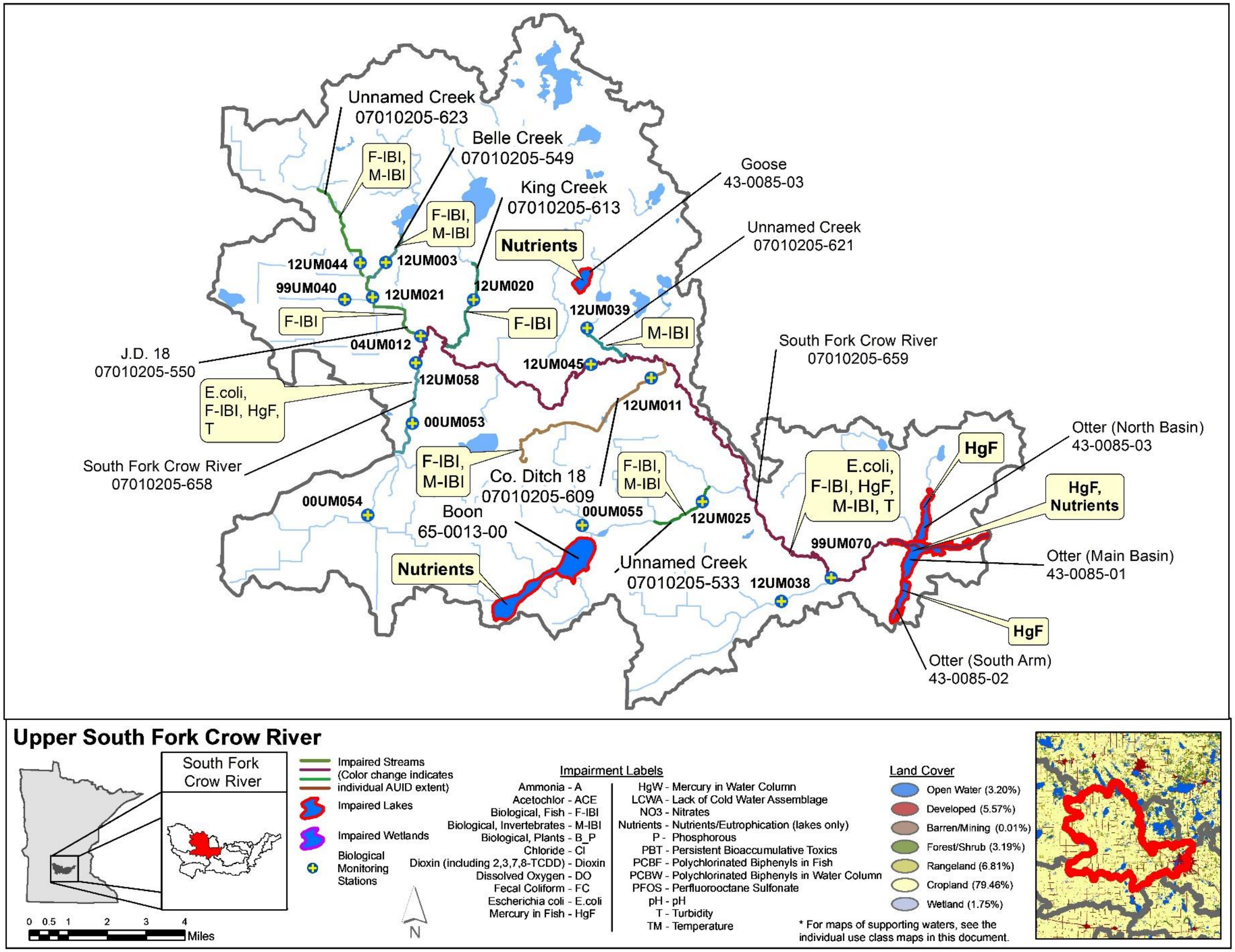

Figure 22. Currently listed impaired waters by parameter and land use characteristics in the Upper South Fork Crow River Subwatershed.

Hoff Lake Subwatershed

The Hoff Lake Subwatershed is small, occupying approximately 40 square miles of south central Meeker and northwestern McLeod Counties. This subwatershed contains several large lakes such as Cedar, Belle, Sioux, Greenleaf and Willie. These and other lakes are connected and drained by a network of small unnamed creeks that outlet to the South Fork Crow River just south of the town of Cedar Mills.

Table 20. Aquatic life and recreation assessments on stream reaches: Hoff Lake Subwatershed.

AUID **_Reach Name_**, _Reach Description_	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:**								**Aquatic Life**	**Aquatic Rec. (Bacteria)**
				Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3		
07010205-656, Unnamed creek, 140th St to Unnamed cr	12UM043	1.17	WWg	EXS	EXS	IF	IF	IF	MTS	MTS	MTS	IMP	SUP
07010205-655, Unnamed creek, Hoff Lk to 140th St		1.37	WWg					MTS				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 21. Minnesota Stream Habitat Assessment (MSHA): Hoff Lake Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	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	12UM043	Trib. to Crow River, South Fork	channelized	0	10.8	18.5	15	22.5	66.8	good
Average Habitat Results: *Hoff Lake Subwatershed*				**0**	**10.8**	**18.5**	**15**	**22.5**	**66.8**	**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 22. Channel Condition and Stability Assessment (CCSI): Hoff 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
2	12UM043	Trib. to Crow River, South Fork	18	20	11	3	52	moderately unstable
Average Stream Stability Results: *Hoff Lake Subwatershed*			**18**	**20**	**11**	**3**	**52**	**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 23. Outlet water chemistry results: Hoff Lake Subwatershed.

Station location:	Unnamed Stream at 140th Street, .5 mi NE of Cedar Mills						
STORET/EQuIS ID:	S006-990						
Station #:	12UM043						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	10	4	21	10	40	
Chloride	mg/L	8	12	16	14	230	
Dissolved Oxygen (DO)	mg/L	19	2.04	11.63	8.33	5	2
pH		19	7.83	9.03	8.43	6.5 - 9	1
Secchi Tube	100 cm	17	47	>100	91	10	
Total suspended solids	mg/L	8	3	22	8.2	65	
Escherichia coli (geometric mean)	MPN/100ml	15	49	83.4		126	
Escherichia coli	MPN/100ml	15	16	563	145	1260	
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	0.21	0.06		
Kjeldahl nitrogen	mg/L	6	1.22	1.68	1.44		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	32	75	50		
Specific Conductance	uS/cm	19	333	430	376		
Temperature, water	deg °C	19	15.8	29.7	24.2		
Sulfate	mg/L	8	<3	13	5		
Hardness	mg/L	8	160	194	172		

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

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

Table 24. Lake assessments: Hoff Lake Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Stahl's	43-0104-00	140	E	58	10.7			31	15.5	1.4	FS	IF
Cedar	43-0115-00	1835	H	100	2.4	1.3		85	47	0.4	NS	IF
Belle	47-0049-01	848	E		7.6	4.3	NT	50	33	1.2	NS	IF
Sioux	47-0060-00	396	H	100	2.1			113		0.5	IF	NA
Willie	47-0061-00	184	E	67	5.2	2.4		61	30	0.9	NS	NA
Greenleaf	47-0062-00	229	H	80	5.5	2.6		74	33	0.7	NS	IF
Hoff	47-0106-00	137	H	100	2.2	1.4		123	62	1.0	NS	NA

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

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

* Mean depth was derived from aerial and topographic maps

Biological monitoring

Aquatic macroinvertebrates and fish were monitored and assessed at one location in this subwatershed, on an unnamed tributary to the South Fork Crow River (-656) downstream of Hoff Lake. Decent water flow was noted at the time of sampling, which was not always the case in the watershed during the macroinvertebrate data collection period (August 2012). This is likely attributed to outflow from the chain of lakes located upstream of the biological monitoring station (12UM043). In addition, there were a variety of habitat types present in the reach that were sampled for macroinvertebrates. Overall, the site scored very well for habitat quality, the second highest MSHA score in the watershed (72). Despite the favorable flow and habitat conditions in this stretch of stream, both fish and macroinvertebrates failed to meet the general use IBI criteria, suggesting that the biological impairment of this stream is due to water quality degradation. The fish community consisted of 12 species and sensitive taxa were not present even though habitat appeared suitable. Low dissolved oxygen and high pH measurements from this stream support this notion. It should be pointed out that this stream is channelized from the outlet of Hoff Lake to the upstream end of the sample reach, passing through drained wetland basins along the way.

Water quality monitoring

Hoff Lake subwatershed is split into six AUIDs, one of which contains enough chemistry data for assessment. The unnamed creek, eight miles northwest of the town of Hutchinson at 140^{th}street, has low levels of bacteria and is supporting aquatic recreation use. The dissolved oxygen does exceed the 5 mg/L standard a few times; the data set is small, but does indicate a potential stressor for fish and invertebrates. This subwatershed had considerably lower phosphorus concentrations that many in the watershed which could be explained due to the large lakes and wetlands that the creek flows through which may be attenuating some nutrients.

Seven of the twenty-three lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 24). A mixture of shallow and deep lakes are in the Hoff Lake watershed with a heavily agriculturally influenced landscape. Stahl's Lake located about four miles north of the town of Hutchinson is meeting the aquatic recreation standard. The land use surrounding the lake is dominated by forest and wetlands. Stahl's Lake should be a priority for protection efforts as it is approaching the standard. Willie Lake is north of the town of Cedar Mills near the headwaters of this subwatershed and is impaired for aquatic recreation. Restoration efforts should be focused on this basin as the current concentrations are close to the standard and the immediate watershed is relatively undisturbed. Flow lines suggest that water from Greenleaf Lake makes it way to Willie Lake through diffusion of the eastern wetland. Greenleaf Lake was listed for impairment of aquatic recreation in 2010 and the current data confirms that the impairment still exists. Belle Lake located on the east side of the subwatershed and is part of the DNR SLICE Program; a long-term, collaborative monitoring effort that is being led by the Minnesota Department of Natural Resources (DNR). The overall program, "Sustaining Lakes in a Changing Environment" (SLICE), is designed to understand and predict the consequences of land use and climate change on lake habitats. There is documented water level alteration and illegal aquatic plant removal that has occurred in Belle Lake. In October 2011 an extensive report was completed on Belle Lake by the MPCA and DNR and it states that measures should be taken to reduce the nonpoint sources of runoff and internal loading is an important consideration to improve water quality. Belle Lake is another lake that should be a higher priority for restoration as the water quality values are closer to the North Central Hardwood Forest standards. To find out more information and view the whole report go to: http://www.pca.state.mn.us/index.php/view-document.html?gid=16987.

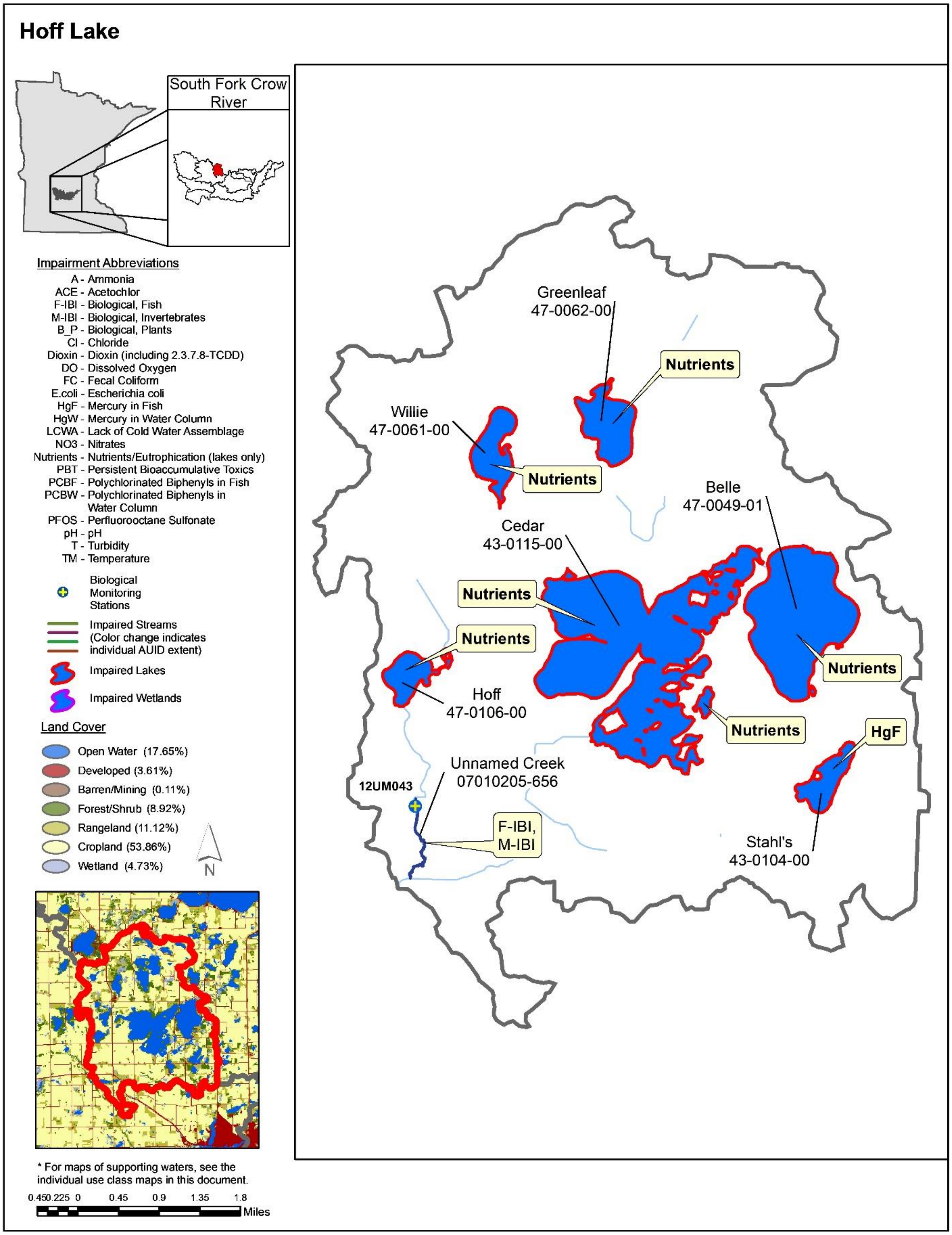

Figure 23. Currently listed impaired waters by parameter and land use characteristics in the Hoff Lake Subwatershed.

Buffalo Creek Subwatershed

The Buffalo Creek Subwatershed is large, occupying 190 square miles of portions of Renville, Meeker, Sibley and Carver Counties. Buffalo Creek enters the subwatershed at its confluence with Judicial Ditch No. 15, just south of Lake Preston and flows east through the towns of Brownton and Glencoe before meeting its confluence with the South Fork Crow River just southwest of New Germany. Schilling and Eagle are sizable lakes in this subwatershed.

Table 25. Aquatic life and recreation assessments on stream reaches: Buffalo Creek Subwatershed.

				Aquatic Life Indicators:									
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-544, County Ditch 12A, T115 R28W S21, west line to Buffalo Cr	12UM008, 12UM064	1.99	LRVW			NA				NA			
07010205-551, Unnamed ditch (County Ditch 63), T116 R30W S19, north line to Eagle Lk	12UM063	4.25	LRVW			NA				NA			
07010205-591, Judicial Ditch 8, Unnamed cr to Buffalo Cr	10EM035, 12UM023	3.37	WWm	EXS	EXS	NA	NA	NA		NA		IMP	
07010205-614, Unnamed creek, Lk Mary to RR crossing	12UM022	2.65	WWm	EXS	NA	NA	NA			NA		IMP	
07010205-615, Unnamed creek, Unnamed cr to Buffalo Cr	12UM024	1.43	WWm	EXS	NA	NA	NA			NA		IMP	
07010205-629, Unnamed creek, Unnamed cr to Buffalo Cr	12UM057	2.46	WWm	NA	NA	NA	NA			NA		NA	
07010205-638, Buffalo Creek, JD 15 to S Fk Crow R	06UM005, 06UM006, 12UM065, 12UM068, 12UM069, 12UM072, 14UM002	52.15	WWg	EXS	EXS	EXS	EX	MTS		MTS	MTS	IMP	IMP

07010205-645, County Ditch 33, 100th St to Buffalo Cr	12UM015	1.77	WWg	EXS	EXS	NA	NA			NA		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 26. Minnesota Stream Habitat Assessment (MSHA): Buffalo Creek Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	Land Use	Riparian (0-15)	Substrate (0-27)	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
1	12UM063	County Ditch 63	channelized	0	8	4	1	10	23	poor
1	12UM057	Trib. to Buffalo Creek	channelized	0	9	4	1	4	18	poor
1	12UM008	County Ditch 12A	channelized	0	8	18	10	7	43	poor
1	10EM035	Judicial Ditch 8	channelized	0	10.5	4	9	1	24.5	poor
1	12UM022	Trib. to Buffalo Creek	channelized	0	7	9	5	7	28	poor
2	12UM023	Judicial Ditch 8	channelized	0	4	9.2	7.5	6	26.7	poor
1	12UM064	County Ditch 12A	channelized	0	9	18.2	12	27	66.2	good
1	12UM024	Trib. to Buffalo Creek	channelized	0	6	11.8	1	10	28.8	poor
1	12UM015	County Ditch 33	natural	0	8	13.7	6	17	44.7	poor
1	06UM005	Buffalo Creek	natural	0	6	13.3	7	17	43.3	poor
1	12UM068	Buffalo Creek	natural	2.5	9	19.4	6	20	56.9	fair
1	12UM069	Buffalo Creek	natural	0	9	14.2	8	19	50.2	fair
2	12UM065	Buffalo Creek	channelized	2.5	9	14.8	8	15.5	49.8	fair
1	12UM072	Buffalo Creek	natural	1.3	4.5	18.2	13	21	58.0	fair
1	06UM006	Buffalo Creek	natural	0	9.5	18.1	9	24	60.6	fair
	Average Habitat Results: *Buffalo Creek Subwatershed*			**0.4**	**7.8**	**12.7**	**6.9**	**13.7**	**41.4**	**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 27. Channel Condition and Stability Assessment (CCSI): Buffalo 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	12UM063	County Ditch 63	36	16	22	3	77	moderately unstable
1	12UM057	Trib. to Buffalo Creek	10	9	28	5	52	moderately unstable
1	12UM008	County Ditch 12A	28	11	16	5	60	moderately unstable
1	10EM035	Judicial Ditch 8	15	5	17	1	38	fairly stable
1	12UM022	Trib. to Buffalo Creek	--	--	--	--	--	--
2	12UM023	Judicial Ditch 8	28	13	28	5	74	moderately unstable
1	12UM064	County Ditch 12A	12	19	13	3	47	moderately unstable
1	12UM024	Trib. to Buffalo Creek	28	15	20	5	68	moderately unstable
1	12UM015	County Ditch 33	13	17	13	3	46	moderately unstable
1	06UM005	Buffalo Creek	--	--	--	--	--	--
1	12UM068	Buffalo Creek	11	22	24	3	60	moderately unstable
1	12UM069	Buffalo Creek	13	15	20	3	51	moderately unstable
2	12UM065	Buffalo Creek	9	13	24	3	49	moderately unstable
1	12UM072	Buffalo Creek	11	19	13	3	46	moderately unstable
1	06UM006	Buffalo Creek	--	--	--	--	--	--
		Average Stream Stability Results: *Buffalo Creek Subwatershed*	**17.8**	**14.5**	**19.8**	**3.5**	**55.7**	**moderately unstable**

Qualitative channel stability ratings

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

Table 28. Outlet water chemistry results: Buffalo Creek Subwatershed.

Station location:	Buffalo Creek at N/S road in S24 4.5 mi N of Plato						
STORET/EQuIS ID:	S000-579						
Station #:	06UM006						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	25	2.2	20	5.9	40	
Chloride	mg/L	8	14	81.9	41	230	
Dissolved Oxygen (DO)	mg/L	19	3.25	10.7	7.7	5	4
pH		19	7.33	8.72	8.18	6.5 - 9	
Secchi Tube	100 cm	17	8	37	24	10	1
Total suspended solids	mg/L	8	21	76	39.8	65	1
Escherichia coli (geometric mean)	MPN/100ml	15	28.3	444.4		126	4
Escherichia coli	MPN/100ml	15	70.3	>2419.6	570.54	1260	2
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	9.3	2.5		
Kjeldahl nitrogen	mg/L	6	1.2	2.2	1.7		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	218	463	353		
Specific Conductance	uS/cm	19	308	922	656		
Temperature, water	deg °C	19	14.3	26.4	22.3		
Sulfate	mg/L	8	38	73	58		
Hardness	mg/L	8	228	350	294		

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

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

Table 29. Lake assessments: Buffalo Creek Subwatershed

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Marion	43-0084-00	522	H	100	4.6	2		92	40	1.1	NS	NA
Eagle	43-0098-00	307	H	100	2.1	*1.0	NT	77	43	0.4	IF	IF

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

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

* Mean depth was derived from aerial and topographic maps

Biological monitoring

Buffalo Creek (-638) is designated as a general use water and was originally listed as impaired in 2006 based on an analysis of aquatic macroinvertebrate and fish data. Data collected since that time (2006 and 2012) confirms the original impairment determination for both communities. The furthest site downstream on this assessment unit was sampled in 2006 and scored well above the general use criteria for macroinvertebrates; this sample contained 20+ EPT taxa, an intolerant taxon, 60% EPT individuals, and a relatively low percentage of tolerant taxa (81%). The riparian corridor along this stretch of the creek was relatively intact, perhaps representing the biological potential of this stream when channel conditions and riparian areas are kept in a natural state. Fish were sampled at seven stations along this assessment unit. High numbers of very tolerant species such as black bullhead, green sunfish and common carp were observed in the samples. Scores were universally poor, falling well below the lower confidence interval of the impairment threshold. No consistent longitudinal pattern was observed along the length of this assessment unit.

Fish communities were sampled at four additional stations on three channelized, modified use tributaries to Buffalo Creek. These assessment reaches and their fish assemblages scored poorly on both habitat metrics and IBIs and were not considered to be meeting aquatic life standards.

Water quality monitoring

Buffalo Creek is split into thirteen AUIDs one of which contains enough chemistry data for assessment. Buffalo Creek stretches 52 miles from Judicial Ditch 15 to the South Fork Crow River. Phosphorus and chlorophyll-*a* concentrations are quite high along this reach; while not formally assessed, eutrophication is likely impacting aquatic life use. Bacteria data confirm the existing aquatic recreation use impairment. The high levels of phosphorus and dissolved oxygen fluctuations are indicative of a potential eutrophication stress to aquatic life. Buffalo Creek was previously listed for bacteria and dissolved oxygen impairment. The newer data confirms both of these impairments.

Two of the fourteen lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 29). Marion, located five miles south of Hutchinson, was previously listed for aquatic recreation in 2010 and the current data confirms that the listing. Marion should be a lake of focus for restoration as it is close to the Western Corn Belt Plain standard. Eagle Lake is also south of the town of Hutchinson and both chlorophyll-*a* and Secchi exceed the standard but phosphorus does not. The 2012 total phosphorus data is suspect due to analytical equipment errors that resulted in a low bias in some of the data; further sampling should occur to make an assessment.

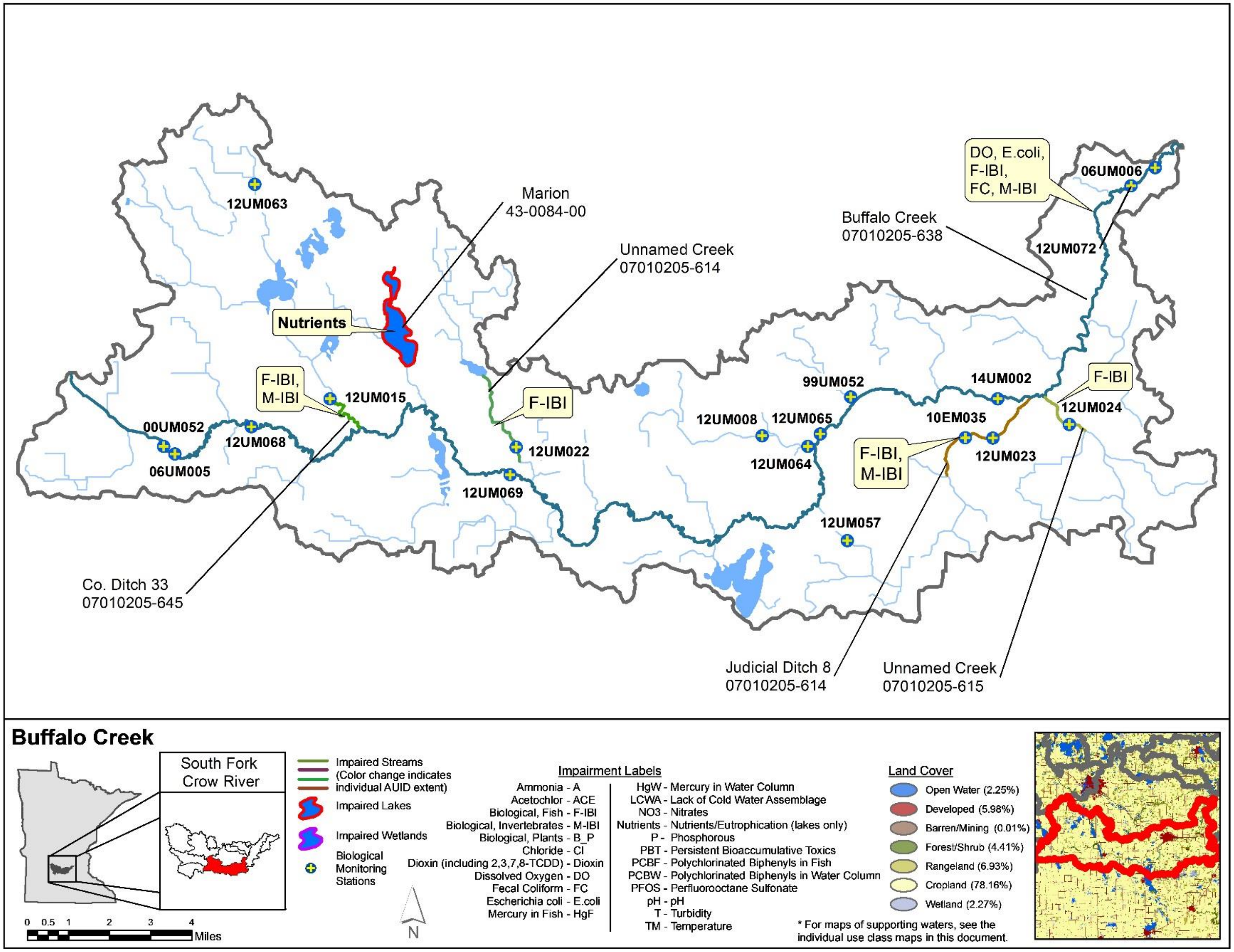

Figure 24. Currently listed impaired waters by parameter and land use characteristics in the Buffalo Creek Subwatershed.

Middle South Fork Crow River Subwatershed

The Middle South Fork Crow River Subwatershed occupies 150 square miles of central McLeod County. The South Fork Crow River enters this subwatershed below the Hutchinson dam and flows in a predominantly easterly direction until its confluence with Buffalo Creek southeast of Lester Prairie. Several tributaries join the main stem of the river as it passes through this subwatershed: McCuen Creek, Bear Creek, Otter Creek, Crane Creek, Silver Creek, and numerous unnamed streams and ditch networks. Silver Lake and Lake Allen are the largest lakes in the subwatershed.

Table 30. Aquatic life and recreation assessments on stream reaches: Middle South Fork Crow River Subwatershed.

				Aquatic Life Indicators:									
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-510, Crow River, South Fork, Hutchinson Dam to Bear Cr	12UM031, 12UM071	17.76	WWg	EXS	EXS	EXS	MTS	MTS		MTS	MTS	IMP	IMP
07010205-511, Crow River, South Fork, Bear Cr to Otter Cr	10EM195, 12UM027, 12UM048,	13.84	WWg	EXS	EXS	IF	EXS	MTS	MTS	MTS	MTS	IMP	IMP
07010205-515, Bear Creek, Headwaters to S Fk Crow R	12UM001, 12UM002	9.79	WWg	EXS	EXS	NA	NA			NA		IMP	
07010205-611, County Ditch 26/27, 165th St to S Fk Crow R	12UM014	1.58	WWg	EXS	EXS	NA	NA			NA		IMP	
07010205-616, McCuen Creek, Headwaters to S Fk Crow R	12UM026	6.22	WWm	MTS	MTS	NA	NA			NA		SUP	
07010205-622, Unnamed creek, T116 R27W S5, west line to S Fk Crow R	12UM040	1.44	WWg	EXS	NA	NA	NA			NA		IMP	
07010205-641, Silver Creek (County Ditch 13), Unnamed cr to S Fk Crow R	12UM009	3.43	WWg	EXS	EXS	NA	NA			NA		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 31. Minnesota Stream Habitat Assessment (MSHA): Middle South Fork Crow River Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	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	12UM014	County Ditch 26	channelized	0	10	22	13	16	61	fair
1	12UM040	Trib. to Crow River, South Fork	natural	0	5.5	18.1	9	21	53.6	fair
1	12UM002	Bear Creek	channelized	0	6.5	22	14	21	63.5	fair
1	12UM009	County Ditch 13	natural	0	14	13.2	11	23	61.2	fair
2	12UM001	Bear Creek	natural	0	10.3	17.6	12.5	22	62.4	fair
1	12UM048	Crow River, South Fork	natural	1.3	8	20	13	18	60.2	fair
1	10EM195	Crow River, South Fork	natural	0	11	20.3	9	21	61.3	fair
1	12UM027	Crow River, South Fork	natural	1	8.5	14.7	10	24	58.2	fair
1	12UM071	Crow River, South Fork	natural	1.25	12.5	21.8	7	23	65.6	good
1	12UM031	Crow River, South Fork	natural	2.5	8	20.4	12	25	67.9	good
1	12UM026	McCuen Creek	channelized	0	9	10.6	5	4	28.6	poor
Average Habitat Results: *Middle South Fork Crow River Subwatershed*				**1.8**	**8.7**	**15.6**	**8.3**	**18.1**	**52.6**	**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): Middle South Fork Crow River Subwatershed.

