Watershed

March 2025

Draft Le Sueur River Watershed Restoration and Protection Strategy Report Update 2025

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

Authors

Paul Davis

Contributors/acknowledgements

Marco Graziani

Anna Bosch

Jeff Strom

Carrie Freeman

Bonnie Goshey

Paul Wymar

Bryan Spindler

Scott Salsbury

Mark Schaetzke

Editing and graphic design

Jinny Fricke (public notice review_2.24.25)

Cover photo credit: Minnesota State University Mankato – Water Resources Center

Document number: wq-ws4-102a

Contents

List of Figures

List of Tables

Key terms and abbreviations

Altered hydrology: Changes in the amount of and way that water moves through the landscape. Examples of altered hydrology include changes in river flow, precipitation, subsurface drainage, impervious surfaces, wetlands, river paths, vegetation, and soil conditions. These changes can be climate- and/or human-caused.

Animal Units (AU): A term typically used in feedlot regulatory language. One AU is roughly equivalent to 1,000 pounds (lb) of animal but varies depending on the specific animal.

Assessment Unit Identifier (AUID): The unique water body identifier for each river reach comprised of the U.S. Geological Survey (USGS) eight-digit Hydrologic Unit Code (HUC) plus a three-character code unique within each HUC.

Aquatic life impairment: The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

Aquatic recreation impairment: Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus and either chlorophyll-*a* or Secchi disc depth standards are not met.

Best management practice (BMP): A term used to describe a type of water pollution control. These can be a structural practice that is physically built to capture water and treat pollution, or a management practice used to limit or control pollution, usually at its source.

Biological impairment: A biological impairment is an impairment to the aquatic life beneficial use due to a low fish and/or aquatic macroinvertebrate (bug) IBI score.

Concentrated Animal Feeding Operation (CAFO): CAFOs are facilities designed for confinement of animals. CAFO is further defined by the Environmental Protection Agency as large, medium, and small based on number of animals in a confined area for more than 45 days.

Designated (or beneficial) use: Water bodies are assigned a designated use based on how the water body is used. Typical beneficial uses include drinking, swimming, fishing, fish consumption, agricultural uses, and limited uses. Water quality standards for pollutants or other parameters are developed to determine if water bodies are meeting their designated use.

Dissolved Oxygen (DO): Oxygen that is present (dissolved) in water.

***Escherichia coli* (*E. coli*):** A bacteria commonly found in the gastrointestinal tract and feces of warm-blooded animals. *E. coli* is a preferred indicator for freshwater recreation and its presence provides direct evidence of fecal contamination from warm-blooded animals.

Eutrophication: The enrichment of a water body with nutrients, typically phosphorus and/or nitrogen.

Flow-weighted Mean Concentration (FWMC): The total mass of a pollutant delivered (by water) over a set period of time by the total volume of water over that same period of time. Typical units are milligrams per liter (mg/L).

Geographic Information System (GIS): A geographic (or geographical) information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. Geographic Information System

Hydrologic Simulation Program-Fortran (HSPF): A computer model developed to simulate hydrology and water quality at the watershed scale.

Hydrologic Unit Code (HUC): A HUC is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Le Sueur River Watershed is assigned a HUC-8 of 07020011.

Impairment: Water bodies are listed as impaired if water quality standards are not met for designated uses including aquatic life, aquatic recreation, and aquatic consumption.

Index of Biotic Integrity (IBI): A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the water body. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

Local Governmental Unit (LGU): Local government, typically city, township, county and Soil and Water Conservation District (SWCD).

Nonpoint source pollutants: Pollutants that are from diffuse sources; most of these sources are not regulated. Nonpoint sources include agricultural field run-off, agricultural drain tile discharge, storm water from smaller cities and roads, bank, bluff, and ravine failures, atmospheric deposition, failing septic systems, animals, and other sources.

Point source pollutant: Pollutants that can be directly attributed to one location; generally, these sources are regulated by permit. Point sources include wastewater treatment plants, industrial dischargers, storm water discharge from larger cities, and storm water runoff from construction activity (construction storm water permit).

Pollutant vs Stressor: Generally, these words could be used interchangeably. However, in this report, a pollutant is used to refer to parameters that have a water quality standard and can be tested for directly. Pollutants affect all beneficial uses. A stressor is used to refer to the parameter(s) identified in the stressor identification process, which is only done when a biological impairment is identified (due to a low fish and/or macroinvertebrate IBI score).

Protection: This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the water bodies.

National Land Cover Database (NLCD): A database of land cover categories generated in cooperation with the Multi-Resolution Land Characteristics Consortium (MRLC) a partnership of Federal agencies working together to produce current, nationally consistent, land cover products for all 50 states and Puerto Rico

Nitrate: The measurement generally reported as “Nitrate” in this report is a measurement of Nitrate + Nitrite Nitrogen.

Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the water bodies.

Stream Class: A classification system for streams to specify the stream's beneficial or designated uses.

Stream Class 2B: The quality of Class 2B surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life and their habitats. These waters shall be suitable for Aquatic Recreation (AQR) of all kinds, including bathing, for which the waters may be used.

Stream Class 7 waters: The quality of Class 7 waters of the state shall be such as to protect aesthetic qualities, secondary body contact use, and groundwater for use as a potable water supply.

Stream reach: Reaches in a surface water network are segments with similar hydrologic characteristics. Reaches are commonly defined by a length of stream between two confluences, or a lake or pond. Each reach is assigned a unique reach number and a flow direction. The length of the reach, the type of reach, and other important information are assigned as attributes to each reach.

Stressor (or biological stressor): This is a broad term that includes both pollutant sources (e.g., excessive sediment, excessive chloride) and nonpollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

Total maximum daily load (TMDL): A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

Total Nitrogen (TN): The sum of all nitrogen forms. Total Nitrogen = Ammonia Nitrogen (NH_3) + Nitrite (NO_2) + Nitrate (NO_3).

Total Phosphorus (TP): A measure of all phosphorus found in a sample, whether that phosphorus is dissolved or particulate.

Total Suspended Solids (TSS) TSS is a measurement of the dry-weight of suspended particles, that are not dissolved, in a sample of water that can be trapped by a filter. TSS consists of soil particles, algae, and other materials that are suspended in water and cause a lack of clarity. Excessive TSS can harm aquatic life, degrade aesthetic and recreational qualities, and make water more expensive to treat for drinking.

Water Body Identifier (WID): The unique WID for each river reach comprised of the U.S. Geological Survey (USGS) eight-digit HUC plus a three-character code unique within each HUC. The term "WID" replaces the old identifier term Assessment Unit ID (AUID).

Watershed Pollutant Load Monitoring Network (WPLMN): A partnership including state and federal agencies, Metropolitan Council Environmental Services, state universities, and local partners, that collects data on water quality and flow in Minnesota. Since 2007, the network of partners has been collecting data to understand long-term trends and observe changes over time.

Yield (water, pollutant, crop, etc.): The amount of mass, volume, or depth per unit land area (e.g., lb/ac, in/ac).

Acronyms

1W1P	One Watershed, One Plan
ACPF	Agricultural Conservation Planning Framework
AQL	Aquatic Life
AQR	Aquatic Recreation
AU	Animal unit
BMP	Best management practice
BOD	Biological Oxygen Demand
CADDIS	Causal Analysis/Diagnosis Decision Information System
Chl-*a*	Chlorophyll-a
CI	Confidence interval
CWMP	Comprehensive Watershed Management Plan
DNR	Minnesota Department of Natural Resources
DO	Dissolved oxygen
E. coli	*Escherichia coli*
EHC	Evaluation of Hydrologic Change
EPA	Environmental Protection Agency
FIBI	Fish Index of Biological Integrity
FWMC	Flow Weighted Mean Concentration
HSPF	Hydrologic Simulation Program-Fortran
HUC	Hydrologic unit code
IBI	Index of Biological Integrity
IWM	Intensive watershed monitoring
LiDAR	Light Detection and Ranging
MIBI	Macroinvertebrate Index of Biological Integrity
MDA	Minnesota Department of Agriculture
MPCA	Minnesota Pollution Control Agency
MS4	municipal separate storm sewer systems
M	Meters
µg/L	Micrograms per liter (also known as parts per billion)
N	Nitrogen
NCHF	North Central Hardwood Forests
NRS	Minnesota Nutrient Reduction Strategy
PTMApp	Prioritize Target and Measure Application
SID	Stressor Identification
SSP	Shared Socioeconomic Pathway
SWCD	Soil and Water Conservation District
SWPPP	Stormwater Pollution Prevention Plan
TALU	Tiered Aquatic Life Use
TN	Total Nitrogen
TMDL	Total maximum daily load
TP	Total phosphorus

TSS	Total suspended solids
USDA	United States Department of Agriculture
WCBP	Western Corn Belt Plains
WID	Water body identification number
WHAF	Watershed Health Assessment Framework
WPLMN	Watershed Pollutant Load Monitoring Network
WRAPS	Watershed Restoration and Protection Strategy
WWTF	Wastewater Treatment Facilities

Executive summary

The State of Minnesota has adopted a Watershed Approach for managing water quality for each of the 80 major watersheds in the state. Each major watershed undergoes surface water monitoring and assessment and has the opportunity for a watershed restoration and protection strategy (WRAPS) update project. The Le Sueur River Watershed first underwent intensive watershed monitoring (IWM) in 2008, with the initial WRAPS report approved in 2015.

The Le Sueur River WRAPS Report Update 2025 is an update of the 2015 WRAPS Report (MPCA 2015a). This WRAPS report update summarizes water quality findings from the second round of IWM (MPCA 2021), stressor identification (SID) (MPCA 2024a), water quality research projects, and studies. The goals of this updated WRAPS report are to:

1. Highlight differences and trends in watershed conditions over the last 10 years.
2. Share updated surface water quality resources, information, and tools for watershed stakeholders as they plan and implement best management practices (BMPs).
3. Provide updated recommendations for prioritizing and targeting implementation throughout the watershed.

Overall, water quality conditions have not significantly changed in the Le Sueur River Watershed since 2008. Many stream reaches were deferred for biological assessment in 2010 due to channelized conditions. These deferred reaches were opted in to the 2018 assessment process so the previous data could be utilized in the Tiered Aquatic Life Use (TALU) assessment process for modified use streams. Several of these reaches were included in the 2020 and 2022 assessment periods. The following summary highlights these updated findings for lakes, streams, and overall watershed conditions.

Condition of Lakes:

- There were no new lakes determined to be impaired by nutrients.
- Three lakes (Madison, Lura, Bass) have impaired aquatic life (AQL) use, based on the Fish Index of Biological Integrity (FIBI).
- Reeds Lake is vulnerable to future impairment for AQL use based on the FIBI as it was at the impairment threshold in the latest assessment.
- Of the five lakes that were designated as impaired, recent data shows that these lakes remain impaired with some parameters improving and some declining.
- There are seven lakes within the Le Sueur River Watershed with water clarity trend data as of 2022. Of these, two lakes had improving water clarity (Reeds and Buffalo), two lakes indicated no change (Madison and Elysian), and three lakes showed no trend (St. Olaf, Bass, and Lura).

Condition of Rivers and Streams:

- There were several new stream impairments identified during both the 2018 assessment of deferred reaches and the 2020 assessment of second cycle watershed monitoring.

- The 2018 assessment found 15 stream reaches had impairments of AQL for Macroinvertebrate Index of Biological Integrity (MIBI) and 17 reaches had impairments of AQL for FIBI.
- The 2020 assessment found five stream reaches had impairments of AQL for MIBI and eight reaches had impairments of AQL for FIBI.

- Two new stream *Escherichia coli* (*E. coli*) impairments and one new total suspended solids (TSS) impairment were found in the 2020 assessment process, along with six impairments for mercury in fish tissue for the mainstem of the Le Sueur River.
- Most streams determined to be impaired for fish and invertebrates in the first watershed assessment are still impaired 10 years later. A few streams flipped conditions from support to impairment and vice versa. These streams were studied further in the SID process to determine what conditions may have affected the change in impairment status.
- With the dry conditions of the 2008 monitoring season and the extremely wet conditions in the 2018 monitoring season, there was a high likelihood that any observed changes in biological condition at the watershed or individual reach scale could be partly due to the differences in the climactic conditions of the two periods.

Watershed and Climate Trends:

- Long term trend analysis was completed on the Le Sueur River near Rapidan using Watershed Pollutant Load Monitoring Network (WPLMN) data (2008 through 2020) (Minnesota Pollution Control Agency (MPCA) internal communication).
    - Flow corrected trends for the Le Sueur River Watershed show that no trend was detected for nitrate-nitrogen, total phosphorus (TP) and TSS. This analysis shows that when flows are normalized, the Le Sueur River continues to be a high loading watershed compared to others around the state.
    - Nonflow corrected trends for the Le Sueur River Watershed show there is an increasing trend in Nitrate-nitrogen, TP, and TSS. This analysis shows that with higher flow conditions the Le Sueur River is seeing an increase in loading related to land use and changing climate. There was a high flow period throughout Minnesota from 2016 through 2019.
- The Minnesota Department of Natural Resources (DNR) Evaluation of Hydrologic Change (EHC) (DNR 2023) and Climate Summary Reports for the Le Sueur River Watershed (DNR 2019), provide the following information for temperature, precipitation, and flow:
    - Temperature - the average, minimum, and maximum temperatures show a slight increase, most notably in the winter (DNR 2019).
    - Precipitation - data show an overall increase in precipitation with greater increases in the spring and summer (DNR 2019).
    - The Le Sueur River Watershed receives on average 18% more precipitation compared to the pre-1990 period of record going back to 1950 (DNR 2023).

- Average annual discharge between the pre and post 1990 period has nearly doubled from an average of 468 cubic feet per second (cfs) to 893 cfs. Annual peak discharge has increased by 61% from 5,331 cfs to 8,579 cfs (DNR 2023).

- MPCA's Hydrologic Simulation Program Fortran (HSPF) watershed modeling reveals the Le Sueur River Watershed produces among the highest loads of sediment, nitrogen (N), and phosphorus in the State of Minnesota.

Watershed Restoration and Protection Goals:

There are several areas that should be prioritized for implementation efforts to help protect the good water quality throughout the watershed, as well as improve water bodies with existing impairments.

- Integrate input from local staff to develop conservation practices to alleviate hydrology concerns and downstream impacts from drainage improvement projects. Coordinate and collaborate with landowners, Soil and Water Conservation District (SWCD) staff, agencies, and engineers early in the process.
- Provide funding opportunities for practices that are flexible, available continuously, and watershed wide. Offer options for landowners to try soil health and cover crop practices, work with SWCD staff, and communicate with other landowners who are implementing these practices.
- Restore healthy channels and riparian areas of streams and ditches throughout the watershed to offer critical habitat, improve water quality, and buffer impacts of other stressors. Prioritize headwater reaches that can be remeandered to restore stable conditions by reconnecting incised streams to their floodplains.
- Consider watershed wide strategies to reduce the effects of high intensity agricultural land use. Implement BMPs that provide benefits beyond the site of installation including improving soil health, groundwater protection through better land management, and nutrient management.
- Prioritize lakes that are currently meeting standards or are in the nearly/barely impaired status. These include St. Olaf, Reeds, and Bass Lakes.
- Lake BMPs recommended to improve water quality include septic system compliance, shoreline protection, in-lake management of curly leaf pondweed, stormwater management and increasing native vegetation along shorelines.
- Prioritize streams that are currently meeting either water quality and/or biological standards. Identify land use and practices in these watersheds to gain understanding of what is needed to improve conditions in impaired reaches.

Minnesota's Watershed Approach

The State of Minnesota developed a watershed approach to focus on each watershed's condition as the scientific basis of permitting, planning, implementation, and measurement of results. This process looks strategically at the drainage area as a whole instead of focusing on lakes and stream sections one at a time, increasing effectiveness and efficiency.

The arrow emphasizes the important connection between state water programs and local water management. Local partners are involved – and often lead – in each stage of this framework.

Every 10 years, each of Minnesota's 80 major watersheds are evaluated through monitoring/data collection and assessed against water quality standards to show trends in water quality and the impact of permitting requirements, as well as any restoration, or protection actions. A WRAPS report is then updated to provide technical information to support the implementation of restoration and protection projects by local partners through their One Watershed, One Plan (1W1P) comprehensive local water plan. The MPCA's watershed work is tailored to meet local conditions and needs, based on factors such as watershed size, landscape diversity, and geographic complexity.

To identify and address threats to water quality in each watershed, WRAPS reports address both strategies for restoration of impaired waters, and strategies for protection of waters that are not impaired. Waters not meeting state standards are listed as impaired and total maximum daily load (TMDL) studies are developed for them. The TMDLs are incorporated into the WRAPS reports.

Key aspects of the MPCA's watershed work are to develop and utilize watershed-scale computer models, perform biological SID, conduct problem investigation monitoring, and use other tools to identify strategies for addressing point and nonpoint-source pollution that will cumulatively achieve water quality targets. Point-source pollution comes from sources such as wastewater treatment plants or industrial facilities; nonpoint-source pollution is the result of runoff or contaminants not being absorbed in the soil. For nonpoint source pollution, the WRAPS report informs local planning efforts, but ultimately the local partners decide what work will be included in their local plans.

Minn. Stat. § 114D, also known as the Clean Water Legacy Act, sets out the policy framework for the Watershed Approach, including requiring the development and updating of WRAPS for all watersheds of the state. The Clean Water, Land, and Legacy Amendment approved by Minnesota voters in 2008 directs dollars from an increase in sales tax to a Clean Water Fund, which is overseen by the Clean Water Council. The Clean Water Fund provides resources to implement the Clean Water Legacy Act to achieve and maintain water quality standards in Minnesota through activities such as monitoring, watershed characterization and scientific study, planning, research, and on-the-ground restoration and protection activities.

1. Watershed background and description

1.1 Watershed Approach and WRAPS

The State of Minnesota uses a "Watershed Approach" (MPCA 2015b) to assess and address the water quality of each of the state's 80 major watersheds on a 10-year cycle. In each cycle of the Watershed Approach, rivers, lakes, and wetlands across the watershed are monitored and assessed, water body restoration and protection strategies and local plans are developed and updated, and conservation practices are implemented. Watershed Approach assessment work started in the Le Sueur River Watershed in 2008 and was revisited for IWM beginning in 2018 (Figure 1).

In addition to information produced in earlier Watershed Approach work, prior to the development of this WRAPS Update, this WRAPS Update report presents additional data and analyses, and summarizes results into a comprehensive story of the watershed's surface water quality.

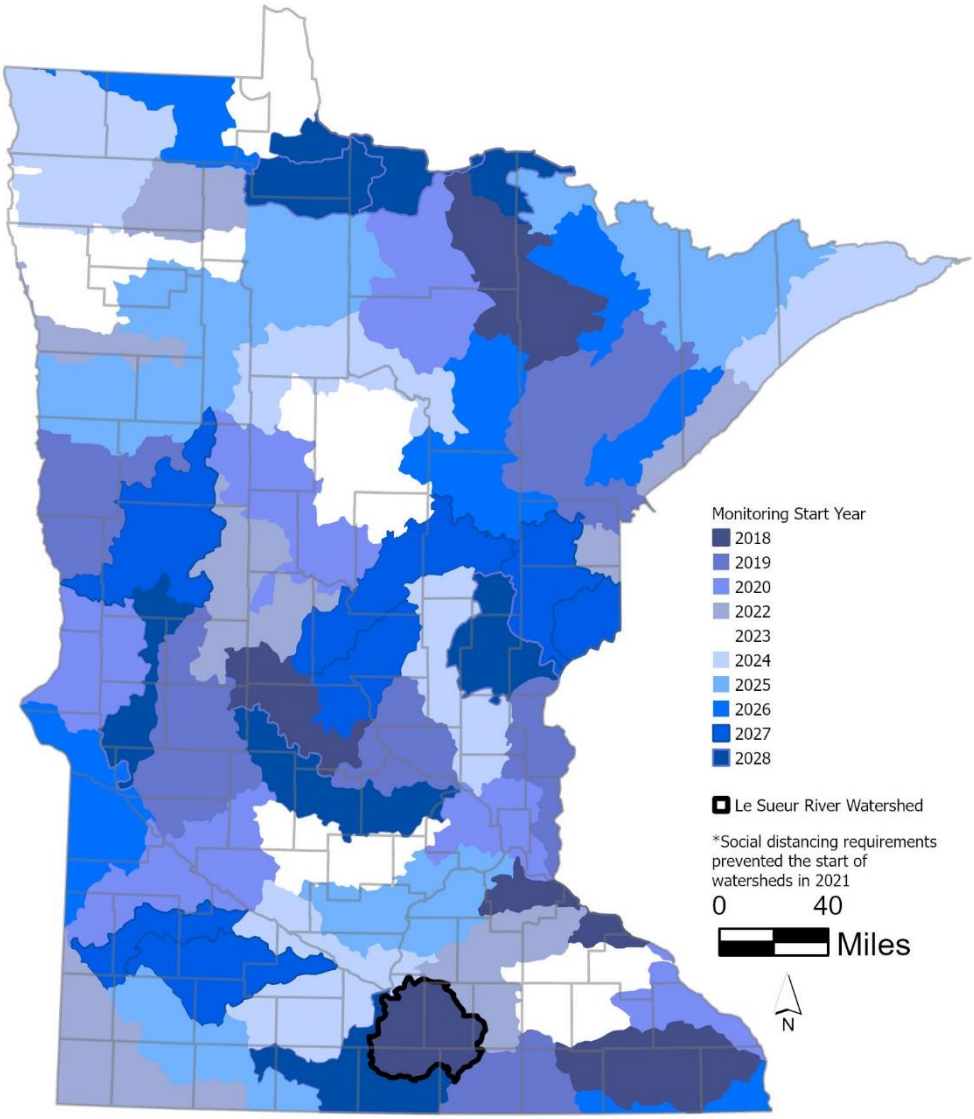
Related Cycle 1 reports are listed below and can be found at: Le Sueur River Watershed information webpage.

- Le Sueur River Watershed Monitoring and Assessment Report (MPCA 2012)
- Le Sueur River Watershed SID Report (MPCA 2014a)
- Le Sueur River WRAPS Report (MPCA 2015a)
- Le Sueur River Watershed TMDL Report (MPCA 2015c)

Connecting to the Minnesota Nutrient Reduction Strategy

The Minnesota Nutrient Reduction Strategy (NRS) was first published in 2014 and provides statewide goals for phosphorus and nitrogen reductions to help mitigate impacts to water quality and aquatic life in the Gulf of Mexico, Lake Winnipeg, and Lake Superior. The MPCA is working with state and federal agency partners, along with the University of Minnesota, to revise the NRS to include the latest data and science related to nutrients in Minnesota. The revised NRS will be completed in late 2025 to early 2026. The Le Sueur Watershed contributes nutrients to the Minnesota River basin and to the Mississippi River system, which ultimately flows to the Gulf. A nutrient load reduction goal of 45% from base line conditions (1980-1996) is needed at the state line by the year 2040 to meet Minnesota's portion of the load reduction needed to reduce the size and frequency of hypoxic conditions in the Gulf during the summer months.

Figure 1. MPCA watershed monitoring schedule.

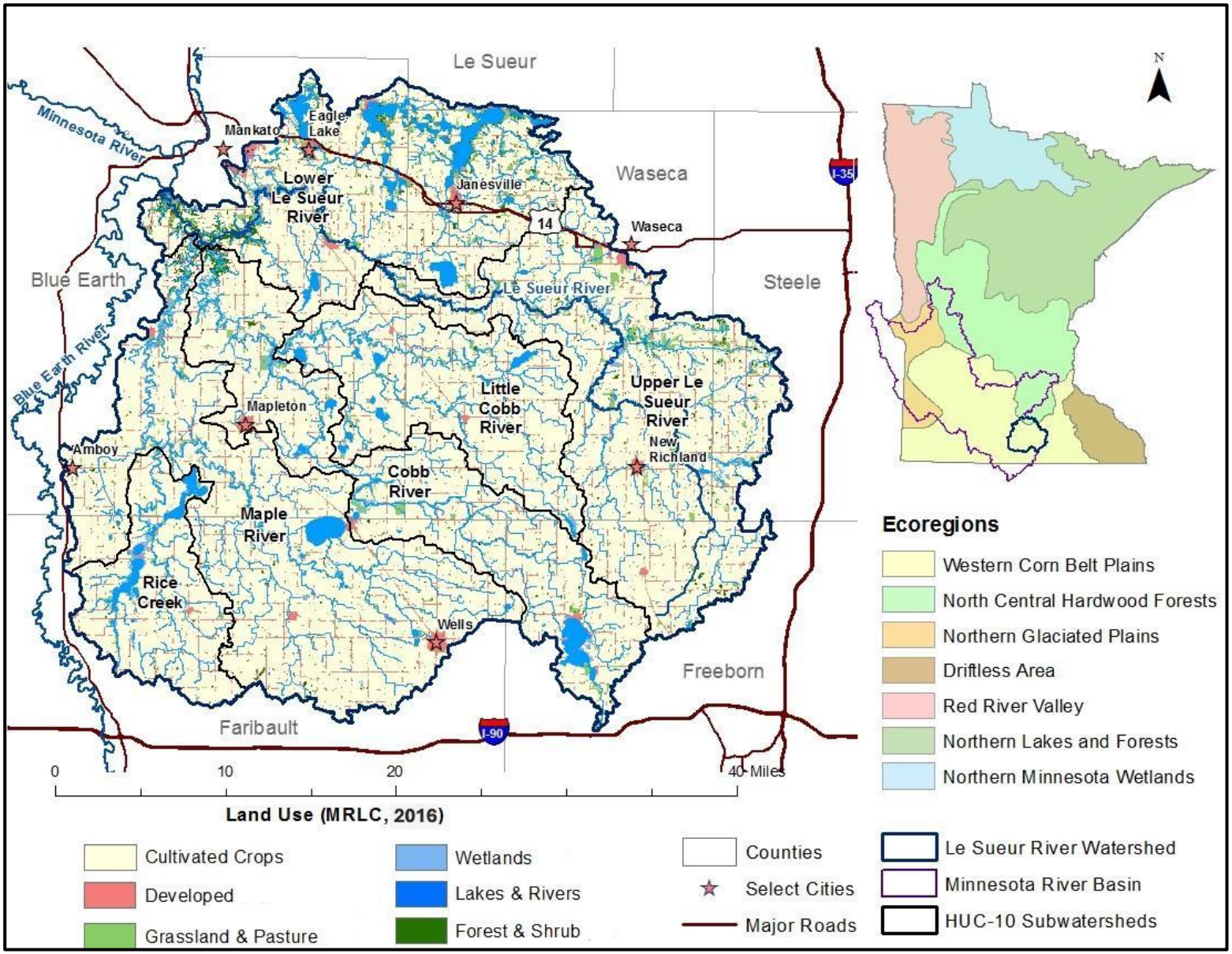


1.2 Watershed Description

The Le Sueur River Watershed is in south central Minnesota and drains approximately 711,000 acres (1,110 square miles) into the Le Sueur River. More than 90% of the watershed is in the Western Corn Belt Plains (WCBP) Ecoregion with a small area in the northern portion of the watershed in the North Central Hardwood Forests (NCHF) Ecoregion. The Le Sueur River flows to the Blue Earth River and these waters join the Minnesota River near Mankato.

The Le Sueur River Watershed lies predominately in four counties: Blue Earth, Waseca, Faribault, and Freeborn, while small portions of the watershed fall in Steele and Le Sueur Counties. The Le Sueur River Watershed contains several rural cities including Eagle Lake, Mapleton, New Richland, Wells, and small portions of Waseca and Mankato (Figure 2).

Figure 2. Le Sueur River Watershed land use and ecoregion location.



The watershed's unique topographical features include the upper headwaters portion that contributes first order streams and ditch systems that impact downstream waters. The middle portion includes the former bed of Glacial Lake Minnesota, which is relatively flat with fine, highly erodible soils that are poorly drained. The Le Sueur River drops elevation quickly in a large knick zone that creates steep, eroding banks, bluffs, and ravines in the downstream portions of the river.

Urban development, while a small percentage of watershed area, has grown around the cities of Mankato and Eagle Lake. Concerns are for the loss of shallow wetlands and potholes being converted to impervious surfaces. While covered by municipal separate storm sewer systems (MS4) rules, more study may be needed to understand the infiltration capacity of stormwater practices developed in the wet soils of the area. There is concern that development proposals have the potential to increase the volume and rate of runoff compared to existing conditions and may be affecting downstream channels.

Increases in new tiling across the landscape to account for the more intense rain fall events in the Le Sueur River Watershed was brought up in discussions with local staff. Ditching and drainage have caused significant changes to the ecosystems and hydrology of the watershed, altering sediment delivery, nutrient cycling, and habitat within the watershed. To counter these activities, the focus for implementation has been on increasing water storage on the landscape to include larger water storage projects, wetland restorations, and increasing implementation of soil health practices. While quantifying the effects of field tile is difficult, there needs to be open discussion of altered hydrology between local staff, landowners, and agencies.

While the percent of agricultural land use in the watershed hasn't changed much over recent time, the management of the land has. Larger farms and equipment that rely on more intense management primarily to produce corn and soybeans have changed how water, nutrients, and chemicals move through and affect the streams and lakes in the watershed. While local SWCDs work hard to promote implementation activities, many of the practices have the potential to be nullified by other land management activities completed to increase production. Quantifying the net benefit of implementation practices is difficult in watersheds like the Le Sueur River Watershed as there are pluses and minuses that occur with each land management decision.

The Le Sueur River plays an important role as a drinking water source to the city of Mankato. The city of Mankato's drinking water well extracts water from below the Blue Earth River, of which roughly one-third is supplied by the Le Sueur River (MPCA 2015a). The primary concern of this drinking water source is N concentrations, which at elevated levels are dangerous to human health and expensive to treat.

1.3 Assessing Water Quality

1.3.1 Lakes and Streams (MPCA Assessment Process)

Water monitoring is essential to determining whether lakes and streams meet water quality standards designed to ensure that waters are fishable and swimmable. While local partners and state agencies monitor water quality on an ongoing basis, the MPCA conducts an intensive exam of major lakes and streams in each of the state's 80 watersheds every 10 years to detect any changes in water quality. This intensive monitoring looks at fish and macroinvertebrate communities as well as water chemistry to gauge water quality. The partners use the data to see which waters are healthy and need protection and which are impaired and need restoration.

The MPCA and partners conducted biological and chemical surveys on lakes, rivers, and streams in 2008-2009 and again in 2018-2019 to ascertain if the water bodies met water quality standards for AQL, AQR, and fish consumption. The biological and water quality data collected from streams and rivers was also used to determine if any change in condition had occurred between the two time periods. The overall goal of these assessments is to ultimately determine which waters are healthy and in need of protection or are polluted and require restoration. Figure 3 shows monitoring locations that contributed water quality and/or biological data that was utilized in the assessment process.

The collection of samples for both water chemistry and biological sampling is relatively straightforward.

- Sampling for stream chemistry involves collecting bottles of water that are analyzed by a certified lab for various chemicals and sediment.
- Biological sampling involves fish and invertebrate species being collected, counted, and analyzed to understand the population numbers and the species present.

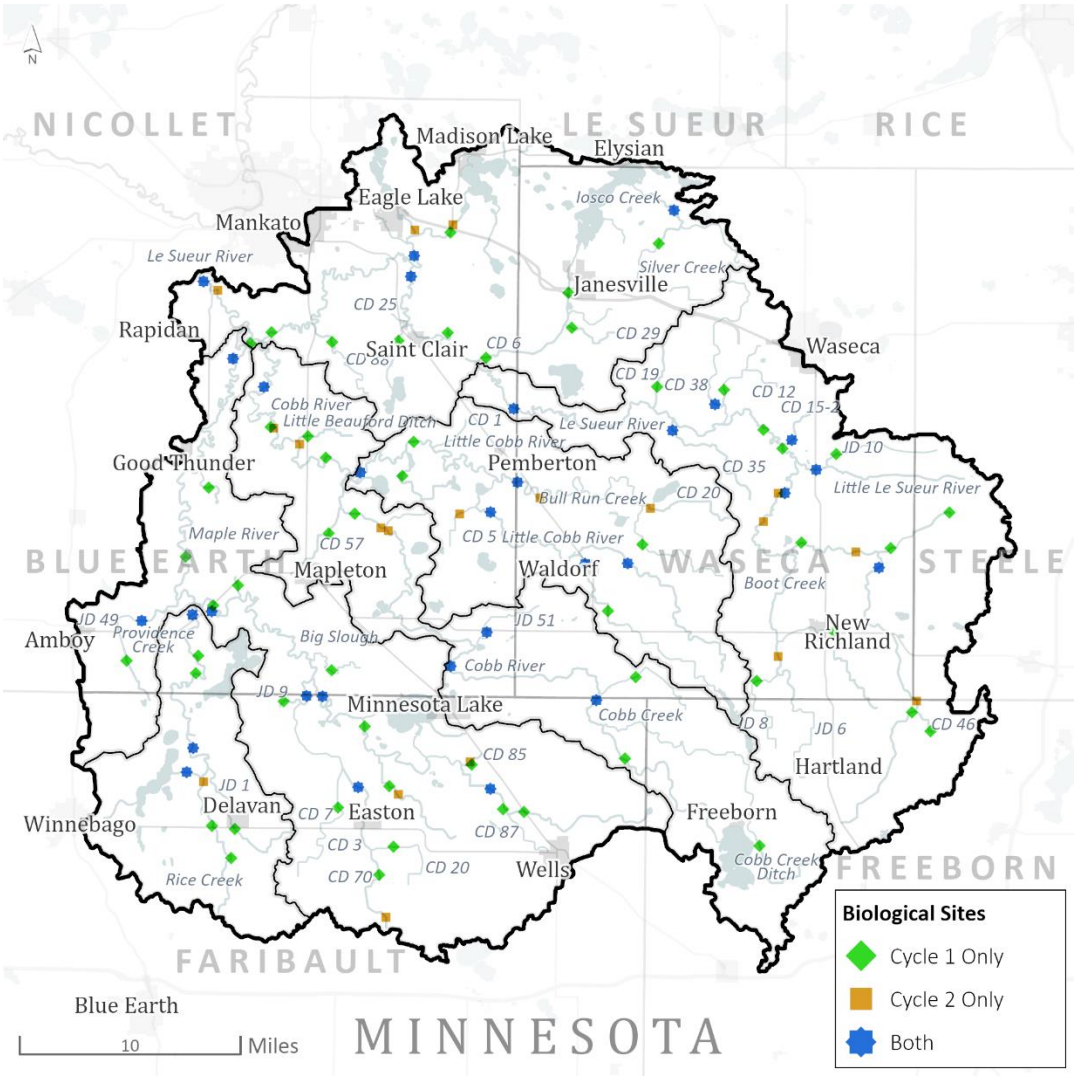
The information is compared to state standards. The standards are what is expected to support AQL and maintain healthy populations. These standards are different for each region of the State and for the different stream types in the State including:

- Modified Use Streams – Generally streams that have been straightened and ditches.
    - The standard for these streams is much lower than general use.
- General Use Streams – Majority of streams like the Le Sueur, Cobb, and Maple Rivers.
- Exceptional Use Streams – North Shore trout waters, other high-quality streams.
    - Much higher standard to be met so the streams remain protected from pollution.

