Watershed

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Le Sueur River Watershed Total Maximum Daily Load Report 2025

E. coli and phosphorus TMDLs for impaired streams

MINNESOTA POLLUTION CONTROL AGENCY

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Contents

List of tables

List of figures

Abbreviations

1W1P	One Watershed, One Plan
AQC	aquatic consumption
AQL	aquatic life
AQR	aquatic recreation
AU	animal unit
BC	boundary condition
BMP	best management practice
BOD	biochemical oxygen demand
BWSR	Board of Water and Soil Resources
CAFO	concentrated animal feeding operation
chl-*a*	chlorophyll-*a*
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CWA	Clean Water Act
DMR	discharge monitoring report
DNR	Minnesota Department of Natural Resources
DO	dissolved oxygen
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
EQuIS	Environmental Quality Information System
HSPF	Hydrologic Simulation Program–Fortran
HUC	Hydrologic Unit Code
IBIs	indices of biotic integrity
I&I	inflow and infiltration
ITPHS	imminent threat to public health and safety
IWM	intensive watershed monitoring
LA	load allocation
lb	pound
lb/day	pounds per day

lb/yr	pounds per year
LDC	load duration curve
LGU	local government unit
LRWN	Le Sueur River Watershed Network
m	meter
MAWQCP	Minnesota Agricultural Water Quality Certification Program
MDA	Minnesota Department of Agriculture
mgd	million gallons per day
mg/L	milligrams per liter
mL	milliliter
MnDOT	Minnesota Department of Transportation
MOS	margin of safety
MPCA	Minnesota Pollution Control Agency
MS4	municipal separate storm sewer system
NASS	National Agricultural Statistics Service
NCHF	north central hardwood forest
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
org	organisms
PWP	Permanent Wetland Preserve
RC	reserve capacity
RES	river eutrophication standard
RIM	Reinvest in Minnesota
SID	Stressor Identification
SDS	state disposal system
SSO	sanitary sewer overflows
SSTS	subsurface sewage treatment systems
SWCD	soil and water conservation district
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
TP	total phosphorus

TSS	total suspended solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBIF	watershed-based implementation funding
WCBP	western cornbelt plain
WID	water unit identification
WLA	wasteload allocation
WPLMN	Watershed Pollutant Load Monitoring Network
WRAPS	watershed restoration and protection strategy
WRP	Wetland Reserve Program
WQBEL	water quality-based effluent limit
WWTP	wastewater treatment plant
μg/L	micrograms per liter

Executive summary

The Federal Clean Water Act (CWA), Section 303(d) requires total maximum daily loads (TMDLs) to be produced for surface waters that do not meet applicable water quality standards necessary to support their designated uses (i.e., impaired waters). A TMDL determines the maximum amount of a pollutant a receiving water body can assimilate while still achieving water quality standards, and allocates allowable pollutant loads to various sources needed to meet water quality standards.

This study is part of the work being completed in the State of Minnesota's Cycle 2 Watershed Approach and is a continuation of Cycle 1 TMDL efforts in the Le Sueur River Watershed that were approved by the U.S. Environmental Protection Agency (EPA) Region 5. Since the 2015 Cycle 1 TMDLs, the Le Sueur River Watershed has been re-visited for intensive watershed monitoring (IWM 2018-2019) and reassessed (2020) for meeting water quality standards. Information from multiple sources was used to evaluate the ecological health of each water body including:

- All available water quality data over the past 10 years (2009 through 2019)
- Published studies
- Cycle 2 Stressor Identification (SID) investigation
- Hydrologic Simulation Program-Fortran (HSPF) model updates
- Stakeholder input

This TMDL study addresses three river eutrophication standard (RES) impairments and one *Escherichia coli* (*E. coli*) impairment in the Le Sueur River Watershed that were identified as needing TMDLs on the 2024 State of Minnesota's 303(d) list of impaired waters. The RES impairments are treated as phosphorus impairments, and therefore this TMDL establishes the maximum amount of phosphorus these reaches can receive daily to meet the RES water quality standard.

This report used a variety of methods to evaluate current loading contributions from various pollutant sources as well as the allowable pollutant loading capacity for each impaired reach. These methods include monitored flow and water quality data, the Le Sueur River HSPF model, and the flow duration curve approach. This TMDL report was developed in conjunction with an updated Watershed Restoration and Protection Strategy (WRAPS) Update Report for the Le Sueur River (MPCA 2025). The WRAPS Update Report provides an update of Cycle 2 efforts throughout the watershed and addresses multiple nonpollutant impairments.

A general strategy and cost estimate for implementation to address the impairments are included in this report. Nonpoint source load reductions will be the focus of implementation efforts. Nonpoint source contributions are not regulated and will need to proceed on a voluntary basis.

1. Project overview

1.1 Introduction

Section 303(d) of the federal CWA requires that TMDLs be developed for waters that do not support their designated uses. These waters are referred to as "impaired" and are included in Minnesota's list of impaired water bodies. The term "TMDL" refers to the maximum amount of a given pollutant a water body can receive on a daily basis and still achieve water quality standards. A TMDL study determines what is needed to attain and maintain water quality standards in waters that are not currently meeting them. A TMDL study identifies pollutant sources and allocates pollutant loads among those sources. The total of all allocations, including wasteload allocations (WLAs) for permitted sources, load allocations (LAs) for nonpermitted sources (including natural background), and the margin of safety (MOS), which is implicitly or explicitly defined, cannot exceed the maximum allowable pollutant load.

The Le Sueur River Watershed is identified as U.S. Geological Survey Hydrologic Unit Code (HUC)-8 07020011 and covers an area of more than 1,100 square miles in south central Minnesota. The Le Sueur River drains portions of five counties (Blue Earth, Faribault, Freeborn, Steele, and Waseca) and is located primarily in the Western Cornbelt Plains (WCBP) ecoregion, although a small portion (approximately 8%) is located in the North Central Hardwood Forest (NCHF) ecoregion. The eastern portion of the watershed is a gently rolling landscape, while the western half of the watershed is dominated by the relatively flat remnant of glacial Lake Minnesota. As the Le Sueur River approaches its confluence with the Blue Earth River, the gradient increases as it cuts through high bluffs. Eagle Lake, Wells, and Janesville are the largest towns in the largely rural watershed. Small portions on the outer edges of Mankato and Waseca also drain to the Le Sueur River.

This TMDL report is a component of a larger effort to develop updated WRAPS for the Le Sueur River Watershed. A Cycle 1 WRAPS report for the Le Sueur River Watershed was completed in 2015 (MPCA 2015a) and accompanied other Cycle 1 efforts including the *Le Sueur River Watershed Monitoring and Assessment Report* (MPCA 2012a), *Assessment of Selected Lakes Within the Le Sueur River Watershed Minnesota River Basin* (MPCA 2010), *Le Sueur River Watershed Biotic Stressor Identification Report* (MPCA 2014a*), Le Sueur River Watershed Priority Management Zone Identification Project* (MPCA 2014b), and the *Le Sueur River Watershed TMDL Report* (MPCA 2015b). The WRAPS Update cycle (i.e., Cycle 2) for the Le Sueur River Watershed kicked off in 2018 and includes the following efforts: *Le Sueur River Watershed Assessment and Trends Update Report* (MPCA 2021a), *Le Sueur River Watershed Stressor Identification Report – Lake*s (DNR 2021), *Le Sueur River Watershed Stressor Identification Update* (MPCA 2024c) and updated calibration to the Le Sueur River Watershed hydrology and water quality model (RESPEC 2014).

Previously approved TMDL reports include many impairments and/or watershed areas in the Le Sueur River Watershed, and downstream of it:

- *Lower Minnesota River Dissolved Oxygen Total Maximum Daily Load Report* (MPCA 2004). This report establishes phosphorus TMDLs to address dissolved oxygen (DO) impairments on the lower 22 miles of the Minnesota River. The Le Sueur River Watershed is upstream of the Lower Minnesota River DO impairments.

- *Fecal Coliform TMDL Assessment for 21 Impaired Streams in the Blue Earth River Basin* (MSU Mankato 2007) and the related 2019 modifications to stormwater WLAs to account for new regulated MS4s (MPCA 2019a). These reports establish fecal coliform TMDLs for two reaches in the Le Sueur River Watershed.
- *South Metro Mississippi River Total Suspended Solids Total Maximum Daily Load* (MPCA 2015c). This report establishes total suspended solids (TSS) TMDLs for the Mississippi River from the confluence with the Minnesota River, through Lake Pepin, to the confluence with the Chippewa River of Wisconsin. The Le Sueur River Watershed contributes a significant amount of sediment to the South Metro Mississippi River.
- *Minnesota River and Greater Blue Earth River Basin Total Suspended Solids Total Maximum Daily Load Study* (MPCA 2020a). This report establishes TSS TMDLs for 13 reaches in the Le Sueur River Watershed. This report also includes TSS TMDLs in other watersheds in the Minnesota River Basin.
- *Lake Pepin and Mississippi River Eutrophication Total Maximum Daily Load Report* (MPCA 2021b). This report establishes phosphorus TMDLs for Lake Pepin and the Mississippi River from the Crow River to the St. Croix River. The Le Sueur River Watershed contributes a significant amount of phosphorus and sediment to Lake Pepin.
- *Minnesota Statewide Mercury TMDL* (MPCA 2007). In the Le Sueur River Watershed, there are 11 water bodies with aquatic consumption (AQC) impairments based on mercury in fish tissue and three based on mercury in the water column. Of these mercury impairments, 12 TMDLs were approved in revisions to Appendix A of the Minnesota Statewide Mercury TMDL, which are submitted to the EPA every two years with the impaired waters list, and two impairments do not have TMDLs.
- *Lura Lake TMDL Study Excess Nutrients* (MPCA 2013). TMDL study completed by Minnesota State University Mankato – Water Resources Center and MPCA for Lura Lake, which is in southern Blue Earth County and northern Faribault County. Beside Lura Lake, there have been four other lake nutrient TMDLs (Madison, Elysian, Eagle – North, and Freeborn) completed in the Le Sueur River Watershed through the Cycle 1 watershed-wide TMDL study (MPCA 2015b).

Because the TMDLs calculated in this report cover some of the same pollutants as previous TMDL reports, this study should be considered (for planning purposes) an addendum to those reports. Findings from this TMDL should be used in conjunction with existing studies to aid in identifying priority areas in the Le Sueur River Watershed.

1.2 Identification of water bodies

This report contains phosphorus TMDLs for three streams with aquatic life (AQL) nutrient impairments and one *E. coli* TMDL for a stream reach with an aquatic recreation (AQR) *E. coli* impairment (Figure 1,

Table 1). The stream phosphorus TMDLs are developed for stream reaches not meeting Minnesota's RES criteria.

One of the phosphorus TMDLs included in this report, Little Cobb River (07020011-504), has a previously approved phosphorus TMDL that was developed during the Cycle 1 TMDL for the Le Sueur River Watershed (MPCA 2015b). The 2015 approved phosphorus TMDL was developed to address a DO (AQL) impairment for this reach of the Little Cobb River, as it was determined that eutrophication driven by high phosphorus levels was a key contributor to low DO in the reach. In 2016, the Little Cobb River was listed as impaired by nutrients (AQL) based on Minnesota's RES, which were adopted in 2015. The Cycle 1 TMDL for the Little Cobb River was developed to meet a slightly higher TP concentration target (~156 µg/L, inferred from model summary information) than the TP standard for the Southern River Nutrient Region (150 µg/L) that was adopted in 2015. The Little Cobb River phosphorus TMDL included in this report was developed to meet the more stringent 150 µg/L TP standard and is a revision of the 2015 TMDL. The revised TMDL completely replaces the 2015 TMDL and addresses the DO impairment, the nutrients impairment, and the fish bioassessment impairment.

TMDLs developed in this report address some of the remaining impairments in the watershed that need a TMDL. The remaining TMDLs will be developed in future TMDL reports (see Table 28 in Appendix A for a list of all impairments in the watershed). The TMDLs that were not developed in this report are primarily biological impairments for which stressors need to be identified to determine the appropriate pollutant for TMDL development.

Although TMDLs are not developed in this report for nonpollutant stressors to biological impairments, all stressors—not just those with associated TMDLs—are addressed in the WRAPS Update Report (MPCA 2025). The WRAPS Update Report provides an opportunity to call for environmental improvements in situations where TMDLs alone would not. Nonpollutant stressors include factors such as habitat alteration or flow, and TMDLs are not developed for nonpollutant stressors because they are not subject to load quantification.

Table 1 below and Table 28 in Appendix A (which includes all known impairments in this watershed) summarize Le Sueur River Watershed impairments and those addressed by TMDLs in this document.

Figure 1. Le Sueur River Watershed impairments addressed in this report and impairment watershed boundaries.

Table 1. Impaired water bodies in the Le Sueur River Watershed addressed in this TMDL report.

This TMDL report presents four TMDLs (WID 501 TP, WID 556 TP, WID 504 TP, and WID 576 *E. coli*), which will address the 9 impairments in this table.

WID [a]	Water body name	Water body description	Use class [b]	Listing year	Affected designated use [c]	Listing parameter addressed by TMDL	TMDL Pollutant	Category in next (2026) impaired waters list [d]
07020011-501	Le Sueur River	Maple R to Blue Earth R	2Bg	2016	AQL	Nutrients	TP	4A
				2012	AQL	Fish bioassessment	TP	5
07020011-556	Cobb River	T107 R26W S30, west line to Le Sueur R	2Bg	2016	AQL	Nutrients	TP	4A
				2012	AQL	Fish bioassessment	TP	5
				2022	AQL	Macroinvertebrate bioassessment	TP	5
07020011-504	Little Cobb River	Bull Run Cr to Cobb R	2Bg	2016	AQL	Nutrients	TP	4A
				2010	AQL	Dissolved oxygen [e]	TP	4A
				2022	AQL	Fish bioassessment	TP	5
07020011-576	Iosco Creek	Silver Cr to T108 R23W S7, west line	2Bg	2022	AQR	*E. coli*	*E. coli*	4A

a. WID = water unit identification

b. 2Bg: general cool and warm water aquatic life and habitat

c. AQR: aquatic recreation; AQL: aquatic life

d. The biological impairments (fish bioassessment and macroinvertebrate bioassessment) remain in category 5 because the phosphorus TMDLs address only one of the identified pollutant stressors causing aquatic life impairment. The biological impairments will be moved to category 4A after TMDLs are approved for all pollutant stressors (see Appendix A for full list of stressors). The impairments noted as 4A in this column are currently in category 5 but 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.

e. This TP TMDL for WID 504 completely replaces the 2015 phosphorus TMDL for Little Cobb River WID 504 and addresses the dissolved oxygen impairment, the nutrient impairment, and the fish bioassessment impairment.

1.3 Tribal lands

The Le Sueur River Watershed is located on the traditional homelands of the Dakota Oyate. However, no part of the Le Sueur River Watershed is located within the boundary of federally recognized Tribal land, and the TMDL does not allocate pollutant load to any federally recognized Tribal Nation in this watershed.

1.4 Priority ranking

The MPCA's TMDL commitments, as indicated on Minnesota's Section 303(d) impaired waters list, reflect Minnesota's priority ranking of the impairments addressed in this report. To meet the needs of EPA's *2022–2032 Vision for the Clean Water Act Section 303(d) Program* (EPA 2022), the MPCA aligned TMDL commitments with the watershed approach and other statewide strategies and initiatives in *Minnesota's Total Maximum Daily Load Studies Prioritization Framework* (MPCA 2024a). As part of these efforts, the MPCA identified water quality impaired segments to be addressed by TMDLs through the watershed approach and other statewide strategies and initiatives (MPCA 2024b).

2. Applicable water quality standards and numeric water quality targets

The federal CWA requires states to designate beneficial uses for all waters and develop water quality standards to protect each use. Water quality standards consist of several parts:

- Beneficial uses—Identify how people, aquatic communities, and wildlife use our waters
- Numeric standards—Amounts of specific pollutants allowed in a body of water that still protect it for the beneficial uses
- Narrative standards—Statements of unacceptable conditions in and on the water
- Antidegradation protections—Extra protection for high-quality or unique waters and existing uses

Together, the beneficial uses, numeric and narrative criteria, and antidegradation protections provide the framework for achieving CWA goals. Minnesota's water quality standards are in Minn. R. chs. 7050 and 7052.

2.1 Beneficial uses

The beneficial uses for waters in Minnesota are grouped into one or more classes as defined in Minn. R. 7050.0140. The classes and associated beneficial uses are:

- Class 1 – domestic consumption
- Class 2 – AQL and AQR
- Class 3 – industrial consumption
- Class 4 – agriculture and wildlife
- Class 5 – aesthetic enjoyment and navigation
- Class 6 – other uses and protection of border waters
- Class 7 – limited resource value waters

The Class 2 AQL beneficial use includes a tiered AQL uses framework for rivers and streams. The framework contains three tiers—exceptional, general, and modified uses.

All surface waters are protected for multiple beneficial uses, and numeric and narrative water quality criteria are adopted into rule to protect each beneficial use. TMDLs are developed to protect the most sensitive use of a water body.

2.2 Narrative and numeric standards

Narrative and numeric water quality standards for all uses are listed for four common categories of surface waters in Minn. R. 7050.0220. The four categories are:

- Cold water AQL and habitat, also protected for drinking water: Classes 1B; 2A, 2Ae, or 2Ag; 3; 4A and 4B; and 5.
- Cool and warm water AQL and habitat, also protected for drinking water: Classes 1B or 1C; 2Bd, 2Bde, 2Bdg, or 2Bdm; 3; 4A and 4B; and 5.
- Cool and warm water AQL and habitat and wetlands: Classes 2B, 2Be, 2Bg, 2Bm, or 2D; 3; 4A and 4B; and 5.
- Limited resource value waters: Classes 3; 4A and 4B; 5; and 7.

The narrative and numeric water quality standards for the individual use classes are listed in Minn. R. 7050.0221 through 7050.0227. The procedures for evaluating the narrative criteria are presented in Minn. R. 7050.0150.

The MPCA assesses individual water bodies for impairment for Class 2 uses— AQL and AQR. Class 2A waters are protected for the propagation and maintenance of a healthy community of cold water AQL and their habitats. Class 2B waters are protected for the propagation and maintenance of a healthy community of cool or warm water AQL and their habitats. Protection of AQL entails the maintenance of a healthy aquatic community as measured by fish and macroinvertebrate indices of biotic integrity (IBIs). Fish and invertebrate IBI scores are evaluated against criteria established for individual monitoring sites by water body type and use subclass (exceptional, general, and modified).

Both Class 2A and 2B waters are also protected for AQR activities including bathing and swimming, and the consumption of fish and other aquatic organisms (org). In streams, AQR is assessed by measuring the concentration of *E. coli* in the water, which is used as an indicator species of potential waterborne pathogens. To determine if a lake supports AQR activities, its trophic status is evaluated using total phosphorus (TP), Secchi depth, and chlorophyll-*a* (chl-*a*) as indicators. The ecoregion standards for AQR protect lake users from nuisance algal bloom conditions fueled by elevated phosphorus concentrations that degrade recreational use potential.

2.3 Antidegradation policies and procedures

The purpose of the antidegradation provisions in Minn. R. ch. 7050.0250 through 7050.0335 is to achieve and maintain the highest possible quality in surface waters of the state. To accomplish this purpose:

- Existing uses and the level of water quality necessary to protect existing uses are maintained and protected.
- Degradation of high water quality is minimized and allowed only to the extent necessary to accommodate important economic or social development.
- Water quality necessary to preserve the exceptional characteristics of outstanding resource value waters is maintained and protected.
- Proposed activities with the potential for water quality impairments associated with thermal discharges are consistent with Section 316 of the CWA, United States Code, title 33, section 1326.

2.4 Le Sueur River Watershed water quality standards

2.4.1 *E. coli*

There are two *E. coli* numeric standards for class 2 waters—one is applied to monthly *E. coli* geometric mean concentrations, and the other is applied to individual samples (Table 2). Exceedances of either *E. coli* standard in class 2 waters indicate that a water body does not meet the applicable designated use. The class 2 standards for *E. coli* apply from April through October. The *E. coli* TMDL in this report is based on the monthly geometric mean standard of 126 org/100 mL. It is assumed that practices implemented to meet the geometric mean standard will also address the individual sample standard (1,260 org/100 mL), and that the individual sample standard will also be met. Although the TMDLs are based on the monthly geometric mean standard, both criteria apply.

Table 2. *E. coli* water quality criteria for class 2 water bodies.

Parameter	Water Quality Standard	Numeric Standard
E. coli	Not to exceed 126 org per 100 milliliters (org/100 mL) as a geometric mean of not less than 5 samples representative of conditions within any calendar month, nor shall more than 10% of all samples taken during any calendar month individually exceed 1,260 org/100 mL. The standard applies only between April 1 and October 31.	≤ 126 org/100 mL (monthly geometric mean) ≤ 1,260 org/100 mL (individual sample)

2.4.2 Phosphorus

The RES water quality standard consists of two parts, requiring an exceedance of the causative variable and a response variable which indicates the presence of eutrophication (Table 3). The causative variable is TP. The response variables include chl-*a*, diel DO flux, 5-day biochemical oxygen demand (BOD), and pH. Exceedance of the phosphorus criterion and chl-*a* (seston), diel DO flux, BOD, or pH is required to determine impairment. The MPCA evaluated extensive datasets from across the state to establish clear relationships between the causal factor TP and the response variables. It is expected that by meeting the TP target, the response variables will also be met. The RESs apply to summer month mean values, for June to September. The Le Sueur River Watershed RES impaired reaches are located in the Southern River Nutrient Region, which has a TP standard of 150 micrograms per liter (µg/L) or 0.15 mg/L.

Table 3. River eutrophication standards for class 2B rivers and streams in the Southern River Nutrient Region.

Parameter	Water Quality Standard[3]
TP (µg/L) (causative [1])	Summer mean less than or equal to 150 µg/L
chl-*a* (µg/L) (response [2])	Summer mean less than or equal to 35 µg/L
Diel DO flux (mg/L) (response [2])	Summer mean less than or equal to 4.5 mg/L
5-day BOD (mg/L) (response [2])	Summer mean less than or equal to 3.0 mg/L
pH (standard units) (response [2])	Summer mean not to be less than 6.5 or greater than 9.0

[1] Primary, causative indicator of impairment; must be exceeded to be assessed as impaired.

[2] Secondary, response indicator of impairment; one of the four response parameters must be exceeded to be assessed as impaired.
[3] Minn R. 7050.0222 incorrectly lists water quality standards for chl-*a*, DO flux, and BOD for 2B Southern Streams. Rulemaking is currently underway to address the correction in Minn R. 7050.0222. The RES standards for the Southern River Nutrient Region that were approved by EPA are presented in Table 3.

3. Watershed and water body characterization

The Le Sueur River Watershed is a major HUC-8 watershed located in south central Minnesota. The Le Sueur River is part of the Greater Blue Earth River Watershed drainage area in the Minnesota River Basin. The Le Sueur River Watershed is approximately 1,109 square miles or 710,650 acres and is located primarily in Blue Earth (33%), Waseca (32%), and Faribault (22%) counties, with smaller portions of the watershed in Freeborn (10%), Steele (3%), and Le Sueur (<1%) counties.

Much of the data in this TMDL report is derived from the MPCA's HSPF model application of the Le Sueur River Watershed, which was first developed in the early 2000s in conjunction with model applications for the Minnesota River Watershed (Tetra Tech 2002). The Le Sueur River portion of the model has been extended, updated, and recalibrated multiple times since its original development (RESPEC 2014, RESPEC 2015, RESPEC 2016, MPCA refined calibration in 2023). HSPF is a comprehensive model of watershed hydrology and water quality that allows the integrated simulation of point sources, land and soil contaminant runoff processes, and in-stream hydraulic and sediment-chemical interactions. The results provide hourly runoff flow rates, sediment concentrations, and nutrient concentrations, along with other water quality constituents, at the outlet of any modeled subwatershed. Within each subwatershed, the upland areas are separated into multiple land cover categories, and loads generated from these land cover categories can be tabulated from the HSPF model. The model evaluates both permitted and nonpermitted sources including watershed runoff, the near channel, and wastewater point sources. The HSPF model is used to simulate flows in the impaired streams and to estimate phosphorus loads and runoff volumes to the impaired streams in this report. Model documentation contains additional details about model development (RESPEC 2014, Tetra Tech 2015, Tetra Tech 2016).

3.1 Climate trends

Climate is a foundational ecological condition that influences hydrology and water quality. *Climate summary for watersheds: Le Sueur River* (DNR 2019) provides an overview of climate conditions based on data from 1895 through 2018. The report focuses on trends in seasonal and annual temperature and precipitation. Long-term data show that annual average temperatures in the Le Sueur River Watershed have increased and that most years during the past two decades have been warmer than average (Figure 2). Monthly average temperatures peak in July, and winter temperatures on average have increased over time, with less change in the summer months (Figure 3).

Annual precipitation in the Le Sueur River Watershed also shows an upward trend (Figure 4). Monthly precipitation is typically highest in May and June and increases in precipitation in recent years were most pronounced in April through July (Figure 5). The frequency of 1-inch and 3-inch rain events has increased in general in Minnesota, along with the size of the heaviest rainfall of the year. Minnesota has also experienced an increase in devastating, large-area extreme rainstorms (DNR 2022). Climate projections indicate these big rains will continue increasing into the future (DNR 2022).

This increase in the frequency and size of rainfall events affects river and stream flows. Peak flows in the Minnesota River have increased over the last few decades (Figure 6) (MPCA, 2023). Higher flows result in greater stream channel erosion and sediment transport. These in turn impact local pollutant loads and concentrations, downstream habitat for fish and other AQL, and may degrade recreational uses.

Figure 2. Annual average temperature, Le Sueur River Watershed (figure from DNR 2019).

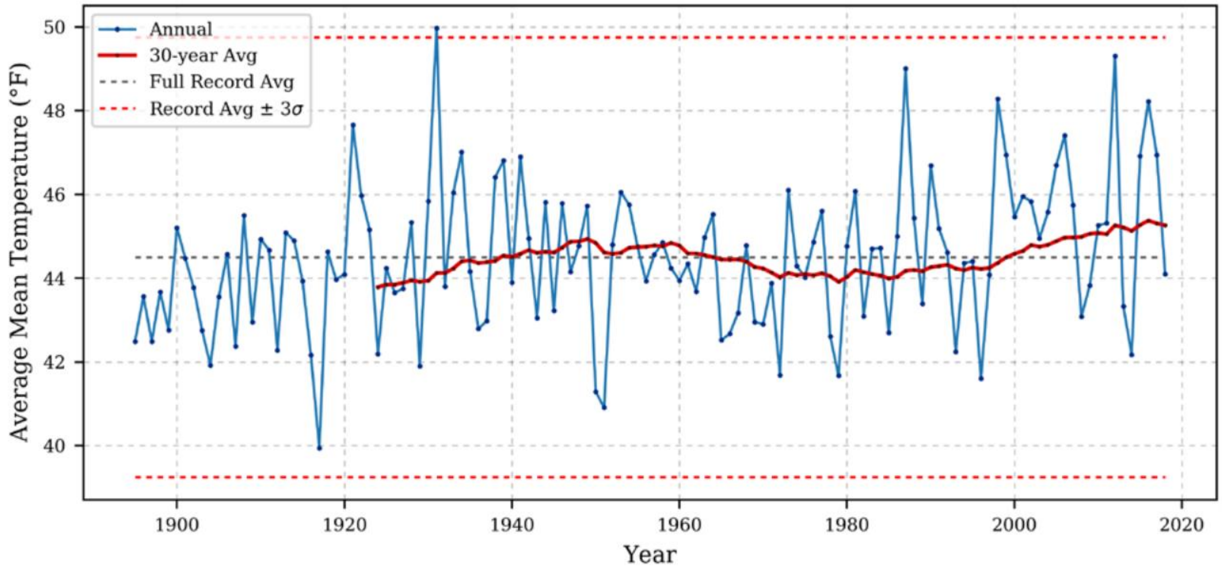


Figure 3. Monthly average temperature distribution and departure from record mean, Le Sueur River Watershed (figure from DNR 2019).

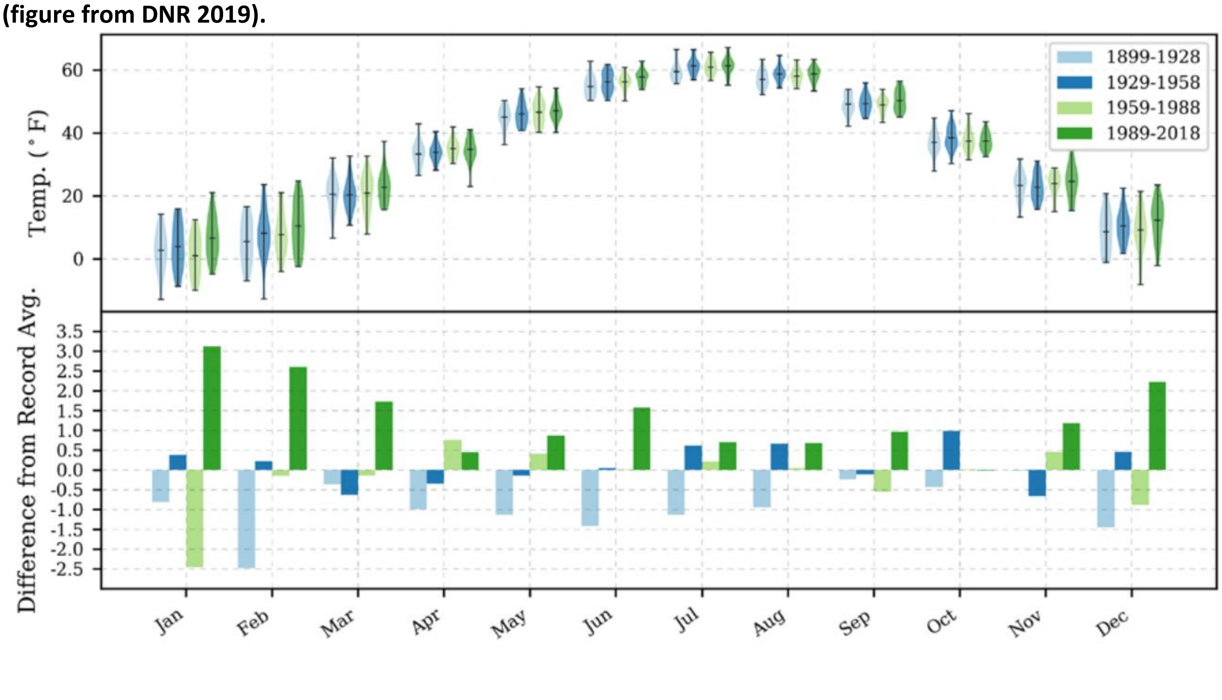


Figure 4. Annual precipitation, Le Sueur River Watershed (figure from DNR 2019).

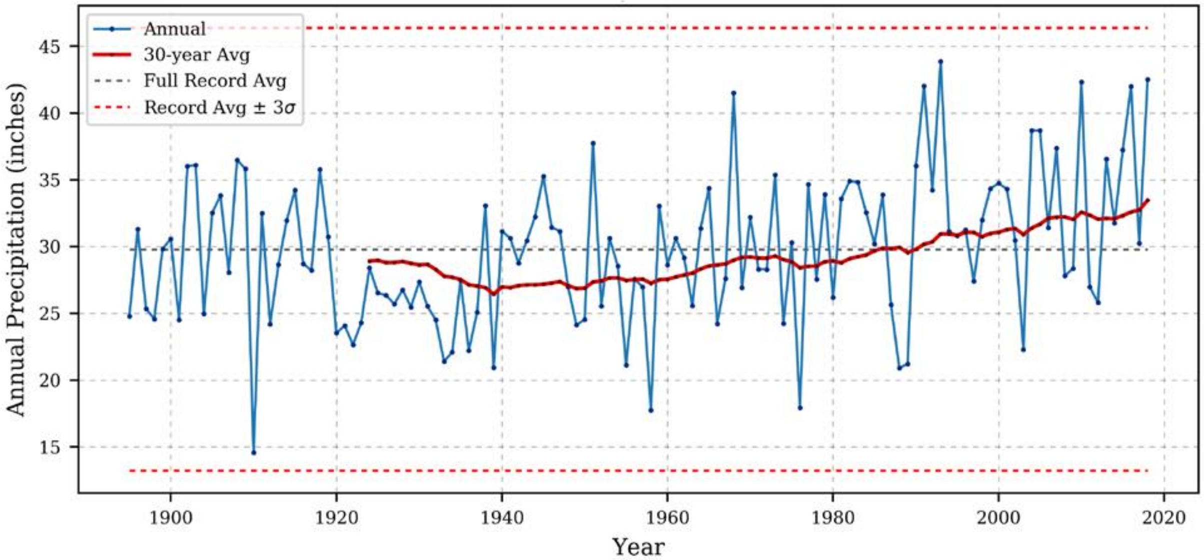


Figure 5. Monthly precipitation and departure from record mean, Le Sueur River Watershed (figure from DNR 2019).

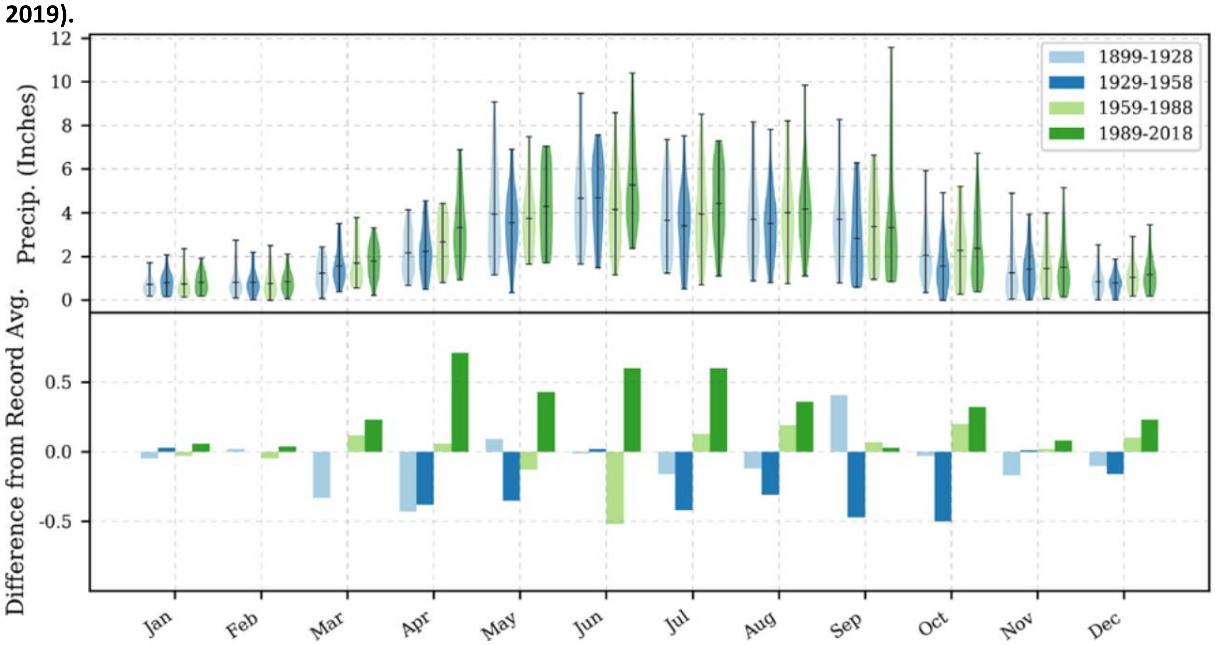
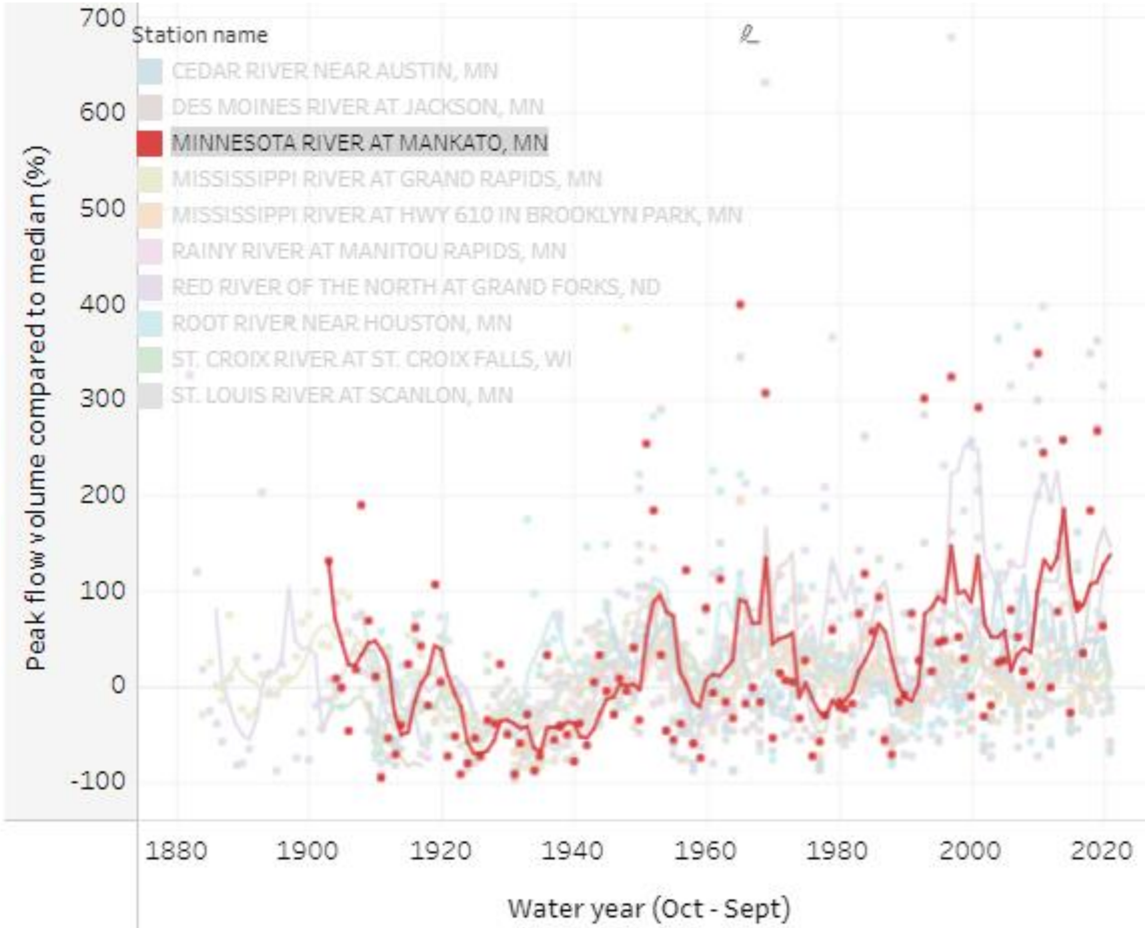


Figure 6. Trends in flood flows: percent difference from median annual peak.
Figure source: *Climate Change and Minnesota's Surface Waters* (MPCA 2023). Points represent water year (Oct–Sep) flow; lines represent the trailing five-year moving average. Data from the USGS National Water Information System.