# Visits	Biological Station ID	Stream Name	Upper Banks (43-4)	Lower Banks (46-5)	Substrat e (37-3)	Channel Evolution (11-1)	CCSI Score (137-13)	CCSI Rating
1	12UM014	County Ditch 26	29	15	13	5	62	moderately unstable
1	12UM040	Trib. to Crow River, South Fork	--	--	--	--	--	--
1	12UM002	Bear Creek	33	17	19	5	74	moderately unstable
1	12UM009	County Ditch 13	32	30	20	7	89	severely unstable
2	12UM001	Bear Creek	23	17	13	3	56	moderately unstable
1	12UM048	Crow River, South Fork	10	15	18	3	46	moderately unstable
1	10EM195	Crow River, South Fork	15	19	17	6	57	moderately unstable
1	12UM027	Crow River, South Fork	9	17	20	3	49	moderately unstable
1	12UM071	Crow River, South Fork	19	21	11	3	54	moderately unstable
1	12UM031	Crow River, South Fork	28	33	32	11	104	severely unstable
1	12UM026	McCuen Creek	29	15	19	3	66	moderately unstable
Average Stream Stability Results: ***Middle South Fork Crow River Subwatershed***			**22.7**	**19.9**	**18.2**	**4.9**	**65.7**	**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: Middle South Fork Crow River Subwatershed.

Station location:	South Fork Crow River at CSAH-8 Bridge, 1.5 mi SE of Hutchinson						
STORET/EQuIS ID:	S001-514						
Station #:	12UM071						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	67	0.1	24	10	40	
Chloride	mg/L	8	15.4	153.5	55.3	230	
Dissolved Oxygen (DO)	mg/L	19	5.18	17.6	9.5	5	
pH		19	7.56	8.81	8.24	6.5 - 9	
Secchi Tube	100 cm	17	13	96	34	10	
Total suspended solids	mg/L	8	11	59	35	65	
Escherichia coli (geometric mean)	MPN/100ml	15	144.7	240.3		126	3
Escherichia coli	MPN/100ml	15	23.1	1413.6	314.9	1260	1
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	0.53	14.45	4..85		
Kjeldahl nitrogen	mg/L	6	1.58	2.52	2.16		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	180	521	320		
Specific Conductance	uS/cm	19	361	1344	757		
Temperature, water	deg °C	19	16.81	28.88	23.85		
Sulfate	mg/L	8	46	93	63		
Hardness	mg/L	8	229	463	310		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Middle South Fork Crow River Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Table 34. Outlet water chemistry results: Middle South Fork Crow River Subwatershed continued.

Station location:	South Fork Crow River 0.5 mi SE of Lester Prairie						
STORET/EQuIS ID:	S001-443						
Station #:	12UM027						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	10	1.6	8.1	4.1	40	
Chloride	mg/L	8	15	75	40	230	
Dissolved Oxygen (DO)	mg/L	19	5.14	9.87	7.32	5	
pH		19	7.43	8.57	8.19	6.5 - 9	
Secchi Tube	100 cm	17	11	60	26	10	
Total suspended solids	mg/L	8	21	85	54	65	4

Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
***Escherichia coli* (geometric mean)**	MPN/100ml	15	105.6	257.9		126	2
Escherichia coli	MPN/100ml	15	<1	1986.3	363.9	1260	1
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	5.3	1.5		
Kjeldahl nitrogen	mg/L	6	1.2	2.3	1.8		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	198	413	304		
Specific Conductance	uS/cm	19	322	865	652		
Temperature, water	deg °C	19	13.9	266	22.1		
Sulfate	mg/L	8	41	85	60		
Hardness	mg/L	8	239	311	279		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Middle South Fork Crow River Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Table 35. Lake assessments: Middle South Fork Crow River Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Silver	43-0034-00	443	H	100	1.8	1.1	NT	271	131	0.6	NS	IF
Bear	43-0076-00	170	H	100	2.7	*1.3	NT	164	88	1.0	NS	IF

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

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

* Mean depth was derived from aerial and topographic map

Biological monitoring

The mainstem of the South Fork River flows through this subwatershed in a general west to east direction and is bisected at the confluence of Bear Creek into two assessment units of roughly equal length. The upstream AUID (-510) flows from Hutchinson to the confluence with Bear Creek and contains two biological monitoring stations, and the downstream portion (-511) flows from there to just downstream of Lester Prairie and contains three additional stations. Fish and macroinvertebrate IBI scores fell short of the general use threshold, resulting in aquatic life use impairments for both South Fork Crow River assessment units. A longitudinal profile of the stations along the river did not reveal any patterns in the condition of aquatic communities (e.g., increasing or decreasing moving downstream). The highest scoring macroinvertebrate site (10EM195) was from data collected in 2010 as part of the random survey of Minnesota's rivers and streams, scoring at the IBI impairment threshold, while all five fish scores fell well below the lower confidence interval of the impairment threshold.

Four other assessment units in this subwatershed (-611, -622, -641, -515) were evaluated under general use criteria for fish. Although habitat scores on these reaches were above average for the South Fork Crow watershed, none of them were determined to be supporting aquatic life. Fish IBI scores were particularly low (<7) in three visits to two stations on Bear Creek (-515), which scored relatively well (>60) on habitat assessments. A pattern of above average habitat scores coupled with poor IBI scores is indicative of poor water quality, likely excessive nutrient loading, that is limiting aquatic life in this system.

McCuen Creek (-616), a modified use water, was the only reach to fully support aquatic life for both fish and macroinvertebrates. The biological monitoring station had poor habitat conditions (MSHA = 28) and based on a limited number of water chemistry measurements it appears to have poor water quality as well. Although the fish community was not diverse and was dominated by the highly tolerant black bullhead, this stream was evaluated under the Low Gradient IBI, which has a much lower impairment threshold than other IBI classes due to the naturally reduced fish diversity found in slower moving waters. The monitoring reach did have a moderate amount of shading and woody debris in the channel from riparian vegetation relative to conditions further upstream and other channelized streams in the watershed, perhaps contributing to the relatively healthy communities by serving as a type of refugium.

Water quality monitoring

Middle South Fork Crow River is split into ten AUIDs, two of which contains enough chemistry data for assessment; both on the South Fork Crow River (07010205-510 and 07010205-511). South Fork Crow River (-510) is 17 miles long and flows into South Fork Crow River (-511) approximately four miles south of the town of Silver Lake. Both AUIDs have aquatic recreation impairments for bacteria which confirm the downstream existing listing as well. The South Fork Crow River (-510) was determined to not support aquatic life based on the dissolved oxygen exceedances. The data show that the impairment occurs downstream the Hutchinson Waste Water Treatment Plant (WWTP) and the impairments decrease as you move downstream from that location. The above tables represent data that was collected far downstream of the WWTP. Both of the stations on the South Fork Crow River have elevated phosphorus concentrations which can lead to increased algal growth. Chloride is below the standard for both stream stations but it is slightly elevated which could be a result of the South Fork Crow River flowing through the large, populated town of Hutchinson. South Fork Crow River (-510) was previously impaired for turbidity in 2006 but the current data suggest that the impairment no longer exists. The amount of natural bank buffers that exist along this reach could be contributing to the low total suspended solids (TSS) and higher Secchi tube values that were observed.

Two of the twenty-two lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 35). Silver Lake and Bear Lake are very shallow and have little buffer and highly cultivated landscapes; both lakes can become highly turbid. The high levels of phosphorus are partially caused by internal loading. Silver Lake is below the standard for chloride but some samples are higher which is most likely caused because of the proximity to the town of Silver Lake. Shallow lakes have a limited ability to assimilate nutrients; reductions in watershed contributions will be necessary to improve quality.

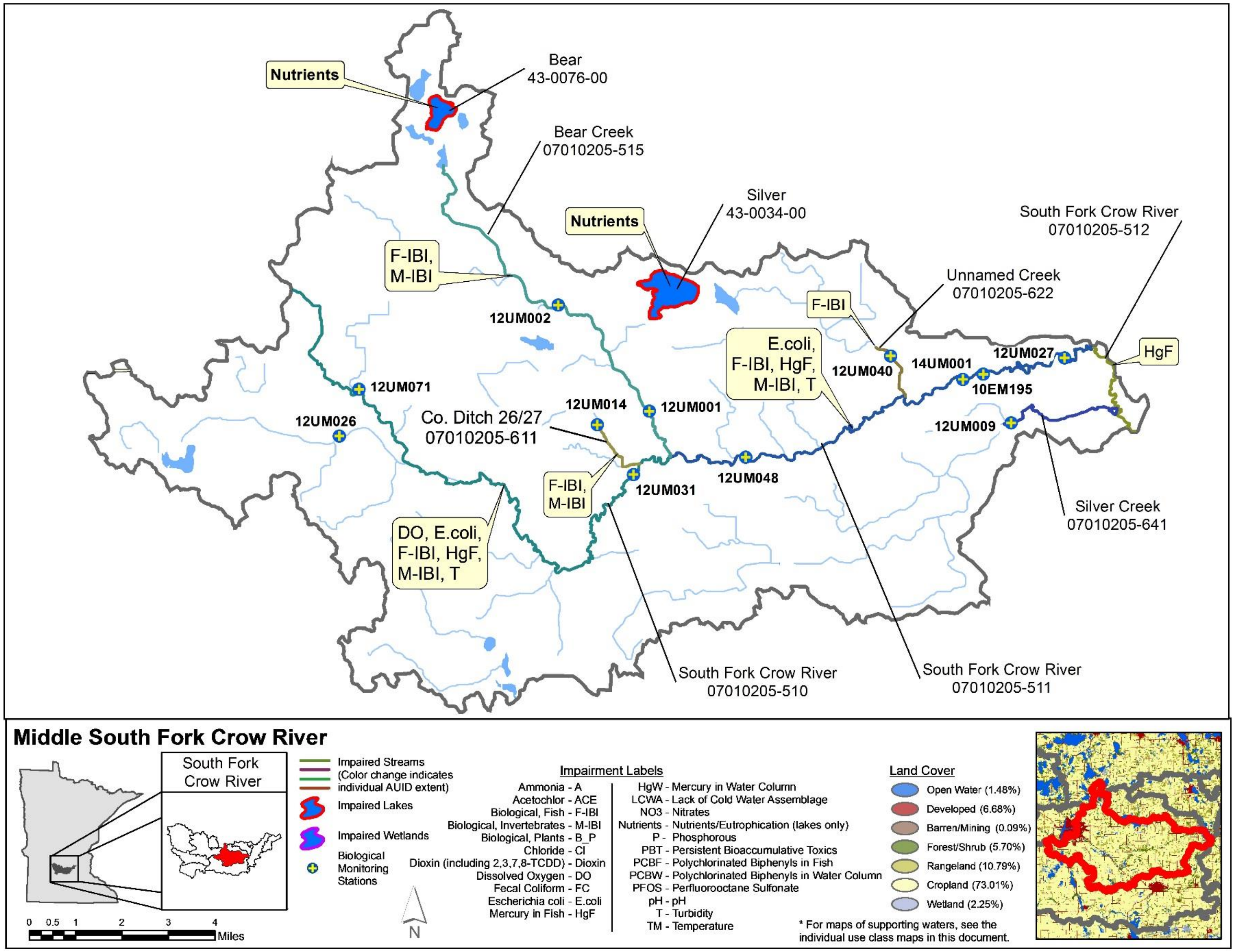

Figure 25. Currently listed impaired waters by parameter and land use characteristics in the Middle South Fork Crow River Subwatershed.

Otter Creek Subwatershed

Occupying just 37 square miles in northeast McLeod County, the Otter Creek Subwatershed is the smallest subwatershed in the South Fork Crow River drainage. A number of ditches outlet to Otter Creek as it flows from west to east until it meets the South Fork Crow River at the town of Lester Prairie. Swan Lake is the only sizable lake within this subwatershed.

Table 36. Aquatic life and recreation assessments on stream reaches: Otter Creek Subwatershed.

AUID ***Reach Name***, *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:**								**Aquatic Life**	**Aquatic Rec. (Bacteria)**
				Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3		
07010205-617, Unnamed creek, Headwaters to Otter Cr	12UM029	4.03	WWm	EXS		NA	NA			NA		IMP	
07010205-642, Otter Creek, Headwaters to Cable Ave	07UM098	5.63	WWm	EXS		NA	NA	NA		NA		IMP	
07010205-643, Otter Creek, Cable Ave to S Fk Crow R	12UM028	4.94	WWg	EXS	MTS	IF	IF	IF	MTS	MTS	MTS	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): Otter Creek Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	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	12UM029	Trib to Otter Creek	channelized	1	10	14	4	5	34	poor
1	07UM098	Otter Creek	channelized	0	10	9	5	14	38	poor
1	12UM028	Otter Creek	natural	0	11.5	16.4	7	22	56.9	fair
Average Habitat Results: *Otter Creek Subwatershed*				**0.3**	**10.5**	**13.1**	**5.3**	**13.7**	**43**	**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 38. Channel Condition and Stability Assessment (CCSI): Otter 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	12UM029	Trib to Otter Creek	--	--	--	--	--	--
1	07UM098	Otter Creek	--	--	--	--	--	--
1	12UM028	Otter Creek	34	46	32	5	117	extremely unstable
Average Stream Stability Results: *Otter Creek Subwatershed*			**34**	**46**	**32**	**5**	**117**	**extremely 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: Otter Creek Subwatershed.

Station location:	Otter Creek at 185th St, 1.3 mi E of Lester Prairie						
STORET/EQuIS ID:	S006-992						
Station #:	12UM030						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Un-ionized Ammonia	ug/L	10	1.3	4	2.2	40	
Chloride	mg/L	8	16	39	29	230	
Dissolved Oxygen (DO)	mg/L	19	4.05	9.76	7.16	5	2
pH		19	7.29	8.08	7.83	6.5 - 9	
Secchi Tube	100 cm	17	6	>100	52	10	1
Total suspended solids	mg/L	8	5	57	23	65	
Escherichia coli **(geometric mean)**	MPN/100ml	15	412.9	462.6		126	3
Escherichia coli	MPN/100ml	15	171	>2419.6	552.7	1260	1
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	0.06	7.1	2.5		
Kjeldahl nitrogen	mg/L	6	0.8	1.9	1.5		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	134	331	208		
Specific Conductance	uS/cm	19	311	755	638		
Temperature, water	deg °C	19	11.4	23	18.7		
Sulfate	mg/L	8	26	52	37		
Hardness	mg/L	8	228	364	301		

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

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

Table 40. Lake assessments: Otter Creek Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Swan	43-0040-00	341	H	100	3.0	*1.5		45	51	0.5	IF	IF

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

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

* Mean depth was derived from aerial and topographic map

Biological monitoring

Otter Creek is divided into an upstream (-642) and downstream (-643) assessment reaches. Due to low flows in August, only fish were sampled in the upstream portion. The fish assemblage at this site (07UM098) consisted of four tolerant taxa and the IBI score (6) was well below the impairment threshold. The highest macroinvertebrate IBI score in the watershed was obtained at the station (12UM028) on the downstream portion of Otter Creek (-643) with a score 59 on the Southern Forest Streams Glide-Pool M-IBI. The sample collected from this station had total of 12 mayfly/caddisfly taxa, 14 clinger taxa, and relatively equal abundances among the taxa that were present, all indications of a healthy aquatic macroinvertebrate community. According to the MSHA the site had relatively good habitat with a score of 57. However, bank erosion and excess sedimentation in the channel suggest that this stream has become over-widened and has channel stability issues. These habitat factors may be having a greater impact on the fish assemblage, as it did not meet the general use threshold for a stream in this class due to a dominance of tolerant forms, lack of overall diversity, and absence of any sensitive taxa. Fishes were sampled on an unnamed tributary (-617) to Otter Creek. The fish community at this site consisted of four somewhat tolerant species and scored very poorly (IBI = 4).

Water quality monitoring

Otter Creek is split into three AUIDs one of which contains enough chemistry data for assessment. Otter Creek flows into the South Fork Crow River and is not supporting aquatic recreation due to high levels of bacteria. The bacteria levels are elevated throughout the summer. Phosphorus concentrations are elevated in this subwatershed. The dissolved oxygen dataset show a few samples that are below the 5 mg/L standard but doesn't look to be an issue for aquatic life (Table 40).

One of the three lakes greater than four hectares (10 acres) was reviewed for aquatic recreation use in this subwatershed. Swan Lake located west of the town of Silver Lake is shallow and algal blooms occur throughout the summer. Chlorophyll-*a* and Secchi exceed the standard but phosphorus does not. The 2012 and 2013 total phosphorus data is suspect due to issues with lab analysis and further sampling is planned to make the assessment.

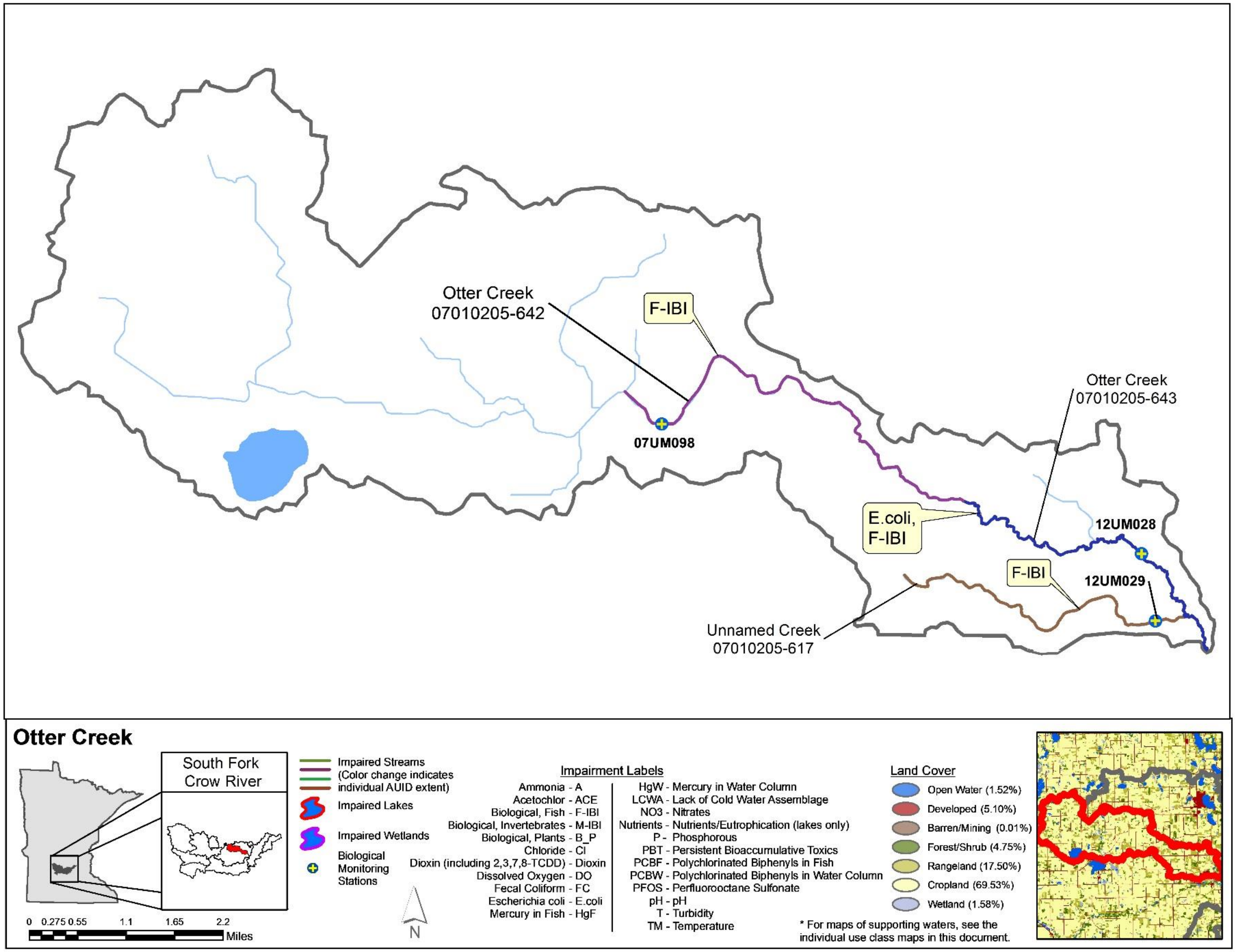

Figure 26. Currently listed impaired waters by parameter and land use characteristics in the Otter Creek Subwatershed.

Crane Creek Subwatershed

The Crane Creek Subwatershed occupies 53 square miles along McLeod county's northern and eastern boundaries with Wright and Carver Counties. Crane Creek is joined by Judicial Ditch 1 southeast of Winsted where it flows south to its confluence with the South Fork Crow River southeast of Lester Prairie. This subwatershed contains several lakes: Winsted, South, Butler, Butternut and Campbell.

Table 41. Aquatic life and recreation assessments on stream reaches: Crane Creek Subwatershed.

AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	**Aquatic Life Indicators:** Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-571, Judicial Ditch 1, Winsted Lk to Unnamed ditch	12UM066	4.39	WWm	MTS	NA	NA	NA			NA		SUP	
07010205-572, Judicial Ditch 1, Unnamed ditch to Unnamed cr	12UM017	2.05	WWg	EXS	EXS	EXS	IF	MTS	MTS	MTS	IF	IMP	IMP
07010205-585, Unnamed creek, CD 11 to Winsted Lk	12UM034	1.10	WWm	EXS	MTS	NA	NA	NA		NA		IMP	
07010205-647, Crane Creek, -94.043, 44-9292 to T117 R27W S25, south line	12UM007	3.17	LRVW	NA	NA	NA				NA		NA	

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

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

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

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

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

Table 42. Minnesota Stream Habitat Assessment (MSHA): Crane Creek Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	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	12UM007	Crane Creek	channelized	0	12	14.3	6	14	46.3	fair
1	12UM034	Trib. to Winsted Lake	channelized	0	5	17.55	8	15	45.55	fair
1	12UM066	Judicial Ditch 1	channelized	0	10.5	9	10	7	36.5	poor
1	12UM017	Judicial Ditch 1	natural	0	12.5	11.4	6	17	46.9	fair
Average Habitat Results: *Crane Creek Subwatershed*				**0**	**10**	**13.1**	**7.5**	**13.3**	**43.8**	**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 43. Channel Condition and Stability Assessment (CCSI): Crane 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	12UM007	Crane Creek	25	22	16	5	68	Moderately unstable
1	12UM034	Trib. to Winsted Lake	17	13	13	3	46	Moderately unstable
1	12UM066	Judicial Ditch 1	17	24	22	5	68	Moderately unstable
Average Stream Stability Results: *Crane Creek Subwatershed*			**19. 7**	**19. 7**	**17**	**4.3**	**60.7**	**Moderately unstable**

Qualitative channel stability ratings

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

Table 44. Outlet water chemistry results: Crane Creek Subwatershed.

Station location:	Judicial Ditch No. 1 at CSAH-33, 2.5 mi N of New Germany						
STORET/EQuIS ID:	S006-991						
Station #:	12UM017						
Parameter	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Mean**	**WQ Standard[1]**	**# of WQ Exceedances[2]**
Un-ionized Ammonia	ug/L	10	2.3	37	15	40	
Chloride	mg/L	8	17.6	100	37.9	230	
Dissolved Oxygen (DO)	mg/L	18	2.16	7.61	5.0	5	9
pH		18	7.32	8.54	7.9	6.5 - 9	
Secchi Tube	100 cm	16	13	83	36	10	
Total suspended solids	mg/L	8	11	37	23.6	65	
***Escherichia coli* (geometric mean)**	MPN/100ml	14	285.6	421.9		126	2
Escherichia coli	MPN/100ml	14	76.7	>2419.6	613.7	1260	3
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	0.23	2.21	0.81		
Kjeldahl nitrogen	mg/L	6	1.61	3.42	2.53		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	330	1050	570		
Specific Conductance	uS/cm	18	372	1112	592		
Temperature, water	deg °C	18	10.48	24.36	20.88		
Sulfate	mg/L	8	3	21	7.5		
Hardness	mg/L	8	171	300	213		

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

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

Table 45. Lake assessments: Crane Creek Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Winsted	43-0012-00	369	H	100	3.7	1.8	NT	373	78	0.9	NS	IF
South	43-0014-00	178	H					621	287	0.3	NS	IF

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

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

* Mean depth was derived from aerial and topographic map

Biological monitoring

Four biological monitoring stations were placed on four assessment units in this subwatershed, two of which (-571,-647) were only sampled for fish due to low water level during the invertebrate sampling period. A long section of Crane Creek (-647) is designated as a Class 7 limited resource value water (LRVW). Fish were sampled at one biological monitoring station on this section. The fish assemblage was dominated by tolerant species and scored poorly, but LRVW are not assessed for aquatic life. Judicial Ditch 1 drains the other half of this subwatershed, flowing through the city of Winsted. Macroinvertebrate samples were collected above Winsted on a channelized reach (-585) and downstream of Winsted on a natural reach (-572). The channelized section had relatively good habitat and macroinvertebrates there met modified use criteria, whereas the fish community was dominated by tolerant taxa and did not. Downstream of Winsted both fish and macroinvertebrates failed to meet general use criteria on this natural section of stream. Preliminary data indicate nutrient issues in this section of Judicial Ditch 1.

Water quality monitoring

Crane Creek is split into ten AUIDs one of which contains enough chemistry data for assessment. Judicial Ditch 1 was determined to not support aquatic recreation (i.e. bacteria). The low dissolved oxygen levels and very high levels of phosphorus could be an indication of elevated nutrients and both could be stressors for the aquatic life. The un-ionized ammonia values are reaching higher levels and could also be a possible stressor. It is possible that these elevated values are influenced by the Winsted Wastewater Treatment Facility (WWTF) which discharges to South Lake upstream of the monitoring location. The city of Winsted has an accepted proposal to improve their facility and move the discharge from the existing location on South Lake to an unnamed tributary to Crane Creek. As this AUID will no longer be receiving discharge from this facility water quality may improve over time.

Three of the thirteen lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 45). Campbell Lake is protected as a lake by DNR; however, an analysis of the basin indicated a maximum depth of two meters. A vegetation survey noted sago and narrow leaf pondweeds in the open water and a dense cattail fringe. As the basin is small and has little fetch, it was determined to be a wetland and was not assessed. South Lake, located south of the town of Winsted, currently receives the discharge from the Winsted WWTF and is surrounded by agriculture. This lake contains extremely high levels of phosphorus and chlorophyll-*a*. Production of algae in South Lake is very high and algal blooms occur frequently throughout the summer. The proposed upgrade to the Winsted WWTF will route the discharge away from South Lake which may alleviate some of the excessive nutrient issues in the future. Winsted Lake, located in the town of Winsted, is not meeting the aquatic recreation standard. Winsted Lake has a lakeshed that is dominated by agriculture, is surround by urbanization, and is downstream of South Lake. The phosphorus and chlorophyll-*a* are very high and because of the shallow nature of the lake internal loading is likely.

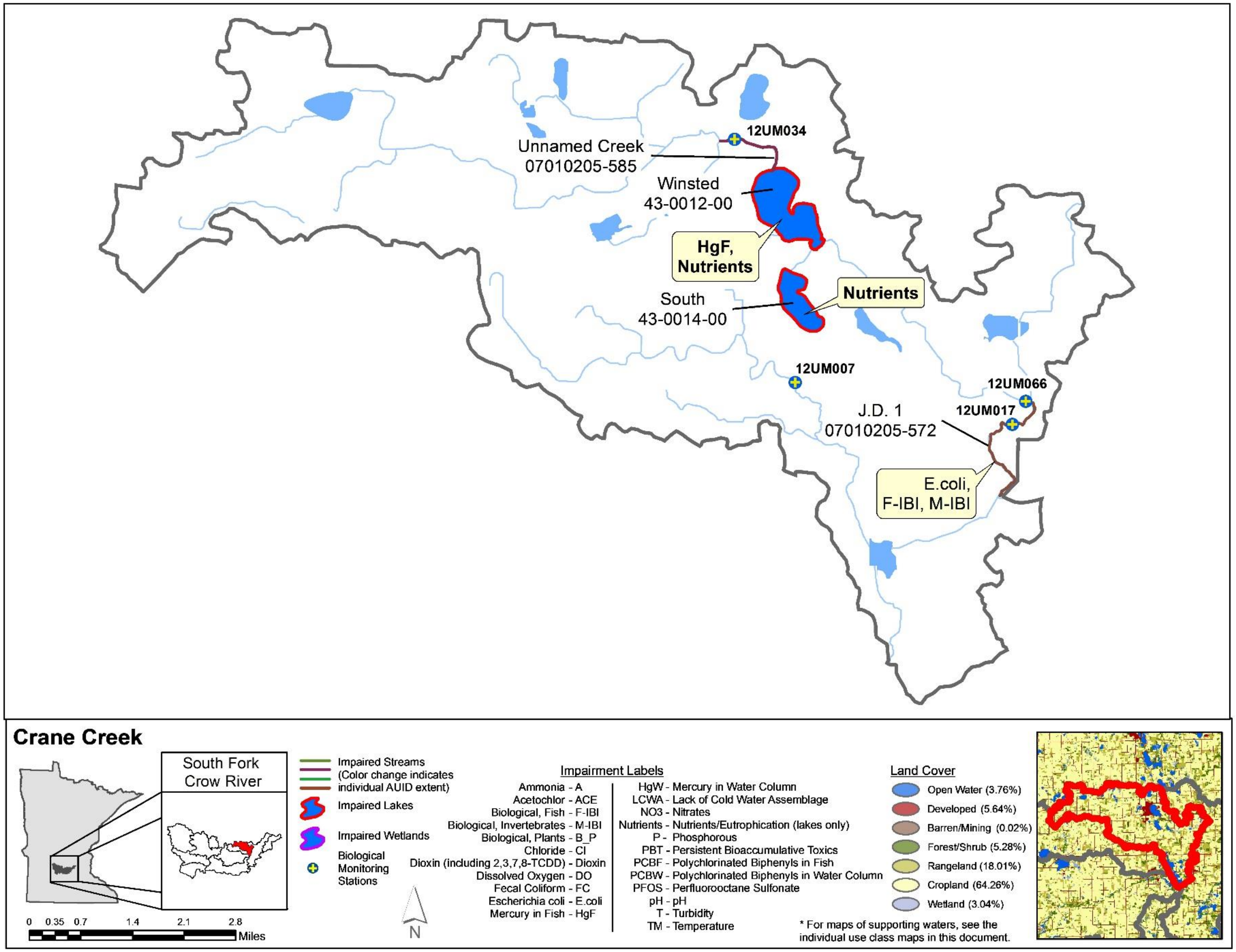

Figure 27. Currently listed impaired waters by parameter and land use characteristics in the Crane Creek Subwatershed.

Lower South Fork Crow Subwatershed

The Lower South Fork Crow Subwatershed contains the lower-most reaches of the South Fork Crow River, occupying 119 square miles mostly within northwestern Carver and southeastern Wright Counties. The South Fork Crow River enters this subwatershed at its confluence with Buffalo Creek southeast of Lester Prairie and flows northeast through the towns of Mayer, Watertown, Delano and ultimately Rockford where it meets the North Fork Crow River. Lake Rebecca and Tiger Lake are the only sizable lakes in the subwatershed.