State of Minnesota standards reflect water quality or fish and bug populations, which will differ in the different parts of the state. For example, the Le Sueur River Watershed will have quite different aquatic biota populations and water quality when compared to North Shore streams. Streams that don't meet the standards are considered "impaired" and studied further to develop a plan to meet the standards.

More information on how waters are assessed can be found in the Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List - 2022 (state.mn.us). The Le Sueur River Watershed Assessment and Trends Update provides additional information on lake and stream monitoring Le Sueur River Watershed Assessment and Trends Update (MPCA 2021) and the Tableau Viewer Water Quality Assessment Results Data Viewer | Tableau Public provides an interactive way to view the data. Section 2 below provides a summary of this information.

Figure 3. Watershed biological monitoring locations.



1.3.2 Stressor Identification

When streams and lakes are found to have impaired fish and macroinvertebrate communities, the causes of these biological impairments are studied and identified in a process called Stressor Identification (SID). SID identifies the parameters negatively impacting the AQL populations, referred to as “stressors”. Stressors are identified using the Environmental Protection Agency (EPA) Causal Analysis/Diagnosis Decision Information System (CADDIS) process. In short, stressors are identified based on the characteristics of the aquatic community in tandem with water quality information and other observations. A summary of the streams and their stressors is included in Table 1. This WRAPS Update report describes the stream SID results in Section 2.2.2, and the full report is available here: Le Sueur River Watershed Stressor Identification Update (MPCA 2024a).

Results for Lake SID is conducted by the DNR and the full report (DNR 2021) is stored in the Minnesota Digital Library Le Sueur River Watershed Stressor Identification Report - Lakes.

Table 1. Le Sueur River Watershed SID summary table.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	Stream Name	Biological Stations (Primary sites)	Impairment	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Upper Le Sueur																					
664	Le Sueur River	07MN057 18MN007	Support																			
665	Le Sueur River	08MN055	F-IBI M-IBI								•				•	•	•			•		
621	Boot Creek	92MN076	F-IBI								•				•		•	•	•	•	•	•
620	Le Sueur River	08MN048 08MN053	Support																			
573	Little Le Sueur	08MN027	F-IBI	•			•		•		•	•			•	•	•	•	•	•		•
511	County Ditch 35	08MN030	Support																			
	Lower Le Sueur																					
576	Iosco Creek	08MN026	F-IBI inc													•	•				•	•
507	Le Sueur River	03MN037	F-IBI						•		•				•	•			•	•		•
510	Unnamed Creek	08MN032	M-IBI					•	•		•	•			•							•
501	Le Sueur River	08MN001	F-IBI*	Potential delisting																		
	Little Cobb																					
524	County Ditch 8	08MN038 8MN039	F-IBI M-IBI	•		•		•	•		•	•			•	•	•		•	•	•	•
566	County Ditch 20	08MN062	F-IBI																		•	•
613	Unnamed Creek	08MN037	F-IBI								•				•	•	•	•	•	•		•
504	Little Cobb River	08MN006	F-IBI Inc	•	•		•		•		•			•								•
647	Bull Run Creek	08MN040 18MN010	F-IBI	•	•		•		•		•						•	•	•	•	•	•
	Cobb River																					
568	Cobb River	08MN067 08MN071	F-IBI M-IBI	•					•		•			•				•	•	•		•
556	Cobb River	08MN005	F-IBI inc	•					•		•		•	•	•	•		•		•		•
541	Judicial Ditch 51	01MN030	Support																			
	Maple River																					
593	County Ditch 85	08MN015 18MN008	F-IBI M-IBI								•				•	•	•		•	•		•
550	County Ditch 3	07MN062	F-IBI M-IBI								•			•	•	•	•	•				•
535	Maple River	08MN091 08MN023	F-IBI M-IBI	•				•				•		•	•	•			•	•		•
534	Maple River	08MN003 08MN019	Support																			
650	Providence Creek	08MN008	M-IBI*	•							•						•	•	•	•		•
652	County Ditch 7	08MN002	F-IBI M-IBI	•			•		•		•				•	•	•		•	•		•
	Rice Creek																					
589	Unnamed Creek	08MN009	F-IBI M-IBI	•		•		•	•		•			•	•		•	•	•	•		•
669	Rice Creek	08MN004	M-IBI	•		•			•		•			•	•	•	•	•	•	•		•

Inconclusive	
Stressor	
Not a stressor	
Potential Driver	•

1.3.3 Computer Modeling

With the Watershed Approach, monitoring for pollutants and stressors is generally extensive, but not every stream or lake can be monitored due to financial and logistical constraints. Computer modeling can extrapolate the known conditions of the watershed to areas with less monitoring data. Computer models, such as Hydrological Simulation Program – FORTRAN, represent complex natural phenomena with numeric estimates and equations of natural features and processes. HSPF incorporates data including stream pollutant monitoring, land use, weather, soil type, etc. to estimate flow, sediment, and nutrient conditions within the watershed. HSPF model output provide a reasonable estimate of pollutant concentrations across watersheds. The output can be used for source assessment, TMDL

calculations, and prioritizing and targeting conservation efforts. Modeled pollutant concentration yields are presented in Section 2.4.2.

The Agricultural Conservation Planning Framework (ACPF) and the Prioritize Target and Measure Application (PTMApp) are two watershed tools that can help determine the best places to site conservation practices on the landscape to improve water quality. The ACPF tool was developed by the United States Department of Agriculture (USDA) and focuses on the siting of upland structural practices, drainage water management practices, and riparian corridor management. The ACPF also creates a field specific runoff risk analysis that helps determine which fields have the highest probability of sediment and nutrient loss to a subwatershed outlet. PTMApp is supported by BWSR and can site over 20 conservation practice types with pollution reduction benefits, provides a source assessment for nutrients and sediment at the field and subwatershed scale, and can calculate the cost effectiveness of implementing various practices. The ACPF tool has been run in 10 subwatersheds in the Le Sueur River Watershed while PTMApp has been run for the entire watershed. In addition, Light Detection and Ranging (LiDAR) derived products, such as the stream power index (SPI), compound topographic index (CTI), and the DNR based travel time grid are also available watershed wide. This information was used in the development of the Goals and Recommendations section of the WRAPS update.

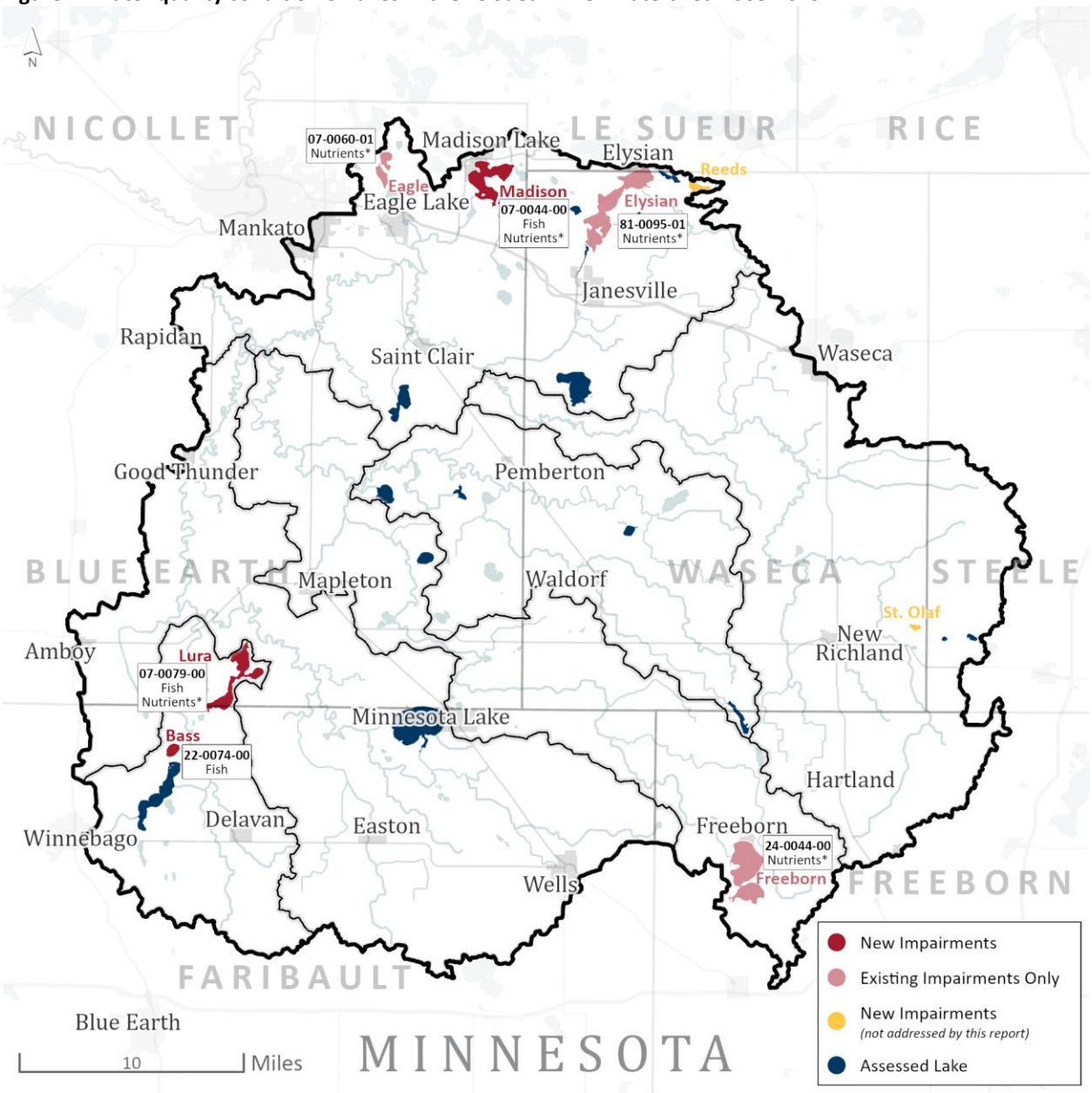
These tools provide a starting point to identify areas that may be contributing higher loads and concentrations of pollutants and be able to narrow down areas that may provide the highest rate of return when installing implementation practices. This information can be used by local staff on an on-going basis to begin discussions with landowners, building trust and relationships that can provide options for implementation activities and funding. The MPCA can provide support to local partners to help develop this information for use in targeting and implementation activities.

2. Watershed conditions

2.1 Water Quality Conditions – Lakes

Section 2.1 provides an overview of the water quality data from 2008 to 2019 used for assessment for lakes including a discussion on existing impaired lakes, and lakes that are vulnerable or near impairment of water quality standards. Of the 19 lakes assessed or reassessed in this cycle, there were no new lakes found to be impaired due to nutrients during this assessment period, but three new lakes were determined to have impaired FIBI (Figure 4).

Figure 4. Water quality condition of lakes in the Le Sueur River Watershed 2008-2019.



2.1.1 New Lake Impairments, De-listings, or Re-categorizations

There were no new aquatic recreational (AQR) lake impairments identified in the watershed during the second cycle of monitoring (MPCA 2021). DNR fisheries did determine that Madison 07-0044-00, Lura 07-0079-00, and Bass Lake 22-0074-00 have impaired AQL (DNR 2021). Madison and Lura Lakes have an existing impairment for AQR (nutrients) and a TMDL has been completed for each. Details about these fish impairments and recommendations to address them can be found in the Lake SID report (DNR 2021) stored in the Minnesota Digital Library at Le Sueur River Watershed Stressor Identification Report - Lakes. There were no lakes that had enough improvement in water quality to de-list from the impaired waters list.

2.1.2 Lakes Vulnerable to Impairment

Three lakes are currently meeting water quality standards but are considered vulnerable to impairment by nutrients based on TP, Chlorophyll-a (Chl-*a*) and Secchi disc depth measured in meters (m) (Surface Water Data Access Tool). These lakes are important to consider because while they currently meet the phosphorous standard, one of the response variables to impairment is not being met. These lakes are more susceptible to future impairment should phosphorus levels rise in the lakes. Local efforts should emphasize a greater understanding of landuse practices affecting nutrient level of the lake and promoting BMPs that maintain the lakes unimpaired status. Notes from the MPCA assessment process (Section 1.3.1) for these lakes (St. Olaf, Reeds, and Bass Lakes) are included in Table 2. This information provides a summary of the lake water quality data collected from the monitoring and assessment process and background information on the lake status.

Table 2. Lakes nearing impaired water quality in the Le Sueur River Watershed (MPCA Assessment Database).

Lakes Vulnerable to AQR Nutrient Impairment	**TP** µg/L	**Chl-*a*** µg/L	**Secchi (m)**
Western Corn Belt Plains (WCBP) – Deep Lake Standard	<65	<22	>0.9
St. Olaf 81-0003-00	25.3	11.4	1.5
Recreational use data available from 2018 and 2019 Cycle 2 IWM work for TP and Chl-*a*. Clarity dataset is much larger with data available across the assessment window, bolstered by volunteer monitoring efforts. St. Olaf is in the DNR Minnesota Sentinel Lake in a Changing Environment (SLICE) monitoring program. MPCA considers it a tier 2 lake, meaning it will be sampled two consecutive years out of every 10 years for the foreseeable future. All eutrophication parameters easily meet regional criteria that signals good recreational water quality. The basin should be considered an outlier of good water quality given the land uses and shoreline development pressures that impact the area. No trend in the long-term clarity dataset. Lake prioritization and protection grade of A identifies this lake as very sensitive to small increases in phosphorus inputs. Overall, recommend full support of AQR use based on all three parameters meeting criteria.			
North Central Hardwood Forest (NCHF) – Deep Lake Standard	<40	<14	>1.4
Reeds Lake 81-0055-00	24.8	14.6	1.9
Recreational use assessment occurred in 2010 based off data collection in 2001 and 2008. At that time, all eutrophication parameters had seasonal averages that were easily meeting regional criteria for this basin. Newer data available from a year one Cycle 2 IWM check up in 2018. All recreational use parameters are easily meeting regional criteria for this lake type. Furthermore, a long-term clarity dataset bolstered by volunteer monitoring efforts provided evidence of an improving trend in water clarity, meaning water clarity is significantly increasing over time. Based on the past full support assessment for AQR, and one year of newer data clearly confirming the initial assessment, recommend full support for recreational use.			
Western Corn Belt Plains (WCBP)– Shallow Lake Standard	<90	<30	>0.7

Lakes Vulnerable to AQR Nutrient Impairment	TP µg/L	Chl-*a* µg/L	Secchi (m)
Bass Lake 22-0074-00	55.4	33.1	0.9
Recreational use data collected in 2018 and 2019 associated with IWM Cycle 2 efforts by MPCA staff. Eutrophication parameters are conflicting and are not conducive to a confident assessment of recreational use conditions. Lake is on the borderline of lake type based on bathymetry but either class would lead to a similar assessment result, given the proportion of the deep area of the lake, mixing is likely occurring regularly. TP data from bottom depth also confirms uniform water chemistry due to lake mixing. Phosphorus mean meets criteria, while both Chl-*a* (30 ug/L) and Secchi (0.7 m) are inconclusively near impairment thresholds. Single data points both meeting and in violation of criteria are seen in all three parameters. Lake is likely nearly/barely impaired, given that it is regularly mixing it should be considered somewhat of an outlier of good water quality in this region of the state given the land use in the contributing watershed. Watershed size-lake area ratio likely a positive effect (small). Lake prioritization and protection grade is A, meaning this water body is significantly sensitive to any increases in phosphorus inputs. Although the overall assessment result is inconclusive, this lake should be considered vulnerable to future impairment and given considerations for protection of current water quality.			

2.1.3 Existing Lake Impairments

Table 3 lists lakes currently impaired by nutrients in the Le Sueur River Watershed. Current assessment data (2018-2019) shows that these lakes remain impaired, with some parameters improving and some declining (MPCA 2021). Similar to Table 2, MPCA assessment comments are provided in Table 3 to provide further context on what factors were discussed and considered during the MPCA assessment process. Lake standards apply for the period of June 1 to September 30.

Table 3. Status of existing impaired lakes in the Le Sueur River Watershed (MPCA Assessment Database).

Impaired Lake Name	Cycle	TP µg/L	Chl-*a* µg/L	Secchi (m)
Western Corn Belt Plains (WCBP) – Shallow Lake Standard		<90	<30	>0.7
Lura Lake 07-0079-00	NA	191	28.5	1.0
	2	103.7	61.9	1.1
This lake was previously assessed in an individual lake study project in 2002 and was listed as impaired by nutrients. Lake monitoring has occurred somewhat regularly since that time, and TMDL work has occurred and been completed. Various efforts of monitoring have occurred within the 10-year assessment window, through TMDL work, the DNR Shallow Lake Program, and MPCA IWM. TP and Chl-*a* means are still indicative of poor recreational water quality. Secchi is meeting the 0.7 meter criteria. Rebounding recreational water quality is likely a long-term milestone. During this assessment, Lura Lake should remain on the impaired waters list for poor recreational water quality.				
Freeborn Lake 24-0044-00	1	332	116.2	0.23
	2	318	315.5	NA
Recreational use data limited to visits in 2014 and 2015 by DNR shallow lake crews. Lake previously assessed and listed impaired in 2010 based on violating parameters from 2008 and 2009 data collection. TMDL work conducted and completed since the initial listing. Water quality improvement is likely a long-term goal. Current single data points would grossly violate respective criteria. Overall, insufficient information for a complete assessment of recreational use conditions since the initial listing.				
Northern Central Hardwood Forests (NCHF) – Shallow Lake Standard		<60	<20	>1.0
Lake Elysian 81-0095-01	1	164.3	74.8	0.51
	2	207.8	102.8	0.4
Newer phosphorus and Chl-*a* data collected during a one-year Cycle 2 IWM checkup in 2018. Phosphorus and Chl-*a* data during that time are confirming poor recreation use conditions, clearly not meeting regional goals for				

Impaired Lake Name	Cycle	TP µg/L	Chl-*a* µg/L	Secchi (m)
a shallow lake. Extensive clarity dataset available bolstered by the volunteer lake monitoring program, mean clarity across the massive dataset is not meeting regional goals. A long-term clarity trend of degrading water clarity over time further confirms the initial impairment. TMDL work has been completed, improvements in water quality are likely a long-term approach. Based on newer data confirming the initial impairment, recommend continued not support based on poor recreational water quality.				
Eagle Lake 07-0060-01	1	163	74.4	0.28
	2	123.9	80.4	0.5
Recreational use assessment occurred in 2010 based on data from 2006 through 2008. All three parameters violated recreational use standards, impairment for nutrient was added. TMDL work has been completed since the initial listing. Data available for current assessment collected through various projects, with the bulk coming from a Cycle 2 IWM water quality checkup in 2018. Conditions appear relatively unchanged from previous assessment; lake should remain on the impaired waters list based on the initial listing and newer confirming data. Water quality changes will likely be a long-term process given the land use and historical inputs to the basin. Improved water quality is ideal for enhancing native plants communities that attract diverse waterfowl communities and improve secondary recreational use.				
Northern Central Hardwood Forests (NCHF) – Deep Lake Standard		<40	<14	>1.4
Madison Lake 07-0044-00	1	75	39.9	1.05
	2	58.9	57.7	1.5
Past recreational use assessment occurred in 2010 with all three eutrophication parameters not meeting regional criteria for a deep-water lake resulting in a new listing at that time. Consistent data collection throughout the 10-year assessment window in association with Minnesota's Sentinel Lake monitoring program by the MPCA water quality monitoring unit, which also monitors lake inlets and groundwater wells to document deeper water quality analysis. Current summary strings included a harmful algae bloom project, which was biased data collection not intended for assessment. Those data points were removed resulting in the following summary means for TP and Chl-*a* respectively: TP 58.9 ug/L, Chl-*a* 57.7 ug/L. TP and Chl-*a* were still not close to meeting regional criteria, while Secchi disk mean falls inconclusively near the impairment threshold with no long-term trend detected in the dataset over time. Previous nutrient listing should remain based on newer data. Continued work with the Sentinel Lake monitoring program is key to developing long term trends and water quality changes over time with respect to climate change and more localized landscape changes. Volunteer monitoring of lakes also solidifies clarity datasets outside of larger monitoring programs.				

2.2 Water Quality Conditions – Streams

Section 2.2 provides an overview of the water quality assessment for streams, including a discussion on existing impaired streams, new stream impairments, and streams that are vulnerable or near impairment of water quality standards (Figure 5). For the 2020 MPCA assessment process there were 83 stream reaches with chemistry and/or biological data within the assessment period. Thirty-three of those reaches had enough data to complete the assessment process. The results of the assessments and impairments found are included below.

Figure 5. Stream assessments and impairments in the Le Sueur River Watershed.

2.2.1 New Stream Impairments

During the initial assessment in 2010, many streams' assessments in the Le Sueur River Watershed were deferred as the methods to assess stream reaches did not account for the conditions that were found in streams that had been straightened and/or ditched (MPCA 2021). In 2018, to allow for a more accurate method to assess these stream types, Minnesota adopted changes to its water quality standards (Minn. R. chs. 7050 and 7052) that establish a TALU framework for rivers and streams. These rule amendments affect Class 2 (AQL) standards. The EPA approved the TALU framework rule also in 2018. Streams that were deferred in the Cycle 1 assessment work were reassessed with the new TALU criteria to meet the 10-year data window for assessment and were listed on the 2020 impaired waters list (Table 4).

There were several new stream impairments identified during the second cycle of watershed monitoring (MPCA 2021). These streams were assessed in 2020 and were added to the 2022 impaired waters list (Table 5). Table 5 below provides additional information on the new impairments.

Table 4. New stream impairments listed in 2020 in the Le Sueur River Watershed.

Stream ID	WID[a]	Listed	Impairment	Data and Assessment Comments
Unnamed creek	546	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Unnamed creek	592	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 29	607	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Bull Run Creek	647	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Maple River	648	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Unnamed creek	661	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Judicial Ditch 10	663	2020	FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 70	548	2020	MIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Judicial Ditch 9	594	2020	MIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Unnamed creek	606	2020	MIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 46	618	2020	MIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Providence Creek (JD 49)	650	2020	MIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Little Cobb River (CD 8)	524	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Maple River	580	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 85	593	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Unnamed creek	599	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.

Stream ID	WID[a]	Listed	Impairment	Data and Assessment Comments
Unnamed creek	601	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 3 (JD 9)	652	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Silver Creek (CD 3)	655	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
Unnamed creek	656	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 88	658	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.
County Ditch 57	530	2020	MIBI, FIBI	Reach opted-in to evaluate Cycle 1 data due to modified use.

a. WID = Water body identifier

Table 5. New stream impairments listed in 2022 in the Le Sueur River Watershed.

Stream ID	WID[a]	Listed	Impairment	Data and Assessment Comments
Cobb River	505	2022	FIBI	No existing fish impairment, the IBI was below threshold with the Biological Condition Gradient (BCG) score of 3. Scores indicate impaired condition.
County Ditch 20	566	2022	FIBI	WID changed to modified use. 2008 nonassessable based on low flow. Station sampled in 2018 and scored 0. Indication of perched culvert.
Unnamed creek	605	2022	FIBI	WID changed to modified use. 18MN006 was sampled in 2018 with a score of 16.7, well below the threshold. Very thick vegetation and choking vegetation was noted on MPCA's Stream Habitat Assessment (MSHA).
Unnamed creek	613	2022	FIBI	Sample from 2018 scored 45.1 out of the 55 threshold. Species were similar to 2008 monitoring, but fewer fish sampled. The site appears to have little habitat.
Boot Creek	621	2022	FIBI	The IBI is 52.9, just below the 55 threshold. N at 13mg/L, DO was 10.74mg/L with a 133.4% saturation could indicate problem. IBI close to threshold, chemistry indicates issues from upstream site.
County Ditch 38	645	2022	FIBI	Scored below threshold in 2008, IBI of 49.6 (55/7). 2018 also below threshold at 51.3. Eleven species were mostly tolerant or very tolerant. Relatively close to threshold and might be a stream that can be restored.
Cobb River	556	2022	MIBI	Existing fish impairment. Current data suggests nonsupport, with each successive sampling of this station receiving lower scores than the previous sampling. Recent MSHA scores suggest a changing habitat condition.
Maple River	648	2022	MIBI	Station changed to modified-use based on channelization and habitat characteristics. Current assessment scores below the threshold, within the confidence interval (CI). The evidence suggests the station is nonsupport of the modified use standard.
Le Sueur River	665	2022	MIBI	New invert data indicates impairment. Turbidity and fish listing will remain based on newer data or lack thereof.
County Ditch 3	550	2022	MIBI, FIBI	WID was changed to modified use, based on channelization and habitat characteristics. MIBI - Data in current assessment window score below the modified use threshold, within the CI. Evidence suggests that this station has a nonsupportive condition, despite what the previous opt-in assessment indicated.

Stream ID	WID[a]	Listed	Impairment	Data and Assessment Comments
				MIBI - Sample 2008 was changed to nonreportable due to high flow after review of the site notes and pictures. The 2018 sample had higher numbers of fish and more species but scoring remained low.
Unnamed creek	589	2022	MIBI, FIBI	MIBI - 2008 assessment determined reach barely supportive and that this station was vulnerable. Current data score below the threshold with poor community, very low diversity and 100% tolerant individuals. FIBI - The IBI from 2008 and 2018 below threshold. The 2018 sample had fewer species however there were more fish. A new and previous failing score are a clear indication of impairment on this WID.
Bull Run Creek	647	2022	*E. coli*	Impairment recategorization request completed to include the impairment in the existing Minnesota River and Greater Blue Earth River Basin TSS TMDL (MPCA 2020).
Iosco Creek	576	2022	*E. coli*	Impairment to be addressed in the 2024 Le Sueur River Watershed TMDL Report (MPCA 2024b).
Bull Run Creek	647	2022	TSS	Impairment recategorization request completed to include the impairment in the existing Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin Report (MPCA 2007).

a. WID = Water body identifier

The Le Sueur River TMDL Report 2025 (MPCA 2025) was developed concurrently with this WRAPS Update Report for approval by the EPA. This report can be found on the Le Sueur River Watershed Webpage and covers the impairments listed in Table 6.

Table 6. Impaired water bodies addressed in the Le Sueur River Watershed TMDL 2025 (MPCA 2025).

WID [a]	Water body name	Water body description	Use class [b]	Listing year	Target completion year	Affected designated use [c]	Listing parameter	TMDL pollutant	Category 4A upon TMDL approval [d]
07020011-501	Le Sueur River	Maple R to Blue Earth R	2Bg	2016	2022	AQL	Nutrients	TP	Y
07020011-504	Little Cobb River	Bull Run Cr to Cobb R							
07020011-556	Cobb River	T107 R26W S30, west line to Le Sueur R							
07020011-576	Iosco Creek	Silver Cr to T108 R23W S7, west line	2Bg	2022	2022	AQR	*E. coli*	*E. coli*	Y

a. WID = Water body identifier

b. Use classes—2B: aquatic life and recreation–cool or warm water habitat; 2Bd: aquatic life and recreation, also protected as a source of drinking water; 2Bg: general cool and warm water aquatic life and habitat; 1C: drinking water, with treatment.

c. AQR: aquatic recreation; AQL: aquatic life

d. Impairment will be categorized as 4A (impaired and a TMDL study has been approved by EPA) upon approval of this TMDL and will appear as 4A in the next impaired waters list. For a biological impairment to be categorized as 4A, TMDLs for all stressors needed to achieve attainment of applicable water quality standards must be approved by EPA. If there are remaining conclusive or inconclusive stressors, the impairment will remain in category 5 until all stressors have been resolved (i.e., inconclusive stressors are determined to be conclusive stressors or not a stressor, and TMDLs are developed for all conclusive pollutant stressors).

2.2.2 Stressors to Stream Biological Impairments

Biologically impaired stream reaches were further investigated following the 2020 assessment process. The SID staff began field work in the summer of 2021 to evaluate the biological assessment data collected at Cycle 2 sites throughout the watershed to determine potential stressors.

The SID process initially identifies a set of candidate causes that are based on the analysis of data collected from the assessment process. These candidate causes provide an overview of the pathways and effects of potential stressors in the watershed. In the Le Sueur River Watershed the candidate causes that were thought to drive the biological impairments included, dissolved oxygen (DO), eutrophication, nitrate, TSS, habitat, connectivity and altered hydrology. These candidate causes were further investigated to confirm the potential stressors on the individual reaches.

The main stressors found as part of the SID process throughout the watershed include altered hydrology, high TSS levels, lack of habitat, and high nutrient loading for nitrates and phosphorous. Stream reaches that were identified as priority areas have more detailed SID information in Section 3.

Please review the entire SID report on the Le Sueur River Watershed webpage for additional information Le Sueur River Stressor Identification Report (MPCA 2024a).

2.2.3 Streams with Change to Impairment Status

The second cycle monitoring did find a few streams that had flipped from impaired to supporting and vice versa. These streams are important to consider as the change in the biological scores impacts the potential impairment status on the reach. The biological communities in these reaches had changed enough in the 10-year cycle that further study is needed to determine if they should be added or removed from the impaired waters list. Information and notes from the MPCA monitoring and assessment work for the individual reaches is included in Table 7. These reaches should be studied more to understand the land use and changes within the watershed that may have flipped their status. Local partner knowledge of practices implemented, and new land use change needs to be considered to understand what may be impacting the score changes. The MPCA will work with local staff to better understand what activities occurred on these reaches and how that information can better translate to implementation activities that will improve water quality conditions throughout the entire Le Sueur River Watershed (MPCA Assessment Database).

Table 7. Streams in the Le Sueur River Watershed that changed impairment status.