3.2 Streams

The watershed areas of the impaired stream reaches are shown in Table 4.

Table 4. Watershed areas of impaired streams in the Le Sueur River Watershed.

WID	Water body name	Watershed area (ac)
07020011-501	Le Sueur River	710,650
07020011-504	Little Cobb River	83,560
07020011-556	Cobb River	198,297
07020011-576	Iosco Creek	12,527

3.3 Subwatersheds

The watershed boundaries of the impaired streams (Figure 1) were developed using multiple data sources, starting with watershed delineations from the Le Sueur River Watershed HSPF model. The model watershed boundaries are based on Minnesota Department of Natural Resources (DNR) Level 7 watershed boundaries. Where additional watershed breaks were needed to define the impairment watersheds, DNR Level 8 and 9 watershed boundaries were used.

Watershed boundaries within and around MS4 areas were further refined by stormsewer and subcatchment information provided by the City of Mankato and the City of Waseca.

3.4 Land cover

Pre-European settlement land cover in the Le Sueur River Watershed was primarily prairie and wet prairie. Lands within the watershed were opened to nonindigenous settlement in the middle 1800s. Over the following century and a half, the landscape was almost entirely converted to agricultural uses. To increase arable land surface, wetlands and free-flowing streams were converted to networks of agricultural drainage ditches.

Current land cover in the Le Sueur River Watershed is primarily agricultural, with corn and soybeans the dominant crops (Figure 7, Table 5). Other crops are present, such as alfalfa and other hay crops, but represent less than 1.7% of the land area of individual impairment watersheds. Drain tile is prevalent in the watershed and developed areas and wetlands also represent a portion of some of the impairment watersheds.

Figure 7. Land cover in the Le Sueur River Watershed.

Data source: 2022 Cropland Data Layer, United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS).

Table 5. Watershed land cover percent area by impairment.

Percentages rounded to nearest tenth. Data source: 2022 Cropland Data Layer, United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS).

Impairment type	WID	Water body name	Corn	Soy-beans	Other crops [a]	Fallow / idle cropland	Grassland / pasture	Developed / Barren	Forest and shrub	Wetland	Open water [b]
Streams, phosphorus	501	Le Sueur River	42.2%	36.9%	1.7%	<0.1%	2.8%	5.2%	2.6%	6.6%	2.1%
	504	Little Cobb River	43.5%	39.2%	1.8%	<0.1%	2.2%	4.4%	1.2%	6.5%	1.2%
	556	Cobb River	44.2%	36.4%	1.3%	<0.1%	2.3%	4.6%	1.9%	7.0%	2.3%
Streams, *E. coli*	576	Iosco Creek	46.5%	31.3%	1.8%	<0.1%	4.3%	4.3%	5.1%	6.5%	0.3%

a. Other crops include spring wheat, oats, alfalfa, other hay, and peas.

b. Open water includes the surface area of the impaired water bodies.

3.5 Flow data

Long-term (1993 to present), continuous flow data are available from the United States Geological Survey (USGS) flow gaging station on the Le Sueur River near Rapidan, Minnesota (USGS site 05320500; Figure 1). Additional, limited flow data are available from two other mainstem stations upstream of the USGS station and four tributaries to the Le Sueur River (Maple River, Big Cobb River, Little Cobb River, and Little Beauford Ditch). Due to limited and inconsistent flow records for these stations, simulated flows from the 2023 recalibrated HSPF model were used to represent average daily flows for each impaired reach during the model simulation period (1996 through 2017). HSPF simulated flows are available at the downstream end of each RES impaired reach covered in this TMDL (Table 6). For Iosco Creek, the end point of the impaired reach is located slightly upstream of the downstream end of the HSPF model reach and therefore a drainage area weighting adjustment was applied to the HSPF simulated flows. Since the HSPF model ends in 2017, regressions were developed between the long-term daily flow record from USGS site 05320500 (located in Reach 07020011-501 and HSPF model reach 850) and the 1996 through 2017 HSPF simulated flow for each impaired reach. These regression relationships showed good correlation (R-squares range from 0.62 to 0.98) and were used to extend the flow record for each impaired reach through 2021 so that water quality samples collected since the end of the HSPF simulation period (i.e., since 2017) may be compared to flow.

The model reports (TetraTech 2002, RESPEC 2014, TetraTech 2015, Tetra Tech 2016) describe the framework and the data that were used to develop the model. See also the brief summary of HSPF modeling in the introduction to Section 3.

Table 6. Model reaches used to simulate stream flow in impaired reaches in the Le Sueur River Watershed. Reach numbers refer to the Le Sueur River Watershed HSPF model. The HSPF simulation is from 1996 through 2017.

WID	Reach name	Model reach number
07020011-501	Le Sueur River	850
07020011-504	Little Cobb River	743
07020011-556	Cobb River	751
07020011-576	Iosco Creek	613 (area-weighted)

Flow duration curves were developed for each impaired reach addressed in this TMDL using the model simulated and USGS regression flow record described above. Flow duration curves relate mean daily flow to the percent of time those values have been met or exceeded. For example, an average daily flow at the 50% exceedance value is the midpoint or median flow value; average daily flow in the reach equals the 50% exceedance value 50% of the time. For the RES impaired reaches, only daily average flows from June through September during the most recent 10-year period (2012 through 2021) were used to develop the flow duration curves. Daily average flows from all months (even those outside of the time period that the standard is in effect) were used to develop the flow duration curve for the *E. coli* impaired reach, Iosco Creek. The Iosco Creek flow duration curve is divided into five flow zones, including very high flows (0% to 10%), high flows (10% to 40%), mid-range flows (40% to 60%), low flows (60% to 90%), and very low flows (90% to 100%). Slightly different flow zone breakpoints were used for the RES impaired reaches: 0% to 20%, 20% to 40%, 40% to 60%, 60% to 80%, and 80% to 100%. See

Section 4.5.1 for more discussion of the RES impaired reach flow duration curves and flow zone breakpoints.

3.6 Water quality

Water quality data are presented to evaluate impairments and trends in water quality. Unless otherwise noted, data from the recent 10 year period of 2012 through 2021 were used in the water quality summary tables. Only water quality data from the MPCA's Environmental Quality Information System (EQuIS) were used for the analyses.

3.6.1 *E. coli* impairment

All the *E. coli* data for Iosco Creek are from 2017 through 2020 at water quality station S014-236 (Figure 1). A total of 89 *E. coli* samples were collected during this period from May through October. *E. coli* concentrations ranged from 40 to over 24,000 org/100 mL. The monthly geometric mean standard was exceeded in all six months that were monitored, and the individual sample standard was exceeded at least one time during all months (Figure 8). The highest monthly geometric mean concentration was in July (1,442 org/100 mL) and 35% of the samples collected during July exceeded the individual sample standard. *E. coli* concentrations did not show strong relationships to flow as concentrations were high during all flow zones (Figure 9). The very high flow zone demonstrated the highest geomean concentration (1,476 org/100 mL) and the highest incidence of individual sample standard exceedances (63%).

Figure 8. Iosco Creek *E. coli* concentrations by month, 2017 - 2020.

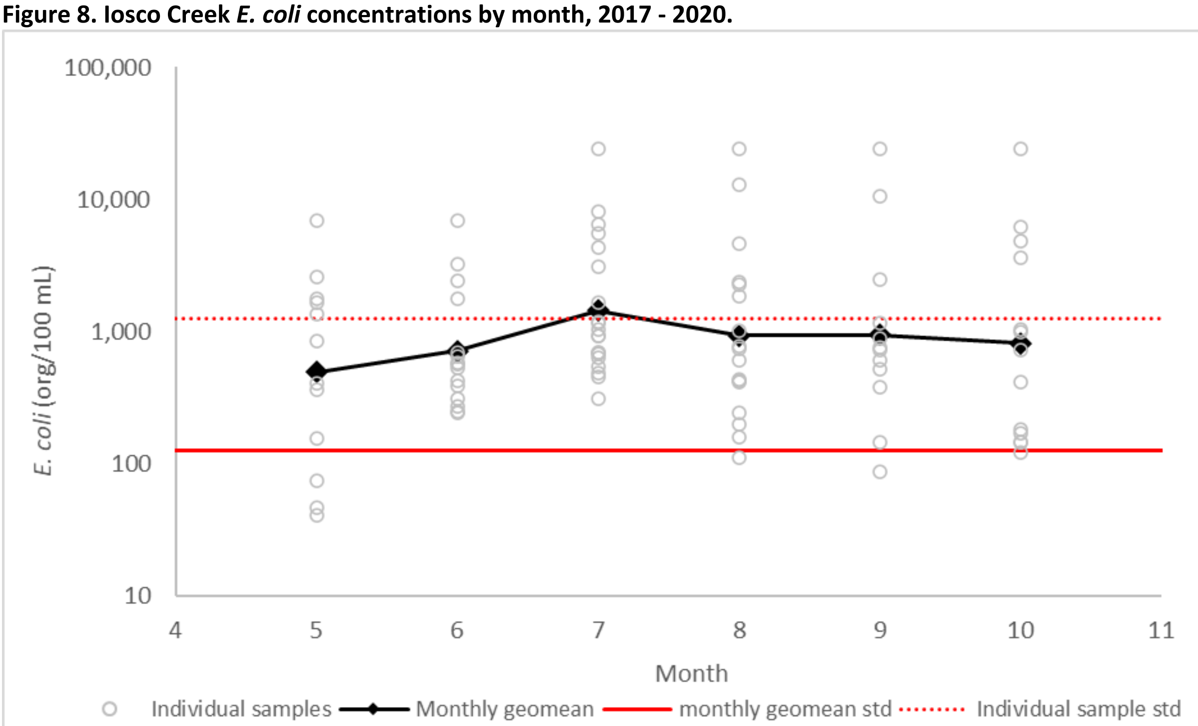
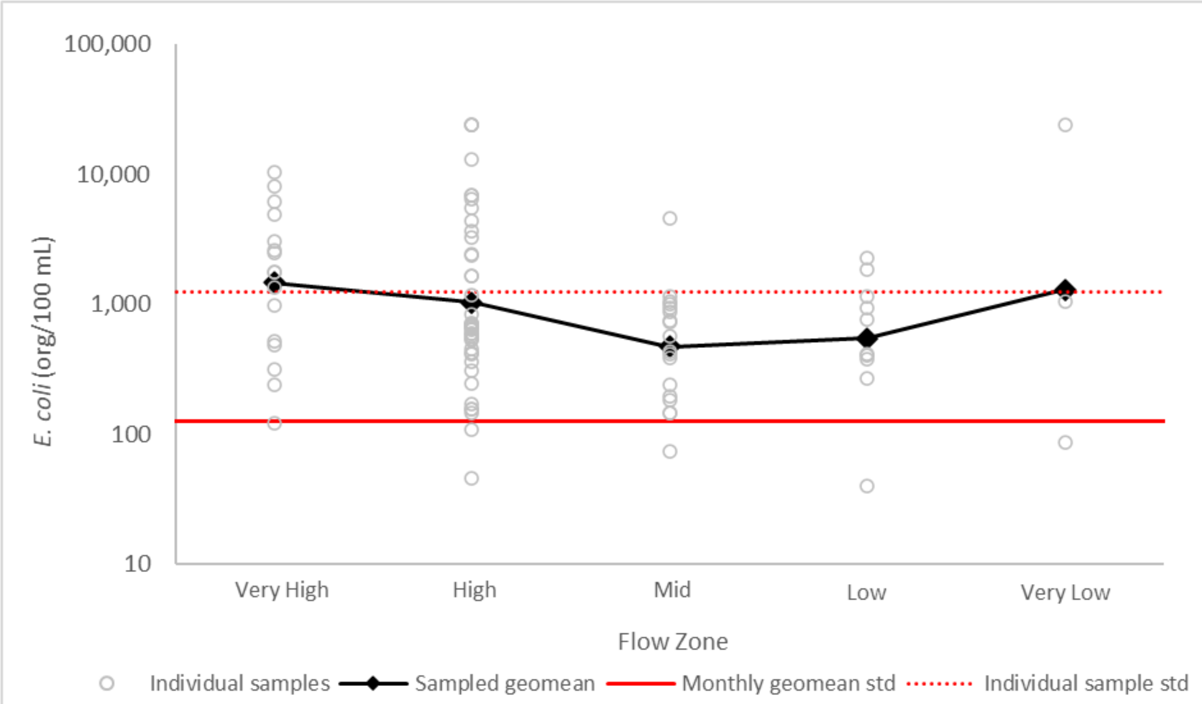


Figure 9. Iosco Creek *E. coli* concentrations by flow zone, 2017 - 2020.



3.6.2 RES impairments

TP and the available RES response variables (chl-*a* and pH) data are summarized in Table 7 for the RES impaired reaches. Available data from the most recent 10-year assessment period (2012 through 2021) were used for development of this TMDL report. No BOD or diel DO flux data was available within the impaired reaches for this TMDL Report time period. No chl-*a* data has been collected in the Cobb and Little Cobb impaired reaches during the most recent assessment period, and therefore data dating back to 2000 is also included in Table 7 for reference.

Table 7. Water quality data for the RES impaired reaches covered in this TMDL.

WID	Reach name	EQuIS Station(s)	RES parameter	Period of record	Samples (count)	Summer Mean	Standard
501	Le Sueur River	S000-340	TP (µg/L)	2012-2021	151	432	150
				2000-2021	251	376	
			chl-*a* (µg/L)	2012-2021	5	10	35
				2000-2021	89	37	
			pH	2012-2021	90	8.2	<6.5, >9.0
				2000-2021	137	8.2	
504	Little Cobb River	S003-574	TP (µg/L)	2012-2021	15	187	150
				2000-2021	113	251	
			chl-*a* (µg/L)	2012-2021	0	--	35
				2000-2021	82	60	
			pH	2012-2021	17	7.9	<6.5, >9.0
				2000-2021	60	8.2	
556	Cobb River	S003-446	TP (µg/L)	2012-2021	124	308	150

WID	Reach name	EQuIS Station(s)	RES parameter	Period of record	Samples (count)	Summer Mean	Standard
				2000-2021	223	281	
			chl-*a* (µg/L)	2012-2021	0	--	35
				2000-2021	79	40	
			pH	2012-2021	76	8.1	<6.5, >9.0
				2000-2021	121	8.2	

Figure 10 through Figure 12 are box plots showing the range in TP, chl-*a*, and pH during the summer growing period (June through September) for the three RES impaired reaches from 2000 through 2021. In these figures the upper and lower edge of each box represents the 75th and 25th percentile of the data range for each site/reach. The error bars above and below each box represent the 95th and 5th percentile of the dataset. The colored dash within each box is the mean concentration of the parameter of interest. The dotted red line represents the Southern River Nutrient Region RES TP standards for TP (150 µg/L), chl-*a* (35 µg/L), and pH (6.5 and 9.0).

Figure 10. Summer TP concentrations for the Le Sueur River Watershed RES impaired reaches.

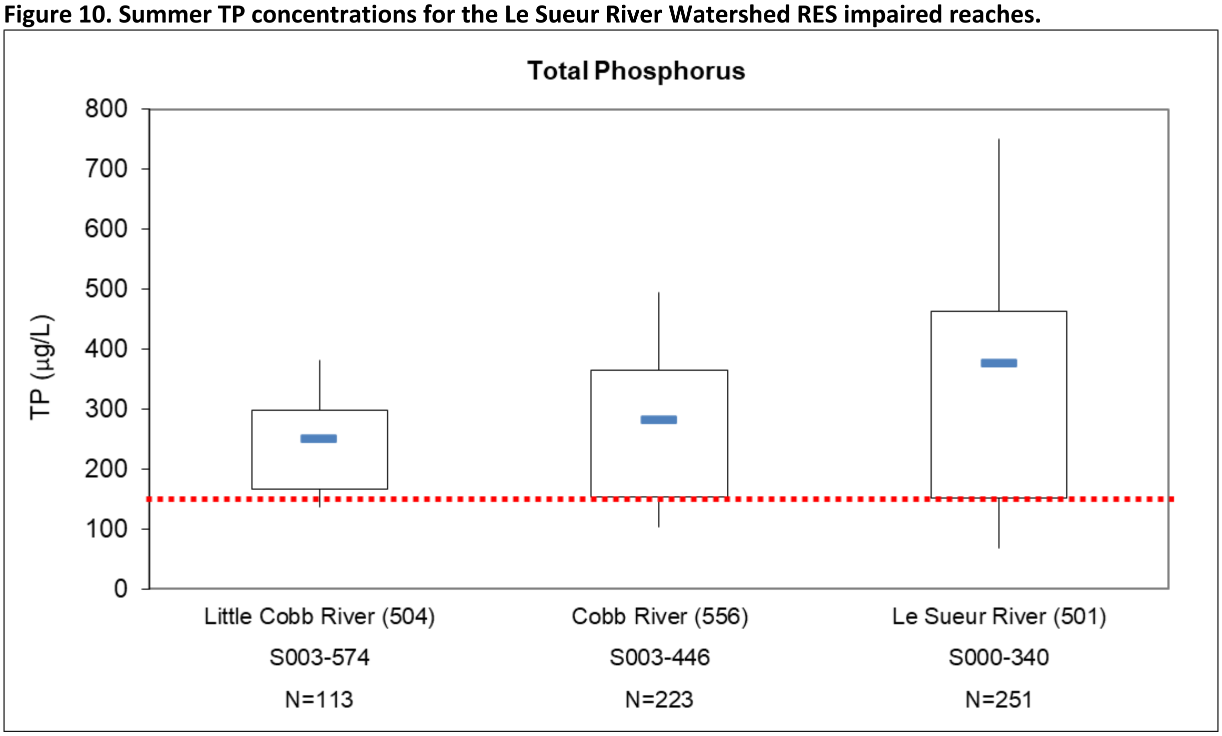


Figure 11. Summer chl-*a* concentrations for the Le Sueur River Watershed RES impaired reaches.

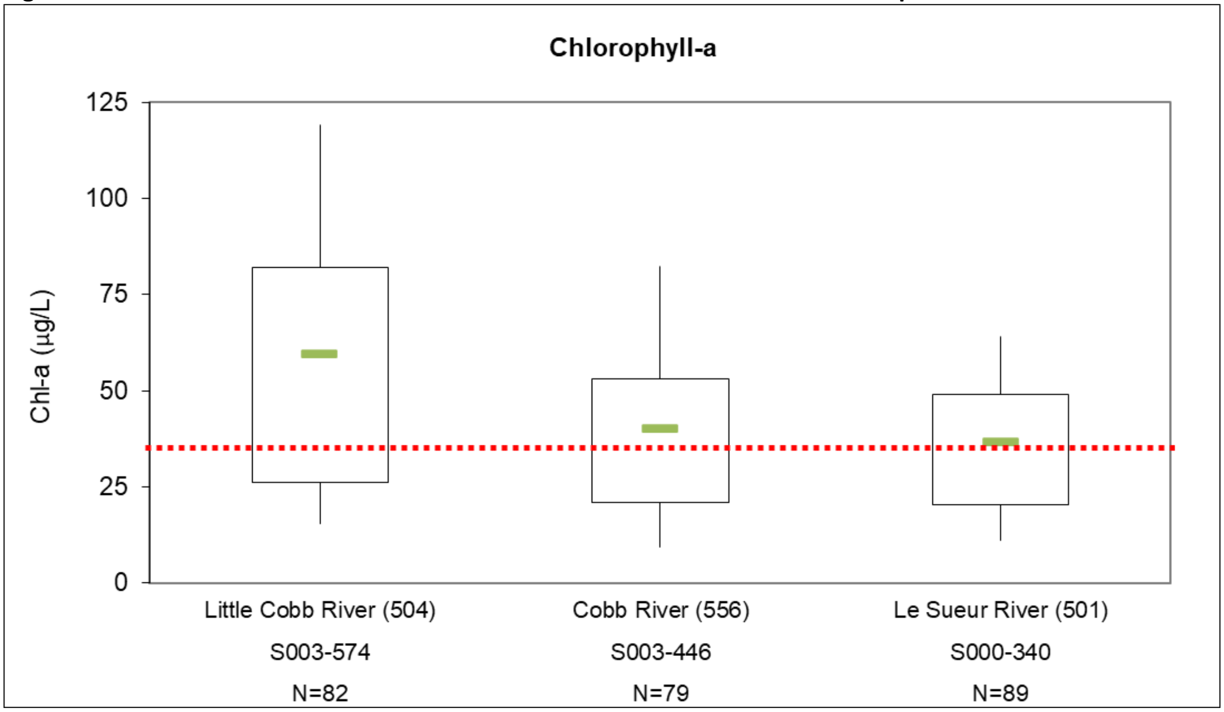
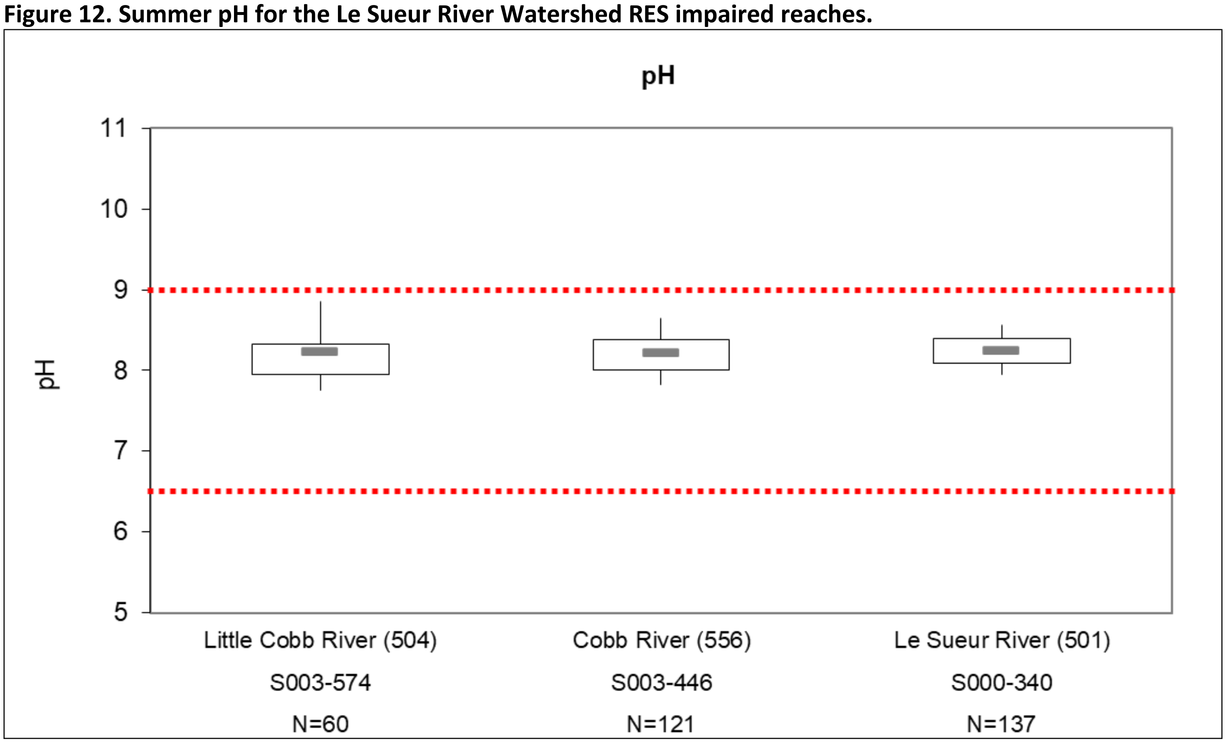


Figure 12. Summer pH for the Le Sueur River Watershed RES impaired reaches.



River eutrophication related data upstream of the impaired reaches were also obtained from EQuIS and analyzed (i.e., box plots) to evaluate phosphorus and eutrophication variability throughout the mainstem of the Le Sueur River and its tributaries. These data are summarized and presented in Appendix B. Also included in Appendix B are several figures to help illustrate and visualize the seasonal (i.e., box plots) and flow-driven patterns (i.e., load duration curves; LDC) of TP and associated response variables within each impaired reach. Below is a summary of some of the key takeaways of the data analyses presented in Appendix B:

- TP concentrations for all three impaired reaches consistently exceed the 150 µg/L standard during the very high (71% to 100%), high (96% to 100%), and mid flow (86% to 90%) zones. TP concentrations are generally lower and individual standard exceedances are less common during the low (36% to 50%) and very low (0% to 30%) flow zones.
- In general, chl-*a* concentrations are highest during the high (37% to 87%), mid (79% to 93%), and low (38% to 64%) flow zones. Chl-*a* concentrations tend to be lower during very high (15% to 50%) flows likely due to light limitation, and during very low (18% to 50%) flows likely due to lower TP concentrations.
- Mean TP concentrations for all three impaired reaches are high and generally exceed the standard from March through October each year.
- Mean chl-*a* concentrations exceed the standard in all three reaches from May through September and occasionally in April.
- The HUC-10 subwatershed with the highest long-term mean TP concentration is the Lower Le Sueur River (376 µg/L) followed by Maple River (292 µg/L), Cobb River (281 µg/L), Little Cobb River (251 µg/L), Upper Le Sueur River (212 µg/L), and Rice Creek (172 µg/L).
- The Little Cobb River (60 µg/L), Cobb River (40 µg/L), and Lower Le Sueur River (37 µg/L) are the only HUC-10 subwatersheds that exceed the 35 µg/L chl-*a* standard during the summer growing season.
- Despite high TP levels, mean chl-*a* concentrations in the Maple River (11 µg/L), Rice Creek (10 µg/L), and the Upper Le Sueur River (8 µg/L) subwatersheds do not exceed the chl-*a* standard likely due to light limitation and/or unfavorable conditions for growing algae.

3.7 Pollutant source summary

Sources of pollutants in the Le Sueur River Watershed include permitted and nonpermitted sources. The permitted sources discussed here are pollutant sources that require an NPDES permit. Nonpermitted sources are pollutant sources that do not require an NPDES permit. Most Minnesota NPDES permits are also SDS permits; however, some pollutant sources require SDS permit coverage alone without NPDES permit coverage (e.g., spray irrigation, large septic systems, land application of biosolids, and some feedlots).

The phrase “nonpermitted” does not indicate that the pollutants are illegal, but rather that they do not require an NPDES permit. Some nonpermitted sources are unregulated, and some nonpermitted sources are regulated through non-NPDES programs and permits such as state and local regulations.

This section describes the *E. coli* and phosphorus sources to the impaired water bodies. A summary of pollutant sources can be found in Sections 3.7.3: *E. coli* source summary and 3.7.4: Phosphorus source summary.

3.7.1 Permitted sources

3.7.1.1 Municipal and industrial wastewater

Permitted municipal and industrial wastewater can be a source of *E. coli* and phosphorus to surface water. Wastewater is domestic sewage and other wastewater collected and treated by municipalities and industries before being discharged to water bodies as wastewater effluent. Wastewater enters surface water either as treated effluent or through releases of untreated wastewater.

A release is an unauthorized discharge of untreated or partially treated wastewater to the environment. Examples include sanitary sewer overflows (SSOs) from a plugged collection system or pumping untreated wastewater out of a manhole to a nearby ditch. Unauthorized releases such as SSOs are most common when wastewater systems are inundated with rain/snow melt or from pump or electrical failures. While NPDES permits do not authorize the discharge of untreated or partially treated wastewater, and operators avoid releasing untreated wastewater into the environment, releases are sometimes necessary or unavoidable for several reasons, including electrical or mechanical failures, flows that exceed the collection system's designed capacity, and treatment system problems. When releases occur, the wastewater treatment plant (WWTP) operator is required to immediately contact the Minnesota Duty Officer, discontinue the release as soon as possible, recover all substances and materials, if possible, collect representative sample(s) of the release, and report sample results to the MPCA.

There is a meaningful distinction between wet weather and dry weather releases. Wet weather releases occur when flows overwhelm a WWTP or its collection system. The excess rain/snow melt or groundwater can enter the wastewater collection system through inflow and infiltration (I&I) from storms, floods, or groundwater due to leaky sewer systems and noncompliant private service lateral lines, as well as improper connections such as sump pumps, foundation drains, or downspouts that are connected to the sanitary sewer. When the excess water overwhelms the designed capacity of the collection system or the WWTP, the release of untreated or partially treated wastewater may be necessary to protect wastewater infrastructure and avoid imminent public health threats associated with sewage backflow into homes and businesses (MPCA 2020b). Wet weather releases are often relatively dilute compared to full strength wastewater, although even dilute wastewater may contain disease causing microorganisms. Because receiving water bodies are typically at high flows during wet weather events, the water quality impact of wet weather releases can be relatively minor. Dry weather releases, which are often due to mechanical failures, can deliver full strength wastewater to water bodies during base flow or low flow, and the resulting water quality impacts can therefore be greater than those associated with wet weather releases.

The degree of environmental harm posed by a release depends on the volume, flow rate, and length of time of the release; the strength of the release; and the volume and flow rate of the receiving water body. For example, a high strength discharge to a small river that is at low summer flow may be harmful. A more diluted discharge to a large river under high flow conditions will have less of an effect. Releases during conditions of flooding may have little measurable impact on water quality.

The wastewater releases that occurred in the Le Sueur River Watershed from 2014 through 2023 were due to wet weather and mechanical failures (Table 8). Wet weather releases occurred more frequently than mechanical failures (which may occur during either dry or wet weather) and ranged from 1 to 11 releases annually. All the cities, towns, and communities in the Le Sueur River Watershed have sanitary sewer systems that are separate from their stormwater conveyance systems and therefore there are no combined sewer systems in the watershed.

Table 8. Wastewater releases from WWTPs in the Le Sueur River Watershed, 2014-2023.

Release type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Wet weather	7	3	11	0	8	4	1	0	6	5	45
Mechanical failures	0	0	0	0	0	3	2	0	0	0	5

E. coli

There are no wastewater dischargers located within the Iosco Creek *E. coli* impaired reach drainage area.

Phosphorus

There are 12 active regulated NPDES wastewater facilities in the RES impaired reach drainage areas that discharge during the summer growing season (Figure 1 and Table 9). Four of the dischargers are mechanical plants that discharge daily throughout the summer. One of the active mechanical facilities, Waseca WWTP, is relatively large while the other three are small.

There are nine active controlled discharge stabilization pond facilities in the RES impaired reach drainage areas. One of these facilities, Waldorf WWTP, used to be a mechanical facility but recently constructed a new stabilization pond that is not authorized to discharge from June 1 through September 30 and therefore is not included in the WLAs for this TMDL (Section 4.5.4.1). Pemberton WWTP is another controlled discharger that is not allowed to discharge between June 1 and September 30 and does not receive a WLA in this TMDL. The other seven active controlled discharge facilities are not allowed to discharge between June 15 and September 15 and therefore have small discharge windows during the summer growing season. These facilities receive WLAs according to the methods described in Section 4.5.4.1. There were also five permitted facilities upstream of Reach 501 that occasionally discharged during the summer period prior to 2011, but their permits were discontinued and/or terminated for various reasons between 2010 and 2012 (Table 9).

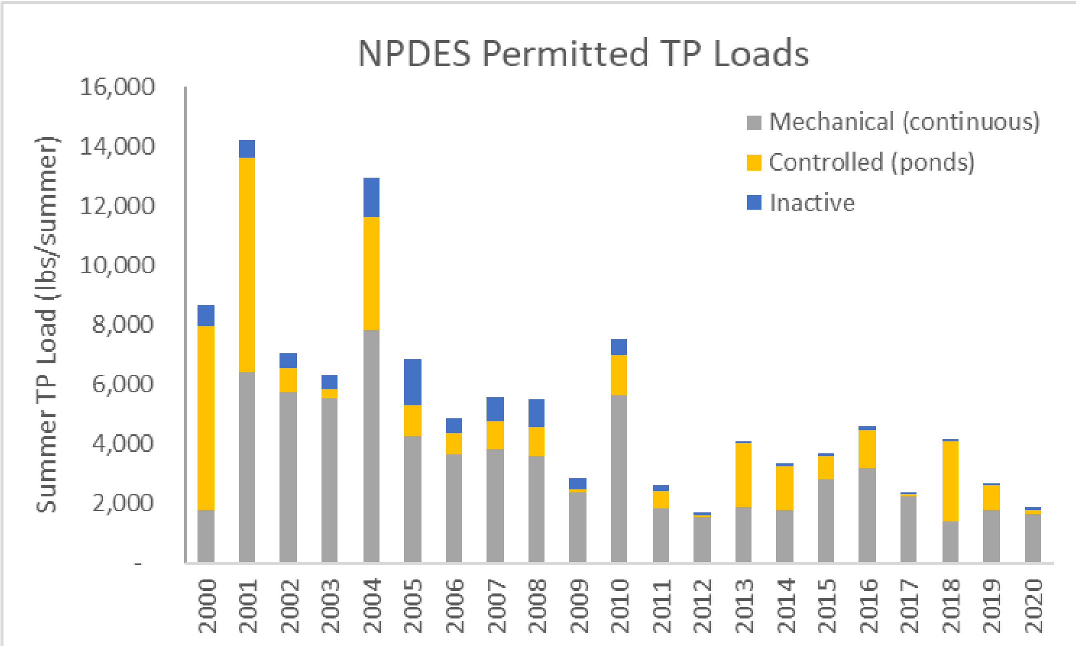
Table 9 and Figure 13 show summer (June through September) TP effluent loads for all NPDES regulated wastewater facilities from 2001 through 2020. Mean summer TP effluent loads across the watershed have decreased by over 4,000 lbs per summer (58% reduction) during the most recent 10-year period (2011 through 2020) compared to the previous 10-year period (2001 through 2010). A significant portion of this reduction (~68%) can be attributed to improved phosphorus removal by the mechanical facilities to meet the new TP effluent limits (see Section 4.5.4.1 for further discussion).

Table 9. Wastewater effluent summer TP loads for each facility in the Le Sueur River Watershed since 2001.
Data source: MPCA Wastewater Data Browser.

Facility name	Permit number	Facility type	Impaired water body WID(s)	Mean Summer TP effluent (lbs/summer; 2001-2010)	Mean Summer TP effluent (lbs/summer; 2011-2020)	WLA in this TMDL (Y/N)
Amboy WWTP	MN0022624	Mechanical	501	185	144	Y
New Richland WWTP	MN0021032	Mechanical	501	367	199	Y
Saint Clair WWTP	MN0024716	Mechanical	501	234	40	Y
Waseca WWTP	MN0020796	Mechanical	501	4,099	1,626	Y
Delavan WWTP	MNG585109	Controlled	501	3.1	6.0	Y
Freeborn WWTP	MNG585018	Controlled	501, 556	3.1	0.4	Y
Good Thunder WWTP	MNG585206	Controlled	501	180	213	Y
Hartland WWTP	MNG585102	Controlled	501	6.0	0	Y
Janesville WWTP	MNG585025	Controlled	501	541	358	Y
Mapleton WWTP	MNG585089	Controlled	501, 556	105	252	Y
Pemberton WWTP[1]	MNG580075	Controlled	501, 556, 504	14	0	N
Waldorf WWTP[1]	MN0021849	Controlled	501, 556, 504	158	82	N
Wells Public Utilities	MN0025224	Controlled	501	905	173	Y
ConAgra Foods Packaged Foods LLC	Inactive since 2013		501	61	--	N
Easton WTP	Permit terminated in 2011		501	0.4	--	N
Guardian Energy	Permit terminated in 2012		501	17	--	N
Madison Lake WWTP	Permit terminated in 2010 (connected to Mankato WWTP)		501	552	--	N
Wells WTP	Permit terminated in 2010		501	0.4	--	N
			Little Cobb River Reach 504 Total	172	82	
			Cobb River Reach 556 Total	280	334	
			Le Sueur River Reach 501 Total	7,431	3,093	

[1] These facilities are not authorized to discharge from June 1 through September 30

Figure 13. Summer wastewater effluent TP loads in the Le Sueur River Watershed from 2000 through 2020.
Data source: MPCA [Wastewater Data Browser]



The Le Sueur River HSPF model can be used to track wastewater reductions over time and their overall TP contribution to the RES impaired reaches compared to other sources. From 2001 through 2010, wastewater effluent represented approximately 1.5% of the total summer TP load for Le Sueur River Reach 501. From 2011 through the end of the HSPF model simulation period in 2017 wastewater effluent decreased to 0.5% of the total summer TP load for Reach 501 due to the facility improvements described above and in Table 9. Smaller modeled wastewater effluent source reductions were observed in Cobb River Reach 556 (~0.2% for both time periods) and Little Cobb River Reach 504 (decrease from 0.3% to 0.1%) due to the fewer number of facilities upstream of these reaches.

The effect of releases of untreated wastewater (Table 8) on phosphorus levels in the RES impaired reaches is not known; quantities, types, and treatment levels of the released wastewater, as well as weather and stream flow conditions, across the reported releases were variable and, in some cases, unknown. Additional information and monitoring in the watershed could be used to further evaluate this source and its potential effect on water quality.

3.7.1.2 Municipal separate storm sewer systems

A 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
- Not part of a publicly owned treatment works

MS4s in Minnesota must satisfy the requirements of the MS4 general permit if they are 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 owned by a municipality with a population of 10,000 or more, or a population of at least 5,000 and the system discharges to specially classified bodies of water. Minnesota state rule (Minn. R. 7090) establishes criteria and a process for designating future MS4s. The MS4 general permit (MNR040000) is designed to reduce the amount of sediment and other pollutants entering state waters from stormwater systems. Entities regulated by the MS4 general permit must develop a stormwater pollution prevention program and adopt best practices.

The Phase II General NPDES/SDS Municipal Stormwater Permit for MS4 communities has been issued to seven entities in the Le Sueur River Watershed (Table 21 and Appendix C): Eagle Lake City (MS400284), Mankato City (MS400226), Waseca City (MS400258), Mankato Township (MS400297), South Bend Township (MS400258), Minnesota Department of Transportation (MnDOT) Outstate (MS400180), and Blue Earth County (MS400276).

Le Sueur River Reach 501 is the only impaired reach covered in this TMDL that is downstream of the MS4s noted above. These MS4s can be a source of phosphorus to surface waters through the impact of urban systems on stormwater runoff. Stormwater runoff, which delivers and transports pollutants to surface waters, is generated in the watershed during precipitation events.

E. coli

There are no MS4s located within the Iosco Creek *E. coli* impaired reach drainage area.