Table 46. Aquatic life and recreation assessments on stream reaches: Lower South Fork Crow River Subwatershed.

AUID *Reach Name,* *Reach Description*	Biological Station ID	Reach Length (miles)	Use Class	Aquatic Life Indicators:								Aquatic Life	Aquatic Rec. (Bacteria)
				Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3		
07010205-624, Unnamed creek, Unnamed cr to Lippert Lk	12UM049	2.57	WWg	EXS	EXS	NA	NA			NA		IMP	IMP
07010205-508, Crow River, South Fork, Buffalo Cr to N Fk Crow R	12UM033, 12UM041, 12UM050, 12UM070	30.83	WWg	EXS	EXS	IF	EXS	EXS	EXS	MTS	MTS	IMP	IMP
07010205-618, Unnamed creek, Unnamed cr to Eagle Lk Outlet	12UM032	1.65	WWg	EXS	EXS	NA	NA			NA		IMP	
07010205-648, County Ditch 9, Headwaters to -93.9053 44.9055	12UM016	4.50	WWm	EXS	EXS	NA	NA			NA		IMP	
07010205-535, Unnamed creek (Eagle Lake Outlet), Eagle Lk to Unnamed cr		2.22	WWg			NA	NA	IF				IF	SUP
07010204-710, Unnamed creek, Headwaters to Lk Rebecca		0.50	WWg			IF	MTS		MTS	MTS		IF	
07010205-564, Unnamed creek, Rice Lk to S Fk Crow R		1.06	WWg			IF	MTS	MTS	MTS	MTS	IF	NA	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

Table 47. Minnesota Stream Habitat Assessment (MSHA): Lower South Fork Crow River Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	Land Use (0-5)	Riparian (0-15)	Substrate	Fish Cover	Channel Morph.	MSHA Score	MSHA Rating
1	12UM049	Trib. to Lippert Lake	natural	0	11	16.5	7	18	52.5	fair
2	12UM016	County Ditch 9	channelized	0	6.5	3	4	4	17.5	poor
1	12UM032	Trib. to Crow River, South Fork	channelized	0	9	12.4	15	17	53.4	fair
1	12UM033	Crow River, South Fork	natural	0	8	12.4	13	16	49.4	fair
1	12UM070	Crow River, South Fork	natural	2.5	9	13.1	7	16	47.6	fair
2	12UM050	Crow River, South Fork	natural	2.5	8.5	11.6	13	18.5	54.1	fair
1	12UM041	Crow River, South Fork	natural	2	10	17.8	12	21	62.8	fair
Average Habitat Results: *Lower South Fork Crow River Subwatershed*				1	8.9	12.4	10.1	15.8	48.2	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 48. Channel Condition and Stability Assessment (CCSI): Lower South Fork Crow 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	12UM049	Trib. to Lippert Lake	17	20	16	3	56	moderately unstable
2	12UM016	County Ditch 9	22	9	26	5	62	moderately unstable
1	12UM032	Trib. to Crow River, South Fork	33	17	20	3	73	moderately unstable
1	12UM033	Crow River, South Fork	17	15	16	5	53	moderately unstable
1	12UM070	Crow River, South Fork	20	13	22	5	60	moderately unstable
2	12UM050	Crow River, South Fork	13	17	16	3	49	moderately unstable
1	12UM041	Crow River, South Fork	10	17	16	3	46	moderately unstable
Average Stream Stability Results:		***Lower South Fork Crow River Subwatershed***	**18.9**	**15.4**	**18.9**	**3.9**	**57**	**moderately unstable**

Qualitative channel stability ratings

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

Table 49. Outlet water chemistry results: Lower South Fork Crow River Subwatershed.

Station location:	South Fork Crow River, BR at Bridge Ave in Delano						
STORET/EQuIS ID:	S001-255						
Station #:	12UM041						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	10	1.6	6.8	3.6	40	
Chloride	mg/L	8	13	64	33	230	
Dissolved Oxygen (DO)	mg/L	19	5.15	11	6.9	5	
pH		19	7.54	8.82	8.14	6.5 - 9	
Secchi Tube	100 cm	17	6	38	22	10	
Total suspended solids	mg/L	8	17	68	46.4	65	1
Escherichia coli (geometric mean)	MPN/100ml	15	34.6	320.2		126	4
Escherichia coli	MPN/100ml	15	44.9	>2419.6	602.5	1260	2
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	5.2	1.4		
Kjeldahl nitrogen	mg/L	6	1.46	2.48	2		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	272	480	386		
Specific Conductance	uS/cm	19	316	802	600		
Temperature, water	deg °C	19	14.4	26.7	22		
Sulfate	mg/L	8	33.5	53.4	40		
Hardness	mg/L	8	243	328	264		

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

**Data found in the table above was compiled using the results from data collected at the outlet monitoring station in the Lower South Fork Crow River Subwatershed, a component of the IWM work conducted between May and September from 2012 and 2013. This specific data does not necessarily reflect all data that was used to assess the AUID.

Table 50. Lake assessments: Lower South Fork Crow River Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Eagle	10-0121-00	177	H	100	4.3	*2.2	NT	203	73	0.6	NS	IF
Rebecca	27-0192-00	264	H	54	9.1		NT	75	46	1.3	NS	IF

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

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

* Mean depth was derived from aerial and topographic map

Biological monitoring

The lowest reach of the South Fork Crow River flows through this subwatershed from the confluence with Buffalo Creek to where it joins the North Fork Crow River just downstream of Delano. Biological monitoring was performed at four stations along this assessment unit (-508). Existing impairments for fish and macroinvertebrate communities were confirmed by intensive watershed monitoring in 2012. Macroinvertebrate IBI scores on this assessment unit were consistently below general use criteria for the Prairie Forest Rivers IBI class, ranging from 19 to 30. Fish IBI scores also failed to meet general use criteria for a stream in this class. Only one station (12UM033) met the impairment threshold, but fell within the confidence interval. Although overall species diversity was higher (>20 spp.) at sites on this AUID, communities were unbalanced with higher numbers of tolerant taxa (green sunfish, fathead minnow, common carp) and a total absence of sensitive species. A longitudinal profile of the stations along the river did not reveal any patterns in the condition of aquatic macroinvertebrate or fish communities (e.g., increasing or decreasing moving downstream).

Fish and macroinvertebrate communities were evaluated on three tributary assessment units in this subwatershed. In all three cases, fish IBI scores were low (9, 15, and 16), communities were composed of tolerant forms, and streams were not found to be meeting aquatic life standards.

Water quality monitoring

Lower South Fork Crow River is split into fourteen AUIDs one of which contains enough chemistry data for assessment. The South Fork Crow River stretches 30 miles flowing predominantly northeast in this subwatershed. The South Fork Crow River is showing impairment for aquatic recreation (i.e. bacteria) which supports the previous impairment of fecal coliform in 2006. June and August have multiple samples that are very high. Phosphorus concentrations are very high on this reach which could lead to increased algal growth. Turbidity was listed as impaired in 2004 and the total suspended solids and Secchi tube data confirm the existing turbidity impairment.

Two of the thirty lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 50). Eagle Lake is located two and a half miles north of the town of Norwood Young America. Previously listed as impaired for aquatic recreation for nutrients/eutrophication in 2002; the newer data from 2003 to 2013 confirm that these impairments still exist. Eagle Lake does have a smaller lakeshed, but the high amount of nutrient surface water runoff into the lake is causing it to remain impaired. Rebecca Lake, located one and a half miles south of the town of Rockford, is also carrying a previous listing for aquatic recreation for nutrients/eutrophication from 2008. In 2008 the Three Rivers Park District made improvements to the watershed including, diverting runoff from a feedlot, installation of exclusion fencing and better manure practices. In addition to those improvements in 2010 and 2011, alum treatments were applied to Rebecca Lake. Those applications significantly reduced the internal loading of phosphorus, however the 2013 and 2014 data suggest that the benefits were short term; higher levels of phosphorus are returning.

Lower South Fork Crow River

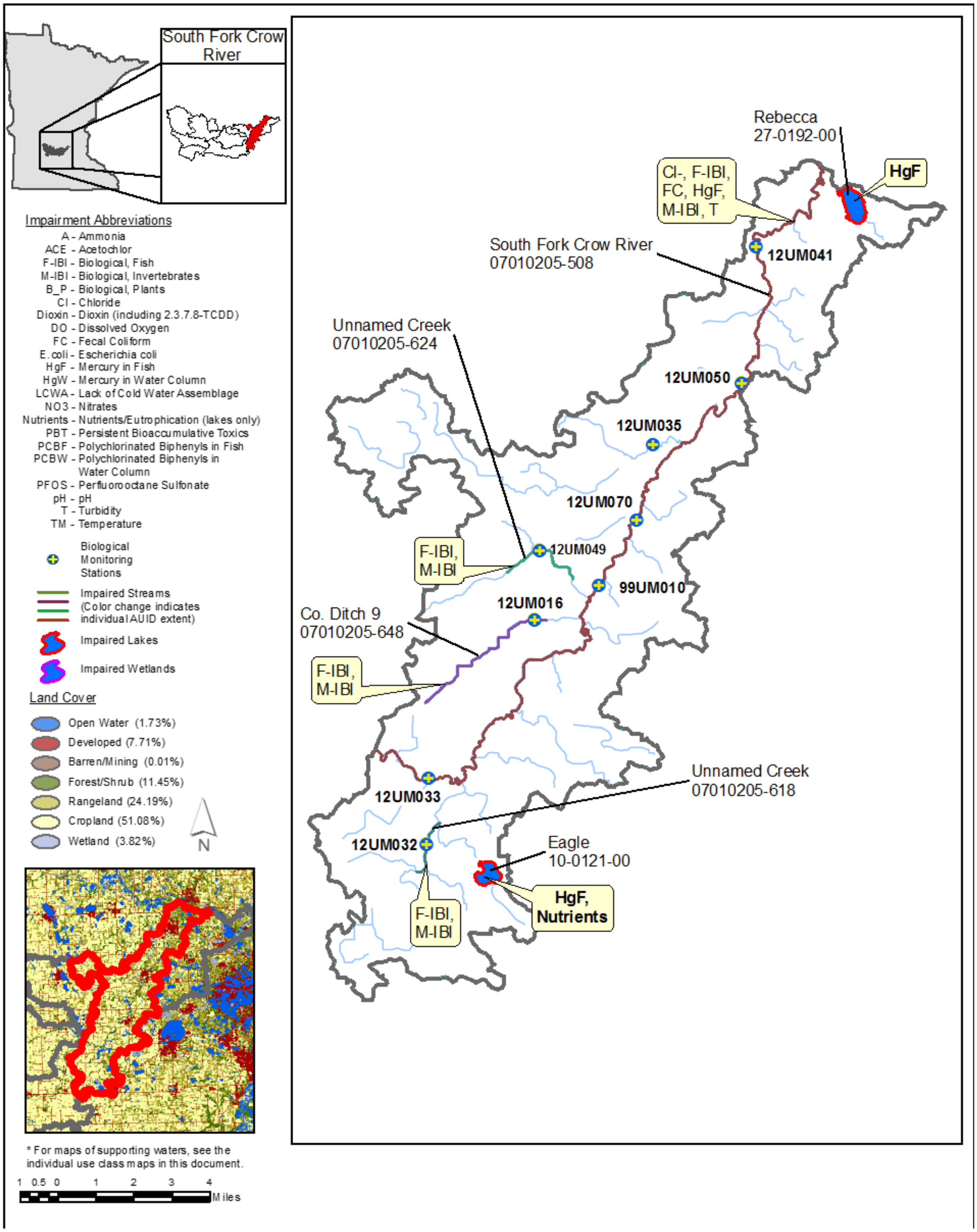

Figure 28. Currently listed impaired waters by parameter and land use characteristics in the Lower South Fork Crow Subwatershed.

Rice Lake Subwatershed

The Rice Lake Subwatershed occupies 55 square miles of western Hennepin County and small portions of neighboring Carver and Wright Counties. This subwatershed contains several large lakes such as Independence, Ox Yoke, Rice, Swede, Oak, Robina and the streams and ditches that connect them. The largest of these being Pioneer Creek, which flows from Lake Independence in the northeastern portion of the subwatershed into Ox Yoke lake, which outlets to Rice Lake and ultimately the South Fork Crow River northeast of Watertown.

Table 51. Aquatic life and recreation assessments on stream reaches: Rice Lake Subwatershed.

				Aquatic Life Indicators:									
AUID ***Reach Name,*** *Reach Description*	**Biological Station ID**	**Reach Length (miles)**	**Use Class**	Fish IBI	Invert IBI	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	Ammonia -NH_3	**Aquatic Life**	**Aquatic Rec. (Bacteria)**
07010205-654, Pioneer Creek, T118 R24W S31, north line to T118 R24W S31, south line	12UM037	1.68	WWg	EXS	EXS	NA	NA			NA	NA	IMP	
07010205-593, Unnamed creek, Mud Lk (10-0094-00) to Rice Lk (86-0032-00)		3.31	WWg			EXS	MTS		MTS	MTS	MTS	IMP	IMP
07010205-526, Spurzem Creek, Winterhaller Lk to Lk Independence		2.11	WWg				MTS					IF	
07010205-564, Unnamed creek, Rice Lk to N Fk Crow R		1.06	WWg			IF	MTS	MTS	MTS	MTS	IF	NA	SUP
07010205-653, Pioneer Creek, Lk Independence to T118 R24W S30, south line		7.09	WWg			EXS	MTS	NA	MTS	MTS	MTS	IMP	IMP
07010205-594, Deer Creek, Unnamed cr to Ox Yoke Lk		2.39	WWg			EXS	MTS		MTS	MTS	MTS	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

Table 52. Minnesota Stream Habitat Assessment (MSHA): Rice Lake Subwatershed.

# Visits	Biological Station ID	Reach Name	Channel Condition	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	12UM037	Pioneer Creek	natural	2	9	16	11	15	53	fair
Average Habitat Results: *Rice Lake Subwatershed*				2	9	16	11	15	53	**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 53. Channel Condition and Stability Assessment (CCSI): Rice 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	12UM037	Pioneer Creek	28	21	14	5	68	moderately unstable
Average Stream Stability Results: *Rice Lake Subwatershed*			**28**	**21**	**14**	**5**	**68**	**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 54. Outlet water chemistry results: Rice Lake Subwatershed.

Station location:	Unnamed Stream at T-11, 3 mi NE of Watertown						
STORET/EQuIS ID:	S006-989						
Station #:	12UM036						
Parameter	Units	# of Samples	Minimum	Maximum	Mean	WQ Standard[1]	# of WQ Exceedances[2]
Un-ionized Ammonia	ug/L	9	2.7	61	29	40	4
Chloride	mg/L	8	14.9	39.8	31.8	230	
Dissolved Oxygen (DO)	mg/L	19	0.77	13.65	5.25	5	8
pH		19	7.39	9.01	8.24	6.5 - 9	1
Secchi Tube	100 cm	17	7	79	30	10	1
Total suspended solids	mg/L	8	24	70	39	65	2
Escherichia coli (geometric mean)	MPN/100ml	15	32.6	94.8		126	
Escherichia coli	MPN/100ml	15	4.1	1699.95	308.3	1260	1
Chlorophyll-a, Corrected	ug/L						
Inorganic nitrogen (nitrate and nitrite)	mg/L	8	<0.03	0.99	0.17		
Kjeldahl nitrogen	mg/L	6	2.07	6.82	3.75		
Orthophosphate	ug/L						
Pheophytin-a	ug/L						
Phosphorus	ug/L	8	253	1120	664		
Specific Conductance	uS/cm	19	316	493	413		
Temperature, water	deg °C	19	12.83	28.04	22.77		
Sulfate	mg/L	8	<3	17.1	5.6		
Hardness	mg/L	8	151	187	166		

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

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

Table 55. Lake assessments: Rice Lake Subwatershed.

Name	DNR Lake ID	Area (acres)	Trophic Status	Percent Littoral	Max. Depth (m)	Mean Depth (m)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Mean Secchi (m)	AQR Support Status	AQL Support Status
Oak	10-0093-00	287	H	100	2.7	1.1	NT	135	64	0.9	NS	NA
Mud	10-0094-00	209	H	100	2.1	*1.0		202	141	0.3	NS	NA
Swede	10-0095-00	312	H	100	1.8	*1.4	NT	369	125	0.5	NS	NA
Peter (North Bay)	27-0147-02	14	E		20.7		NT	53	26	3.0	NS	NA
Spurzem	27-0149-00	73	H	57	11		NT	153	71	1.0	NS	NA
Half Moon	27-0152-00	31	H	55	7.9		D	129	50	1.0	NS	NA
Ardmore	27-0153-00	11	H	90	6.1			218	106	0.5	NS	NA
Independence	27-0176-00	814	E	51	17.7	4.8	NT	57	29	1.4	NS	IF
Ox Yoke	27-0178-00	93	H	100	1.2		NT			0.7	IF	NA
North Little Long	27-0179-01	49	M	78	23.2	1.6	D	17	4.6	4.2	FS	IF
South Little Long	27-0179-02	17	M		12.2	3.7	NT	16	4.5	4.8	FS	NA
North Whaletail	27-0184-01	347	H	100	3.1	1.6	NT	82	37	0.6	NS	IF
South Whaletail	27-0184-02	151	H	66	7.1	3.7	I	53	29	1.1	NS	IF
Robina	27-0188-00	234	H					143	78	0.7	NS	NA
Irene	27-0189-00	19	H					177	68	0.7	NS	NA
Rice	86-0032-00	140	H	100	0.6	*0.3		349	81	0.6	NS	NA

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

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

* Mean depth was derived from aerial and topographic map

Biological monitoring

Biological monitoring was conducted at only one location in the Rice Lake subwatershed. Pioneer Creek (-654) was sampled and had a macroinvertebrate IBI score just above the general use threshold. Despite meeting the IBI criteria, this creek was determined to be impaired for aquatic life. Low macroinvertebrate taxa richness, a biological condition gradient score of five (indicating major shifts in the macroinvertebrate community), severe bank erosion as well as extensive filamentous algal growth provided several lines of evidence that this stream was impaired for aquatic life. Since the macroinvertebrate IBI score was well within the 90% confidence interval of the threshold, examination of further evidence was required in order to determine the status of Pioneer Creek. The fish community was characterized by a dominance of tolerant species and an absent of sensitive or darter taxa and fell far below the impairment threshold.

Water quality monitoring

Rice Creek is split into sixteen AUIDs, four of which contains enough chemistry data for assessment. The unnamed creek is split into two AUIDs, the headwaters portion flows from Mud Lake (10-0094-00) north to Rice Lake (86-0032-00). The downstream AUID flows from Rice Lake to the confluence with the South Fork Crow River. This reach downstream of Rice Lake is very heavily influenced by the lake therefore a representative aquatic life stream assessment cannot be made. Both reaches of unnamed creek were determined to not support aquatic recreation due to elevated bacteria levels. The headwaters portion of the creek was determined to be impaired for aquatic life due to the low dissolved oxygen that occurs throughout the AUID. Deer Creek flows into Ox Yoke Lake (27-0178-00) and was determined not supporting for aquatic life (i.e. dissolved oxygen) and aquatic recreation (i.e. bacteria). Pioneer Creek flows from Independence Lake 7 miles then is split into 2 other AUID and then empties in to Ox Yoke Lake. Pioneer Creek was also determined not supporting for aquatic life (i.e. dissolved oxygen) and aquatic recreation (i.e. bacteria). The high levels of phosphorus and significant dissolved oxygen fluctuation are indicative of a potential eutrophication stress to aquatic life. The high levels of un-ionized ammonia were noted to be taken from standing water and during very low flow events which resulted in the high values.

Sixteen of the forty lakes greater than four hectares (10 acres) were reviewed for the aquatic recreation use in the watershed (Table 55). The lakes are a mix of deep and shallow lakes in the North Central Hardwood ecoregion (NCHF). Every shallow lake is impaired for aquatic recreation use except for Ox Yoke which doesn't have enough data for an assessment decision. Shallow lakes in this subwatershed are going to have internal sediment loading and as a result of wind re-suspension, the total phosphorus levels are high. Peter (North Bay) Lake is located in the headwaters west of Loretto. Data from 2009 to 2011 show water quality that meets the North Central Hardwoods Forest standard, but the addition of the 2013 data to the overall chemistry dataset yields significantly higher phosphorus and chlorophyll-*a* levels. The increase in these may be in indication that this lake is trending in the wrong directions; these issues should be investigated and addressed. A large wetland west of the lake is a contributor to Peter (North Bay) Lake but no aerial land use changes occur from 2011 to 2013. Factors contributing to this significant decrease in water quality are unknown at this time. North Whaletail is located west of Mound. North Whaletail Lake has a lower level of total phosphorus compared to the other shallow lakes which can be attributed to having a small watershed with a large fringe of wetland vegetation that surrounds the lake. South Whaletail has similar attributes but is considered a deep lake, however both lakes exceed their respective standards. Independence Lake located north of the town of Maple Plain is heavily urbanized. The large amount of wetland and undeveloped area to the east of the lake can potentially help reduce the runoff to the lake, but is not enough to prevent impairment. North and South Little Long Lake are located northwest of the town of Mound. Both have very low amounts of phosphorus, chlorophyll-*a* and high Secchi measurements. These results can be contributed to the small lakeshed and no direct stream flow from developed land use. The good water quality is a direct reflection of the surrounding landscape which is mostly forest and some wetland.

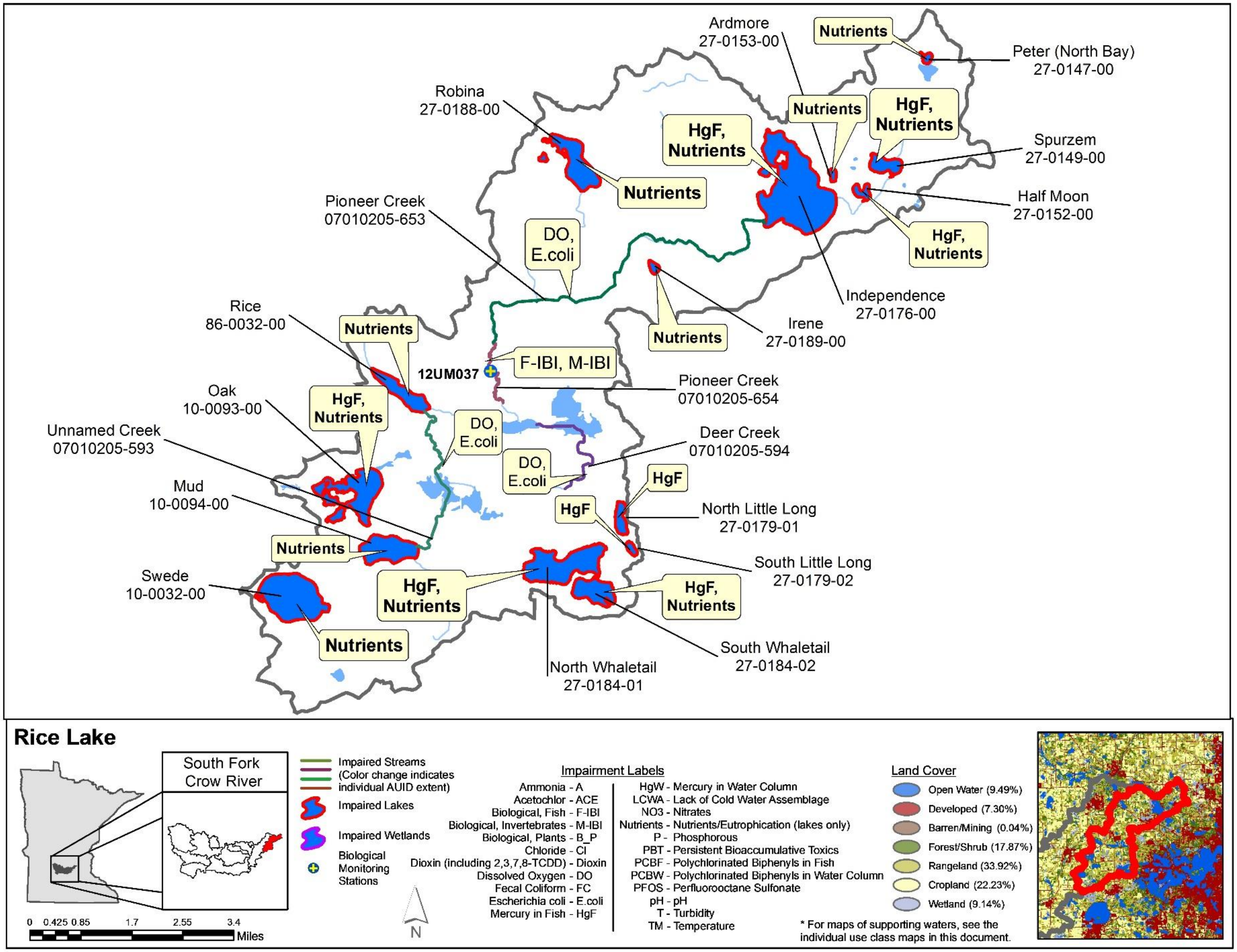

Figure 29. Currently listed impaired waters by parameter and land use characteristics in the Rice Lake Subwatershed.

Watershed-wide results and discussion

Assessment results and data summaries are included below for the entire HUC-8 watershed unit of the South Fork Crow River Watershed, grouped by sample type. Summaries are provided for load monitoring data results near the mouth of the river, aquatic life and recreation uses in streams and lakes throughout the watershed, and for aquatic consumption results at select river and lake locations along the watershed. Additionally, groundwater monitoring results and long-term monitoring trends are included where applicable.

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

Pollutant load monitoring

The South Fork Crow River is monitored on Bridge Avenue at Delano, approximately six river miles above the confluence with the main stem of the Crow River and approximately 34 miles above the confluence of the Crow River with the Mississippi River. 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, 2013). Of the state's three RNRs (North, Central, South), the South Fork Crow River's monitoring station is located within the South RNR.

Annual flow weighed mean concentrations (FWMCs) were calculated for years 2010-2012 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 ten percent and greater, over the most recent ten 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 ten percent 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. Elevated levels of total suspended solids (TSS) and nitrate plus nitrite-nitrogen (NO_3 + NO_2-N) are generally regarded as "non-point" source derived pollutants originating from many small diffuse sources such as urban or agricultural runoff. Excess total phosphorus (TP) and dissolved orthophosphate (DOP) can be attributed to both "non-point" as well as "point" or end of pipe sources such as industrial or 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, and NO_3 + NO_2-N levels tend to be elevated.

Total suspended solids (TSS)

Water clarity refers to the transparency of water. The lack of transparency or "cloudiness" of water is 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. Low transparency 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 TSS, further compounding the problem. Periods of high TSS 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 total suspended solids were adopted into State Rule Ch 7050 in 2014 and approved by the EPA in January 2015. Within the South RNR, a river is considered impaired when greater than ten percent of the individual samples exceed the TSS standard of 65 mg/L. (MPCA, 2011). In 2010, no samples exceeded the standard. In 2011, only one sample exceeded the standard in August after a rainfall event. In 2012, there were nine samples that exceeded the standard, most of which were in response to rainfall events. Table 56 shows that 2011 carried the highest load, which relates well with the runoff data presented in Figure 18.

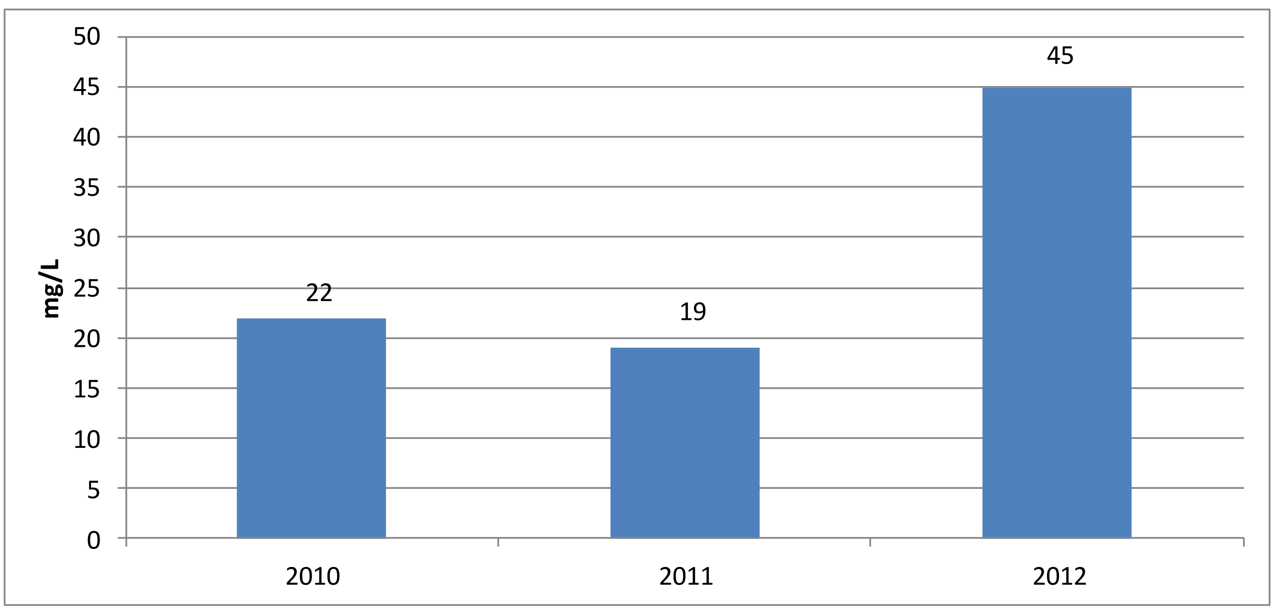

Figure 30. Total suspended solids (TSS) flow weighted mean concentrations for the South Fork Crow River at Delano.

Table 56. Annual Pollutant Loads by Parameter Calculated for the South Fork Crow River at Delano.

	2010	**2011**	**2012**
Parameter	Mass (kg)	Mass (kg)	Mass (kg)
Total Suspended Solids	23,053,220	24,095,400	19,596,630
Total Phosphorus	270,617	292,834	*
Dissolved Orthophosphate	186,596	219,814	88,162
Nitrate + Nitrite Nitrogen	4,886,144	6,983,383	1,821,166

*TP was not calculated for 2012 due to laboratory equipment errors.