Impaired to Support	
Stream ID 511 – County Ditch 35	**Impairments** Fish
Data and Notes Cycle 2 assessment This WID has a proposed use class change (modified use) due to limited habitat. This WID has deferred fish and invert impairments from Cycle 1 watershed assessment due to being predominantly channelized. One visit from one station sampled in 2008 as part of Cycle 1 watershed monitoring, scores below modified use threshold (one point) but within the CI. BCG score of four indicates ecosystem function largely maintained. Nutrients are high (N and phosphorus) but more susceptible invert community is meeting modified use threshold at this time. This station (08MN030) will be sampled in Cycle 2 as a state and local needs site in 2018, recommend insufficient information (IF) and continued deferment of fish impairment until the conclusion of Cycle 2 sampling to confirm nonsupport of modified AQL use based on fish assessment. This WID has an existing fish impairment and has been changed to Modified Use. Site 08MN030 was sampled in 2008 and scored 32.1 which is below the modified use threshold by less than a point. The site was sampled again in 2018 and scored well above the threshold, with a score of 51.4. There were fewer fish and species during the second sample. The 2008 sample had more fish and species, but it did not have any sensitive taxa. The BCG score for the 2018 sample was four and the MSHA score was only 33. Based on the fish data and the change to modified use, recommend this WID be full support for fish, and the impairment be corrected.	
Stream ID 511 – County Ditch 35	**Impairments** Invert
Data and Notes Cycle 2 assessment Both fish and inverts were originally determined to be impaired during assessment year 2010 but were deferred. Recent use attainability analysis (UAA) has determined that habitat is limiting and therefore a modified warmwater use designation is appropriate. Current dataset now indicates support of modified warmwater AQL use based on invert assessment and fish data is insufficient to determine use support at this time and will be sampled in Cycle 2 in 2018. The deferred status for the fish impairment should remain for now and the invert impairment should be removed (corrected). WID has one station (08MN030), sampled in 2008 and 2018. This station has been recommended for a use designation change to modified-use based on channelization and habitat characteristics. Data in current assessment window scores above the threshold, above the confidence limit, and agrees with data from previous assessment. Recommend full-support of modified AQL use based on macroinvertebrate data.	
Stream ID 534 – Maple R, Rice Cr to Le Sueur R	**Impairments** Invert
Data and Notes Cycle 2 assessment Invertebrates - Sample collection was on April 15, 2010. Two invertebrate sites in this AUID. The sites sampled resulted in one score above threshold, within CI, one score below threshold, within CI. The site scoring above threshold might be misclassified and should be examined to determine gradient class for a thorough comparison. Given the questionable classification of the supporting site, as the data currently stand, due to a score well above the threshold, and one just below, the invertebrate data for this AUID indicates marginal nonsupport of AQL (MIBI). No evidence of natural background conditions causing low biological scores. Recommendation of insufficient data or nonreview until follow-up investigation is complete. IBI score increase of 22 points at station initial responsible for listing. This, along with other supporting data in WID suggests a fully supporting condition, and that this station be removed from impaired waters list. No known restoration activities that would lead to this decision. WID has two stations (08MN003, 08MN019) sampled a total of three times, twice in 2008 and once in 2018. Data from current assessment suggests a nonimpaired condition – new data from 08MN003 scores above the threshold, above the confidence limit. The invertebrate community is excellent, with three intolerant taxa present, and abundant clinger and Ephemeroptera, Plecoptera, Trichoptera (EPT) diversity. BCG = 3. This disagrees with the previous data at this station, which scored six points below the threshold, and agrees with the data collected from the other station on this reach (08MN019), which previously scored above the threshold within the confidence limit. Excellent habitat conditions at 08MN003 in both 2008 and 2018, suggest the 2008 invertebrate data was reflective of temporal scale decrease in MIBI score, or was anomalous for an	

undetermined reason. The preponderance of data across both assessment cycles suggests a full-support condition. Recommend that this WID be changed to full support of AQL based on macroinvertebrate data.

Assessment Consistency Technical Team (ACTT) sub-team, 06/10/2020: Review team agrees with the logic detailed above – a delisting to the impaired waters list for benthic macroinvertebrates is merited based on new data indicating AQL use is now being attained. However, there are no known corrective action(s) identified and the delisting will be for unknown reasons. Recommend a delisting to the impaired waters list for benthic macroinvertebrates. Applicable water quality standards attained; due to unknown reasons.

Stream ID 576 – Iosco Creek	**Impairments** Invert

Data and Notes Cycle 2 assessment

Invertebrates - 4/15/10 - One biological, invertebrate site in this AUID. The site scored below threshold, within CI. The invertebrate data for this AUID indicates nonsupport of AQL (MIBI). No evidence of natural background conditions causing low biological scores. Natural channel conditions. Recommend a new listing for biological impairment, invertebrates.

Although site appears to be on a primarily natural stream channel, AUID may be greater than 50% channelized. Invert assessor indicates previous MIBI listing will be corrected and removed from the impaired waters list based on a stream class change.

The station responsible for listing this WID was initially classified as high gradient, and it was determined that the station should be considered low gradient. The new classification results in a high score which falls above the low gradient class standard. This station should be corrected to full support.

WID has one station (08MN026) sampled twice, once in 2008 and once in 2018. Data in current assessment window score below the GU threshold, above the CI. This agrees with previously collected data which scores below the GU threshold, within the CI. Despite collecting riffles at each sample, comments and associated MSHA data suggest this station should be considered low-gradient. Low gradient scores are above the GU threshold, within CI. The classification of this station will be changed to low gradient, and a correction will be made to the impaired waters list. Recommend full support of the general AQL use based on macroinvertebrate data.

Stream ID 534 – Maple R, Rice Cr to Le Sueur R	**Impairments** Invert

Data and Notes Cycle 2 assessment

Invertebrates - Sample collection was on April 15, 2010. Two invertebrate sites in this AUID. The sites sampled resulted in one score above threshold, within CI, one score below threshold, within CI. The site scoring above threshold might be misclassified and should be examined to determine gradient class for a thorough comparison. Given the questionable classification of the supporting site, as the data currently stand, due to a score well above the threshold, and one just below, the invertebrate data for this AUID indicates marginal nonsupport of AQL (MIBI). No evidence of natural background conditions causing low biological scores. Recommendation of insufficient data or nonreview until follow-up investigation is complete.

IBI score increase of 22 points at station initial responsible for listing. This, along with other supporting data in WID suggests a fully supporting condition, and that this station be removed from impaired waters list. No known restoration activities that would lead to this decision.

WID has two stations (08MN003, 08MN019) sampled a total of three times, twice in 2008 and once in 2018. Data from current assessment suggests a nonimpaired condition – new data from 08MN003 scores above the threshold, above the confidence limit. The invertebrate community is excellent, with three intolerant taxa present, and abundant clinger and Ephemeroptera, Plecoptera, Trichoptera (EPT) diversity. BCG = 3. This disagrees with the previous data at this station, which scored six points below the threshold, and agrees with the data collected from the other station on this reach (08MN019), which previously scored above the threshold within the confidence limit. Excellent habitat conditions at 08MN003 in both 2008 and 2018, suggest the 2008 invertebrate data was reflective of temporal scale decrease in MIBI score, or was anomalous for an undetermined reason. The preponderance of data across both assessment cycles suggests a full-support condition. Recommend that this WID be changed to full support of AQL based on macroinvertebrate data.

Assessment Consistency Technical Team (ACTT) sub-team, 06/10/2020: Review team agrees with the logic detailed above – a delisting to the impaired waters list for benthic macroinvertebrates is merited based on new data indicating AQL use is now being attained. However, there are no known corrective action(s) identified and the delisting will be for unknown reasons. Recommend a delisting to the impaired waters list for benthic macroinvertebrates. Applicable water quality standards attained; due to unknown reasons.

Stream ID 576 – Iosco Creek	**Impairments** Invert

Data and Notes Cycle 2 assessment

Invertebrates - 4/15/10 - One biological, invertebrate site in this AUID. The site scored below threshold, within CI. The invertebrate data for this AUID indicates nonsupport of AQL (MIBI). No evidence of natural background conditions causing low biological scores. Natural channel conditions. Recommend a new listing for biological impairment, invertebrates.

Although site appears to be on a primarily natural stream channel, AUID may be greater than 50% channelized. Invert assessor indicates previous MIBI listing will be corrected and removed from the impaired waters list based on a stream class change.
The station responsible for listing this WID was initially classified as high gradient, and it was determined that the station should be considered low gradient. The new classification results in a high score which falls above the low gradient class standard. This station should be corrected to full support.

WID has one station (08MN026) sampled twice, once in 2008 and once in 2018. Data in current assessment window score below the GU threshold, above the CI. This agrees with previously collected data which scores below the GU threshold, within the CI. Despite collecting riffles at each sample, comments and associated MSHA data suggest this station should be considered low-gradient. Low gradient scores are above the GU threshold, within CI. The classification of this station will be changed to low gradient, and a correction will be made to the impaired waters list. Recommend full support of the general AQL use based on macroinvertebrate data.

Support to Impaired	
Stream ID 505 – Little Cobb R, T107 to R26W S31	**Impairments** Fish
Data and Notes Cycle 2 assessment BioFish – 4/15/10 - Two samples from two stations on this AUID sampled in 2008 and 2001. 2008, one sample above threshold and one sample below threshold (by 1 point - sampled in 2001). Given the more recent data suggests support and the older sample is close to the threshold (and within a channelized reach) - biological data (fish) for this AUID indicates support for AQL. 5/3/2011 - Modification to FIBI affected scoring of sites on this AUID. Further review of channel condition determined that both stations have a natural stream channel condition, and the data should be assessed. One sample (2008) above threshold and one sample (2001) below threshold, indicating potential impairment. However, the lower scoring site (01MN039) was sampled again in 2010 as part of phase 2 work (data not available during assessment in spring 2010) and scored above threshold. More recent data (2008 & 2010) indicates support for AQL. 5/3/11 - Follow up - Channel condition reviewed for biological sampling stations (both sites have a natural stream channel and should be assessed). Also reviewed fish and invert data after modification to IBI's to re-evaluate assessment. Biological data (fish and inverts) indicates support for AQL. There is not an existing fish impairment on this WID. Station 10MN162 was sampled for fish in 2010. The IBI was below threshold. The BCG score was 3. A score below threshold indicates a continuing impaired condition. Recommend nonsupport for AQL for fish. Edited: 3/24/2020 by Melissa Markert	
Stream ID 556 – Cobb River, T107 R26W to Le Sueur R	**Impairments** Invert
Data and Notes Cycle 2 assessment WID has one station (08MN005), sampled a total of three times, once in 2008, 2010, and 2018. Data in current assessment window scores 5.5 point below the GU threshold, within the CI, and right at the GU threshold. This disagrees with previous assessment, in which scores were four points above, and right at the GU threshold. BCG scores of 4 and 5. The most current data suggest a nonsupporting conditioning, with each successive sampling of this station receiving lower scores from the previous sampling. More recent MSHA scores also suggest a changing habitat condition. Recommend nonsupport of general AQL use based on macroinvertebrate data. Fish, Nutrients, and TSS confirming initial listings for AQL use. Fish potentially improving. Inverts indicate poor AQL use conditions, will be added to impaired waters list. Assess Year: 2020	

2.2.4 Existing Stream Impairments

Table 8 shows the streams that were found to be impaired in Cycle 1 and updated information gathered during the second cycle of MPCA assessments. Most streams impaired in Cycle 1 are still impaired 10 years later (MPCA 2021).

Table 8. Status of Le Sueur River Watershed existing stream impairments from Cycle 1.

Stream ID 501 - Le Sueur R, Maple R-Blue Earth R	**Impairments** TSS, *E. coli*, Fish
Data and Notes Cycle 2 assessment TSS - datasets indicate poor water quality for AQL. Daily concentrations reveal a 55% violation rate of HSPF modeled values over the entire 10-year assessment window. *E. coli* - Data for assessment collected in 2009 and 2010. Individual violations not numerous, but persistently high concentrations are clear in monthly mean calculations. FIBI - More fish collected in 2019 than 2008, unclear if increase is a result of watershed changes or flow and upstream conditions. Recommend the data be considered inconclusive.	
Stream ID 504 - Little Cobb R, Bull Run Cr-Cobb R	**Impairments** DO, TSS, Nutrients, Fish, *E. coli*
Data and Notes Cycle 2 assessment DO/TSS/Nutrients - Extensive datasets for chemistry from multiple stations on this reach. Newer phosphorus data grossly violates summer mean concentration. DO dataset is limited. Would need pre 9am data to support a delisting effort, no violations since 2010. TSS data indicate the initial impairment should remain with significant violations occurring in 2010, 2011, and 2012. Impairments should remain, noting that recent TSS data is meeting criteria, a similar case for DO as well.	

Fish - Flows in 2019 were questionable. The IBI is higher than Cycle 1, but under the threshold. Large stream blown out with areas too deep to sample that were knee depth in Cycle 1. The species count is the same, but the number of total fish is significantly lower in 2019. Recommend inconclusive for fish. *E. coli* - Reach previously listed prior to 2008. Newer bacteria data collected between 2010, 2018, and 2019. Persistently high concentrations in monthly mean violate four months available.	
Stream ID 507 - Le Sueur R, CD 6-Cobb R	**Impairments** TSS, Fish, *E. coli*
Data and Notes Cycle 2 assessment TSS - Extensive datasets for chemistry for several stations across all years of the assessment window on this reach. TSS and S Tube datasets confirm the initial listing, recommend the initial turbidity listing remain and consider excess nutrient impacts on downstream water bodies in future monitoring. Fish - Recent assessable sample scored nine points below threshold. The new sample supports the existing impairment. No data from the other sites to show improving conditions on the WID. *E. coli* – Data from 2009 and 2010 collected at upstream and downstream station resulted in impairment AQR. TMDL work has been completed. Recommend initial listing remain until newer bacteria data becomes available in the future.	
Stream ID 510 - Unnamed Cr, Unnamed Cr-Le Sueur R	**Impairments** Invert
Data and Notes Cycle 2 assessment WID sampled in 2008 and 2018. Data in current assessment window scores below the threshold and confirms the previous invertebrate impairment.	
Stream ID 534 - Maple R, Rice Cr-Le Sueur R	**Impairments** TSS, *E. coli*
Data and Notes Cycle 2 assessment TSS - Extensive datasets for water chemistry available and buoyed by WPLMN monitoring station. TSS datasets are robust revealing newer data that indicates high sediment concentrations are still impacting AQL health in this stream. Other AQL use indicators are meeting criteria. *E. coli* - Newer data in the 10-year assessment window shows individual violations not as numerous but persistently high bacteria concentrations in monthly means are in violation of the standard.	
Stream ID 535 - Maple R, Minnesota Lk-Rice Cr	**Impairments** TSS, Fish, Invert
Data and Notes Cycle 2 assessment TSS - Newer data sparse for chemistry related AQL use. TSS spotty for stations and years, not enough data to confidently reassess TSS conditions. Initial turbidity listing should remain. Fish - Existing impairment on this WID, however downstream WID is not impaired. There are three sites on this WID (08MN023, 08MN024, 08MN091). 08MN091 sampled four times since cycle one with only one sample scoring above the general use threshold. The three failing scores from this site and one from 08MN023 indicate this reach should remain impaired. Invert - WID has two stations (08MN023, 08MN091) sampled a total of seven times. Previous samples at these two stations show different flow regimes and habitat conditions. The current data agree with the previous assessment and suggest that this WID maintain as nonsupport of AQL.	
Stream ID 556 - Cobb R, T107 R26W S30-Le Sueur R	**Impairments** TSS, RES, Fish, *E. coli*
Data and Notes Cycle 2 assessment TSS - Previous listing for AQL use based on turbidity (2008). Robust TSS data reveals poor conditions for AQL still persists, TMDL work has been underway. RES – Previous listing for AQL use based on nutrients (2016). Extensive phosphorus data indicates persistently elevated concentrations across the years. RES listing will remain at this time based on grossly violating TP and Chl-*a* response data. Fish - 2008 and 2010 both score below general use threshold. The 2018 sample scored just above the threshold but well within the CI. Gar and large flathead catfish collected. 2019 sample nonreportable due to high flows, two shovelnose sturgeon and a shortnose gar were collected. Still indicates stressors to the fish but **this site could be a location to focus efforts on future delisting**. *E. coli* - Reach was listed in 2010 based on previous bacteria datasets. Data limited to 2009 and 2010 for consideration during this most recent assessment. TMDL activities have been initiated since the listing. Recommend initial listing remain for recreation use.	
Stream ID 568 - Cobb R, T104 R23W S34-Little Cobb R	**Impairments** TSS, Fish, Invert
Data and Notes Cycle 2 assessment	

TSS - Data limited to one visit in 2010 near the midpoint of this reach. Insufficient water chemistry data to make a confident assessment on chemistry data alone.
Fish - There are a couple scores above the threshold, but not all sites that contributed to the impairment were sampled to achieve a passing score. **Stream appears to have potential for scores to reach threshold and possible delisting**. Recommend WID remain listed as impaired.
Invert - WID has five stations sampled a total of six times from 2008 to 2018. Samples in current assessment window score below the General Use threshold. These data agree with previously collected data, recommend assessment of nonsupport be maintained in current assessment cycle.

Stream ID 573 - Little Le Sueur R, T106 R22W S12-Le Sueur R	**Impairments** Fish

Data and Notes Cycle 2 assessment
Fish – Site sampled in 2008 scored 46.2. Site was sampled again in 2018 and was almost identical at 46.4. A new bridge was installed at this location earlier in the summer. The species count was very similar and fatheads were the most abundant species in both samples.

Stream ID 576 - Iosco Cr, Silver Cr-T108 R23W S7	**Impairments** Fish

Data and Notes Cycle 2 assessment
Fish - The station sampled in 2008 scored only 12. Seven species were collected with fathead minnows the most abundant. In 2018 after a period of high water, the IBI jumped up to 63.2, above the general use threshold. A very different community of fish was collected including yellow perch and black crappie. It is possible these fish moved in from Lake Elysian and species like fathead minnows were noticeably missing. Because of the drastic change and IBI and persistent high water in 2018, the site was sampled again in 2019 and the IBI was zero. The three species collected included yellow perch, largemouth bass, and white sucker. Fewer than 25 fish were collected. With such drastic changes it does not appear there is enough evidence to delist the stream, even with the very high passing score in 2018.

Stream ID 593 - CD 85, Unnamed Cr-Maple R	**Impairments** Fish, Invert

Data and Notes Cycle 2 assessment
Fish - Both fish and inverts were originally determined to be impaired during assessment year 2010 but were deferred. WID was changed to modified use. 2008 sample IBI was 21.1, below threshold. There is no new data from this location. A new station was sampled in 2018 with an IBI score of 27.3, which is below threshold. The new data supports the impairment.
Invert - WID has two stations, 08MN015 sampled twice in 2008, and 18MN008 sampled once in 2018. This station has been changed to modified use and was opted in as nonsupporting of the MU threshold. Current assessment scored above the threshold, but data is from a different reach than originally listed and is not sufficient to support a delisting as previously collected data show a very impaired community.

Stream ID 605 - Unnamed Cr, Mud Lk -Unnamed Cr	**Impairments** Fish

Data and Notes Cycle 2 assessment
Fish were originally determined to be impaired during assessment year 2010 but impairment was deferred. Samples in 2008 are below the threshold and would have contributed to the impairment. 18MN006 was sampled in 2018 scoring 16.7, well below the threshold. Very thick vegetation and choking vegetation was noted on MSHA.

Stream ID 609 - CD 15-2, Headwaters-Le Sueur R	**Impairments** Fish, Invert

Data and Notes Cycle 2 assessment
Fish - Stream was sampled in 2008 and 2010. 2008 sample scored 32.8 and was below threshold. The sample from 2010 scored 46.8, also below the impairment threshold. The new failing score from 2010 indicates the fish community is still impaired.
Invert - WID has one station (08MN051) sampled once in 2008 and 2010. Data in current assessment window score below the GU threshold. Data from previous assessment show several coldwater obligate taxa present in sample. Current data show a complete lack of coldwater individuals.

Stream ID 620 - Le Sueur R, Boot Cr-CD 6	**Impairments** TSS

Data and Notes Cycle 2 assessment
TSS - Water chemistry data available from multiple stations from a variety of efforts including volunteer monitoring, Cycle 2 IWM, biological monitoring and local projects. Newer TSS dataset light and only from two stations in 2010. Larger S-Tube dataset confirms low water clarity associated with persistently high sediment loads.

2.3 Watershed Data Summaries

2.3.1 Lake Clarity Trends

Six lakes in the Le Sueur River Watershed had enough data (minimum 8 years and 50 data points) to determine if a trend in water clarity was present (MPCA 2021). Of these, one lake showed an improving trend, two lakes showed no change, and three lakes had no trend based on the water clarity data (Table 9).

Table 9. Water clarity trends for lakes in the Le Sueur River Watershed (1945-2022).

Lake ID	Lake Name	County	Trend Result
07-0014-00	Unnamed	Blue Earth	Insufficient Data
07-0019-00	Hobza Marsh	Blue Earth	Insufficient Data
07-0024-00	Cottonwood	Blue Earth	Insufficient Data
07-0043-00	Indian	Blue Earth	Insufficient Data
07-0058-00	Perch	Blue Earth	Insufficient Data
07-0059-00	Rice	Blue Earth	Insufficient Data
07-0060-01	Eagle (North)	Blue Earth	Insufficient Data
22-0033-00	Minnesota	Faribault	Insufficient Data
22-0075-00	Rice	Faribault	Insufficient Data
22-0093-00	Unnamed	Faribault	Insufficient Data
24-0044-00	Freeborn	Freeborn	Insufficient Data
81-0044-00	Silver	Waseca	Insufficient Data
81-0067-00	Lily	Waseca	Insufficient Data
81-0076-00	Mott	Waseca	Insufficient Data
81-0091-00	Unnamed	Waseca	Insufficient Data
81-0095-02	Elysian (Outlet Marsh)	Waseca	Insufficient Data
81-0083-00	Buffalo	Waseca	Insufficient Data
07-0079-00	Lura	Blue Earth	No Trend
22-0074-00	Bass	Faribault	No Trend
81-0003-00	St. Olaf	Waseca	No Trend
81-0095-01	Elysian (Upper - U/S Dam)	Waseca	No Change
07-0044-00	Madison	Blue Earth	No Change
81-0055-00	Reeds	Waseca	Improving

2.3.2 Stream Biological Trends

The health of the biological communities at each biological monitoring station were investigated using the Index of Biological Integrity (IBI) for fish and macroinvertebrates. Stream IBIs are developed to account for natural variation in community structure. Streams are expected to meet community criteria based on drainage area, gradient, water temperature and geographic region of the state. A unique suite of metrics, scoring functions, impairment thresholds, and confidence intervals are identified for each of the classes. IBI scores above the impairment threshold indicate AQL use support; while scores below the impairment threshold indicate that streams do not support AQL use. This information was used to develop an overall summary of wastershed health in the Le Sueur River Watershed.

Paired t-tests of FIBI and MIBI scores were used to evaluate if biological conditions of the watershed's rivers and streams have changed between time periods (Table 10). Independent tests were performed on each community with 22 sites evaluated for macroinvertebrates and 26 sites evaluated for fish (i.e., sites that were sampled in both time periods). The average MIBI score for the watershed increased by 0.3 points between 2008 and 2018, which did not represent a statistically significant increase in the biological condition for the watershed. FIBI scores across the Le Sueur River Watershed increased by 4.3 points, which does indicate a statistically significant increase in the biological condition for the watershed (MPCA 2021).

Table 10. Fish and macroinvertebrate IBI score analysis between Cycle 1 and Cycle 2 assessments for the Le Sueur River Watershed (MPCA 2021) Green shows increase in score, Red shows decrease in score.

Macroinvertebrate IBI					Fish IBI				
FieldNum	WBName	*2008*	*2018*	Diff	FieldNum	WBName	*2008*	*2018*	Diff
03MN071	Le Sueur River	47.23	43.42	-3.8	03MN071	Le Sueur River	34.43	39.96	5.5
07MN062	County Ditch 3	36.17	18.97	-17.2	07MN062	County Ditch 3	34.23	25.08	-9.2
07MN068	County Ditch 6	15.41	26.47	11.1	07MN068	County Ditch 6	23.07	38.71	15.6
08MN001	Le Sueur River	43.18	47.44	4.3	08MN001	Le Sueur River	38.65	59.05	20.4
08MN002	County Ditch 3	1.42	0	-1.4	08MN002	County Ditch 3	21.67	22.50	0.8
08MN003	Maple River	31.83	53.03	21.2	08MN003	Maple River	56.84	55.57	-1.3
08MN004	Rice Creek	46.17	52.01	5.8	08MN004	Rice Creek	45.38	46.36	1.0
08MN005	Cobb River	41.07	31.38	-9.7	08MN005	Cobb River	25.35	50.13	24.8
08MN007	Boot Creek	55.02	54.79	-0.2	08MN006	Little Cobb River	30.25	42.95	12.7
08MN008	Providence Creek	20.99	25.40	4.4	08MN007	Boot Creek	32.46	38.37	5.9
08MN009	Trib. to Rice Creek	36.26	10.12	-26.1	08MN008	Providence Creek	15.57	23.80	8.2
08MN017	Cobb River	24.98	32.06	7.1	08MN009	Trib. to Rice Creek	34.01	36.67	2.7
08MN022	Maple River	25.75	19.05	-6.7	08MN017	Cobb River	32.71	27.85	-4.9
08MN023	Maple River	20.65	31.78	11.1	08MN022	Maple River	41.55	34.54	-7.0
08MN026	Iosco Creek	25.38	28.24	2.9	08MN023	Maple River	41.71	49.01	7.3
08MN027	Little Le Sueur River	50.42	58.03	7.6	08MN026	Iosco Creek	11.99	0.00	-12.0
08MN032	Unnamed creek	34.26	25.75	-8.5	08MN027	Little Le Sueur River	46.21	46.43	0.2
08MN048	Le Sueur River	52.26	56.73	4.5	08MN032	Unnamed creek	48.65	61.91	13.3
08MN050	County Ditch 38	47.78	57.43	9.6	08MN039	Little Cobb River	30.34	41.17	10.8
08MN053	Le Sueur River	38.22	39.35	1.1	08MN040	Bull Run Creek	18.90	36.28	17.4
08MN055	Le Sueur River	39.05	31.29	-7.8	08MN048	Le Sueur River	48.85	39.34	-9.5
08MN091	Maple River	61.87	59.62	-2.2	08MN050	County Ditch 38	49.57	51.26	1.7
		36.2	**36.5**	**0.3**	08MN053	Le Sueur River	52.27	56.23	4.0
					08MN055	Le Sueur River	40.77	38.25	-2.5
					08MN071	Cobb River	39.46	51.14	11.7
					08MN084	County Ditch 12	42.61	37.38	-5.2
							36.1	**40.4**	**4.3**

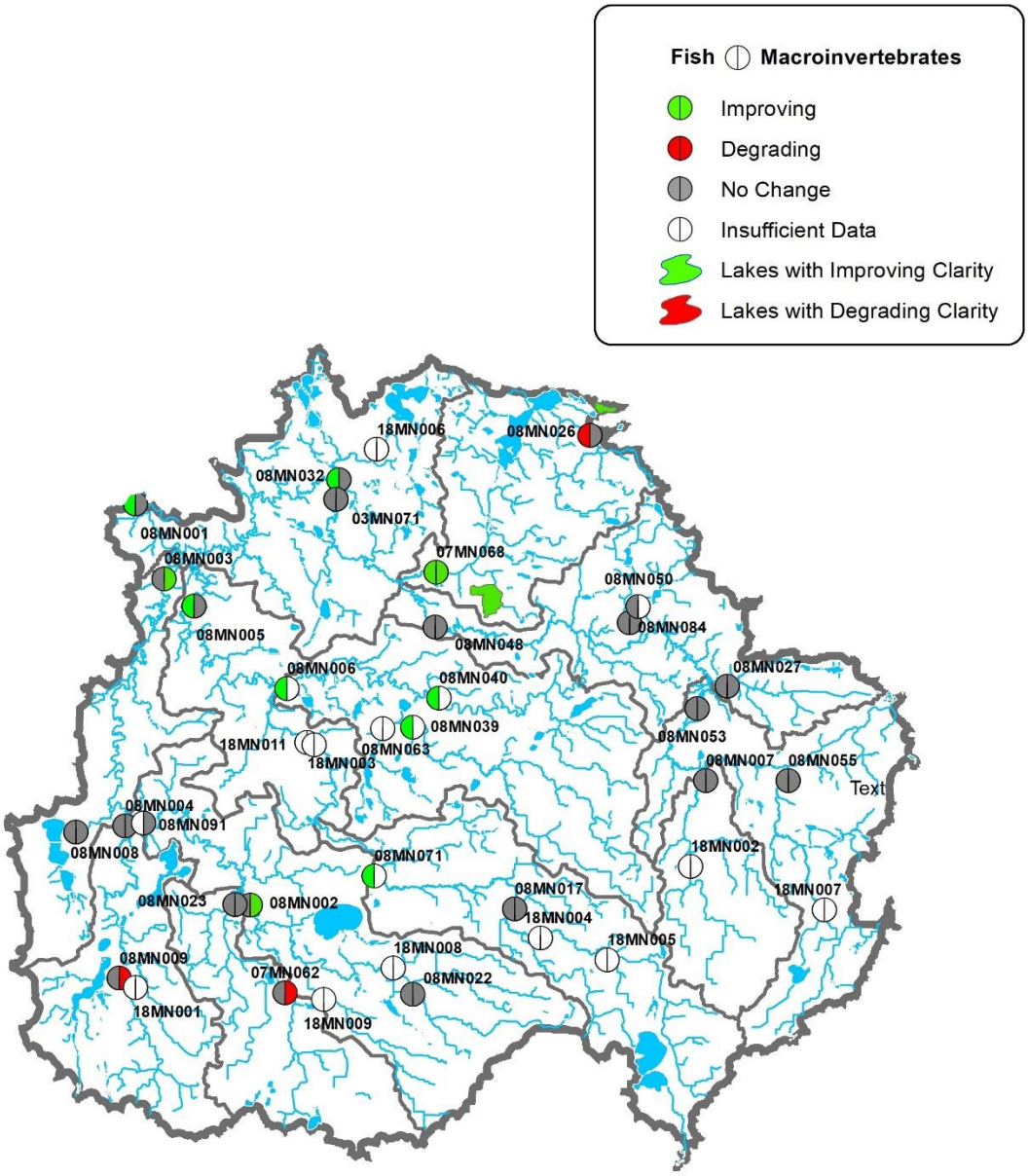
Macroinvertebrate IBI change analysis results:
In Cycle 2 of IWM, on average MIBI scores in the watershed increased by 0.3 points (n = 22 sites), this however does not represent a statistically significant increase in biological condition for the watershed (P = 0.887). Wilcoxon Signed Rank Test also indicates that a significant change did not occur for invert community condition over this period (P = 0.679).

Fish IBI change analysis results:
In Cycle 2 of IWM, on average FIBI scores in the watershed increased by 4.3 points (n = 26 sites), this represents a statistically significant increase in biological condition for the watershed (P = 0.031). Wilcoxon Signed Rank Test also indicates that a significant change occured for fish community condition over this period (P = 0.041).

Context for the change analysis results is provided by a characterization of the conditions under which biological monitoring occurred in 2008-2009 and 2018-2019. In 2008, the Le Sueur River Watershed experienced a moderate to severe rainfall deficit (- 4.8 in) and normal temperatures during the May to September time period. In 2018, the watershed had extremely high rainfall (+10.2 in) and above normal temperatures (+1.8°F) over the May to September time period. About one-third of the stream stations

could not be sampled for fish in 2018 due to high water level. Given the dry conditions in 2008 and extremely wet conditions of 2018, there is a high likelihood that any observed changes in biological condition at either the watershed or individual site scale are at least partially due to differences in climatic conditions (Figure 6).

Figure 6. Fish and macroinvertebrate changes between Cycle 1 and Cycle 2 by monitoring site in the Le Sueur River Watershed (MPCA 2021).



2.3.3 Stream Water Quality and Flow Trends

Information and summaries for this section utilized the water quality data from 2007 through 2020 from the WPLMN data viewer. The WPLMN has six water quality monitoring stations within the Le Sueur River Watershed (Figure 7). The mainstem of the Le Sueur River has three water quality monitoring stations. The outlet is monitored upstream of the Red Jacket County Park (E32077001). The second mainstem site

is monitored on County Road (CR) 8 (H32076001) upstream of the outlets of the Cobb and Maple Rivers. The third site is monitored near the city of St. Clair at the bridge of CSAH 28 (H32079001). The Maple River has two stations that are monitored to help understand the loading from the upper and lower sections of the incised portions of the Le Sueur River Watershed. The upper site, at CR 18 (H32062001) near the town of Sterling Center, collects information from the upper, flatter reaches of the watershed. The lower site, collected at CR35 (H32072001), helps to understand the loading created by the incised area of the Maple River. This information is important to understand the amount, source, and drivers of loading in these reaches. The final Le Sueur River Watershed site is on the Big Cobb River at the crossing of CSAH 16 (H32071001) near the town of Beauford. Subwatershed stations are sampled from snow melt through October 31 annually, versus the major watershed station, which has water samples collected year-round. All stations are considered long-term with monitoring continuing indefinitely into the future. Sites are monitored for TSS, TP, and Nitrate-Nitrogen (Watershed Pollutant Load Monitoring Network (WPLMN) Data Viewer | Tableau Public).

Figure 7. WPLMN monitoring stations in the Le Sueur River Watershed.

Results of water quality monitoring at the Le Sueur River Watershed long-term sites are shown in Table 11 and expressed as average Flow Weighted Mean Concentrations (FWMC), which is the average concentration of a pollutant in all the water that passed a monitoring station over the course of the monitoring period.

Table 11. Average annual FWMC (2007-2020) of nutrients and sediment at long-term monitoring stations in the Le Sueur River Watershed.

Station	Station ID	TSS (mg/L)	TN (mg/L)	TP (mg/L)
Le Sueur nr Red Jacket Park	S000-340	246	10.4	0.37
Le Sueur at CR 8	S003-860	281	10.8	0.37
Le Sueur at CSAH 28	S003-448	128	10.8	0.27
Maple River at CR 35	S002-427	219	11.0	0.38
Maple River at CR 18	S004-101	60.4	11.2	0.28
Big Cobb at CSAH 16	S003-446	118	11.3	0.28

Total nitrate concentrations at all stations are high within the Le Sueur River Watershed. While there currently is no surface water nitrate standard for AQL, the average FWMC for each long-term site for the time period is over the drinking water standard of 10 mg/L. The yearly average nitrate concentration for all long-term stations during the time period from 2007 through 2020 has ranged from a low of 5.24 mg/L to a high of 16.5 mg/L while the highest individual total nitrate sample collected was 25.66 mg/L. High nitrate concentrations are found throughout the watershed and add to the drinking water concerns for individual homeowners with wells and the city of Mankato. High nitrate concentrations have also been shown to be a stressor on many stream reaches affecting fish and macroinvertebrate communities. HSPF modeling in the Le Sueur River Watershed estimates the main source of nitrate is from agricultural drainage (MPCA 2015a).