Phosphorus

Urbanized areas can be a source of phosphorus to lakes through decaying vegetation (leaves, grass clippings, lawns, etc.), domestic and wild animal waste, soil and deposited particulates from the air, road salt, and oil and grease from vehicles. Land cover in the drainage area to Le Sueur River Reach 501 is predominantly cultivated crops, with the seven MS4s representing approximately 2% of the impaired reach drainage area. However, only about 18% of the total MS4 area is considered developed (i.e., residential, commercial, industrial park, parkland, etc.). As of 2022, approximately 51% of the MS4 jurisdictions within the Reach 501 drainage area were undeveloped cropland (Blue Earth County ROW (0.0%), Eagle Lake City (31.7%), Mankato City (25.2%), Mankato TWP (58.0%), MnDOT Outstate (4.6%), South Bend TWP (49.2%) and Waseca City (32.2%)).

Phosphorus loads throughout the Le Sueur River Watershed were estimated using the HSPF model, which is summarized in more detail in Section 3.7.4, and indicate that MS4s are not the primary source.

3.7.1.3 Construction stormwater

Construction stormwater is regulated through an NPDES/SDS permit. Untreated stormwater that runs off a construction site often carries sediment to surface water bodies. Because phosphorus travels adsorbed to sediment, construction sites can also be a source of phosphorus to surface waters. Phase II of the stormwater rules adopted by the EPA requires an NPDES/SDS permit for a construction activity that disturbs one acre or more of soil; a permit is needed for smaller sites if the activity is either part of a larger development or if the MPCA determines that the activity poses a risk to water resources. Coverage under the construction stormwater general permit requires sediment and erosion control measures that reduce stormwater pollution during and after construction activities (see Section 8.1.1). Pollutant loading from construction stormwater is inherently incorporated in the watershed runoff estimates and is not considered a significant source.

E. coli

E. coli is not a typical pollutant in construction stormwater.

Phosphorus

On average, less than 0.1% of the area in the Le Sueur River Watershed is under construction stormwater permit coverage (2018 through 2022). Phosphorus loading from construction stormwater is inherently incorporated in the watershed runoff estimates and is not considered a significant source.

3.7.1.4 Industrial stormwater

Industrial stormwater is regulated through an NPDES/SDS permit when stormwater discharges have the potential to come into contact with materials and activities associated with the industrial activity.

E. coli

E. coli is not a typical pollutant in industrial stormwater.

Phosphorus

Industrial stormwater is limited in the watersheds of the RES impaired reaches (less than 0.1% of watershed area). Pollutant loading from industrial stormwater is inherently incorporated in the watershed runoff estimates and is not considered a significant source.

3.7.1.5 NPDES and SDS permitted animal feedlots

Feedlots and manure storage areas can be a source of *E. coli* and phosphorus due to runoff from the animal holding areas or the manure storage areas. Although TMDL reports typically consider only NPDES permitted sources in discussions of permitted sources, this discussion of permitted feedlots includes NPDES and SDS permitted feedlots because of similar discharge requirements.

Concentrated animal feeding operation (CAFO) is a federal definition that implies not only a certain number of animals but also specific animal types. The MPCA uses the federal definition of a CAFO in its permit requirements of animal feedlots along with the state definition of an animal unit (AU). In Minnesota, the following types of livestock facilities are issued, and must operate under, an NPDES or SDS permit as follows (MPCA 2021c):

a) All federally defined CAFOs as required by federal law, some of which are under 1,000 AUs in size, must operate under an NPDES permit.

b) All CAFOs and non-CAFOs that have 1,000 or more AUs must operate under an NPDES or SDS permit.

CAFOs with fewer than 1,000 AUs and that are not required by federal law to maintain NPDES permit coverage may choose to operate without an NPDES permit. A current manure management plan that complies with Minn. R. 7020.2225 and the respective permit is required for all CAFOs and feedlots with 1,000 or more AUs.

CAFOs and feedlots with 1,000 or more AUs must be designed to contain all manure, manure contaminated runoff, process wastewater, and the precipitation from a 25-year, 24-hour storm event. Having and complying with an NPDES or SDS permit authorizes discharges to waters of the United States and waters of the state (with NPDES permits) or waters of the state (with SDS permits) due to a 25-year, 24-hour precipitation event (approximately 5.4 inches in the Le Sueur River Watershed [data source: NOAA National Weather Service]) when the discharge does not cause or contribute to nonattainment of applicable state water quality standards. Large CAFOs with fewer than 1,000 AUs that have chosen to forego NPDES permit coverage are not authorized to discharge and must contain all runoff, regardless of the precipitation event. Large CAFOs permitted with an SDS permit are authorized to discharge to waters of the state, although they are not authorized to discharge to waters of the U.S. Therefore, many large CAFOs in Minnesota have chosen to obtain an NPDES permit, even if discharges have not occurred at the facility.

CAFOs are inspected by the MPCA in accordance with the MPCA NPDES Compliance Monitoring Strategy approved by the EPA. All CAFOs (NPDES permitted, SDS permitted, and not required to be permitted) are inspected by the MPCA on a routine basis with an appropriate mix of field inspections, offsite monitoring, and compliance assistance.

For feedlots with NPDES and SDS permits, surface applied solid manure is prohibited during the month of March. Winter application of manure (December through February) requires fields to be approved in their manure management plan, and the feedlot owner/operator must follow a standard list of setbacks and BMPs. Winter application of surface applied liquid manure is prohibited except for emergency manure application as defined by the NPDES permit. “Winter application” refers to application of manure to frozen or snow-covered soils (December through March), except when manure can be applied below the soil surface and incorporated within 24 hours.

Of the approximately 527 animal feedlots in the Le Sueur River Watershed, there are 114 CAFOs of which 86 which have NPDES or SDS permits. All NPDES and SDS permitted feedlots are designed to contain all manure, manure-contaminated runoff, process wastewater, and the precipitation from a 25-year, 24-hour storm event, and as such they are not considered a significant source of phosphorus or *E. coli*. All other feedlots are accounted for as nonpermitted sources. The land application of all manure, regardless of whether the source of the manure originated from permitted (e.g., CAFOs) or nonpermitted feedlots, is also accounted for as a nonpermitted source.

3.7.2 Nonpermitted sources

Nonpermitted sources of *E. coli* and phosphorus in the Le Sueur River Watershed include watershed runoff, nonpermitted feedlots and wastewater, upstream impaired lakes, near channel losses, natural background sources, and naturalized *E. coli*.

3.7.2.1 Watershed runoff

Precipitation that falls in a watershed drains across the land surface, and a portion of it eventually reaches lakes and streams. Pollutants such as fecal bacteria and phosphorus are carried with the runoff water and delivered to surface water bodies. The sources of pollutants in watershed runoff may include soils, fertilizer, vegetation, release from wetlands, and livestock, pet, and wildlife waste. A portion of the pollutants in watershed runoff can be considered natural background sources, which are inputs that would be expected under natural, undisturbed conditions.

E. coli

The primary source of *E. coli* that is transported to surface water bodies through watershed runoff in the Le Sueur River Watershed is livestock manure from nonpermitted feedlots and from land application of manure. This source is discussed under non-NPDES/SDS permitted animal feeding operations above.

Watershed runoff from developed areas that are not permitted MS4s has the same source types and mechanisms of delivery as watershed runoff from permitted MS4s, discussed under MS4 under Permitted sources (Section 3.7.1.2).

Phosphorus

Phosphorus loads in watershed runoff to the RES impaired reaches were estimated with the Le Sueur River Watershed HSPF model. Table 10 presents HSPF simulated mean summer (2011 through 2017) TP area loading rates and concentrations at the outlet of the RES impaired reaches for seven land cover categories. These TP loading rates and concentrations account for phosphorus fate, transport, and losses (e.g., uptake by algae/vegetation, settling) that occur within the impaired reach and the river and stream network upstream of the impaired reaches. Table 11 presents the mean watershed-wide TP area loading rates delivered from upland areas to the stream channels and do not consider the in-channel phosphorus described above. Comparison of the rates in Table 10 and Table 11 suggest that approximately 32% (Reach 504), 49% (Reach 556), and 42% (Reach 501) of the phosphorus delivered to the stream network from upland runoff throughout each watershed settles out and/or is taken up in lake, stream, and rivers systems and therefore does not make it to the outlet of the impaired reach. Section 3.7.4 provides a summary of the HSPF simulated TP load contribution of each land cover type to the individual RES impaired reaches.

Table 10. Summer period (2011-2017) unit area loading rates and mean runoff concentrations by land cover type at the outlet of the RES impaired reaches derived from the Le Sueur River Watershed HSPF model.

	Little Cobb River Reach 504 (HSPF 743)		Cobb River Reach 556 (HSPF 751)		Le Sueur River Reach 501 (HSPF 850)	
Land cover	**TP yield (lb/ac-yr)**	**TP concentration (µg/L)**	**TP yield (lb/ac-yr)**	**TP concentration (µg/L)**	**TP yield (lb/ac-yr)**	**TP concentration (µg/L)**
Cropland	0.603	567	0.429	427	0.545	540
Developed	0.129	120	0.090	90	0.174	166
Forest	0.029	44	0.026	42	0.060	93
Grassland	0.115	169	0.091	141	0.206	309
Pasture	0.144	206	0.087	148	0.192	276
Wetland	0.028	56	0.021	46	0.035	77
Feedlot	0.173	334	0.156	258	0.316	495

Table 11. Summer period (2011-2017) unit area loading rates and mean runoff concentrations by land cover type delivered to the stream channels and network upstream of the RES impaired reaches (does not include in-channel losses) derived from the Le Sueur River Watershed HSPF model.

	Little Cobb River Reach 504 (HSPF 743)		Cobb River Reach 556 (HSPF 751)		Le Sueur River Reach 501 (HSPF 850)	
Land cover	**TP yield (lb/ac-yr)**	**TP concentration (µg/L)**	**TP yield (lb/ac-yr)**	**TP concentration (µg/L)**	**TP yield (lb/ac-yr)**	**TP concentration (µg/L)**
Cropland	0.882	801	0.849	792	0.937	879
Developed	0.186	169	0.186	173	0.304	269
Forest	0.041	60	0.040	61	0.092	129
Grassland	0.154	217	0.148	217	0.298	423
Pasture	0.200	271	0.190	274	0.406	489
Wetland	0.039	78	0.038	79	0.069	136
Feedlot	0.230	431	0.286	443	0.498	725

3.7.2.2 Non-NPDES/SDS permitted animal feedlot and manure application

Livestock are potential sources of fecal bacteria and nutrients 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. In Minnesota, feedlots under 1,000 AUs and those that are not federally defined as CAFOs do not operate with permits. In Minnesota, feedlots with greater than 50 AUs, or greater than 10 AUs in shoreland areas, are required to register with the county feedlot officer if the county is delegated, or with the MPCA if the county is nondelegated. Facilities with fewer AUs are not required to register. Shoreland is defined by Minn. R. 7020.0300 as land within 1,000 feet from the normal high-water mark of a lake, pond, or flowage, and land within 300 feet of a river or stream.

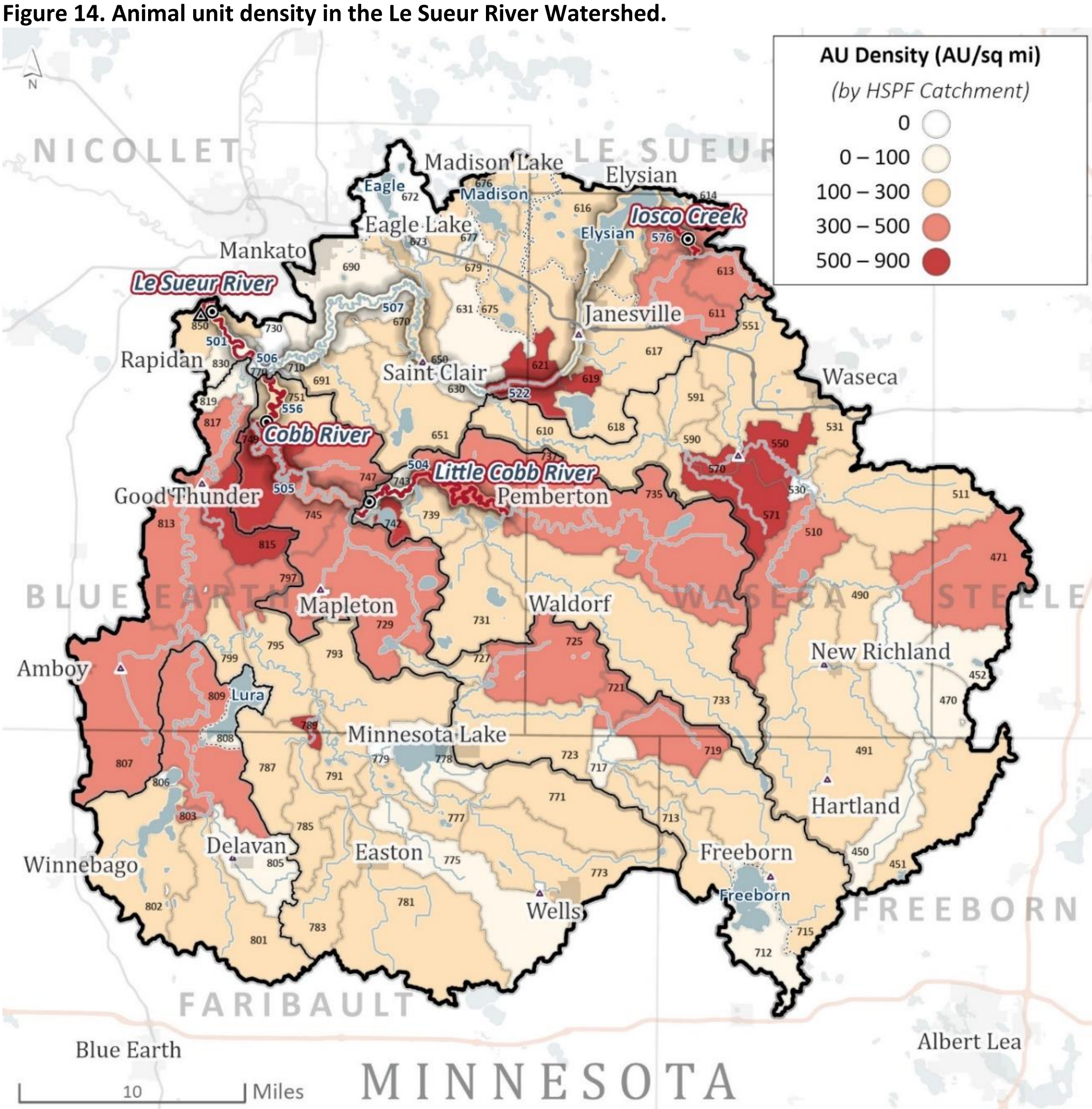
Manure that is generated on feedlots is usually stockpiled on site or on crop fields, or stored in liquid manure storage areas on site until field conditions and the crop rotation allow for applying the manure as fertilizer. Manure can be delivered to surface waters from failure of manure containment, runoff from the feedlot itself, or runoff from nearby fields where the manure is applied. The timing of manure spreading, as well as the application rate and method, affects the likelihood of pollutant loading to nearby water bodies. The spreading of manure on frozen soil in the late winter is likely to result in surface runoff with precipitation and snowmelt runoff events. Deferring manure application until snow has melted and soils have thawed decreases overland runoff associated with large precipitation events. Injecting or incorporating manure is a preferred BMP to reduce the runoff of waste and associated pollutants. Incorporating manure into the soil reduces the risk of surface runoff associated with large precipitation events.

While a full accounting of the fate and transport of manure was not conducted for this project, a large portion of it is ultimately applied to the land surface and, therefore, this source is of possible concern. Minn. R. 7020.2225 contains several requirements for land application of manure; however, there are no explicit requirements for *E. coli* treatment prior to land application.

All non-CAFOs are inspected in delegated counties by the county feedlot officer on a routine basis in accordance with the delegated county's Delegation Agreement and Work Plan, which is prepared with and approved by MPCA every other year. Non-CAFOs in nondelegated counties are inspected by MPCA on an as-needed or complaint-driven basis. All the counties in the Le Sueur River Watershed are delegated counties.

Information on feedlot locations and the numbers of registered animals and AUs were obtained from the MPCA's database of registered feedlots. This database includes the maximum number of animals that each registered feedlot can hold; therefore, the actual number of livestock in registered facilities is likely lower. Because feedlot registrations change over time, the estimates of the number of feedlots and animals in this report are approximate. AU densities in feedlots in the Le Sueur River Watershed are mapped in Figure 14, and more detail on livestock in the watersheds of the RES and *E. coli* impaired reaches are provided on the following pages.

Figure 14. Animal unit density in the Le Sueur River Watershed.



Data source: MPCA feedlot database dated 5/17/2024. Animal units include nonpermitted and permitted feedlots.

E. coli

There are approximately 7,499 AUs in the Iosco Creek *E. coli* impaired reach watershed (Table 12). The primary animal type is swine (76%), followed by cattle (23%). The Iosco Creek drainage area has high AU density (~353 AU/sq mi) compared to other subwatersheds in the Le Sueur River Watershed (Figure 14).

Table 12 includes feedlots that have zero discharge requirements (CAFOs and NPDES/SDS-permitted feedlots) and feedlots that do not have zero discharge requirements and therefore have the potential to contribute *E. coli* directly to surface water runoff. The "zero discharge" feedlots, if compliant with regulations, do not contribute *E. coli* directly to surface waters. However, because a large portion of manure from these facilities is ultimately applied to nearby land surfaces as fertilizer, some of this *E. coli* does reach surface waters and is thus a potential primary source. The "contributing" feedlots have the potential to contribute *E. coli* directly to surface waters through watershed runoff from the feedlots themselves.

Table 12. Livestock animal units and density in the Iosco Creek Watershed.
Data source: MPCA feedlot database dated 5/17/2024.

Reach	Primary livestock type	CAFOs		Non-CAFOs		Animal unit density (AU/square mile)
		Animal units	# feedlots	Animal units	# feedlots	
Iosco Creek Reach 576	Swine	4,620	3	2,879	16	353

Phosphorus

The primary animal type in the RES impaired watersheds is swine (primarily swine between 55 lbs and 300 lbs), followed by cattle (primarily slaughter steer or stock cow), and poultry (primarily turkeys greater than 5 lbs). The numbers of AUs in all registered feedlots were summed by impairment watershed and animal type (Table 13). These numbers include CAFOs and non-CAFOs because a large portion of manure from these facilities is ultimately applied to nearby land surfaces as fertilizer. In general, the Little Cobb and Cobb River RES impaired reach drainage areas have high AU densities compared to other subwatersheds in the Le Sueur River Watershed (Figure 14).

Table 13. Livestock animal units and densities in the RES impaired reach watersheds.

Reach	Primary livestock type	CAFOs		Non-CAFOs		Animal unit density (AU/square mile)
		AUs	# feedlots	AUs	# feedlots	
Little Cobb River Reach 504	Swine	25,741	21	12,914	50	299
Cobb River Reach 556	Swine	30,925	26	24,602	83	317
Le Sueur River Reach 501	Swine	143,503	114	113,585	413	236
Le Sueur River Reach 501 (Only)	Swine	82,217	64	73,190	264	204

3.7.2.3 Nonpermitted wastewater

Individual subsurface sewage treatment systems

Adequate wastewater treatment is vital to protecting the health, safety, and environment in Minnesota. Approximately 30% of Minnesotans rely on subsurface sewage treatment systems (SSTSs). SSTSs that fail to treat wastewater adequately threaten groundwater used for drinking water and surface water used for recreation. Inadequate treatment of wastewater/sewage, which contains bacteria, viruses, parasites, nutrients, and chemicals, can result in contamination of drinking water sources. Additionally, straight-pipe wastewater “systems,” which route raw wastewater to the ground or nearby waters, can directly impact lakes, streams, and wetlands.

SSTSs can fail for a variety of reasons, including excessive water use, poor design, physical damage, and lack of maintenance. Common limitations that contribute to failure include seasonal high-water table, fine-grained soils, bedrock, and fragipan (i.e., altered subsurface soil layer that restricts water flow and root penetration). Septic systems can fail hydraulically through surface breakouts or hydrogeologically from inadequate soil filtration. Failure potentially results in higher levels of pollutant loading to nearby surface waters.

Septic systems that are conforming and are appropriately sited still discharge small amounts of phosphorus, but they typically do not discharge *E. coli*. Failing septic systems do not protect groundwater from contamination; these systems are seepage pits, cesspools, drywells, leaching pits, or other pits, and any system with less than the required vertical separation distance from the seasonal high water table. Septic systems that discharge untreated sewage to the land surface or directly to streams are considered imminent threats to public health and safety (ITPHS) and can contribute *E. coli* and phosphorus directly to surface waters. ITPHS typically include straight pipes (i.e., no treatment), effluent ponding at ground surface, effluent backing up into homes, unsafe tank lids, electrical hazards, or any other unsafe condition deemed by a certified SSTS inspector. Therefore, not all the ITPHSs discharge pollutants directly to surface waters. Straight pipe systems are required to be addressed 10 months after discovery (Minn. Stat. § 15.55, subd. 11). Outhouses, or privies, are legal disposal systems and are regulated under Minn. R. 7080.2150, subp. 2F and Minn. R. 7080.2280.

Currently, the exact number and status of SSTSs in the Le Sueur River Watershed is unknown. However, each year, every county in the state reports estimated SSTS compliance estimates to the MPCA. It should be noted that these rates are county-wide estimates and were developed using a wide range of methods and resources and are intended for planning purposes only. Estimates of SSTS failure rates range from 1% to 26%, and ITPHS rates range from 7% to 14% (Table 14). Rates of noncompliant SSTS overall have been decreasing in the watershed.

The Le Sueur River Watershed HSPF model provides estimates of phosphorus loading from SSTS throughout the watershed. These estimates are based on the estimated number of ITPHS systems in the watershed and per capita flow and phosphorus loading rate assumptions from other studies (TetraTech 2002). The model estimates that average phosphorus loading from septics to the outlet of the RES impaired reaches range from 85 to 650 lbs per summer and account for less than 1% of the total load to these reaches (Table 16).

Table 14. Average county SSTS failure and ITPHS rates (2017-2022) for counties in the Le Sueur River Watershed. Rates are provided by counties to MPCA and are estimates only; the data do not represent verified compliance status.

County Name	Failing	ITPHS
Blue Earth	21%	7%
Faribault	1%	12%
Freeborn	26%	13%
Steele	22%	8%
Waseca	23%	14%

Small community wastewater treatment areas of concern

To ensure that effective sewage treatment occurs across the state, the MPCA regularly conducts surveys of local governmental units to identify areas in the state that may be areas of concern; these areas are defined as five or more homes within a half mile of each other that have inadequate sewage treatment. These areas are generally unincorporated communities, may not have an organized structure, may consist of families with limited financial resources, and many times do not qualify for the same financial assistance as large, incorporated communities. As of 2024, there were 11 communities in the impairment watersheds identified as areas and communities with SSTS concerns. The communities may have been listed because they were known to be noncompliant (i.e., imminent threat to public health and safety that backs up into the house or surface discharges inadequately treated wastewater, or a treatment system that is failing to protect groundwater and has a leaky tank or not enough soil separation under the SSTS before reaching saturated soil conditions) or due to an unknown status of SSTS compliance and were listed because of poor soils in the area, small lot size, or are older systems that may be out of compliance.

3.7.2.3 Upstream impaired lakes

There are five nutrient impaired lakes upstream of at least one of the RES impaired reaches covered in this report (Table 15). All five lakes have completed TMDLs that set phosphorus goals to meet the lake eutrophication TP standards identified in Table 15. All the lakes currently exceed their lake TP standard, and two of the lakes (Elysian and Freeborn) exceed the 150 µg/L RES standard and therefore are potential sources of phosphorus and algae to the RES impaired reaches. Collectively, the five impaired lakes cover approximately 9% of the drainage area to Le Sueur River Reach 501. The HSPF model estimates that outflow from the five lakes accounts for about 7% of the mean summer flow in Reach 501 and 3% of the summer TP load.

Freeborn Lake is the only nutrient impaired lake upstream of Cobb River Reach 556. The Freeborn Lake drainage area accounts for approximately 4% of the area draining to Reach 556. HSPF predicted outflow from Freeborn Lake represents approximately 3% of the summer flow in Reach 556 and about 2% of the summer TP load.

Table 15. Nutrient impaired lakes with completed TMDLs in the Le Sueur River Watershed.

Lake Name and ID	RES impaired reach(es)	Lake TP Standard (µg/L)	Current TP (µg/L)[1]	Lake drainage area (acres)	Percent of impaired reach drainage area
Eagle 07-0060-01	501	60	138	6,043	0.9% (501)
Elysian 81-0095-00	501	60	208	29,098	4.1% (501)
Freeborn 24-0044-00	556, 501	90	318	7,666	3.9% (556), 1.1% (501)
Lura 07-0079-00	501	90	104	2,658	0.4% (501)
Madison 07-0044-00	501	40	56	11,166	1.6% (501)

[1] Current TP represents the mean of all available summer growing season surface TP measurements from 2010 through 2023.

3.7.2.4 Near channel sources

Near-channel sources of sediment and phosphorus are those near the stream channel, including bluffs, banks, ravines, and the stream channel itself. Hydrologic changes in the landscape and altered precipitation patterns driven by climate change can lead to increased TSS and sediment-bound phosphorus in surface waters. Subsurface drainage tiling, channelization of waterways, land cover alteration, and increases in impervious surfaces all decrease detention time in the watershed and increase flow from fields and in streams. Draining and tiling wetland areas can decrease water storage on the landscape, which can lead to lower evapotranspiration and increased river flow (Schottler et al. 2013).

The straightening and ditching of natural rivers increase the slope of the original watercourse and moves water off the land at a higher velocity in a shorter amount of time. These changes to the way water moves through a watershed and how it makes its way into a river can lead to increases in water velocity, scouring of the river channel, and increased erosion of the river banks (Schottler et al. 2013, Lenhart et al. 2013).

For the purposes of this TMDL study, near-channel TP loading from ravines, bluffs, and streambanks was estimated using the Le Sueur River Watershed HSPF model. The HSPF near-channel estimates are based on multiple research efforts from various watersheds in the Minnesota River Basin. The partitioning of watershed and near-channel sources is based primarily on analysis of sediment cores (Schottler et al. 2010) and sediment mass balance studies for the Le Sueur River and Greater Blue Earth River watersheds (Gran et al. 2011). Model documentation (RESPEC 2014) contains additional details about the model development and calibration. The HSPF model estimates that approximately 41% of the TSS load at the outlet of the Le Sueur River (i.e., Reach 501) comes from near-channel sources. However, since there is very little organic material and phosphorus attached to the sediment in eroding stream and river banks, the model estimates that less than 1% of the Reach 501 phosphorus load is from near channel-sources.

3.7.2.5 Natural background sources

“Natural background” is defined in both Minnesota statute and rule. The Clean Water Legacy Act (Minn. Stat. § 114D.15, subd. 10) defines natural background as “characteristics of the water body resulting from the multiplicity of factors in nature, including climate and ecosystem dynamics, that affect the physical, chemical, or biological conditions in a water body, but does not include measurable and distinguishable pollution that is attributable to human activity or influence.” Minn. R. 7050.0150, subp. 4

states, "'Natural causes' means the multiplicity of factors that determine the physical, chemical, or biological conditions that would exist in a water body in the absence of measurable impacts from human activity or influence."

Natural background sources are inputs that would be expected under natural, undisturbed conditions. Natural background sources can include inputs from natural geologic processes such as soil loss from upland erosion and stream development, atmospheric deposition, and loading from forested land and wildlife. However, for each impairment, natural background levels are implicitly incorporated in the water quality standards used by the MPCA to determine/assess impairment, and therefore natural background is accounted for and addressed through the MPCA's water body assessment process. Natural background conditions were evaluated within the source assessment portion of this study. These source assessment exercises indicate that natural background inputs are generally low compared to livestock, cropland, streambank, wastewater treatment facilities, failing SSTSs, and other anthropogenic sources**.**

Based on the MPCA's water body assessment process and the TMDL source assessment exercises, there is no evidence at this time to suggest that natural background sources are a major driver of any of the impairments and/or affect the water bodies' ability to meet state water quality standards.

3.7.2.6 Naturalized *E. coli*

The adaptation and evolution of naturalized *E*. *coli* that allow it to survive and reproduce in the environment make it physically and genetically distinct from *E*. *coli* that cannot survive outside of a warm-blooded host. This naturalized *E. coli* may be a source of *E. coli* to the impairments.

The relationship between *E. coli* sources and *E. coli* concentrations found in streams is complex, involving precipitation and flow, temperature, sunlight and shading, livestock management practices, wildlife contributions, *E. coli* survival rates, land use practices, and other environmental factors. Research in the last 15 years has found the persistence of *E. coli* in soil, beach sand, and sediments throughout the year in the north central United States without the continuous presence of sewage or mammalian sources. This *E. coli* that persists in the environment outside of a warm-blooded host is referred to as naturalized *E. coli* (Jang et al. 2017). Naturalized *E. coli* can originate from different types of *E. coli* sources, including 1) natural background sources such as wildlife and 2) human attributed sources such as pets, livestock, and human wastewater. Therefore, whereas naturalized *E. coli* can be related to natural background sources, naturalized *E. coli* is not always from a natural background source.

An Alaskan study (Adhikari et al. 2007) found that total coliform bacteria in soil were able to survive for six months in subfreezing conditions. Two studies near Duluth, Minnesota found that *E. coli* were able to grow in agricultural field soil (Ishii et al. 2010) and temperate soils (Ishii et al. 2006). A study by Chandrasekaran et al. (2015) of ditch sediment in the Seven Mile Creek Watershed in southern Minnesota found that strains of *E. coli* had become naturalized to the water−sediment ecosystem. Survival and growth of fecal coliform has been documented in storm sewer sediment in Michigan (Marino and Gannon 1991), and *E. coli* regrowth was documented on concrete and stone habitat within an urban Minnesota watershed (Burns & McDonnell Engineering Company, Inc. 2017). This ability of

E. coli to survive and persist naturally in watercourse sediment can increase *E. coli* counts in the water column, especially after resuspension of sediment (e.g., Jamieson et al. 2005).

Although naturalized *E. coli* might exist in the watershed, there is no evidence to suggest that naturalized *E. coli* are a major driver of impairment and/or affect the water bodies' ability to meet state water quality standards.

3.7.3 *E. coli* source summary

The behavior of fecal bacteria in the environment is complex. Concentrations of fecal bacteria in a water body depend not only on their source but also factors such as weather, flow, and water temperature. As these factors fluctuate, the concentrations of fecal bacteria in the water may increase or decrease. Some fecal bacteria can survive and grow in the environment while others tend to die off with time (Ishii et al. 2006, Chandrasekaran et al. 2015, and Burns & McDonnell 2017). See Water Quality and Bacteria Frequently Asked Questions (MPCA 2019c) for additional background information about sources of fecal bacteria. The MPCA uses the *E. coli* water quality standard to identify water bodies that may be contaminated with fecal waste. Higher levels of *E. coli* in the water may or may not be accompanied by higher levels of pathogens and an increased risk of harm. Varying survival rates of fecal bacteria make it impossible to definitively state when pathogens are present.

Monitoring data for Iosco Creek indicate that *E. coli* concentrations are elevated under all flow conditions (Figure 9), suggesting that a range of source types contribute to impairment including runoff driven sources and sources that enter a water body directly. The primary sources of *E. coli* to Iosco Creek are from the following nonpermitted sources:

- Livestock (see Figure 14 and Table 12)
    - Runoff from feedlots or manure stockpiles without runoff controls, pastures, and agricultural fields where manure is applied (especially surface applied manure)
    - Runoff from noncompliant feedlots
    - Direct access of livestock to riparian areas
- Inadequately treated wastewater: rates of ITPHS septic systems in Waseca County is 14% (Table 14), but information on the specific locations of ITPHS are not known. Because the rates of ITPHS are substantial throughout the watershed, ITPHS are considered a likely source of *E. coli*.

Waste from wildlife may be a source of *E. coli* to the impaired streams but is generally considered to be low compared to other sources. Wildlife could represent a more substantial part of overall *E. coli* loading in isolated areas of high wildlife density and under low flow conditions.

3.7.4 Phosphorus source summary

This TMDL uses the Le Sueur River 2023 recalibrated HSPF model as the primary tool to evaluate phosphorus loading from various sources to the RES impaired reaches covered in this TMDL.

Table 16 presents HSPF predicted mean summer TP loads by major source category for the three RES impaired reaches. These values represent simulated source loads at the outlet of each impaired reach and therefore account for phosphorus losses (e.g., uptake by algae/vegetation, settling) that occur within the impaired reach and the river and stream network upstream of the impaired reaches. Results suggest summer phosphorus loads for each reach are dominated by watershed runoff from cropland.

Table 16. HSPF simulated total phosphorus loading by source at the outlet of each RES impaired reach. Numbers in this table are based on HSPF average summer growing season (June through September) loads (accounting for in-channel losses and gains) from 2011 through 2017.

	Little Cobb River Reach 504 (HSPF 743)		**Cobb River Reach 556 (HSPF 751)**		**Le Sueur River Reach 501 (HSPF 850)**	
Source	**Mean Summer TP Load (lbs)**	**Percent of Total**	**Mean Summer TP Load (lbs)**	**Percent of Total**	**Mean Summer TP Load (lbs)**	**Percent of Total**
Cropland	43,463	97%	71,852	97%	318,557	94%
Developed	612	1.4%	1,044	1.4%	7,975	2.4%
Forest	16	<1.0%	41	<1.0%	538	<1.0%
Grassland	199	<1.0%	373	<1.0%	3,550	1.0%
Pasture	75	<1.0%	132	<1.0%	1,864	<1.0%
Wetland	96	<1.0%	181	<1.0%	959	<1.0%
Feedlot	43	<1.0%	91	<1.0%	498	<1.0%
Near channel[1]	18	<1.0%	82	<1.0%	1,569	<1.0%
Septics	85	<1.0%	172	<1.0%	650	<1.0%
Wastewater[2]	69	<1.0%	201	<1.0%	2,109	<1.0%
Atm. Deposition	102	<1.0%	266	<1.0%	910	<1.0%
TOTAL	44,778	100%	74,435	100%	339,179	100%

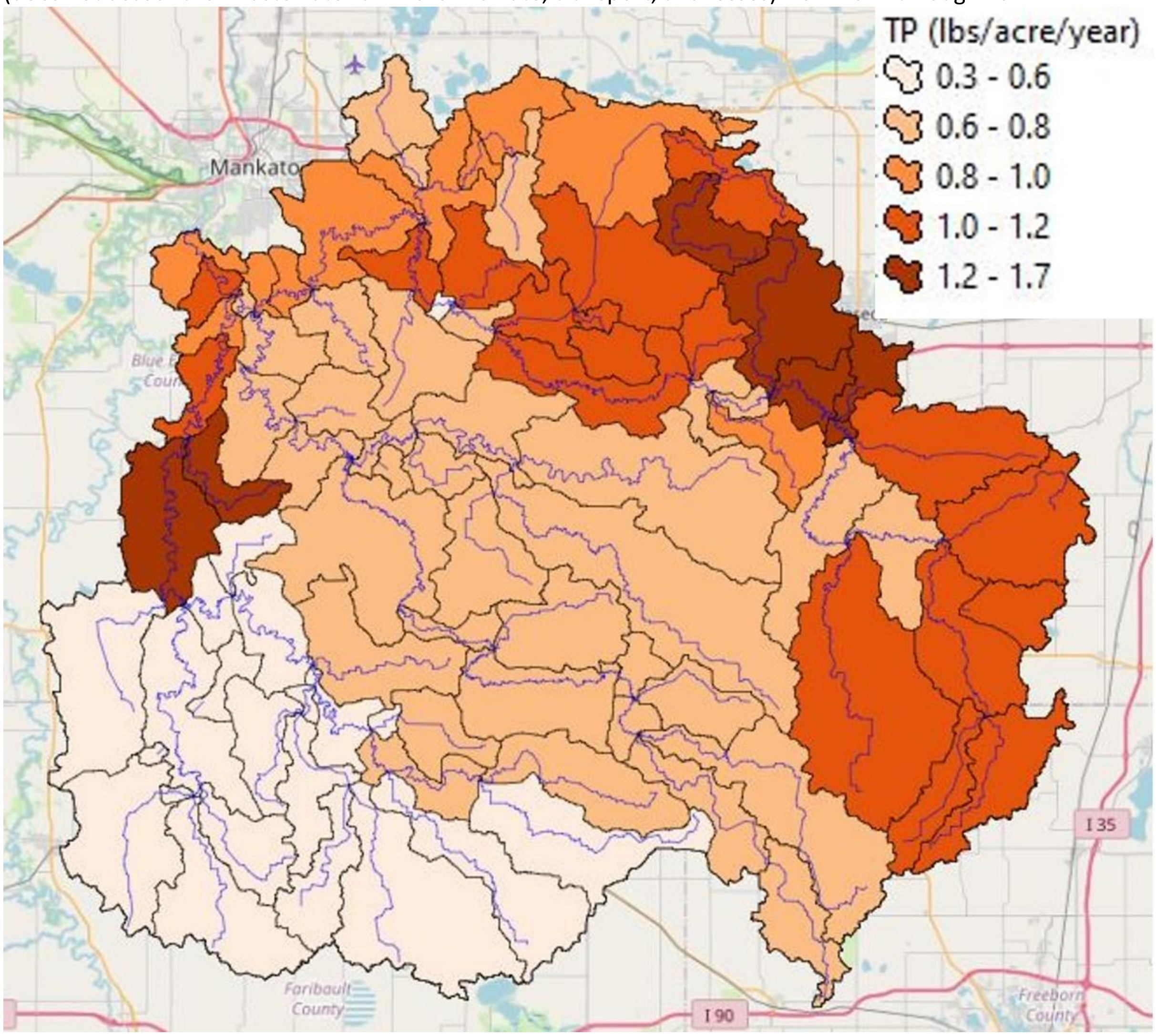
[1] Includes loading from bluff, ravine, and bed/bank erosion

[2] The loads from wastewater presented in this table take into account in-channel losses through the stream network and therefore are less than the loads presented in Table 9.

Figure 15 displays HSPF-predicted areal phosphorus subwatershed loading rates (lbs/acre/year) from upland areas to local stream channels and waterways throughout the larger Le Sueur River Watershed. The HSPF model predicts the highest subwatershed loading rates occur in areas with highly erodible soils (northern and eastern portion of the watershed) and areas with high ravine and in-channel erosion (northwest portion of watershed). The high ravine and in-channel erosion occur along the watershed's knick zone which contains migrating knickpoints where the stream slope changes in an attempt to match the much lower elevation of the Minnesota River (MPCA 2015a; Gran et al. 2009). This creates steep, eroding banks, bluffs, and ravines in the downstream portions of the river that are highly susceptible to erosion. From a management perspective, targeting upland BMPs in the high-loading subwatersheds closest to the RES impaired reaches will likely have the greatest impact in reducing phosphorus concentrations in these reaches.

Figure 15. HSPF simulated TP loading rates from upland areas to local stream channels in the Le Sueur River Watershed.