Total phosphorus (TP)

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, dissolved oxygen flux, chlorophyll-a) must also occur along with the numeric TP violation for the water to be listed. A comparison of the 2010 and 2011 data collected during the summer averaging period show TP exceedances occurred 100% of the time. Often early spring concentrations are below the TP standard and by mid-May concentrations increase above the TP standard. Mean TP concentration values for samples taken during the summers of 2010 and 2011 were 0.301 mg/L and 0.298 mg/L, respectively. The 2012 total phosphorus data was not included due to analytical equipment errors at the Minnesota Department of Health Environmental Laboratory. Figure 31 illustrates FWMCs greater than the standard, which also includes data throughout the year (not just summer values). Table 56 lists annual loads for 2010-2012. High loading totals reflect consistently high concentrations of TP found in samples throughout both years.

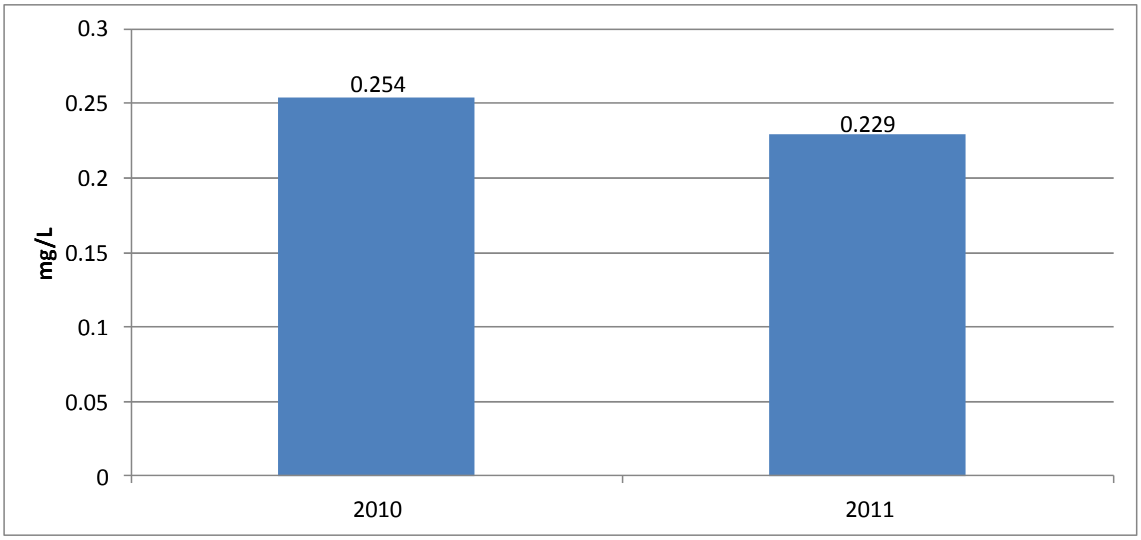

Figure 31. Total phosphorus (TP) flow weighted mean concentrations for the South Fork Crow River at Delano.

Dissolved orthophosphate (DOP)

Dissolved orthophosphate (DOP) is a water soluble form of phosphorus that is readily available to algae (bioavailable) (MPCA and MSUM 2009). While orthophosphates occur naturally in the environment, river and stream concentrations may become elevated with additional inputs from waste water treatment plants, noncompliant septic systems, and fertilizers in urban and agricultural runoff. Calculated FWMCs from 2010-2012 were 0.175 mg/L, 0.172 mg/L, and 0.213 mg/L, respectively. DOP FWMCs accounted for 69% of total phosphorus in 2010 and 89% of total phosphorus in 2011. A sharp decrease in annual DOP loading in 2012 (see Table 56), despite higher calculated FWMC values, may be related to a less intense annual peak flow and lesser estimated surface runoff when compared to the two previous years.

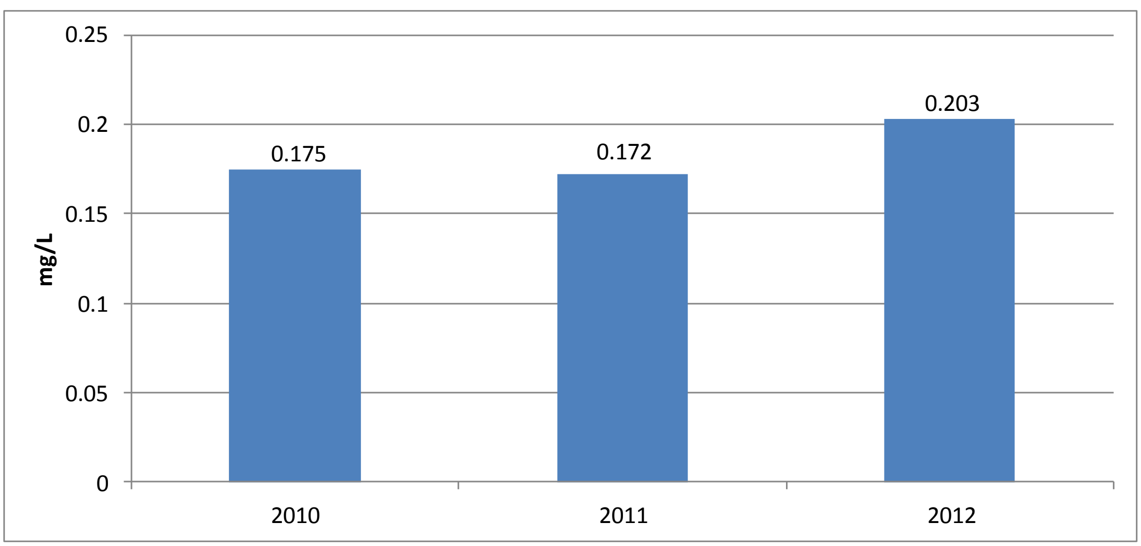

Figure 32. Dissolved orthophosphate (DOP) flow weighted mean concentrations for the South Fork Crow River at Delano.

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 nitrite-N to be readily converted to nitrate-nitrogen is the basis for the combined laboratory analysis of nitrate plus nitrite-nitrogen (NO_3 + NO_2-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. Environmentally, studies have shown that the elevated nitrate-nitrogen levels in the Minnesota River basin contribute to hypoxia (low levels of dissolved oxygen) in the Gulf of Mexico. This occurs by nitrate-nitrogen stimulating the growth of algae which, through death and biological decomposition, consume large amounts of dissolved oxygen and thereby threaten aquatic life (MPCA and MSUM, 2009).

Nitrate-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. 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 chronic value for Class 2B (warm water) surface waters is 4.9 mg/L nitrate-N for a 4-day duration. In addition, 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 33 shows the NO_3 + NO_2-N FWMCs over the three-year period for the South Fork Crow River at Delano monitoring site. The FWMCs for 2010 and 2012 fell below the draft acute and draft chronic nitrate-N standards for Class 2B surface waters, but the 2011 FWMC exceeded the draft chronic Class 2B nitrate-N standard. Exceedance of the draft chronic Class 2B nitrate-N standard occurred throughout the year although there may be some relationship with runoff events. Concentrations were typically low during late summer, low flow periods. Table 56 lists annual NO_3 + NO_2-N loads which show a sharp decrease in 2012. This may be related to fewer and less intense high flow events in 2012 when compared to the previous two years. There were no documented exceedances of the draft acute Class 2B standard for nitrate-N during the reporting period.

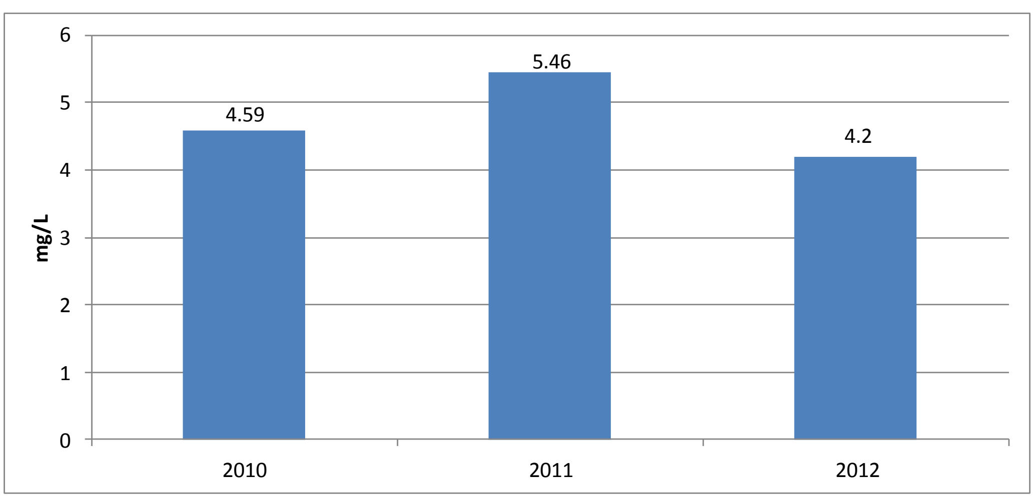

Figure 33. Nitrate + Nitrite Nitrogen (NO3 + NO2-N) flow weighted mean concentrations for the South Fork Crow River at Delano.

Stream water quality

88 of the 128 stream AUIDs were assessed (Table 57). Of the assessed streams, only six streams were considered to be fully supporting of aquatic life and four were fully supporting of aquatic recreation. Six AUIDs were not assessed due to their classification as limited resource waters.

Throughout the watersheds, 59 AUIDs are non-supporting for aquatic life and/or recreation. Of those AUIDs, 46 are non-supporting for aquatic life and 14 are non-supporting for aquatic recreation. Common water quality issues among the streams in the South Fork Crow River Watershed are high levels of TSS and low transparency. There is one delisting for turbidity on the main stem of the South Fork Crow River and by viewing the aerial photos of the river you can see large buffers that cover the river's edge. There are some sections of the watershed that have low levels of dissolved oxygen which can affect the biology of the stream. Many of the streams also contain high levels of bacteria and that is shown in the new aquatic recreation impairments. Excessive nutrient enrichment in streams is a widespread stressor throughout this watershed

Table 57. Assessment summary for stream water quality in the South Fork Crow River Watershed.

				Supporting		Non-supporting			
Watershed	**Area (acres)**	**# Total AUIDs**	**# Assessed AUIDs**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
South Fork Crow River 07010205 **HUC 8**	**818,099**	**128**	**88**	**6**	**4**	**46**	**14**	**9**	
Headwaters South Fork Crow River 0701020501-*01*	138,683	24	8	2		3	1	3	
Upper South Fork Crow River 0701020502-01	120,517	16	10	2		8	1		
Hoff Lake 0701020502-02	26,040	6	2		1	1		1	
Middle South Fork Crow River 0701020503-01	95,756	10	7	1		6	2		1
Crane Creek 0701020503-02	33,773	10	3	1		2	1		
Otter Creek 0701020503-03	24,738	3	3			3	1		
Judicial Ditch No. 28A 0701020504-01	81,575	11	7			6	1	2	
Judicial Ditch No. 15 0701020505-01	63,673	6	5			4	1		
Buffalo Creek 0701020506-01	121,574	13	5			5	1		
Lower South Fork Crow River 0701020507-01	76,248	15	6		2	4	2	2	
Rice Lake 0701020507-02	35,524	14	6		1	4	3	1	

Lake water quality

Of the 179 lakes greater than 4 hectares (10 acres), 52 lakes had sufficient data to complete an assessment. High levels of nutrients on 37 lakes caused impairment for aquatic recreation. The impairments are a mix of shallow and deep lakes. Many of the shallow lakes would continuously resuspend bottom sediments from wind action throughout the open water season. The resuspension of sediments combined with high temperatures and pH can result in internal release of phosphorus into the water column. In addition, the majority of the impaired lakes lie within large agricultural dominated catchment areas which can have the potential for high amounts of external nutrient to contribute to the water bodies. The deeper impaired lakes have the ability to absorb higher levels of nutrients and limit the amount of internal nutrient release through mixing which is shown in the total phosphorus summer average levels. In contrast the fully supporting lakes are deep and in small forest and wetland dominated catchments.

Table 58. Assessment summary for lake water chemistry in the South Fork Crow River Watershed.

			Supporting		Non-supporting			
Watershed	**Area (acres)**	**Lakes >10 Acres**	**# Aquatic Life**	**# Aquatic Recreation**	**# Aquatic Life**	**# Aquatic Recreation**	**Insufficient Data**	**# Delistings**
South Fork Crow River 07010205 **HUC 8**	**818,099**	**179**		**4**		**37**	**41**	
Headwaters South Fork Crow River 0701020501-*01*	138,683	38		1		8	13	
Upper South Fork Crow River 0701020502-01	120,517	31				3	4	
Hoff Lake 0701020502-02	26,040	20		1		5	5	
Middle South Fork Crow River 0701020503-01	95,756	14				2	2	
Crane Creek 0701020503-02	33,773	13				2	2	
Otter Creek 0701020503-03	24,738	3					2	
Judicial Ditch No. 28A 0701020504-01	81,575	4				1	3	
Judicial Ditch No. 15 0701020505-01	63,673							
Buffalo Creek 0701020506-01	121,574	12				1	2	
Lower South Fork Crow River 0701020507-01	76,248	18				2	3	
Rice Lake 0701020507-02	35,524	26		2		13	5	

Remote sensing

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

Remote sensing data was used to describe lake transparencies on 65 lakes without water chemistry data in the South Fork Crow River Watershed. Seventeen lakes had estimated transparencies greater than the Western Corn Belt Plains Ecoregion Lake Eutrophication Standard of 0.9 m. Twenty four lakes had estimated transparencies greater than the Western Corn Belt Plains Ecoregion Shallow Lake Eutrophication Standard of 0.7 m. Five lakes had estimated transparencies greater than the North Central Hardwood Forest Ecoregion Lake Eutrophication Standard of 1.4 m. Seventeen lakes had estimated transparencies greater than the North Central Hardwood Forest Ecoregion Shallow Lake Eutrophication Standard of 1.0 m. Lakes that had estimates of transparencies that fell below their respective eutrophication standard may warrant further investigation into water quality conditions. However, confounding variables must be examined as well, such as lake depth and color, which may impact the remote sensing data. Overall, transparencies look to be in poor (n=33) to fair (n=30) condition for the majority of lakes without water chemistry data. Only two lakes had transparencies greater than two meters.

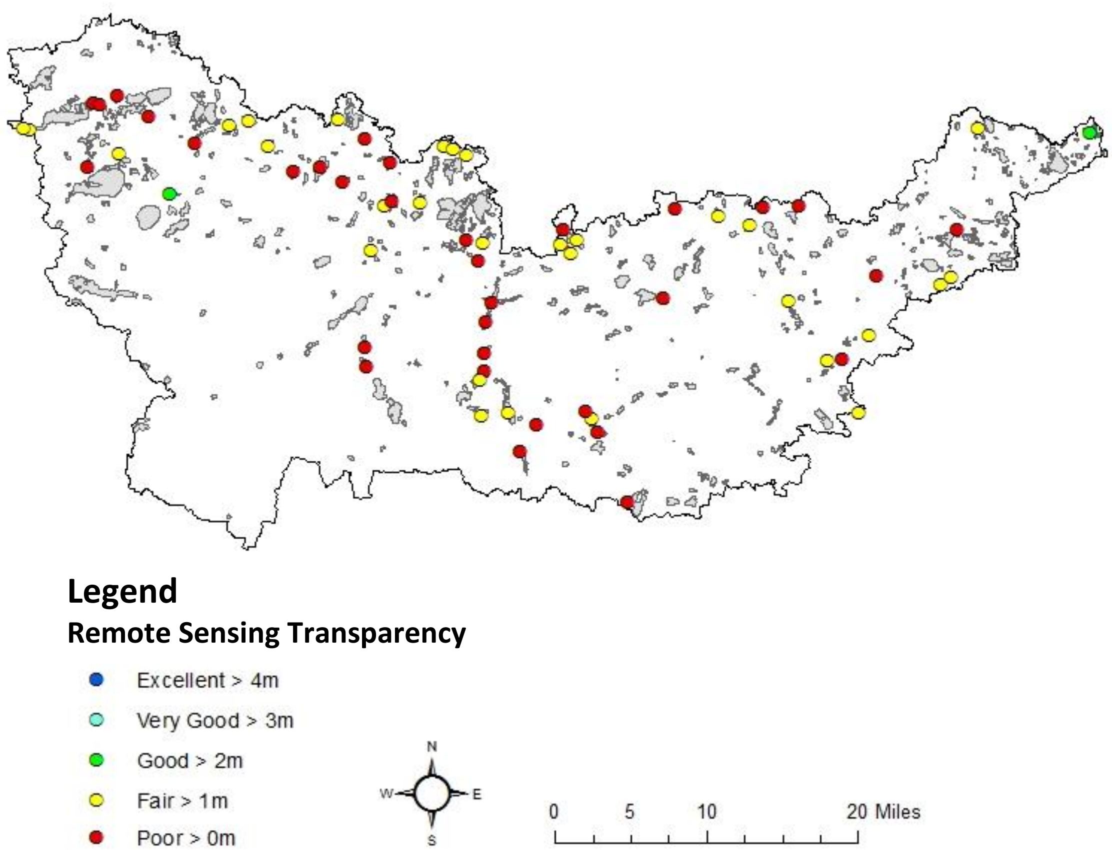

Figure 34. Lakes in the South Fork Crow River Watershed with remote sensing transparency data.

Fish contaminant results

Twenty fish species from the river and lakes were tested for contaminants. A total of 1,171 fish were collected for contaminant analysis between 1983 and 2013. Fish species are identified by codes that are defined by their common and scientific names in Table 59.

Table 60 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).

Fish from the South Fork Crow River were most recently collected in 2012. The mercury concentrations were measured in five shorthead redhorse (SRD) and eight walleye. The mean concentrations were 0.243 and 0.318 mg/kg, respectively. Shorthead redhorse had not been previously tested for contaminants in the river. Walleye had been tested in 1994 and had a mean mercury concentration of 0.238 mg/kg. The highest mercury concentration from the entire record for this watershed was 0.616 mg/kg in a walleye collected from the river in 2012.

Fourteen lakes and the South Fork Crow River are listed as impaired for mercury in fish tissue. They are identified in Table 60 with a red asterisk (*). None of the waterways are impaired for PCBs or PFOS in fish tissue. All of the impaired waterways are addressed by the Statewide Mercury TMDL. Site specific TMDLs are not needed.

Most of the PCB concentrations in fish tissue from the river were near or below the reporting limit. The highest PCB concentration was 0.082 mg/kg in a common carp collected from Belle Lake in 1992. In the South Fork Crow River, two shorthead redhorse and two walleyes were tested for PCBs in 2012. Both shorthead redhorse and one of the walleye did not have PCB concentrations above the reporting limit (0.025 mg/kg). Another walleye had a measured concentration of only 0.05 mg/kg.

Perfluorooctane sulfonate (PFOS) concentration is measured in µg/kg (ppb), which is 1000 times lower units than mercury and PCBs. The impairment threshold is the threshold for a meal per month fish consumption advisory: 200 µg/kg. PFOS concentration measurements from a variety of species tested from the seven lakes were below the reporting limit (~5 µg/kg) and the few measureable concentrations were very low. The highest PFOS concentration was 19 µg/kg in a largemouth bass from Spurzem Lake (in 2009). The next highest concentration was 9.32 µg/kg in a northern pike from the same lake.

Overall, the fish contaminant results PCBs and PFOS are not a contaminant issue in the tested waterways of this watershed. Mercury remains a concern for the South Fork Crow River and the 14 impaired lakes. Mercury concentrations should be retested in the same fish species at five year intervals to assess if mercury levels are changing.

Table 59.Fish species codes, common names, and scientific names.

Species	Common name	Scientific name
BBU	Bigmouth buffalo	*Ictiobus cyprinellus*
BGS	Bluegill sunfish	*Lepomis macrochirus*
BKB	Black bullhead	*Ameiurus melas*
BKS	Black crappie	*Pomoxis nigromaculatis*
BRB	Brown bullhead	*Ameiurus nebulosus*
C	Common Carp	*Cyprinus carpio*
CHC	Channel catfish	*Ictalurus punctatus*
LMB	Largemouth bass	*Micropterus salmoides*

Species	Common name	Scientific name
NP	Northern pike	*Esox lucius*
SRD	Shorthead redhorse	*Moxostoma macrolepidotum*
WE	Walleye	*Sander vitreus*
WHS	White crappie	*Pomoxis annularis*
WSU	White sucker	*Catostomus commersoni*
YEB	Yellow bullhead	*Ameiurus natalis*
YP	Yellow perch	*Perca flavescens*

Table 60. Summary statistics of mercury, PCBs and PFOS, by waterway-species-year.

						Length (in)			Mercury (mg/kg)				PCBs (mg/kg)			PFOS (µg/kg)		
Waterway	AUID	Species[1]	Year	Anatomy[2]	No. Fish	Mean	Min	Max	N	Mean	Min	Max	N	Min	Max	N	Min	Max
		BKS	1994	FILSK	4	9.3			1	0.150								
		C	1994	FILSK	16	18.9	16.0	22.7	5	0.134	0.070	0.260	3	<0.01	0.054			
		NP	1984	FILSK	5	19.9			1	0.240			1	<0.05				
		SRD	2012	FILSK	5	15.0	12.3	17.2	5	0.243	0.150	0.383	2	<0.025	<0.025			
			1994	FILSK	14	17.1	13.3	20.5	4	0.238	0.062	0.310	1	0.034				
		WE	2012	FILSK	8	14.5	11.5	20.5	8	0.318	0.205	0.616	2	<0.025	0.05			
South Fork Crow River*	07010105-508, -510, -511, -512, -540	WSU	1984	FILSK	5	13.5			1	0.100			1	<0.05				
		BGS	2007	FILSK	10	6.5			1	0.014						1	<0.98	
			1992	FILSK	7	7.9			1	0.100								
			2007	FILSK	10	7.3			1	0.013								
		BKS	2008	FILSK	10	7.1			1	0.027								
			1992	FILSK	10	21.0	13.1	27.0	3	0.031	0.010	0.046	2	0.022	0.082			
		C	2008	FILSK	3	26.1			1	0.098								
		LMB	2007	FILSK	3	12.4	9.7	16.0	3	0.059	0.026	0.115						
		NP	2008	FILSK	6	25.7	23.7	29.6	6	0.093	0.067	0.126						
			1992	FILSK	10	17.1	13.6	20.5	2	0.128	0.075	0.180	1	<0.01				
	47004900	WE	2008	FILSK	8	17.9	15.3	19.2	8	0.066	0.045	0.088						
Belle	47004901	NP	2013	FILSK	15	24.1	21.1	28.2	15	0.118	0.086	0.178						
		BKB	1991	FILET	8	10.7			1	0.078								
		C	1991	FILSK	7	23.0	18.5	27.4	2	0.057	0.037	0.076	1	0.017				
			1991	FILSK	3	20.5	17.6	23.3	2	0.185	0.140	0.230	1	<0.01				
			2004	FILSK	1	22.3			1	0.111	0.111	0.111						
		NP	2011	FILSK	3	17.6	13.8	24.9	3	0.105	0.053	0.158						
			1991	FILSK	18	18.9	13.8	25.5	4	0.178	0.100	0.280	1	0.016				
			1996	FILSK	10	14.9	7.8	23.2	10	0.088	0.030	0.288						
			2000	FILSK	10	16.6	15.2	20.0	10	0.068	<0.01	0.240						
			2004	FILSK	12	17.1	10.9	28.1	12	0.123	0.026	0.337						
		WE	2011	FILSK	12	14.1	11.1	17.2	12	0.063	0.024	0.099						
		WSU	1991	FILSK	2	17.8			1	0.082			1	0.012				
			1991	FILSK	10	8.7			1	0.050								
			2000	WHORG	2	8.0	7.9	8.1	2	0.050	0.020	0.080						
				FILSK	7	9.5			1	0.045								
Big Kandiyohi*	34008600	YP	2004	WHORG	3	5.7			1	0.013								

Waterway	AUID	Species[1]	Year	Anatomy[2]	No. Fish	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)			PFOS (µg/kg)		
						Mean	Min	Max	N	Mean	Min	Max	N	Min	Max	N	Min	Max
		BKB	2009	FILET	1	13.1			1	0.056								
		BKS	2009	FILSK	5	7.6			1	0.046								
		C	2009	FILSK	1	18.5			1	0.074								
Carrie	34003200	YEB	2009	FILET	3	10.2			1	0.181								
		BKS	2008	FILSK	10	8.9			1	0.050								
		C	2008	FILSK	3	26.4			1	0.043								
Cedar	43011500	NP	2008	FILSK	5	27.0	22.0	32.5	5	0.102	0.056	0.149						
		BGS	2008	FILSK	7	6.7			1	0.082								
		BKB	2002	FILET	8	12.8			1	0.066								
		BKS	2002	FILSK	7	8.5			1	0.178								
Eagle*	10012100	WE	2002	FILSK	5	20.2	11.0	24.8	5	0.332	0.104	0.423						
		BKB	1991	FILET	8	9.8			1	0.140			1	<0.01				
		C	1991	FILSK	14	20.2	16.7	23.6	2	0.068	0.046	0.090	1	<0.01				
		NP	1991	FILSK	4	19.9	17.8	22.0	2	0.160	0.150	0.170	1	<0.01				
			1991	FILSK	13	14.1	11.9	16.3	2	0.175	0.140	0.210	1	<0.01				
		WE	2011	FILSK	8	14.6	11.6	16.4	8	0.034	0.019	0.045						
		WHS	1991	FILSK	7	8.4			1	0.120								
		WSU	2011	FILSK	4	17.6			1	0.012								
Elizabeth*	34002200	YP	2011	FILSK	6	9.4	9.0	9.8	2	0.039	0.038	0.039						
		BGS	2008	FILSK	8	6.2			1	0.060								
		C	2008	FILSK	3	23.0			1	0.150								
French	43010900	NP	2008	FILSK	4	21.9	21.4	22.4	4	0.229	0.128	0.428						
		BGS	2007	FILSK	10	5.4			1	0.015						1	<0.98	
Greenleaf	47006200	LMB	2007	FILSK	5	11.0	8.4	15.5	5	0.037	0.029	0.052						
		BGS	2009	FILSK	2	8.1			1	0.204								
		BKS	2009	FILSK	5	7.6			1	0.137								
		BRB	2009	FILET	5	10.6			1	0.161								
Half Moon*	27015200	NP	2009	FILSK	5	28.0	25.5	30.9	5	0.301	0.264	0.351						
			2006	FILSK	8	6.7			1	0.054								
		BGS	2007	FILSK	10	4.7	3.7	5.9								6	<4.83	5.41
			2001	FILSK	10	7.9			1	0.060								
		BKS	2007	FILSK	5	7.6	7.1	8.7								5	<4.89	<5.00
		C	2001	FILSK	4	26.6	26.6	26.6	1	0.070			1	0.070				
Indepen- Dence*	27017600	NP	2006	FILSK	4	26.6	19.6	30.7	4	0.317	0.094	0.562						

Waterway	AUID	Species[1]	Year	Anatomy[2]	No. Fish	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)			PFOS (µg/kg)		
						Mean	Min	Max	N	Mean	Min	Max	N	Min	Max	N	Min	Max
			2007	FILSK	2	22.4	22.4	22.4								2	<5.24	<5.54
			2010	FILSK	14	25.9	18.1	35.8	14	0.151	0.051	0.495						
		WE	2001	FILSK	10	18.5	12.2	27.2	10	0.213	0.057	0.507						
		BGS	2006	FILSK	10	5.5			1	0.108								
			2000	FILSK	9	20.2	17.3	27.0	9	0.251	0.170	0.310	1	<0.01				
			2006	FILSK	11	21.9	16.3	28.3	11	0.196	0.141	0.291						
		NP	2012	FILSK	15	21.0	16.6	27.2	15	0.218	0.165	0.372						
		YEB	2006	FILET	8	11.1			1	0.171								
Little Long*	27017900	YP	2000	WHORG	8	6.1	5.7	6.5	8	0.126	0.090	0.180						
			1992	FILSK	10	6.6			1	0.068								
		BGS	2007	FILSK	5	6.1			1	<0.01						1	<0.98	
		BKS	2007	FILSK	5	8.4			1	0.023								
		C	1992	FILSK	6	18.4	13.9	22.8	2	0.027	0.019	0.034	2	<0.01	<0.01			
		CHC	1992	FILET	5	22.2	14.8	27.3	3	0.121	0.072	0.180	2	0.014	0.020			
		LMB	2007	FILSK	4	13.5	10.2	16.1	4	0.056	0.027	0.095						
		NP	1992	FILSK	13	21.9	17.9	26.0	3	0.129	0.078	0.200	1	<0.01				
Marion*	43008400	WE	1992	FILSK	14	18.5	13.9	22.4	3	0.247	0.140	0.320	1	0.028				
			2005	FILSK	8	6.3			1	0.067								
		BGS	2010	FILSK	10	6.6	6.3	6.8								2	<4.85	<4.88
		BKB	2005	FILET	8	7.6			1	0.058								
		BKS	2005	FILSK	10	7.4			1	0.051								
		LMB	2010	FILSK	5	14.6	12.4	15.9								5	<4.67	<4.98
			2005	FILSK	6	20.7	17.5	23.1	6	0.248	0.099	0.343						
Oak*	10009300	WE	2010	FILSK	6	18.9	16.3	24.8								6	<4.69	<4.93
		C	2005	FILSK	3	25.9	25.7	26.2	3	0.122	0.104	0.142	1	<0.01				
		NP	2005	FILSK	6	26.7	20.6	33.0	6	0.153	0.085	0.215						
Otter*	43008500	WHS	2005	FILSK	10	9.7			1	0.108								
		BKS	1992	FILSK	10	8.2			1	0.074								
		C	1992	FILSK	10	22.5	18.3	28.0	3	0.010	0.010	0.010	2	<0.01				
Preston	65000200	WE	1992	FILSK	8	14.9	12.4	17.3	2	0.057	0.042	0.072	1	<0.01				
			1991	FILSK	15	6.1			1	0.058			1	<0.01				
			2005	FILSK	11	6.2			1	0.113								
		BGS	2011	FILSK	10	6.5	6.2	6.7	2	0.045	0.042	0.047						
Rebecca*	27019200	BKB	1991	FILET	8	13.0			1	0.032			1	<0.01				