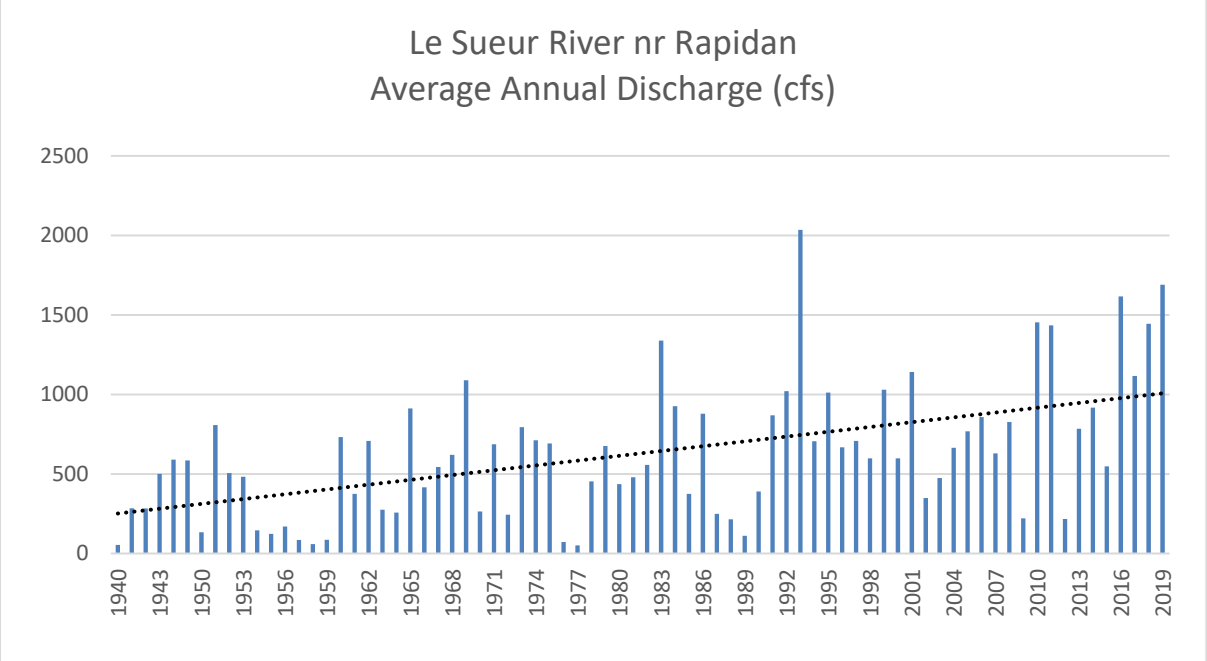
TP concentrations were also quite high for the same time period with FWMCs for each of the sites well over the water quality standard of 0.150 mg/L. Few streams in the Le Sueur River Watershed have been listed as impaired by violation of the River Eutrophication Standard (RES) as the standard also requires assessment against response variables including Chl-*a*, DO flux, or biological oxygen demand (BOD). In most cases, data sufficient for assessment of the response variables was not available. The yearly TP FWMCs for the long-term sites (2007 through 2020) ranged from a low of 0.166 mg/L to a high of 0.612 mg/L with the highest individual sample at 3.48 mg/L. High phosphorus loading can lead to stream reach impairment but can also contribute to lake nutrient impairments with high loading stream as the main source of phosphorus. Increased flow and pollutant concentrations are commonly associated with rising flows following heavy rain events, which suggests that phosphorus is bound within the sediment particles eroded from topsoil and/or riverbanks and sediment accumulated in the channel. Pollutant concentrations then are reduced as flow decreases within the rivers after most precipitation has runoff.

Sediment loading is greatly affected by precipitation duration, intensity, and timing. In the Le Sueur River Watershed, spring storms can create large loading events that have repercussions on sediment supply for the entire season. The TSS concentrations were consistently over the state standard of 65 mg/L for the Le Sueur River and many stream reaches are listed as impaired. The yearly FWMCs for the long-term sites (2007 through 2020) ranged from a low of 45 mg/L to a high of 567 mg/L with the highest individual sample reaching 3,680 mg/L. High TSS concentrations in impaired streams will often

have direct impacts on the stream's biology affecting fish health and reproduction and decreasing habitat that supports healthy fish communities leaving more tolerant species to thrive.

Figure 8 displays the USGS long term yearly average flow data of the Le Sueur River near Rapidan from 1940 to 2019 (USGS Streamflow 05320500). The figure shows that over the 79-year period of record, average yearly flows have increased. These increased flow changes are very important for downstream waters (i.e., the Minnesota and Mississippi Rivers) because more flow indicates increased overall pollutant load (mass) even if pollutant concentrations are unchanged.

Figure 8. Long term average annual discharge data of the Le Sueur River near Rapidan from 1940 to 2019.



Land use has an important connection to water quality in this predominately agricultural watershed. High levels of all pollutants can be found throughout the watershed. Continued alterations to land use will add to the issues with altered hydrology and the loading of total nitrogen (TN), TP, and TSS to the watershed and further into the Minnesota and Mississippi River Basins. Continued monitoring helps to define quantities and sources of pollutants. More information on watershed monitoring efforts can be found at the Watershed pollutant load monitoring website.

2.3.4 Climate Trends

According to the DNR Climate Summary for the Le Sueur Watershed (DNR 2019), climate measurements are showing a shift in foundational climate conditions. Other ecological processes are changing in response. Communities and individuals making decisions about managing land and water resources for infrastructure, flood protection, habitat protection, water supply, and other needs must be aware of this shift and informed about its potential impacts.

The DNR Climate Summary Report for the Le Sueur River Watershed summarizes climate data using 30-year averages and compares the most recent 30-year average (1989 through 2018) to the entire climate record average (1895 through 2018). This approach generates values for the amount of change

(deviation) seen in the most recent 30 years when compared to the entire 120-year period of record for temperature and precipitation.

According to the climate summary report summarized in the table below (Table 12), the average, minimum, and maximum temperatures show a slight increase, most notably in the winter. The precipitation data show an overall increase in average precipitation with most of the increased precipitation occurring in the spring and summer. Additional details about this climate summary report (Major Watershed Reports), as well as the Watershed Health Assessment Framework (WHAF) tool as a whole, can be found at Watershed Health Assessment Framework | Minnesota DNR (state.mn.us).

Table 12. Le Sueur River Watershed climate trends (DNR 2019).

Time Period	Watershed Average Departure			
	Average Temperature (degrees Fahrenheit)	Minimum Temperature (degrees Fahrenheit)	Maximum Temperature (degrees Fahrenheit)	Average Precipitation (inches)
Annual	0.8°	1.3°	0.2°	3.7"
Winter (Dec. - Feb.)	1.9°	2.5°	1.3°	0.3"
Spring (March - May)	0.6°	1.0°	0.1°	1.4"
Summer (June - Aug.)	0.0°	1.0°	-0.9°	1.6"
Fall (Sept. Nov.)	0.5°	0.7°	0.3°	0.4"

2.3.5 Municipal Separate Storm Sewer Systems

A Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains, etc.) that is also:

- Owned or operated by a public entity (which can include the state, cities, townships, counties, or other public body having jurisdiction over disposal of stormwater);
- Designed or used for collecting or conveying stormwater;
- Not a combined sewer and;
- Not part of a publicly owned treatment works.

MS4s in Minnesota must satisfy the requirements of the Small MS4 General Permit (MNR040000) if they are located in an urban area with a population of 50,000 or more people as determined by the latest Decennial Census by the Bureau of the Census, or if they meet certain population triggers. The MS4 general permit is designed to reduce the amount of sediment and other pollutants entering state waters from stormwater systems.

The MPCA is responsible for applying federal and state regulations to protect and enhance water quality in Minnesota. The MPCA is the regulatory authority for the MS4 entities listed in this WRAPS Update report. Entities regulated by the MS4 general permit must develop a stormwater pollution prevention plan (SWPPP) to reduce the discharge of pollutants from their MS4. The SWPPP includes the following six minimum control measures:

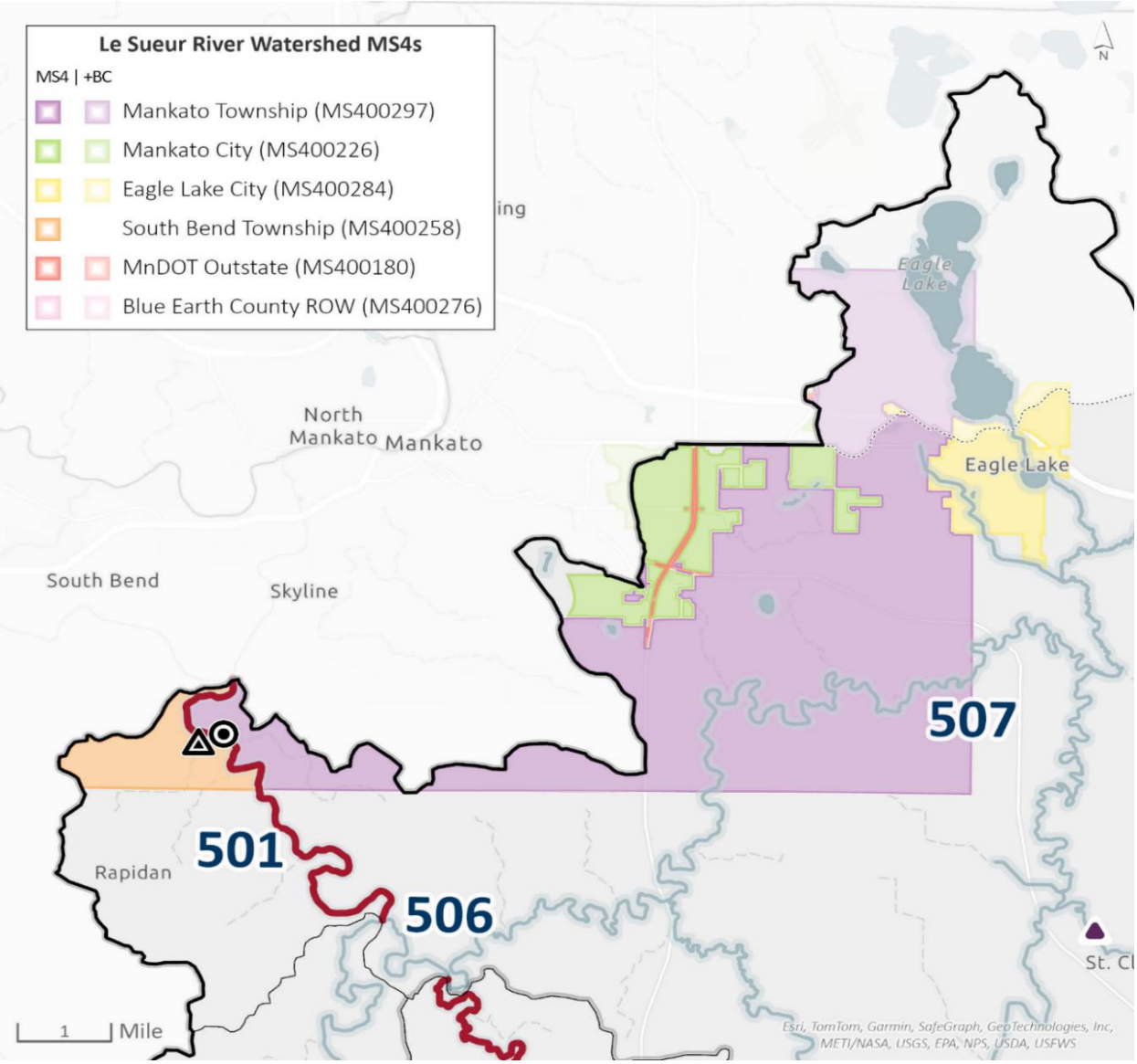
1. Public education and outreach, which includes teaching the public about better stormwater management.

2. Public participation: Include residents in solving stormwater pollution problems.
3. A plan to detect and eliminate illicit discharges to the storm sewer system (like chemical dumping and wastewater connections).
4. Construction-site runoff controls.
5. Post-construction runoff controls.
6. Pollution prevention and municipal “good housekeeping” measures, like inspecting and maintaining infrastructure, covering salt piles, and street sweeping.

They must identify BMPs for each minimum control measure and submit an annual report on the implementation of the SWPPP. The regulated entity must also identify BMPs they will implement to reduce pollution from reaching impaired waters covered by a TMDL study.

The MS4 general permit has been issued to seven entities in the Le Sueur River Watershed: Eagle Lake City (MS400284), Mankato City (MS400226), Waseca City (MS400258), Mankato Township (MS400297), South Bend Township (MS400258), MnDOT Outstate (MS400180), and Blue Earth County (MS400276) (Figure 9). They have all received wasteload allocations in the accompanying TMDL report (MPCA, 2025) and will have to submit annual pollutant reduction amounts under the next permit. However, due to changes in the latest Decennial Census (2020), Eagle Lake City may be released from MS4 regulation.

Figure 9. Le Sueur River Watershed current MS4 areas (Waseca not shown on map).



2.3.6 Land Use Changes

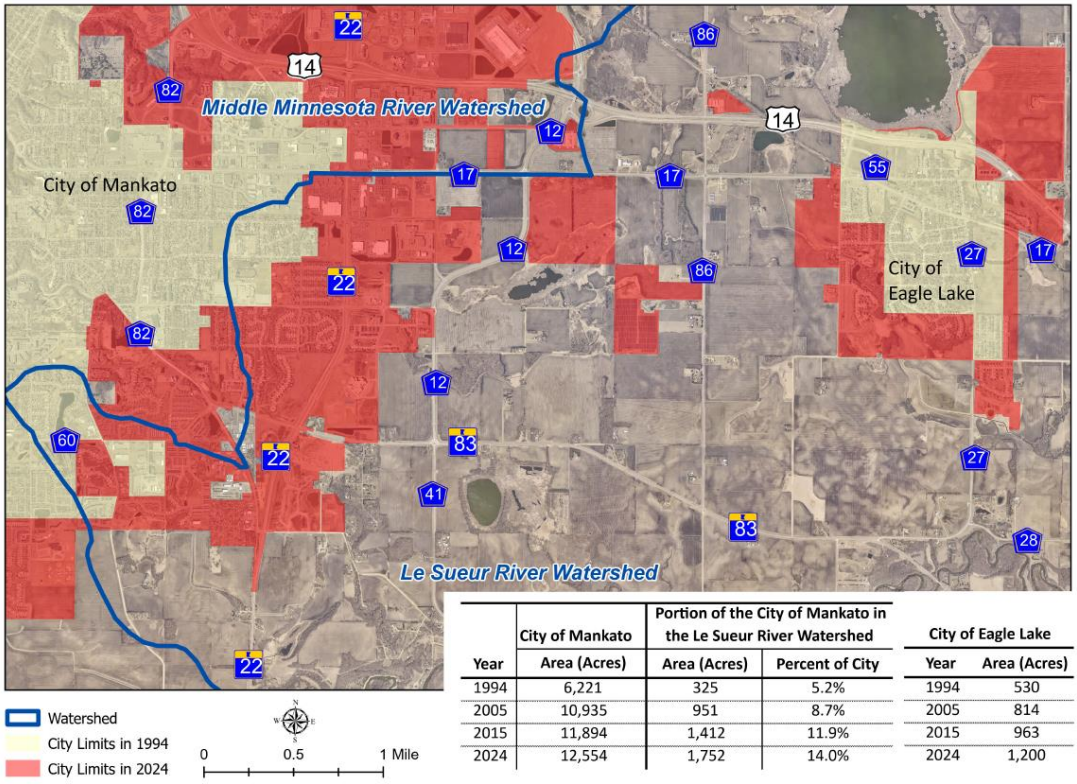
At the time of the Le Sueur River Watershed Cycle 2 assessment, the most current National Land Cover Database (NLCD) data were from 2016. Land use in the Le Sueur River Watershed changed little in the 2006 to 2016 time period (Table 13), however it is important to note where most of the change has occurred. While urban/impervious areas are still not a large percentage of the overall watershed, some of the fastest growing areas of Mankato are in the Le Sueur River Watershed. This is one area where agricultural land is being converted to urban area with a change in how stormwater is being removed from the landscape. Increased frequency of large storm events and overall increases in flow needs to be considered with this change. Understanding the hydrologic change from this conversion will help to manage storm events.

Table 13. Le Sueur River Watershed NLCD land use change 2006 to 2016.

Land Cover Class	% Total Area 2006	% Total Area 2016
Water	2.1%	2.1%
Developed	5.0%	5.1%
Barren	0.1%	0.1%
Forest	1.7%	1.7%
Shrub and Herbaceous	1.0%	1.0%
Pasture and Hay	1.4%	1.4%
Cultivated	84.0%	83.8%
Wetland	4.6%	4.8%

The developing area around Mankato is growing east and southeast toward Eagle Lake (Figure 10). There is concern that seasonal wetlands could be converted to impervious surfaces. Blue Earth County would like to be sure that development proposals aren't increasing the volume and rate of runoff compared to existing conditions to protect downstream channels. This area has very wet soils that limit the ability for infiltration and stormwater practices that can infiltrate water.

Figure 10. Mankato and Eagle Lake expansion and land use change.



Year	City of Mankato Area (Acres)	Portion of the City of Mankato in the Le Sueur River Watershed Area (Acres)	Portion of the City of Mankato in the Le Sueur River Watershed Percent of City	City of Eagle Lake Year	City of Eagle Lake Area (Acres)
1994	6,221	325	5.2%	1994	530
2005	10,935	951	8.7%	2005	814
2015	11,894	1,412	11.9%	2015	963
2024	12,554	1,752	14.0%	2024	1,200

2.3.7 Wastewater Treatment Facility Trends

Annual loading data from wastewater treatment facilities (WWTFs) located in the Le Sueur River Watershed was compiled from 2000 through 2023 for TP, TSS, and TN values. As shown in Figure 11 and Figure 12 below, TP and TSS loads from WWTFs have been decreasing over time. The TN data (Figure 13) was estimated during the first round of WRAPS reporting but since 2012, the majority of the estimated loading is based on facility specific sampling. When compared to total loading to the Le Sueur River,

WWTFs contributed approximately 3% of the TP, 2% of TN, and less than 1% of TSS loading when compared to the 2021 watershed load estimates from the WPLMN at the outlet of the Le Sueur River. This percent of the total loading to the watershed was similar to the analysis completed in the Cycle I WRAPS report for wastewater facilities.

There are 13 municipal WWTFs in the Le Sueur River Watershed (Madison Lake wastewater has been routed to the Mankato WWTP since 2010). Six are small to very small facilities with design flows of less than 0.1 million gallons per day (mgd). Five are mid-sized facilities with design flows ranging from 0.2 to 0.6 mgd. Two are large facilities with design flows of over 1.0 mgd day. WWTF pollutant loads are calculated as a function of effluent flows and concentrations. TP, TSS, and TN loads discharged by Waseca and Wells Public Utilities WWTFs are large relative to the loads discharged by other WWTFs because those large facilities discharge more water than the small facilities in the watershed.

Figure 11. Le Sueur River Watershed WWTF total phosphorus loads 2000-2023.

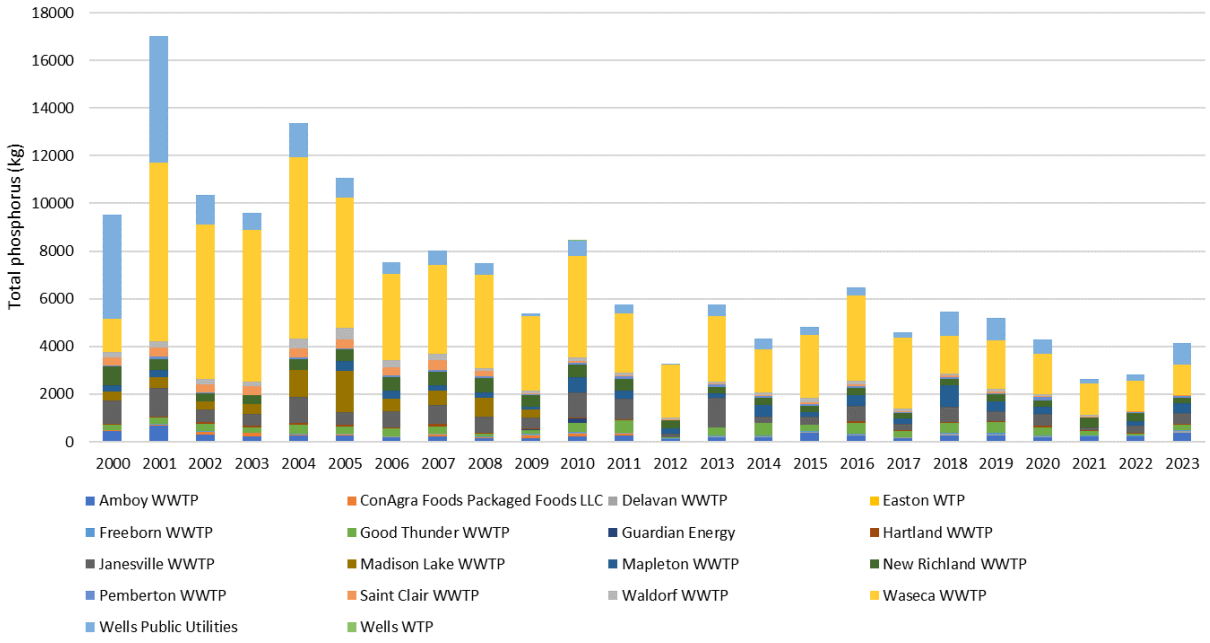


Figure 12. Le Sueur River Watershed WWTF total suspended solids loads 2000-2023.

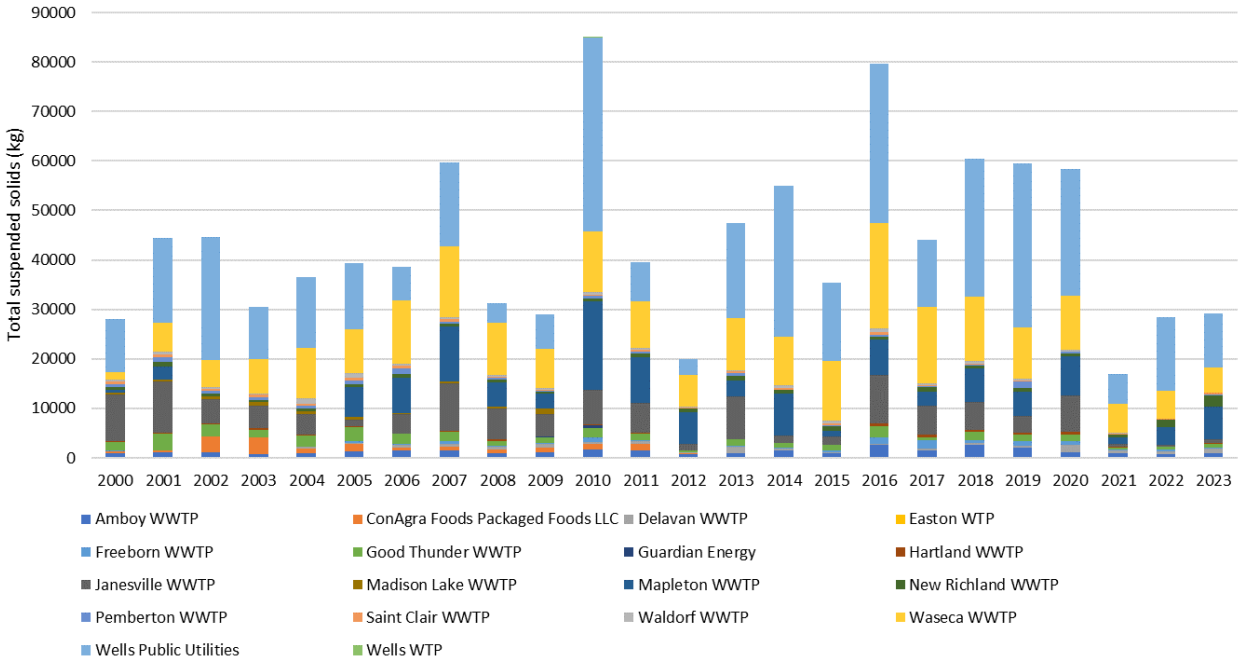
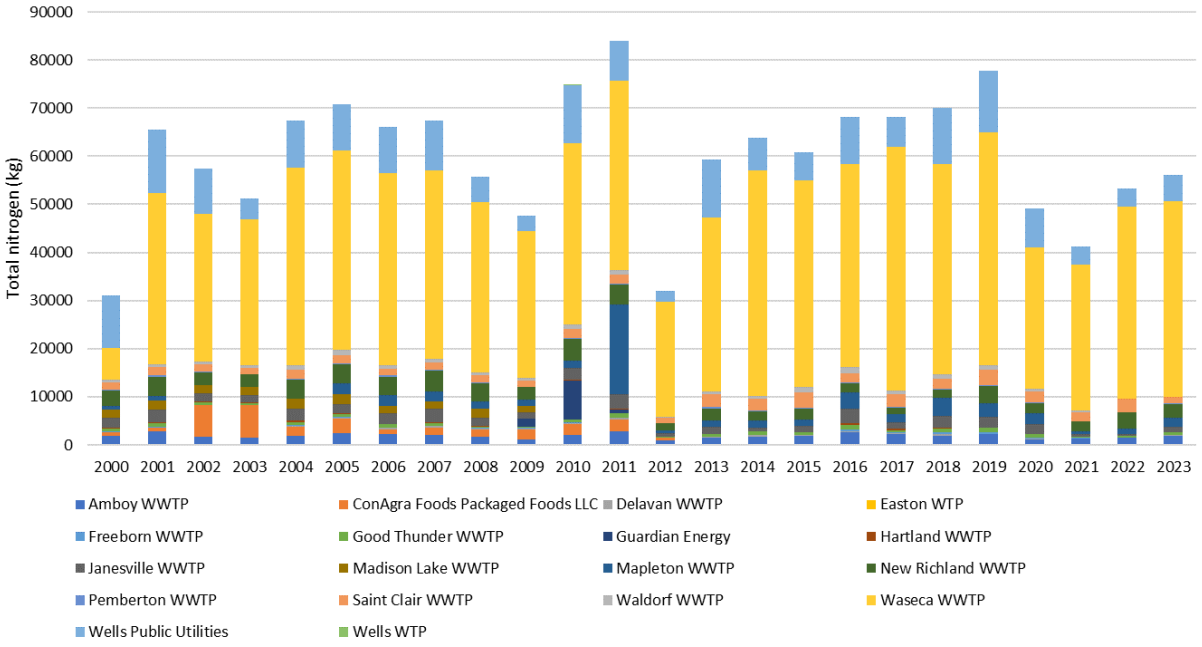


Figure 13. Le Sueur River Watershed WWTF total nitrogen loads 2000-2023.



2.3.8 Feedlot Data

Livestock are potential sources of bacteria, phosphorus, and N to streams in the Le Sueur River Watershed, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas.

Because most feedlots are regulated to have minimal runoff, the largest water quality risk associated with feedlots is from land-applied manure. Manure is a by-product of animal production, and large

numbers of animals create large quantities of manure. This manure is usually stored and then spread over agricultural fields to help fertilize the soil. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition and helps build soil health. Manure, however, can pose water quality concerns when it is not applied properly or leaks or spills from nearby fields, storage pits, lagoons, or tanks.

A review of the MPCA internal feedlot database shows the number of active feedlots has been decreasing from its high of 1,048 active permits in 2009 to 739 in 2024 (Figure 14). The number of animal units (AUs) in the Le Sueur River Watershed fluctuates from year to year. The number has been as low as 172,596 in 2006 and as high as 270,153 in 2022 (Figure 15).

Figure 14. Registered feedlots in the Le Sueur River Watershed 2005-2024.

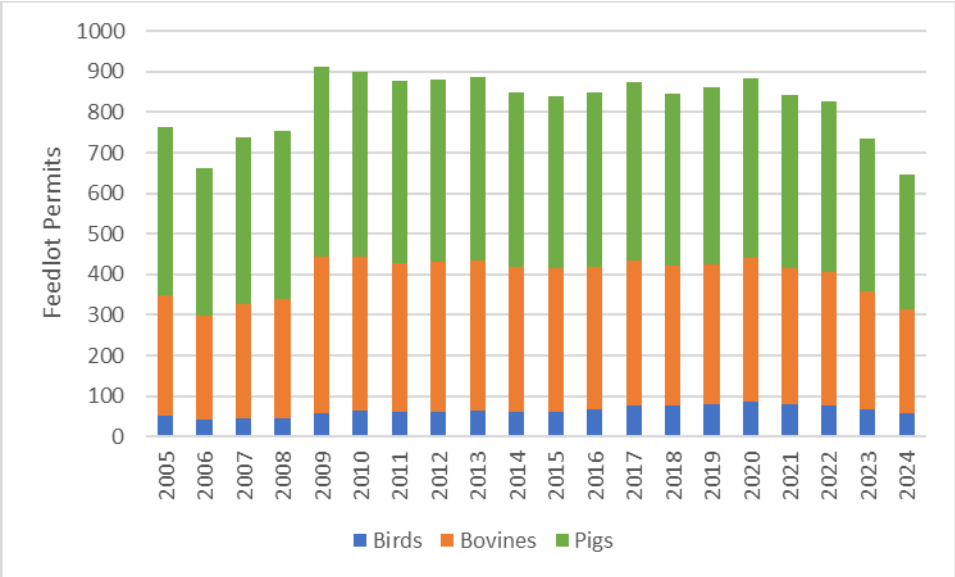
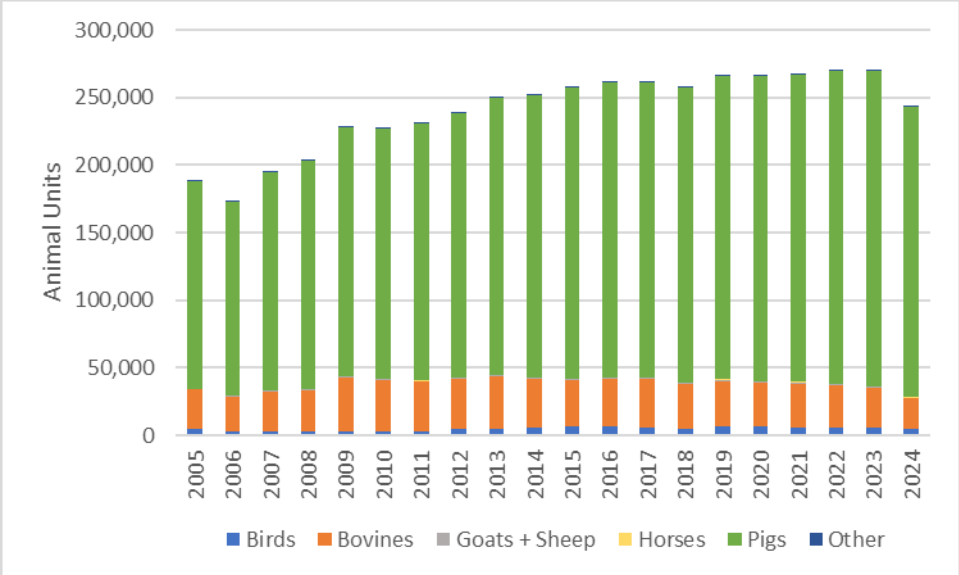


Figure 15. Registered animal units in the Le Sueur River Watershed 2005-2024.



2.4 Watershed Models

2.4.1 HSPF Models

The Le Sueur River Watershed HSPF model was updated to include the years 1996 through 2017 to illustrate the variability across the watershed. HSPF incorporates stream pollutant monitoring and flow data, land use, weather, and soil types to estimate water quality and quantity conditions across the watershed. Building a Picture of a Watershed explains the model's uses and development. Estimates of the pollutant yield (mass per acre) of TSS (Figure 16), TN (Table 17), and TP (Figure 18) at the stream reach outlets were modeled. This information provides a reasonable estimate of pollutant concentrations across the watershed.

Watershed models can be used to help better understand water quality and predict how it could change under different land management practices. The model uses real-world observed data to ensure it properly mimics these interconnected processes. After confirming the model's accuracy, through a process called calibration, MPCA scientists and local partners can use it to model different scenarios of land use change and how those changes might affect water quality.

These maps can be used to target conservation practices to reduce local or downstream pollutant concentrations or minimize the total pollutant mass. This information can be calculated at the smaller scale for use by local partners to help identify areas to potentially focus implementation efforts. The maps below provide yield estimates (mass/acre) on the watershed scale. The broad scale can be used to begin prioritization of work efforts at various scales to support local efforts. Examples of finer scale modeling are included in the goals and recommendations section of this report. Local partners are asked to contact the MPCA to assist if they have questions on HSPF modeling and to help with any efforts that may provide information on implementation activities or calculating reduction potential from implementation activities.