TP rates are based on HSPF average summer growing season (June through September) watershed runoff loads (does not account for wastewater or in-channel fate, transport, and losses) from 2011 through 2017.



In addition to the HSPF model, this TMDL also used monitored data upstream of the impaired reaches to evaluate what tributaries and locations throughout the Le Sueur River Watershed have the highest phosphorus concentrations and loading potential. Figure 47 through Figure 57 in Appendix B show how TP concentrations, as well as the other RES response variables, change from upstream to downstream throughout the Le Sueur River Watershed. The monitored data and the HSPF model both indicate that TP levels generally increase from upstream to downstream across the watershed.

4. TMDL development

A water body's TMDL represents the loading capacity, or the amount of pollutant that a water body can assimilate while still meeting water quality standards. The loading capacity is divided up and allocated to the water body's pollutant sources. The allocations include WLAs for NPDES-permitted sources, LAs for nonpermitted sources (including natural background), and an MOS, which is implicitly or explicitly defined. The sum of the allocations and MOS cannot exceed the loading capacity, or TMDL. This section describes the approach used to derive the TMDLs and allocations.

Reserve capacities (RCs) were included in the RES TMDLs in this report (Section 4.5.5). A RC was not assigned in the Iosco Creek *E. coli* TMDL since the existing population in the impaired reach drainage area is not currently served by permitted wastewater treatment facilities nor does it have sufficient population density to justify the use of RC.

4.1 Overall approach

The stream *E. coli* TMDL was developed using LDCs while a seasonal weighted average approach was used for the phosphorus TMDLs. More details on these approaches are in Section 4.4.1 and 4.5.1, respectively.

4.2 Seasonal variation and critical conditions

Critical conditions for the RES impaired reaches are during the summer months, which is when phosphorus and chl-*a* concentrations peak. Stream assessments for eutrophication focus on summer average TP concentration, chl-*a* concentration, BOD, and diel DO flux. The TMDL models are focused on the growing season (June 1 through September 30) as the critical condition, which inherently accounts for the seasonal variation. The frequency and severity of nuisance algal growth in Minnesota streams is typically highest during the growing season. The load reductions are designed so that the stream will meet the water quality standards over the course of the growing season as a long-term average. The nutrient standards set by the MPCA, which are a growing season concentration average rather than an individual sample (i.e., daily) concentration value, were set with this concept in mind. Additionally, by setting the TMDL to meet targets established for the applicable summer period, the TMDL will inherently be protective of water quality during all other seasons.

The application of an LDC in the *E. coli* TMDL addresses seasonal variation and critical conditions. LDCs evaluate pollutant loading across all flow regimes including high flow, which is when pollutant loading from watershed runoff is typically the greatest, and low flow, which is when loading from direct sources to the stream typically has the most impact. Because flow varies seasonally, LDCs address seasonality through their application across all flow conditions in the impaired water body. Seasonal variation and critical conditions are also addressed by the *E. coli* water quality standard, which applies from April through October. This time period is when AQR is more likely to occur in Minnesota waters and when high *E. coli* concentrations generally occur.

4.3 Baseline year

For the Iosco Creek *E. coli* impairment, the monitoring data used to calculate the percent reductions are from 2017 through 2021. The baseline year for implementation is 2019 (end of year), the midpoint of the time period. BMPs present on the landscape during the model simulation time period are implicitly accounted for in the model.

The monitoring data used to calculate the phosphorus percent reduction for the RES impaired reaches are from 2012 through 2021 for Reaches 501 and 556; and 2012, 2018, and 2019 for Reach 504. For Reaches 501 and 556, the baseline year for implementation is 2016 (end of year), the midpoint of the time period. For Reach 504, the baseline year for implementation is 2018 (end of year).

4.4 *E. coli*

Because the *E. coli* standards for the impairment addressed in this report apply April through October, the *E. coli* TMDL and allocations also apply April through October.

4.4.1 Loading capacity methodology

The loading capacities for the *E. coli* impairment were developed using an LDC. See Section 3.5 for a description of LDC development. The loading capacity was calculated as simulated flow at the downstream end of each impaired reach multiplied by the *E. coli* monthly geometric mean standard (126 org/100 mL). The LDC provides loading capacities for all flows observed in the stream along with observed loads calculated from monitoring data and simulated flow. For any given flow in the LDC, the loading capacity is determined by selecting the point on the LDC that corresponds to the flow exceedance (along the x-axis).

The LDC method is based on an analysis that encompasses the cumulative frequency of historical flow data over a specified period. Because this method uses a long-term record of daily flow volumes, virtually the full spectrum of allowable loading capacities is represented by the resulting curve. In the TMDL equation tables of this report, only five points on the entire loading capacity curve are depicted (the midpoints of the designated flow zones). However, the entire curve represents the TMDL and is what the EPA ultimately approves.

4.4.2 Margin of safety

The MOS accounts for uncertainty concerning the relationship between water quality and allocated loads. The MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as a load set aside). An explicit MOS of 10% was included in the Iosco Creek *E. coli* TMDL to account for these uncertainties. The use of an explicit MOS accounts for uncertainty in water quality monitoring, environmental variability in flow and pollutant loading, calibration and validation of modeling efforts, and uncertainty in modeling outputs. This MOS is considered to be sufficient given the robust flow dataset and the calibration results of the HSPF model. Simulated flows from the HSPF model were used to develop the LDCs for the *E. coli* impairment (the HSPF model does not simulate *E. coli* loads). The Le Sueur River HSPF model was recalibrated in 2023 and calibration results indicate that the HSPF model is a valid representation of hydrologic conditions in the watershed.

4.4.3 Wasteload allocation methodology

The WLA is allocated to existing or future NPDES-permitted pollutant sources.

4.4.3.1 Municipal and industrial wastewater

There are no permitted wastewater dischargers located in the watershed draining to the *E. coli* impaired reach.

4.4.3.2 Municipal separate storm sewer systems

There are no permitted MS4s located in the watershed draining to the *E. coli* impaired reach.

4.4.3.3 Construction stormwater

WLAs for regulated construction stormwater (MNR100001) are not developed in Minnesota because *E. coli* is not a typical pollutant from construction sites.

4.4.3.4 Industrial stormwater

Industrial stormwater receives a WLA only if the pollutant is part of benchmark monitoring for an industrial site in the watershed of an impaired water body. There are no fecal bacteria or *E. coli* benchmarks associated with the industrial stormwater general permit (MNR050000), and therefore industrial stormwater *E. coli* WLAs were not assigned.

4.4.3.5 NPDES/SDS permitted animal feeding operations

WLAs are not assigned to CAFOs, including CAFOs with NPDES or SDS permits, and CAFOs not requiring permits; this is equivalent to a WLA of zero. Although the NPDES and SDS permits allow discharge of manure and manure contaminated runoff due to a precipitation event greater than or equal to a 25-year, 24-hour precipitation event, the permits prohibit discharges that cause or contribute to nonattainment of water quality standards.

All other non-CAFO feedlots and the land application of all manure are accounted for in the LA for nonpermitted sources.

4.4.4 Load allocation methodology

The LA is allocated to existing or future nonpermitted pollutant sources. The LA was calculated as the TMDL minus the MOS and the WLAs.

Natural background conditions were also evaluated, where possible, within the modeling and source assessment portion of this study (Sections 3.7.2.6 and 3.7.2.7). For all impairments addressed in this TMDL report, natural background sources are implicitly included in the LA portion of the TMDL tables, and reductions should focus on the major human attributed sources identified in the source assessment.

4.4.5 Percent reduction

The estimated percent reduction provides a rough approximation of the overall reduction needed for the water body to meet the TMDL. The percent reduction is a means to capture the level of effort needed to reduce *E. coli* concentrations in the watershed. The percent reduction should not be construed to mean that each of the separate sources listed in the TMDL table needs to be reduced by that amount.

The existing concentration was calculated as the maximum monthly observed geometric mean *E. coli* concentration for the impaired reach. The percent reduction needed to meet the standard was calculated as the maximum monthly observed geometric mean concentration minus the geometric mean standard (126 org/100 mL) divided by the maximum monthly observed geometric mean concentration. By using the highest observed monthly geometric mean, the percent reduction calculation approximates the reduction in concentration (as opposed to load) needed to meet the monthly geometric mean standard overall, aggregated across all flow conditions.

4.4.6 TMDL summary

The Iosco Creek *E. coli* LDC and TMDL table are presented in Figure 16 and Table 17, respectively. All *E. coli* loads in Table 17 are reported in billions of org/day and were rounded to three significant figures. The estimated percent reductions needed to meet the *E. coli* TMDL is approximately 91%. The *E. coli* LDC shows *E. coli* load exceedances during all flow conditions. This suggests a variety of sources likely contribute to the impairments and load reductions will be needed from multiple source types (see Section 3.7.3). Iosco Creek daily flows simulated by the HSPF model suggest the reach is dry (i.e., no flow or stagnant flow conditions) for approximately 6% of the summer growing season (Figure 16). Thus, the TMDL for the very low flow category in Table 17 is presented as an equation rather than an absolute number.

Figure 16. Iosco Creek (07020011-576) *E. coli* load duration curve and monitored loads.

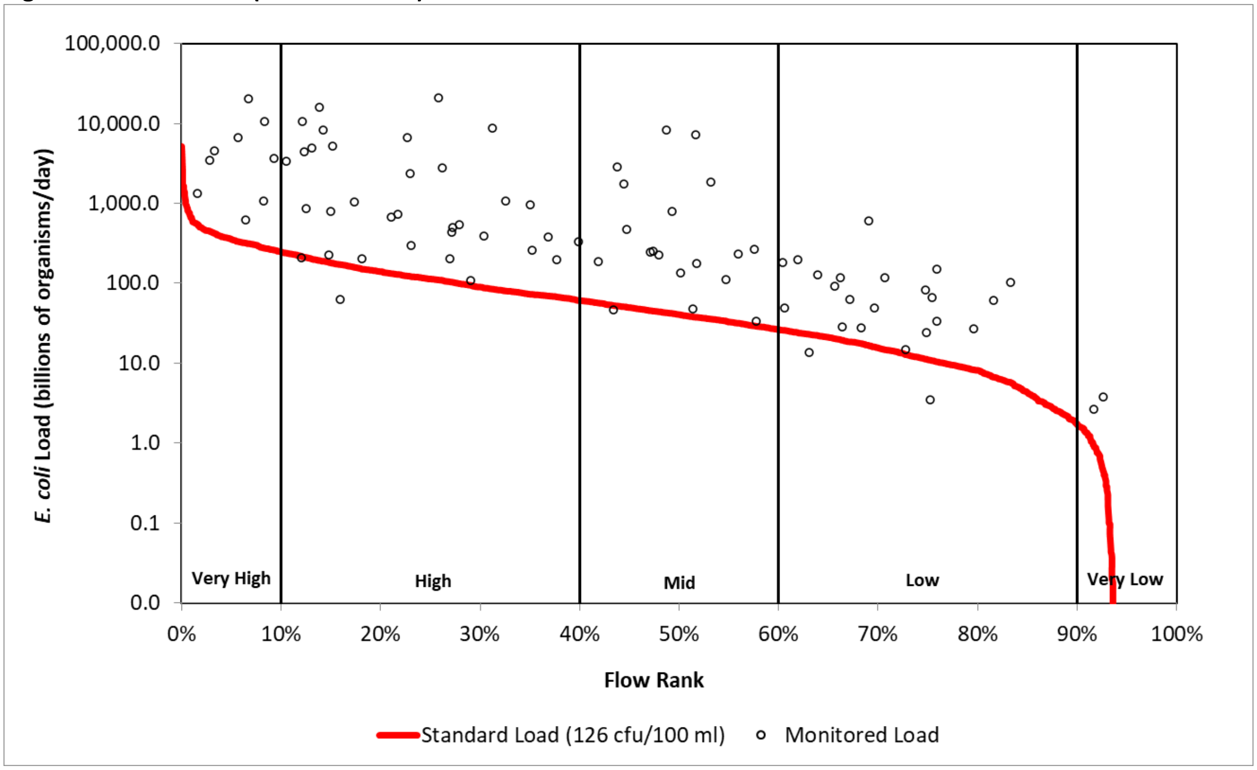


Table 17. Iosco Creek (07020011-576) *E. coli* TMDL summary.

- Listing year: 2022
- Baseline year: 2019 (end of year)
- Numeric standard used to calculate TMDL: geometric mean of 126 org/100 mL
- TMDL and allocations apply Apr-Oct

	TMDL *E. coli* load (billion org/day) by flow zone				
TMDL parameter	**Very high**	**High**	**Mid**	**Low**	**Very low**
Total LA	492	158	56.6	15.4	*
MOS	54.7	17.5	6.29	1.71	*
TMDL	547	175	62.9	17.1	*
Maximum monthly geometric mean (org/100 mL)	1,442				
Estimated percent reduction	91%				

* The median flow for the very low flow zone is zero. The allocations for this flow zone are expressed as an equation rather than an absolute number: allocation = (flow contribution from a given source) x 126 org/100 mL.

4.5 Stream Phosphorus

4.5.1 Loading capacity methodology

The loading capacities for the RES impaired reaches were calculated as the average seasonal (June through September) flow multiplied by the South River Nutrient Region TP standard of 150 µg/L. Summer average flows for each reach were estimated by taking the midpoint HSPF simulated flows of five equally spaced flow zones: 0% to 20%, 20% to 40%, 40% to 60%, 60% to 80%, and 80% to 100% exceeds flow. In other words, the average seasonal flow for each impaired reach is the average of the 10%, 30%, 50%, 70%, and 90% exceeds flows. This type of averaging was used over a simple average of all flows in order to limit the bias of very high flows on phosphorus loading, recognizing that the effects of phosphorus (i.e., algal growth) are most problematic at lower flows. Note that these five flow zones are divided differently than those typically used in TSS and *E. coli* TMDLs (i.e., 5%, 25%, 50%, 75%, and 95%). The phosphorus approach is based on using an average of the five flow zones and having five equally-sized zones avoids weighting some zones more than others when calculating the average flow condition. Table 18 provides the average seasonal flows for each exceedance interval and the resulting summer weighted average flow used to develop each RES TMDL.

Table 18. Summer weighted average flow for each RES impaired reach (2012-2021).

Exceedance interval	Le Sueur River Reach 501 (cfs)	Cobb River Reach 556 (cfs)	Little Cobb River Reach 504 (cfs)
10%	2,700	741	338
30%	1,148	335	141
50%	547	158	64
70%	241	74	25
90%	43	8	2
Weighted Average	936	263	114

4.5.2 Margin of safety

The purpose of the MOS is to account for uncertainty with the allocations resulting in attaining water quality standards. Uncertainty can be associated with data collection, lab analysis, data analysis, modeling error, and implementation activities. Quantifying the uncertainty of the various assumptions made in defining the linkage between TP loads and resulting water quality and developing the TMDLs is challenging. Therefore, an explicit MOS equal to 5% of the LC was applied in the TMDLs, based on best professional judgment. The MOS is intended to acknowledge that there is uncertainty in the linkage between TP loads and resulting water quality.

This 5% MOS is considered to be sufficient given the robust water quality and flow monitoring datasets (see Section 3.5 and 3.6), and the use of a high quality hydrologic and water quality model (HSPF) to support these TMDLs. The HSPF model for the Le Sueur River HUC-8 Watershed was originally developed in 2002 and then extended and updated in 2014 (RESPEC 2014) to better refine the model calibration. The model was further updated in 2019 by extending the simulation period through 2017 and recalibrating water quality constituents. The model was recalibrated again in 2023 to ensure the RES impaired reaches accurately represent the system and recent monitoring data during summer flow conditions. Below is a summary of the hydrologic validation statistics for the HSPF model at the Le Sueur River near Rapidan, Minnesota (USGS station ID 05320500):

- -3.19% error in total flow volume
- -26.29% error in bottom 50% low flows
- A Nash-Sutcliffe coefficient of model fit efficiency (NSE) of 0.678 for daily flows
- An NSE of 0.845 for monthly flows

Overall, the HSPF model was determined to be “Good.” There is no reason to believe a 5% MOS is inappropriate as it is consistent with HSPF modeling errors and the HSPF model is a valid representation of hydrological and chemical conditions in the watershed.

4.5.3 Boundary conditions

Boundary conditions (BCs) are used to set aside load for a geographic area in a TMDL watershed without establishing LAs or WLAs for that area. If part of an impairment watershed is covered by another TMDL, a BC can be used to allocate a lump sum load to that area. BCs were established for the five upstream impaired lakes with completed phosphorus TMDLs (see Section 3.7.2.4). It is expected that each upstream impaired lake will be at or below the lake TP standard during the summer growing season when the individual lake TMDL loading goals are achieved. Thus, the impaired lake BC for each lake was calculated as the mean summer HSPF simulated flow at the lake outlet multiplied by the TP lake water quality standard (Table 19). Since the lake TP standards are well below the 150 µg/L river TP standard, it is assumed that the loading goals identified in the lake phosphorus TMDLs will also support the river phosphorus TMDLs presented in this report.

Table 19. Boundary condition assumptions for the nutrient impaired lakes upstream of RES impairments.

Lake Name and ID	RES impaired reach(es)	Lake TP Standard (µg/L)	HSPF simulated mean summer outflow (cfs)	Percent of impaired reach drainage area flow	BC TP load allocation (lbs/day)
Eagle 07-0060-01	501	60	6.0	0.64% (501)	1.95
Elysian 81-0095-00	501	60	42.7	4.56% (501)	13.80
Freeborn 24-0044-00	556, 501	90	6.6	2.50% (556); 0.70% (501)	3.18
Lura 07-0079-00	501	90	0.6	0.07% (501)	0.30
Madison 07-0044-00	501	40	11.4	1.22% (501)	2.47
				Total BC load for Reach 501	21.70
				Total BC load for Reach 556	3.18

4.5.4 Wasteload allocation methodology

The WLA is allocated to existing or future NPDES-permitted pollutant sources.

4.5.4.1 Municipal and industrial wastewater

There are two technical memorandums (memos) that investigate the potential of the 11 active NPDES dischargers to contribute to phosphorus impairments in the Minnesota River and the Le Sueur River Watershed. The MPCA’s “Phosphorus Effluent Limit Review: Minnesota River Basin” memo (Wasley 2017; Appendix D) evaluated a range of sediment and nutrient reduction scenarios using HSPF to determine TP WLAs needed for attainment of RES criteria in the Minnesota River that are consistent with the WLAs established for the Lower Minnesota River DO TMDL (MPCA 2004). For these scenarios, it was demonstrated that average summer TP concentrations within the Minnesota River would meet RES and TMDL TP targets as long as two conditions were met: 1) a broad suite of nonpoint source BMPs are implemented that targeted TSS and TP reductions; and 2) effluent limits for all permitted mechanical plants are established at levels identified in the memo.

The “Phosphorus Effluent Limit Review for the Le Sueur River Watershed Version 1.4” memo (Lindon 2017; Appendix E) was developed shortly after the Minnesota River Basin memo and focused specifically on TP contributions from the 11 wastewater facilities that discharge upstream of the three RES impaired reaches in the Le Sueur River Watershed.

The memo determined that the four *mechanical* (noted as “continuous” flow type in Table 20) plant TP effluent limits needed to achieve RES criteria in the Minnesota River and the TP targets in the Lower Minnesota River DO TMDL also support achievement of the RES standards in the Le Sueur River impaired reaches. Further, the mechanical plant TP limits identified for the Minnesota River are more restrictive than those established in the Lake Pepin and Mississippi River TMDL Report (MPCA 2021b), and therefore are protective of that TMDL. As a result, the mechanical facility TP WLAs developed for the Le Sueur River and Minnesota River memos were determined appropriate and are used in this TMDL study (Table 20). As of June 2024, NPDES/SDS permits for four of the mechanical plants in the Le Sueur River Watershed (Amboy WWTP, New Richland WWTP, St. Clair WWTP, and Waseca WWTP) include June through September TP effluent limits that are consistent with the WLAs developed in the previous memos and this TMDL.

NPDES/SDS permit conditions for the seven active *controlled discharge* stabilization pond facilities in the Le Sueur River Watershed restrict discharge between June 15 and September 15. This leaves 30 days during the 122-day growing season in which the pond facilities can discharge (24.6% of growing-season days). Based on a review of MPCA discharge monitoring reports (DMRs), all seven pond facilities have discharged on average six days or less per summer over the past five years (2019 through 2023) (see Table 26 in Section 8.1.4). Three of the pond facilities (Janesville WWTP, Mapleton WWTP, and Wells Public Utilities) have large secondary pond cells (22 acres to 95.5 acres) that result in large daily effluent design flows that are approximately equal to, or in the case of Wells Public Utilities several times greater than, the largest mechanical facility in the Le Sueur River Watershed—Waseca WWTP. Allocating these facilities for 30 days at their full daily effluent design flows would result in very large WLAs that are not considered to be necessary based on current or expected future facility operations. Further, allocations based on effluent design flows would significantly decrease the loading capacity available to other WLA and LA sources throughout the watershed (e.g., MS4s, construction and industrial stormwater, nonpoint watershed runoff). Thus, the following assumptions and approach were used to calculate TP WLAs for each controlled pond facility in the Le Sueur River Watershed:

- A daily WLA flow in million gallons per day (mgd) was calculated for each pond facility that assumes a 6-inch drawdown rate per day across average operational surface area of each facility’s secondary pond(s).
- For small pond facilities (daily WLA flow <1 mgd), total summer period TP WLAs were calculated by multiplying each facility’s WLA flow by a 2.0 mg/L TP concentration target, a unit correction factor, and an assumed maximum summer discharge volume of 15 days at the WLA daily flow rate. The summer TP WLAs were divided by 122 days to calculate daily TP WLAs for each facility.
- For large pond facilities (daily WLA flow >1 mgd), total summer period TP WLAs were calculated by multiplying each facility’s WLA flow by a 1.0 mg/L TP concentration target, a unit correction

factor, and an assumed maximum summer discharge volume of 15 days at the WLA daily flow rate. The summer TP WLAs were divided by 122 days to calculate daily TP WLAs for each facility.

The pond facility TP WLAs developed for the Lake Pepin and Mississippi River TMDL (MPCA 2021b) are presented as annual loads. The following equation was used to convert the annual Lake Pepin TMDL WLAs to summer loads so that they could be compared to the summer TP WLAs developed for this TMDL:

$$\text{Pepin TMDL allowable summer TP load} = \text{annual TP WLA} \div 365 \text{ days} \times 30 \text{ discharge days}$$

For all seven controlled pond facilities in the Le Sueur River Watershed, the Lake Pepin TMDL summer period allowable TP loads are less than the summer TP WLA targets presented in Table 20. Therefore, annual permit limits consistent with the Lake Pepin WLAs will be sufficient to meet the summer and daily RES WLAs for controlled pond facilities in the Le Sueur River Watershed.

Implementation of the pond facility TP WLAs should not be evaluated based on the individual conditions used to develop the TMDL WLAs (i.e., WLA flow, TP concentration target, max summer discharge period). Rather, TMDL implementation for each facility should be measured by comparing long-term (e.g., 5-year rolling average) monitored summer TP loads to the summer TP WLAs presented in Table 20. Table 26 in Section 8.1.4 provides a summary of each facility's average monitored summer phosphorus load over the last five years compared to the summer WLAs presented in Table 20. All pond facilities in the Le Sueur River Watershed currently meet the WLAs presented in this report and should be able to continue meeting their WLAs by minimizing discharge and effluent TP concentrations during the summer period.

Table 20. Individual TP WLAs for permitted wastewater facilities in the RES impaired reach drainage areas.

Facility name	Permit number (surface discharge station)	Flow type	Impaired water body WID(s)	WLA flow (mgd)[1]	WLA TP concentration (mg/L)	Le Sueur TMDL Summer discharge assumption for WLA calculation (days)	Le Sueur TMDL Summer period TP WLA (lbs/summer)	Le Sueur TMDL Daily TP WLA (lbs/day)	Pepin TMDL controlled facility Summer TP WLA (lbs/summer)	Existing permit consistent with WLA assumptions
Amboy WWTP	MN0022624-SD 002	Continuous	501	0.287	0.63	122	183	1.50	NA	Y
Delavan WWTP	MNG585109-SD 001	Controlled	501	0.407	2.00	15	102	0.83	26	Y
Freeborn WWTP	MNG585018-SD 001	Controlled	501, 556	0.244	2.00	15	61	0.50	18	Y
Good Thunder WWTP	MNG585206-SD 002	Controlled	501	0.709	2.00	15	177	1.45	42	Y
Hartland WWTP	MNG585102-SD 001	Controlled	501	0.396	2.00	15	99	0.81	22	Y
Janesville WWTP	MNG585025-SD 003	Controlled	501	3.421	1.00	15	428	3.51	86	Y
Mapleton WWTP	MNG585089-SD 001	Controlled	501, 556	3.584	1.00	15	448	3.68	101	Y
New Richland WWTP	MN0021032-SD 002	Continuous	501	0.600	0.63	122	385	3.15	NA	Y
Saint Clair WWTP	MN0024716-SD 001	Continuous	501	0.212	0.64	122	137	1.12	NA	Y
Waseca WWTP	MN0020796-SD 003	Continuous	501	3.500	0.37	122	1,320	10.82	NA	Y
Wells Public Utilities	MN0025224-SD 006	Controlled	501	15.559	1.00	15	1,947	15.96	218	Y

[1] For controlled (pond) facilities, WLA flow was calculated assuming a 6-inch drawdown rate per day across average operational surface area of each facility's secondary pond(s).

4.5.4.2 Municipal separate storm sewer systems

There are seven permitted MS4s in the watersheds of the RES impaired reaches (Table 21). All the MS4s drain to the Le Sueur River and are therefore included in the RES TMDL for Le Sueur River Reach 501. There are no permitted MS4s in the watersheds to Cobb River Reach 556 or Little Cobb River Reach 504. Figure 1 shows the MS4 boundaries and their locations in the Le Sueur River Watershed. MS4 areas located within the Eagle Lake impaired lake BC were excluded from this TMDL because these areas of the Le Sueur River Watershed are covered by an approved TMDL that are protective of this TMDL.

Legislation passed in 2019, and subsequently amended in 2021, changed the regulated area for certain MS4s, including Eagle Lake City, and Mankato and South Bend townships. To accommodate potential future changes to regulated areas per this legislation, WLAs were developed for all of the municipalities in the study area using their entire jurisdictional areas within the impaired reach watersheds, instead of only currently regulated areas. As of the 2020 Decennial Census, Eagle Lake City is no longer located within the census-defined urban area and may be released from MS4 General Permit regulation. They are still included in the area estimations and TMDL tables to reflect their permit condition at the time of TMDL development, and the uncertainty of changes in permit status.

MS4 regulation for permitted transportation authorities apply to roads within the 2020 Urban Area with population over 50,000 as determined by the U.S. Census Bureau. Therefore, the WLA areas for Blue Earth County and MnDOT MS4s were approximated using buffers to the centerlines of roads owned by the respective entity. Ninety-foot buffers were used for MnDOT and 35-foot buffers for Blue Earth County. The buffers were excluded from the areas for townships and cities and clipped to the 2020 Census Urban Area with population over 50,000.

The approximated WLA area of each MS4 was divided by the total area of the watershed (710,650 acres) minus the BCs to represent the percent coverage of the permitted MS4 within the impairment watershed (Table 21). The WLAs for the permitted MS4s were calculated as the percent coverage of the permitted MS4 multiplied by the loading capacity minus the RC, MOS, BC, and wastewater WLAs.

Assigned WLAs will result in additional MS4 permit requirements per the next MS4 General Permit; see Section 8.1.3 and Appendix C for more information.

Table 21. Permitted MS4s and estimated jurisdictional area for RES impairments.

MS4 name and permit number	Estimated WLA area (ac)	Estimated jurisdictional percent area of watershed[1]	Impaired water body	Impaired water body WID(s)	Pollutant
Mankato Township (MS400297)	9,295	1.31%	Le Sueur River	501	TP
Mankato City (MS400226)	1,624	0.23%	Le Sueur River	501	TP
Eagle Lake City[2] (MS400284)	1,074	0.15%	Le Sueur River	501	TP
South Bend Township (MS400299)	850	0.12%	Le Sueur River	501	TP

MS4 name and permit number	Estimated WLA area (ac)	Estimated jurisdictional percent area of watershed[1]	Impaired water body	Impaired water body WID(s)	Pollutant
Waseca City (MS400258)	354	0.05%	Le Sueur River	501	TP
MnDOT ROW Outstate District (MS400180)	75	0.01%	Le Sueur River	501	TP
Blue Earth County ROW (MS400276)	5	0.001%	Le Sueur River	501	TP

[1] Does not include BCs (i.e., area draining to upstream impaired lakes)
[2] Eagle Lake City may be released from MS4 General Permit regulation but is included here to reflect permit status at the time of TMDL development.

4.5.4.3 Construction stormwater

WLAs are assigned to permitted construction stormwater (NPDES permit MNR100001) to account for existing and potential future sources. A categorical WLA for construction stormwater was calculated for each RES TMDL. On average, 0.05% of the area in the Le Sueur River Watershed is under construction stormwater permit coverage (2017 through 2021). Construction stormwater WLAs were calculated as 0.05% multiplied by the loading capacity minus the RC, MOS, BC, and wastewater WLAs. The WLAs for permitted construction stormwater within MS4 areas are combined with the individual MS4 WLAs, as any activity within these areas are presumed to discharge to the MS4.

4.5.4.4 Industrial stormwater

Industrial stormwater is regulated through NPDES permits (MNR050000 and MNG490000) when stormwater discharges have the potential to come into contact with materials and activities associated with the industrial activity. To allow for current and future permitted industrial stormwater activities, the WLA for industrial stormwater was calculated as equal to the construction stormwater WLA: 0.05% multiplied by the loading capacity minus the RC, MOS, BC, and wastewater WLAs. The WLAs for permitted industrial stormwater within MS4 areas are combined with the MS4 WLA, as any activity within these areas is presumed to discharge to the MS4.

4.5.4.5 NPDES/SDS permitted animal feeding operations

WLAs are not assigned to CAFOs, including CAFOs with NPDES or SDS permits, and CAFOs not requiring permits; this is equivalent to a WLA of zero. Although the NPDES and SDS permits allow discharge of manure and manure contaminated runoff due to a precipitation event greater than or equal to a 25-year, 24-hour precipitation event, the permits prohibit discharges that cause or contribute to nonattainment of water quality standards.

All other non-CAFO feedlots and the land application of all manure are accounted for in the LA for nonpermitted sources.

4.5.5 Reserve capacity

The RC represents a set-aside load for potential future loading sources. In this TMDL report, the RC is reserved for projects that address failing or nonconforming septic systems and unsewered communities and will be made available only to new WWTPs or existing WWTPs that provide service to existing populations with failing or nonconforming systems. The potential need for RC for these situations has been estimated based on the assumption that 10% of the unsewered population within the project watershed may discharge to WWTPs in the future. The potential TP load from future WWTPs serving these populations has been calculated based on an assumption of 0.8 kg/capita/year of TP load to the WWTP and a reduction efficiency of 80% at the WWTP, resulting in a load to the receiving water of 0.16 kg/capita/year (MPCA 2012b).

The Le Sueur River Watershed is likely to have "unsewered" communities become "sewered" in the future, and therefore a RC was allocated for each RES impaired reach addressed in this TMDL report. A summary of the RC calculations for future "sewered" communities is presented in Table 22.

Table 22. Reserve capacity for futured "sewered" communities in the Le Sueur River RES impaired reaches.

Impaired water body WID	Estimated population not currently connected to NPDES WWTP	Estimated required future population	Estimated untreated TP load (lbs/yr)	Reserve Capacity (80% removal) (lbs/yr)	Reserve Capacity (80% removal) (lbs/day)
501	12,772	1,277	2,253	451	1.23
556	2,725	273	481	96	0.26
504	1,017	102	179	36	0.10

4.5.6 Load allocation methodology

The LA is comprised of the nonpoint source load that is allocated to an impaired reach after the WLAs (point sources, construction and industrial stormwater), MOS, BC, and RC were determined and subtracted from the total LC. This residual remaining LC is meant to represent all nonregulated (nonpoint) sources of phosphorus upstream of the impaired reaches. The LA includes nonpoint pollution sources that are not subject to NPDES Permit requirements such as wind-blown materials, soil erosion from stream channel and upland areas, and natural background. The LA also includes runoff from agricultural lands and non-MS4 stormwater runoff.

Natural background conditions were also evaluated, where possible, within the modeling and source assessment portion of this study (Section 3.7.2.6). Natural background sources are implicitly included in the LA portion of the TMDL tables, and reductions should focus on the major human attributed sources identified in the source assessment.

4.5.7 Percent reduction

The existing TP concentration for each impaired reach was calculated by taking the average summer growing season TP concentration for years with available data (see Table 7). The overall estimated concentration-based percent reduction needed to meet the TMDL was calculated as the existing TP concentration minus the TP standard (150 µg/L) divided by the existing concentration. The percent reduction reported in the TMDL tables represent the overall reductions needed to meet the TMDLs but do not necessarily apply to each of the sources/allocations individually.

4.5.8 TMDL summary

The TP TMDL tables (Table 23 through Table 25) present the TMDL, MOS, WLAs, RC, BC, and the LAs for each RES impaired reach. TMDL allocations for the impaired reaches include the entire watershed draining to the reach. All values in the tables have been rounded to the nearest hundredth of a pound.

Table 23. Le Sueur River (07020011-501) TP TMDL summary.

- Listing year or proposed year: 2016
- Baseline year: 2016 (end of year)
- Numeric standard used to calculate TMDL: 150 µg/L TP
- TMDL and allocations apply June 1 - September 30
- Flow used to develop TMDL: HSPF simulated flow from June - September for HSPF reach 850 (2012-2017) and June through September monitored flow from Le Sueur River USGS station 05320500 (2018-2021) (see Table 18)

TMDL parameter		TMDL TP load (lbs/day)
WLA[4]	Amboy WWTP[1] (MN0022624)	1.50
	Delavan WWTP[1] (MNG585109)	0.83
	Freeborn WWTP[1] (MNG585018)	0.50
	Good Thunder WWTP[1] (MNG585206)	1.45
	Hartland WWTP[1] (MNG585102)	0.81
	Janesville WWTP[1] (MNG585025)	3.51
	Mapleton WWTP[1] (MNG585089)	3.68
	New Richland WWTP[1] (MN0021032)	3.15
	Saint Clair WWTP[1] (MN0024716)	1.12
	Waseca WWTP[1] (MN0020796)	10.82
	Wells Public Utilities WWTP[1] (MN0025224)	15.96
	Mankato Township MS4 (MS400297)[2]	9.28
	Mankato City MS4 (MS400226)[2]	1.62
	Eagle Lake City MS4 (MS400284)[2]	1.07
	South Bend Township MS4 (MS400299)[2]	0.85
	Waseca City MS4 (MS400258)[2]	0.35
	MnDOT ROW MS4 (MS400180)[2]	0.07
	Blue Earth County ROW MS4 (MS400276)[2,5]	0.01
	Construction stormwater[2]	0.29
	Industrial stormwater[2]	0.29
	Total WLA	57.16
BC (Eagle, Elysian, Freeborn, Lura, Madison Lakes)		21.70
MOS		37.86
RC		1.23
Total LA[2]		639.26
TMDL		757.21
Existing summer mean TP concentration (µg/L)[3]		432
Estimated percent reduction[3]		65%

[1] Existing NPDES/SDS TP limits are sufficient to ensure compliance with these WLAs

[2] The daily WLAs for MS4s, construction and industrial stormwater, and the total LA (i.e., nonpermitted watershed runoff) equate to a mean summer TP runoff concentration target of 141 µg/L. This target is for the outlet of Reach 501 and therefore

includes losses of phosphorus in the impaired reach and stream network upstream of the impaired reach (see Sections 3.7.2.1 and 8.1.3 for further discussion)
[3] Water quality monitoring station(s) used to estimate reductions: S000-340
[4] WLAs for Pemberton WWTF and Waldorf WWTF were not developed for this TMDL because they are not authorized to discharge from June 1 through September 30 (see Section 3.7.1.1)
[5] Blue Earth County MS4 is not a significant contributor to the impairment in Reach 501, see Appendix C

Table 24. Cobb River (07020011-556) TP TMDL summary.

- Listing year or proposed year: 2016
- Baseline year: 2016 (end of year)
- Numeric standard used to calculate TMDL: 150 µg/L TP
- TMDL and allocations apply June 1 through September 30
- Flow used to develop TMDL: HSPF simulated flow from June through September for HSPF reach 751 (2012-2017) and June through September simulated flows (2018-2021) based on regression relationship between Le Sueur River USGS station 05320500 and HSPF reach 751 (see Section 3.5 and Table 18)

TMDL parameter		TMDL TP load (lbs/day)
WLA[4]	Freeborn WWTP[1] (MNG585018)	0.50
	Mapleton WWTP[1] (MNG585089)	3.68
	Construction stormwater[2]	0.09
	Industrial stormwater[2]	0.09
	Total WLA	4.36
BC (Freeborn Lake)		3.18
MOS		10.50
RC		0.26
Total LA[2]		191.70
TMDL		210.00
Existing summer mean TP concentration (µg/L)[3]		308
Estimated percent reduction[3]		51%

[1] Existing NPDES/SDS TP limits are sufficient to ensure compliance with these WLAs
[2] The daily WLAs for construction and industrial stormwater and the total LA (i.e., nonpermitted watershed runoff) equate to a mean summer TP runoff concentration target of 141 µg/L. This target is for the outlet of Reach 556 and therefore includes losses of phosphorus in the impaired reach and stream network upstream of the impaired reach (see Section 3.7.2.1 further discussion)
[3] Water quality monitoring station(s) used to estimate reductions: S003-446
[4] WLAs for Pemberton WWTF and Waldorf WWTF were not developed for this TMDL because they are not authorized to discharge from June 1 through September 30 (see Section 3.7.1.1)

Table 25. Little Cobb River (07020011-504) TP TMDL summary.

- Listing year or proposed year: 2016
- Baseline year: 2018 (end of year)
- Numeric standard used to calculate TMDL: 150 µg/L TP
- TMDL and allocations apply June 1 through September 30
- Flow used to develop TMDL: HSPF simulated flow from June through September for HSPF reach 743 (2012-2017) and June through September simulated flows (2018-2021) based on regression relationship between Le Sueur River USGS station 05320500 and HSPF reach 743 (see Section 3.5 and Table 18)

TMDL parameter		TMDL TP load (lbs/day)
WLA	Construction stormwater[1]	0.04
	Industrial stormwater[1]	0.04
	Total WLA	0.08
MOS		4.26
RC		0.10
Total LA[1]		80.84
TMDL		85.28
Existing summer mean TP concentration (µg/L)[2]		187
Estimated percent reduction[3]		20%

[1] The daily WLAs for construction and industrial stormwater and the total LA (i.e., nonpermitted watershed runoff) equate to a mean summer TP runoff concentration target of 141 µg/L. This target is for the outlet of Reach 504 and therefore includes losses of phosphorus in the impaired reach and stream network upstream of the impaired reach (see Section 3.7.2.1 further discussion).