Waterway	AUID	Species[1]	Year	Anatomy[2]	No. Fish	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)			PFOS (µg/kg)		
						Mean	Min	Max	N	Mean	Min	Max	N	Min	Max	N	Min	Max
			2005	FILET	2	8.3			1	0.031								
		BKS	2011	FILSK	10	7.7	7.5	7.9	2	0.091	0.086	0.095						
		BRB	1983	FILET	4	12.0			1	0.060			1	<0.05				
			1991	FILSK	2	19.6	18.2	21.0	2	0.037	0.032	0.041	2	<0.01	<0.01			
		C	2005	FILSK	1	20.0			1	0.045								
			1983	FILSK	5	13.0			1	0.090			1	<0.05				
		WE	1991	FILSK	3	22.3	19.2	26.1	3	0.343	0.230	0.550	3	<0.01	<0.01			
		BGS	2009	FILSK	5	7.2			1	0.150						1	11.1	
			2003	FILSK	7	7.8			1	0.242								
		BKS	2009	FILSK	5	8.1										1	5.43	
		C	2003	FILSK	4	23.5							1	<0.01				
		LMB	2009	FILSK	1	11.8	11.8	11.8	1	0.252						1	19.0	
			2003	FILSK	5	23.5	20.3	28.2	5	0.344	0.205	0.452						
Spurzem*	27014900	NP	2009	FILSK	3	31.5	27.6	37.0	1	0.597						2	7.54	9.32
			1997	FILSK	24	19.9	17.6	25.5	24	0.121	0.030	0.440	1	<0.01				
				WHORG	24	19.9	17.6	25.5	24	0.081	0.030	0.280						
		NP	2008	FILSK	10	23.4	21.4	28.6	10	0.173	0.107	0.268						
			1997	WHORG	10	3.1	3.0	3.2	10	<0.016	<0.016	<0.016						
Stahl's*	43010400	YP	2008	WHORG	9	5.8	5.4	6.1	2	0.024	0.023	0.025						
		BGS	2013	FILSK	9	7.4	6.7	8.1	2	0.027	0.023	0.030						
		BKB	1991	FILET	8	11.2			1	0.030								
			1991	FILSK	10	6.3			1	0.170								
		BKS	2013	FILSK	10	9.7	9.1	10.2	2	0.041	0.038	0.044						
		C	2013	FILSK	5	25.6			1	0.081								
			1991	FILSK	6	18.8	17.5	20.1	2	<0.01	<0.01	<0.01	1	<0.01				
		NP	2013	FILSK	8	27.8	20.0	34.3	8	0.102	0.058	0.143						
			1991	FILSK	7	15.0	14.6	15.3	2	0.049	0.045	0.052	1	<0.01				
Star	47012900	WE	2013	FILSK	8	21.7	18.5	27.9	8	0.104	0.057	0.240						
		BKS	2007	FILSK	10	10.2			1	0.034								
		C	2007	FILSK	8	12.7			1	<0.01								
Swan	43004000	WE	2007	FILSK	6	14.9	13.1	16.6	6	0.037	0.028	0.055						
		BGS	2006	FILSK	8	7.3			1	0.071								
		BKS	2006	FILSK	8	7.1			1	0.059								
Swede	10009500	C	2006	FILSK	8	16.8			1	0.021								

Waterway	AUID	Species[1]	Year	Anatomy[2]	No. Fish	Length (in)			Mercury (mg/kg)				PCBs (mg/kg)			PFOS (µg/kg)		
						Mean	Min	Max	N	Mean	Min	Max	N	Min	Max	N	Min	Max
		YP	2006	FILSK	10	7.9			1	0.061								
		BKB	2013	FILET	5	9.3			1	0.060								
		C	2013	FILSK	4	18.3			1	0.046								
Thompson	47015900	YP	2013	FILSK	5	8.7			1	0.076								
		BGS	2005	FILSK	6	6.0			1	0.016								
			1993	FILSK	10	6.8			1	0.025								
		BKS	2005	FILSK	10	6.1			1	0.028								
			1993	FILSK	3	26.2			1	0.044			1	0.011				
		C	2005	FILSK	4	25.6			1	0.090			1	<0.01				
			1993	FILSK	13	26.9	24.0	30.1	3	0.081	0.060	0.120	1	<0.01				
		NP	2005	FILSK	5	29.0	25.7	33.0	5	0.152	0.071	0.209						
		WHS	2005	FILSK	2	10.1			1	0.059								
		WSU	1993	FILSK	3	19.8			1	0.028								
Whaletail*	27018400	YEB	2005	FILET	8	10.9			1	0.114								
		BBU	2013	FILSK	3	14.8			1	0.055								
		BGS	2013	FILSK	3	6.8			1	0.070								
		BKS	2013	FILSK	5	7.0			1	0.055								
		C	2013	FILSK	3	20.1			1	0.046								
		NP	2013	FILSK	6	20.8	18.1	27.2	6	0.287	0.171	0.564						
		WE	2013	FILSK	3	15.8	11.7	18.3	3	0.303	0.136	0.413						
Willie	47006100	WSU	2013	FILSK	1	17.2			1	0.036								
		BGS	2004	FILSK	10	7.7			1	0.344								
			2004	FILSK	10	9.7			1	0.450								
		BKS	2009	FILSK	9	7.2	7.0	7.4								2	<4.72	<5.05
			2004	FILSK	3	23.9			1	0.215			1	0.040				
		C	2009	FILSK	6	19.9	15.2	24.6	2	0.175	0.127	0.222						
			2004	FILSK	5	23.0	18.2	26.2	5	0.449	0.364	0.480						
Winsted*	43001200	NP	2009	FILSK	6	24.7	21.3	29.1								6	<4.88	6.66

* Impaired for mercury in fish tissue as of 2012 Draft Impaired Waters List; categorized as EPA Class 4a for waters covered by the Statewide Mercury TMDL.

1 Species codes are defined in Table FC1

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

Groundwater monitoring

Groundwater quality

A baseline study conducted by the MPCA found that the groundwater quality in this region is considered poor when compared to other areas with similar aquifers (MPCA, 1998). The results of this study identified exceedances of drinking water criteria in the four different aquifers found in the region: Cretaceous, Precambrian, buried sand and gravel, and surficial sand and gravel aquifers. The exceedances identified manganese and boron as the two most important chemicals of concern associated with natural sources, and nitrate as the primary concern associated with anthropogenic sources.

There is currently one MPCA Ambient Groundwater Monitoring well within the South Fork Crow River Watershed. Results from this well have not differed greatly from those found in the baseline study. Figure 35 displays the locations of ambient groundwater wells in and around the specified watershed.

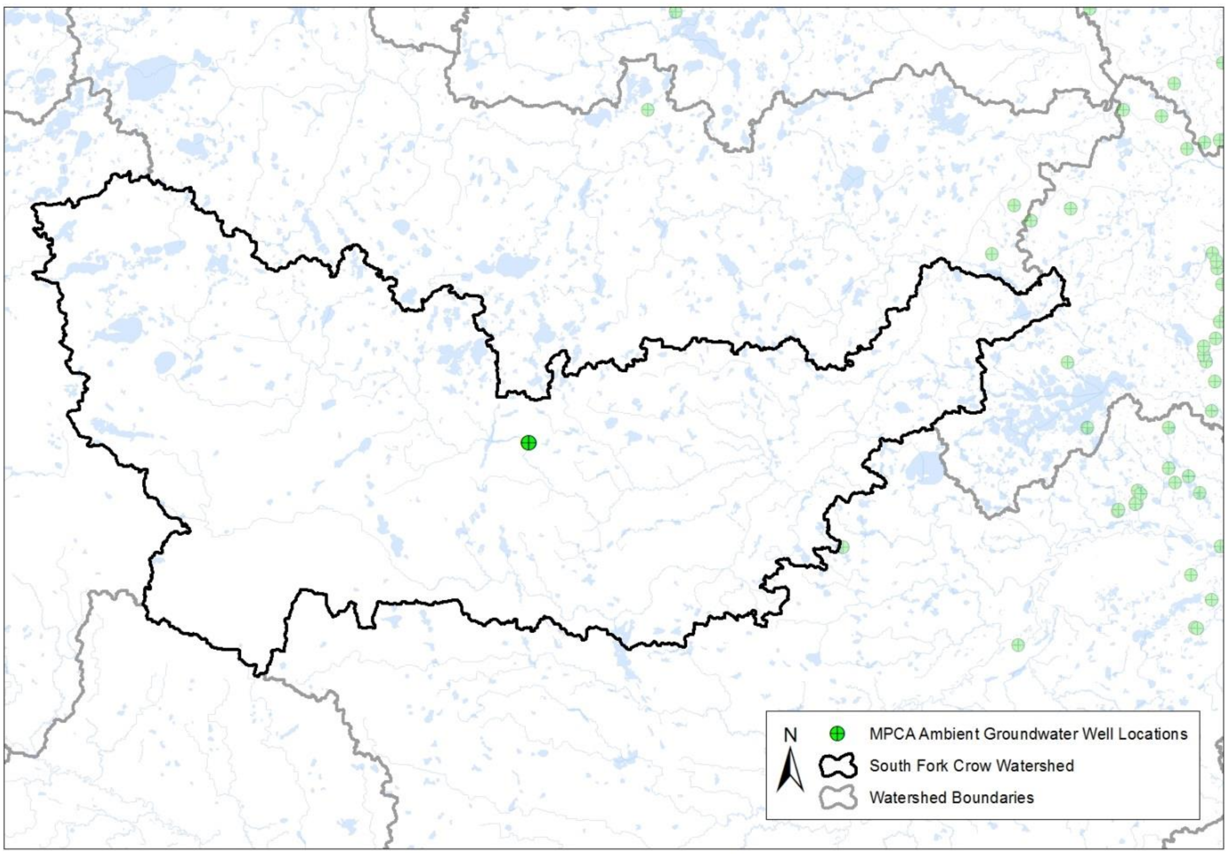

Figure 35. MPCA ambient groundwater monitoring well locations around the South Fork Crow River Watershed.

The Minnesota Department of Agriculture monitors pesticides and nitrate on an annual basis in groundwater across agricultural areas in the state. The South Fork Crow River Watershed lies within MDA's Pesticide Monitoring Region 8 (PMR 8), also referred to as the South Central Region, which is comprised of primarily loam and clay loam soils with infiltration rates ranging from poor to good. In 2013, pesticides were detected in this region but not at levels exceeding drinking water criteria (MDA, 2014). Unfortunately, there are no MDA groundwater monitoring locations specifically within the South Fork Crow River Watershed.

The 2013 Water Quality Monitoring Report also determined that nitrate was present in 63% of the wells sampled in PMR 8 and at a median concentration of 2.75 milligrams per liter (mg/L) (MDA, 2014). Of those samples, 15% were at or below background level of 3.00 mg/L, 22% were within 3.01 and 10.00 mg/L, and 26% were above drinking water standard of 10.00 mg/L (MDA, 2014).

Additionally, a MPCA report on the statewide condition of Minnesota's groundwater found that Central and Southwestern regions have the greatest nitrate concentrations in the state, with approximately 20% of the shallow sand and gravel aquifer wells exceeding the maximum contaminant level (Kroening and Ferrey, 2013).

Another source of information on groundwater quality comes from the Minnesota Department of Health. Mandatory testing for arsenic of all newly constructed wells has found that 10.4% of all wells installed from 2008 to 2013 have arsenic levels above the MCL for drinking water of 10 micrograms per liter (MDH). In Southwest Minnesota, the majority of new wells are within the water quality standards for arsenic levels, but there are some exceedances (Figure 36).

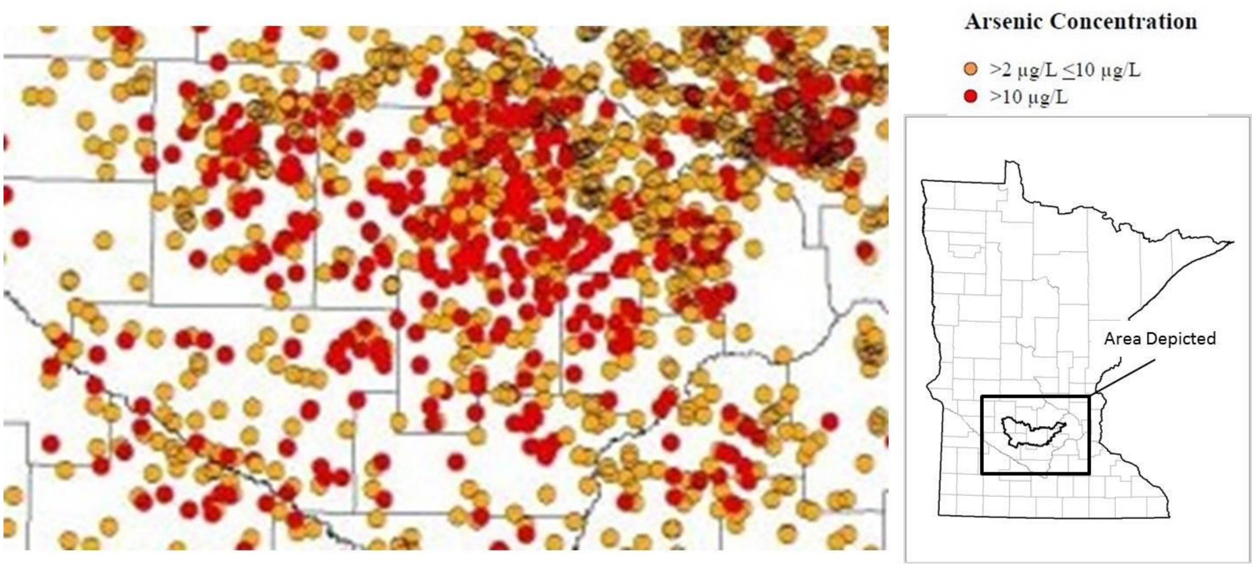

Figure 36. Arsenic Occurrence in New Wells (2008-2012) (Source: MDH, 2012)

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 Department of Natural Resources 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 South Fork Crow River Watershed are mostly for municipal and industrial use (agricultural).

Figure 38 displays total groundwater withdrawals from the watershed from 1991-2011 are displayed below as blue diamonds with total surface water withdrawals as red squares. During this time period within the South Fork Crow River Watershed, both groundwater and surface water exhibit statistically significant rising trends (groundwater p=0.01, surface water p=0.001).

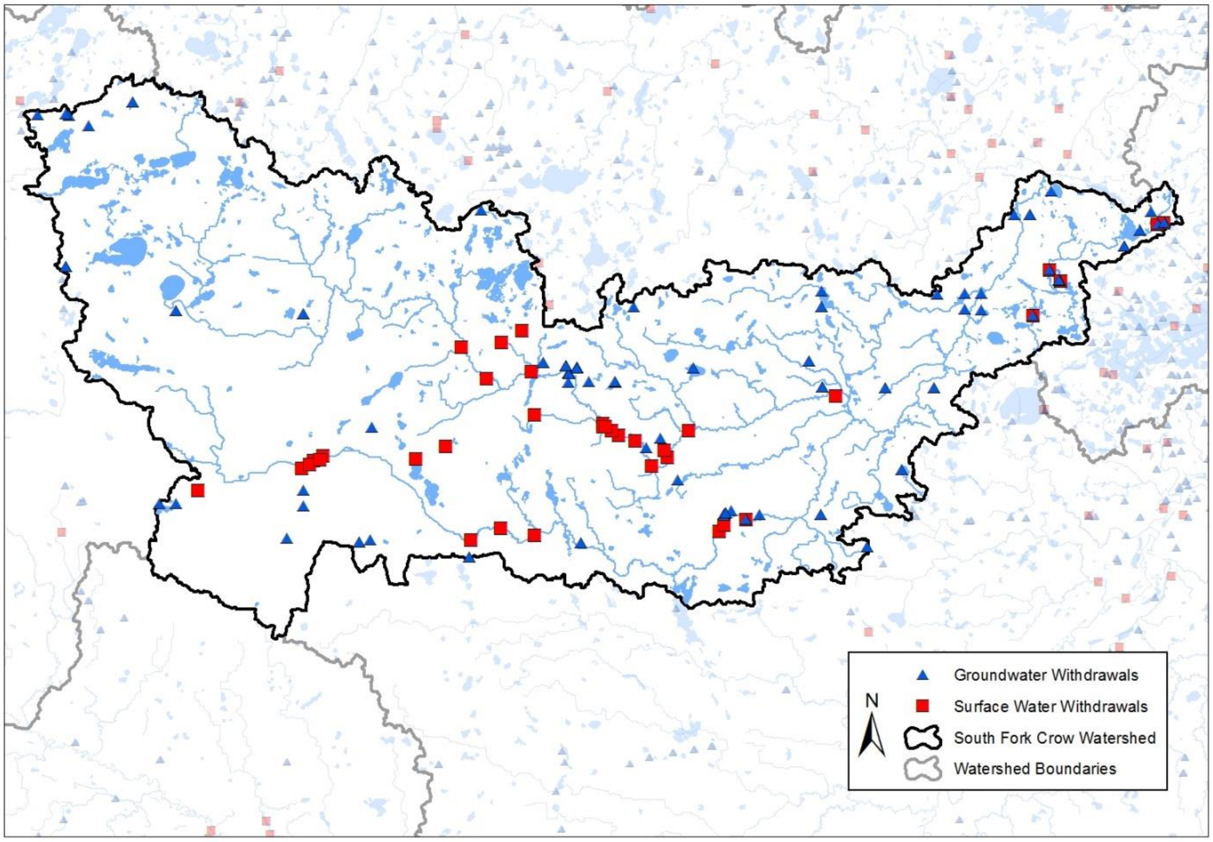

Figure 37. Locations of permitted groundwater withdrawals in the South Fork Crow River Watershed.

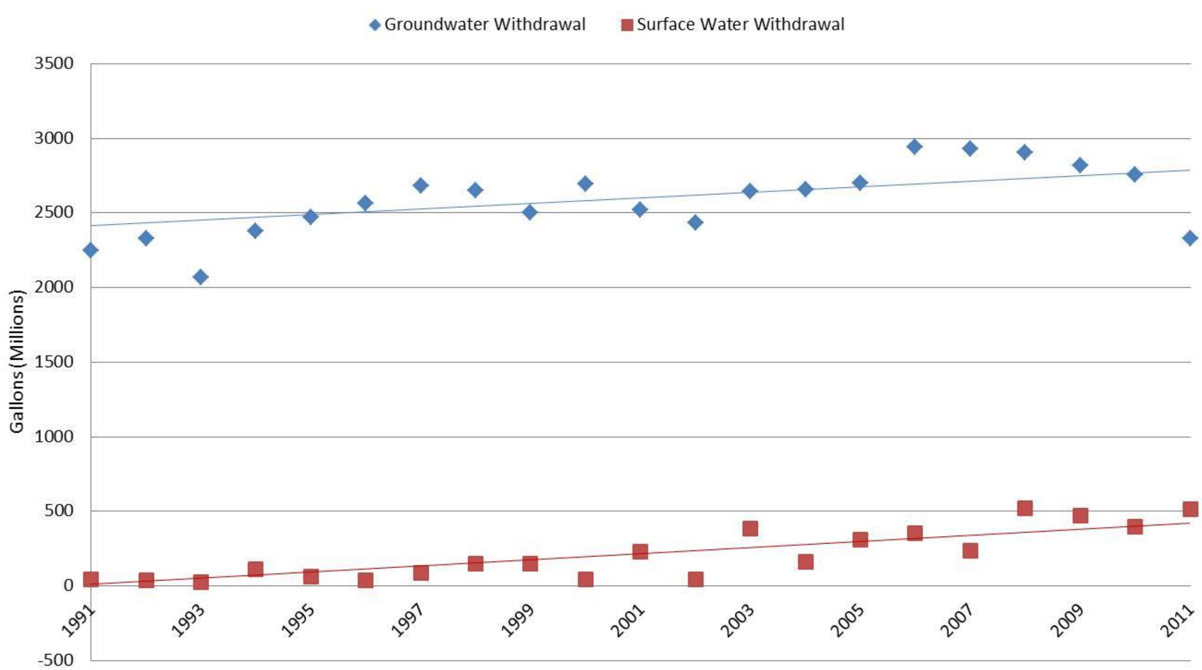

Figure 38. Total annual groundwater and surface water withdrawals in the South Fork Crow River Watershed (1991-2011).

Stream flow

The United States Geological Survey (USGS) maintains real-time streamflow gaging stations across the United States. Measurements can be viewed at http://waterdata.usgs.gov/nwis/rt.

Stream flow for the Crow River in the South Fork Crow River Watershed 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 Crow River at Rockford from 2004 to 2013. The data show that there is an increase in stream flow over time, but there is no statistically significant trend. Figure 40 displays July and August mean flows for the last 10 years for the same water body. Both months also show an increase in stream flow, but the level of significance is not high. 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.

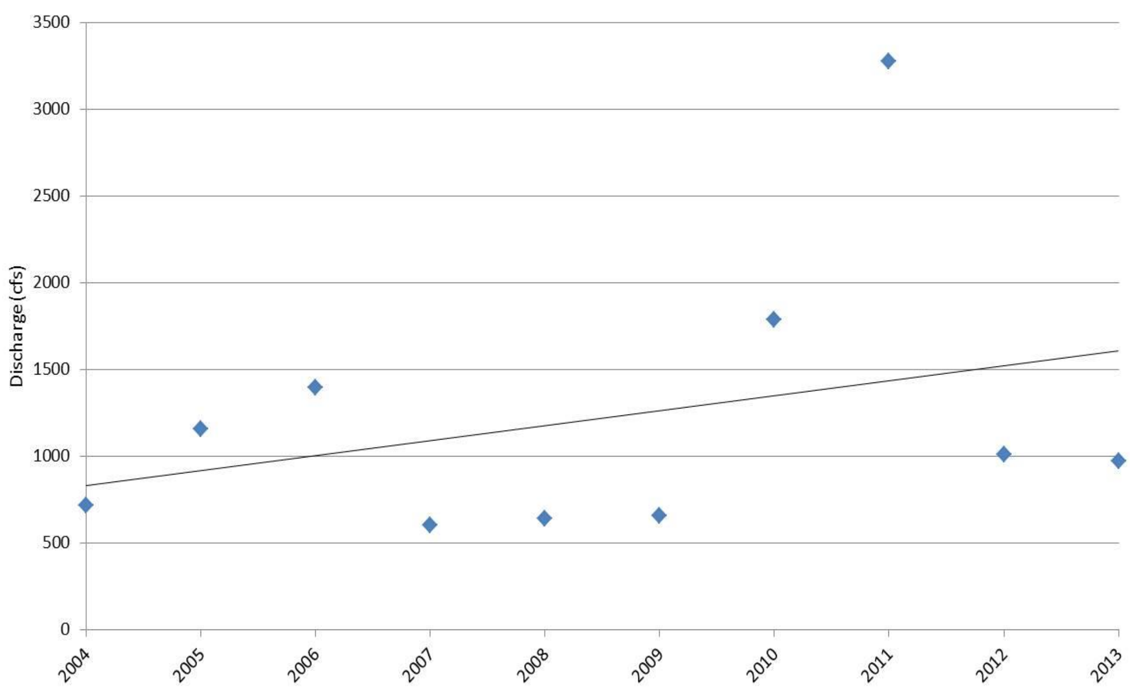

Figure 39. Annual Mean Discharge for Crow River at Rockford (2004-2013).

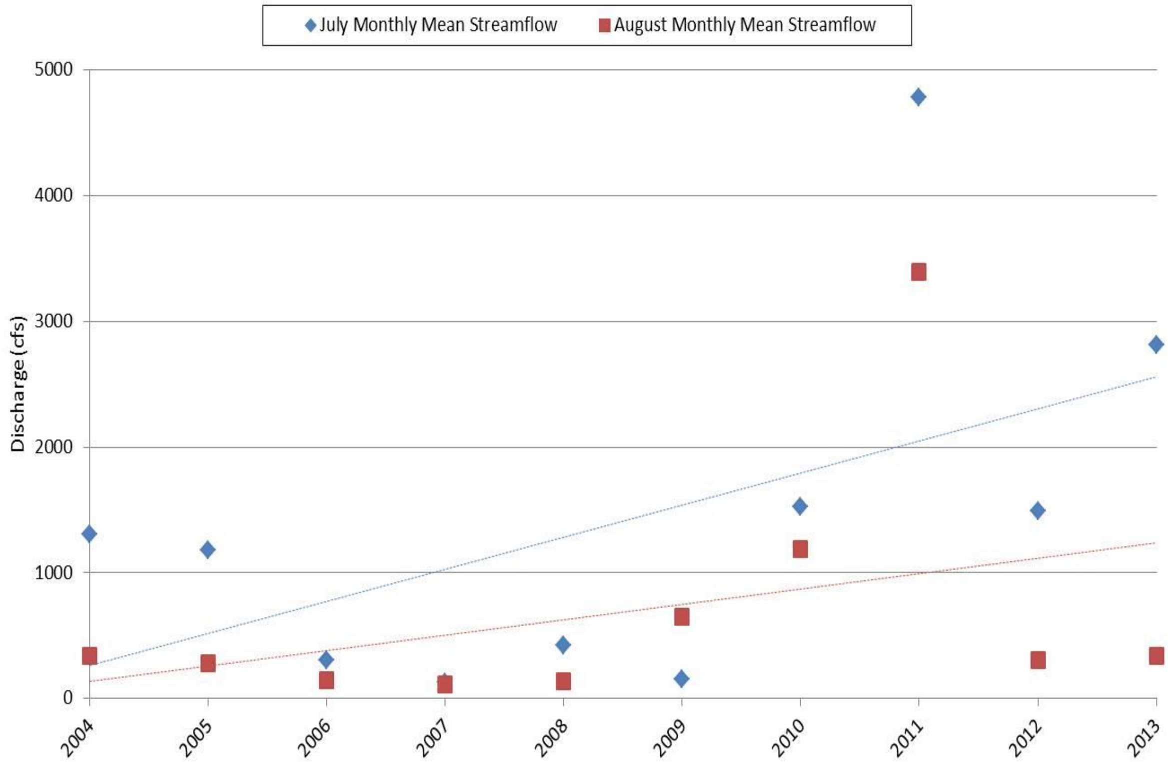

Figure 40. Mean monthly discharge measurements for July and August flows for Crow River at Rockford (2004-2013).

Wetland condition

Portions of the South Fork Crow River Watershed lie within the MWP and TP level II ecoregions, the regional classification system used for depressional wetland IBIs. For depressional wetlands in the MWP ecoregion, macroinvertebrate IBI scores ranged from 59 to 76 with a mean of 68. Generally speaking, these results indicate that depressional wetland macroinvertebrate communities are in good ecological condition in the MWP portion of the watershed (Figure 41). For the TP portion of the watershed, macroinvertebrate IBI scores ranged from 42 to 72 with a mean of 60, indicating fair ecological condition at these wetland sites. While some of these sites were randomly selected for monitoring, it should be noted that this limited sample may not be accurately represent depressional wetland condition in the watershed.

Plant IBI scores ranged from 35 to 50 with a mean of 42 for depressional wetlands in the MWP portion of the watershed—indicative of fair ecological condition (Figure 41). In the TP portion of the watershed, plant IBI scores ranged from 26 to 78 with a mean score of 56. In this ecoregion, an average plant IBI of 56 represents poor ecological condition. Again, this small sample of sites may not be an unbiased representation of depressional wetland condition in the South Fork Crow River Watershed.

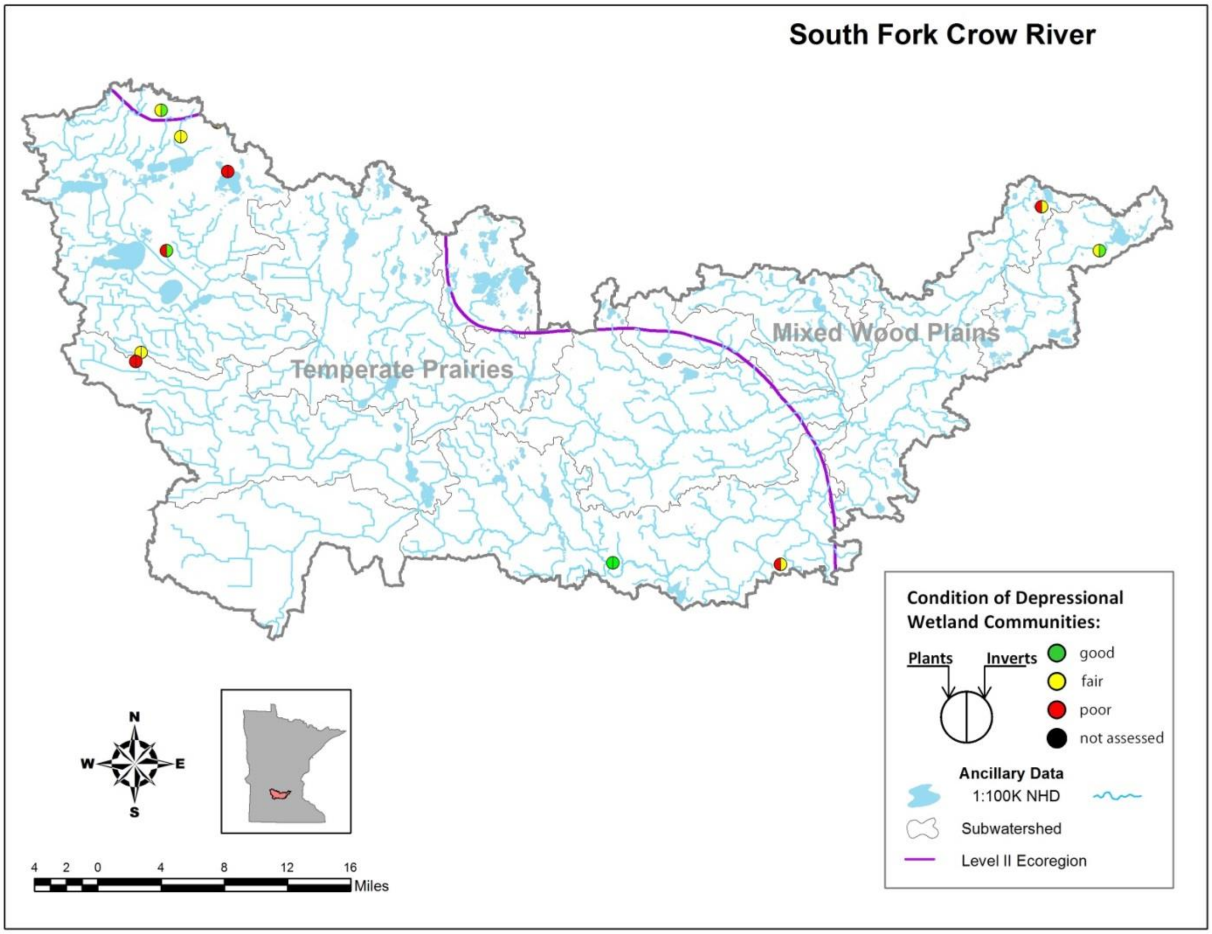

Figure 41. Depressional wetland condition in the South Fork Crow River Watershed.