Figure 16. Modeled TSS yields in the Le Sueur River Watershed 1996 – 2017.

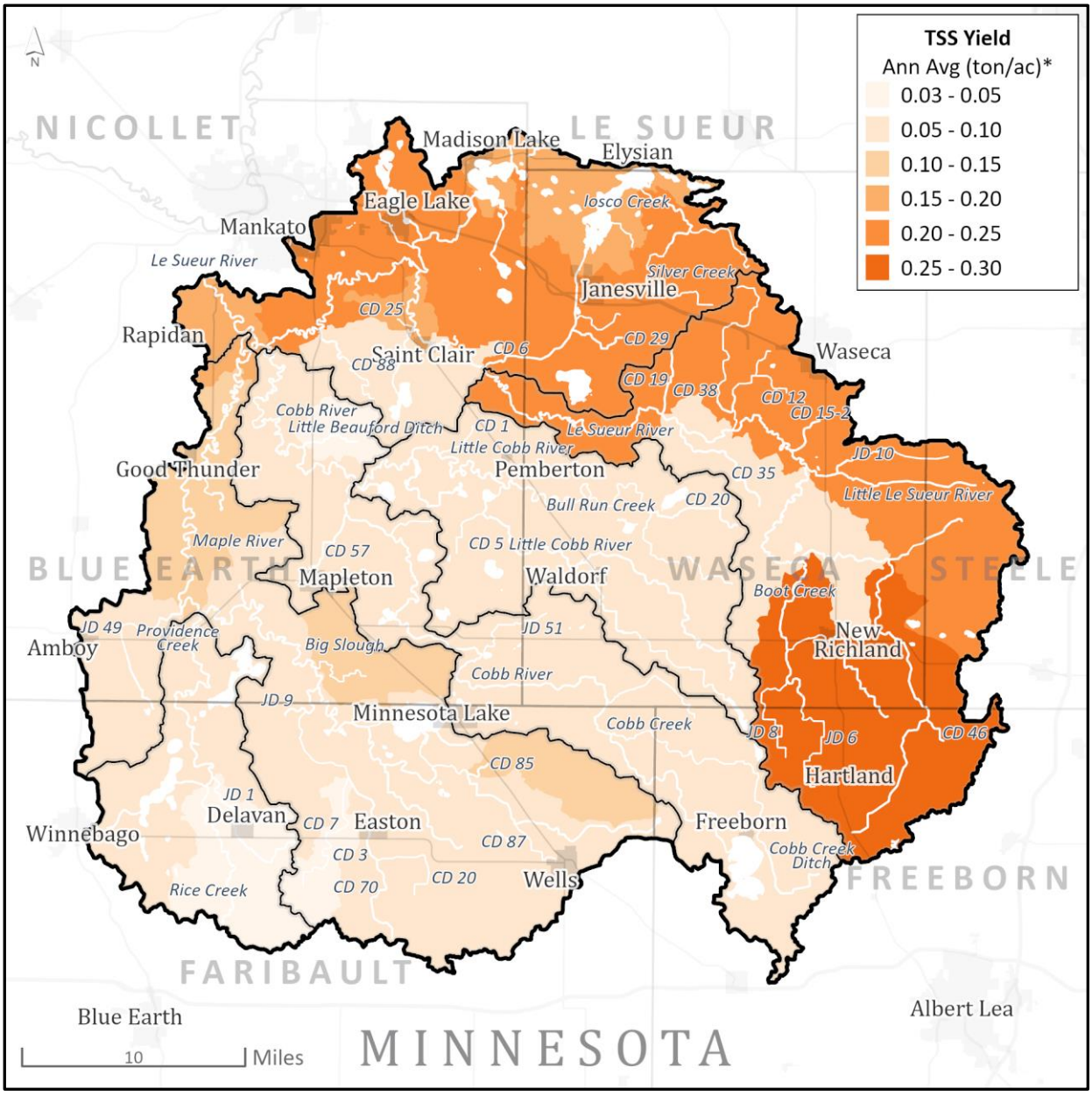


Figure 17. Modeled total nitrogen yields in the Le Sueur River Watershed 1996-2017.

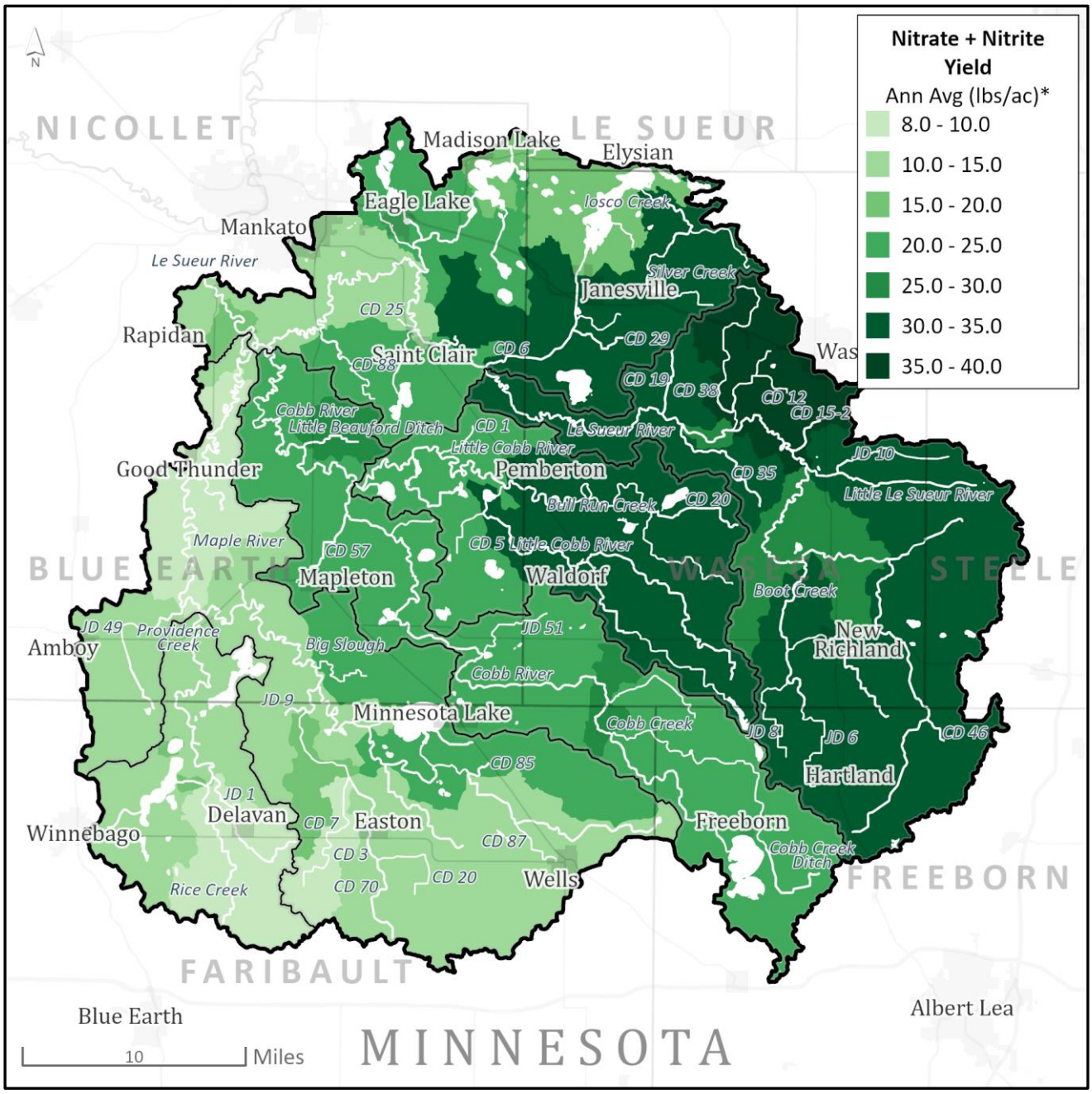
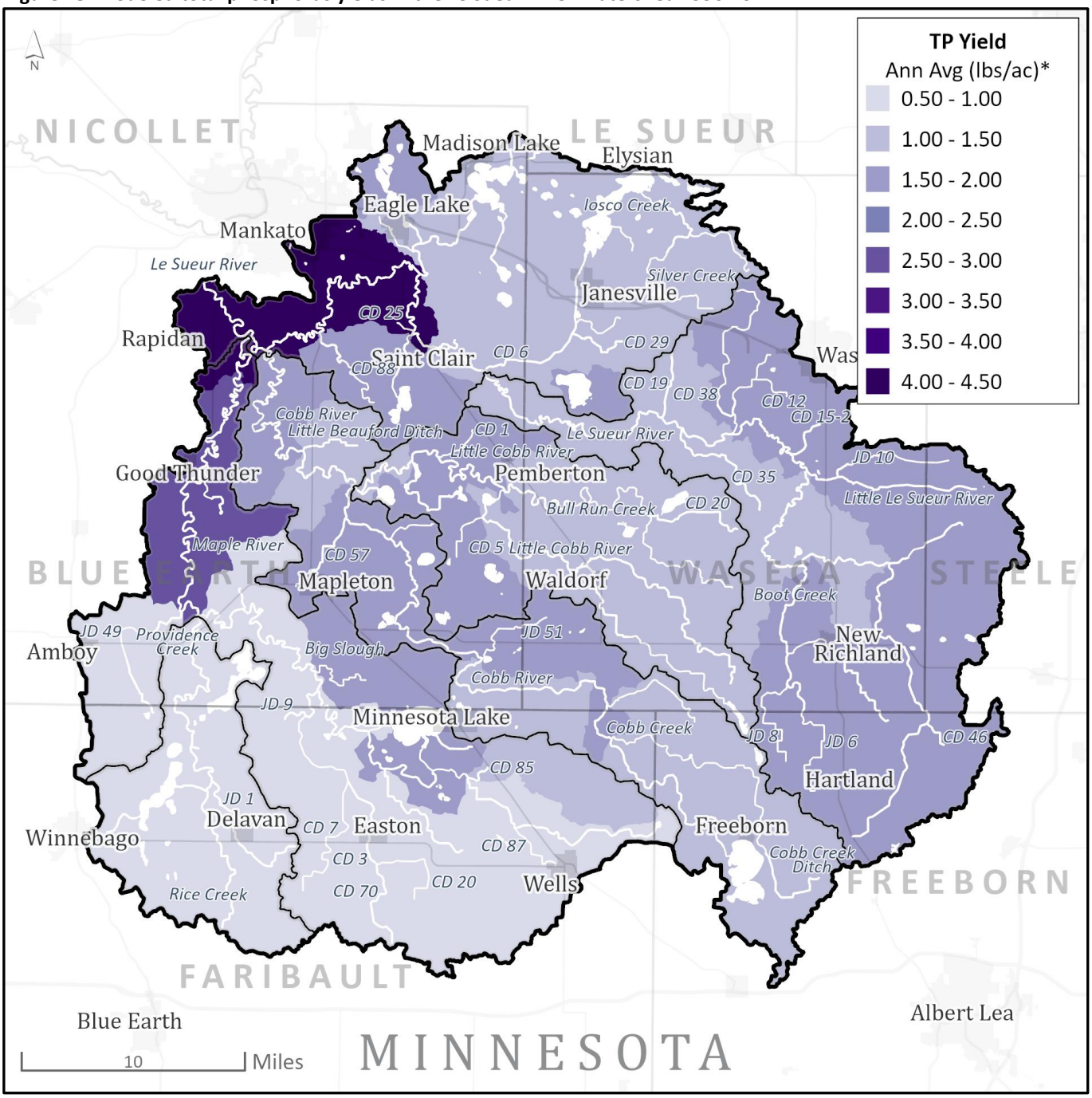


Figure 18. Modeled total phosphorus yields in the Le Sueur River Watershed 1996-2017.



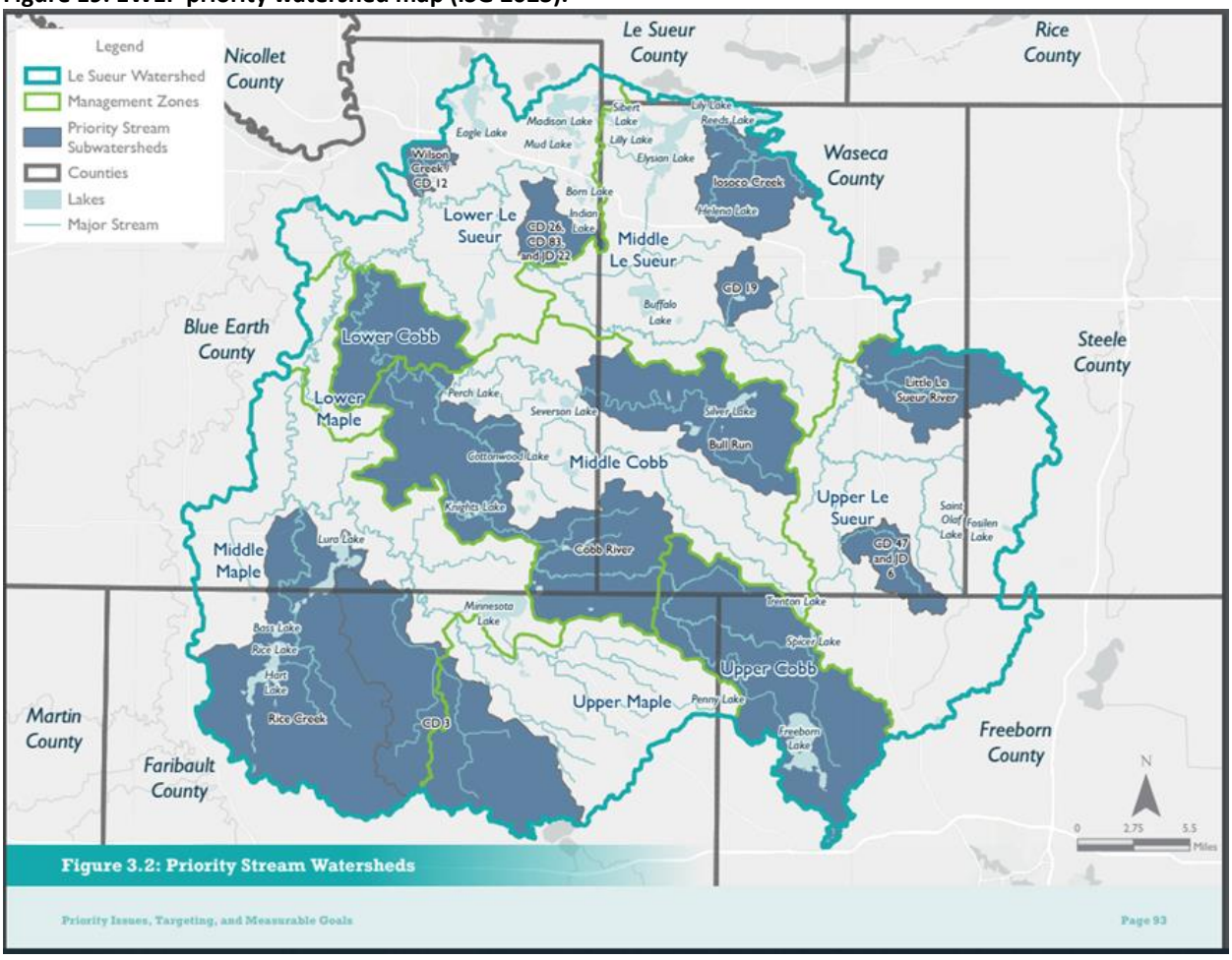
3. Goals and recommendations

It is important to use information gathered during this second cycle of watershed monitoring to help support implementation efforts by local partners in the Le Sueur River Watershed. The MPCA is required by the Clean Water Legacy Act to monitor and assess waters in the state and then develop strategies to restore waters that do not meet standards. Minnesota also has the opportunity to work with local partners who specialize in implementing BMPs that can address many of these impaired waters, as well as protecting high value lakes and streams, through the One Watershed, One Plan (1W1P) framework. The Le Sueur River Watershed 1W1P planning process and finalization were completed before the Le Sueur River Watershed Cycle 2 monitoring and SID work were completed. Information from this report and the priority area framework will continue to be used to help prioritize conservation efforts within the watershed (Figure 19). Information collected from the Watershed Approach monitoring and SID reports are included to add detail to priority efforts. County and SWCD staff are encouraged to contact MPCA staff to further inquire on chemical, biological, and modeling information that can help in identifying priority areas to consider for future implementation.

The Le Sueur Watershed is identified as a high priority watershed in the NRS and is one of the highest nutrient load contributors in the state. Through a modeling effort for the NRS, the portion of specific loads required for each major watershed have been developed and will be updated in the revised NRS. The strategies and practices outlined in this WRAPS update and through the Le Sueur Comprehensive Watershed Management Plan (CWMP) will help towards meeting the overall nutrient goals for the NRS. But, to meet the nutrient reduction goals in the long term for the NRS, adoption of practices to address non-point source nutrient contributions, especially for nitrogen, will need to be adopted watershed wide and beyond targeted areas.

3.1 Priority Subwatershed Restoration Information

Figure 19. 1W1P priority watershed map (ISG 2023).



3.1.1 Lakes

As discussed in Section 2, there are five lakes that are impaired by excess nutrients, and three lakes that are approaching nutrient impairment in the Le Sueur River Watershed. St Olaf, Reeds, and Bass are lakes that are close to the water quality standard and nearing impairment. These are important lakes to prioritize for implementation efforts to keep off the impaired waters list and maintain their beneficial uses.

An additional study (MPCA 2024b) was completed for Bass Lake at the request of local partners to better understand land use and water quality issues and guide potential implementation activities. This study includes the following components:

- Review of background information and data
- Development of a lake phosphorus budget and water quality model
- Establishment of in-lake phosphorus targets and load reductions to improve water quality
- Potential strategies to achieve phosphorus targets and load reductions
- Considerations for future monitoring

This study identifies three water quality improvement goal options for Bass Lake that local partners can use to help guide implementation efforts with the intent to reduce mean summer Chl-*a* levels. The conservative goal could be achieved through a high level of adoption of the BMPs, while the moderate and aggressive goals will be difficult to meet based on the BMP scenario reduction estimates presented. To achieve these goals, drastic changes in land use/cover (e.g., conversion of cropland and residential to grass land or wetland) and/or engineered solutions such as in-lake treatments to decrease internal phosphorus recycling may be needed. The MPCA recommends feasibility studies be performed prior to pursuing in-lake management and these strategies be paired with watershed BMPs to improve project longevity.

The study included recommendations to implement cropland BMPs such as conservation till, no-till, and cover crops and septic system upgrades and rain gardens on residential properties surrounding Bass Lake. Implementation should target pollutant sources with direct pathways to the lake including native shoreline buffers to restore and protect fish habitat as the lake was recently listed as impaired for AQL (fish community) and a lack of native shoreline vegetation was identified as one of the primary stressors.

Additional monitoring activities and analyses would be beneficial over the course of the implementation period. These items will help refine and update the watershed and lake models, assist in prioritizing and targeting BMPs, and track response to BMPs as they are implemented using an adaptive management approach.

The full report for Bass Lake can be found here: Bass Lake Water Quality Improvement Study. BMPs recommended to improve water quality in all impaired lakes in the Le Sueur River Watershed include septic system compliance, shoreline protection, in-lake management of curly leaf pondweed, stormwater management and increasing native vegetation along the shore.

There are several additional BMPs recommended to address the FIBI impairments related to Madison, Lura, and Bass Lakes beyond the strategies recommended above (DNR 2021). Strategies considered were developed to include practices related to the stressors of eutrophication, physical habitat alteration, altered species competition and pesticide application. The full report on the lakes SID can be found at the link: Le Sueur River Watershed Stressor Identification Report - Lakes.

3.1.2 Streams

This section provides information and analyses of several areas designated as priorities in the Le Sueur River Comprehensive Watershed Management Plan. Each reach was selected to help narrow down areas to be considered for implementation practices. Each stream reach includes a summary of the process, and local partners are asked to contact the MPCA for more information that can be provided to help identify areas or projects. Priority subwatershed summaries will provide the following information:

- Map of the priority area and impairments within the reach
- 1W1P priority status and the loading information for the reach
- Summary of the Monitoring and Assessment (MPCA 2021) and SID (MPCA 2024a) process
- HSPF loading map
- Estimate of practices needed to meet the 1W1P load reductions

- Potential water storage within the priority area

HSPF maps are included to help identify areas that are potentially contributing higher loads and/or yields to be considered for implementation practices, and to contact landowners and build relationships to discuss practices and programs to develop future projects.

The Watershed Pollutant Load Reduction Calculator was used to estimate the amount of practices needed to meet the reduction goals from the 1W1P report (ISG 2023). Practices were selected based on discussions with local partners on what would be amenable to landowners and that have the greatest reduction potential. An estimate of the amount of pollutant reduction at the HUC-12 watershed outlet scale is provided. This work would continue until the goals to meet the standards at the outlet were met and all impairments removed.

In 2024, the MPCA investigated the use of the HSPF model to determine what subwatersheds within the Minnesota River Basin impacted hydrology the most with a focus on a siting water storage practices. Seven detailed technical reports related to this project are available on the Minnesota Water Research Digital Library:

Water Storage Options Assessment (Report 1A)

Existing Tools and Approaches for Mapping Water Storage Practices (Report 1B)

Technical Approach for Mapping Water Storage Practices (Report 1C)

HUC8-Scale Water Storage Opportunities and Mapping Recommendations (Report 1D)

Development of HSPF Model Hydrology-Based Priority Maps for Water Storage (Report 2A)

Additional Considerations for Water Storage Prioritization (Report 2B)

River Flow Reduction Modeling and Recommendations for Goal-Setting (Reports 3A/3B)

This information was used to create the water storage potential maps for the priority watersheds.

3.1.2.1 Rice Creek Subwatershed (668, 669)

Rice Creek (52,258 acres subwatershed) is currently listed in its entirety for turbidity and *E. coli* impairments and the lower reach (-669) includes impairments for fish and bugs (Figure 20). Monitoring results (2018-2019) show that the TSS concentrations and aquatic bug communities have improved from the initial round of sampling (MPCA 2021). This watershed is the focus of a Federal Clean Water Act Section 319 small watershed grant, which is working to implement projects and practices to improve water quality. The 1W1P process selected this watershed as a priority area due to its higher nutrient loading and three priority lakes.

Figure 20 provides smaller scale HSPF watershed yield information for TSS, TP, and TN within the priority watershed. This information is based on the agricultural land use as these areas are where the focus of implementation efforts will be promoted by local partners. Higher yielding areas should be considered for implementation activities to reduce loading to the watershed to address impaired waters and their stressors.

Figure 20. Map of watershed impairments and modeled HSPF yields and relative loading in the Rice Creek Subwatershed.

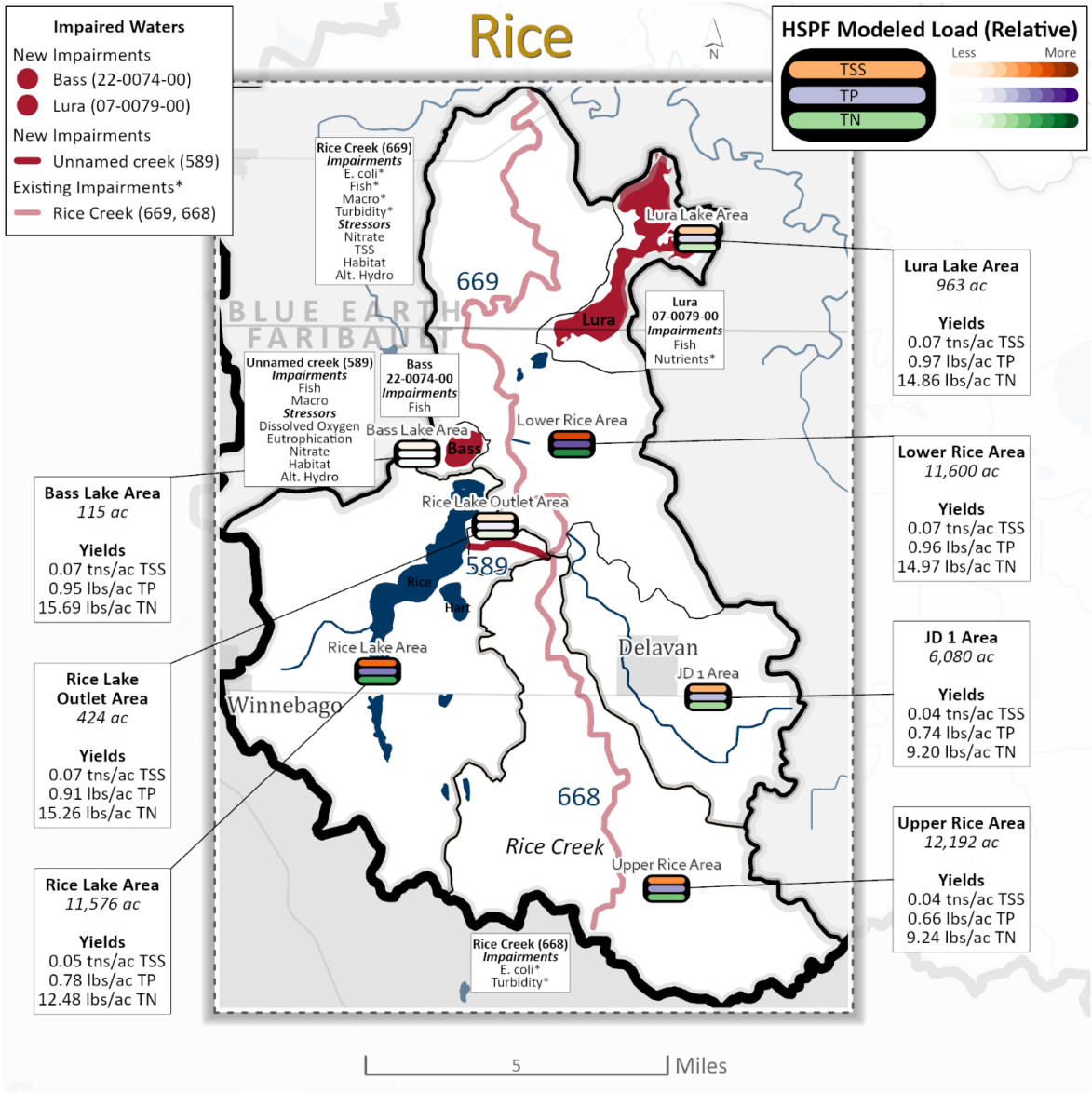


Table 14 shows the criteria used to prioritize the Rice Creek Subwatershed area in the 1W1P process and current loading from the watershed based on HSPF modeling. Also included are the pollutant load reduction estimates proposed for the priority area.

Table 14. 1W1P priority criteria, load summary, and proposed percent reduction for the Rice Creek Subwatershed.

Management Zone	Stream	Prioritization Criteria
Middle Maple	Rice Creek	High N loading subwatershed with three priority lakes - Rice, Bass, and Lura Lakes.

HSPF Subwatershed Number	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr(%)) reduction	TP (lbs/yr(%)) reduction	TN (lbs/yr(%)) reduction
809	2,109	24,281	802,397	240 (11.5%)	2,000 (8.3%)	23,000 (2.9%)

Monitoring and Assessment Summary (-669) (MPCA assessment database)

This Rice Creek Water Body Identifier (WID;-669) was first listed for a fish impairment in 2006. Cycle 2 biological monitoring collected fewer fish than previous samples from this WID. Cycle 2 samples were taken at base flow and it is possible that earlier high flows impacted the fish community. With so few fish collected, it can't be determined it was from a result of flows or impairment. Therefore, the existing fish impairment on this WID remained following the most recent assessment with the recommendation that fish be called inconclusive at this time.

Macroinvertebrates were previously assessed in 2012 and found to be a nonsupported AQL. Cycle 2 data indicate the macroinvertebrate community has somewhat improved, but still show an impaired condition. Despite a small increase in IBI score at site 08MN004, the preponderance of evidence suggests a nonsupporting condition for macroinvertebrates.

The reach was listed for a turbidity impairment in 2010 based on data from 2001 to 2009. Newer data for TSS did not have a single violation of the standard across 11 samples. However, volunteer monitoring using Secchi tubes indicated low clarity associated with high sediment concentrations still occurred. Therefore, it was recommended this reach carry forward the turbidity impairment.

Cycle 2 data indicate TP is elevated above the standard, but there is not a significant response in the Chl-*a* dataset. DO had a few violations, two of which were relatively weak in magnitude, and some higher values during daytime hours in the summer months suggesting diurnal flux may be erratic. Therefore, the reach was not listed for an RES impairment at this time.

This reach was listed for bacteria impairment in 2010 based on data from 2008 and 2009. Newer bacteria data collected with Cycle 2 monitoring efforts show no individual violations of the acute 1,260 org/100 mL criteria, but there is a persistently high pattern of bacterial contamination that violates the chronic 126 org/100 mL criteria confirming the initial bacteria impairment.

Stressor Identification Summary (MPCA 2024a)

The mainstem of Rice Creek is one of the longest reaches within the Le Sueur River Watershed with a total of six monitoring stations. Only one station (08MN004) was sampled in both 2008 and 2018 and was found to be nonsupporting of AQL in 2012. Cycle 2 macroinvertebrate data appear somewhat improved, but still show an impaired condition. While this station scored above the threshold in both assessments, all other stations on this reach scored below the threshold. Due to questionable data timed with varying flows at some stations at the time of fish sampling, the status of the fish community was inconclusive. However, some of the fish data may still be used as indications of stressors to the macroinvertebrate community.

Habitat generally improves the further downstream monitoring sites are. Overall, stations that were sampled multiple times scored consistently with what had been surveyed years prior. Channel stability and substrate seemed to have the poorest scores. This is consistent with signals of TSS impacts and turbidity stream impairment.

Within the headwaters, the macroinvertebrate community shows evidence that low DO or eutrophication is limiting the community and phosphorus data shows high concentrations that exceed the standard. There have been concerning levels of DO flux measurements that are indicative of a eutrophic response. Further downstream on the mainstem of Rice Creek there seems to be a shift in

stressors to the communities where TSS is likely the dominant stressor. Eutrophication, DO, and nitrate were all inconclusive as stressors because of conflicting and inconsistent findings of biological metrics and the chemistry data.

Priority Area Implementation Targeting Information

The MPCA developed tools were utilized to map and provide data that may be useful to local partners in their identification of areas and practices to reach the load reduction goals for the priority area. Local partners are asked to contact the MPCA to assist with their efforts as they work in the priority area. Figure 21 shows potential areas for water storage in the Rice Creek Subwatershed.

Figure 21. Potential Water Storage Area in Rice Creek Subwatershed.

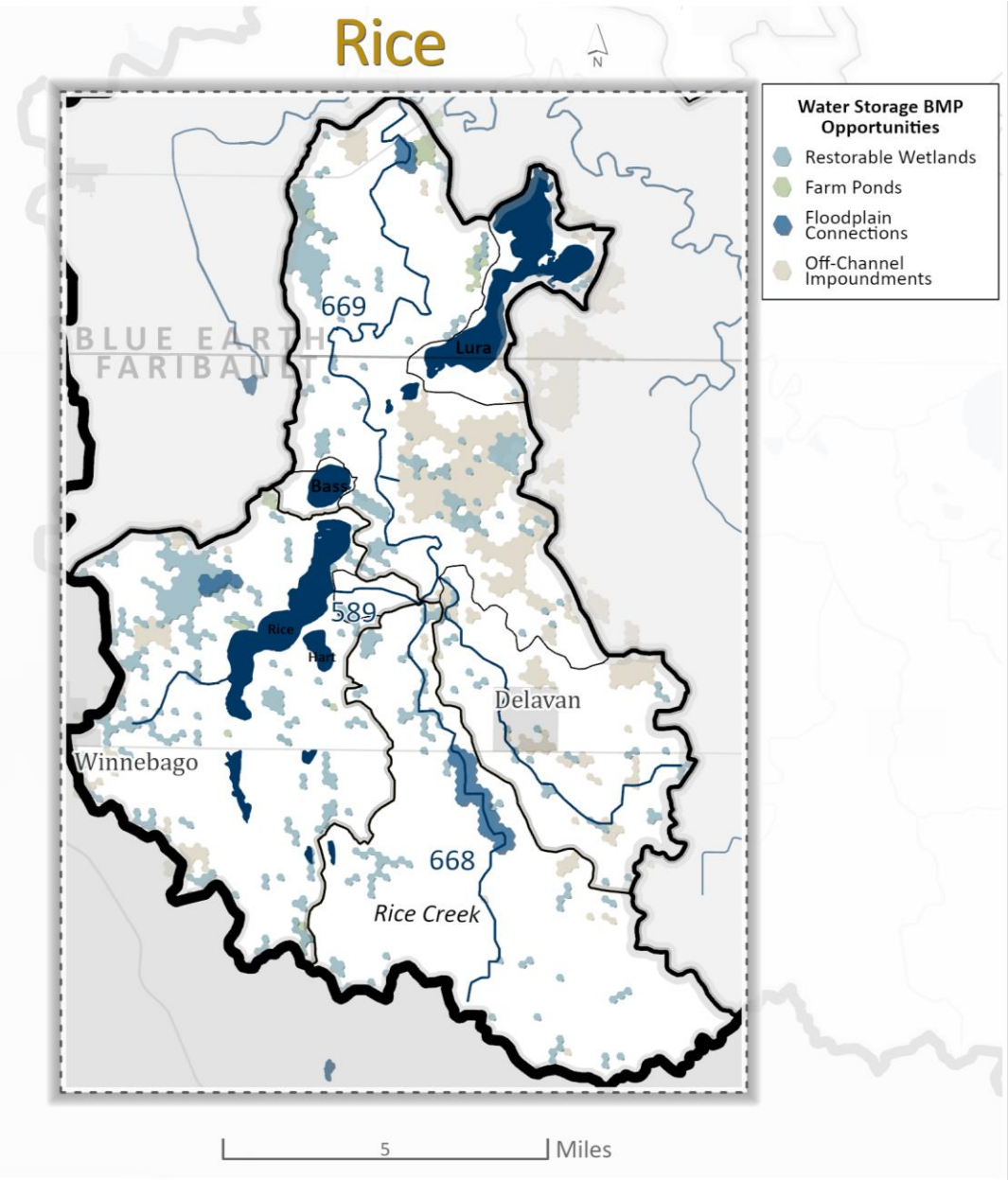


Table 15 provides a summary of reduction potential for practices that local partners considered the most viable options with landowners. An analysis of the number of acres needed to meet the 1W1P reduction goals was generated using the Watershed Pollutant Load Reduction Calculator.