[2] Water quality monitoring station(s) used to estimate reductions: S003-574.

5. Future growth considerations

Potential changes in population and land cover over time in the Le Sueur River Watershed could result in changing pollutant sources and water quality conditions. According to the Minnesota State Demographic Center (Minnesota Department of Administration 2023) from 2020 to 2040, the populations of three of the five counties in the Le Sueur River Watershed are projected to decrease by 12% (Faribault County), 6.5% (Freeborn County), and 6.1% (Waseca County). Populations of Blue Earth and Steele Counties are expected to increase by approximately 13% and 2.2%, respectively, between 2020 and 2040. These projected increases are primarily driven by growth of the city of Mankato area in Blue Earth County and the city of Owatonna in Steele County. The overall projection for all five counties is a 2.8% population increase between 2020 and 2040. However, it should be noted that the city of Owatonna is not in or adjacent to the Le Sueur River Watershed and only a small portion of the city of Mankato's municipal boundary is located within the Le Sueur River Watershed. For these reasons the MPCA does not anticipate significant population growth within the Le Sueur River Watershed over the next 20 years.

5.1 New or expanding permitted MS4 WLA transfer process

Future transfer of watershed runoff loads in this TMDL may be necessary if any of the following scenarios occur within the project watershed boundaries.

1. New development occurs within a permitted MS4. Newly developed areas that are not already included in the WLA must be transferred from the LA to the WLA to account for the growth.
2. One permitted MS4 acquires land from another permitted MS4. Examples include annexation or highway expansions. In these cases, the transfer is WLA to WLA.
3. One or more nonpermitted MS4s become permitted. If this has not been accounted for in the WLA, then a transfer must occur from the LA.
4. Expansion of a U.S. Census Bureau Urbanized Area encompasses new regulated areas for existing permittees. An example is existing state highways that were outside an urban area at the time the TMDL was completed but are now inside a newly expanded urban area. This will require either a WLA to WLA transfer or a LA to WLA transfer.
5. A new MS4 or other stormwater-related point source is identified and is covered under an NPDES permit. In this situation, a transfer must occur from the LA.

Load transfers will be based on methods consistent with those used in setting the allocations in this TMDL. In cases where WLA is transferred from or to a permitted MS4, the permittees will be notified of the transfer and have an opportunity to comment.

5.2 New or expanding wastewater

The MPCA, in coordination with the EPA Region 5, has developed a streamlined process for setting or revising WLAs for new or expanding wastewater discharges to water bodies with an EPA approved TMDL for TSS or *E. coli* (described in MPCA 2012c). This procedure will be used to update WLAs in approved TMDLs for new or expanding wastewater dischargers whose permitted effluent limits are at or below the instream target and will ensure that the effluent concentrations will not exceed applicable water quality standards or surrogate measures. The process for modifying any and all WLAs will be handled by the MPCA, with input and involvement by the EPA, once a permit request or reissuance is submitted. The overall process will use the permitting public notice process to allow for the public and EPA to comment on the permit changes based on the proposed WLA modification(s). Once any comments or concerns are addressed, and the MPCA determines that the new or expanded wastewater discharge is consistent with the applicable water quality standards, the permit will be issued and any updates to the TMDL WLA(s) will be made.

A small phosphorus RC was set aside for the RES TMDLs for future treatment of unsewered communities that may become sewered and discharge to a WWTP in the future. Because phosphorus loading must be reduced substantially to the impaired reaches, there is little capacity for new sources that will result in more phosphorus being added during the months of June through September. For this reason, only a small RC is available to establish WLAs for the conversion of existing phosphorus loads. The RC will support projects that convert unsewered communities to sewered communities and will be made available only to new WWTPs or existing WWTPs that provide service to existing unsewered populations.

6. Reasonable assurance

"Reasonable assurance" shows that elements are in place, for both permitted and nonpermitted sources, that are making (or will make) progress toward needed pollutant reductions.

6.1 Reduction of permitted sources

6.1.1 Permitted MS4s

The MPCA is responsible for applying federal and state regulations to protect and enhance water quality in Minnesota. The MPCA oversees stormwater management accounting activities for all MS4 entities listed in this TMDL report. The MS4 General Permit requires regulated municipalities to implement BMPs that reduce pollutants in stormwater to the maximum extent practicable. A critical component of permit compliance is the requirement for the owners or operators of a permitted MS4 conveyance to develop a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP addresses all permit requirements, including the following six measures:

- Public education and outreach
- Public participation
- Illicit discharge detection and elimination program
- Construction site runoff controls
- Post-construction runoff controls
- Pollution prevention and municipal good housekeeping measures

A SWPPP is a management plan that describes the MS4 permittee's activities for managing stormwater within their regulated area. In the event of a completed TMDL study, MS4 permittees must document the WLA in their future NPDES/SDS permit application and provide an outline of the BMPs to be implemented that address needed reductions. The MPCA requires MS4 owners or operators to submit their application and corresponding SWPPP document to the MPCA for review. Once the application and SWPPP are deemed complete by the MPCA, all application materials are placed on 30-day public notice, allowing the public an opportunity to review and comment on the prospective program. Once NPDES/SDS permit coverage is granted, permittees must implement the activities described within their SWPPP and submit an annual report to the MPCA documenting the implementation activities completed within the previous year, along with an estimate of the cumulative pollutant reduction achieved by those activities.

This TMDL report assigns WLAs to permitted MS4s in the study area. The MS4 General Permit requires permittees to develop compliance schedules for EPA approved TMDL WLAs not already being met at the time of permit application. A compliance schedule includes BMPs that will be implemented over the permit term, a timeline for their implementation, and a long-term strategy for continuing progress toward assigned WLAs. For WLAs being met at the time of permit application, the same level of treatment must be maintained in the future. Regardless of WLA attainment, all permitted MS4s are still required to reduce pollutant loadings to the maximum extent practicable.

The MPCA's stormwater program and its NPDES permit program are regulatory activities providing reasonable assurance that implementation activities are initiated, maintained, and consistent with WLAs assigned in this study.

6.1.2 Permitted construction stormwater

Regulated construction stormwater was given a categorical WLA is this study. Construction activities disturbing one acre or more are required to obtain NPDES permit coverage through the MPCA. Compliance with TMDL requirements are assumed when a construction site owner/operator meets the conditions of the Construction General Permit and properly selects, installs, and maintains all BMPs required under the permit, including any applicable additional BMPs required in Section 23 of the Construction General Permit for discharges to impaired waters, or compliance with local construction stormwater requirements if they are more restrictive than those in the State General Permit.

6.1.3 Permitted industrial stormwater

Industrial stormwater was given a categorical WLA in this study. Industrial activities require permit coverage under the state's NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) or NPDES/SDS Nonmetallic Mining/Associated Activities General Permit (MNG490000). If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS permit and properly selects, installs, and maintains BMPs sufficient to meet the benchmark values in the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report.

6.1.4 Permitted wastewater

Any NPDES permitted facility discharging wastewater that has a reasonable potential to cause or contribute to the water quality impairments addressed by these TMDLs include, or will include upon permit reissuance, water quality based effluent limits that are consistent with the assumptions and requirements of these TMDL WLAs. Discharge monitoring is conducted by permittees and routinely submitted to the MPCA for review.

NPDES/SDS permits for discharges that may cause or have reasonable potential to cause or contribute to an exceedance of a water quality standard are required to contain water quality-based effluent limits (WQBELs) consistent with the assumptions and requirements of the WLAs in this TMDL report. Attaining the WLAs, as developed and presented in this TMDL report, is assumed to ensure meeting the water quality standards for the relevant impaired waters listings. During the permit issuance or reissuance process, wastewater discharges will be evaluated for the potential to cause or contribute to violations of water quality standards. WQBELs will be developed for facilities whose discharges are found to have a reasonable potential to cause or contribute to exceedances of applicable water quality standards. The WQBELs will be calculated based on low flow conditions, may vary slightly from the TMDL WLAs, and will include concentration based effluent limitations.

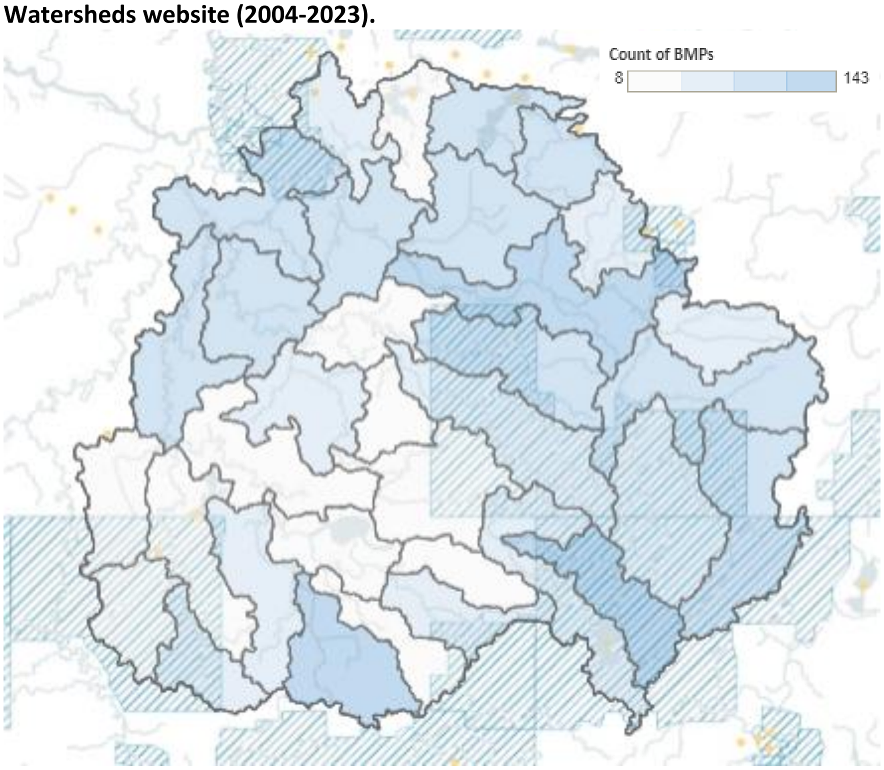
6.1.5 Permitted feedlots

See the discussion of the state's Feedlot Program in Section 6.2.2, which applies to both permitted and nonpermitted feedlots.

6.2 Reduction of nonpermitted sources

Several nonpermitted reduction programs exist to support implementation of nonpoint source reduction BMPs in the Le Sueur River Watershed. These programs identify BMPs, provide means of focusing BMPs, and support their implementation via state initiatives, ordinances, and/or dedicated funding. Figure 17 shows the number of BMPs per subwatershed, as tracked on the MPCA's Healthier Watersheds website.

Figure 17. Number of BMPs per subwatershed in the Le Sueur River Watershed; data from the MPCA's Healthier Watersheds website (2004-2023).



Many soil and water conservation districts (SWCDs) are active in the project area, and many provide technical and financial assistance to reduce impacts from agricultural and urban sources. Focus areas include nutrient management and tillage practices to reduce sediment and nutrient loading. Many practices recommended to landowners are designed to provide multiple water quality benefits including diversifying crops, expanding buffer opportunities, improving manure storage and application, and mitigating impacts of tile drainage.

The following examples describe large-scale programs that have proven to be effective and/or will reduce pollutant loads going forward.

6.2.1 SSTS regulation

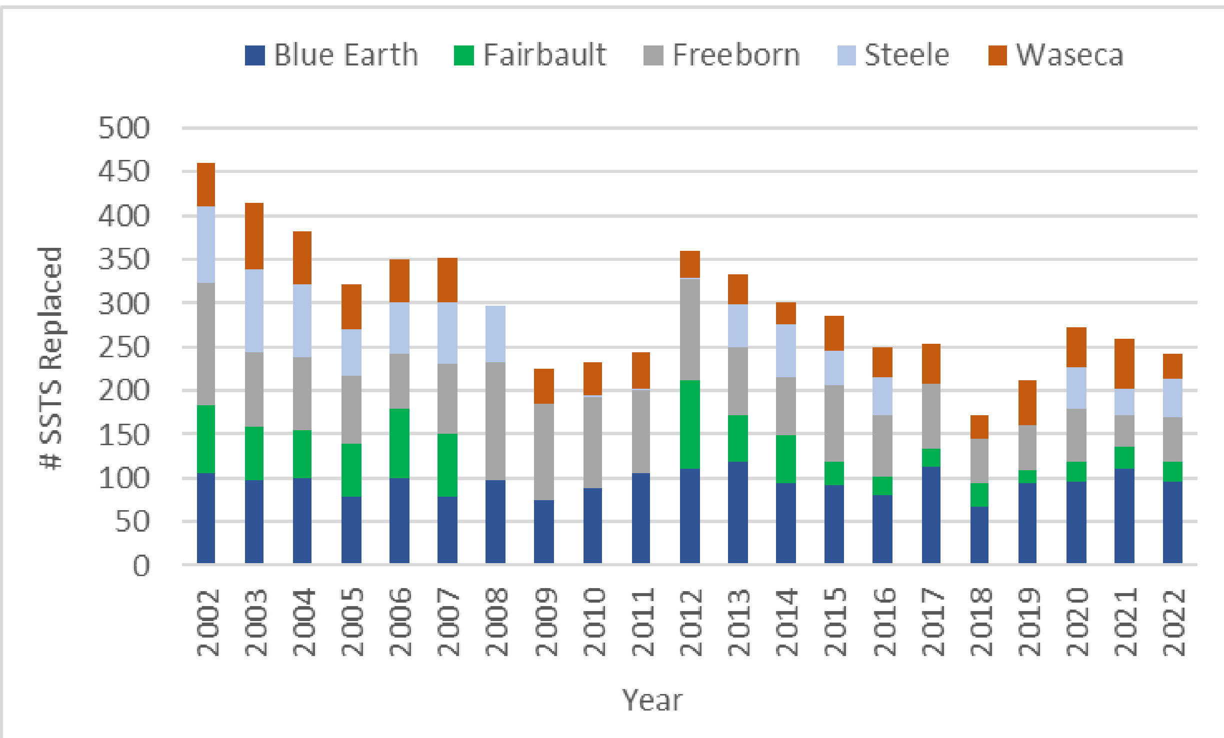
SSTSs are regulated through Minn. Stat. §§ 115.55 and 115.56. SSTS specific rule requirements can be found in Minn. R. 7080 through 7083. Regulations include the following:

- Minimum technical standards for design and installation of individual and mid-size SSTS.
- A framework for local units of government to administer SSTS programs.

- Statewide licensing and certification of SSTS professionals, SSTS product review and registration, and establishment of the SSTS Advisory Committee.
- Various ordinances for SSTS installation, maintenance, and inspection.

Each county maintains an SSTS ordinance, in accordance with Minn. Stat. and Minn. R., establishing minimum requirements for regulation of SSTS, for the treatment and dispersal of sewage within the applicable jurisdiction of the county, to protect public health and safety, to protect groundwater quality, and to prevent or eliminate the development of public nuisances. Ordinances serve the best interests of the county's citizens by protecting health, safety, general welfare, and natural resources. In addition, each county zoning ordinance prescribes the technical standards that on-site septic systems are required to meet for compliance and outlines the requirements for the upgrade of systems found not to be in compliance. This includes systems subject to inspection at transfer of property, upon the addition of living space that includes a bedroom and/or a bathroom, and at discovery of the failure of an existing system. Since 2002, it is estimated that the counties within the Le Sueur River Watershed have, on average, replaced 296 SSTS systems per year (Figure 18).

Figure 18. Estimated SSTS replacements by county by year.
Note: the numbers presented in this figure are county estimates provided to MPCA for reporting purposes and are not intended to be exact values.



All ITPHS are recorded in a statewide database by the MPCA. From 2006 to 2019, 797 alleged straight pipes were tracked by the MPCA statewide, 765 of which were abandoned, fixed, or were found not to be a straight pipe system. The remaining known, unfixed, straight pipe systems have received a notice of noncompliance and are currently within the 10-month deadline to be fixed, have been issued Administrative Penalty Orders, or are docketed in court. The MPCA, through the Clean Water Partnership Loan Program, has awarded over $2,747,597 to counties within the Le Sueur River

Watershed to provide low interest loans for SSTS upgrades since 2000. More information can be found on the MPCA SSTS financial assistance webpage.

6.2.2 Feedlot Program

This section describes the MPCA's Feedlot Program, which addresses both permitted and nonpermitted feedlots. The Feedlot Program implements rules governing the collection, transportation, storage, processing, and disposal of animal manure and other livestock operation wastes. Minn. R. ch. 7020 regulates feedlots in the state of Minnesota. All feedlots are subject to this rule. The focus of the rule is on animal feedlots and manure storage areas that have the greatest potential for environmental impact. All feedlots capable of holding 50 or more AUs, or 10 in shoreland areas, are required to register. A feedlot holding 1,000 or more AUs is required to obtain a permit.

The Feedlot Program is implemented through cooperation between MPCA and delegated county governments in 50 counties in the state. The MPCA works with county representatives to provide training, program oversight, policy and technical support, and formal enforcement support when needed. A county participating in the program has been delegated authority by the MPCA to administer the Feedlot Program. These delegated counties receive state grants to help fund their feedlot programs based on the number of feedlots in the county and the level of inspections they complete. In recent years, annual grants given to these counties statewide totaled about two million dollars (MPCA 2017), with a larger amount allocated in the FY24-25 biennium. All the counties in the Le Sueur River Watershed have been delegated to administer the Feedlot Program.

From 2014 through 2023, 439 feedlot facilities were inspected in the Le Sueur River Watershed, with 357 of those inspections occurring at non-CAFO facilities and 83 at CAFO facilities. There have been an additional six facilities with manure application reviews within the watershed, all of which were conducted at CAFO facilities.

6.2.3 Minnesota buffer law

Minnesota's buffer law (Minn. Stat. § 103F.48) requires perennial vegetative buffers of up to 50 feet along lakes, rivers, and streams and buffers of 16.5 feet along ditches. These buffers help filter out phosphorus, nitrogen, and sediment. Alternative practices are allowed in place of a perennial buffer in some cases. Amendments enacted in 2017 clarify the application of the buffer requirement to public waters, provide additional statutory authority for alternative practices, address concerns over the potential spread of invasive species through buffer establishment, establish a riparian protection aid program to fund local government buffer law enforcement and implementation, and allowed landowners to be granted a compliance waiver until July 1, 2018, when they filed a compliance plan with the appropriate SWCD.

The Board of Water and Soil Resources (BWSR) provides oversight of the buffer program, which is primarily administered at the local level. Compliance with the buffer law ranges from 95% to 100% for counties in the Le Sueur River Watershed as of January 2023.

6.2.4 Minnesota Agricultural Water Quality Certification Program

The Minnesota Agricultural Water Quality Certification Program (MAWQCP) is a voluntary opportunity for farmers and agricultural landowners to take the lead in implementing conservation practices that protect our water. Those who implement and maintain approved farm management practices will be certified and, in turn, obtain regulatory certainty for a period of 10 years.

Through this program, certified producers receive:

- Regulatory certainty: certified producers are deemed to be in compliance with any new water quality rules or laws during the period of certification
- Recognition: certified producers may use their status to promote their business as protective of water quality
- Priority for technical assistance: producers seeking certification can obtain specially designated technical and financial assistance to implement practices that promote water quality

Through this program, the public receives assurance that certified producers are using conservation practices to protect Minnesota's lakes, rivers, and streams. Since the start of the program in 2014, the program has achieved the following (estimates as of January 2024):

- Enrolled over 973,000 acres
- Included 1,428 producers
- Added more than 2,786 new conservation practices
- Kept over 47,000 tons of sediment out of Minnesota rivers
- Saved 142,000 tons of soil and 59,000 lbs of phosphorus on farms
- Cut greenhouse gas emissions by more than 47,000 tons annually

Approximately 19,211 acres in the Le Sueur River Watershed are certified under the MAWQCP (through January 3, 2024).

6.2.5 Clean Water Act Section 319 Small Watershed Focus Program

The federal CWA Section 319 grant program provides funding to states to address nonpoint source water pollution in watersheds. The MPCA has adopted a Section 319 Small Watersheds Focus Program to focus on geographically smaller and longer-term watershed projects. The intent of the program is to make measurable progress for targeted water bodies in the Section 319 focus watersheds, ultimately restoring impaired waters and preventing degradation of unimpaired waters. Successful restorations in the Rice Creek Watershed (Figure 1) through this program will support the required pollutant reductions.

6.2.6 Minnesota Nutrient Reduction Strategy

The *Minnesota Nutrient Reduction Strategy* (MPCA 2014c) guides activities that support nitrogen and phosphorus reductions in Minnesota water bodies and water bodies downstream of the state (e.g., Lake Winnipeg, Lake Superior, and the Gulf Coast). The Nutrient Reduction Strategy was developed by an interagency steering team with help from public input, and a progress report was completed in 2020. The *5-year Progress Report on Minnesota's Nutrient Reduction Strategy* (MPCA 2020c) provides an update on progress made in the state toward achieving the nutrient reduction goals and associated BMP implementation outlined in the original 2014 strategy. *Watershed Nutrient Loads to Accomplish Minnesota's Nutrient Reduction Strategy Goals* (MPCA 2022a) integrates the state's nutrient reduction strategy into local watershed work by developing load reduction planning goals on a HUC-8 watershed basis. Currently, the same 10 organizations involved in creating the original strategy are working on a 10-year revision, expected in late 2025. The goal of the revision is to safeguard water from excess nutrients and protect the health and well-being of Minnesotans and downstream neighbors.

Fundamental elements of the *Minnesota Nutrient Reduction Strategy* include:

- Defining progress with clear goals
- Building on current strategies and success
- Prioritizing problems and solutions
- Supporting local planning and implementation
- Improving tracking and accountability

Included within the strategy discussion are alternatives and tools for consideration by drainage authorities and local water resource managers, information on available approaches for reducing phosphorus and nitrogen loading and tracking efforts within a watershed, and additional research priorities. The *Minnesota Nutrient Reduction Strategy* is focused on incremental progress and provides meaningful and achievable nutrient load reduction milestones that allow for better understanding of incremental and adaptive progress toward final goals. The strategy set a reduction goal of 45% for both phosphorus and nitrogen in the Mississippi River basin (relative to average 1980 to 1996 conditions), a similar level of nutrient reduction for the Red River/Lake Winnipeg basin (relative to the mid to late 1990s), and a no net increase goal from the 1970s for the Lake Superior basin. The strategy also emphasizes the need to achieve local nutrient reduction needs within HUC-8 watersheds.

Successful implementation of the *Minnesota Nutrient Reduction Strategy* will continue to require broad support, coordination, and collaboration among agencies, academia, local government, and private industry. Minnesota is implementing a watershed approach to integrate its water quality management programs on a major watershed scale, a process that includes:

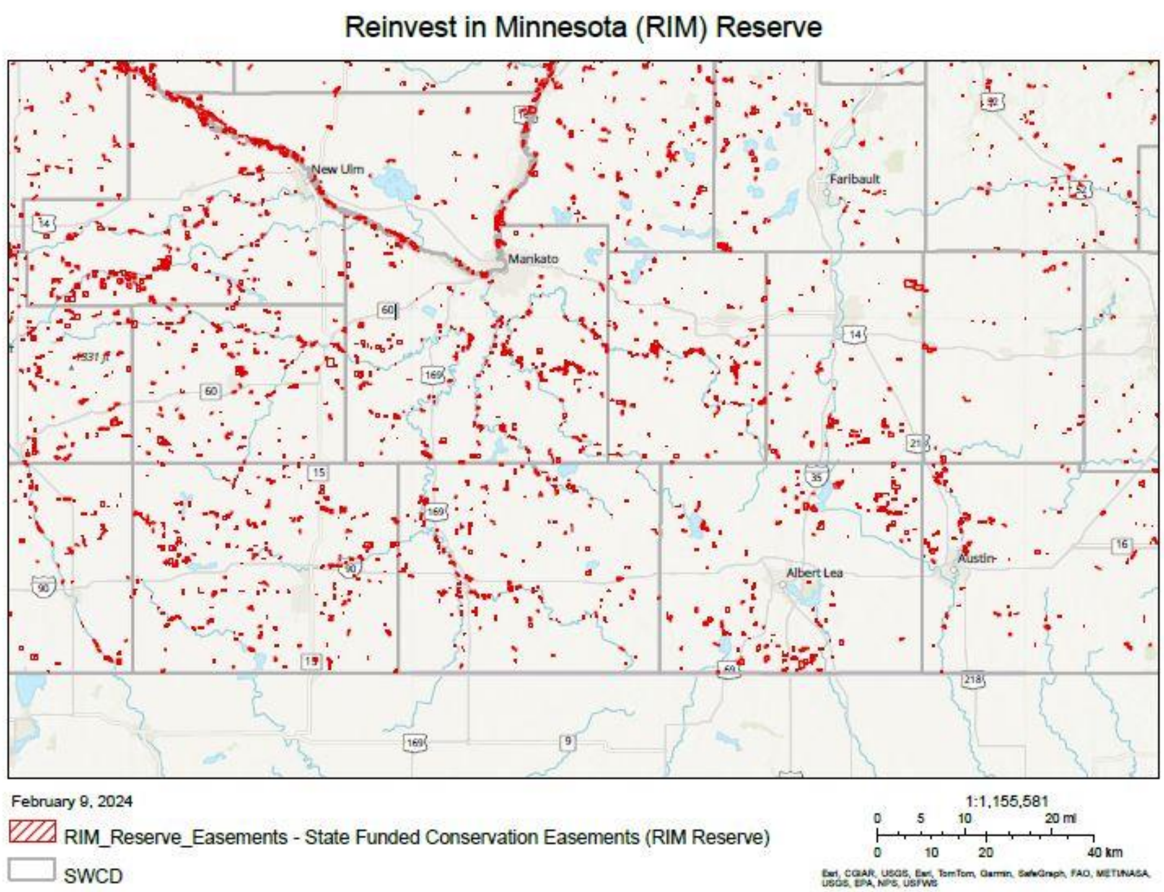
- IWM
- Assessment of watershed health
- Development of WRAPS Update Reports that include BMP scenarios to achieve nutrient load reductions
- Management of NPDES and other regulatory and assistance programs

This framework will result in nutrient reduction for the basin as a whole and the major watersheds within the basin.

6.2.7 Conservation easements

Conservation easements are a critical component of the state's efforts to improve water quality by reducing soil erosion, reducing phosphorus and nitrogen loading, and improving wildlife habitat and flood attenuation on private lands. Easements protect the state's water and soil resources by permanently restoring wetlands, adjacent native grassland wildlife habitat complexes, and permanent riparian buffers. In cooperation with county SWCDs, state and federal programs compensate landowners for granting conservation easements and establishing native vegetation habitat on economically marginal, flood prone, environmentally sensitive, or highly erodible lands. These easements vary in length of time from 10 years to permanent/perpetual easements. Conservation easement types in Minnesota include Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Reinvest in Minnesota (RIM), and the Wetland Reserve Program (WRP) or Permanent Wetland Preserve (PWP). As of July 2023, in the counties that are located in the Le Sueur River Watershed, there were 41,984 acres of short-term conservation easements such as CRP and 34,203 acres of long term or permanent easements (CREP, RIM, WRP; Figure 19).

Figure 19. Reinvest In Minnesota Reserve state-funded conservation easements in the counties that are located in the Le Sueur River Watershed (data from BWSR).



6.3 Summary of local plans

Minnesota has a long history of water management by local government, which included developing water management plans along county boundaries since the 1980s. The BWSR-led One Watershed, One Plan (1W1P) program is rooted in work initiated by the Local Government Water Roundtable (Association of Minnesota Counties, Minnesota Association of Watershed Districts, and Minnesota Association of SWCDs). The Roundtable recommended that local governments organize to develop focused implementation plans based on watershed boundaries. That recommendation was followed by the legislation (Minn. Stat. § 103B.801) that established the 1W1P program, which provides policy, guidance, and support for developing comprehensive watershed management plans:

- Align local water planning purposes and procedures on watershed boundaries to create a systematic, watershed-wide, science-based approach to watershed management.
- Acknowledge and build off of existing local government structure, water plan services, and local capacity.
- Incorporate and make use of data and information, including WRAPS and WRAPS Update Reports.
- Solicit input and engage experts from agencies, citizens, and stakeholder groups; focus on implementation of prioritized and targeted actions capable of achieving measurable progress.
- Serve as a substitute for a comprehensive plan, local water management plan, or watershed management plan developed or amended, approved, and adopted.

In August 2020, the Le Sueur River Watershed was selected for the 1W1P planning grant to create a comprehensive watershed management plan to align local water planning on the Le Sueur major watershed boundary. Eight local government units participated in the planning process to develop strategies to prioritize, target, and measure implementation activities at the watershed scale. The Le Sueur River Comprehensive Watershed Plan (ISG 2023) was approved in April 2023 and the local governments have applied for and been granted funding for implementation efforts. All counties in the Le Sueur River Watershed are represented under the plan and therefore it replaces the previous local county water plans in this watershed.

Priority areas include the Cobb, Maple, and Le Sueur River mainstem reaches and the plan includes implementation activities for three different management zones of the Le Sueur River Watershed: the upper, middle, and lower zones. Further prioritization will occur during the implementation planning and development phase to target areas that will provide greater opportunities for pollution reduction.

Examples of pollution reduction efforts

The Le Sueur River Watershed Comprehensive Management Plan has identified the Cobb River Subwatershed as a priority area for watershed implementation. The counties have identified soil erosion as one of the main drivers of the nutrient issues within the watershed. Efforts for funding will be focused on increasing the use of soil heath practices, reducing tillage, and increasing cover crop adoption throughout the Cobb River Subwatershed. Other strategies include identifying and promoting water storage practices related to ditch improvement projects and to identify historic basins for restoration.

Local efforts have been focused recently on the Bull Run Creek tributary. Water storage efforts are considered throughout the Le Sueur to reduce the volume of water reaching the incised areas to reduce sediment loading increases through this highly erosional area.

Iosco Creek has been a priority for monitoring by the local SWCD and is included as a priority area in the 1W1P process due to the *E. coli* impairment and its recreational impacts to Lake Elysian. The plan calls for more study into the sources of *E. coli* and plans to identify landowners on septic and manure management activities that could reduce the loading to the stream.

6.4 Funding

Funding sources to implement TMDLs can come from local, state, federal, and/or private sources. Examples include BWSR's Watershed-based Implementation Funding (WBIF), Clean Water Fund Competitive Grants (e.g., Projects and Practices), and conservation funds from Natural Resources Conservation Service (NRCS) (e.g., Environmental Quality Incentives Program and Conservation Stewardship Program).

WBIF is a noncompetitive process to fund water quality improvement and protection projects for lakes, rivers/streams, and groundwater. This funding allows collaborating local governments to pursue timely solutions based on a watershed's highest priority needs. The approach depends on the completion of a comprehensive watershed management plan developed under the 1W1P program to provide assurance that actions are prioritized, targeted, and measurable.

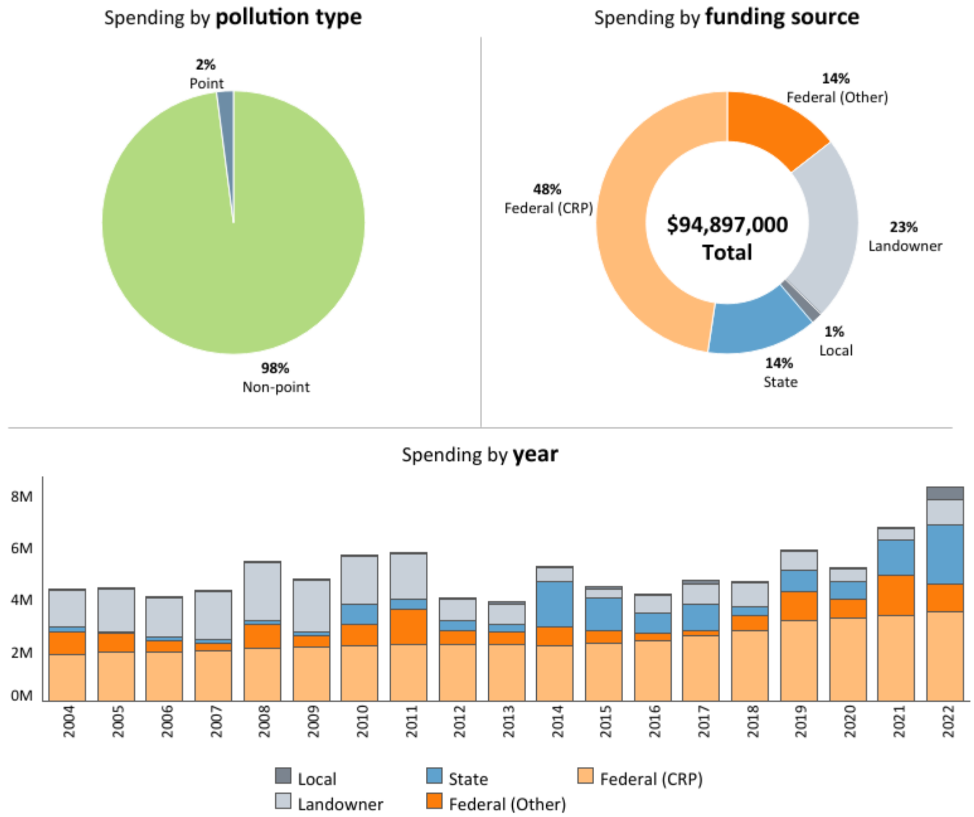
BWSR has been moving more of its available funding away from competitive grants and toward WBIF to accelerate water management outcomes, enhance accountability, and improve consistency and efficiency across the state. This approach allows more clean water projects identified through planning to be implemented without having to compete for funds, and helps local governments spend limited resources where they are most needed.

WBIF assurance measures summarize and systematically evaluate how WBIF dollars are being used to achieve clean water goals identified in comprehensive watershed plans. The measures will be used by BWSR to provide additional context about watershed plan implementation challenges and opportunities. The following assurance measures are supplemental to existing reporting and on-going grant monitoring efforts:

- Understand contributions of prioritized, targeted, and measurable work in achieving clean water goals.
- Review progress of programs, projects, and practices implemented in identified priority areas.
- Complete Clean Water Fund grant work on schedule and on budget.
- Leverage funds beyond the state grant.

The Le Sueur River Watershed was awarded $1,355,872 in WBIF funds in 2024. Over $94,000,000 has been spent on watershed implementation projects in the Le Sueur River Watershed since 2004 (Figure 20).

**Figure 20. Spending for watershed implementation projects in the Le Sueur River Watershed; data from the [MPCA's Healthier Watersheds website](). **



6.5 Other partners and organizations

The Le Sueur River Watershed Network (LRWN) started as part of the Cycle I WRAPS development process and has been active in the watershed since 2013. This volunteer led group has been helping to support and promote clean water efforts within the Le Sueur River Watershed and provide educational efforts and outreach related to improving watershed health. More info can be found at their website: Le Sueur River Watershed Network.

6.6 Reasonable assurance conclusion

In summary, significant time and resources have been devoted to identifying the best BMPs, providing means of focusing them on the Le Sueur River Watershed, and supporting their implementation via state, local, and federal initiatives and dedicated funding. The Le Sueur River Watershed WRAPS Update Report and TMDL process engaged partners to arrive at reasonable scenarios of BMP combinations that attain pollutant reduction goals. Minnesota is a leader in watershed planning as well as monitoring and tracking progress toward water quality goals and pollutant load reductions.

7. Monitoring

7.1 Monitoring

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 shorter and longer term changes in water quality and land management. Monitoring is important for several reasons:

- Evaluating water bodies to determine if they are meeting water quality standards and tracking trends
- Assessing potential sources of pollutants
- Determining the effectiveness of implementation activities in the watershed
- Delisting of waters that are no longer impaired; and
- Implementing an adaptive management approach to help determine when a change in management is needed.

There are many monitoring efforts in place to address the different types of monitoring. Several key monitoring programs will provide the information to track trends in water quality and evaluate compliance with TMDLs:

- Monitoring and assessment at the HUC-8 scale associated with Minnesota's watershed approach. This monitoring effort is conducted by the MPCA approximately every 10 years for each HUC-8. 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 2012a) and the Le Sueur River Watershed Assessment and Trends Update (MPCA 2021a) for more information.
    - The MPCA's Watershed Pollutant Load Monitoring Network (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. 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).

- Implementation tracking is conducted by both BWSR (i.e., eLINK) and the USDA. Both agencies 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.
- Discharges from 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.
- The Minnesota Department of Agriculture (MDA) conducts MDA's 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.

8. Implementation strategy summary

This section summarizes implementation strategies that could be used to help achieve the TMDLs in this report.

For many of the implementation strategies discussed in this section, BMPs will need to be selected, designed, operated, and maintained to account for climate trends, including warmer surface waters and the expected continued increase in the size and frequency of rain events (Section 3.1: Climate trends). Climate change will affect the function of many BMPs, and implementation planning should account for the resilience of BMPs to the impacts of climate change (Johnson et al. 2022).

8.1 Permitted sources

8.1.1 Construction stormwater

The WLA for stormwater discharges from sites where there is construction activity reflects the number of construction sites greater than one acre expected to be active in the watershed at any one time, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. The BMPs and other stormwater control measures that should be implemented at construction sites are defined in Minnesota’s NPDES/SDS General Stormwater Permit for Construction Activity (MNR100001). If a construction site owner/operator obtains coverage under the NPDES/SDS General Stormwater Permit and properly selects, installs, and maintains all BMPs required under the permit, including those related to impaired waters discharges and any applicable additional requirements found in Section 23 of the Construction Stormwater General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. Construction activity must also meet all local government construction stormwater requirements.

8.1.2 Industrial stormwater

The WLA for stormwater discharges from sites where there is industrial activity reflects the number of sites in the watershed for which NPDES industrial stormwater permit coverage is required, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. Minnesota’s NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) and NPDES/SDS Nonmetallic Mining/Associated Activities General Permit (MNG490000) establish benchmark concentrations for pollutants in industrial stormwater discharges. If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS Permit and properly selects, installs, and maintains BMPs sufficient to meet the benchmark values in the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report. Industrial activity must also meet all local government stormwater requirements.

8.1.3 Municipal separate storm sewer systems

Seven MS4s are assigned phosphorus WLAs for the Le Sueur River Reach 501 RES TMDL (Table 21 and Table 23). The general NPDES/SDS permit requirements must be consistent with the assumptions and requirements of an approved TMDL and associated WLAs. The BMP stormwater control measure requirements are defined in the State's General Municipal Separate Storm Sewer NPDES/SDS Permit (MNR040000).