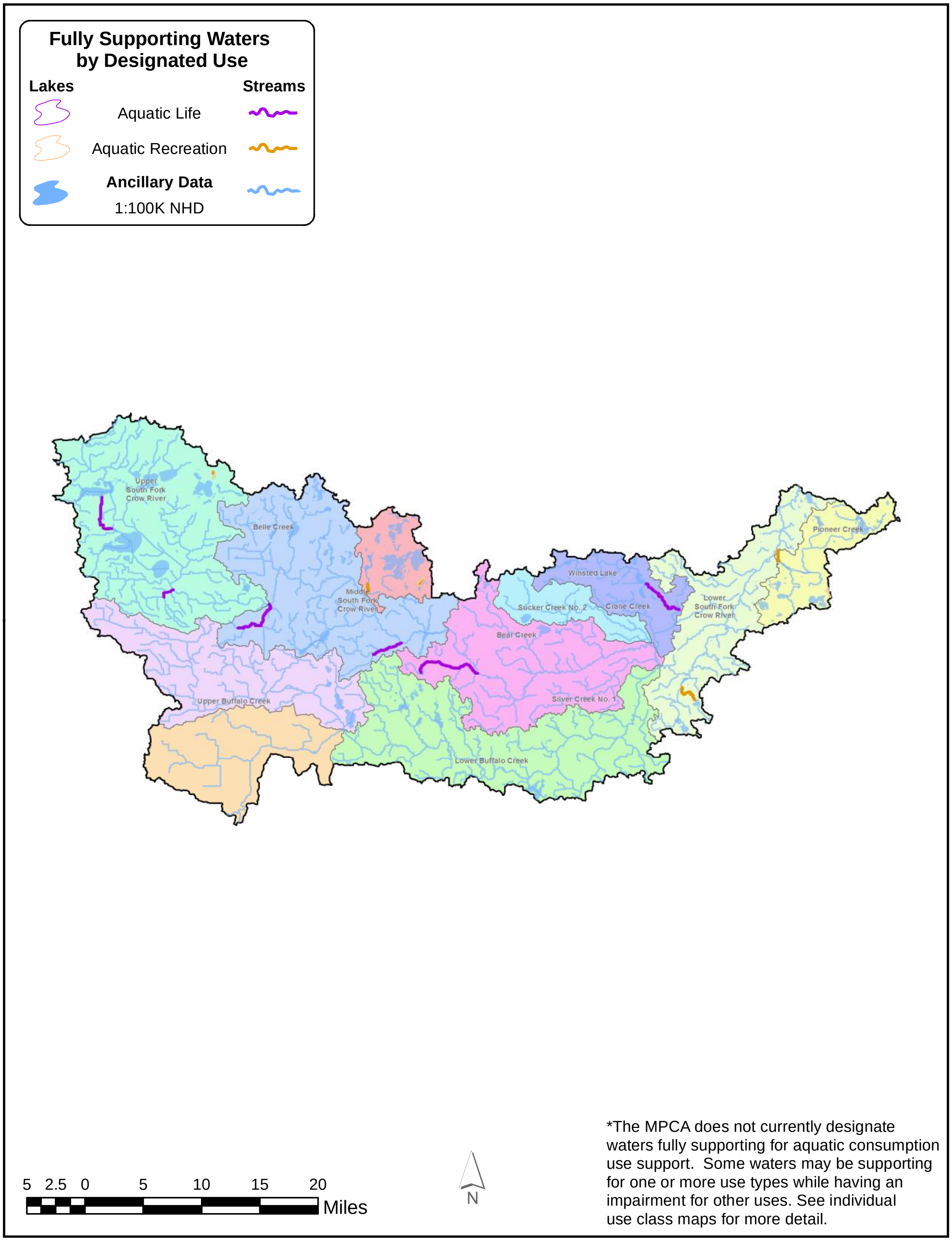

Figure 42. Fully supporting waters by designated use in the South Fork Crow River Watershed.

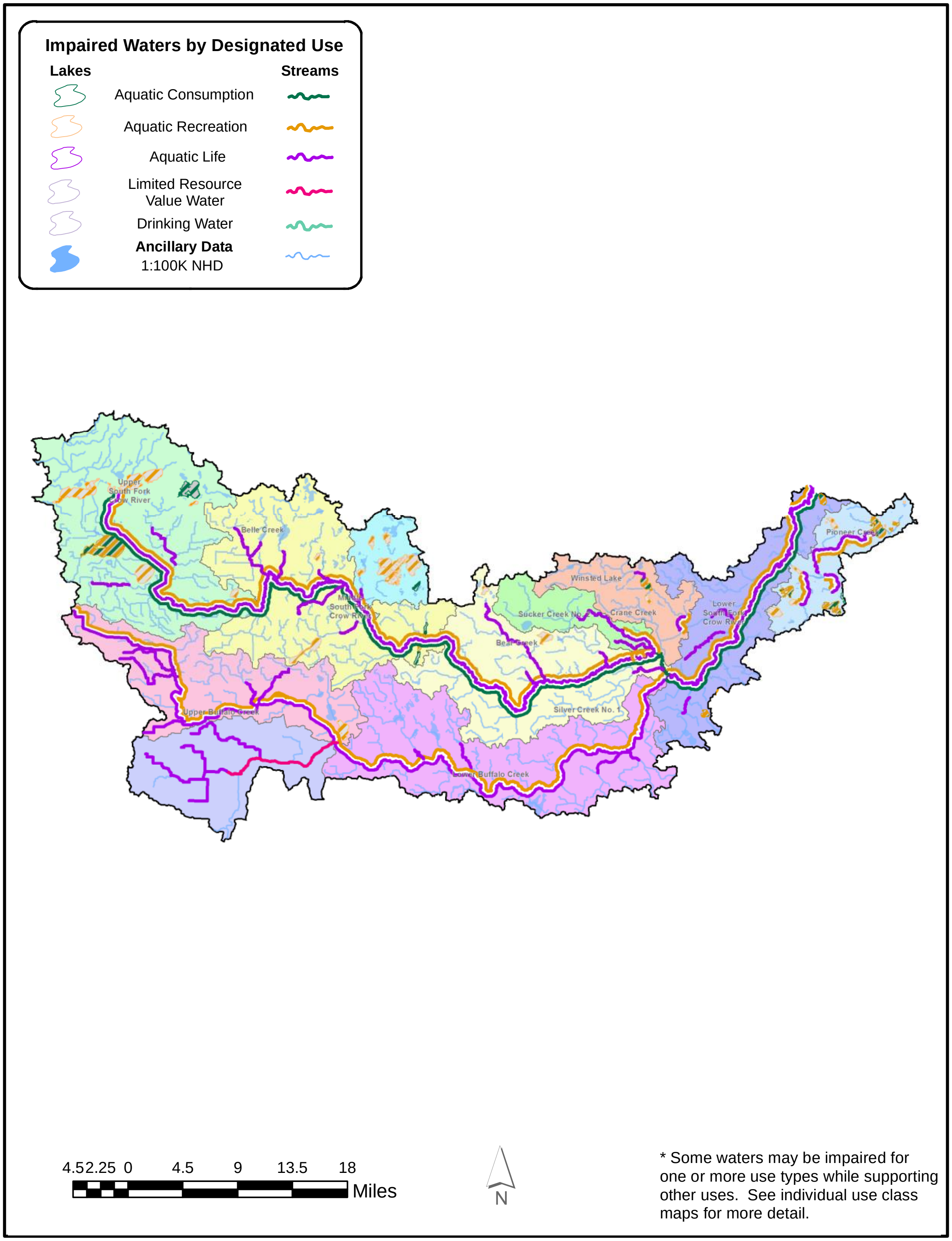

Figure 43. Impaired waters by designated use in the South Fork Crow River Watershed.

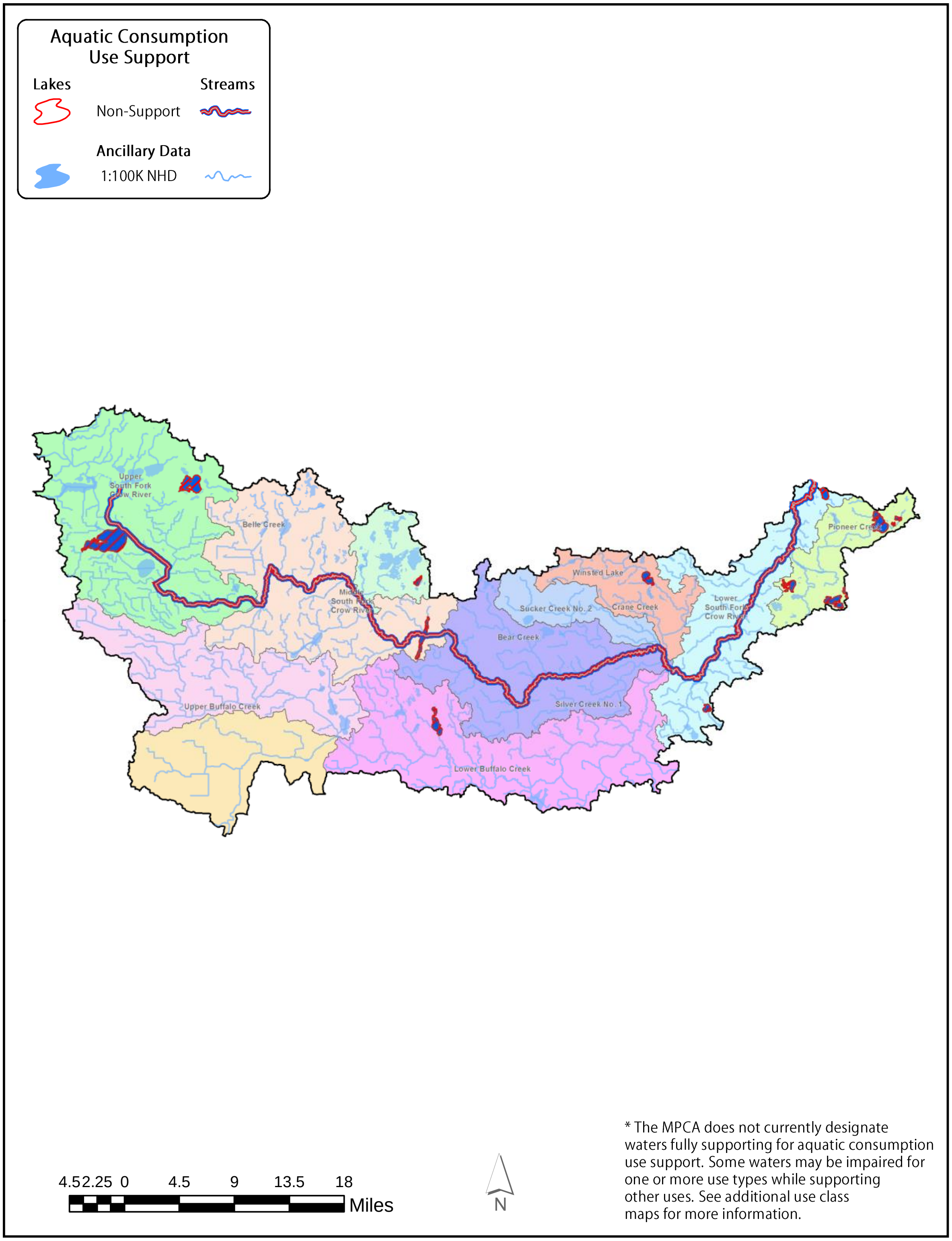

Figure 44. Aquatic consumption use support in the South Fork Crow River Watershed.

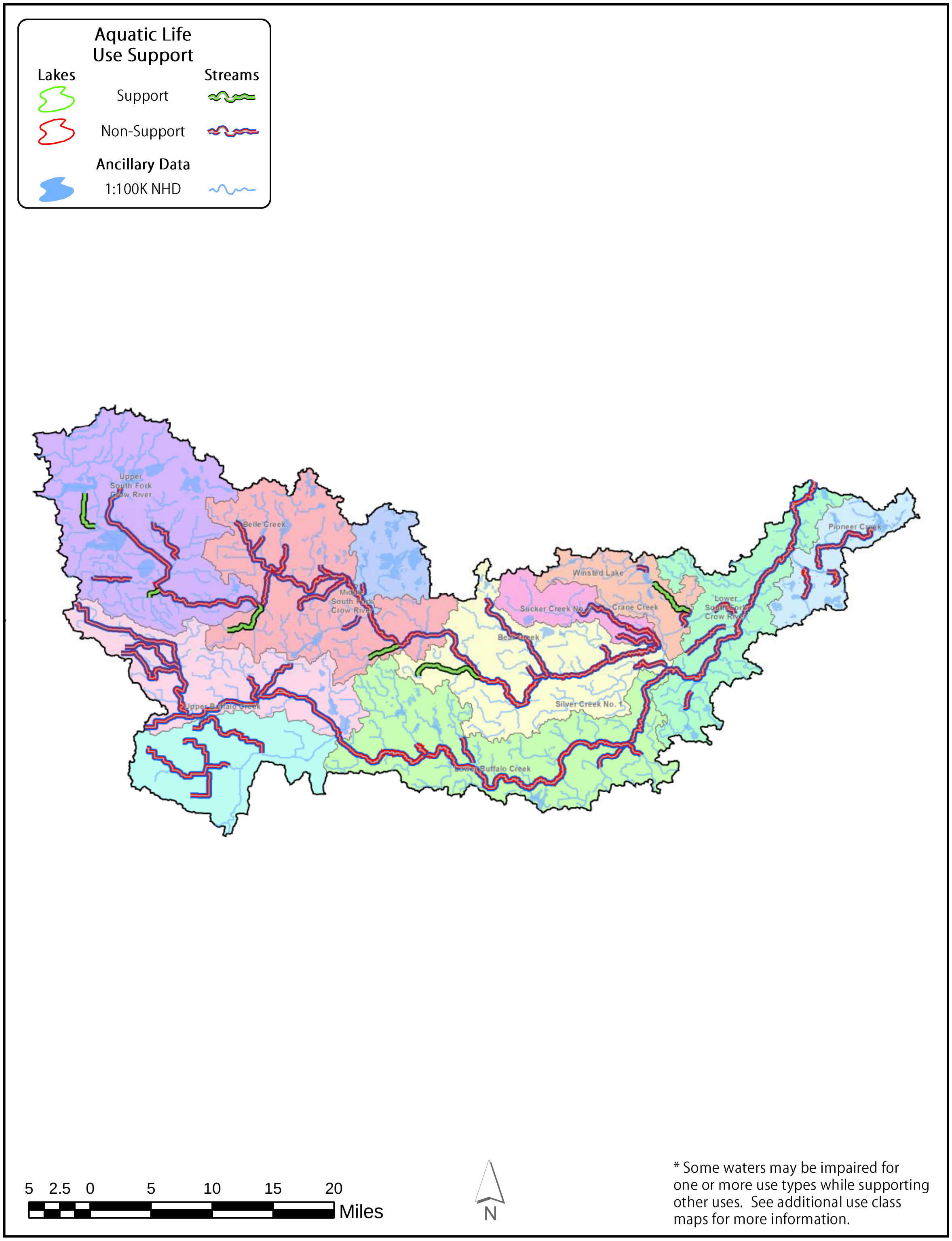

Figure 45. Aquatic life use support in the South Fork Crow River Watershed.

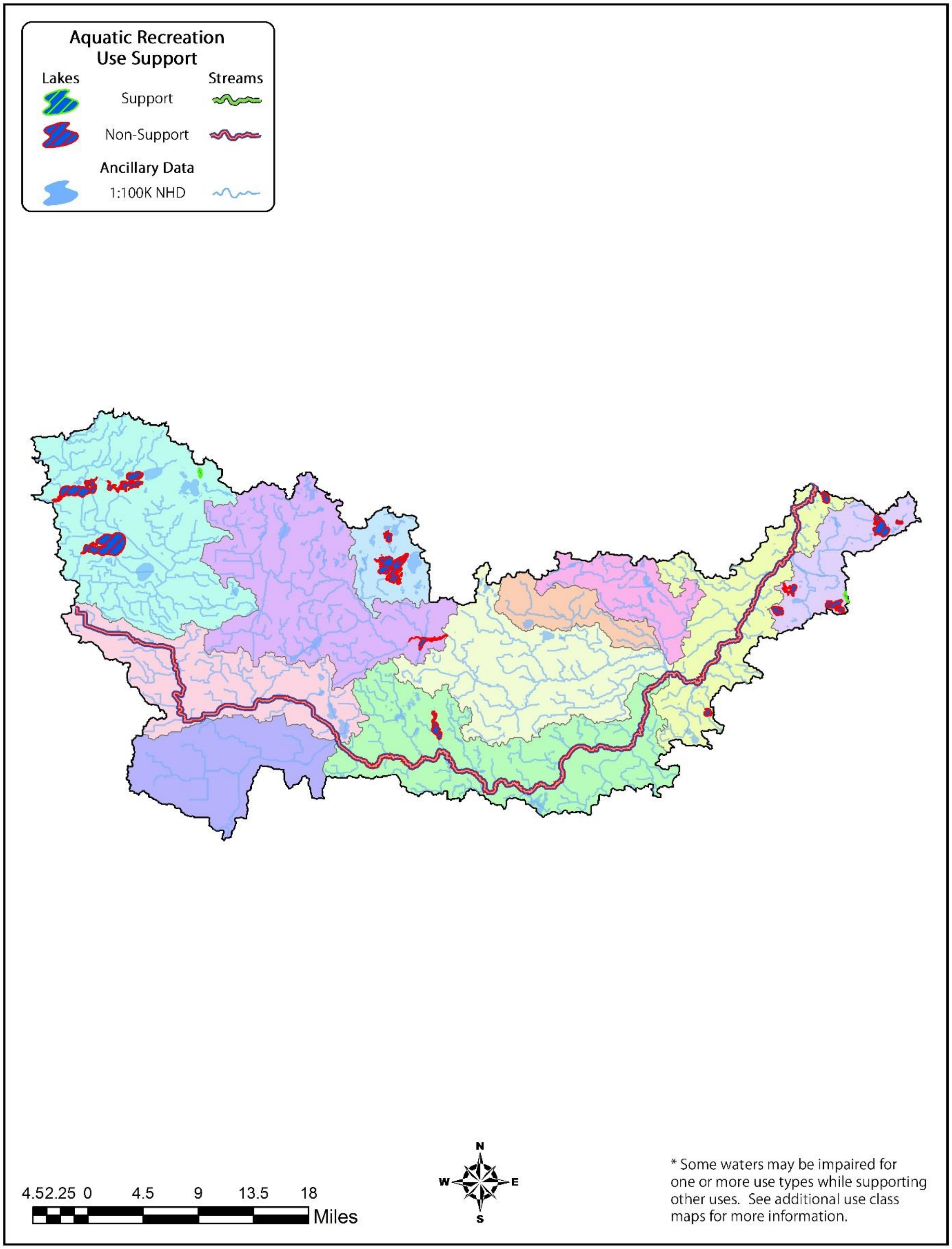

Figure 46. Aquatic recreation use support in the South Fork Crow River Watershed.

Pollutant trends for the South Fork Crow River Watershed

Water quality trends at long-term monitoring stations

There are no long term water quality monitoring stations located within the South Fork Crow River Watershed.

Water clarity trends at citizen monitoring sites

Citizen volunteer monitoring occurs at only 14 streams and 14 lakes in the watershed. There are very few volunteer monitors in the South Fork Crow Watershed. The overall datasets are small and without more information a trend analysis cannot be calculated. The site with the increasing trend is somewhat protected by forest and buffer strips but the trend is small. The range for the long-term trend is between no trend and an increase of transparency of seven centimeters per decade. The overall trends for lakes are low transparency with two lakes on a declining trend.

Table 61. Water clarity trends at citizen monitoring sites.

South Fork Crow Watershed HUC 07010205	Citizen Stream Monitoring Program	Citizen Lake Monitoring Program
Number of sites w/increasing trend	1	0
Number of sites w/decreasing trend	0	2
Number of sites w/no trend	7	9

Summaries and recommendations

Biological monitoring

The condition of fish and macroinvertebrate stream communities in the South Fork Crow River Watershed reflect the land use, hydrologic modification, and discharge of pollutants (point and non-point) upstream of each monitoring location. The habitats, surficial hydrology, and water quality of this watershed have been dramatically altered from their natural condition. These alterations have brought about a stark shift in the biological communities that these waters are capable of supporting.

The prevalence of stream channelization and drainage tiling results in an engineered surficial hydrology that does not retain water from precipitation in the same manner as an unaltered landscape; rain events result in a rapid spike in discharge volumes, while intervening periods of low precipitation result in exceptionally low flows. High discharge events destabilize and erode stream banks which result in high sediment loads and ever wider, shallower channels. The loss of riparian tree cover and rooted, perennial vegetation can greatly exacerbate these issues by further destabilizing banks and increasing water temperatures from lack of shade and cover. Streams impacted by these processes are characterized by uniform depths, homogenous fine substrates and lack of well-developed riffle- pool-run sequences; they provide little habitat for diverse and healthy aquatic communities.

Overall, scores of biological communities in this watershed were resoundingly poor: only six streams (<7%) were determined to be supporting aquatic life for modified use (which holds communities to a lower threshold than general use waters) for both fish and invertebrate communities. Not a single general use stream in the South Fork Crow River Watershed fully supported aquatic life for both fish and macroinvertebrates.

The assessment of biological community data in the South Fork Crow River Watershed required the application of eight distinct IBIs. Fish scores were evaluated under four IBI classes: low gradient, northern headwaters, northern streams and northern rivers. Macroinverebrates were also evaluated under four IBI classes: Prairie Streams (Glide/Pool Habitat), Southern Forest Streams (Glide/Pool Habitat), Southern Streams (Riffle/Run Habitat), and Prairie Forest Rivers. Having class-specific IBIs allows natural variability to be accounted for and therefore increases the resolution of the signal provided by human disturbance and anthropogenic factors.

Fish

Fish assemblages were assessed in 49 reaches of streams and rivers throughout the South Fork Crow River Watershed. An overwhelming majority of these assessment units, 86% (n=42), exhibited fish communities that did not meet aquatic life standards and were listed as impaired. Only 14% (n=7) of these assessment units sustained fish communities that met modified use criteria. None of the general use streams were determined to be supporting aquatic life for fish.

An overall total of 39 fish species were collected in the South Fork Crow River Watershed in a total of 91 stream visits. The five most commonly collected species of fish, both in number of sites where present and in number of individuals collected, were species that are highly tolerant of extreme degradations to habitat and water quality: fathead minnow (present at 98% of sites), black bullhead (89%), green sunfish (87%), common carp (80%), and orangespotted sunfish (74%). These taxa are characterized by an ability to survive and even thrive in conditions that are lethal to many stream fishes: extremely high water temperatures, low dissolved oxygen, and homogenous substrates and habitats. The preponderance of these species at sites throughout this watershed reflects the severely degraded habitats and water quality of the South Fork Crow River. Presence of these taxa (perhaps with the exception of the non-native, invasive common carp) is not in itself an indication of poor water quality.

However, when these tolerant forms come to dominate the community composition in a stream it is highly indicative of drastic alterations to habitat and water quality; stream conditions no longer permit the survival of anything but the most tolerant species.

Relatively sensitive species such as Iowa darter (present at 16% of sites), longnose dace (8%), and smallmouth bass (3%) were collected at far fewer sites, and in much lower numbers. The varied habitats and water quality necessary to sustain these and other common species simply do not exist throughout much of this watershed.

Macroinvertebrates

Out of the 40 stream and river assessment units where macroinvertebrate data was assessed, 29 (73%) were determined to have impaired aquatic macroinvertebrate communities (13 modified use, 16 general use). Of the 11 assessment units that exhibited healthy macroinvertebrate communities, only one was a designated general aquatic life use stream (Otter Creek, -643).

Overall, a total of 223 genera in 63 families of macroinvertebrates were collected in the South Fork Crow River Watershed based on 91 qualitative multi-habitat samples collected primarily in 2012. The most commonly collected macroinvertebrates in this watershed included: midges in the genera *Polypedilum*, *Thienemannimyia*, and *Dicrotendipes*; oligochaete worms; snails in the genus Physa; and mayflies in the genus *Caenis*. A total of 183 macroinvertebrate genera were collected from low gradient (i.e., glide/pool) streams, the most common of which were: oligochaete worms; midges in the genera *Polypedilum*, *Paratanytarsus*, and *Dicrotendipes*; *Physa*; *Caenis*; and the giant water bug *Belostoma*. In high gradient (i.e., riffle/run habitat) streams 153 macroinvertebrate genera were collected, the most common of which were: caddisflies in the genus *Cheumatopsyche*; midges *Polypedilum*, *Rheotanytarsus*, and *Thienemannimyia*; *Physa*; and oligochaetes. A total of 77 genera were collected from the South Fork Crow River mainstem where the drainage area was large enough (>500 mi^2) to be evaluated using the Prairie Forest Rivers IBI (9 stations). Caddisflies in the genera *Hydropsyche* and *Cheumatopsyche*; *Polypedilum*; riffle beetle genera *Stenelmis* and *Macronychus*; mayflies in the genera *Maccaffertium* and *Tricorythodes*; and blackflies in the genus *Simulium* were collected at all nine mainstem biological monitoring stations.

Water quality monitoring

Surface water quality in the South Fork Crow River is severely impaired; bacterial contamination, nutrient exceedances, and dissolved oxygen issues are widespread throughout the watershed and surpass permissible water quality standards. An overwhelming majority of stream reaches with sufficient water chemistry data to make an assessment (72%) are not capable of supporting aquatic recreation. These streams exhibit levels of bacterial contamination that surpass permissible water quality thresholds. Of 52 lakes with sufficient data to make an assessment, 37 (71%) were impaired for aquatic recreation, principally due to excessive nutrients contributing to plant and algal growth.

Wetlands

Nearly 90% of the wetlands in the South Fork Crow River Watershed have been drained or substantially altered from their natural condition. The remaining wetlands in this region span two distinct ecoregions (Figure 41); wetland invertebrate and plant communities from each ecoregion were evaluated separately. Invertebrate and plant community scores in the Mixed Wood Plains (MWP) ecoregion were considered to be in good (mean IBI=68) and fair (mean IBI=42) ecological condition respectively. In the Temperate Prairies (TP) ecoregion, invertebrate and plant communities scored slightly lower. Invertebrate communities in the TP ecoregion were considered to be in fair ecological condition (mean IBI=60), while plant communities in this ecoregion were determined to be in poor condition (mean IBI=56).

Fish contaminants

Fish tissues from 26 lakes and the mainstem of the South Fork Crow River were analyzed for chemical contaminants. Polychlorinated biphenyls (PCBs) and perfluorooctane sulfonate (PFOS) were present in fish tissues but were generally below the reporting limit. Over half of the tested lakes (n=14) and the mainstem of the South Fork Crow River were found to have levels of mercury that were above the permissible threshold and were listed as impaired.

Groundwater

Local conditions may vary, but due to the region's geology, arsenic is a contaminant of concern and because of heavy agricultural use, nitrate is a contaminant of concern in this area of Minnesota. The MDA regularly samples groundwater across the region for nitrate and the Minnesota Department of Health encourages well owners to test their water supply for arsenic at least once and nitrate on a regular basis.

The direct correlation of increasing groundwater withdrawals and decreasing surficial water quantity has been documented in other areas of Minnesota such as Little Rock Creek and White Bear Lake. With little stream flow information for some watersheds, correlating withdrawals and surface water quantity is not possible. Flow within the South Fork of the Crow does not appear to exhibit any trend, while groundwater withdrawals have increased. To provide a detailed a cause and effect between withdrawals and water quantity is beyond the scope of this report.

In recent years, decreased groundwater quantity across Southwest Minnesota has been a topic of concern. Periods of seasonal drought have made it particularly difficult for citizens to obtain water for consumptive use. Low recharge rates coupled with increasing groundwater withdrawals heighten the need for water conservation and a more complete understanding of groundwater in the region.

It is not realistic to expect a shift in land use within the South Fork Crow River Watershed as lands are almost entirely privately owned and agriculture is the basis of the region's economy. Through best land management practices such as the implementation of perennial vegetation buffers along stream reaches, improved control of waste runoff at livestock operations, installation of exclusion fencing to limit animal access to streams, and novel manners to mitigate nutrient loading to surface waters from fertilizer application would have profound impacts on water quality throughout the region.