Table 15. Watershed pollutant load reduction calculator estimate to meet Rice Creek 1W1P goals. Reductions for TSS, TP, and TN are estimated based on potential adoption of BMP acreage.

BMP	Potential New Acres	Annual TSS Reduction in tons	Annual TP Reduction in lbs.	Annual TN reduction in lbs.
Conservation Cover Perennials	100	3	37	1,556
Cover Crops with Corn and Soybeans	500	13	64	2,348
Drainage Side Inlet	500	11	135	586
Feedlot Runoff Reduction/Treatment	2,000	64	473	10,879
Nutrient Management Improved Rates/Timing	1,500	0	70	3,178
Nutrient Management Precision/Variable Rate	200	0	14	806
Reduced Tillage (30% residue Cover)	2,000	35	295	2,053
Reduced Tillage No Till	200	6	61	492
Water and Sediment Control Basin	500	17	206	1,839
Total	**7,500**	**149**	**1,355**	**23,737**
1W1P reduction goal		240	2,000	23,000
Progress toward goal		**62%**	**68%**	**103%**
Watershed acres	**52,258**			
% of area in watershed	**14.4%**			

3.1.2.2 Cobb River

Upper Cobb Subwatershed

The Upper Cobb Subwatershed, with a watershed of 71,817 acres, is listed for fish and bug impairments on reaches -568 and -530 and turbidity on reach -568. The headwaters begin at Freeborn Lake, which is impaired by nutrients and is addressed in the Le Sueur River Watershed TMDL Report (MPCA 2015c). The turbidity impairment is addressed in the Minnesota River and Greater Blue Earth River Basin TSS TMDL (MPCA 2020).

Figure 22 provides smaller scale HSPF watershed yield information for TSS, TP, and TN within the priority watershed. This information is based on the agricultural land use as these areas are where the focus of implementation efforts will be promoted by local partners. Higher yielding areas should be considered for implementation activities to reduce loading to the watershed to address impaired waters and their stressors.

Figure 22. Map of watershed impairments and modeled HSPF yields and relative loading in the Upper Cobb Subwatershed.

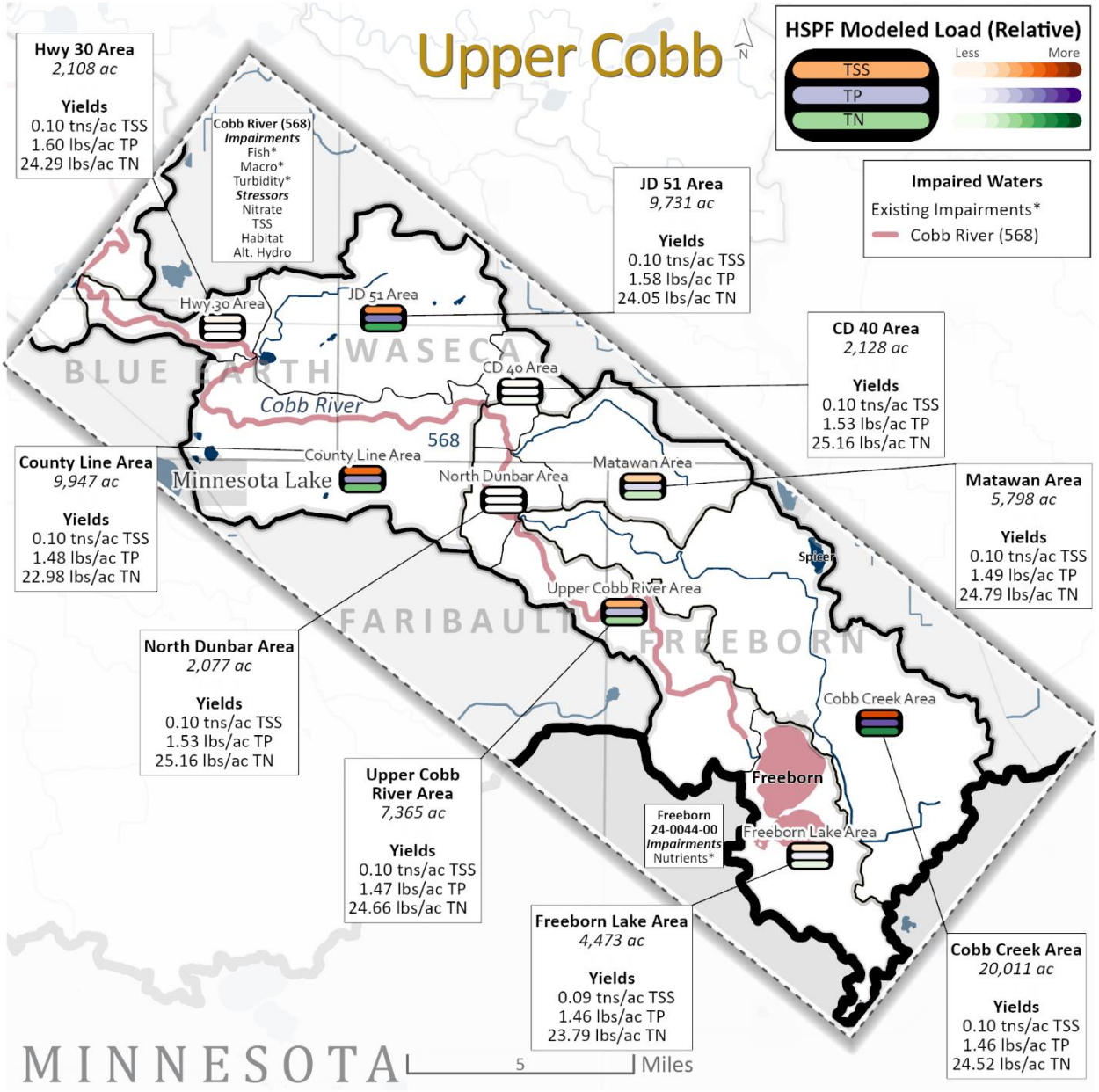


Table 16 shows the criteria used to prioritize the Upper Cobb Subwatershed area in the 1W1P process and current loading from the watershed based on HSPF modeling. Also included are the pollutant load reduction estimates proposed for the priority area.

Table 16. 1W1P priority criteria, load summary, and proposed percent reduction for the Upper Cobb Subwatershed.

Management Zone	Stream	Prioritization Criteria
Upper Cobb	Cobb River	Nearly/Barely impaired. Freeborn Lake, a priority lake located in the subwatershed.

HSPF Subwatershed Number	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr(%)) reduction	TP (lbs/yr(%)) reduction	TN (lbs/yr(%)) reduction
721	3,245	36,698	1,272,827	320 (9.8%)	3,100 (8.5%)	41,000 (3.2%)

Monitoring and Assessment Summary -530, -568 (MPCA assessment database)

WID -530 was sampled in 2008 for fish and scored below the threshold and below the CI for modified use streams during assessment in the 2018 opt in process. Nutrients were high (N and phosphorus) and abundant filamentous algae mats were present. Fish community was hyper dominated by the very tolerant fathead minnow.

One invertebrate site (08MN066) is located in this WID -530 and was sampled in 2008. The sample scored below the modified use threshold for the 2018 opt in assessment due mainly to channelization and limited habitat. The sample was dominated by tolerant taxa and individuals.

WID -568 has five invertebrate stations (08MN017, 08MN067, 08MN071, 08MN081, 18MN003), with one station, 08MN017, sampled in 2008 and 2018. Samples in the current assessment window score below the general use threshold and within the CI, with 18MN003 scoring below the threshold and below the CI. These data agree with the previous assessment of nonsupport of macroinvertebrates.

WID -568 has an existing fish impairment. There were multiple sites and several new samples used for this assessment. Recent high-water events started new channel development with a clear oxbow forming. Site 08MN071 was sampled in 2008 and 2019. The more recent sample saw four additional species. Site 18MN011 is a new station sampled in 2019, 28 species were collected, which may be lower than what could be expected as the site was sampled when the flows had dropped back to normal. There were scores above the threshold, but not all sites that contributed to the impairment were resampled. This may be a stream to focus on as it appears there is potential for scores to reach threshold and possibly to be delisted. It was recommended to leave the WID listed as impaired based on all fish data.

Stressor Identification Summary (MPCA 2024a)

This is the furthest upstream WID within the Cobb River Subwatershed and the longest at a little over 53 miles. Several stations were assessed in both cycles, with many that scored poorly in both rounds with the exception of station 18MN011. While the macroinvertebrate community was severely impaired throughout all sections, the fish community did show some improvement at the downstream location.

The stream's channel has changed significantly within the last 10 years, leading to mass channel erosion and loss of land. The current turbidity impairment coincides with the high erosion rates. Fish and macroinvertebrates also show consistent TSS stress with a lack of intolerant species, and an overabundance of TSS tolerant species. Across all parameters, TSS metric values indicated a clear stressor to AQL.

The stream declined in habitat between Cycle 1 and Cycle 2, typical for areas with high erosion and turbidity. There has been an increased loss to overall habitat due to stream instability and loss of diversity within the streambed. Fish and macroinvertebrates did indicate a species displacement from lack of available habitat. Macroinvertebrates that are tolerant to degraded habitat seemed to increase in overall population, while fish species such as riffle dwellers and lithophilic spawners were in decline between the two cycles.

Nitrate was also thought to be playing a role in limiting biological communities. Across all years and communities sampled, nitrate sensitive species were consistently lacking. Nitrate had the most data collected out of all the other parameters (20 samples) yielding an average concentration of 8.75 mg/L.

DO did not seem to clearly limit the fish community, nor were there exceptionally high or low DO values collected. Without continuous DO monitoring, it was difficult to fully rule out DO as a stressor to AQL or as an indication to eutrophication, leaving both parameters inconclusive as stressors.

There is a clear biological response in both fish and macroinvertebrates that was indicative of an algae dominant system, particularly upstream. There has been a shift in the macroinvertebrate community with the dominant feeder types of “gatherers” and “predators” shifting to “filter feeders” and “scrapers”. Half the collected phosphorus samples were above the standard of 0.15 mg/L but no secondary response variables were collected to determine eutrophic status. As with many streams that have headwaters prone to high nutrients and open canopy, it was plausible the algae within the water column were coming from upstream sources rather than developing within this section itself.

Priority Area Implementation Targeting Information

The MPCA developed tools were utilized to map and provide data that may be useful to local partners in their identification of areas and practices to reach the load reduction goals for the priority area. Local partners are asked to contact the MPCA to assist with the efforts as they work in the priority area. Figure 23 shows potential areas for water storage in the Upper Cobb Subwatershed.

Figure 23. Potential water storage area in Upper Cobb River Subwatershed.

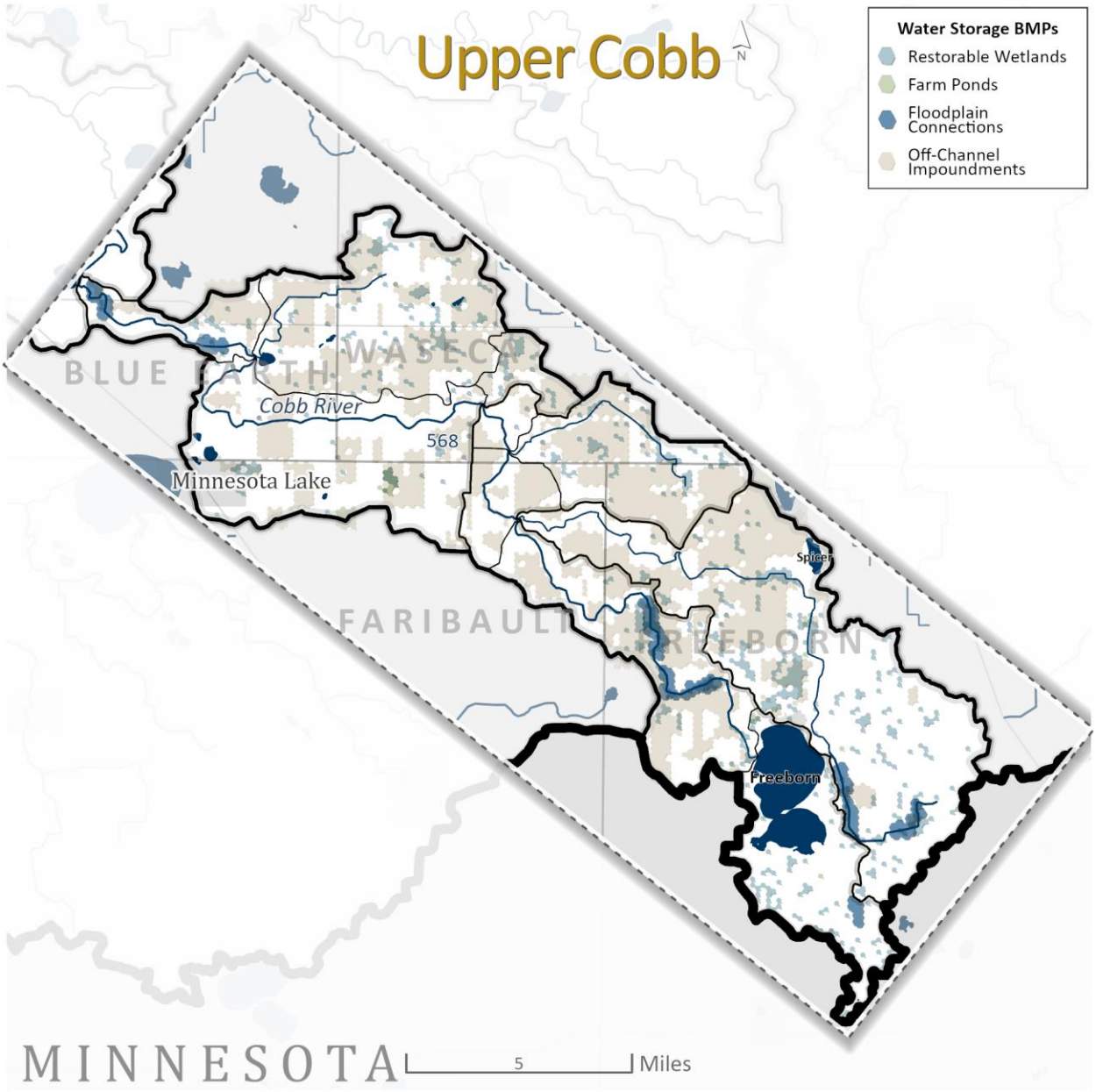


Table 17 provides a summary of reduction potential for practices that local partners considered the most viable options with landowners. An analysis of the number of acres needed to meet the 1W1P reduction goals was generated using the Watershed Pollutant Load Reduction Calculator.

Table 17. Watershed pollutant load reduction calculator estimate to meet Upper Cobb River Subwatershed 1W1P goals. Reductions for TSS, TP, and TN are estimated based on potential adoption of BMP acreage.

BMP	Potential New Acres	Annual TSS Reduction in tons	Annual TP Reduction in lbs	Annual TN reduction in lbs
Conservation Cover Perennials	500	27	266	12,579
Cover Crops with Corn and Soybeans	2,000	82	367	15,188
Drainage Side Inlet	500	18	193	931
Feedlot Runoff Reduction/Treatment	1,000	63	411	10,978
Nutrient Management Improved Rates/Timing	1,000	0	67	3,429
Nutrient ManagementPrecision/Variable Rate	100	0	10	653
Reduced Tillage (30% residue Cover)	2,000	56	422	3,291
Reduced Tillage No Till	1,000	45	435	3,939
Water and Sediment Control Basin	500	28	292	2,769
Total	**8,600**	**319**	**2,463**	**53,757**
1W1P reduction goal		320	3,100	41,000
Progress toward goal		**100%**	**79%**	**131%**
Watershed acres	**71,817**			
% of area in watershed	**12.0%**			

Lower Cobb Subwatershed

The Lower Cobb Subwatershed, with a watershed of 42,921 acres, is listed as impaired by fish, bugs, *E. coli*, turbidity, and nutrients on reach -556, the lowest reach that outlets to the mainstem of the Le Sueur River. The turbidity impairment is addressed in the Minnesota River and Greater Blue Earth River Basin TSS TMDL (MPCA 2020) and the *E. coli* impairment is addressed in the Le Sueur River Watershed TMDL (MPCA 2015c). The nutrient impairment is addressed in the Le Sueur River Watershed TMDL Report 2025 (MPCA 2025). Reach -505 is listed for a fish impairment. This subwatershed also includes reaches -642 and -643, the Little Beauford Ditch.

Figure 24 provides smaller scale HSPF watershed yield information for TSS, TP, and TN within the priority watershed. This information is based on the agricultural land use as these areas are where the focus of implementation efforts will be promoted by local partners. Higher yielding areas should be considered for implementation activities to reduce loading to the watershed to address impaired waters and their stressors.

Figure 24. Map of watershed impairments and modeled HSPF yields and relative loading of the Lower Cobb River Subwatershed.

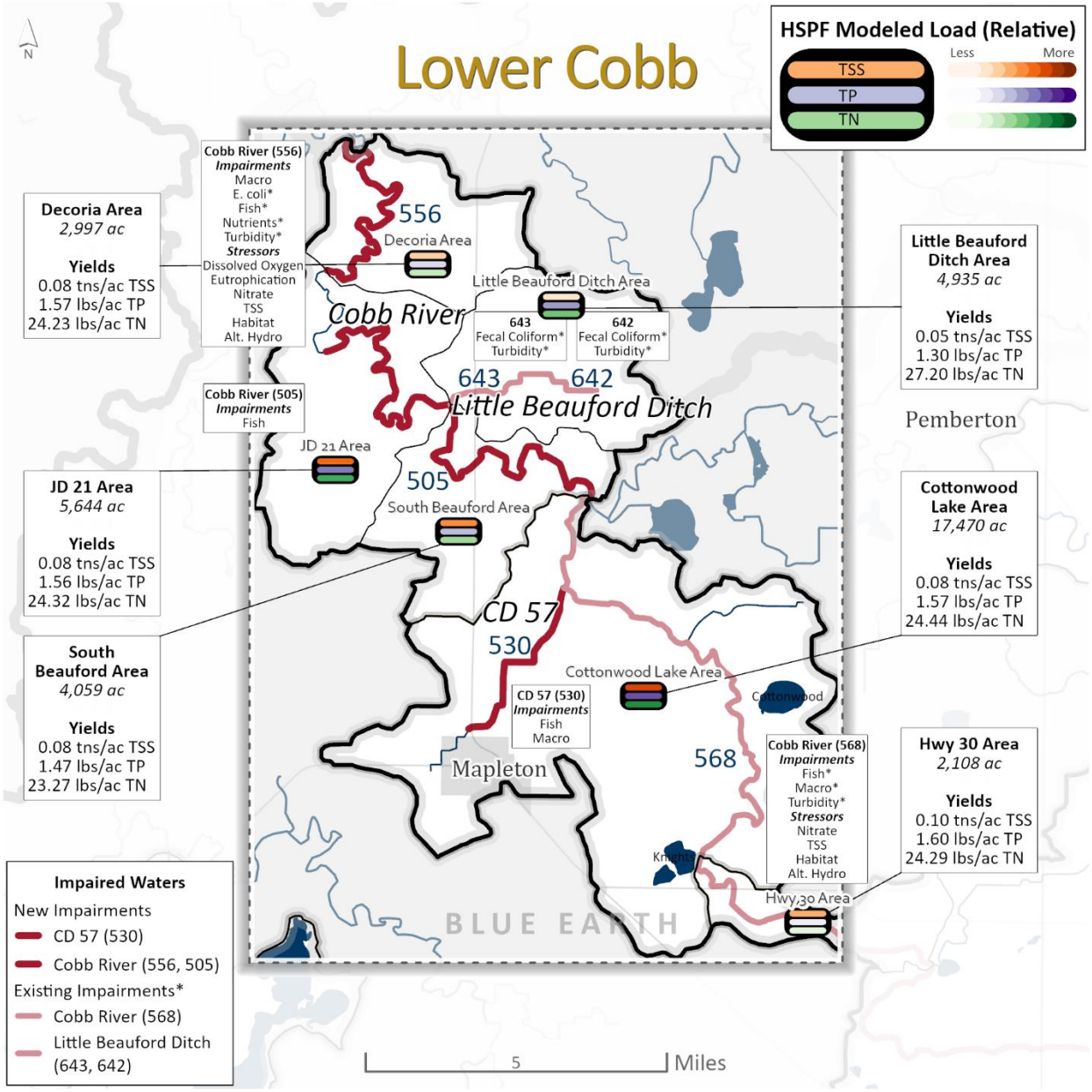


Table 18 shows the criteria used to prioritize the Lower Cobb Subwatershed area in the 1W1P process and current loading from the subwatershed based on HSPF modeling. Also included are the pollutant load reduction estimates proposed for the priority area.

Table 18. 1W1P priority criteria, load summary, and proposed percent reduction for Lower Cobb River Subwatershed.

Management Zone	Stream	Prioritization Criteria
Lower Cobb	Cobb River	High loading TSS and N subwatershed from agricultural field sources.

HSPF Subwatershed Number	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr(%)) reduction	TP (lbs/yr(%)) reduction	TN (lbs/yr(%)) reduction
751	20,878	118,682	5,227,920	880 (4.2%)	5,900 (5.0%)	94,000 (1.8%)

Monitoring and Assessment Summary (MPCA assessment database)

WID -556 has been listed as impaired for fish since 2012. The fish sample from 2019 was changed to nonreportable as the flows were high and significantly fewer fish were found. During the sample, two shovelnose sturgeon and a shortnose gar were collected. While the newest fish score was above threshold, it is well within the CI and the 2010 sample was below. There were still indicators of stressors to the fish community, such as erosion and the community being dominated by sand shiners. There was not enough data to pursue delisting, but this site could be a location to focus monitoring efforts for delisting in the future.

The most recent macroinvertebrate data (2017 – 2018) suggest a nonsupporting condition, with each successive sampling of this station receiving lower scores than the previous sampling. More recent MSHA scores also suggest a changing habitat condition. Therefore, the WID was determined to be nonsupport of general AQL use based on macroinvertebrate data.

Extensive phosphorus data indicates persistently elevated concentrations across the years (2006 through 2020) and Chl-*a* data indicates a significant response to elevated nutrients. The WID remains listed for RES at this time based on grossly violating TP and Chl-*a* response data.

A robust TSS and Secchi tube dataset reveals poor conditions for AQL persist since the initial turbidity listing in 2008.

Stressor Identification Summary (MPCA 2024a)

This section is the outlet of the Lower Cobb Subwatershed before it converges with the Le Sueur River mainstem. This WID is close to delisting its biological impairment, therefore is considered a priority location.

WID -556 on the Lower Cobb Subwatershed has one station (08MN005), sampled a total of three times, once in 2008, 2010, and 2018. The 2018 sample scored just above the threshold at 50.1. Notable species collected in this sample were gar and large flathead. An additional fish collection in 2019 (nonreportable as a result of flows) sampled two shovelnose sturgeon and a shortnose gar. While the newest score is above threshold, it did not meet statistically significant growth to place it out of fish impairment status. The macroinvertebrate samples throughout the years fall above and below the threshold, within the CI. Like the fish community, the macroinvertebrate community is not far off from reaching a supportive status.

There are robust water chemistry datasets available within the assessment window at multiple stations across this reach of the Lower Cobb River. Datasets are buoyed by regular watershed pollutant load

monitoring at one upstream station (H32071001). In addition to the biologic impairment, this stream has a previous listing for AQL use based on turbidity (2008) and nutrients (2016). Extensive phosphorus data indicates elevated concentrations across the years. Chl-*a* data indicates a significant response to elevated nutrients and highlights eutrophication. Robust TSS and Secchi tube datasets reveal poor conditions for AQL. This can be noted in the stream's poor riparian scores as well as morphology.

Priority Area Implementation Targeting Information

The MPCA-developed tools were utilized to map and provide data that may be useful to local partners in their identification of areas and practices to reach the load reduction goals for the priority area. Local partners are asked to contact the MPCA to assist with the efforts as they work in the priority area. Figure 25 shows potential areas for water storage in the Lower Cobb Subwatershed.

Figure 25. Potential water storage area in Lower Cobb River Subwatershed.

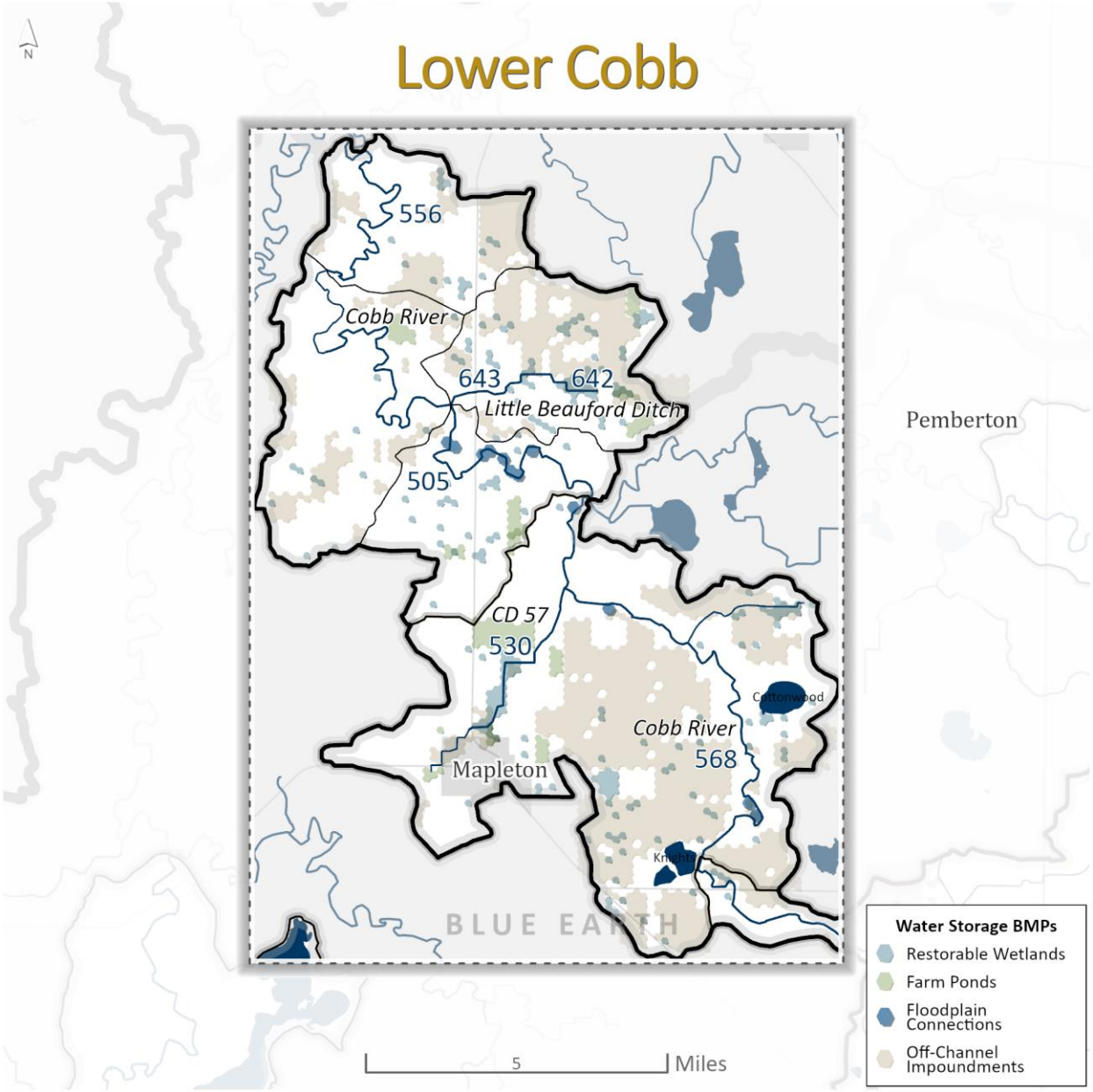


Table 19 provides a summary of reduction potential for practices that local partners considered the most viable options with landowners. An analysis of the number of acres needed to meet the 1W1P reduction goals was generated using the Watershed Pollutant Load Reduction Calculator.

Table 19. Watershed pollutant load reduction calculator estimate to meet Lower Cobb River Subwatershed 1W1P goals. Reductions for TSS, TP, and TN are estimated based on potential adoption of BMP acreage.

BMP	Potential New Acres	Annual TSS Reduction in tons	Annual TP Reduction in lbs	Annual TN reduction in lbs
Conservation Cover Perennials	100	6	70	2,817
Cover Crops with Corn and Soybeans	1,500	64	363	12,754
Drainage Side Inlet	100	4	51	208
Feedlot Runoff Reduction/Treatment	300	14	152	3,535
Nutrient Management Improved Rates/Timing	500	0	44	1,919
Nutrient Management Precision/Variable Rate	0	0	0	0
Reduced Tillage (30% residue Cover)	1,500	43	417	2,763
Reduced Tillage No Till	100	5	57	441
Water and Sediment Control Basin	150	9	118	938
Total	**4,250**	**145**	**1,272**	**25,375**
1W1P reduction goal		150	1,800	19,800
Progress toward goal		**97%**	**71%**	**128%**
Watershed acres	**42,921**			
% of area in watershed	**9.9%**			

3.1.2.3 Iosco Creek Subwatershed (576)

Iosco Creek, with a watershed of 13,614 acres, is impaired for fish and *E. coli* on reach -576 and for fish and bugs on reach -655 (Silver Creek). The *E. coli* impairment is a new listing from 2022 and is included in the Le Sueur River Watershed TMDL Report 2025 (MPCA 2025).

Figure 26 provides smaller scale HSPF watershed yield information for TSS, TP, and TN within the priority watershed. This information is based on the agricultural land use as these areas are where the focus of implementation efforts will be promoted by local partners. Higher yielding areas should be considered for implementation activities to reduce loading to the watershed to address impaired waters and their stressors.

Figure 26. Map of watershed impairments and modeled HSPF yields and relative loading for Iosco Creek Subwatershed.