The MS4 WLAs for the Le Sueur River Reach 501 RES TMDL equate to a mean summer watershed runoff target of 141 µg/L TP. In each MS4's NPDES/SDS MS4 permit application submitted to the MPCA after approval of this TMDL, the MS4 will provide an outline of BMPs to be implemented that address the reductions needed to meet the MS4 runoff concentration target noted above. As noted in

Table 23, these targets represent the MS4 runoff contribution at the outlet of Reach 501 and include phosphorus fate, transport, and losses in the impaired reach and stream network upstream of the impaired reach. If a model that does not account for in-channel processes and losses is used to model the MS4 area(s) for Reach 501 TMDL compliance, a correction factor should be applied to account for phosphorus losses in the stream channels downstream of the MS4 area(s). The HSPF model estimates that approximately 42% of the phosphorus load from upland areas throughout the entire watershed settles out in the stream channels and/or is consumed by aquatic org before it reaches the outlet of Reach 501 (see Table 10 and Table 11 and discussion in Section 3.7.2.1). The amount of in-channel phosphorus settling and loss varies significantly throughout the watershed ranging from 1% in the subwatersheds closest to Reach 501 to 97% in the headwater and lake subwatersheds further away from Reach 501. On average, the HSPF model estimates that 14% of the phosphorus delivered from the subwatersheds containing the MS4s in the Lower Le Sueur River HUC-10 (i.e., Eagle Lake, Blue Earth County, MnDOT, South Bend Township, and Mankato City and Township) is lost before it reaches Reach 501. Therefore, a correction factor of 0.86 should be applied to evaluate compliance with this TMDL's MS4 runoff concentration target (141 µg/L TP) if a watershed loading model is used that does not account for in-channel processes and losses in the downstream drainage network. For the subwatersheds containing the city of Waseca MS4 areas, the HSPF model estimates that 46% of the phosphorus is lost before reaching Reach 501 and therefore a correction factor of 0.54 should be used for these areas. The MS4 correction factors and other considerations for MS4 areas are discussed in further detail in Appendix C.

Projects undertaken recently may take a few years to influence water quality. Any wasteload-reducing BMP implemented after the baseline year will be creditable toward the MS4's load reductions. If a BMP was implemented during or just prior to the baseline year, the MPCA is open to presentation of evidence by the MS4 permit holder to demonstrate that it should be considered as a credit.

Prior to implementation, permitted MS4s are encouraged to compare their sewersheds (e.g., catchments, pipesheds, etc.) with the drainage areas for each impaired water body to ensure appropriate BMP crediting. If a permitted MS4 sewershed is different from what is defined as the drainage area in this report, the sewershed should be considered part of the MS4 contribution to the impaired water if sufficient evidence of the appropriate sewershed area is provided to the MPCA. With Agency approval, any wasteload-reducing BMP implemented since the TMDL baseline year within the sewershed of an impaired water will be creditable toward an MS4's load reduction for purposes of annual reporting and demonstrating progress toward meeting the WLA(s).

8.1.4 Wastewater

Municipal WWTPs are regulated through NPDES permits. Eleven permitted municipal wastewater dischargers have been assigned TP WLAs in this TMDL report (Table 20). A summer WLA for each of these facilities was developed to protect the Le Sueur River RES impaired reaches. The approach and methodology for determining the summer WLA for each facility can be found in Section 4.5.4.1. The WLAs to protect these reaches, which have been determined to also protect Lake Pepin and the Minnesota River, are included as WQBELs in the facilities' NPDES permits.

All of the wastewater discharges in the Le Sueur River Watershed have existing permit limits that are consistent with the WLAs in this TMDL (see Table 20). At permit reissuance, WQBELs and/or additional monitoring requirements are considered by permitting staff. Based on review of data available on the MPCA's Wastewater Data Browser, all continuous and controlled facilities are currently meeting the TP WLA requirements set forth in this TMDL (Table 26).

Table 26. Individual wastewater monitored loads compared to TMDL WLAs.

Facility name	Flow type	Impaired water body WID(s)	Reported Discharge Days per summer (2019-2023 mean)	Reported TP Load per summer (2019-2023 mean)	Summer period TP WLA in this TMDL (lbs/summer)	Currently meeting summer period TP WLA (Y/N)
Amboy WWTP	Continuous	501	122	121	183	Y
Delavan WWTP	Controlled	501	1	3	102	Y
Freeborn WWTP	Controlled	501, 556	0	0	61	Y
Good Thunder WWTP	Controlled	501	6	109	177	Y
Hartland WWTP	Controlled	501	0	0	99	Y
Janesville WWTP	Controlled	501	3	201	428	Y
Mapleton WWTP	Controlled	501, 556	4	116	448	Y
New Richland WWTP	Continuous	501	122	221	385	Y
Saint Clair WWTP	Continuous	501	122	35	137	Y
Waseca WWTP	Continuous	501	122	949	1,320	Y
Wells Public Utilities	Controlled	501	2	62	1,947	Y

To address wastewater releases (see Municipal and Industrial wastewater in Section 3.7.1: Permitted sources), implementation strategies are recommended to decrease the I&I of stormwater and groundwater into wastewater collection systems and reduce the frequency of excess flows that lead to releases of untreated wastewater. Adoption of clean water intrusion ordinances also help reduce the frequency and magnitude of wastewater releases through the development of policies and funding programs to assess and, where necessary, replace leaky private lateral connections to the sanitary system. Funding options, such as the MPCA's Clean Water Partnership Loan can be used to help local governments and residents update lateral pipes.

8.1.5 Feedlots

The NPDES and SDS feedlot permits include design, construction, operation, and maintenance standards that all CAFOs must follow. WLAs are not assigned to CAFOs in this TMDL report, including CAFOs with NPDES or SDS permits, and CAFOs not requiring permits; this is equivalent to a WLA of zero. If the CAFOs are properly permitted and operate under the applicable NPDES or SDS permit, then the CAFOs are expected to be consistent with this TMDL. MPCA inspections of large CAFOs focus on high-risk facilities located within or near environmental justice areas, waters impaired by *E. coli* or excess nutrients, drinking water supply and vulnerable groundwater areas, and other sensitive water features, and on facilities that haven't been inspected in the most recent five years. CAFOs that are found to be noncompliant are required to return to compliance in accordance with applicable NPDES or SDS conditions and Minn. R. ch. 7020.

8.2 Nonpermitted sources

Implementation of the Le Sueur River Watershed TMDL will require numerous BMPs that address non-NPDES-permitted sources of *E. coli* and phosphorus. This section provides an overview of example BMPs that may be used for implementation. The BMPs included in this section are not exhaustive, and the list may be amended. Likely sources of *E. coli* to target for implementation are livestock and ITPHS, and phosphorus sources to target for implementation are cropland runoff. SSTSs that are failing to protect groundwater are required by state law to be addressed and are therefore also considered a priority source of phosphorus.

Table 27 summarizes example BMPs that can be implemented to achieve goals of the TMDLs. The table is not an exhaustive list of all applicable BMPs, and actual implementation may vary. Descriptions of BMP examples can be found in the *Agricultural BMP Handbook for Minnesota* (Lenhart et al. 2017), the *Minnesota Stormwater Manual* (MPCA 2021d), and the University of Minnesota Extension's *Onsite Sewage Treatment Program* website. The Le Sueur River Watershed WRAPS Update Report (MPCA 2025) developed concurrently with this report contains a more comprehensive list of implementation strategies.

Table 27. Example BMPs for nonpermitted sources.

Strategy	**BMP examples**	**Targeted pollutant**	
		E. coli	Phosphorus
Agricultural runoff control and manure management	Conservation tillage		X
	Cover crops		X
	Filter strips and field borders	X	X
Feedlot runoff control	Feedlot runoff reduction and treatment	X	X
	Feedlot manure/storage addition	X	X

Strategy	BMP examples	Targeted pollutant	
		E. coli	Phosphorus
Nutrient management	Nutrient management	X	X
	Manure incorporation within 24 hours	X	X
Pasture management	Conventional pasture to prescribed rotational grazing		X
	Livestock access control	X	X
Septic system improvements	Septic system improvement (maintenance and replacement)	X	X
Converting land to perennials	Conservation cover perennials		X
Buffers and filters	Riparian buffers and field boarders	X	X
Urban stormwater runoff control	Green infrastructure practices	X	X
	Improved lawn/turf vegetation and soil practices	X	X

8.3 Water quality trading

Water quality trading can help achieve compliance with WLAs or water quality based effluent limits. Water quality trading can also offset increased pollutant loads in accordance with antidegradation regulations. Water quality trading reduces pollutants (e.g., TP or TSS) in rivers and lakes by allowing a point source discharger to enter into agreements under which the point source "offsets" its pollutant load by obtaining reductions in a pollutant load discharged by another point source operation or a nonpoint source or sources in the same watershed. The MPCA must establish specific conditions governing trading in the point source discharger's NPDES permit or in a general permit that covers the point source discharger. The MPCA implements water quality trading through permits. See MPCA's *Water Quality Trading Guidance* (MPCA 2022b) for more information.

8.4 Cost

The costs to achieve the TMDLs are approximately $350 to $500 million dollars. This range reflects the level of uncertainty in the source assessment and addresses the likely sources identified in Section 3.7. The cost includes increasing local capacity over the next 20 years to oversee implementation in the watershed and the voluntary actions needed to achieve necessary TMDL reductions. Costs for implementing the TMDL and achieving the required pollutant load reductions were estimated by developing implementation scenarios; actual implementation will likely differ. While these cost estimates appear high, they were developed for the Le Sueur River Reach 501 drainage area which encompasses the entire Le Sueur River Watershed. These implementation scenarios include BMPs that will benefit all impairments throughout the watershed and will result in reductions in other pollutants not explicitly covered in this TMDL (i.e., TSS and bacteria and nutrient impairments covered in previous TMDLs).

8.4.1 *E. coli* cost methods

Costs to achieve the *E. coli* TMDLs were calculated based on feedlot BMPs and manure/fertilizer management. This cost assessment accounts for the uncertainty of a qualitative *E. coli* source assessment.

For feedlots, the unit cost for bringing feedlots into compliance with feedlot regulations is based on the MPCA's 1999 Statement of Need and Reasonableness (SONAR) In the Matter of Proposed Amendments to Minnesota Rules Relating to Animal Feedlots, Storage, Transportation, and Utilization of Animal Manure (MPCA 1999). In the SONAR, the estimated cost to bring a facility into compliance with the feedlot rules is provided by livestock sector: $19,000 for the beef sector, $36,000 for the dairy sector, and $43,000 for the swine sector. For the TMDL implementation cost estimate, these costs were adjusted for average United States inflation rates through 2023, and for TMDL implementation cost estimation purposes it was assumed that 10% of beef and dairy feedlots are not in compliance and 20% of swine facilities are not in compliance. Costs for manure/fertilizer management on cropland throughout the *E. coli* impaired reach was estimated using the BMP database of HSPF–Scenario Application Manager (SAM; version 2.12). The total estimated cost of implementing feedlot and fertilizer/manure management throughout the Iosco Creek drainage over a 20-year implementation period is approximately $700,000.

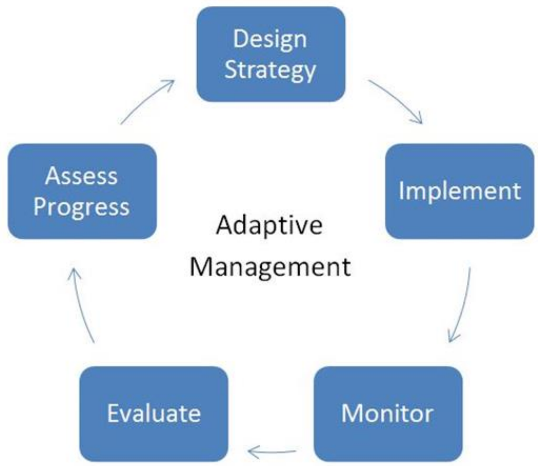
8.4.2 Phosphorus cost methods

To estimate costs to achieve phosphorus water quality standards in the RES impaired reaches, BMP efficiencies and costs in the BMP database of HSPF–SAM were used as a starting point to develop an implementation scenario that achieves the TP percent reductions called for in the TMDL tables. The HSPF-SAM cost assumptions were reviewed by local SWCD staff in the Le Sueur River Watershed and adjusted as necessary. As discussed in Section 3.7, cropland runoff is the largest source of phosphorus to the impaired reaches during the summer growing season (94% to 97% of current load) and therefore should be the primary target for implementation to meet TMDL goals. It is estimated that a 65% reduction of summer TP load is needed for Le Sueur River Reach 501. A majority of this reduction will need to come from applying BMPs to the 585,000 estimated acres of cropland throughout the Le Sueur River Watershed. The primary management practices selected for the cost scenario were cover crops, reduced tillage, and nutrient and manure management. It was assumed a significant portion of the cropland throughout the watershed will need to include one or more of these practices to achieve the 65% watershed-wide TP reduction goal. Structural BMPs such as filter strips, water and sediment control basins, and alternative tile intakes were also selected for the cost scenario but were applied to only a fraction of the suitable cropland areas defined in the HSPF-SAM model. Multiple implementation scenarios were established by adjusting BMP types and scale of adoption to estimate a high (~$500 million), low (~$350 million), and median (~$400 million) implementation cost estimate over a 20-year implementation period. The example implementation scenarios are estimates of cost-share dollars needed to incentivize adoption of the practice. The costs do not take into account design and construction oversight or operation and maintenance costs.

8.5 Adaptive management

The implementation strategies and the more detailed WRAPS Update Report, which was prepared concurrently with this TMDL report, are based on the principle of adaptive management (Figure 21). Continued monitoring and "course corrections" responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL report. Management activities will be changed or refined as appropriate over time to efficiently meet the TMDL and lay the groundwork for de-listing the impaired water bodies.

Figure 21. Adaptive management.



9. Public participation

The Le Sueur 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 citizens to discuss issues and promote common understanding and provide potential solutions to improve water quality. These efforts eventually lead to the formation of the LRWN 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. 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 webpage.

Finally, the Le Sueur River Watershed's county and SWCD staff worked to develop the Le Sueur River Comprehensive Watershed Management Plan (ISG 2023). 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. Information on the plan is available at the Le Sueur River Watershed Comprehensive Watershed Management Plan website.

An opportunity for public comment on the draft TMDL report was provided via a public notice in the State Register from March 3, 2025, through April 2, 2025. There was one comment letter received and responded to as a result of the public comment period. For further information on public participation for this TMDL report, please see the WRAPS Update Report.

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Appendix A. Impaired waters and TMDL status

This appendix lists all the impairments in the Le Sueur River Watershed along with the TMDL status of each impairment (Table 28). Planned recategorizations are provided for listings that have been further assessed and for which recategorization will be considered. Recategorizations will not be final until they are approved by EPA as part of Minnesota's list of impaired water bodies; therefore, this table represents a snapshot in time, and the EPA category or planned recategorization may change.

Table 28. Impaired water bodies in the Le Sueur River Watershed.

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments: Confirmed	Stressors to bioassessment impairments: Inconclusive	EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2002	AQC	Mercury in water column	NA	NA	4A		N
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2002	AQC	PCBs	NA	NA	5		N
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2012	AQC	PCBs in fish	NA	NA	5		N
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2022	AQC	Mercury in fish tissue	NA	NA	4A		N
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2002	AQL	Turbidity	NA	NA	4A		N
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2012	AQL	Fish bio	Eutrophication, Nitrates, TSS, Habitat, Altered Hydrology		5		N
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2016	AQL	Nutrients	NA	NA	5	4A	Y
Le Sueur River	Maple R to Blue Earth R	501	2Bg	2008	AQR	Fecal coliform	NA	NA	4A		
Little Cobb River	Bull Run Cr to Cobb R	504	2Bg	2002	AQC	Mercury in water column			5		N
Little Cobb River	Bull Run Cr to Cobb R	504	2Bg	2002	AQL	Fish bio	Dissolved Oxygen, Eutrophication, Nitrates, Habitat, TSS, Altered Hydrology	Connectivity	5		N
Little Cobb River	Bull Run Cr to Cobb R	504	2Bg	2002	AQL	Turbidity	NA	NA	4A		N
Little Cobb River	Bull Run Cr to Cobb R	504	2Bg	2010	AQL	Dissolved oxygen	NA	NA	4A		N
Little Cobb River	Bull Run Cr to Cobb R	504	2Bg	2016	AQL	Nutrients	NA	NA	5	4A	Y

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments		EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
							Confirmed	Inconclusive			
				2008	AQR	Fecal coliform	NA	NA	4A		N
Cobb River	Little Cobb R to T107 R26W S31, west line	505	2Bg	2022	AQL	Fish bio	Not assessed		5		N
Le Sueur River	Cobb R to Maple R	506	2Bg	2012	AQC	PCBs in fish	NA	NA	5		N
				2022	AQC	Mercury in fish tissue	NA	NA	4A		N
				2010	AQL	Turbidity	NA	NA	4A		N
Le Sueur River	CD 6 to Cobb R	507	2Bg	2012	AQC	PCBs in fish	NA	NA	5		N
				2022	AQC	Mercury in fish tissue	NA	NA	4A		N
				2008	AQL	Turbidity	NA	NA	4A		N
				2012	AQL	Fish bio	Habitat, TSS, Altered Hydrology	Eutrophication, Nitrate	5		N
				2010	AQR	*E. coli*	NA	NA	4A		N
Unnamed creek	Unnamed cr to Le Sueur R	510	2Bg	2012	AQL	Invert bio	Nitrate, Altered Hydrology	Eutrophication, TSS	5		N
Boot Creek	Unnamed cr to T105 R22W S6, north line	516	7	2012	AQR	*E. coli*	NA	NA	4A		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments: Confirmed	Stressors to bioassessment impairments: Inconclusive	EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
County Ditch 6	T107 R25W S14, east line to Le Sueur R	522	2Bg	2012	AQL	Invert bio	Habitat, Nitrate, Eutrophication, Altered Hydrology		5		N
Little Cobb River (County Ditch 8)	Unnamed ditch to Severson Lk	524	2Bg	2020	AQL	Fish bio	Nitrate, TSS, Habitat, Connectivity, Altered Hydrology	Dissolved Oxygen, Eutrophication	5		N
				2020	AQL	Invert bio			5		N
County Ditch 57	Unnamed ditch to Cobb R	530	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2020	AQL	Invert bio			5		N
Maple River	Rice Cr to Le Sueur R	534	2Bg	2008	AQL	Turbidity	NA	NA	4A		N
				2008	AQR	Fecal coliform	NA	NA	4A		N
Maple River	Minnesota Lk outlet to Rice Cr	535	2Bg	2010	AQL	Turbidity	NA	NA	4A		N
				2012	AQL	Fish bio	TSS, Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication, Nitrate	5		N
				2012	AQL	Invert bio			5		N
Unnamed creek	Unnamed cr to Le Sueur R	546	2Bg	2020	AQL	Fish bio	Not assessed		5		N
County Ditch 70	Unnamed cr to CD 3	548	2Bg	2020	AQL	Invert bio	Not assessed		5		N
County Ditch 3	Unnamed cr to CD 7	550	2Bg	2022	AQL	Fish bio	Nitrate, TSS, Habitat, Altered Hydrology		5		N
				2022	AQL	Invert bio			5		N
Cobb River		556	2Bg	2008	AQL	Turbidity	NA	NA	4A		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments		EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
							Confirmed	Inconclusive			
	T107 R26W S30, west line to Le Sueur R			2012	AQL	Fish bio	Dissolved Oxygen, Eutrophication, Nitrate, TSS, Habitat, Altered Hydrology		5		N
				2022	AQL	Invert bio			5		N
				2016	AQL	Nutrients	NA	NA	5	4A	Y
				2010	AQR	*E. coli*	NA	NA	4A		N
County Ditch 12	T107 R23W S27, north line to Unnamed cr	558	2Bg	2012	AQL	Fish bio	Habitat, Nitrate, Altered Hydrology		5		N
				2012	AQL	Invert bio			5		N
County Ditch 20	Headwaters to Silver Lk outlet	566	2Bg	2022	AQL	Fish bio	Connectivity, Altered Hydrology		5		N
Cobb River	T104 R23W S34, south line to Little Cobb R	568	2Bg	2004	AQL	Fish bio	Nitrate, TSS, Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication	5		N
				2012	AQL	Invert bio			5		N
				2010	AQL	Turbidity	NA	NA	4A		N
Little Le Sueur River	T106 R22W S12, east line to Le Sueur R	573	2Bg	2012	AQL	Fish bio	Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication, Nitrate, TSS	5		N
Iosco Creek	Silver Cr to T108 R23W S7, west line	576	2Bg	2012	AQL	Fish bio	Connectivity, Altered Hydrology	TSS, Habitat	5		N
				2022	AQR	*E. coli*	NA	NA	5	4A	Y
Maple River	Unnamed cr to Minnesota Lk outlet	580	2Bg	2020	AQL	Fish bio	Not Assessed		5		N
				2020	AQL	Invert bio			5		N
	Rice Lk to Rice Cr	589	2Bg	2022	AQL	Fish bio		TSS	5		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments: Confirmed	Stressors to bioassessment impairments: Inconclusive	EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
Unnamed creek				2022	AQL	Invert bio	Dissolved Oxygen, Eutrophication, Nitrate, Habitat, Altered Hydrology		5		N
Unnamed creek	Unnamed cr to Maple R	592	2Bg	2020	AQL	Fish bio	Not assessed		5		N
County Ditch 85	Unnamed cr to Maple R	593	2Bg	2020	AQL	Fish bio	Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication, Nitrate, TSS	5		N
				2020	AQL	Invert bio			5		N
Judicial Ditch 9	Unnamed cr to CD 3	594	2Bg	2020	AQL	Invert bio	Not assessed		5		N
Unnamed creek	Unnamed lk (Hobza Marsh 07-0019-00) to Unnamed cr	599	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2020	AQL	Invert bio			5		N
Unnamed creek	CD 26 to Le Sueur R	601	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2020	AQL	Invert bio			5		N
Unnamed creek	Mud Lk (07-0034-00) to Unnamed cr	605	2Bg	2022	AQL	Fish bio	Not assessed		5		N
Unnamed creek	Eagle Lk to Unnamed cr	606	2Bg	2020	AQL	Invert bio	Not assessed		5		N
County Ditch 29	Unnamed ditch to CD 6	607	2Bg	2020	AQL	Fish bio	Not assessed		5		N
County Ditch 19	Headwaters to Le Sueur R	608	2Bg	2012	AQL	Fish bio	Habitat, Altered Hydrology		5		N
				2012	AQL	Invert bio	Physical Habitat	Dissolved Oxygen, Eutrophication, Flow Alteration, Ionic	5		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments: Confirmed	Stressors to bioassessment impairments: Inconclusive	EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
								Strength, Metals/Toxic, Nitrates, Pesticides, Suspended Solids			
County Ditch 15-2	Headwaters to Le Sueur R	609	2Bg	2012	AQL	Fish bio	Nitrate, Habitat, Altered Hydrology		5		N
				2012	AQL	Invert bio			5		N
Unnamed creek	Headwaters to Unnamed cr	613	2Bg	2022	AQL	Fish bio	TSS, Habitat, Altered Hydrology	Nitrate, Connectivity	5		N
County Ditch 46	Unnamed ditch to Le Sueur R	618	2Bg	2020	AQL	Invert bio	Not assessed		5		N
Le Sueur River	Boot Cr to CD 6	620	2Bg	2012	AQC	PCBs in fish	NA	NA	5		N
				2022	AQC	Mercury in fish tissue	NA	NA	4A		N
				2010	AQL	Turbidity	NA	NA	4A		N
Boot Creek	T105 R22W S31, south line to T105 R23W S25, north line	621	2Bg	2022	AQL	Fish bio	Nitrate, Habitat, Connectivity, Altered Hydrology	TSS	5		N
Unnamed creek (Little Beauford Ditch)	Headwaters to Victory Dr (MN22)	642	2Bg	2002	AQC	Mercury in water column	NA	NA	5		N
				2002	AQC	PCBs	NA	NA	5		N
				2002	AQL	Turbidity	NA	NA	4A		N
				2004	AQR	Fecal coliform	NA	NA	4A		N
		643	2Bg	2002	AQL	Turbidity	NA	NA	4A		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments: Confirmed	Stressors to bioassessment impairments: Inconclusive	EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
Unnamed creek (Little Beauford Ditch)	Victory Dr (MN22) to Cobb R			2004	AQR	Fecal coliform	NA	NA	4A		N
County Ditch 38	-93.594, 44.047 to Unnamed cr	645	2Bg	2022	AQL	Fish bio	Not assessed		5		N
Bull Run Creek	20th St to Little Cobb R	647	2Bg	2020	AQL	Fish bio	Dissolved Oxygen, Eutrophication, TSS, Habitat, Connectivity, Altered Hydrology	Nitrate	5		N
				2022	AQL	TSS	NA	NA	4A		N
				2022	AQR	*E. coli*	NA	NA	4A		N
Maple River	Headwaters (Penny Lk 24-0048-00) to 525th Ave	648	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2022	AQL	Invert bio			5		N
Providence Creek (Judicial Ditch 49)	T105 R27W S17, west line to -94.086, 43-902	650	2Bg	2020	AQL	Invert bio	Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication, Nitrate, TSS	5		N
County Ditch 3 (Judicial Ditch 9)	JD 9 to -93.958, 43.852	652	2Bg	2010	AQL	Turbidity	NA	NA	4A		N
				2020	AQL	Fish bio	Nitrate, TSS, Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication	5		N
				2020	AQL	Invert bio			5		N
				2012	AQR	*E. coli*	NA	NA	4A		N
		653	2Bg	2010	AQL	Turbidity	NA	NA	4A		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments		EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
							Confirmed	Inconclusive			
County Ditch 3 (Judicial Ditch 9)	-93.958, 43.852 to Maple R			2012	AQR	*E. coli*	NA	NA	4A		N
Silver Creek (County Ditch 3)	405th Ave to Iosco Cr	655	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2020	AQL	Invert bio			5		N
Unnamed creek	Unnamed lk to 557th Ave	656	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2020	AQL	Invert bio			5		N
County Ditch 88	Unnamed cr to -93.874, 44.085	658	2Bg	2020	AQL	Fish bio	Not assessed		5		N
				2020	AQL	Invert bio			5		N
Unnamed creek	-93.934, 44.073 to Unnamed cr	661	2Bg	2020	AQL	Fish bio	Not assessed		5		N
Judicial Ditch 10	145th St to Little Le Sueur R	663	2Bg	2020	AQL	Fish bio	Not assessed		5		N
Le Sueur River	Headwaters to Freeborn/Steele County border	664	2Bg	2012	AQC	PCBs in fish	NA	NA	5		N
				2022	AQC	Mercury in fish tissue	NA	NA	4A		N
Le Sueur River	Freeborn/Steele County border to Boot Cr	665	2Bg	2012	AQC	PCBs in fish	NA	NA	5		N
				2022	AQC	Mercury in fish tissue	NA	NA	4A		N
				2010	AQL	Turbidity	NA	NA	4A		N
				2012	AQL	Fish bio	Nitrate, TSS, Habitat, Altered Hydrology		5		N
				2022	AQL	Invert bio			5		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments		EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
							Confirmed	Inconclusive			
Rice Creek	Headwaters to T103 R27W S2, north line	668	2Bg	2010	AQL	Turbidity	NA	NA	4A		N
				2012	AQR	*E. coli*	NA	NA	4A		N
Rice Creek	T104 R27W S35, south line to Maple R	669	2Bg	2006	AQL	Fish bio	Nitrate, TSS, Habitat, Altered Hydrology	Dissolved Oxygen, Eutrophication	5		N
				2012	AQL	Invert bio			5		N
				2010	AQL	Turbidity	NA	NA	4A		N
				2012	AQR	*E. coli*	NA	NA	4A		N
Bass	Lake or Reservoir	22-0074-00	2B	1998	AQC	Mercury in fish tissue	NA	NA	4A		N
				2022	AQL	Fish bio	Eutrophication, Physical Habitat Alteration	Altered Interspecific Competition, Pesticide Application	5		N
Freeborn	Lake or Reservoir	24-0044-00	2B	2012	AQR	Nutrients	NA	NA	4A		N
St. Olaf	Lake or Reservoir	81-0003-00	2B	2018	AQC	Mercury in fish tissue	NA	NA	4A		N
Reeds	Lake or Reservoir	81-0055-00	2B	2012	AQC	Mercury in fish tissue	NA	NA	4A		N
Elysian (Main Lake)	Lake or Reservoir	81-0095-01	2B	2008	AQR	Nutrients	NA	NA	4A		N
Madison	Lake or Reservoir		2B	1998	AQC	Mercury in fish tissue	NA	NA	4A		N

Water body name	Water body description	WID (HUC-8-)	Use class [a]	Year added to list	Affected designated use [b]	Listing parameter	Stressors to bioassessment impairments		EPA category in next impaired waters list [c]	Planned recategor-ization [d]	TMDL developed in this report
							Confirmed	Inconclusive			
		07-0044-00		2010	AQR	Nutrients	NA	NA	4A		N
				2022	AQL	Fish bio	Eutrophication, Physical Habitat Alteration	Altered Interspecific Competition, Pesticide Application	5		N
Eagle (North)	Lake or Reservoir	07-0060-01	2B	2010	AQR	Nutrients	NA	NA	4A		N
Lura	Lake or Reservoir	07-0079-00	2B	2002	AQC	Mercury in fish tissue	NA	NA	4A		N
				2002	AQR	Nutrients	NA	NA	4A		N
				2022	AQL	Fish bio	Eutrophication	Physical Habitat Alteration, Altered Interspecific Competition, Pesticide Application	5		N

a. 1B: domestic consumption; 2Ag: AQL and AQR —general cold water habitat; 2Bg: AQL and AQR —general warm water habitat; 7: limited resource value water.
b. AQR: aquatic recreation, AQL: aquatic life, AQC: aquatic consumption
c. 4A: Impaired and a TMDL study has been approved by USEPA. All TMDLs needed to result in attainment of applicable water quality standards for this impairment have been approved or established by EPA. For biological impairments, there are no remaining inconclusive stressors.
4C: Impaired but a TMDL study is not required because the impairment is not caused by a pollutant.
4D: Impaired but a TMDL study is not required because the impairment is due to natural conditions with insignificant anthropogenic influence.
5: Impaired and a TMDL study has not been approved by EPA.
d. Provided for listings that have been further assessed and are proposed for recategorization. Recategorizations will not be final until they are approved by EPA as part of Minnesota's list of impaired water bodies.

Appendix B. RES supporting analysis

This appendix provides additional data and information for the RES impaired reaches and upstream drainage areas, including:

- TP and chl-*a* LDCs for each impaired reach.
- TP and chl-*a* monthly box plots for each impaired reach.
- Mean summer TP and chl-*a* concentration in relation to mean summer flow.
- Box plots showing how TP, chl-*a*, and TSS concentrations vary spatially throughout each HUC-10 subwatershed in the Le Sueur River Watershed.

For the box plot figures presented in this appendix, the upper and lower edge of each box represents the 75th and 25th percentile of the data range for each site/reach. The error bars above and below each box represent the 95th and 5th percentile of the dataset. The colored dash within each box is the mean concentration of the parameter of interest. The dotted red line represents the Southern River Nutrient Region TP (150 µg/L), chl-*a* (35 µg/L), and TSS (65 mg/L) standards. Only data from 2000 through 2021 during the summer growing season (June through September) is included in each box plot

Figure 22. Le Sueur River Reach 501 summer (June through September) TP load duration curve and monitored loads (2012-2021).

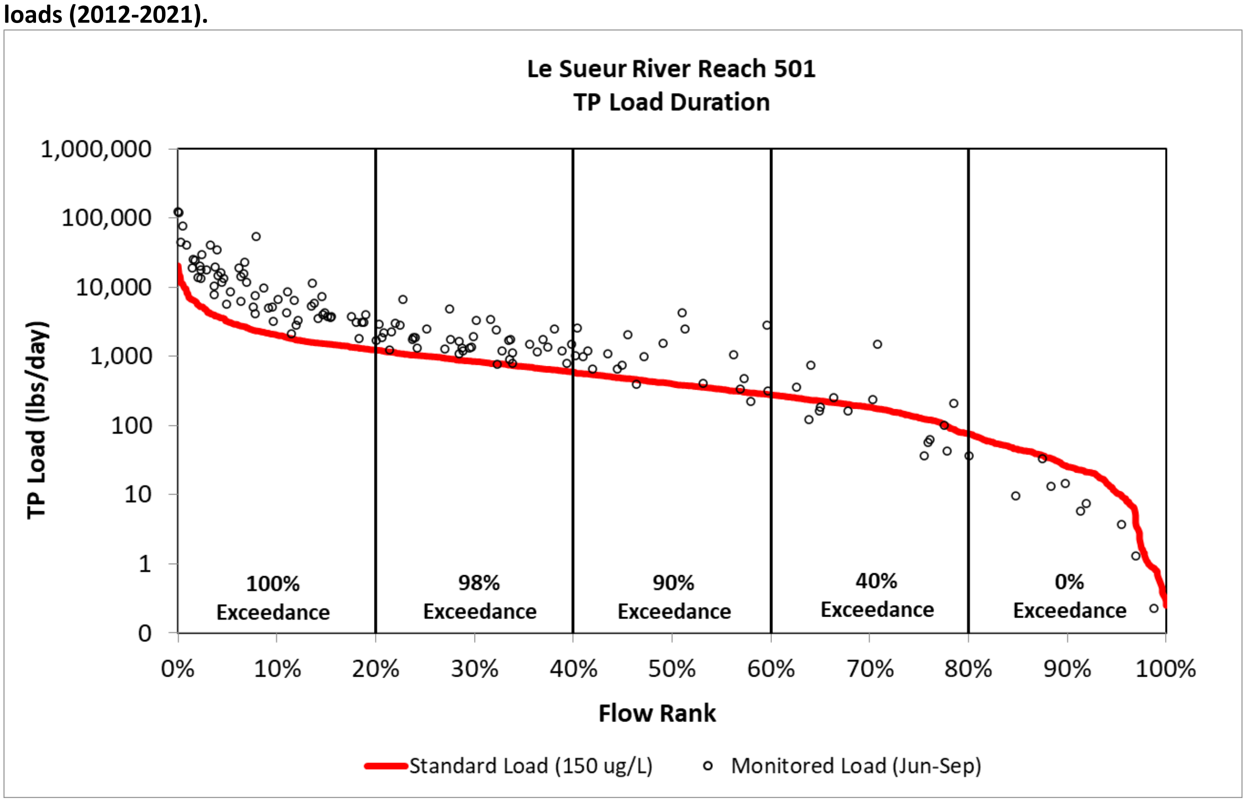


Figure 23. Le Sueur River Reach 501 summer TP by year (2005-2021).

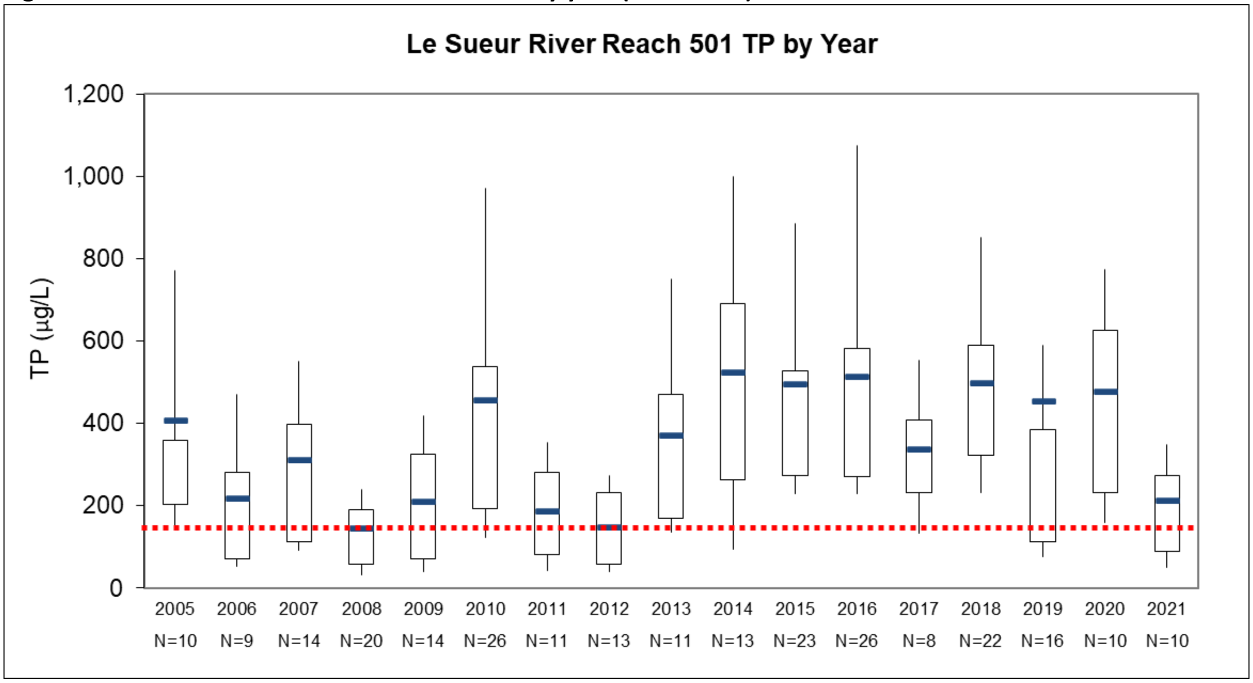


Figure 24. Le Sueur River Reach 501 summer TP by month (2005-2021).