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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 South Fork Crow River Watershed

Biological Station ID	STORET/ EQuIS ID	Waterbody Name	Location	Sub Watershed
00UM051	S002-016	Judicial Ditch 15	At 550th St. 3 mi. NE of Buffalo Lake	Judicial Ditch 15
00UM053	S002-015	Crow River, South Fork	At Hwy 7 in Cosmos	Headwaters South Fork Crow
12UM072	S000-579	Buffalo Creek	Zero Ave., 4 mi. SE of Lester Prairie	Buffalo Creek
12UM006	S002-017	Buffalo Creek	At CSAH 24 (No. of CR 56), 4 mi. NE of Buffalo Lake	Judicial Ditch 28A
12UM017	S006-991	Judicial Ditch 1	At CR-33, 1.5 mi. N. of Hollywood	Crane Creek
12UM027	S001-443	Crow River, South Fork	Downstream of CR-9, 5mi. SE of Lester Prairie	Middle South Fork Crow
12UM030	S006-992	Otter Creek	At CSAH 23 in Lester Prairie	Otter Creek
12UM036	S006-989	Unnamed Creek	110th St. SE, 3 mi. NE of Watertown	Rice Lake
12UM041	S001-255	Crow River, South Fork	At Bridge Ave., in Delano	Lower South Fork Crow
12UM043	S006-990	Trib. To Crow River, South Fork	140th St., 1 mi. SE of Cedar Mills	Hoff Lake
12UM071	S001-514	Crow River, South Fork	Downstream of Hutchinson WWTP	Middle South Fork Crow
99UM070	S002-014	Crow River, South Fork	At CR115, 2.0 mi. SW of Hutchinson	Upper South Fork Crow

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

AUID DESCRIPTIONS		USES						Aquatic Life Indicators:														Aquatic Recreation Indicators:
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water	303d listed impairments 2014	Fish	Macroinvertebrates	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	AmmoniaNH3	Phosphorous	Chlorophyl A	Chlorophyl A Uncorrected	BOD	DO Flux	Pesticides	Bacteria
Headwaters South Fork Crow Subwatershed																						
07010205-556, County Ditch 24A, Unnamed ditch to S Fk Crow River	3	2Bg, 3C	IF									MTS										
07010205-557, Unnamed ditch, Unnamed lk (34-0440-00) to Big Kandiyohi Lk	0.39	2Bg, 3C	IF									MTS										
07010205-607, Big Kandiyohi Channel, Wagonga Lk to Unnamed lk (34-0440-00)	3.80	2Bm, 3C	FS					MTS	MTS	NA	NA			NA								
07010205-608, State Ditch Branch 2, Unnamed ditch to Unnamed ditch	4.58	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-610, County Ditch 24A, Unnamed ditch to Unnamed ditch	3.56	2Bm, 3C	NS					EXS		NA	NA			NA								
07010205-612, Unnamed ditch, CD 51 to S Fk Crow River	1.26	2Bm, 3C	FS					MTS	MTS	NA	NA			NA								
07010205-658, Crow River, South Fork, Headwaters to 145th St	25.3	2Bm, 3C	NS	NS	NA			EXS	MTS	IF	EX	EX	MTS	MTS	MTS							EX
Judicial Ditch 28A subwatershed																						
07010205-502, Buffalo Creek, Headwaters to JD 15	35.58	2Bm, 3C	NS	NS				EXS	EXS	IF	MTS	MTS	MTS	MTS	MTS							EX
07010205-504, Judicial Ditch 67, Headwaters to Buffalo Cr	5.54	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-528, County Ditch 4, Unnamed ditch to Buffalo Cr	2.76	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								

Full Support (FS); Not Supporting (NS); Insufficient Data (IF); Not Assessed (NA); Meets standards or ecoregion expectations (MT/MTS), 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						Aquatic Life Indicators:														Aquatic Recreation Indicators:
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water	303d listed impairments 2014	Fish	Macroinvertebrates	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	AmmoniaNH3	Phosphorous	Chlorophyl A	Chlorophyl A Uncorrected	BOD	DO Flux	Pesticides	Bacteria
Judicial Ditch 28A subwatershed continued																						
07010205-566, Unnamed creek, Lk Allie to Preston Lk	0.21	2Bg, 3C	IF								IF	MTS										
07010205-568, Unnamed creek, Preston Lk to JD 28A (Buffalo Cr)	0.49	2Bg, 3C	IF							NA	MTS	MTS	NA	NA	NA							
07010205-625, Judicial Ditch 9, Headwaters to Buffalo Cr	7.10	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-630, Unnamed ditch, Headwaters to Buffalo Cr	4.02	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-631, County Ditch 7A, Unnamed cr to Buffalo Cr	4.33	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
Judicial Ditch 15 subwatershed																						
07010205-509, Judicial Ditch 15, Headwaters to T115 R32W S31, east line	9.16	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-513, Judicial Ditch 15, T115 R32W S32, west line to Buffalo Cr	11.27	7	NA	NA						IF				MTS	MTS							EX
07010205-626, Judicial Ditch 15 branch, Headwaters to JD 15 main stem	3.63	2Bm, 3C	NS					EXS		NA	NA			NA								
07010205-627, Judicial Ditch 15 branch, Headwaters to JD 15 main stem	4.05	2Bm, 3C	NS					EXS		NA	NA			NA								
07010205-628, Judicial DItch 15 branch, Headwaters to JD 15 main stem	8.88	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								

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

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

AUID DESCRIPTIONS		USES						Aquatic Life Indicators:														Aquatic Recreation Indicators:
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	**Reach Length (Miles)**	**Use Class**	**Aquatic Life**	**Aquatic Recreation**	**Aquatic Consumption**	**Drinking Water**	**303d listed impairments 2014**	**Fish**	**Macroinvertebrates**	**Dissolved Oxygen**	**TSS**	**Secchi Tube**	**Chloride**	**pH**	**AmmoniaNH3**	**Phosphorous**	**Chlorophyl A**	**Chlorophyl A Uncorrected**	**BOD**	**DO Flux**	**Pesticides**	**Bacteria**
Upper South Fork Crow subwatershed																						
07010205-506, Judicial Ditch 29, Headwaters to S Fk Crow River	4.60	2Bm, 3C	FS					MTS	MTS	NA	NA			NA								
07010205-533, Unnamed creek, Unnamed cr to Unnamed cr	1.86	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-549, Belle Creek, Headwaters to JD 18	1.55	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-550, Judicial Ditch 18, Belle Cr to S Fk Crow River	2.81	2Bm, 3C	NS					EXS	MTS	NA	NA			NA								
07010205-609, County DItch 18, Headwaters to S Fk Crow R	5.76	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-613, King Creek, T118 R32W S36, north line to S Fk Crow River	3.11	2Bm, 3C	NS					EXS	MTS	NA	NA			NA								
07010205-620, Judicial Ditch 1, Unnamed cr to S Fk Crow River	2.70	2Bm, 3C	FS					MTS	MTS	NA	NA			NA								
07010205-621, Unnamed creek, Unnamed cr to S Fk Crow River	1.74	2Bm, 3C	NS					MTS	EXS	NA	NA			NA								
07010205-623, Unnamed creek, Unnamed cr to JD 18	2.88	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-659, Crow River, South Fork, 145th St to Hutchinson Dam	25.56	2Bg, 3C	NS	NS	NA			EXS	EXS	IF	EX	MTS	MTS	MTS	MTS							EX
Hoff Lake subwatershed																						
07010205-655, Unnamed creek, Hoff Lk to 140th St	1.37	2Bg, 3C	IF									MTS										
07010205-656, Unnamed creek, 140th St to Unnamed cr	1.17	2Bg, 3C	NS	FS				EXS	EXS	IF	IF	IF	MTS	MTS	MTS							MTS

AUID DESCRIPTIONS		USES						Aquatic Life Indicators:														Aquatic Recreation Indicators:
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	**Reach Length (Miles)**	**Use Class**	**Aquatic Life**	**Aquatic Recreation**	**Aquatic Consumption**	**Drinking Water**	**303d listed impairments 2014**	**Fish**	**Macroinvertebrates**	**Dissolved Oxygen**	**TSS**	**Secchi Tube**	**Chloride**	**pH**	**AmmoniaNH3**	**Phosphorous**	**Chlorophyl A**	**Chlorophyl A Uncorrected**	**BOD**	**DO Flux**	**Pesticides**	**Bacteria**
Buffalo Creek Subwatershed																						
07010205-591, Judicial Ditch 8, Unnamed cr to Buffalo Cr	3.37	2Bm, 3C	NS					EXS	EXS	NA	NA	NA		NA								
07010205-614, Unnamed creek, Lk Mary to RR crossing	2.65	2Bm+, 3C	NS					EXS		NA	NA			NA								
07010205-615, Unnamed creek, Unnamed cr to Buffalo Cr	1.43	2Bm, 3C	NS					EXS		NA	NA			NA								
07010205-638, Buffalo Creek, JD 15 to S Fk Crow River	52.15	2Bg, 3C	NS	NS				EXS	EXS	IF	EX	MTS		MTS	MTS							
07010205-645, County Ditch 33, 100th St to Buffalo Cr	1.77	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								
Middle Fork South Fork Crow Subwatershed																						
07010205-510, Crow River, South Fork, Hutchinson Dam to Bear Cr	17.76	2Bg, 3C	NS	NS				EXS	EXS	EX	MTS	MTS		MTS	MTS							
07010205-511, Crow River, South Fork, Bear Cr to Otter Cr	13.84	2Bg, 3C	NS	NS				EXS	EXS	IF	EX	MTS	MTS	MTS	MTS							EX
07010205-515, Bear Creek, Headwaters to S Fk Crow River	9.79	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-611, County Ditch 26/27, 165th St to S Fk Crow River	1.58	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-616, McCuen Creek, Headwaters to S Fk Crow River	6.22	2Bm, 3C	FS					MTS	MTS	NA	NA			NA								
07010205-622, Unnamed creek, T116 R27W S5, west line to S Fk Crow River	1.44	2Bg, 3C	NS					EXS	NA	NA	NA			NA								
07010205-641, Silver Creek (County Ditch 13), Unnamed cr to S Fk Crow River	3.43	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								

AUID DESCRIPTIONS		USES						Aquatic Life Indicators:														Aquatic Recreation Indicators:
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	**Reach Length (Miles)**	**Use Class**	**Aquatic Life**	**Aquatic Recreation**	**Aquatic Consumption**	**Drinking Water**	**303d listed impairments 2014**	**Fish**	**Macroinvertebrates**	**Dissolved Oxygen**	**TSS**	**Secchi Tube**	**Chloride**	**pH**	**AmmoniaNH3**	**Phosphorous**	**Chlorophyl A**	**Chlorophyl A Uncorrected**	**BOD**	**DO Flux**	**Pesticides**	**Bacteria**
Otter Creek Subwatershed																						
07010205-617, Unnamed creek, Headwaters to Otter Cr	4.03	2Bm, 3C	NS					EXS		NA	NA			NA								
07010205-642, Otter Creek, Headwaters to Cable Ave	5.63	2Bm, 3C	NS					EXS		NA	NA	NA		NA								
07010205-643, Otter Creek, Cable Ave to S Fk Crow River	4.94	2Bg, 3C	NS	NS				EXS	MTS	IF	IF	IF	MTS	MTS	MTS							EX
Crane Creek Subwatershed																						
07010205-571, Judicial Ditch 1, Winsted Lk to Unnamed ditch	4.39	2Bm, 3C	FS					MTS		NA	NA			NA								
07010205-572, Judicial Ditch 1, Unnamed ditch to Unnamed cr	2.05	2Bg, 3C	NS	NS				EXS	EXS	EX	IF	MTS	MTS	MTS	IF							EX
07010205-585, Unnamed creek, CD 11 to Winsted Lk	1.10	2Bm, 3C	NS					EXS	MTS	NA	NA	NA		NA								
Lower South Fork Crow Subwatershed																						
07010204-710, Unnamed creek, Headwaters to Lk Rebecca	0.50	2Bg, 3C	IF							IF	MTS		MTS	MTS								
07010205-508, Crow River, South Fork, Buffalo Cr to N Fk Crow River	30.83	2Bg, 3C	NS	NS				EXS	EXS	IF	EX	EX	EX	MTS	MTS							EX
07010205-535, Unnamed creek (Eagle Lake Outlet), Eagle Lk to Unnamed cr	2.22	2Bg, 3C	IF	FS						NA	NA	IF										MTS
07010205-618, Unnamed creek, Unnamed cr to Eagle Lk Outlet	1.65	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-624, Unnamed creek, Unnamed cr to Lippert Lk	2.57	2Bg, 3C	NS					EXS	EXS	NA	NA			NA								
07010205-648, County Ditch 9, Headwaters to -93.9053 44.9055	4.50	2Bm, 3C	NS					EXS	EXS	NA	NA			NA								

AUID DESCRIPTIONS		USES						Aquatic Life Indicators:														Aquatic Recreation Indicators:
Assessment Unit ID (AUID), Stream Reach Name, Reach Description	Reach Length (Miles)	Use Class	Aquatic Life	Aquatic Recreation	Aquatic Consumption	Drinking Water	303d listed impairments 2014	Fish	Macroinvertebrates	Dissolved Oxygen	TSS	Secchi Tube	Chloride	pH	AmmoniaNH3	Phosphorous	Chlorophyl A	Chlorophyl A Uncorrected	BOD	DO Flux	Pesticides	Bacteria
Rice Lake Subwatershed																						
07010205-526, Spurzem Creek, Winterhaller Lk to Lk Independence	2.11	2Bg, 3C	IF								MTS											
07010205-564, Unnamed creek, Rice Lk to N Fk Crow R	1.06	2Bg, 3C	NA	FS						IF	MTS	MTS	MTS	MTS	IF							MTS
07010205-587, Unnamed creek, Headwaters to Thomas Lk	1.61	2Bg, 3C									NA											
07010205-593, Unnamed creek, Mud Lk (10-0094-00) to Rice Lk (86-0032-00)	3.31	2Bg, 3C	NS	NS						EX	MTS		MTS	MTS	MTS							EX
07010205-594, Deer Creek, Unnamed cr to Ox Yoke Lk	2.39	2Bg, 3C	NS	NS						EX	MTS		MTS	MTS	MTS							EX
07010205-653, Pioneer Creek, Lk Independence to T118 R24W S30, south line	7.09	2Bg, 3C	NS	NS						EX	MTS	NA	MTS	MTS	MTS							EX
07010205-654, Pioneer Creek, T118 R24W S31, north line to T118 R24W S31, south line	1.68	2Bg, 3C	NS					EXS	EXS	NA	NA			NA	NA							

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

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

Appendix 3.2 - Assessment results for lakes in the South Fork Crow River Watershed

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
10-0090-00	Millman	Carver	0701020506-01	NCHF	17.7						
10-0091-00	Unnamed	Carver	0701020506-01	NCHF	194.9						
10-0093-00	Oak	Carver	0701020506-01	NCHF	333.2	1.1	1174		1.1	NS	NA
10-0094-00	Mud	Carver	0701020506-01	NCHF	199.6	*1	553			NS	NA
10-0095-00	Swede	Carver	0701020506-01	NCHF	432.8	*1.4	813			NS	NA
10-0098-00	Buck	Carver	0701020506-01	NCHF	71.0						
10-0099-00	Unnamed	Carver	0701020506-01	NCHF	20.6						
10-0103-00	Berliner	Carver	0701020506-01	NCHF	46.1						
10-0104-00	Lippert	Carver	0701020506-01	NCHF	47.6						
10-0107-00	Braunworth	Carver	0701020506-01	NCHF	37.0						
10-0108-00	Tiger	Carver	0701020506-01	NCHF	405.9					IF	NA
10-0116-00	Unnamed	Carver	0701020506-01	NCHF	93.3						
10-0117-00	Unnamed	Carver	0701020503-02	NCHF	12.6						
10-0120-00	Smith	Carver	0701020503-02	NCHF	20.9						
10-0121-00	Eagle	Carver	0701020503-02	NCHF	183.2	*2.2	1753	100		NS	IF
10-0123-00	Unnamed	Carver	0701020503-02	NCHF	107.6						
10-0125-00	Crookshank	Carver	0701020503-02	NCHF	98.2						
10-0127-00	Campbell	Carver	0701020503-02	NCHF	65.9					NA	NA
10-0146-00	Unnamed	Carver	0701020503-02	NCHF	211.7						

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
10-0153-00	Unnamed	Carver	0701020503-02	NCHF	12.8						
10-0154-00	Unnamed	Carver	0701020503-02	NCHF	22.2						
10-0162-00	Unnamed	Carver	0701020503-02	NCHF	84.2						
27-0147-01	Peter (Main Basin)	Hennepin	0701020503-02	NCHF	38.1						
27-0147-02	Peter (North Bay)	Hennepin	0701020503-02	NCHF	14.8					NS	NA
27-0148-00	Winterhalter	Hennepin	0701020503-02	NCHF	16.4						
27-0149-00	Spurzem	Hennepin	0701020501-01	NCHF	81.9			57.3		NS	NA
27-0152-00	Half Moon	Hennepin	0701020501-01	NCHF	33.0			63.1		NS	NA
27-0153-00	Ardmore	Hennepin	0701020501-01	NCHF	13.3			88.5		NS	NA
27-0176-00	Independence	Hennepin	0701020501-01	NCHF	832.0	4.8	8408	50.4	4.8	NS	IF
27-0178-00	Ox Yoke	Hennepin	0701020501-01	NCHF	118.8						
27-0179-01	North Little Long	Hennepin	0701020501-01	NCHF	49.0					FS	IF
27-0179-02	South Little Long	Hennepin	0701020501-01	NCHF	17					FS	NA
27-0184-00	Whaletail	Hennepin	0701020501-01	NCHF	510.0						
27-0184-01	North Whaletail	Hennepin	0701020501-01	NCHF	361.6	1.6	2246	100	1.4	NS	IF
27-0184-02	South Whaletail	Hennepin	0701020501-01	NCHF	148.4	3.7	806	88	1.4	NS	IF
27-0187-00	Haughey	Hennepin	0701020501-01	NCHF	53.9						
27-0188-00	Robina	Hennepin	0701020501-01	NCHF	235.1					NS	NA
27-0189-00	Irene, Lake	Hennepin	0701020501-01	NCHF	17.4					NS	NA
27-0192-00	Rebecca	Hennepin	0701020501-01	NCHF	263.3			54		NS	IF

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
27-0380-00	Unnamed	Hennepin	0701020501-01	NCHF	24.5						
27-0411-00	Unnamed	Hennepin	0701020501-01	NCHF	28.7						
27-0412-00	Unnamed	Hennepin	0701020501-01	NCHF	18.9						
27-0499-00	Unnamed	Hennepin	0701020501-01	NCHF	14.6						
27-0926-00	Unnamed	Hennepin	0701020501-01	NCHF	245.5						
34-0002-00	Emma	Kandiyohi	0701020501-01	WCBP	185.6						
34-0003-00	Dog	Kandiyohi	0701020501-01	WCBP	481.2						
34-0005-00	Unnamed	Kandiyohi	0701020501-01	WCBP	122.7						
34-0006-00	Unnamed	Kandiyohi	0701020501-01	WCBP	35.6						
34-0007-00	Unnamed	Kandiyohi	0701020501-01	WCBP	15.9						
34-0008-00	Unnamed	Kandiyohi	0701020501-01	WCBP	27.3						
34-0009-00	Unnamed	Kandiyohi	0701020501-01	WCBP	17.4						
34-0012-00	Johnson	Kandiyohi	0701020501-01	WCBP	99.4					NS	NA
34-0013-00	Otter	Kandiyohi	0701020501-01	WCBP	79.0						
34-0019-00	Unnamed	Kandiyohi	0701020501-01	WCBP	21.8						
34-0021-00	Mud	Kandiyohi	0701020501-01	WCBP	63.5					IF	NA
34-0022-02	Elizabeth (Main Lake)	Kandiyohi	0701020501-01	WCBP	1023.5	1.2	8611		1.2	IF	IF
34-0025-00	Unnamed	Kandiyohi	0701020501-01	NCHF	11.2						
34-0031-00	Unnamed	Kandiyohi	0701020501-01	WCBP	19.3						
34-0032-00	Carrie	Kandiyohi	0701020501-01	WCBP	89.4	3	777	25.3	3	FS	IF
34-0033-00	Ella	Kandiyohi	0701020501-01	WCBP	153.0	1.3	1550	100	1.3	IF	IF

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
34-0072-00	Lillian	Kandiyohi	0701020501-01	WCBP	1151.4	0.7	41237	100	0.7	NS	IF
34-0073-00	Cherry	Kandiyohi	0701020501-01	WCBP	61.9						
34-0075-00	Unnamed	Kandiyohi	0701020501-01	WCBP	51.3						
34-0076-00	Minnetaga	Kandiyohi	0701020501-01	WCBP	791.1	*1.1	8189			NS	IF
34-0086-00	Big Kandiyohi	Kandiyohi	0701020502-02	WCBP	2682.5	3.7	37219		3.7	NS	IF
34-0089-00	Unnamed	Kandiyohi	0701020502-02	WCBP	13.0						
34-0093-00	Unnamed	Kandiyohi	0701020502-02	WCBP	176.2						
34-0096-00	Little Kandiyohi	Kandiyohi	0701020502-02	WCBP	665.1					NS	IF
34-0097-00	Eleanor	Kandiyohi	0701020502-02	WCBP	167.7			100		IF	NA
34-0105-00	Kasota	Kandiyohi	0701020502-02	WCBP	429.7					NS	NA
34-0106-00	Swan	Kandiyohi	0701020502-02	WCBP	235.8						
34-0169-03	Wakanda Lake	Kandiyohi	0701020502-02	WCBP	1754.2	2.1	24921		2.1	NS	IF
34-0363-00	Unnamed	Kandiyohi	0701020502-02	WCBP	18.9						
34-0439-00	Two Island	Kandiyohi	0701020502-02	WCBP	47.2						
34-0440-00	Johnson	Kandiyohi	0701020502-02	WCBP	105.5						
34-0468-00	Unnamed	Kandiyohi	0701020502-02	WCBP	21.2						
34-0469-00	Unnamed	Kandiyohi	0701020502-02	WCBP	33.2						
34-0595-00	Unnamed	Kandiyohi	0701020502-02	WCBP	46.4						
34-0604-00	Unnamed	Kandiyohi	0701020502-02	WCBP	20.8						
43-0001-00	Reich	McLeod	0701020502-02	NCHF	88.9						
43-0012-00	Winsted	McLeod	0701020502-02	NCHF	382.4	1.8	17054	100	1.8	NS	IF
43-0013-00	Grass	McLeod	0701020502-02	NCHF	61.9						

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
43-0014-00	South	McLeod	0701020502-02	NCHF	173.4					NS	IF
43-0020-00	Coon	McLeod	0701020502-02	NCHF	60.7						
43-0033-00	Mud	McLeod	0701020504-01	WCBP	103.7						
43-0034-00	Silver	McLeod	0701020504-01	WCBP	452.7	1.1	1320	100	1.1	NS	IF
43-0038-00	Bullhead	McLeod	0701020504-01	WCBP	241.6						
43-0040-00	Swan	McLeod	0701020504-01	WCBP	351.6	*1.5	777	100		IF	IF
43-0041-00	Mud Lakebed	McLeod	0701020507-01	WCBP	242.3						
43-0042-00	Rice	McLeod	0701020507-01	WCBP	58.1						
43-0056-00	Mary	McLeod	0701020507-01	WCBP	83.4						
43-0057-00	Unnamed	McLeod	0701020507-01	WCBP	38.2						
43-0058-00	Ryan	McLeod	0701020507-01	WCBP	33.6						
43-0059-00	Unnamed	McLeod	0701020507-01	WCBP	38.4						
43-0060-00	Clear	McLeod	0701020507-01	WCBP	62.0						
43-0061-00	Addie	McLeod	0701020507-01	WCBP	198.7						
43-0063-00	Unnamed (Lewis)	McLeod	0701020507-01	WCBP	57.7						
43-0067-00	Little Bear	McLeod	0701020507-01	NCHF	101.9						
43-0075-00	Tomlinson	McLeod	0701020507-01	NCHF	39.1						
43-0076-00	Bear	McLeod	0701020507-01	NCHF	172.3	*1.3	1140			NS	IF
43-0077-00	Sustacek	McLeod	0701020507-01	NCHF	44.8						
43-0078-00	Piker's	McLeod	0701020507-01	NCHF	56.9						
43-0079-00	Harrington	McLeod	0701020507-01	NCHF	51.1						

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
43-0084-00	Marion	McLeod	0701020507-01	WCBP	520.4	2	4741	100	2	NS	NA
43-0085-01	Otter	McLeod	0701020507-01	WCBP	641.8	0.8	285381	100	0.8	NS	IF
43-0087-00	Judson	McLeod	0701020507-01	WCBP	165.0						
43-0097-00	Whitney	McLeod	0701020503-01	WCBP	134.0						
43-0098-00	Eagle	McLeod	0701020503-01	WCBP	347.3	*1.0	12662			IF	IF
43-0099-00	Allen	McLeod	0701020503-01	WCBP	141.3						
43-0100-00	Barber	McLeod	0701020503-01	WCBP	138.2						
43-0101-00	Mud	McLeod	0701020503-01	WCBP	211.6						
43-0103-00	Clear	McLeod	0701020503-01	NCHF	82.4						
43-0104-00	Stahl's	McLeod	0701020503-01	NCHF	140.6			57.7		FS	IF
43-0106-00	Mud	McLeod	0701020503-01	NCHF	19.5						
43-0109-00	French	McLeod	0701020503-01	NCHF	42.4						
43-0112-00	Pierce	McLeod	0701020503-01	WCBP	37.2						
43-0113-00	Fernold	McLeod	0701020503-01	WCBP	40.4						
43-0115-00	Cedar	McLeod	0701020503-01	NCHF	1860.0	1.3	11998	100	1.3	NS	IF
43-0117-00	Unnamed	McLeod	0701020503-01	WCBP	18.5						
43-0118-00	Unnamed	McLeod	0701020503-01	WCBP	11.3						
43-0121-00	Unnamed	McLeod	0701020503-03	WCBP	12.0						
43-0122-00	Unnamed	McLeod	0701020503-03	NCHF	67.0						
43-0145-00	Unnamed	McLeod	0701020503-03	WCBP	14.2						
43-0156-00	Unnamed	McLeod	0701020507-02	NCHF	17.2						
43-0161-00	Nass Pond	McLeod	0701020507-02	WCBP	18.0						

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
47-0049-01	Belle Lake	Meeker	0701020507-02	NCHF	863.9	4.3	5204		4.3	NS	IF
47-0053-00	Hurley	Meeker	0701020507-02	NCHF	53.6						
47-0054-00	Benton	Meeker	0701020507-02	NCHF	29.4						
47-0058-00	Eighty Acre	Meeker	0701020507-02	NCHF	38.1						
47-0059-00	Mud	Meeker	0701020507-02	NCHF	71.0						
47-0060-00	Sioux	Meeker	0701020507-02	NCHF	399.3			100		IF	NA
47-0061-00	Willie	Meeker	0701020507-02	NCHF	191.1	2.4	7725	66.5	2.4	NS	NA
47-0062-00	Greenleaf	Meeker	0701020507-02	NCHF	238.6	2.6	5663	80.4	2.6	NS	IF
47-0104-00	Unnamed	Meeker	0701020507-02	WCBP	22.8						
47-0106-00	Hoff	Meeker	0701020507-02	WCBP	138.5	1.4	23659	100	1.4	NS	NA
47-0110-00	Pipe	Meeker	0701020507-02	WCBP	21.1						
47-0112-00	Harden	Meeker	0701020507-02	NCHF	151.7						
47-0113-00	Coombs	Meeker	0701020507-02	WCBP	106.9						
47-0114-00	Atkinson	Meeker	0701020507-02	WCBP	133.7						
47-0115-00	Unnamed	Meeker	0701020507-02	WCBP	80.1						
47-0118-00	Evenson	Meeker	0701020507-02	WCBP	128.7						
47-0121-00	Mud	Meeker	0701020507-02	WCBP	97.9						
47-0122-00	Unnamed	Meeker	0701020507-02	WCBP	25.7						
47-0124-00	Unnamed	Meeker	0701020507-02	NCHF	35.3						
47-0126-00	Unnamed	Meeker	0701020507-02	WCBP	73.1						
47-0127-00	Goose	Meeker	0701020507-02	WCBP	119.4	*1.8	423	100		NS	NA
47-0128-00	Unnamed	Meeker	0701020507-02	WCBP	19.2						

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
47-0129-00	Star	Meeker	0701020507-02	WCBP	552.9	2.3	1956	100	2.3	IF	IF
47-0130-00	Unnamed	Meeker	0701020507-02	WCBP	34.0						
47-0139-00	Unnamed (Mud)	Meeker	0701020502-01	WCBP	69.3						
47-0152-00	Mud	Meeker	0701020502-01	WCBP	340.5						
47-0153-00	King	Meeker	0701020502-01	WCBP	574.4						
47-0156-00	Unnamed	Meeker	0701020502-01	WCBP	96.1						
47-0159-00	Thompson	Meeker	0701020502-01	WCBP	225.8	*1.1	1240	100		NS	IF
47-0163-00	Unnamed	Meeker	0701020502-01	WCBP	126.2						
47-0164-00	Unnamed	Meeker	0701020502-01	WCBP	24.4						
47-0168-00	Middle	Meeker	0701020502-01	WCBP	19.7						
47-0169-00	Rodewald	Meeker	0701020502-01	WCBP	14.0						
47-0171-00	Belle	Meeker	0701020502-01	WCBP	143.9						
47-0264-00	Unnamed	Meeker	0701020502-01	NCHF	61.6						
47-0283-00	Unnamed	Meeker	0701020502-01	WCBP	21.9						
47-0290-00	Unnamed	Meeker	0701020502-01	WCBP	19.3						
47-0352-00	Unnamed	Meeker	0701020502-01	NCHF	27.2						
65-0002-00	Preston	Renville	0701020502-01	WCBP	655.0	1.8	9206		1.8	NS	IF
65-0006-00	Allie	Renville	0701020502-01	WCBP	509.1	2.3	5137	100	2.3	IF	IF
65-0007-00	Unnamed	Renville	0701020502-01	WCBP	29.7						
65-0010-00	Hodgson	Renville	0701020502-01	WCBP	140.9						
65-0012-00	Phare	Renville	0701020502-01	WCBP	127.5						

Lake ID	Lake Name	County	HUC-12	Ecoregion	Lake Area (acres)	Max Depth (m)	Watershed Area (acres)	% Littoral	Mean depth (m)	AQR Support Status	AQL Support Status
65-0013-00	Boon	Renville	0701020502-01	WCBP	754.9	*0.9	7708			NS	IF
72-0049-00	Schilling	Sibley	0701020502-01	WCBP	763.4						
86-0032-00	Rice	Wright	0701020502-01	NCHF	141.6	*0.3	35219			NS	NA
86-0036-00	Unnamed	Wright	0701020502-01	NCHF	136.1						
86-0038-00	Mud	Wright	0701020502-01	NCHF	73.6						
86-0103-00	Ida	Wright	0701020502-01	NCHF	84.7						
86-0196-00	Unnamed	Wright	0701020502-01	NCHF	24.6						
86-0197-00	Maple	Wright	0701020502-01	NCHF	54.2						
86-0198-00	Butler	Wright	0701020502-01	NCHF	123.7						
86-0253-00	Butternut	Wright	0701020502-01	NCHF	120.8						

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

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

*These depths were created by MPCA Staff.