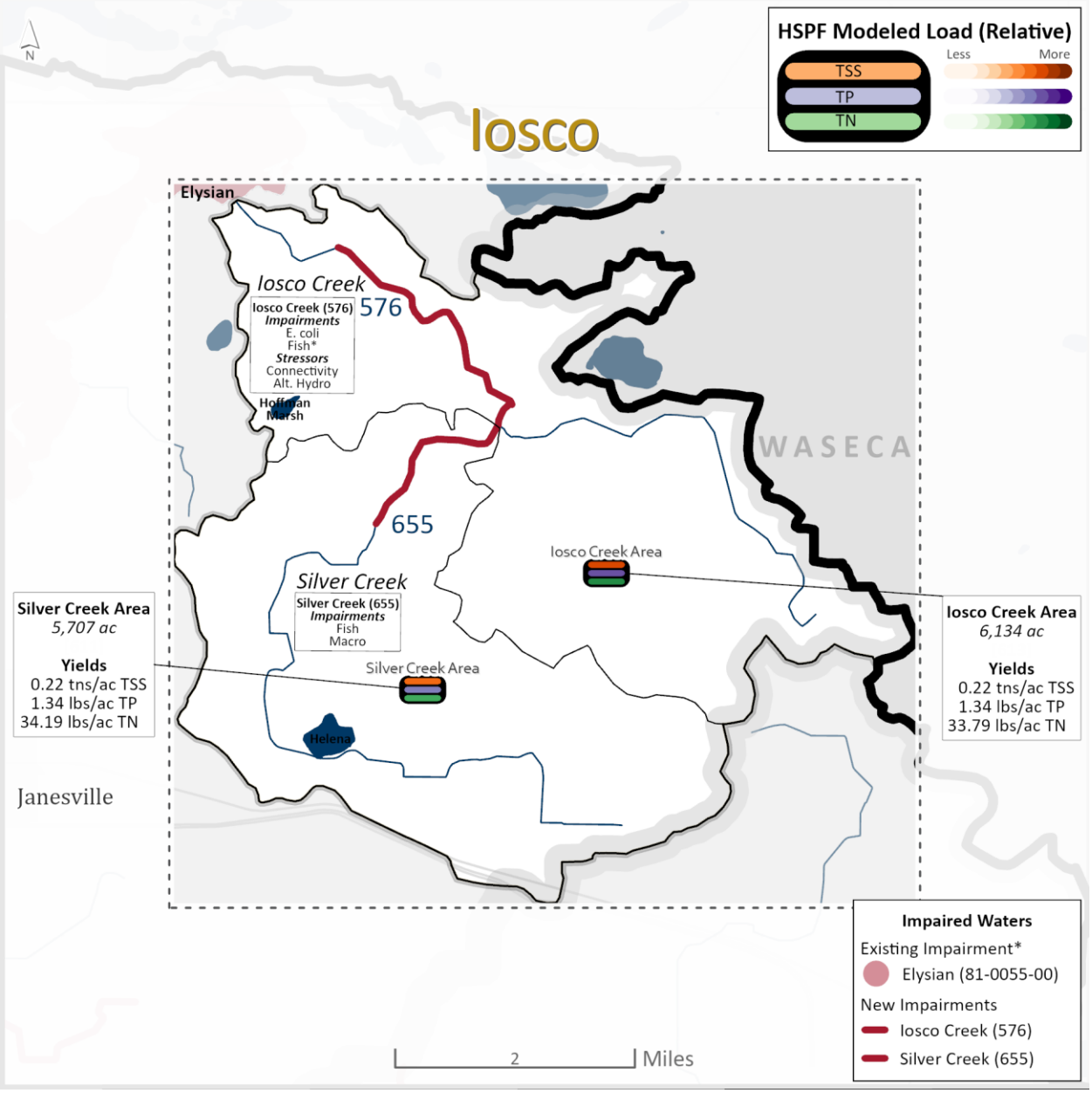


Table 20 shows the criteria used to prioritize the Iosco Creek Subwatershed area in the 1W1P process and current loading from the subwatershed based on HSPF modeling. Also included are the pollutant load reduction estimates proposed for the priority area.

Table 20. 1W1P priority criteria, load summary, and proposed percent reduction for Iosco Creek Subwatershed.

Management Zone	Stream	Prioritization Criteria
Middle Le Sueur	Iosco Creek	High loading TSS and N subwatershed from agricultural sources draining into Lake Elysian, a priority lake.

HSPF Subwatershed Number	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr(%)) reduction	TP (lbs/yr(%)) reduction	TN (lbs/yr(%)) reduction
613	2,398	11,548	480,344	200 (8.4%)	700 (6.1%)	10,500 (2.2%)

Monitoring and Assessment Summary (MPCA assessment database)

Water chemistry data for Iosco Creek -576 was collected during 2017 and 2018 in association with local water planning efforts. Mean phosphorus concentrations were in significant violation of the water quality standard to protect AQL use (36 of 42 samples exceeded standards in 2018). However, no response data was available to complete river eutrophication assessment. This should be a priority for future monitoring efforts.

TSS and Secchi tube sampling during 2017 and 2018 indicated only a single violation of the standard. Overall, there was insufficient information to make a complete AQL use assessment for TSS based on water chemistry alone.

Bacteria (*E. coli*) data was collected during 2017 and 2018 with numerous severe violations of the individual standard (1,260 org/100 ml) over those two years.

There is an existing fish impairment on this WID -576 based on sampling in 2008. The fish community scored very low. The stream was re-sampled in 2018 after a period of high water and scored quite high but with a very different community of fish. It is possible these fish moved into the stream from Lake Elysian. Because of the drastic change, the site was sampled again in 2019 and scored zero. Only three species were identified with fewer than 25 individual fish collected. With such drastic changes in IBI from the most recent samples, it does not appear there is enough evidence to delist the stream, even with the very high 2018 passing score.

The macroinvertebrate community was found to be in support based on 2017 and 2018 monitoring.

Stressor Identification Summary (MPCA 2024a)

This stream has been identified as a high priority location, as there may be land improvements and local interests that could improve this stream section.

While there was some level of uncertainty around Iosco Creek's fish impairment status, there was a clear trend of decreasing habitat. The MSHA scores shows a decline between the assessment cycles that typically indicates a stream's structural integrity seems to be changing.

New channel formation and widening were noted at the time of monitoring and aerial photo review shows a clear change in the stream's sinuosity. The stream appears to be trying to reach a new equilibrium and the changes can be seen particularly within the stream bed and near channel.

It is plausible that Iosco Creek would show an improved community with improvements to habitat and erosion as the result of a historically modified stream finding its equilibrium. Fish migration does seem to still be limiting the fish community as the fish barrier on County Ditch 6 prohibits fish from entering Lake Elysian from the larger stream systems.

TP concerns for the stream are reduced by the canopy cover and stream gradient that allows steady flows that are likely reducing the ability to grow algae. The high phosphorous concentrations do contribute to the loading in Lake Elysian which was listed in 2010 for nutrient impairment.

Nitrates, while at times elevated, have been below concerning levels in the last 10 years. In addition, the macroinvertebrate community did show improvement by the emergence of some nitrate sensitive species, with a decline in nitrate tolerant species.

Priority Area Implementation Targeting Information

The MPCA-developed tools were utilized to map and provide data that may be useful to local partners in their identification of areas and practices to reach the load reduction goals for the priority area. Local partners are asked to contact the MPCA to assist with the efforts as they work in the priority area. Figure 27 shows potential areas for water storage in the Iosco Creek Subwatershed.

Figure 27. Potential water storage area in Iosco Creek Subwatershed.

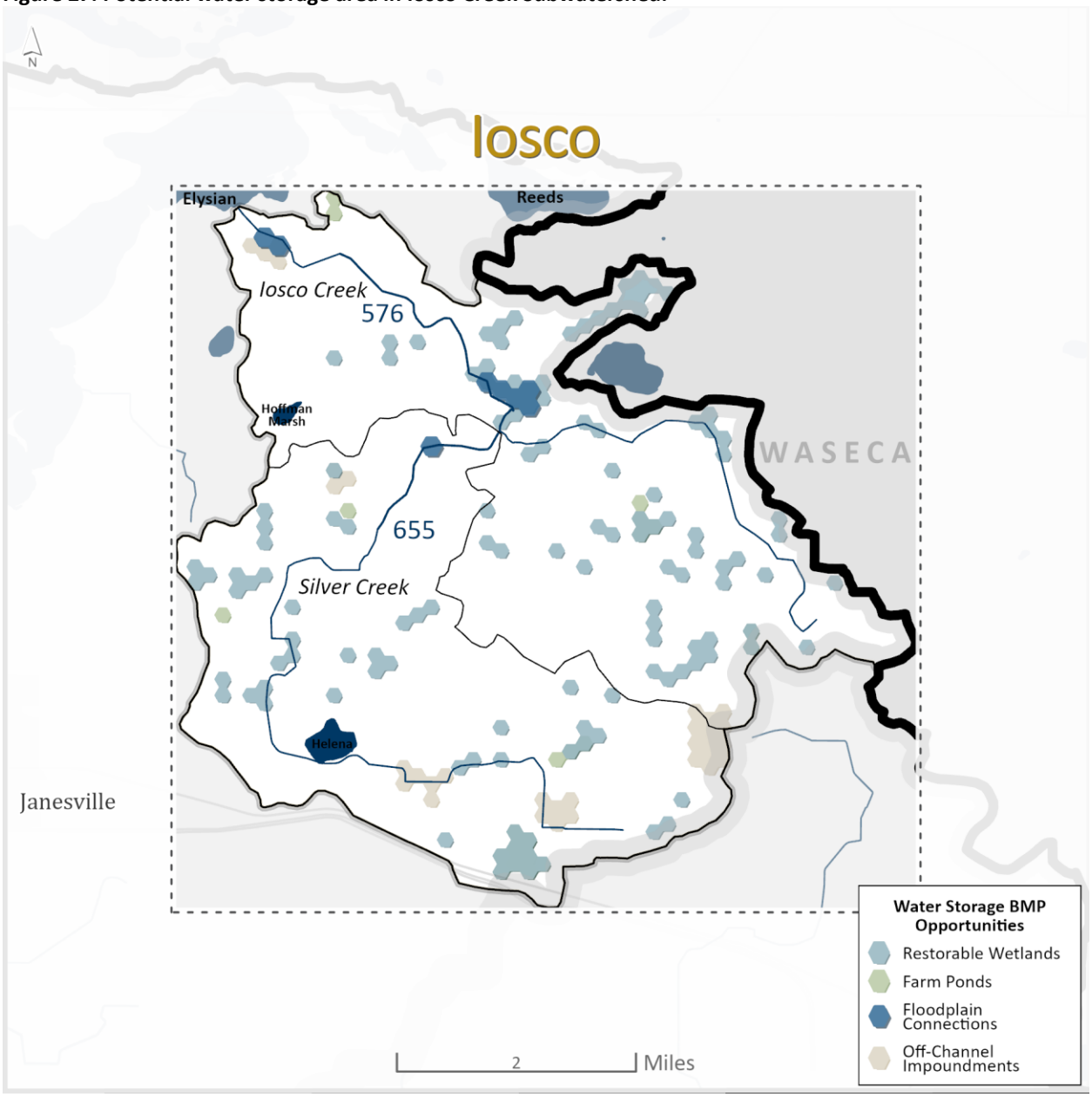


Table 21 provides a summary of reduction potential for practices that local partners considered the most viable options with landowners. An analysis of the number of acres needed to meet the 1W1P reduction goals was generated using the Watershed Pollutant Load Reduction Calculator.

Table 21. Watershed pollutant load reduction calculator estimates to meet Iosco Creek 1W1P goals. Reductions for TSS, TP, and TN are estimated based on potential adoption of BMP acreage.

BMP	Potential New Acres	Annual TSS Reduction in tons	Annual TP Reduction in lbs	Annual TN reduction in lbs
Conservation Cover Perennials	50	8	36	1,924
Cover Crops with Corn and Soybeans	200	24	49	2,324
Drainage Side Inlet	0	0	0	0
Feedlot Runoff Reduction/Treatment	200	8	77	2,867
Nutrient Management Improved Rates/Timing	500	0	44	2,614
Nutrient Management Precision/Variable Rate	0	0	0	0
Reduced Tillage (30% residue Cover)	500	40	141	1,296
Reduced Tillage No Till	100	13	58	620
Water and Sediment Control Basin	50	8	38	510
Total	**1,600**	**101**	**443**	**12,155**
1W1P Goal		200	700	10,000
Progress toward goal		**50%**	**63%**	**122%**
Watershed acres	**13,614**			
% of area in watershed	**11.8%**			

3.1.2.4 Bull Run Creek Subwatershed(647)

Bull Run Creek, with a watershed of 27,073 acres, was listed for fish in 2020 after being deferred until the TALU process was completed. It was also added to the 2022 list for TSS and *E. coli* impairments. The TSS and *E. coli* impairments were included as part of the Minnesota River and Greater Blue Earth River Basin TSS TMDL (MPCA 2020) and the Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin Report (MPCA 2007) through the recategorization process.

Figure 28 provides smaller scale HSPF watershed yield information for TSS, TP, and TN within the priority subwatershed. This information is based on the agricultural land use as these areas are where the focus of implementation efforts will be promoted by local partners. Higher yielding areas should be considered for implementation activities to reduce loading to the watershed to address impaired waters and their stressors.

Figure 28. Map of watershed impairments and modeled HSPF yields and relative loading for Bull Run Creek Subwatershed.

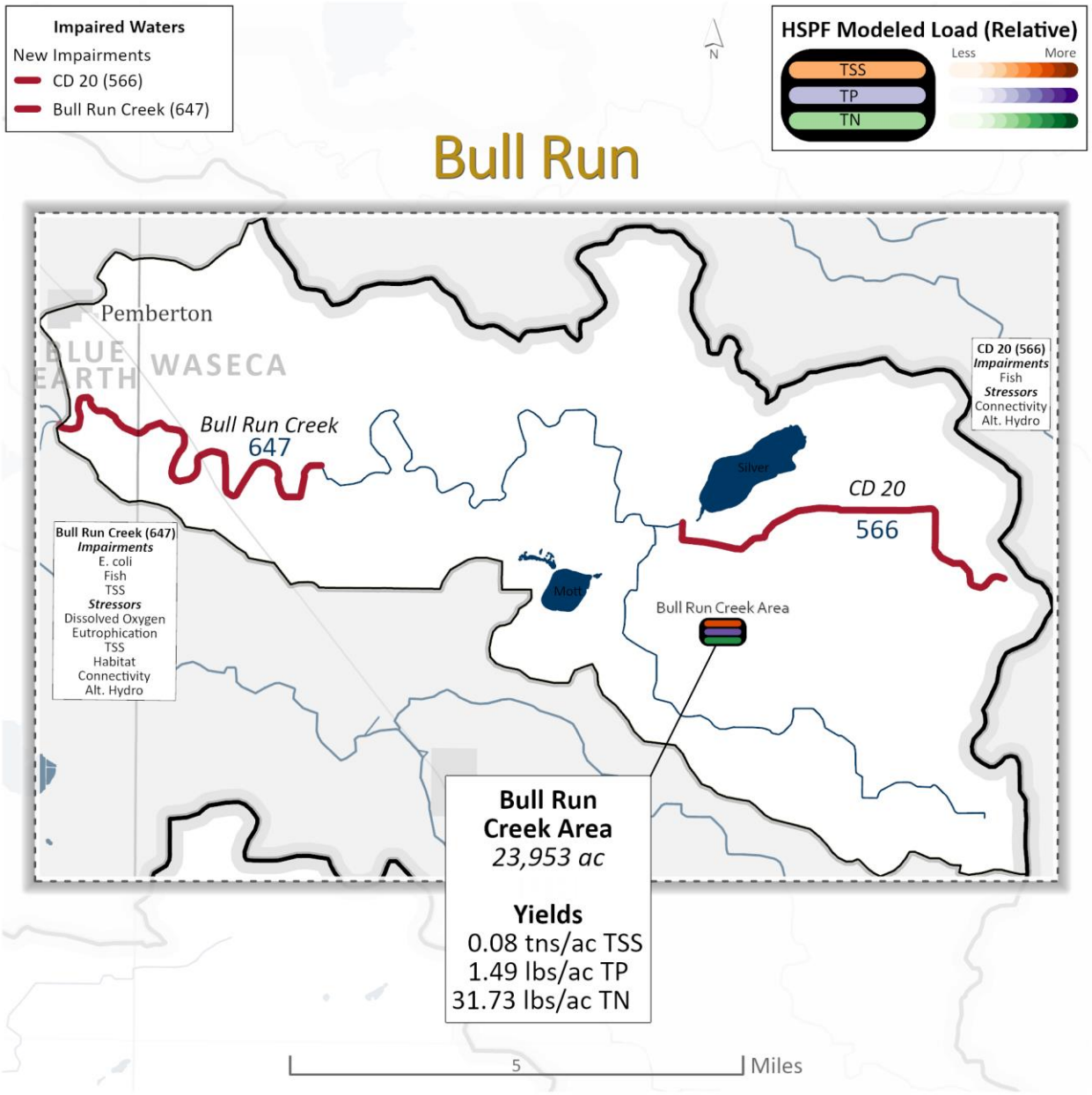


Table 22 shows the criteria used to prioritize the Bull Run Creek Subwatershed area in the 1W1P process and current loading from the watershed based on HSPF modeling. Also included are the pollutant load reduction estimates proposed for the priority area.

Table 22. 1W1P priority criteria, load summary, and proposed percent reduction for Bull Run Creek Subwatershed.

Management Zone	Stream	Prioritization Criteria
Middle Cobb	Bull Run	Community momentum and leadership.

HSPF Subwatershed Number	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr(%)) reduction	TP (lbs/yr(%)) reduction	TN (lbs/yr(%)) reduction
735	1,771	24,661	894,498	150 (8.6%)	1,700 (7.1%)	24,000 (2.7%)

Monitoring and Assessment Summary (MPCA assessment database)

Cycle 1 fish data (2008) on this reach resulted in a fish IBI impairment following the development of TALU for modified streams. The sample notes indicate there is a lot of sediment in the stream, and the MSHA supports this with a score of only 26. The stream appears to have very little habitat and poor channel morphology. MSHA indicates the stream is dominated by sand and silt and there is severe embeddedness with heavy silt. Both samples were dominated by tolerant taxa, and spotfin shiners were a dominating species. A single dominating species can indicate a stressed biological community. With very low scores in 2008, and a score just above threshold in 2018, paired with the poor habitat and low BCG scores, this site remained listed as impaired for fish.

Bull Run Creek (-647) has two stations that were sampled for macroinvertebrates in 2018. Data from both stations scored above the modified use threshold, and above the CI. Therefore, it was determined this WID is in full support of the modified AQL use based on macroinvertebrate data.

Bacteria (*E. coli*) data was collected in 2017 and 2018 through local monitoring efforts. Numerous individual violations and persistently high monthly mean values were found. The dataset is clearly indicative of poor recreational water quality due to bacterial contamination. Therefore, the WID was determined to not support recreational use based on severely violating bacteria concentrations.

TP water chemistry data was collected between 2017 and 2018 in association with local monitoring efforts. Excessive nutrients within this reach are common, resulting in an elevated summer average for phosphorus well above regional criteria (0.150 mg/L). There was no response data for full eutrophication assessment at this time. Therefore, the WID was not listed for violation of the RES standard. However, nutrients could be a stressor to aquatic communities (DO flux).

TSS and Secchi tube data were collected intensively during 2017 and 2018, with significant violation rates in both datasets (35% above TSS standard, 27% of Secchi tube readings). High sediment concentrations are clearly present when prolonged events are captured. Sampling showed long term violations of the standard (June 2017 and 2018) indicating poor conditions are not short-term deviations in quality. The magnitude of violations suggests a significant problem exists and paired TSS and Secchi tube samples confirm poor water clarity associated with high sediment loading.

Stressor Identification Summary (MPCA 2024a)

Habitat and TSS are the leading stressors within this WID. There are also clear indications of eutrophication occurring leading to TSS issues driven by both algae and sediment. DO stress could be created by both eutrophication as well as sediment-oxygen demand. However, continuous data does show DO flux that would correlate to eutrophication, with low DO occurring mostly at night.

Connectivity was also found to be a stressor at times of low flow, as a culvert is slightly perched. Most times of the year, during normal flows, this is passable.

Priority Area Implementation Targeting Information

The MPCA-developed tools were utilized to map and provide data that may be useful to local partners in their identification of areas and practices to reach the load reduction goals for the priority area. Local partners are asked to contact the MPCA to assist with the efforts as they work in the priority area. Figure 29 shows potential areas for water storage in the Bull Run Creek Subwatershed.

Figure 29. Potential water storage areas in Bull Run Creek Subwatershed.

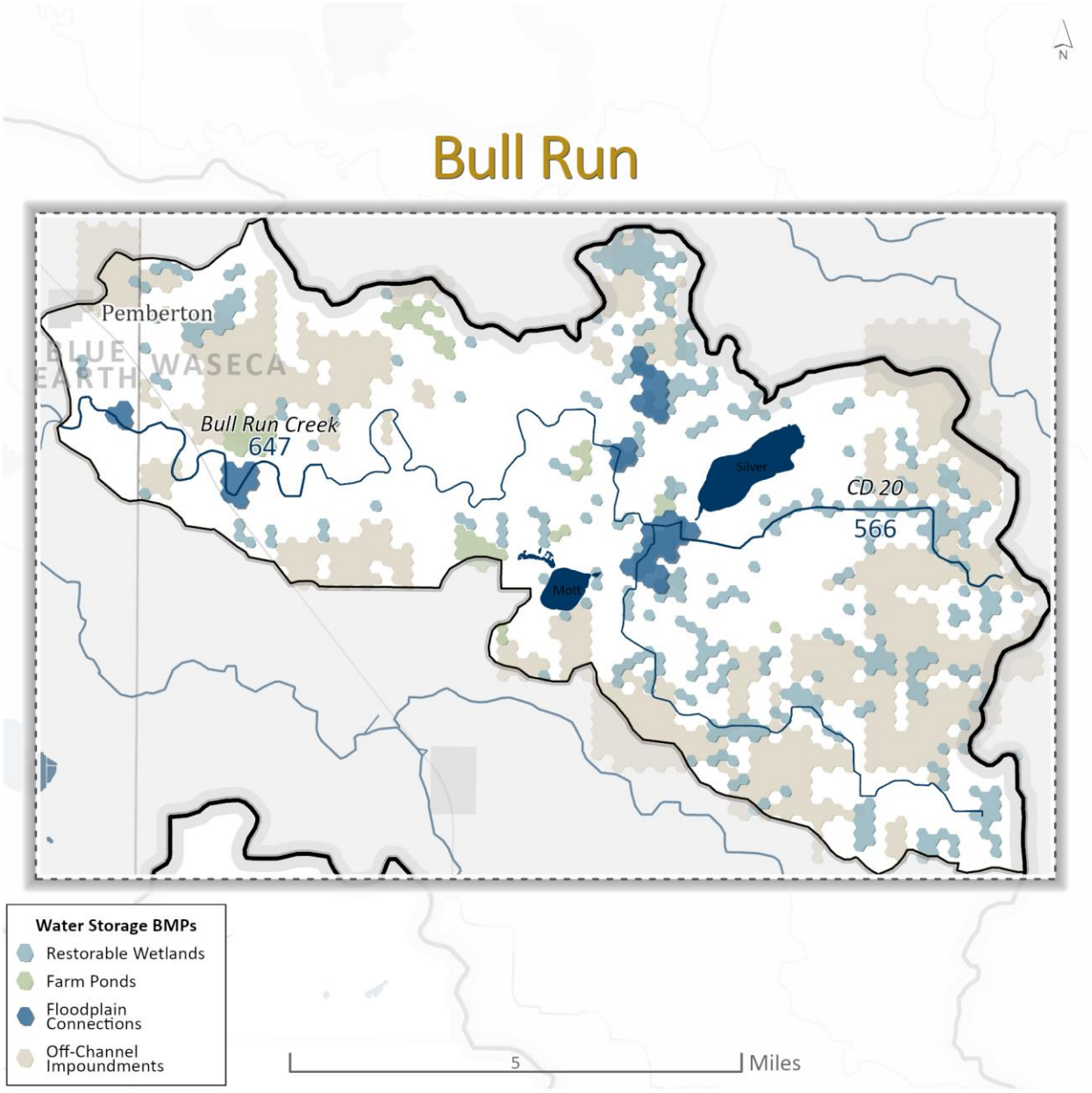


Table 23 provides a summary of reduction potential for practices that local partners considered the most viable options with landowners. An analysis of the number of acres needed to meet the 1W1P reduction goals was generated using the Watershed Pollutant Load Reduction Calculator.

Table 23. Watershed pollutant load reduction calculator estimates to meet Bull Run Creek 1W1P goals. Reductions for TSS, TP, and TN are estimated based on potential adoption of BMP acreage.

BMP	Potential New Acres	Annual TSS Reduction in tons	Annual TP Reduction in lbs	Annual TN reduction in lbs
Conservation Cover Perennials	200	11	141	6,656
Cover Crops with Corn and Soybeans	1,500	63	366	15,068
Drainage Side Inlet	200	7	103	490
Feedlot Runoff Reduction/Treatment	0	0	0	0
Nutrient Management Improved Rates/Timing	500	0	45	2,268
Nutrient ManagementPrecision/Variable Rate	0	0	0	0
Reduced Tillage (30% residue Cover)	1,000	29	281	2,170
Reduced Tillage No Till	200	9	116	1,039
Water and Sediment Control Basin	300	17	235	2,157
Total	**3,900**	**136**	**1,287**	**29,848**
1W1P progress goal		150	1,700	24,000
Progress toward goal		**91%**	**76%**	**124%**
Watershed acres	**27,073**			
% of area in watershed	**14.4%**			

3.2 Protecting Water Quality

The original Le Sueur River WRAPS Report (MPCA 2015a) highlighted several areas on which to focus protection efforts that are still relevant today. A summary of protection strategies from the original WRAPS Report for priority lakes and streams is listed below.

- **Lakes and streams near water quality thresholds** – Prevent water bodies that are at or near water quality and biological standards from further degradation. These areas need further study to identify landuse and other trends that will keep these waterbodies from future impairment.
- **Shoreline development** - A healthy shoreline supports a diverse community of fish and wildlife by providing native vegetation that fulfills their habitat needs where land and water meet. Native vegetation provides important water quality functions by slowing and filtering water runoff as it moves to the lake or stream. Shorelines with a diverse mixture of native plants extending inland as well as offshore of the bank are more resilient to wave and ice erosion.
- **Wetland protection** - Wetlands are beneficial because they store water, which is metered out slowly to surface waters, groundwater, and evapotranspiration. Few high-quality wetlands remain in the Le Sueur River Watershed and should be protected from development and agricultural degradation.
- **Agricultural pesticide management** - Watershed residents have expressed concerns about nutrients and pesticides in the watershed. The Minnesota Department of Agriculture (MDA)

monitors extensively for pesticides in Minnesota's water resources. They are the lead agency for all aspects of pesticide environmental and regulatory functions and provide educational information on proper use and management of pesticides to reduce the potential for environmental contamination.

- **Source-water protection** - The Le Sueur River plays an important role as a drinking water source to the city of Mankato. The primary concern of this drinking water source is N concentrations which are dangerous to human health and expensive to treat. Strategies to reduce N contributions through nutrient management practices and agricultural BMPs can be utilized watershed wide to reduce this source.
- **Sensitive shorelines** - Sensitive areas are places that provide unique or critical ecological habitat. These areas along the shore or in near-shore areas of the lake are crucial to the health and well-being of fish, wildlife, and native plants.
- **Protect high quality habitat** – Including but not limited to designated wildlife habitat areas, wildlife lakes, forested riparian areas, and wetland/upland habitat complexes.

3.3 Environmental Justice

The MPCA is committed to environmental justice, the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, concerning the development, implementation, and enforcement of environmental laws, regulations, and policies. The MPCA is committed to making decisions that do not place disproportionate pollution burdens on these communities.

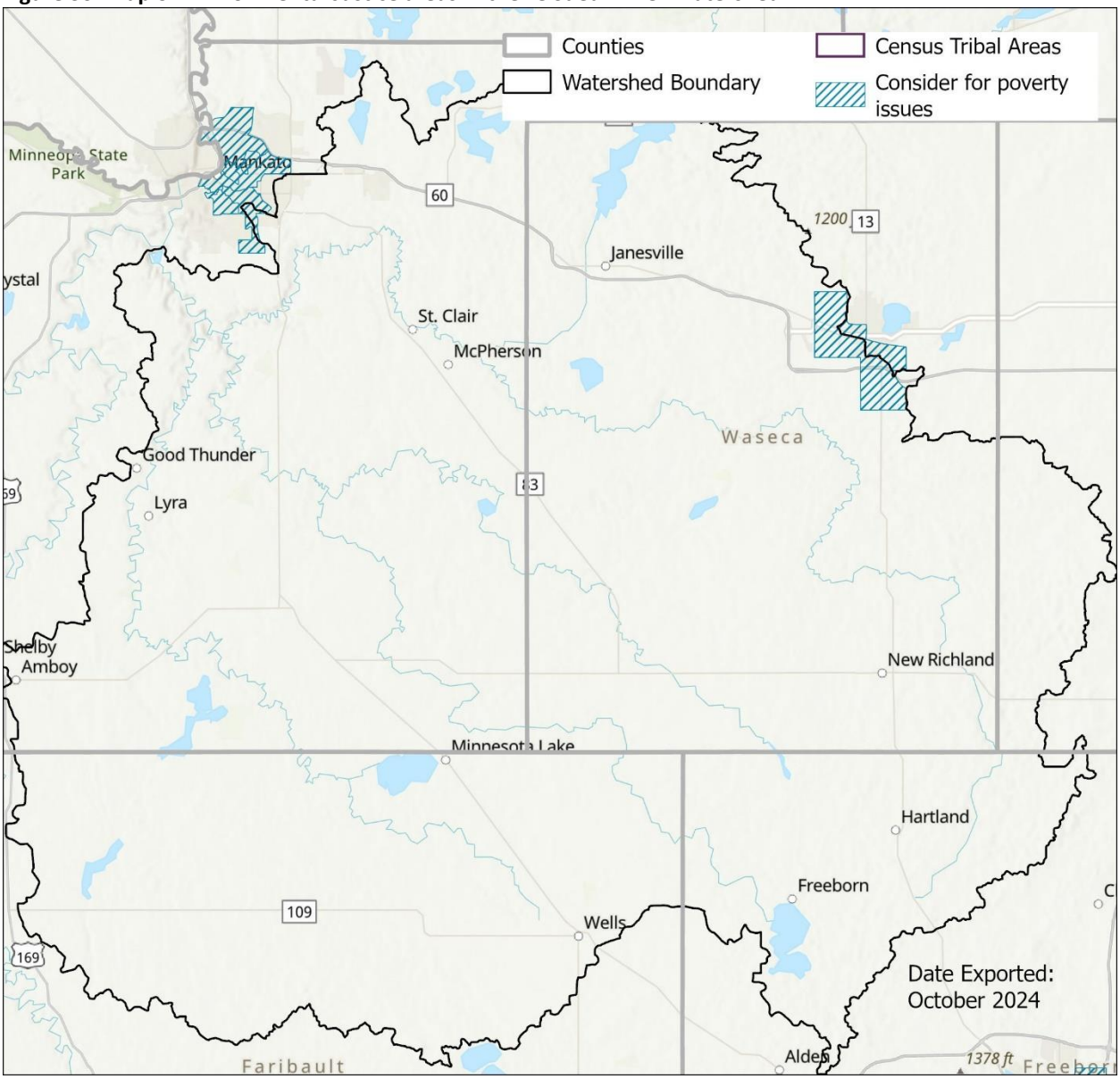
The MPCA uses environmental justice principles when reviewing and issuing grants to reduce pollution and improve air quality. Environmental justice is part of the decision-making process when writing new or renewal permits for facilities. The framework consists of strategies that integrate environmental justice into the MPCA's regulatory, monitoring, and assistance programs. It outlines the procedures, resources, and tools needed to support integration. This includes:

1. Identify areas where low-income Minnesotans, people of color, and others may be experiencing more harm or are more susceptible to environmental conditions as areas of focus for environmental justice action.
2. Modify our approach and increase our work to address environmental justice issues through better understanding sources of pollution, reducing sources through regulatory authority and influence, and providing education and public participation and engagement of people around the actions and decisions that affect them.

Areas of concern in the Le Sueur River Watershed include low-income communities around the cities of Mankato and Waseca (Figure 30). These barriers can lead to a lack of participation in environmental restoration and protection efforts. This could be true for reasons of cost, time commitment, travel, and lack of feeling ownership of the efforts. Low-income communities often face challenges that deter their participation in environmental conservation efforts.

Addressing these challenges requires a comprehensive approach that includes improving access to resources, education, and addressing systemic injustices as implementation efforts proceed.

Figure 30. Map of Environmental Justice areas in the Le Sueur River Watershed.



3.4 Climate Change and the Le Sueur River Watershed

Minnesota's climate is shifting toward wetter (Figure 31) and warmer (Figure 32) conditions, resulting in more intense rainfall. This not only challenges water management strategies but also affects groundwater recharge and the availability of water resources across the state. The increase in larger storms has led to greater runoff, reducing the infiltration of water into groundwater supplies, which is crucial for sustaining water needs during dryer periods. Understanding these trends is essential for developing future water management and conservation strategies (DNR 2019).

Figure 31. Annual precipitation in the Le Sueur River Watershed (DNR 2019).