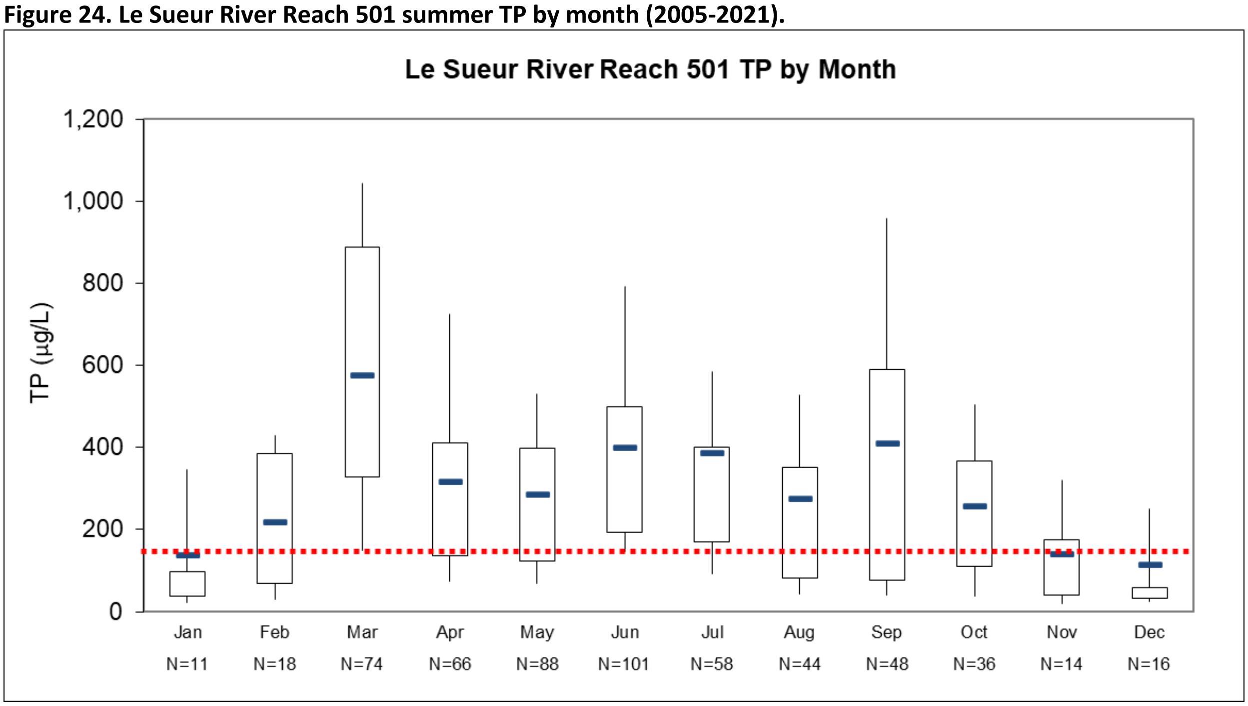


Figure 25. Le Sueur River Reach 501 mean summer flow versus summer mean TP concentration (2005-2021).

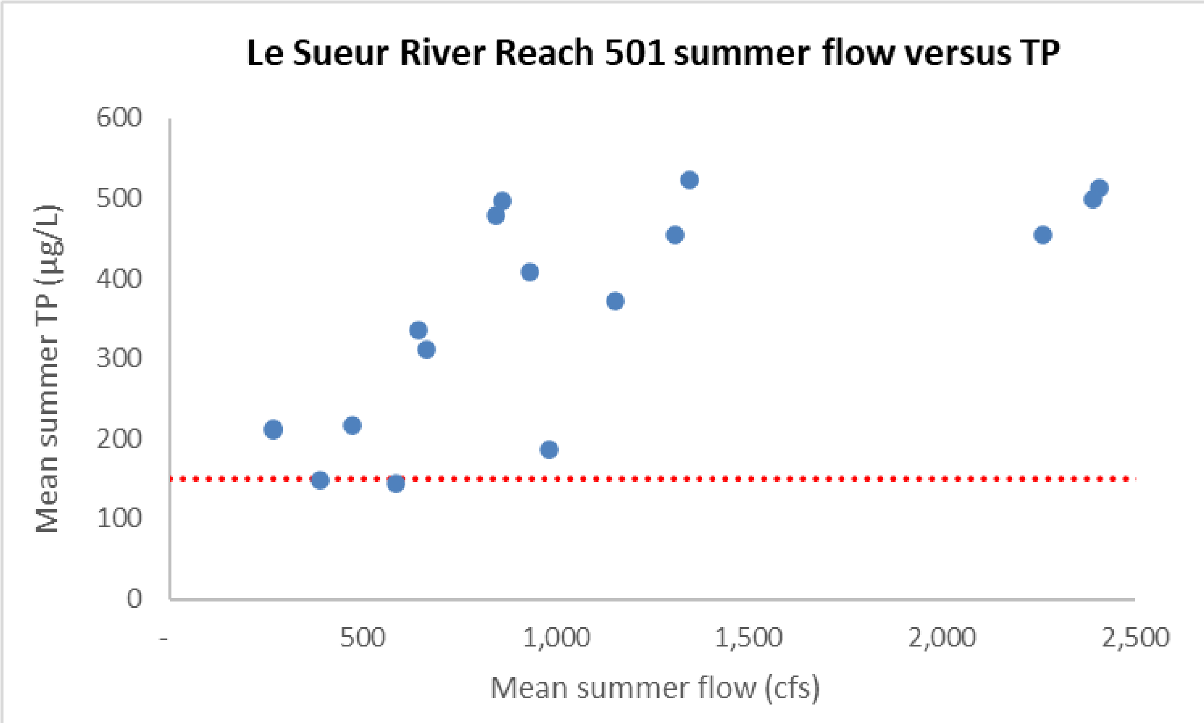


Figure 26. Le Sueur River Reach 501 summer (June through September) chl-*a* load duration curve and monitored loads (2005-2021).

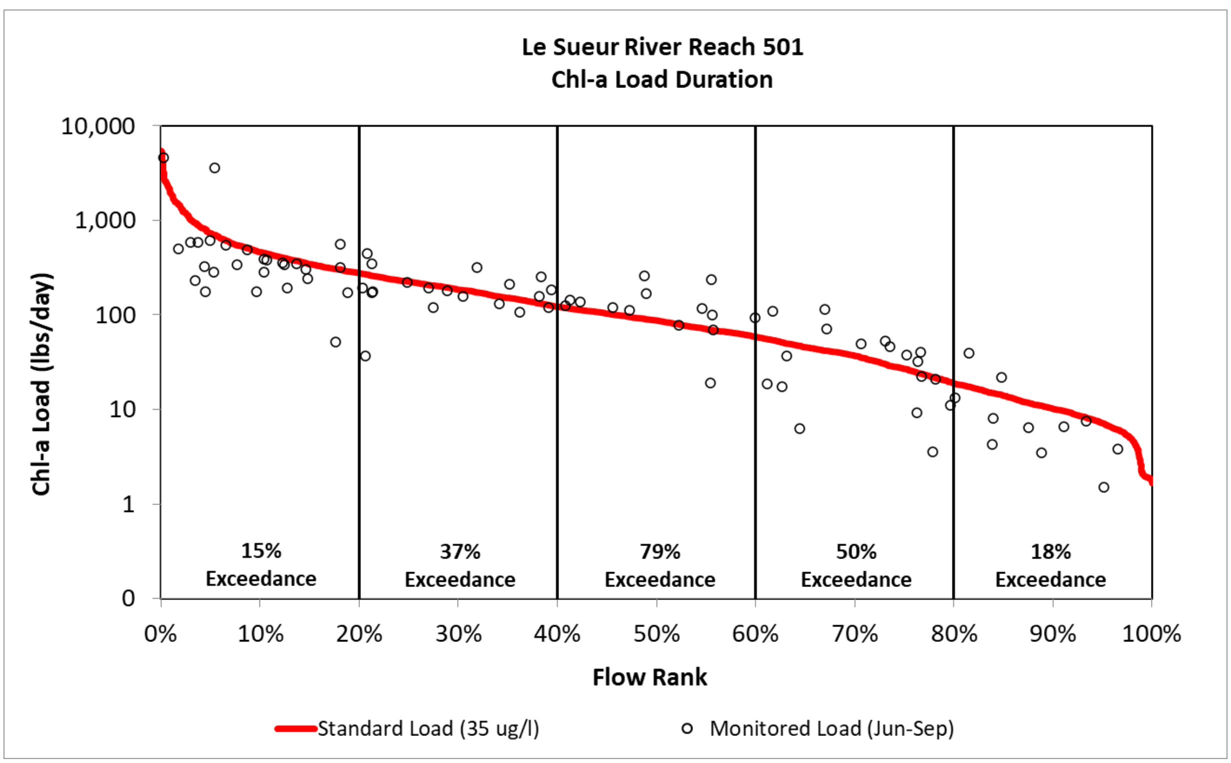


Figure 27. Le Sueur River Reach 501 summer chl-*a* by year (2005-2021).

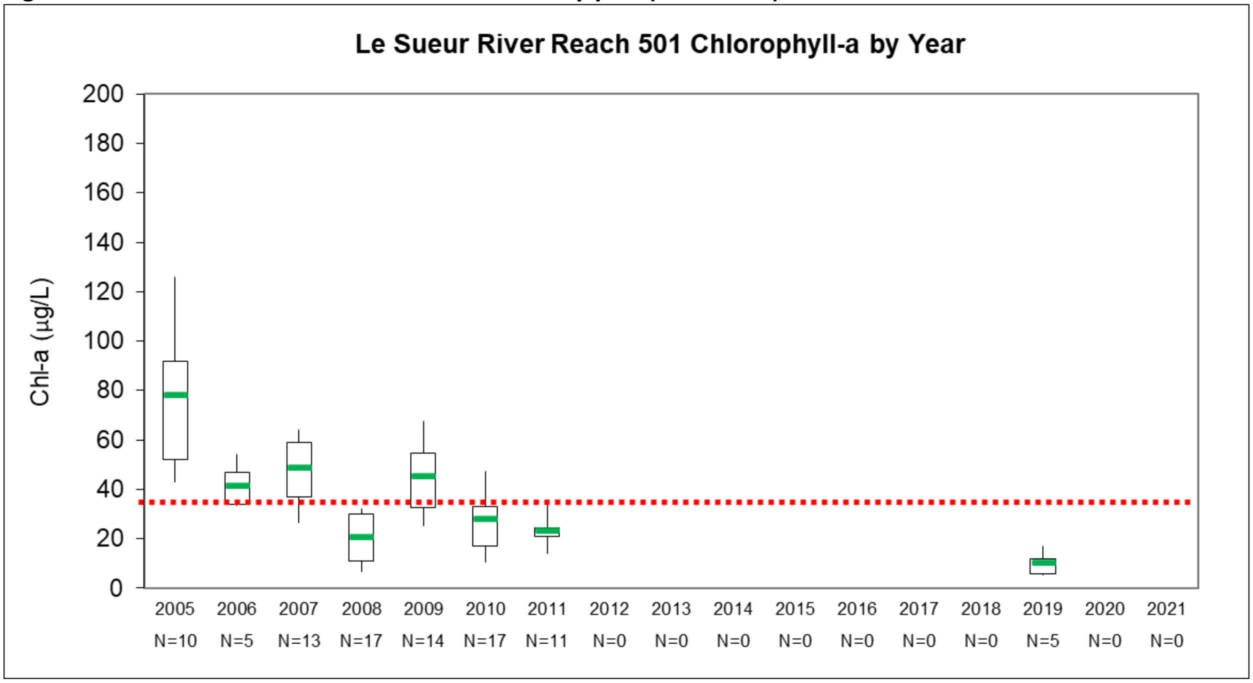


Figure 28. Le Sueur River Reach 501 summer chl-*a* by month (2005-2021).

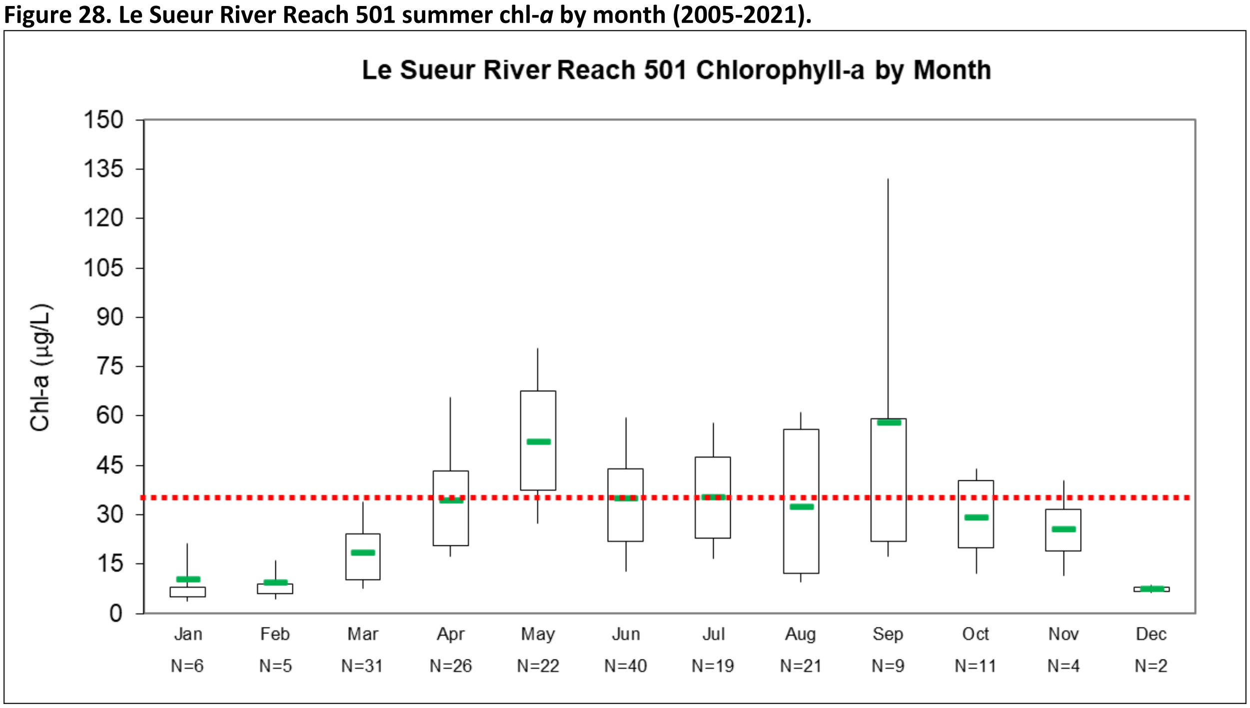


Figure 29. Le Sueur River Reach 501 mean summer flow versus summer mean chl-*a* concentration (2005-2021).

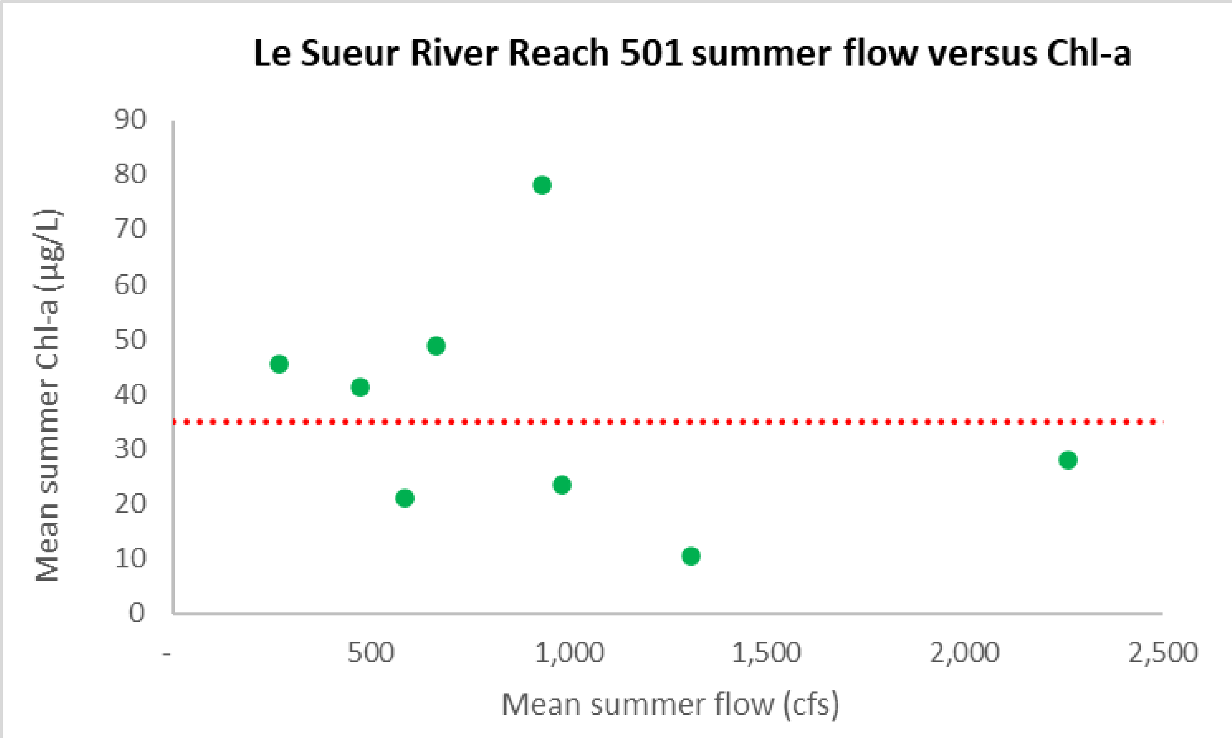


Figure 30. Cobb River Reach 556 summer (June through September) TP load duration curve and monitored loads (2012-2021).

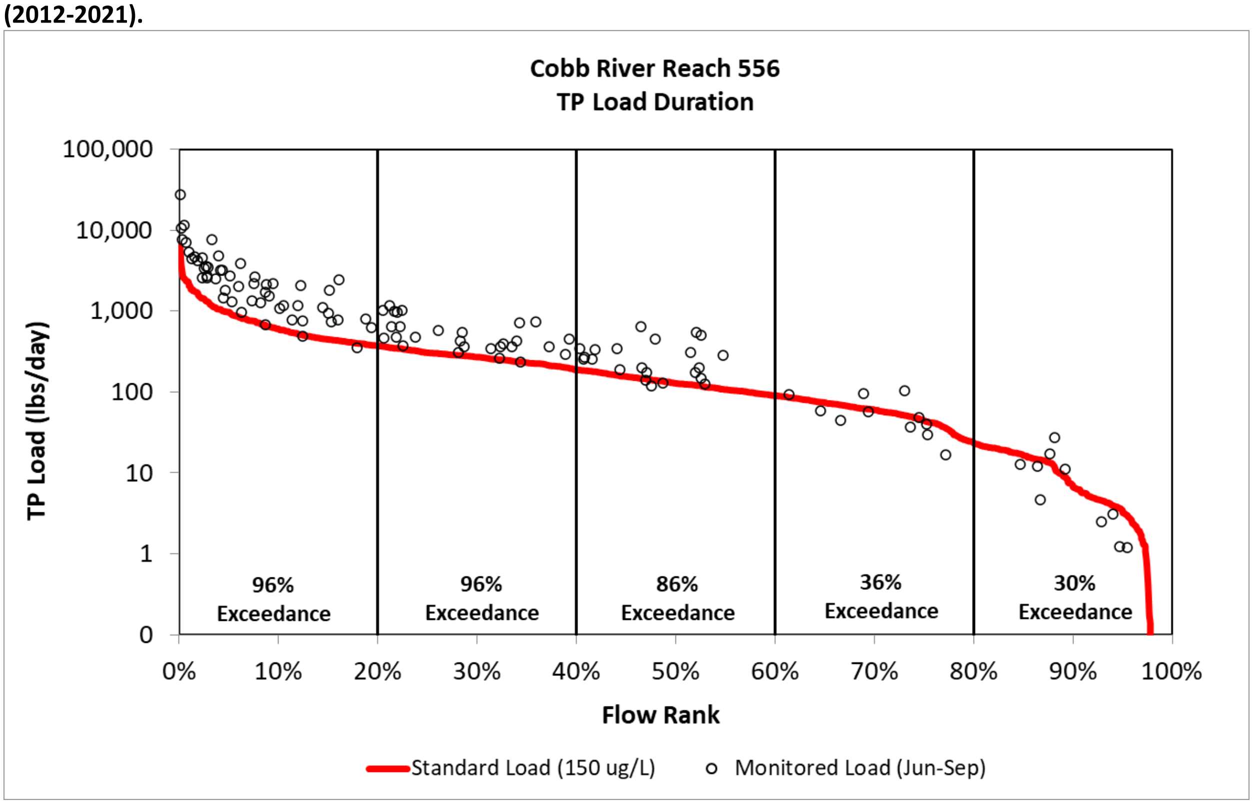


Figure 31. Cobb River Reach 556 summer TP by year (2005-2021).

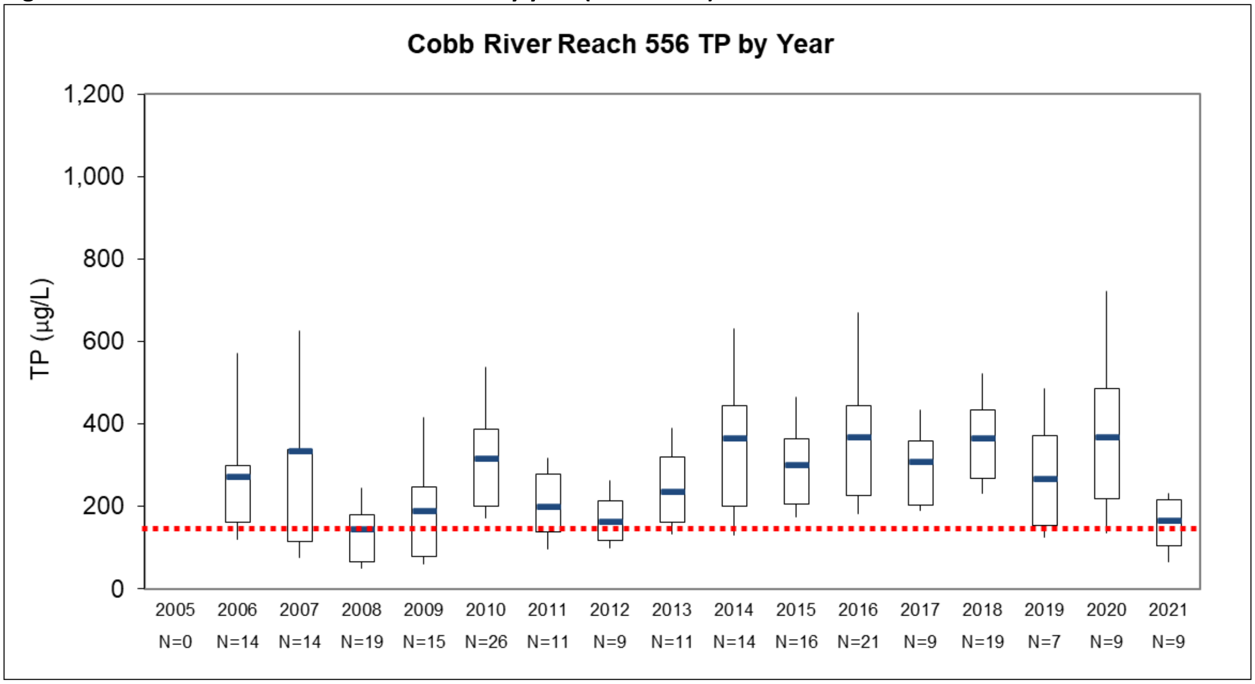


Figure 32. Cobb River Reach 556 summer TP by month (2005-2021).

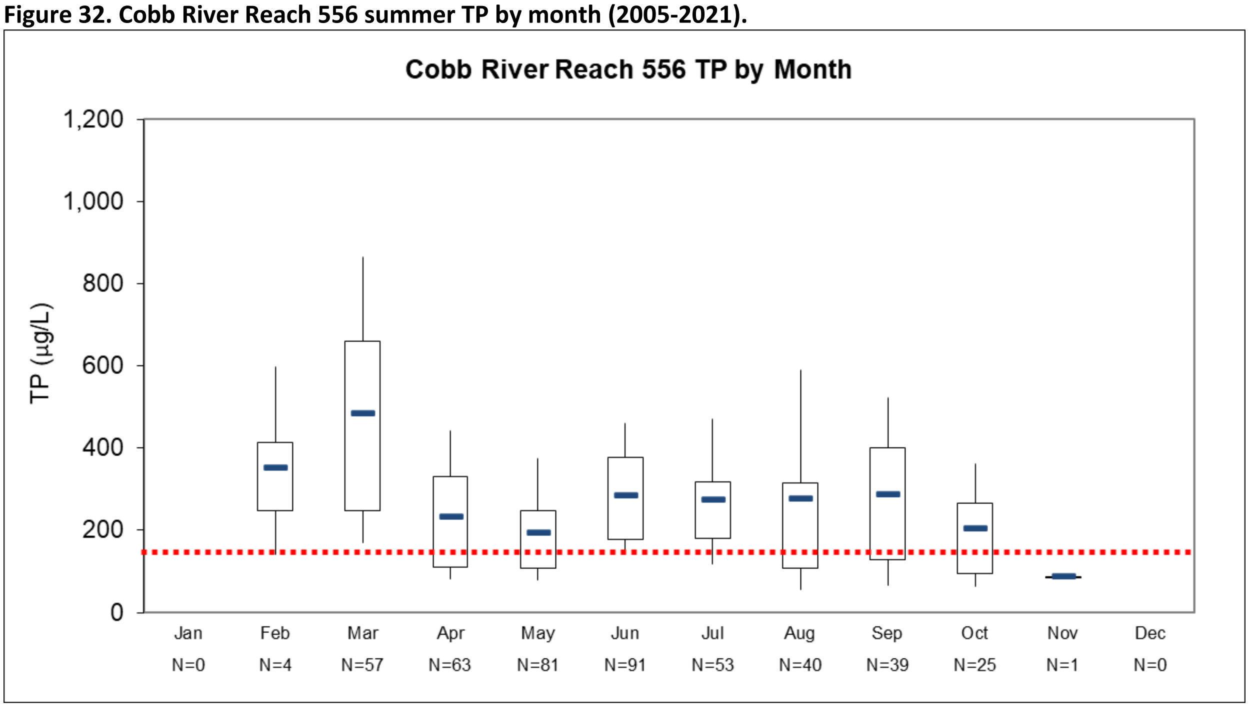


Figure 33. Cobb River Reach 556 mean summer flow versus summer mean TP concentration (2005-2021).

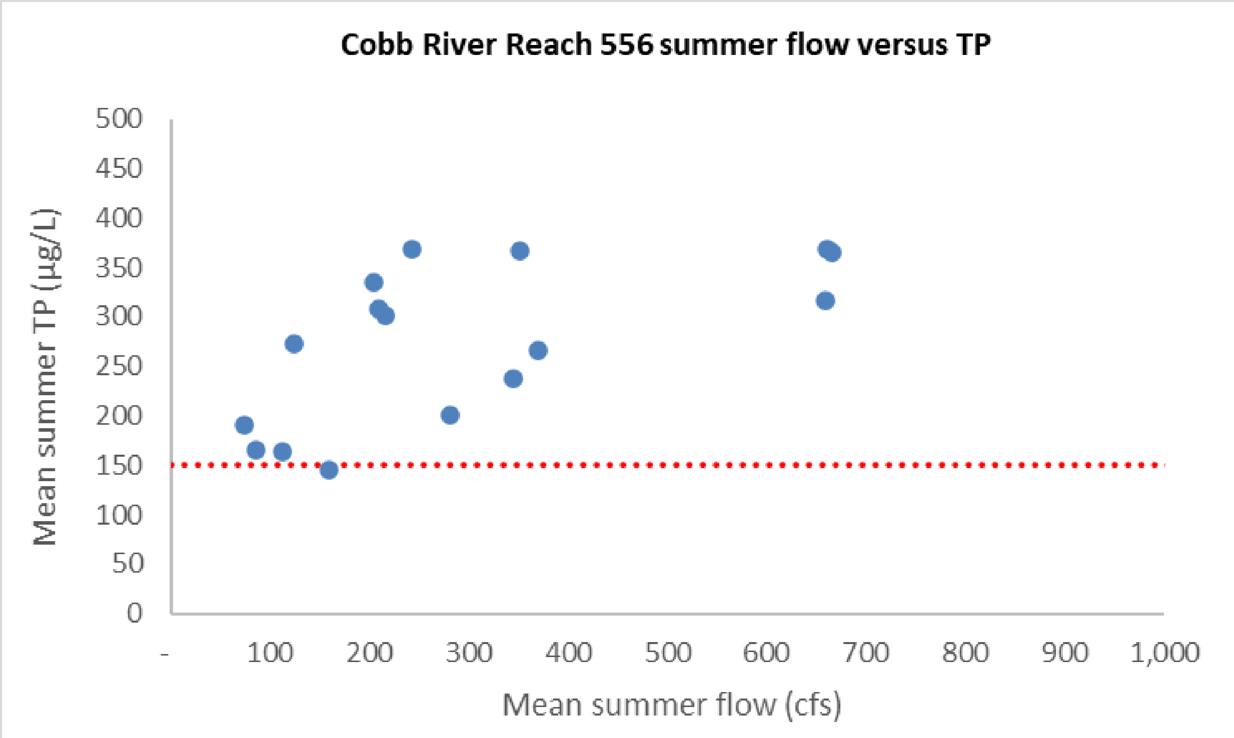


Figure 34. Cobb River Reach 556 summer (June through September) chl-*a* load duration curve and monitored loads (2005-2021).

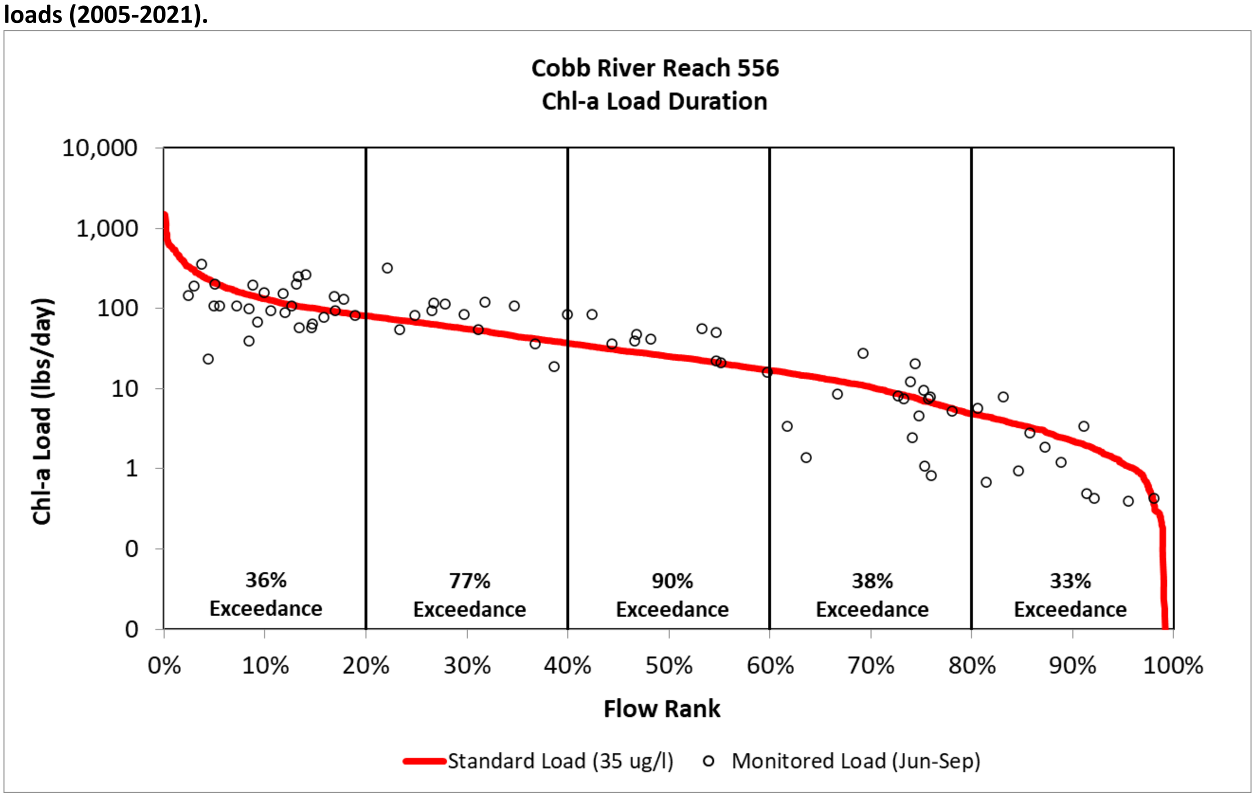


Figure 35. Cobb River Reach 556 summer chl-*a* by year (2005-2021).

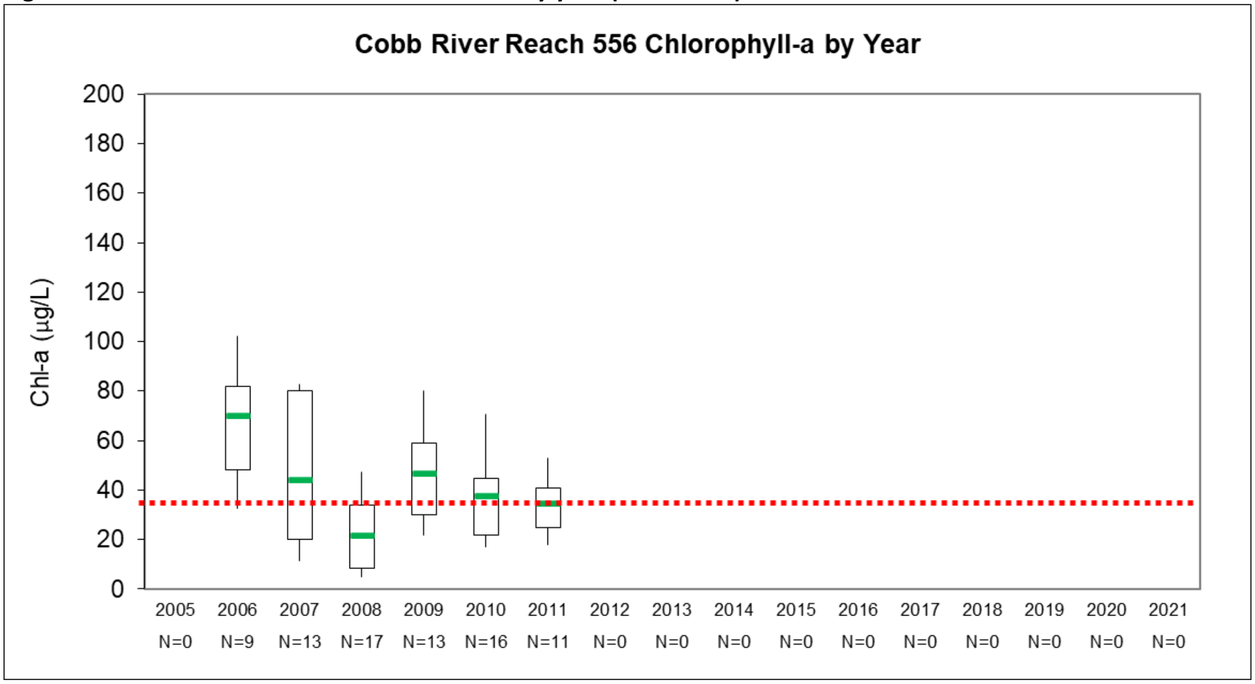


Figure 36. Cobb River Reach 556 summer chl-*a* by month (2005-2021).

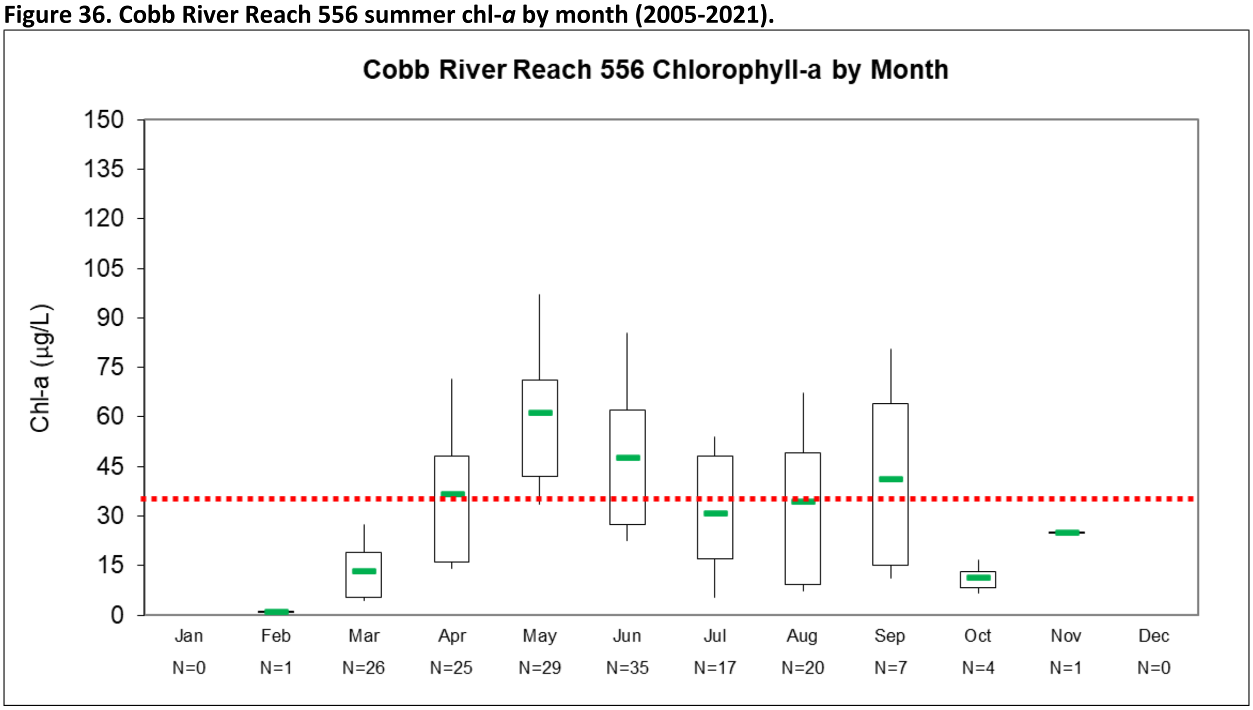


Figure 37. Cobb River Reach 556 mean summer flow versus summer mean chl-*a* concentration (2005-2021).

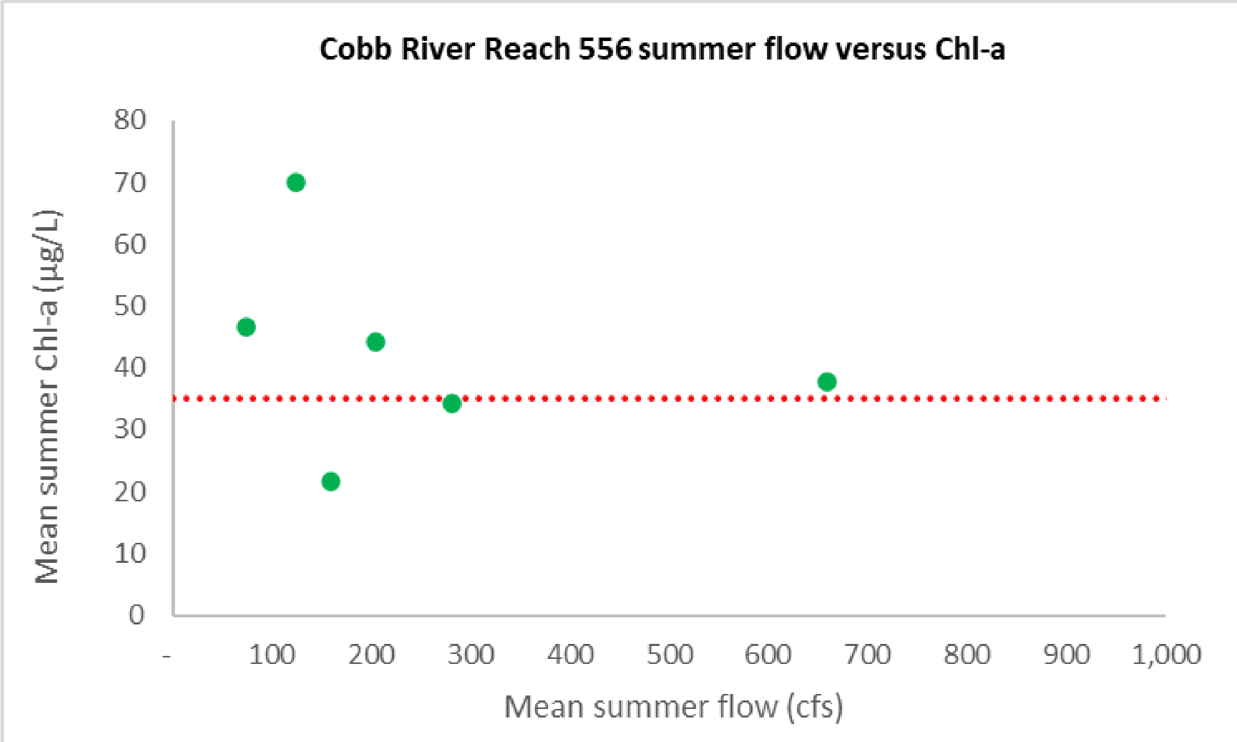


Figure 38. Little Cobb River Reach 504 summer (June through September) TP load duration curve and monitored loads (2012-2021).