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 Mi2	Fish Class	Threshold	FIBI	Visit Date
Headwaters South Fork Crow River							
07010205-650	12UM062	Unnamed ditch	3.65	6	42	2	18-Jul-12
07010205-541	12UM012	County Ditch 23A	26.22	7	42	22	25-Jul-12
07010205-607	12UM004	Big Kandiyohi Channel	40.40	7	42	37	06-Aug-12
07010205-610	12UM013	County Ditch 24A	13.56	7	42	12	19-Jul-12
07010205-608	12UM005	State Ditch Branch 2	8.98	7	42	18	08-Aug-12
07010205-612	12UM019	Unnamed ditch	9.00	6	42	24	19-Jul-12
07010205-592	10EM147	Unnamed ditch	1.49	6	42	15	05-Aug-10
Judicial Ditch No 28A							
07010205-504	01UM005	Judicial Ditch 67	7.03	7	42	0	09-Jul-12
07010205-625	12UM051	Judicial Ditch 9	7.49	7	42	6	09-Jul-12
07010205-630	12UM059	Unnamed ditch	3.98	7	42	13	10-Jul-12
07010205-528	00UM050	County Ditch 4	16.52	6	42	23	08-Aug-12
07010205-528	00UM050	County Ditch 4	16.52	6	42	34	10-Jul-12
07010205-502	07UM103	Buffalo Creek	62.34	5	47	15	10-Jul-12
07010205-502	07UM103	Buffalo Creek	62.34	5	47	30	27-Aug-07
07010205-502	12UM006	Buffalo Creek	109.12	5	47	21	11-Jul-12
07010205-502	01UM004	Buffalo Creek	41.74	6	42	28	08-Aug-12
07010205-502	01UM004	Buffalo Creek	41.74	6	42	31	09-Jul-12
07010205-502	01UM003	Buffalo Creek	15.69	7	42	14	09-Jul-12
07010205-631	12UM067	County Ditch 7A	8.54	7	42	13	10-Jul-12
Judicial Ditch 15							
07010205-626	12UM053	Judicial Ditch 15	7.17	6	42	23	11-Jul-12
07010205-509	12UM060	Judicial Ditch 15	16.99	7	42	16	12-Jul-12
07010205-627	12UM054	Judicial Ditch 15	7.31	6	42	15	12-Jul-12
07010205-627	12UM054	Judicial Ditch 15	7.31	6	42	15	08-Aug-12
07010205-513	00UM051	Judicial Ditch 15	99.34	5	47	16	11-Jul-12
07010205-513	12UM052	Judicial Ditch 15	60.61	5	47	24	17-Jul-12

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
Judicial Ditch 15 cont.							
07010205-513	12UM055	Judicial Ditch 15	43.09	7	42	19	17-Jul-12
07010205-628	12UM056	Judicial DItch 15	12.21	7	42	15	10-Jul-12
Upper South Fork Crow							
07010205-506	00UM054	Judicial Ditch 29	13.04	7	42	18	10-Jul-12
07010205-549	12UM003	Belle Creek	8.68	6	42	2	09-Jul-12
07010205-550	12UM021	Judicial Ditch 18	24.96	6	42	19	10-Jul-12
07010205-623	12UM044	Unnamed creek	10.22	6	42	28	09-Jul-12
07010205-613	12UM020	King Creek	22.25	6	42	10	10-Jul-12
07010205-621	12UM039	Unnamed creek	15.30	6	42	35	10-Jul-12
07010205-658	00UM048	Crow River, South Fork	200.71	5	47	12	08-Aug-12
07010205-658	00UM053	Crow River, South Fork	234.02	5	47	15	08-Aug-12
07010205-658	12UM058	Crow River, South Fork	235.53	5	47	23	13-Aug-12
07010205-658	12UM018	Crow River, South Fork	46.61	7	42	22	08-Aug-12
07010205-658	12UM042	Crow River, South Fork	32.38	7	42	32	06-Aug-12
07010205-609	12UM011	County Ditch 18	8.47	7	42	0	10-Jul-12
07010205-533	12UM025	Unnamed creek	20.76	6	42	0	10-Jul-12
07010205-659	12UM045	Crow River, South Fork	305.05	5	47	18	13-Aug-12
07010205-659	99UM070	Crow River, South Fork	407.07	5	47	41	14-Aug-12
07010205-659	99UM070	Crow River, South Fork	407.07	5	47	44	07-Aug-12
07010205-620	12UM038	Judicial Ditch 1	13.54	6	42	38	11-Jul-12
Hoff Lake							
07010205-656	12UM043	Unnamed creek	38.56	6	42	26	07-Aug-12
07010205-656	12UM043	Unnamed creek	38.56	6	42	31	11-Jul-12
Buffalo Creek							
07010205-645	12UM015	County Ditch 33	23.33	7	42	39	19-Jul-12
07010205-551	12UM063	Unnamed ditch (County Ditch 63)	3.36	7	42	38	18-Jul-12
07010205-638	06UM005	Buffalo Creek	237.64	5	47	34	20-Sep-06
07010205-638	06UM006	Buffalo Creek	416.47	5	47	13	20-Sep-06
07010205-638	12UM068	Buffalo Creek	245.95	5	47	16	14-Aug-12
07010205-638	12UM069	Buffalo Creek	299.58	5	47	19	14-Aug-12
07010205-638	12UM072	Buffalo Creek	416.02	5	47	32	14-Aug-12

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
Buffalo Creek cont.							
07010205-638	12UM065	Buffalo Creek	358.21	5	47	16	26-Jul-12
07010205-638	12UM065	Buffalo Creek	358.21	5	47	20	13-Aug-12
07010205-614	12UM022	Unnamed creek	9.19	6	42	5	11-Jul-12
07010205-544	12UM008	County Ditch 12A	8.41	6	42	13	17-Jul-12
07010205-544	12UM064	County Ditch 12A	10.72	6	42	33	17-Jul-12
07010205-629	12UM057	Unnamed creek	6.27	7	42	8	19-Jul-12
07010205-591	12UM023	Judicial Ditch 8	9.99	6	42	3	08-Aug-12
07010205-591	12UM023	Judicial Ditch 8	9.99	6	42	4	11-Jul-12
07010205-615	12UM024	Unnamed creek	11.01	6	42	19	12-Jul-12
07010205-591	10EM035	Judicial Ditch 8	9.02	7	42	0	03-Aug-10
Middle South Fork Crow							
07010205-616	12UM026	McCuen Creek	13.28	7	42	33	11-Jul-12
07010205-510	12UM031	Crow River, South Fork	502.58	4	38	25	09-Aug-12
07010205-510	12UM071	Crow River, South Fork	453.99	5	47	30	07-Aug-12
07010205-611	12UM014	County Ditch 26/27	6.14	6	42	26	11-Jul-12
07010205-515	12UM001	Bear Creek	26.15	6	42	5	11-Jul-12
07010205-515	12UM001	Bear Creek	26.15	6	42	6	09-Aug-12
07010205-515	12UM002	Bear Creek	18.02	6	42	0	11-Jul-12
07010205-641	12UM009	Silver Creek (County Ditch 13)	26.03	6	42	20	31-Jul-12
07010205-511	10EM195	Crow River, South Fork	562.85	4	38	25	14-Sep-10
07010205-511	12UM027	Crow River, South Fork	564.95	4	38	28	14-Aug-12
07010205-511	12UM048	Crow River, South Fork	543.27	4	38	16	13-Aug-12
07010205-622	12UM040	Unnamed creek	9.91	6	42	25	31-Jul-12
Otter Creek							
07010205-643	12UM028	Otter Creek	34.48	6	42	29	30-Jul-12
07010205-617	12UM029	Unnamed creek	3.45	6	42	4	07-Aug-12
07010205-642	07UM098	Otter Creek	25.82	7	42	6	12-Jul-07
Crane Creek							
07010205-647	12UM007	Crane Creek	6.85	6	42	21	18-Jul-12
07010205-572	12UM017	Judicial Ditch 1	35.30	6	42	23	07-Aug-12
07010205-571	12UM066	Judicial Ditch 1	31.30	6	42	33	18-Jul-12

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi2	Fish Class	Threshold	FIBI	Visit Date
Crane Creek cont.							
07010205-585	12UM034	Unnamed creek	21.08	6	42	20	30-Jul-12
07010205-624	12UM049	Unnamed creek	6.15	6	42	9	06-Aug-12
Lower South Fork Crow							
07010205-508	12UM033	Crow River, South Fork	1110.71	4	38	40	14-Aug-12
07010205-508	12UM041	Crow River, South Fork	1270.50	4	38	24	21-Aug-12
07010205-508	12UM050	Crow River, South Fork	1200.55	4	38	18	15-Aug-12
07010205-508	12UM050	Crow River, South Fork	1200.55	4	38	27	21-Aug-12
07010205-508	12UM070	Crow River, South Fork	1172.22	4	38	23	15-Aug-12
07010205-618	12UM032	Unnamed creek	12.44	6	42	16	12-Jul-12
07010205-648	12UM016	County Ditch 9	6.56	7	42	16	07-Aug-12
Rice Lake							
07010205-654	12UM037	Pioneer Creek	27.86	6	42	21	06-Aug-12

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 Mi²	Invert Class	Threshold	MIBI	Visit Date
Headwaters South Fork Crow River							
07010205-541	12UM012	County Ditch 23A	26.22	7	41	27.32	31-Jul-12
07010205-607	12UM004	Big Kandiyohi Channel	40.40	7	41	25.35	31-Jul-12
07010205-650	12UM062	Unnamed ditch	3.65	7	41	28.98	31-Jul-12
07010205-608	12UM005	State Ditch Branch 2	8.98	7	41	21.89	31-Jul-12
07010205-612	12UM019	Unnamed ditch	9.00	7	41	28.94	30-Jul-12
07010205-592	10EM147	Unnamed ditch	1.49	7	41	22.70	26-Aug-10
Judicial Ditch No 28A							
07010205-504	01UM005	Judicial Ditch 67	7.03	7	41	3.49	06-Aug-12
07010205-625	12UM051	Judicial Ditch 9	7.49	7	41	11.55	06-Aug-12
07010205-630	12UM059	Unnamed ditch	3.98	7	41	18.81	06-Aug-12
07010205-528	00UM050	County Ditch 4	16.52	5	37	22.35	07-Aug-12
07010205-502	01UM003	Buffalo Creek	15.69	7	41	6.93	06-Aug-12
07010205-502	01UM004	Buffalo Creek	41.74	7	41	19.41	06-Aug-12
07010205-502	07UM103	Buffalo Creek	62.34	7	41	21.92	07-Aug-12
07010205-502	07UM103	Buffalo Creek	62.34	7	41	23.40	07-Aug-12
07010205-502	12UM006	Buffalo Creek	109.12	5	37	31.23	07-Aug-12
07010205-631	12UM067	County Ditch 7A	8.54	7	41	15.92	07-Aug-12
Judicial Ditch No 15							
07010205-509	12UM060	Judicial Ditch 15	16.99	7	41	15.92	06-Aug-12
07010205-513	00UM051	Judicial Ditch 15	99.34	5	37	4.37	07-Aug-12
07010205-513	12UM052	Judicial Ditch 15	60.61	7	41	13.47	07-Aug-12
07010205-513	12UM052	Judicial Ditch 15	60.61	7	41	19.02	07-Aug-12
07010205-513	12UM055	Judicial Ditch 15	43.09	7	41	27.01	07-Aug-12
07010205-628	12UM056	Judicial DItch 15	12.21	7	41	9.88	07-Aug-12
Upper South Fork Crow							
07010205-506	00UM054	Judicial Ditch 29	13.04	7	41	24.92	31-Jul-12
07010205-506	00UM054	Judicial Ditch 29	13.04	7	41	32.66	31-Jul-12
07010205-549	12UM003	Belle Creek	8.68	7	41	17.47	01-Aug-12

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Invert Class	Threshold	MIBI	Visit Date
Upper South Fork Crow cont.							
07010205-550	04UM012	Judicial Ditch 18	34.28	6	43	32.31	07-Sep-04
07010205-550	12UM021	Judicial Ditch 18	24.96	7	41	27.12	01-Aug-12
07010205-623	12UM044	Unnamed creek	10.22	5	37	25.65	01-Aug-12
07010205-613	12UM020	King Creek	22.25	7	41	30.04	31-Jul-12
07010205-621	12UM039	Unnamed creek	15.30	7	41	13.55	01-Aug-12
07010205-658	00UM048	Crow River, South Fork	200.71	7	41	23.48	31-Jul-12
07010205-658	00UM053	Crow River, South Fork	234.02	7	41	37.07	31-Jul-12
07010205-658	12UM042	Crow River, South Fork	32.38	7	41	25.53	30-Jul-12
07010205-658	12UM058	Crow River, South Fork	235.53	7	41	41.23	31-Jul-12
07010205-609	12UM011	County DItch 18	8.47	7	41	7.27	30-Jul-12
07010205-533	12UM025	Unnamed creek	20.76	7	41	5.92	01-Aug-12
07010205-533	12UM025	Unnamed creek	20.76	7	41	9.59	01-Aug-12
07010205-659	12UM045	Crow River, South Fork	305.05	7	41	41.71	01-Aug-12
07010205-659	99UM070	Crow River, South Fork	407.07	5	37	23.91	02-Aug-12
07010205-620	12UM038	Judicial Ditch 1	13.54	7	41	40.83	01-Aug-12
Hoff Lake							
07010205-656	12UM043	Unnamed creek	38.56	5	37	21.74	30-Jul-12
Buffalo Creek							
07010205-645	12UM015	County Ditch 33	23.33	5	37	30.92	07-Aug-12
07010205-551	12UM063	Unnamed ditch (County Ditch 63)	3.36	7	41	20.89	01-Aug-12
07010205-638	06UM005	Buffalo Creek	237.64	5	37	28.07	20-Sep-06
07010205-638	06UM006	Buffalo Creek	416.47	5	37	49.00	20-Sep-06
07010205-638	12UM068	Buffalo Creek	245.95	7	41	45.27	07-Aug-12
07010205-638	12UM069	Buffalo Creek	299.58	5	37	15.01	08-Aug-12
07010205-638	12UM072	Buffalo Creek	416.02	5	37	33.38	08-Aug-12
07010205-638	12UM065	Buffalo Creek	358.21	5	37	15.70	08-Aug-12
07010205-544	12UM008	County Ditch 12A	8.41	7	41	38.82	08-Aug-12
07010205-544	12UM064	County Ditch 12A	10.72	5	37	29.21	08-Aug-12
07010205-629	12UM057	Unnamed creek	6.27	6	43	22.29	08-Aug-12
07010205-591	10EM035	Judicial Ditch 8	9.02	6	43	10.61	26-Aug-10
07010205-591	12UM023	Judicial Ditch 8	9.99	6	43	33.92	08-Aug-12

National Hydrography Dataset (NHD) Assessment Segment AUID	Biological Station ID	Stream Segment Name	Drainage Area Mi²	Invert Class	Threshold	MIBI	Visit Date
Middle South Fork Crow							
07010205-616	12UM026	McCuen Creek	13.28	7	41	42.13	02-Aug-12
07010205-510	12UM031	Crow River, South Fork	502.58	2	31	18.36	02-Aug-12
07010205-510	12UM071	Crow River, South Fork	453.99	7	41	35.35	02-Aug-12
07010205-611	12UM014	County Ditch 26/27	6.14	6	43	21.35	02-Aug-12
07010205-515	12UM001	Bear Creek	26.15	5	37	33.02	02-Aug-12
07010205-515	12UM002	Bear Creek	18.02	6	43	49.60	02-Aug-12
07010205-641	12UM009	Silver Creek (County Ditch 13)	26.03	5	37	26.04	14-Aug-12
07010205-511	10EM195	Crow River, South Fork	562.85	2	31	30.82	26-Aug-10
07010205-511	12UM027	Crow River, South Fork	564.95	2	31	16.76	08-Aug-12
07010205-511	12UM048	Crow River, South Fork	543.27	2	31	9.80	14-Aug-12
07010205-622	12UM040	Unnamed creek	9.91	6	43	33.64	14-Aug-12
Otter Creek							
07010205-643	12UM028	Otter Creek	34.48	6	43	58.99	14-Aug-12
Crane Creek							
07010205-572	12UM017	Judicial Ditch 1	35.30	5	37	21.21	09-Aug-12
07010205-585	12UM034	Unnamed creek	21.08	5	37	35.55	08-Aug-12
07010205-624	12UM049	Unnamed creek	6.15	5	37	29.85	09-Aug-12
Lower South Fork Crow							
07010205-618	12UM032	Unnamed creek	12.44	6	43	40.97	14-Aug-12
07010205-508	12UM070	Crow River, South Fork	1172.22	2	31	26.38	09-Aug-12
07010205-508	12UM033	Crow River, South Fork	1110.71	2	31	19.30	09-Aug-12
07010205-508	12UM041	Crow River, South Fork	1270.50	2	31	19.90	09-Aug-12
Lower South Fork Crow cont.							
07010205-508	12UM050	Crow River, South Fork	1200.55	2	31	30.19	09-Aug-12
07010205-648	12UM016	County Ditch 9	6.56	6	43	18.48	09-Aug-12
Rice Lake							
07010205-654	12UM037	Pioneer Creek	27.86	6	43	44.69	14-Aug-12

Appendix 5.1 - Minnesota's ecoregion-based lake eutrophication standards

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

Appendix 5.2 - MINLEAP model estimates of phosphorus loads for lakes in the South Fork Crow River Watershed

Lake ID	Lake Name	Obs TP (µg/L)	MINLEAP TP (µg/L)	Obs Chl-a (µg/L)	MINLEAP Chl-a (µg/L)	Obs Secchi (m)	MINLEAP Secchi (m)	Avg. TP Inflow (µg/L)	TP Load (kg/yr)	Background TP (µg/L)	%P Retention	Outflow (hm3/yr)	Residence Time (yrs)	Areal Load (m/yr)	Trophic Status
10-0093-00	Oak	135	52	64	21	0.9	1.3	196	132	25.8	0.74	0.67	2.2	0.5	H
10-0094-00	*Mud	202	51	141	21	0.3	1.3	208	67	18.5	0.75	0.32	2.5	0.4	H
10-0095-00	*Swede	369	41	125	15	0.5	1.6	233	116	19.6	0.82	0.5	4.9	0.28	H
10-0121-00	*Eagle	203	51	73	21	0.6	1.3	167	159	17.9	0.69	0.95	1.7	1.29	H
27-0176-00	Independence	57	38	29	13	1.4	1.7	166	756	18.3	0.77	4.56	3.5	1.35	E
27-0184-01	North Little Long	82	51	37	21	0.6	1.3	176	219	19.9	0.71	1.24	1.9	0.85	H
27-0184-02	South Little Long	53	35	29	12	1.1	1.8	180	81	18.5	0.81	0.45	4.9	0.75	E
34-0022-02	Elizabeth (Main Lake)	89	141	23	91	0.6	0.5	566	2706	39.9	0.75	4.78	1	1.15	H
34-0032-00	Carrie	18	97	6	52	1.4	0.8	566	244	30.1	0.83	0.43	2.5	1.19	M
34-0033-00	Ella	74	147	37	96	0.6	0.5	567	483	39.1	0.74	0.85	0.9	1.38	H
34-0072-00	Lillian	87	277	49	244	1.3	0.3	569	12506	49.6	0.51	21.91	0.1	4.72	H
34-0076-00	*Minnetaga	264	158	32	107	0.4	0.5	567	2552	43.9	0.72	4.5	0.8	1.41	H
34-0086-00	Big Kandiyohi	147	107	20	61	1.1	0.7	568	11487	28.1	0.81	20.23	2	1.86	H
34-0169-00	Wakanda	190	138	121	88	0.4	0.6	568	7686	32.3	0.76	13.54	1.1	1.91	H
43-0012-00	Winsted	373	82	78	41	0.9	0.9	152	1374	34.5	0.46	9.03	0.3	5.84	H
43-0034-00	Silver	271	96	131	52	0.6	0.8	560	451	37.9	0.83	0.8	2.5	0.44	H
43-0040-00	*Swan	45	75	51	36	0.5	0.9	558	276	35.8	0.87	0.49	4.3	0.35	E
43-0076-00	*Bear	164	56	88	24	1	1.2	175	110	36	0.68	0.63	1.4	0.9	H
43-0084-00	Marion	92	118	40	70	1.1	0.6	567	1485	31	0.79	2.62	1.6	1.25	H
43-0085-00	Otter	350	441	95	481	0.4	0.2	570	85656	49	0.23	150.29	0	57.85	H
43-0098-00	*Eagle	77	251	43	211	0.4	0.3	569	3839	41.6	0.56	6.75	0.2	4.8	H
43-0115-00	Cedar	85	56	47	24	0.4	1.2	175	1160	36.8	0.68	6.61	1.5	0.88	H
47-0049-01	Belle	50	34	33	11	1.2	1.9	177	510	24.6	0.81	2.88	5.2	0.82	E
47-0061-00	Sioux	61	74	30	36	0.9	0.9	153	625	19.9	0.51	4.09	0.5	5.3	E
47-0062-00	Greenleaf	74	63	33	28	0.7	1.1	156	470	28.1	0.6	3.02	0.8	3.12	H
47-0106-00	Hoff	123	343	62	332	1	0.3	570	7112	24.6	0.4	12.48	0.1	22.19	H
47-0127-00	*Goose	399	83	99	42	0.9	0.9	562	141	21.9	0.85	0.25	3.4	0.52	H

Lake ID	Lake Name	Obs TP (µg/L)	MINLEAP TP (µg/L)	Obs Chl-a (µg/L)	MINLEAP Chl-a (µg/L)	Obs Secchi (m)	MINLEAP Secchi (m)	Avg. TP Inflow (µg/L)	TP Load (kg/yr)	Background TP (µg/L)	%P Retention	Outflow (hm3/yr)	Residence Time (yrs)	Areal Load (m/yr)	Trophic Status
47-0129-00	Star	73	74	48	35	0.4	0.9	562	654	28.4	0.87	1.16	4.4	0.52	H
47-0159-00	*Thompson	111	124	36	75	1.1	0.6	565	399	40	0.78	0.71	1.4	0.77	H
65-0002-00	Preston	123	146	43	96	0.7	0.5	568	2840	33.8	0.74	5	1	1.89	H
65-0006-00	Allie	252	115	12	68	0.9	0.6	567	1602	33.2	0.8	2.83	1.7	1.37	H
65-0013-00	*Boon	174	170	109	119	0.3	0.5	567	2403	42.5	0.7	4.24	0.6	1.39	H
86-0032-00	*Rice	349	132	81	82	0.6	0.3	149	2759	34.6	0.11	18.55	0	32.28	H

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

Appendix 6 – Fish species found during biological monitoring surveys

Common Name	Quantity of Stations Where Present	Quantity of Individuals Collected
fathead minnow	89	6133
black bullhead	81	2647
green sunfish	79	3283
common carp	73	4992
orangespotted sunfish	67	1764
white sucker	64	737
creek chub	55	1924
johnny darter	54	1051
yellow perch	47	723
bigmouth shiner	40	1125
central mudminnow	40	958
black crappie	39	302
brook stickleback	38	1737
tadpole madtom	38	281
walleye	37	272
largemouth bass	35	321
northern pike	34	132
bluegill	33	497
brassy minnow	33	806
sand shiner	31	1722
blackside darter	28	576
spotfin shiner	27	1223
yellow bullhead	26	92
channel catfish	23	1492
bigmouth buffalo	22	405
golden shiner	22	116
shorthead redhorse	19	323
central stoneroller	15	633
Iowa darter	15	40
blacknose dace	14	529
bluntnose minnow	14	228
hybrid sunfish	10	244
longnose dace	7	120
pumpkinseed	6	12
spottail shiner	5	22
Gen: redhorses	4	41
silver redhorse	4	4
bowfin	3	4
smallmouth bass	3	5
trout-perch	3	3
common shiner	1	1

Appendix 7 – Macroinvertebrate taxa found during biological monitoring surveys

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Ablabesmyia	41	131
Acari	44	166
Acentrella	11	26
Acentrella parvula	2	8
Acerpenna	10	54
Acricotopus	1	3
Acroneuria	5	2
Aedes	3	21
Aeshna	16	15
Aeshnidae	6	6
Agnetina	1	1
Amnicola	6	154
Amphipoda	2	2
Anacaena	4	5
Anafroptilum	5	14
Anax	15	7
Anopheles	2	17
Anthopotamus	9	42
Anthopotamus myops	1	2
Antocha	2	3
Aquarius	1	1
Argia	5	10
Atherix	10	32
Atrichopogon	5	5
Baetidae	12	34
Baetis	34	494
Baetis intercalaris	4	68
Baetisca	4	4
Belostoma	14	13
Belostoma flumineum	7	7
Berosus	3	4
Bezzia	2	10
Bezzia/Palpomyia	2	7
Brachycentrus	5	10
Brachycentrus numerosus	2	68
Brillia	11	47
Buenoa	1	1
Caecidotea	1	5
Caenis	54	1282

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Caenis diminuta	4	10
Caenis hilaris	4	8
Callibaetis	10	45
Calopterygidae	4	12
Calopteryx	12	30
Calopteryx aequabilis	1	4
Cambaridae	10	3
Cambarus	3	1
Ceraclea	2	2
Ceratopogonidae	3	6
Ceratopogoninae	11	25
Ceratopsyche	19	198
Chauliodes	7	7
Cheumatopsyche	35	470
Chimarra	2	50
Chironomidae	1	1
Chironomini	25	58
Chironomus	18	73
Chrysops	2	18
Cladopelma	10	20
Cladotanytarsus	10	37
Climacia	1	1
Clinotanypus	1	3
Coenagrionidae	39	697
Conchapelopia	8	14
Corixidae	39	218
Corydalidae	2	3
Corynoneura	15	30
Crambidae	1	4
Cricotopus	38	201
Cryptochironomus	20	27
Cryptotendipes	8	12
Culex	4	20
Culicidae	7	16
Cyphon	1	1
Dasyhelea	2	2
Desmopachria	1	1
Dicranota	1	1
Dicrotendipes	47	576
Dineutus	1	1
Dixella	5	12
Dixidae	2	2

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Dolichopodidae	1	1
Dubiraphia	47	662
Dytiscidae	10	11
Elmidae	5	13
Empididae	4	5
Enallagma	29	330
Endochironomus	16	174
Enochrus	3	8
Ephydridae	20	55
Eukiefferiella	1	1
Fallceon	4	14
Ferrissia	17	45
Forcipomyia	4	5
Forcipomyiinae	4	5
Fossaria	4	7
Fridericia	1	2
Gammarus	3	6
Gerridae	4	4
Glossosomatidae	1	1
Glyptotendipes	21	738
Gomphidae	4	5
Gymnochthebius	4	7
Gyraulus	18	145
Gyrinus	9	9
Haliplidae	3	7
Haliplus	21	55
Hayesomyia sonata	1	1
Helicopsyche	6	80
Helicopsyche borealis	1	1
Helisoma	1	0
Helophorus	1	1
Hemerodromia	15	25
Heptagenia	6	24
Heptageniidae	21	106
Hesperocorixa	1	1
Hetaerina	2	6
Hexagenia	4	3
Hirudinea	39	99
Hyalella	55	3549
Hydaticus	1	1
Hydra	7	16
Hydraena	7	11

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Hydrobaenus	1	1
Hydrobiidae	1	3
Hydrochus	9	11
Hydrophilidae	3	2
Hydroporus	1	2
Hydropsyche	28	254
Hydropsyche incommoda	2	11
Hydropsyche placoda	1	1
Hydropsyche simulans	2	16
Hydropsychidae	32	364
Hydroptila	26	196
Hydroptilidae	10	48
Hygrotus	3	4
Ilybius	1	0
Isonychia	3	4
Iswaeon	4	26
Labiobaetis dardanus	1	1
Labiobaetis propinquus	2	10
Labrundinia	21	83
Laccophilus	3	5
Lampyridae	2	2
Larsia	5	5
Leptoceridae	18	29
Leptocerus	1	10
Leptophlebiidae	14	46
Leucrocuta	2	3
Libellulidae	3	1
Limnephilidae	1	3
Limnophyes	7	11
Liodessus	5	8
Lymnaea	2	2
Lymnaeidae	17	60
Maccaffertium	24	188
Maccaffertium terminatum	1	1
Macronychus	17	125
Macronychus glabratus	5	27
Mayatrichia	3	8
Menetus	2	10
Mesovelia	2	1
Metrobates	1	1
Micrasema	4	8
Microchironomus	1	1

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Micropsectra	17	289
Microtendipes	33	165
Microvelia	1	1
Muscidae	1	1
Mystacides	2	4
Nais	4	27
Nanocladius	23	55
Nectopsyche	16	102
Nectopsyche candida	4	68
Nectopsyche diarina	3	26
Nectopsyche exquisita	2	4
Nemata	2	6
Nematoda	3	4
Nematomorpha	1	0
Neoplasta	2	4
Neoplea	26	169
Neoplea striola	6	27
Neoporus	8	24
Nilotanypus	8	11
Notonecta	2	1
Notonectidae	1	0
Nyctiophylax	2	8
Ochthebius	3	7
Odontomyia	8	16
Odontomyia /Hedriodiscus	1	1
Oecetis	16	46
Oecetis avara	2	16
Oecetis furva	1	4
Oligochaeta	46	1057
Ophidonais serpentina	1	1
Optioservus	8	25
Orconectes	15	6
Orthocladiinae	16	36
Orthocladius	12	33
Oxyethira	3	16
Palmacorixa	10	55
Parachironomus	9	17
Paracladopelma	2	2
Paracricotopus	1	24
Paracymus	4	4
Paragnetina	1	1
Parakiefferiella	5	9

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Paralauterborniella	3	4
Paraleptophlebia	3	3
Paramerina	9	23
Parametriocnemus	5	7
Paratanytarsus	41	310
Paratendipes	25	84
Peltodytes	8	10
Pentaneura	11	110
Perlesta	2	2
Perlidae	2	2
Petrophila	3	4
Phaenopsectra	20	120
Phryganeidae	4	6
Physa	57	1165
Physella	3	40
Physidae	2	6
Pisidiidae	50	415
Planorbella	13	18
Planorbidae	12	46
Plathemis	2	1
Plauditus	8	90
Polycentropodidae	1	1
Polycentropus	2	5
Polypedilum	66	1086
Potamyia	8	72
Potamyia flava	2	12
Potthastia	4	5
Prionocera	2	2
Procladius	33	113
Procloeon	5	15
Prodiamesa	2	2
Promenetus	2	2
Protoptila	1	4
Psectrocladius	3	3
Psectrotanypus	1	2
Pseudocentroptiloides	1	2
Pseudochironomus	3	7
Pseudocloeon	9	115
Pseudocloeon propinquum	1	14
Psychodidae	1	2
Psychomyia	2	5
Pteronarcys	6	10

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Pycnopsyche	8	3
Ranatra	3	4
Rhagovelia	1	1
Rheocricotopus	7	19
Rheotanytarsus	31	610
Rhyacophila	1	1
Saetheria	1	1
Sciomyzidae	4	5
Scirtes	2	2
Scirtidae	5	5
Serromyia	1	1
Sialis	7	25
Sigara	17	47
Simuliidae	9	27
Simulium	38	530
Stagnicola	11	18
Stempellinella	8	32
Stenacron	11	58
Stenacron interpunctatum	1	2
Stenelmis	32	316
Stenochironomus	18	45
Stratiomyidae	3	2
Stylurus	1	1
Tabanidae	4	5
Taeniopteryx	1	1
Tanypodinae	27	49
Tanypus	5	16
Tanytarsini	26	107
Tanytarsus	36	329
Thienemanniella	20	48
Thienemannimyia	1	1
Thienemannimyia Gr.	67	544
Tipula	3	3
Tipulidae	3	3
Trepaxonemata	2	2
Triaenodes	4	6
Tribelos	2	6
Trichocorixa	11	31
Tricorythodes	38	711
Trissopelopia	1	1
Tropisternus	4	1
Tubificinae	4	18

Taxonomic name	Quantity of stations where present	Quantity of individuals collected
Turbellaria	23	114
Tvetenia	2	2
Uenoidae	1	1
Unionidae	4	0
Valvata	2	3
Xenochironomus	1	1
Zavreliella	3	3
Zavrelimyia	4	15