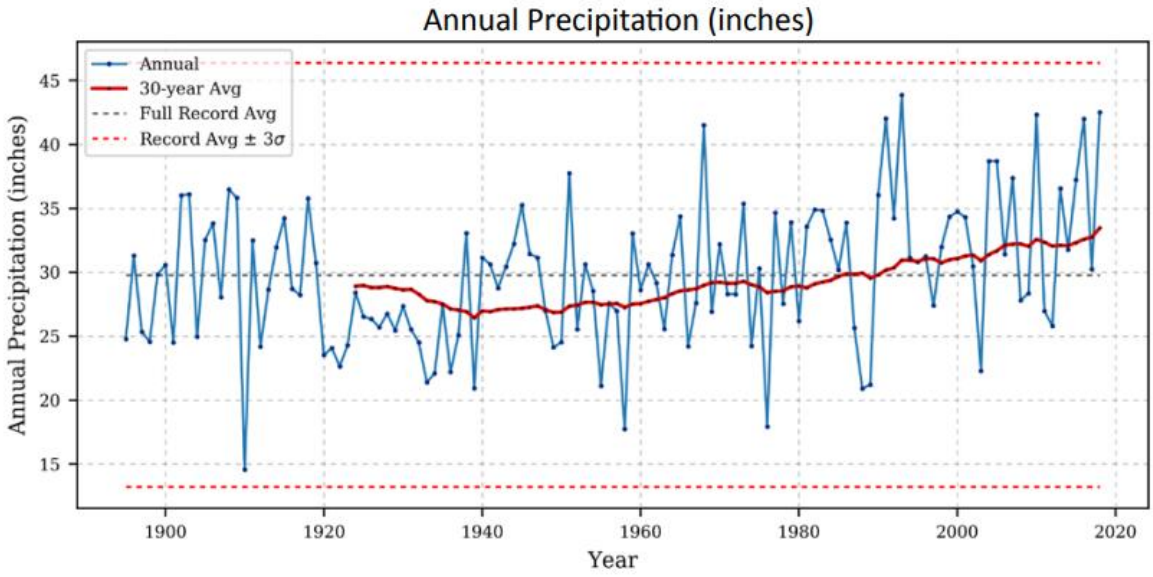
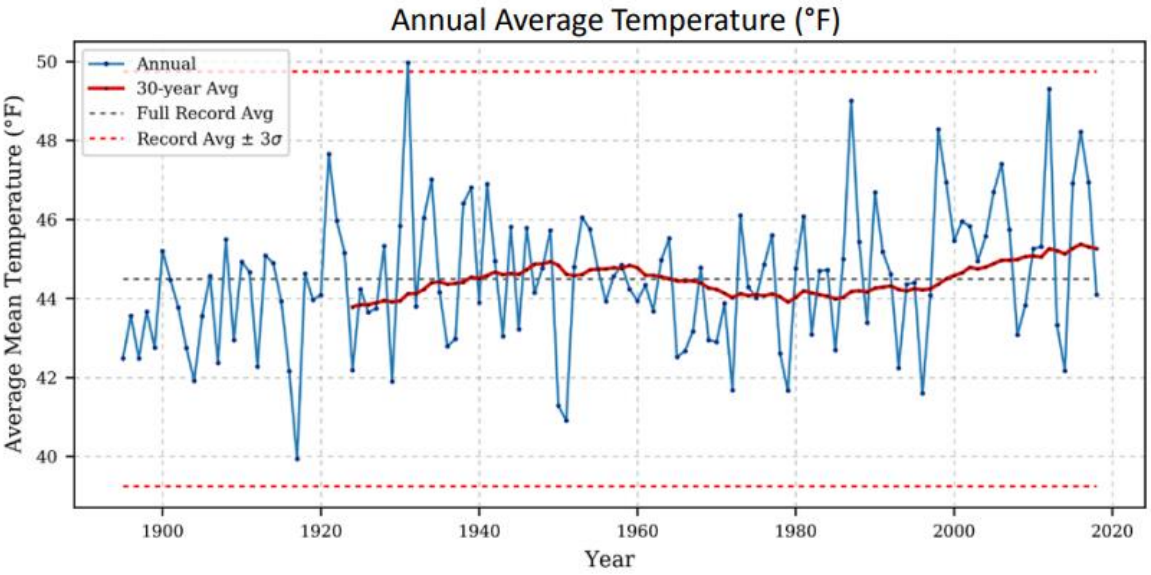


Figure 32. Average annual temperature in the Le Sueur River Watershed (DNR 2019).



Overview of Climate Data vs. Weather Data

Understanding the distinction between climate data and weather data is pivotal for grasping the implications of climate change. Climate data encapsulates long-term averages of weather conditions over decades, providing insight into enduring patterns like average temperatures, humidity levels, and precipitation. In contrast, weather describes daily fluctuations. For instance, while Minnesota's typically cold February is a reflection of climate, an unexpected April snowstorm represents weather variability. Recognizing these differences helps in understanding that individual weather incidents do not contradict the broader trends of climate change, which include increasing instances of extreme weather due to long-term shifts in climate patterns.

Climate change in the Le Sueur River Watershed

The Le Sueur River Watershed serves as a prime example of the ongoing changes attributable to climate change. Over the past century, the watershed has experienced a steady rise in both temperatures and precipitation. These changes have led to warmer winters and more frequent, intense rain events. Such conditions are anticipated to persist, complicating existing water management efforts, and increasing the risk of extreme weather occurrences. This WRAPS Update Report underscores the importance of tailored, regional approaches to climate adaptation and water management (DNR 2019).

Predicting the Future with the University of Minnesota's Climate Tool

The University of Minnesota's climate tool (MN CliMAT) is designed to predict and help us prepare for future climate conditions. By analyzing historical data and simulating future scenarios, the tool offers valuable insights for sectors like agriculture, infrastructure, and water management, enabling better decision-making in the face of climate change.

The tool begins by analyzing decades of historical climate data—such as temperature and precipitation patterns—to create a baseline understanding of a region's climate. It then uses advanced models to project future climate conditions, considering various potential socioeconomic developments.

These projections help users anticipate changes like shifts in average temperatures, altered precipitation patterns, and increased likelihood of extreme weather events. This foresight is crucial for making informed decisions, whether it's determining the best crops to plant or designing resilient infrastructure.

Central to the tool's projections are Shared Socioeconomic Pathways (SSPs). These scenarios represent different ways the world might develop over the 21st century, based on factors like population growth, economic development, and energy use. The SSPs range from a sustainable future with low emissions (SSP1) to a fossil-fueled development pathway with high emissions (SSP5).

Each SSP influences future climate outcomes differently, allowing users to explore a range of potential futures. For example, under SSP2 (Middle of the Road), the Le Sueur River Watershed might see temperature and precipitation increases, leading to shorter winters and more frequent rain events. Under SSP5, these changes would be more extreme, potentially causing severe flooding and infrastructure challenges.

The University of Minnesota's climate tool offers several key benefits:

1. **Informed Decision-Making:** By providing projections of future climate conditions, the tool helps farmers, planners, and policymakers make better decisions, such as choosing climate-resilient crops or designing infrastructure that can withstand extreme weather.
2. **Risk Management:** The tool helps identify future risks, allowing proactive steps to mitigate them, such as enhancing water management to cope with increased runoff.
3. **Long-Term Planning:** The tool's ability to simulate long-term scenarios is invaluable for strategic planning, whether for infrastructure investments or policy development.
4. **Adaptation Strategies:** Users can evaluate different adaptation strategies to determine the best options for their specific circumstances under various climate futures.

The University of Minnesota's climate tool is an essential resource for planning in a changing climate. By integrating historical data with simulations based on SSPs, the tool provides critical insights into future climate risks and opportunities. This enables communities, businesses, and policymakers to make informed decisions, manage risks, and build resilience for the future.

Predicting the Future in the Le Sueur River Watershed with MN CliMAT

The University of Minnesota's MN CliMAT tool was used to compare historic conditions against predicted mid-century conditions (2040-2059) following a "Middle of the Road" scenario where economic, social, and technological trends follow historical patterns (SSP245) (Figure 33 and Figure 34).

In this scenario the MN CliMAT model predicted the following climate changes relative to historical simulations:

- Annual precipitation in the Le Sueur River Watershed is projected to increase 1.7 inches.
- Annual daily average temperature is projected to increase 3.8° F.
- The annual number of days that exceed 90° F is projected to increase by 19 days.
- The annual number of days with a minimum temperature below 32° F is projected to decrease 21 days.

Figure 33. MN CliMAT "Middle of the Road" summary for the Le Sueur River Watershed daily average temperature change.

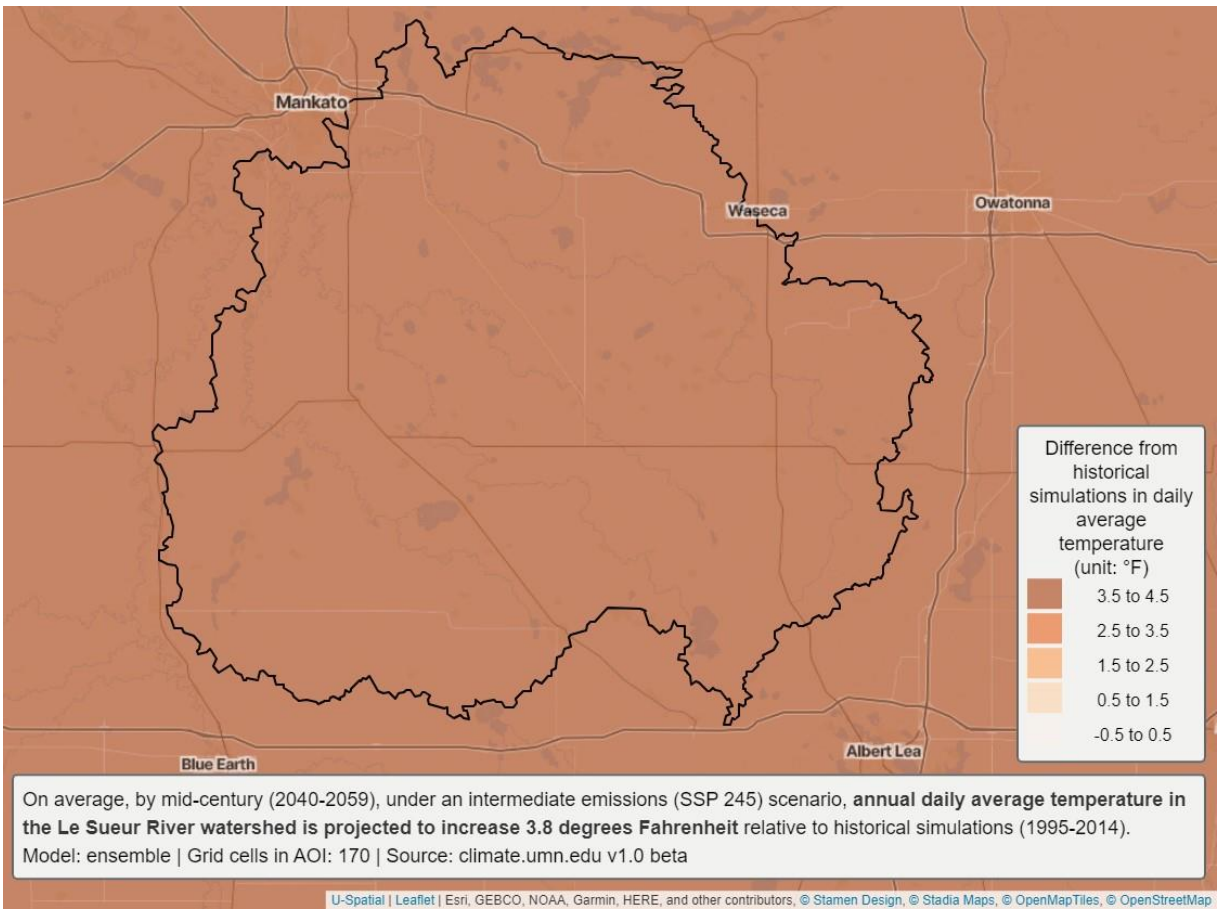
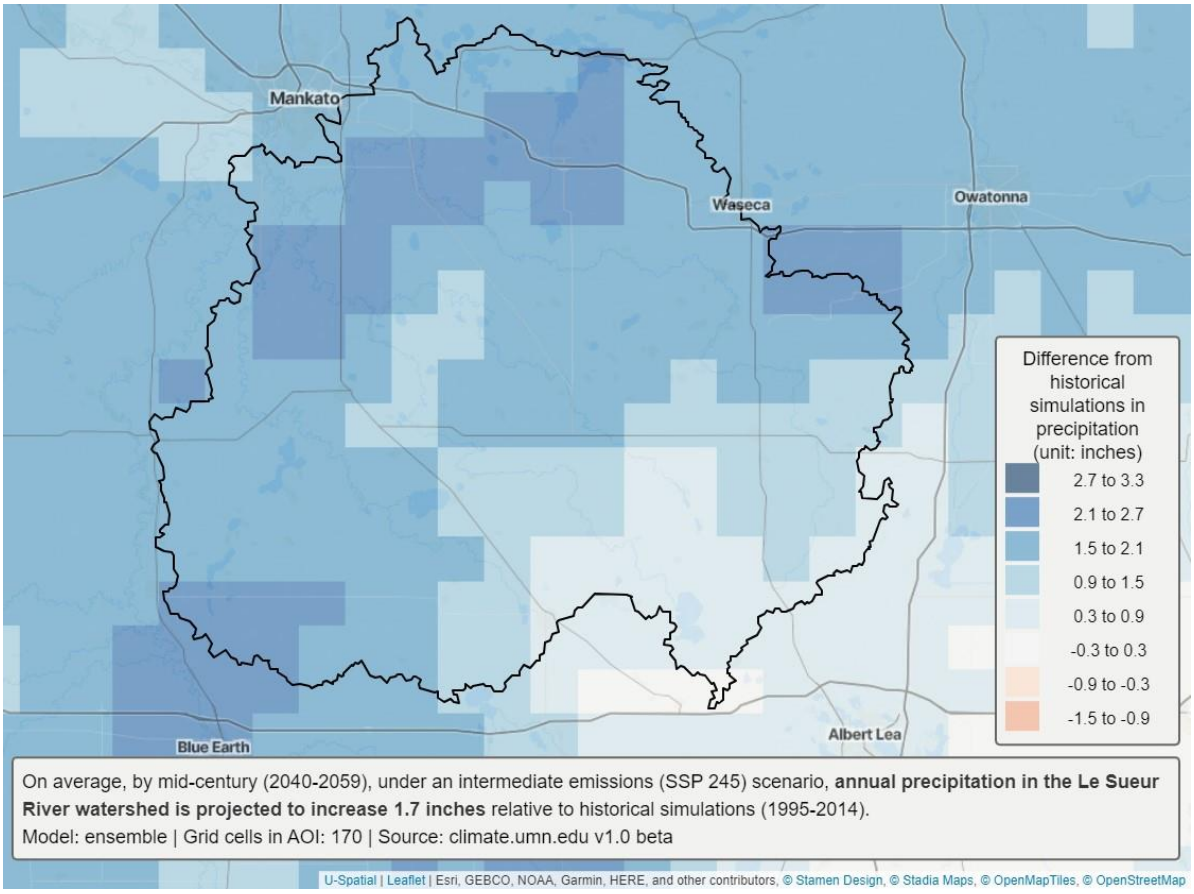


Figure 34. MN CliMAT "Middle of the Road" summary for the Le Sueur River Watershed annual precipitation change.



Climate Resiliency and Mitigation Strategies

The WRAPS Update report provides an overview of the current and projected impacts of climate change in the Le Sueur River Watershed, emphasizing the need for informed decision-making and strategic planning to address these challenges effectively.

Climate resilience involves two key approaches: mitigation and adaptation. Both strategies are crucial in addressing climate change, but they serve different purposes. Mitigation focuses on reducing or preventing the causes of climate change, such as greenhouse gas emissions, while adaptation involves making adjustments to live with the changes that are already happening or are inevitable (MPCA 2013, Schilling 2007).

Mitigation strategies aim to limit the severity of future climate change by addressing its root causes. For farmers, businesses, and communities, mitigation not only helps the environment but can also lead to financial savings and improved efficiency.

1. **Reducing Energy Consumption**
    - **What It Is**: This involves using less energy in homes, businesses, and agricultural operations by adopting energy-efficient practices and technologies.

- **Benefits to the Implementer**: Lower energy bills, reduced operating costs, and eligibility for tax incentives or grants. Energy efficiency can also improve productivity and reduce maintenance costs.

2. **Increasing the Use of Renewable Energy Sources**
   - **What It Is**: Shifting from fossil fuels to renewable energy sources like solar, wind, or bioenergy.
   - **Benefits to the Implementer**: Although there may be upfront costs, renewable energy can lead to long-term savings and energy independence. It also protects against energy price volatility and can enhance a brand's image as environmentally responsible.
3. **Sustainable Land Use Practices**
   - **What It Is**: This includes practices like agroforestry, crop rotation, and organic farming, which enhance the natural environment while reducing carbon footprints.
   - **Benefits to the Implementer**: Improved soil health, higher yields, and long-term sustainability of the land. These practices can also open up new markets for sustainably produced goods and may attract premium prices.
4. **Improving** N **Use Efficiency in Agriculture**
   - **What It Is**: Applying fertilizers more efficiently to reduce the emission of nitrous oxide, a potent greenhouse gas.
   - **Benefits to the Implementer**: Cost savings from using less fertilizer and improved crop yields due to more precise application. It also reduces the risk of water pollution, which can pollute wells and hurt aquatic wildlife populations.

Adaptation strategies involve preparing for and managing the impacts of climate change that are already occurring or are expected in the future. These strategies not only protect communities and businesses from climate risks but also offer practical benefits to those who implement them.

1. **Improving Water Management Practices**
   - **What It Is**: Techniques include water storage practices, drip irrigation, rainwater harvesting, and efficient drainage systems to help manage water resources more effectively.
   - **Benefits to the Implementer**: Reduced water usage leads to lower water bills and increased crop resilience during droughts. Effective water management can also prevent flooding and reduce soil erosion, protecting property and infrastructure.
2. **Enhancing Soil Health**
   - **What It Is**: Practices such as cover cropping, reduced tillage, and adding organic matter to the soil help maintain or improve soil fertility and structure.
   - **Benefits to the Implementer**: Healthier soils lead to better crop yields, reduced need for chemical inputs, and greater resilience to extreme weather. Improved soil health can also increase carbon sequestration, which may generate income through carbon credits.
3. **Developing Drought-Resistant Crops**

- **What It Is**: Planting crops that are genetically adapted to withstand periods of low water availability.
- **Benefits to the Implementer**: These crops ensure more reliable harvests during droughts, reducing the risk of crop failure and income loss. They can also reduce the need for irrigation, saving water and associated costs.

4. **Planting Conservation Perennials**
   - **What It Is**: Introducing perennial plants that require less maintenance and are better suited to changing climate conditions.
   - **Benefits to the Implementer**: Lower input costs (e.g., less need for fertilizers and pesticides), reduced soil erosion, and improved wildlife habitat. These plants can also offer long-term income stability since they are less susceptible to climate variability.
5. **Natural Shoreline Buffers**
   - **What It Is**: Creating or maintaining vegetated areas along lakeshores and riverbanks to protect against erosion and water pollution.
   - **Benefits to the Implementer**: Protects property from erosion and flooding, improves water quality, and enhances the aesthetic and recreational value of the land. Natural buffers can also increase property values and reduce the need for costly artificial structures like retaining walls.

For farmers, businesses, and communities, the decision to implement mitigation and adaptation strategies isn't just about protecting the environment—it's about securing long-term benefits. These strategies can lead to financial savings, improved productivity, and resilience against climate impacts.

Impact and Resilience Strategies for Minnesota's Lakes

Minnesota's lakes are increasingly feeling the strain of climate change, manifested through a range of environmental shifts that are altering aquatic ecosystems. These changes include notably warmer water temperatures, reduced ice coverage during winter, and intensified precipitation events. Such climatic shifts are contributing to several ecological disturbances (MPCA 2021b).

Temperature and Ice Coverage Changes: As climate change progresses, lake surface temperatures across Minnesota have risen, impacting the seasonal behaviors and habitats of AQL. For example, walleye, a species preferring cooler water temperatures (ideally between 65° F and 70° F), is experiencing population declines in smaller, warmer lakes. Additionally, shorter winter ice coverage, decreasing by approximately 10 to 14 days over the past 50 years, has shortened the ice fishing season, affecting recreational activities and the winter sports economy (Fang 2009, Jacobson 2012). MPCA, DNR: Minnesota's lake ice season decreased by up to 14 days due to climate change | Minnesota Pollution Control Agency (state.mn.us)

Increased Precipitation and Runoff: More intense and frequent rainfall is leading to higher runoff volumes, carrying increased loads of sediments and nutrients into lakes. This surge contributes to eutrophication, where lakes become overly enriched with nutrients, leading to excessive growth of algae, including harmful algal blooms. These blooms not only degrade water quality but also create anoxic conditions (depleted oxygen levels) that can kill fish and other aquatic organisms (Anderson 2015).

Ecological and Hydrological Shifts: The heightened nutrient and sediment levels are disrupting the natural balance of lake ecosystems, promoting longer periods of stratification (layering based on temperature and density), which further complicates the oxygen dynamics within these water bodies. Additionally, the fluctuating lake levels caused by irregular precipitation patterns can lead to increased shoreline erosion and alter the habitats of both aquatic and terrestrial species living near these water bodies (O'Reily 2015).

Strategies for Building Resilience: To combat these challenges and protect the integrity of Minnesota's lakes, a combination of mitigation and adaptation strategies is essential:

1. **Enhancing Soil Health and Water Management:**
    - **Soil Conservation:** Implementing practices such as cover cropping and no-till farming can reduce runoff and sedimentation.
    - **Advanced Water Management:** Techniques like constructing wetlands to buffer runoff and using rain gardens can help manage water flows more effectively, preventing pollutants from reaching the lakes.
2. **Creating Natural Shoreline Buffers:**
    - **Buffer Zones:** Establishing and maintaining vegetated buffer zones around lakes absorbs runoff, traps sediments, and provides habitat for wildlife. These zones also protect against shoreline erosion.
3. **Adaptive Management of Aquatic Species:**
    - **Habitat Restoration:** Restoring and creating new habitats can help support species affected by temperature changes and reduced ice cover.
    - **Stock Management:** Adjusting fish stocking practices to account for changing water temperatures and ecological conditions can help maintain fish populations.
4. **Public Engagement and Policy Implementation:**
    - **Community Involvement:** Engaging local communities in conservation efforts through educational programs about the impacts of climate change and the importance of sustainable practices.
    - **Policy Development:** Advocating for and implementing policies that promote environmental sustainability and protect water resources.

Addressing the impacts of climate change on Minnesota's lakes requires a proactive approach, focusing on both preventing further degradation and restoring the health of these vital ecosystems. By integrating scientific research with practical management strategies and community involvement, Minnesota can ensure the resilience of its lakes against the ongoing challenges of a changing climate (DNR 2015, EPA 2014).

3.5 Monitoring and Data Collection

There are several recommendations for future monitoring to be considered. The MPCA has a detailed statewide monitoring approach outlined in the Minnesota's Water Quality Monitoring Strategy 2021 to

2031 (state.mn.us). The following describes different types of monitoring to be considered in the watershed. These monitoring activities provide an overview of what is expected to occur at many scales in the Le Sueur River Watershed, subject to availability of monitoring resources. The AQR and AQL designated uses will be the ultimate measures of water quality. Improving the state of these designated uses depends on many factors, and improvements may not be detected over the next 5 to 10 years or much longer. Consequently, a monitoring plan is needed to track short- and long-term changes in water quality and land management.

WPLMN - The MPCA's WPLMN measures and compares data on pollutant loads from Minnesota's rivers and streams and tracks water quality trends. WPLMN data will be used to assist with assessing impaired waters, watershed modeling, determining pollutant source contributions, developing watershed and water quality reports, and measuring the effectiveness of water quality restoration efforts. WPLMN stations record streamflow on a continuous basis every year, either year-round or during open water (non-ice cover) conditions. Water quality samples are also collected on a regular basis year-round during these same periods, such that on-going records of load can be calculated. With this design, between 20 to 35 mid-stream grab samples are collected per year from each load monitoring station. Monitoring is targeted to characterize: major precipitation events, particularly spring runoff; base flow conditions, which typically occur during the winter months; and background flow conditions, primarily during the summer months. The water quality samples are analyzed for TSS, nitrate, phosphorus, total Kjeldahl nitrogen (subset of sites), orthophosphate (subset of sites), pH, conductivity, and transparency. These water quality and discharge data are then used to compute annual pollutant loads for nitrate-plus-nitrite nitrogen, TP, dissolved orthophosphate, and TSS.

Data are collected along major river main stems, at major watershed (i.e., HUC-8) outlets to major rivers, and in several subwatersheds. In the Le Sueur River Watershed, WPLMN sites are located at the outlet of the Le Sueur River near Rapidan (32076001), the Le Sueur River at St Clair (32079001), the Big Cobb River near Beauford (32071001), the Maple River near Rapidan (320720010) and near Sterling (32062001), and on the Little Beauford Ditch (32073001).

Stream Monitoring – Sites that were sampled in 2018 to 2019 are likely to be monitored again during the next 10-year monitoring effort. Monitoring and assessment at the HUC-8 scale associated with Minnesota's watershed approach. An outcome of this monitoring effort is the identification of waters that are impaired (i.e., do not meet standards and need restoration) and waters in need of protection to prevent impairment. Over time, condition monitoring can also identify trends in water quality. This helps determine whether water quality conditions are improving or declining, and it identifies how management actions are improving the state's waters overall. See the Le Sueur River Watershed Monitoring and Assessment Report (MPCA 2012) and the Le Sueur River Watershed Assessment and Trends Update (MPCA 2021) for more information.

Streams with existing impairments due to *E. coli* are recommended to be sampled again to determine if water quality is improving or declining, especially those areas that have had focused implementation.

Lake Water Quality Sampling – Previously assessed lakes will continue to be monitored during the next assessment cycle. It is recommended to sample the lakes that are impaired or vulnerable to impairment to determine if water quality is improving. Madison Lake (07-0044-00) and St. Olaf Lake (81-0003-00) are part of the state's Sentinel Lake program and will be monitored annually.

Lake IBI Sampling – Lakes previously assessed by the DNR should continue to be monitored to assess whether they remain impaired or vulnerable to biological impairment and the stressors related to impairment. New assessments may be requested by stakeholders with lake quality concerns and are experiencing significant impacts from water quality and biological issues.

Implementation Tracking - BWSR and the USDA both track the locations of BMP installations. Tillage transects and crop residue data are collected periodically and reported through the Minnesota Tillage Transect Survey Data Center. BMP tracking information is readily available through the MPCA's Healthier Watersheds webpage.

Permitted Discharges - Permitted municipal and industrial wastewater sources are reported through discharge monitoring records; these records are used to evaluate compliance with NPDES/SDS permits. Summaries of discharge monitoring records are available through the MPCA's Wastewater Data Browser.

Pesticide Monitoring - The MDA conducts pesticide water quality monitoring in groundwater and surface water with a variety of cooperators to analyze water for up to approximately 180 different pesticide compounds. The purpose is to determine the presence and concentration of pesticides and present long-term trend analysis. Data collection includes pesticides in addition to more conventional water quality parameters. MDA monitoring reports are available on their website: MDA Water Monitoring Reports and Resources. Two sites are currently being monitored in the Le Sueur River Watershed. The Little Cobb River is a Tier 2 site with grab samples collected targeting stormflow conditions with follow up grab samples to understand persistence during events. The Beauford Ditch which is a Tier 3 site that utilizes auto samplers to collect pesticide water quality samples over several days during storm events to understand the duration and concentration effects of storm events.

4. Public Participation

Public outreach

Public outreach refers to education, outreach, marketing, training, technical assistance, and other methods of working with stakeholders to achieve water resource management goals. In this second cycle of the watershed approach, there was less emphasis on public outreach for the WRAPS Update Report. This is because of active engagement already occurring in the watershed and because outreach activities were not identified as a WRAPS Update priority task.

The Le Sueur River Watershed has a long history of promoting civic engagement activities associated with the Watershed Approach process. Initial work involved building better working relationships with local partners and state agencies, gathering ideas, and providing opportunities to coordinate activities. The goal was to better understand watershed work, develop outreach activities and bring in watershed residents to discuss issues and promote common understanding and provide potential solutions to improve water quality. These efforts eventually lead to the formation of the Le Sueur River Watershed Network and the Seven Steps Towards Cleaner Water and River Health document. More information on the group and educational information on the watershed can be found at their website: Le Sueur River Watershed Network.

The Cycle 2 watershed work continued this approach by developing a local work group with agencies and counties to connect, share, and co-develop events in the Le Sueur River Watershed. The primary goal of this project was to develop and implement mutually beneficial projects through collaborative planning and leveraged existing resources to accelerate watershed restoration and protection within the Le Sueur River Watershed. Civic engagement projects were designed to meet priorities for the Le Sueur River Watershed that included:

- Educate the general public or select audiences on watershed science
- Develop relationships, networks, and partnerships to accelerate implementation
- Assess social conditions to develop strategies to restore and protect water quality
- Inform landowners about conservation opportunities through contacts with local staff

While the group had developed many outreach activities designed to bring individuals together to discuss their roles and opportunities for watershed and water quality improvement, the Covid 19 pandemic and shutdowns didn't allow public meetings for much of the grant period (July 2019 through June 2022). The group did rework their planning efforts to develop opportunities to provide educational outreach and work individually with landowners remotely to promote practices. More information can be found on the Le Sueur River Watershed Network Homepage.

Finally, the Le Sueur River Watershed's county and SWCD staff worked to develop the Le Sueur River Watershed Comprehensive Watershed Management Plan (2023-2033). The project worked with the Water Resources Center at Minnesota State University - Mankato to include input from nonagency stakeholders to gather input on the planning process with a focus on restoring impaired waters and habitats, protecting high quality lakes, reducing peak flows through water storage, and protecting groundwater quality through resource management.

Public notice for comments

An opportunity for public comment on the draft WRAPS Update Report was provided via a public notice in the State Register from March 3, 2025 through April 2, 2025. There were XXX comment letters received and responded to as a result of the public comment period.

5. References

Anderson, J., et al. 2015. Increased Precipitation and Runoff: Hydrologic impacts of climate change on Minnesota's water resources. Journal of the American Water Resources Association, 51(4), 845-860.

DeStasio, B. T., et al. 1996. Potential effects of global climate change on small north-temperate lakes: Physics, fish, and plankton. Limnology and Oceanography, 41(5), 1136-1149.

Fang, X., & Stefan, H. G. 2009. Temperature and Ice Coverage Changes: Simulations of climate effects on water temperature, dissolved oxygen, and ice and snow covers in lakes of the contiguous United States under past and future climate scenarios. Limnology and Oceanography, 54(6), 2359-2370.

Gretchen J. A. Hansen, Jordan S. Read, Jonathan F. Hansen, Luke A. Winslow. 2016. Projected shifts in fish species dominance in Wisconsin lakes under climate change. https://doi.org/10.1111/gcb.13462. Global Change Biology | Environmental Change Journal | Wiley Online Library

Heiskary, S., & Wilson, C. B. 2005. Minnesota lake water quality assessment report: Developing nutrient criteria. Minnesota Pollution Control Agency.

ISG. 2023. Le Sueur River Watershed Comprehensive Watershed Management Plan. https://www.wasecacounty.gov/DocumentCenter/View/8759/2023_leSueurRiverWatershed_comprehensiveManagementPlan_ISG?bidId=

Jacobson, P. C., et al. 2012. Climate change effects on fish habitat in Minnesota lakes: Projecting impacts on walleye populations. Environmental Biology of Fishes, 94, 215–229.

Minnesota Department of Natural Resources (DNR). 2009. Guidelines for Assessing Biodiversity Significance Ranks MBS Site Biodiversity Significance Ranks | Minnesota DNR (state.mn.us)

Minnesota Department of Natural Resources. 2015. Managing Minnesota's fisheries in a changing climate: Strategies for Minnesota.

Minnesota Department of Natural Resources (DNR). 2019. Climate Summary for Watersheds, Le Sueur River.

Minnesota Department of Natural Resources (DNR). 2021. Le Sueur River Watershed Stressor Identification Report—Lakes.

Minnesota Department of Natural Resources (DNR). 2023. Evaluation of Hydrologic Change Technical Summary Le Sueur River Watershed.

Minnesota Pollution Control Agency (MPCA). 2007. Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin.

Minnesota Pollution Control Agency (MPCA). 2012. Le Sueur River Watershed Monitoring and Assessment Report.

Minnesota Pollution Control Agency (MPCA). 2013. Protecting Minnesota's waters: Climate adaptation strategies.

Minnesota Pollution Control Agency (MPCA). 2014a. Le Sueur River Watershed Biotic Stressor Identification.

Minnesota Pollution Control Agency (MPCA). 2015a. Le Sueur River WRAPS Report. https://www.pca.state.mn.us/sites/default/files/wq-ws4-10a.pdf.

Minnesota Pollution Control Agency (MPCA). 2015b. Watershed approach to water quality | Minnesota Pollution Control Agency (state.mn.us).

Minnesota Pollution Control Agency (MPCA). 2015c. Le Sueur River Watershed Total Maximum Daily Load. https://www.pca.state.mn.us/sites/default/files/wq-iw7-39e.pdf.

Minnesota Pollution Control Agency (MPCA). 2020. Minnesota River and Greater Blue Earth River Basin TMDL for TSS.

Minnesota Pollution Control Agency (MPCA). 2021. Watershed assessment and trends update Le Sueur River Watershed.

Minnesota Pollution Control Agency (MPCA). 2021b. Climate change impacting Minnesota lakes. https://www.pca.state.mn.us/sites/default/files/cc-wq2-1.pdf

Minnesota Pollution Control Agency (MPCA). 2024a. Le Sueur River Watershed Stressor Identification Update.

Minnesota Pollution Control Agency (MPCA). 2024b. Bass Lake Water Quality Improvement Study .

Minnesota Pollution Control Agency (MPCA). 2025. Le Sueur River Watershed Total Maximum Daily Load Report, 2025.

O'Reilly, C. M., et al. 2015. Ecological and Hydrological Shifts: Rapid and highly variable warming of lake surface waters around the globe. Geophysical Research Letters, 42(24), 10,773-10,781.

Schilling, K. E., & Wolter, C. F. 2007. The role of conservation practices in achieving water quality goals in Iowa. Journal of Soil and Water Conservation, 62(4), 141-152.

U.S. Environmental Protection Agency (EPA). 2014. Climate change adaptation plan. U.S. EPA.