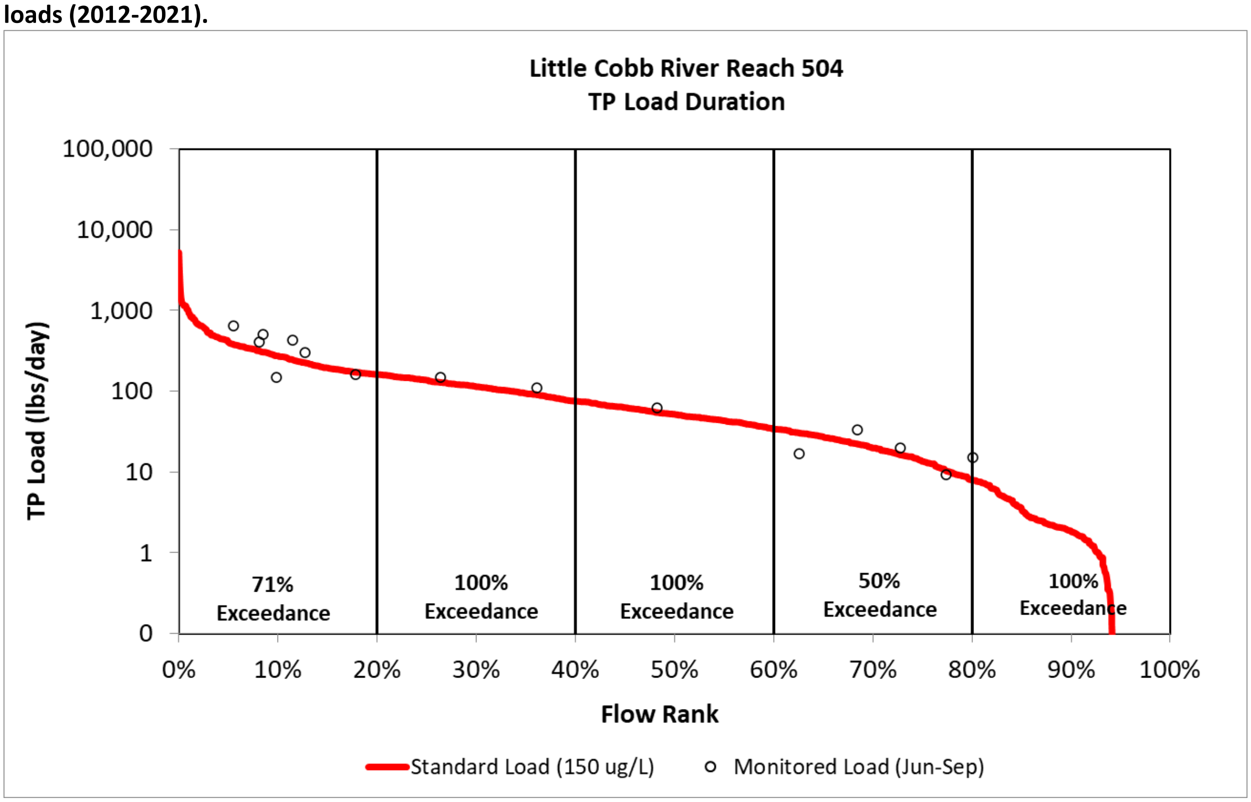


Figure 39. Little Cobb River Reach 504 summer TP by year (2005-2021).

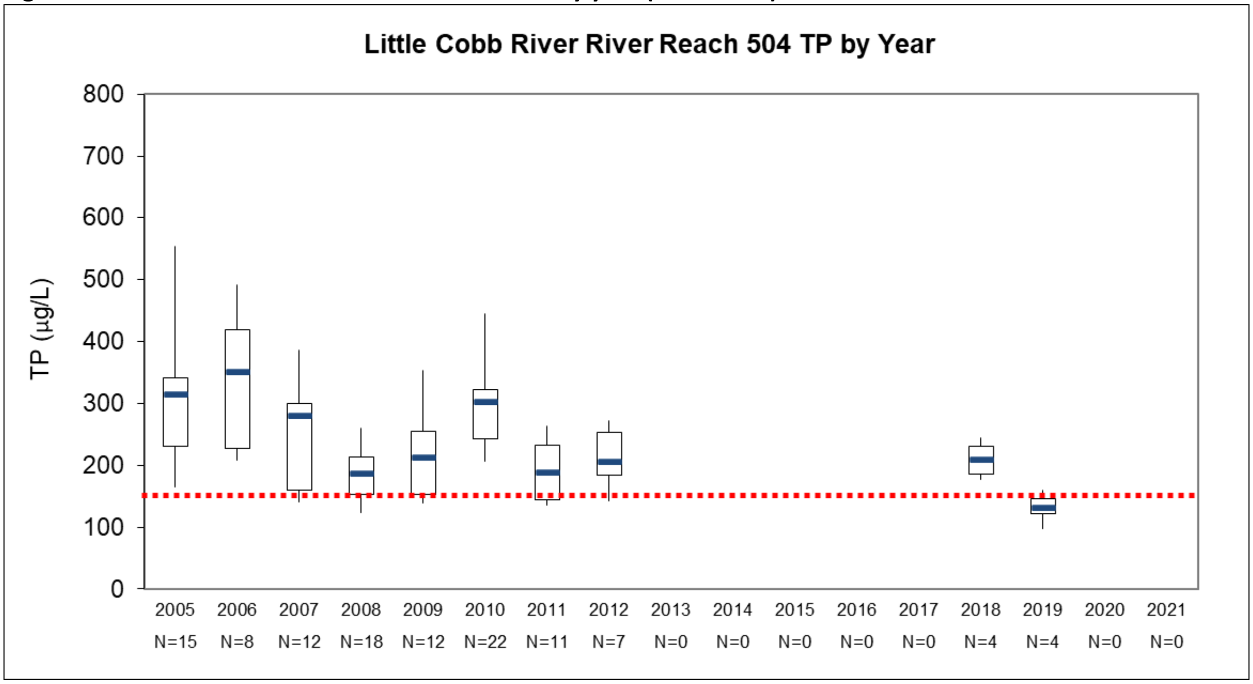


Figure 40. Little Cobb River Reach 504 summer TP by month (2005-2021).

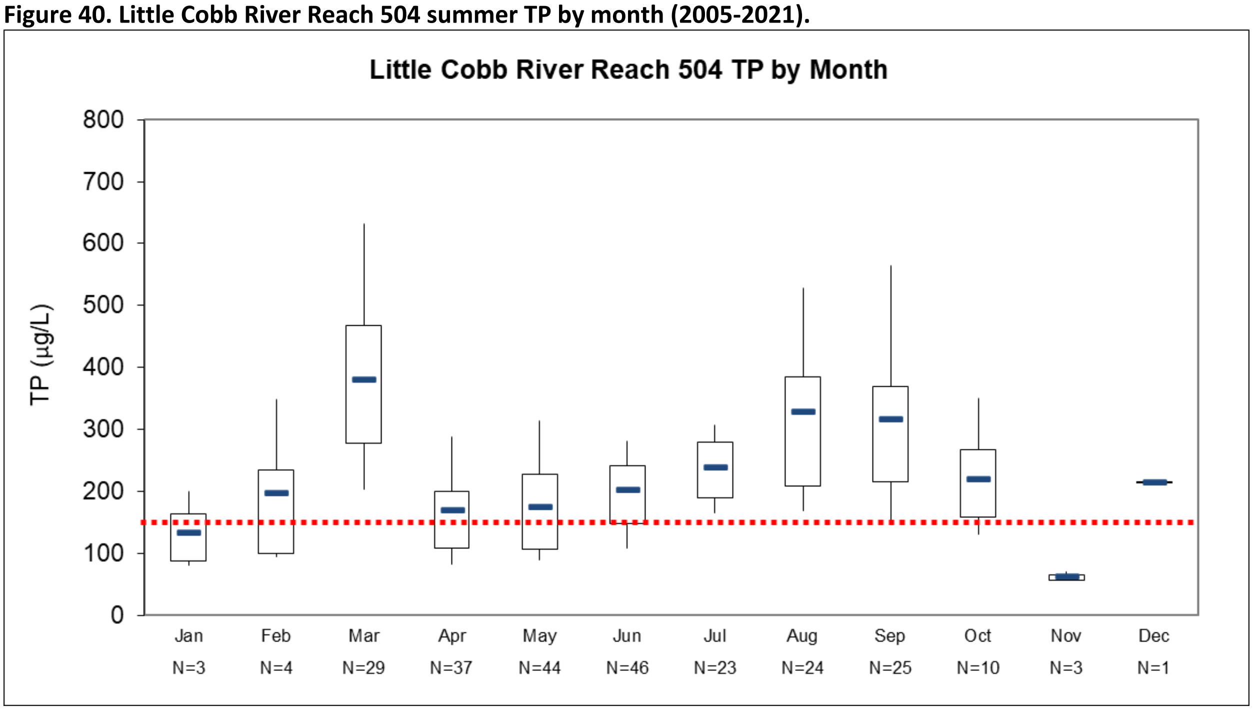


Figure 41. Little Cobb River Reach 504 mean summer flow versus summer mean TP concentration (2005-2021).

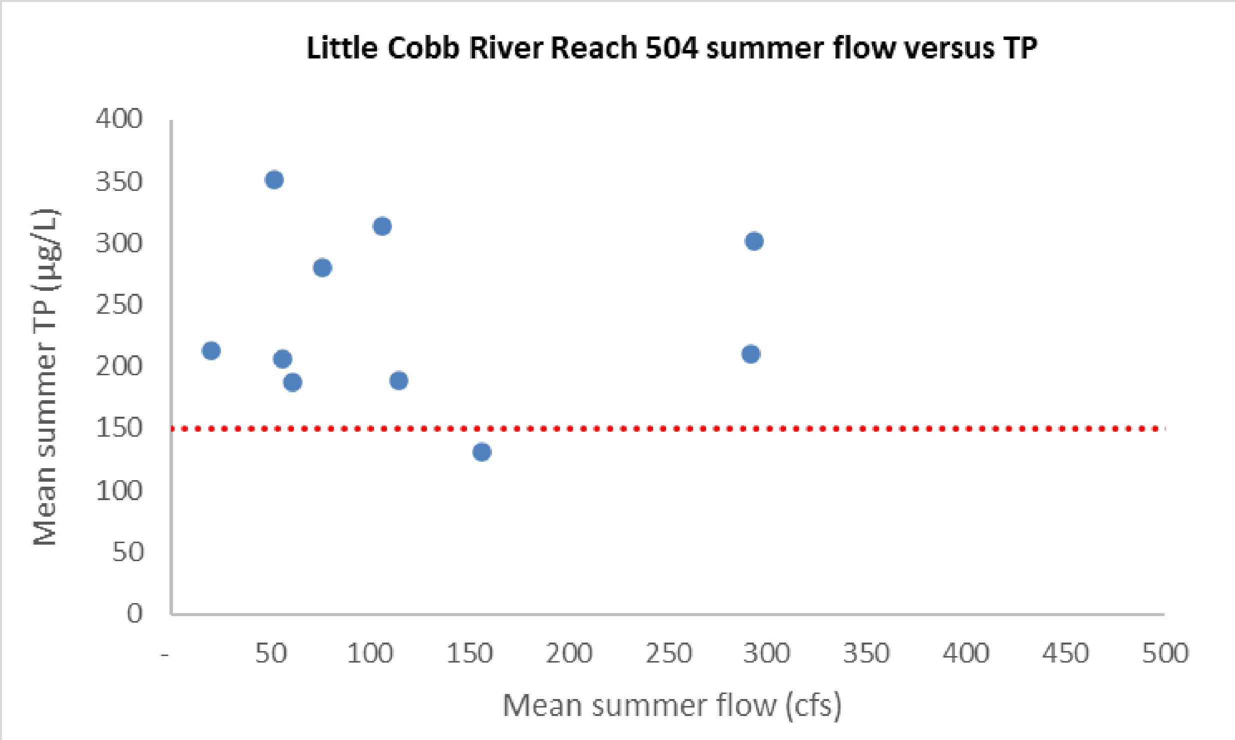


Figure 42. Little Cobb River Reach 504 summer (June through September) chl-*a* load duration curve and monitored loads (2005-2021).

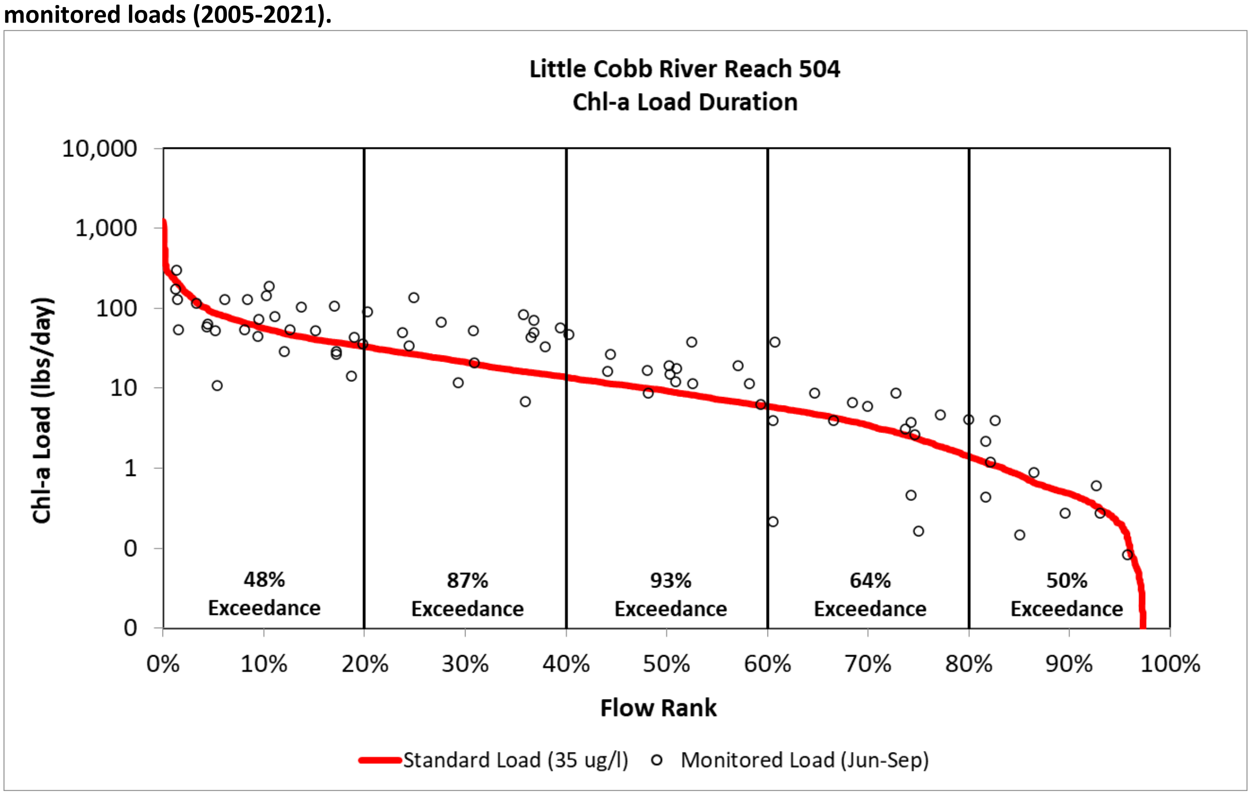


Figure 43. Little Cobb River Reach 504 summer chl-*a* by year (2005-2021).

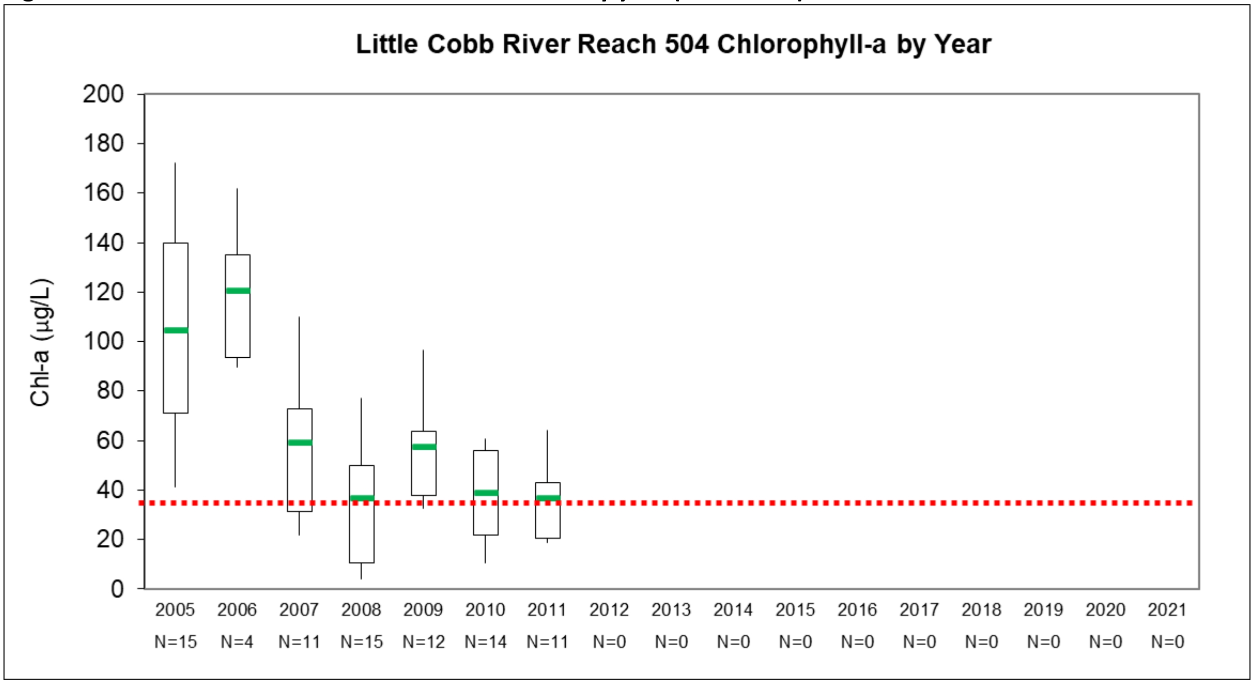


Figure 44. Little Cobb River Reach 504 summer chl-*a* by month (2005-2021).

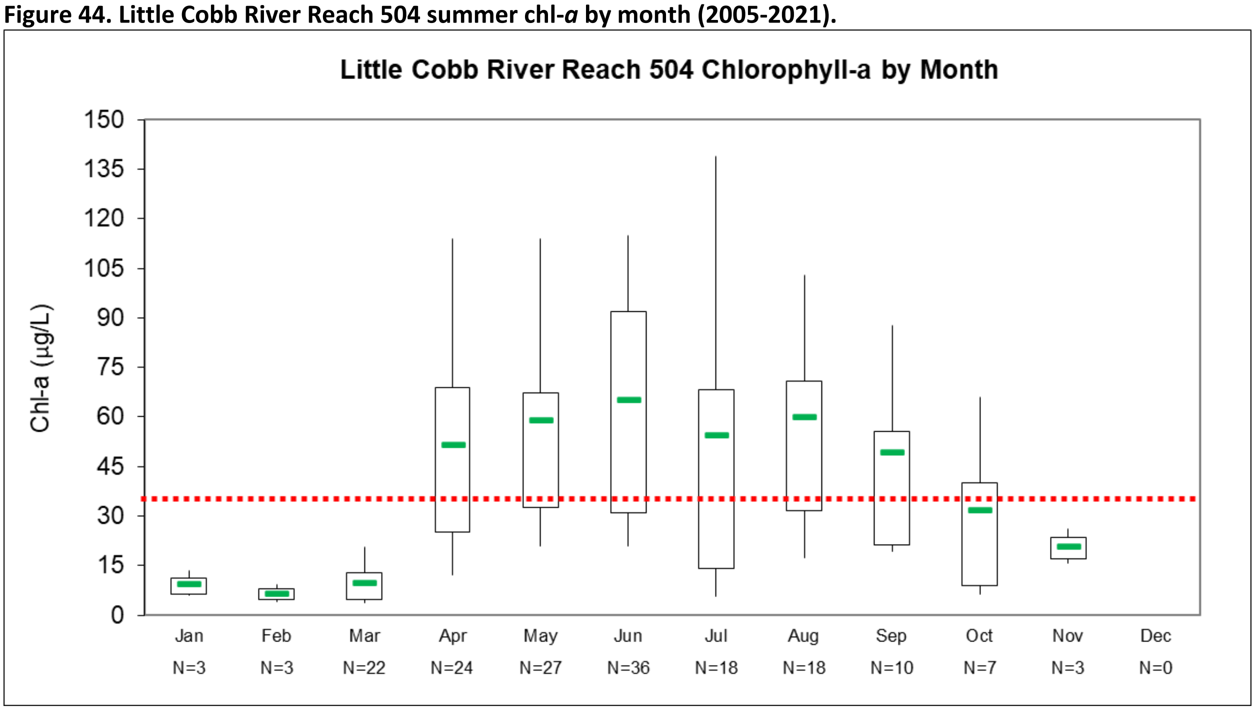


Figure 45. Little Cobb River Reach 504 mean summer flow versus summer mean chl-*a* concentration (2005-2021).

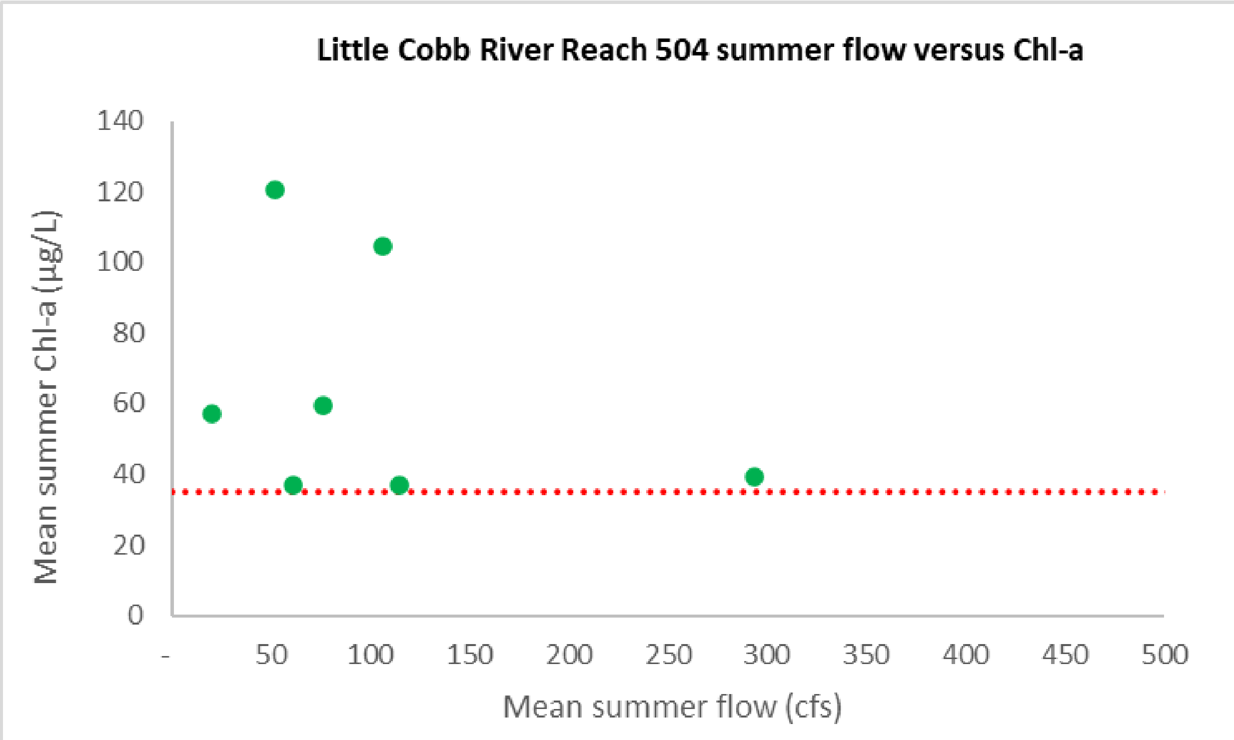


Figure 46. Maple River and Rice Creek HUC-10 water quality monitoring stations and wastewater facilities.

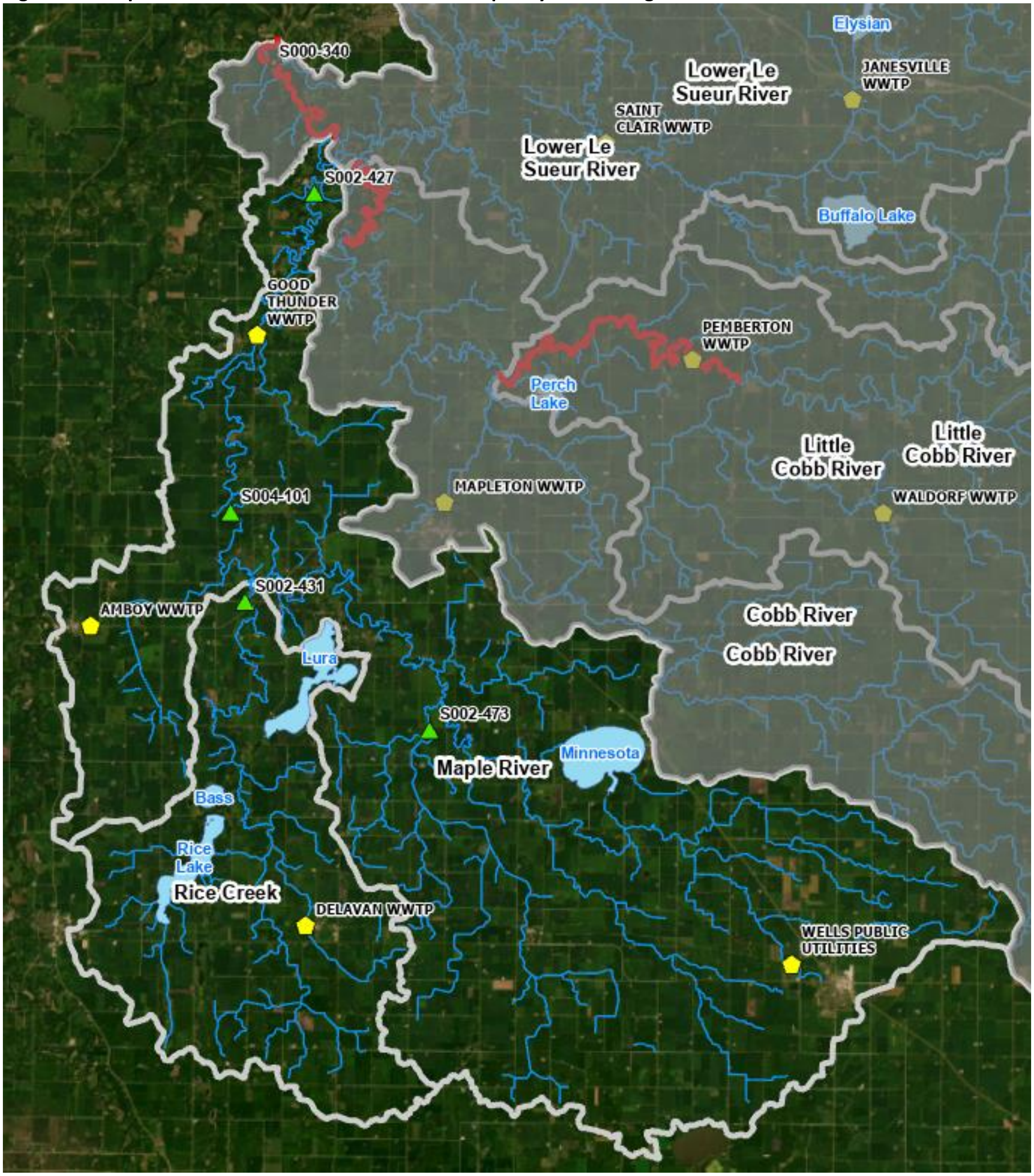


Figure 47. Monitored total phosphorus concentrations in the Maple River and Rice Creek HUC-10 subwatersheds from upstream to downstream.

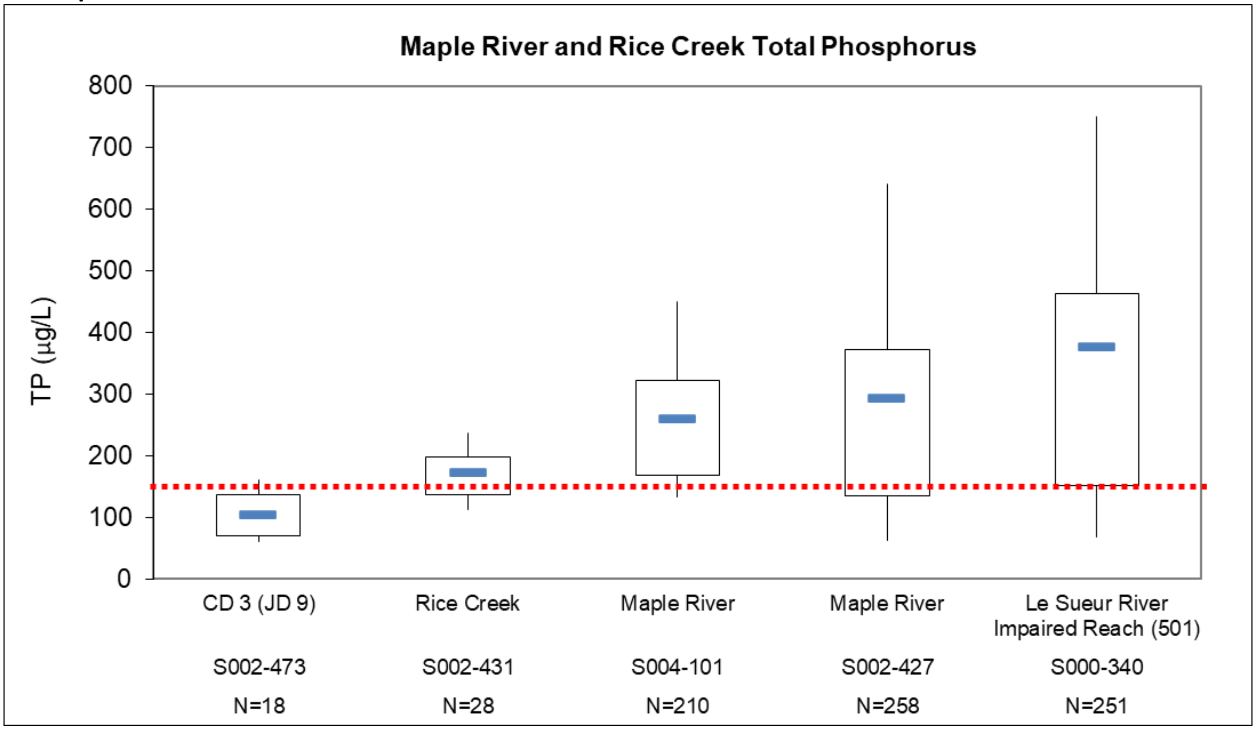


Figure 48. Monitored chl-*a* concentrations in the Maple River and Rice Creek HUC-10 subwatersheds from upstream to downstream.

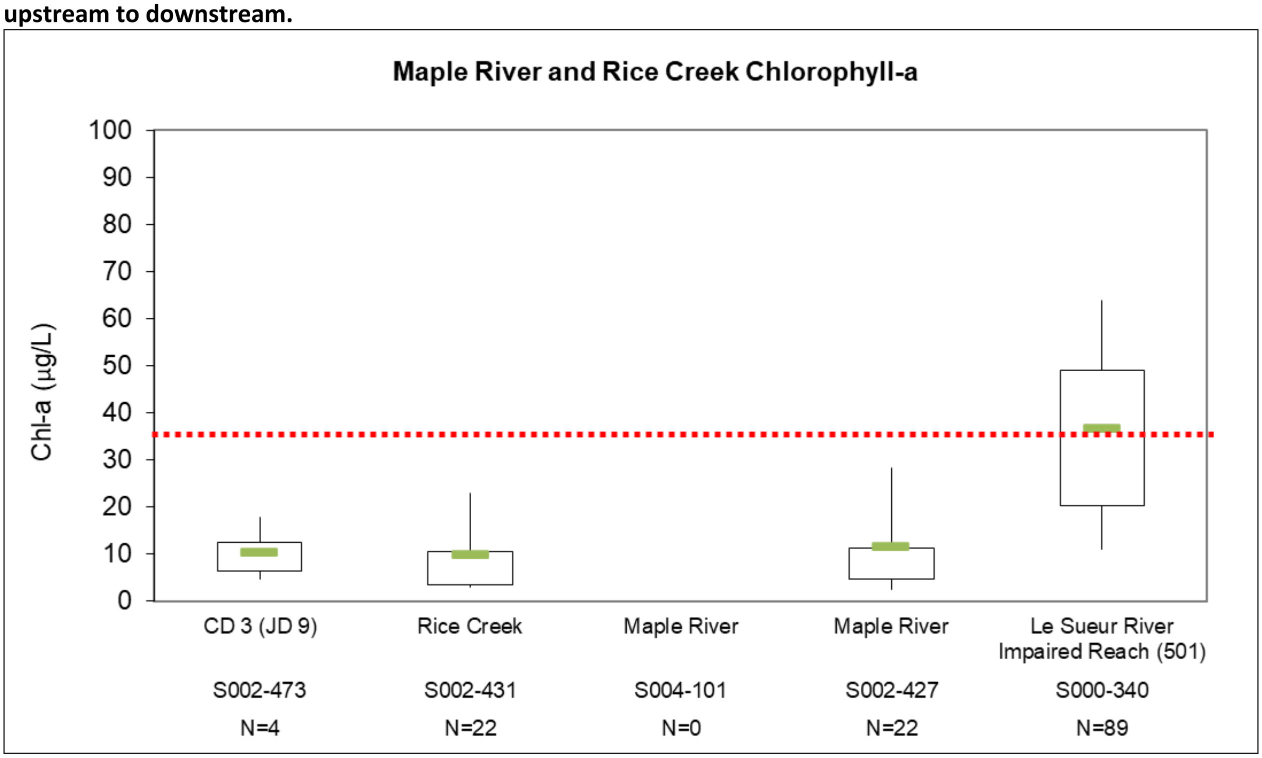


Figure 49. Monitored total suspended solids concentrations in the Maple River and Rice Creek HUC-10 subwatersheds from upstream to downstream.

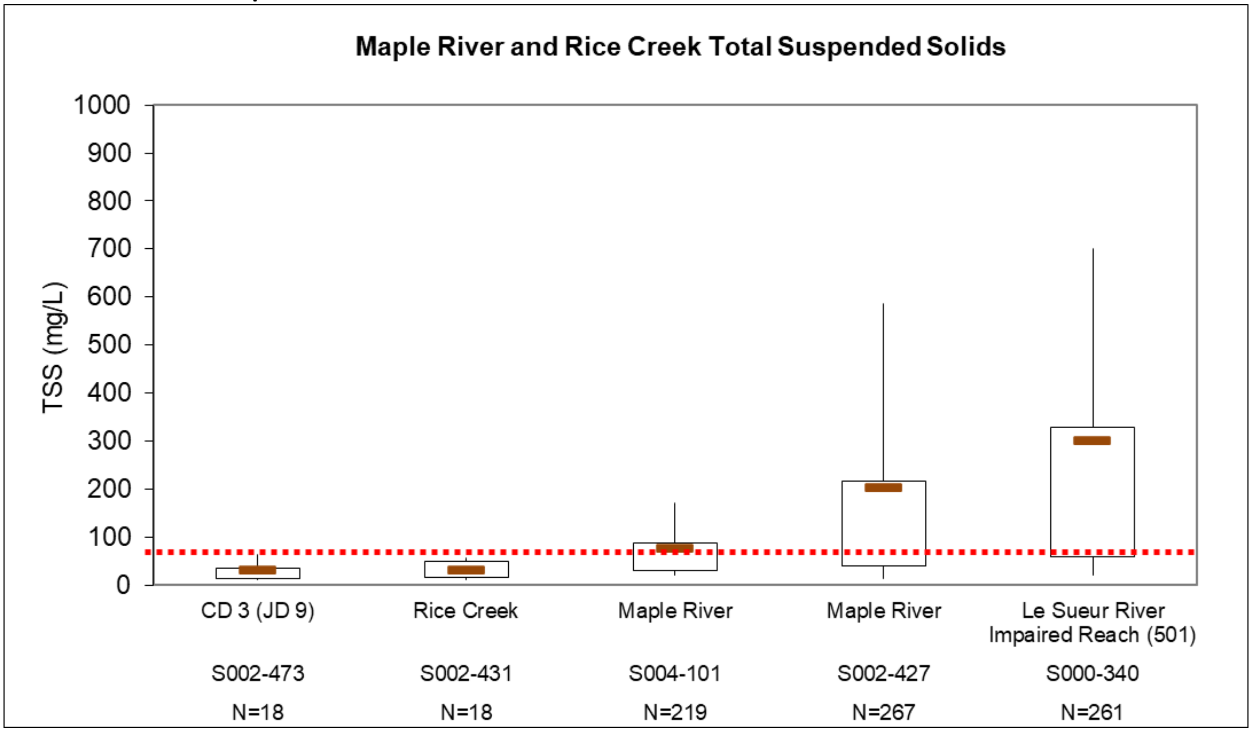


Figure 50. Cobb and Little Cobb River HUC-10 water quality monitoring stations and wastewater facilities.

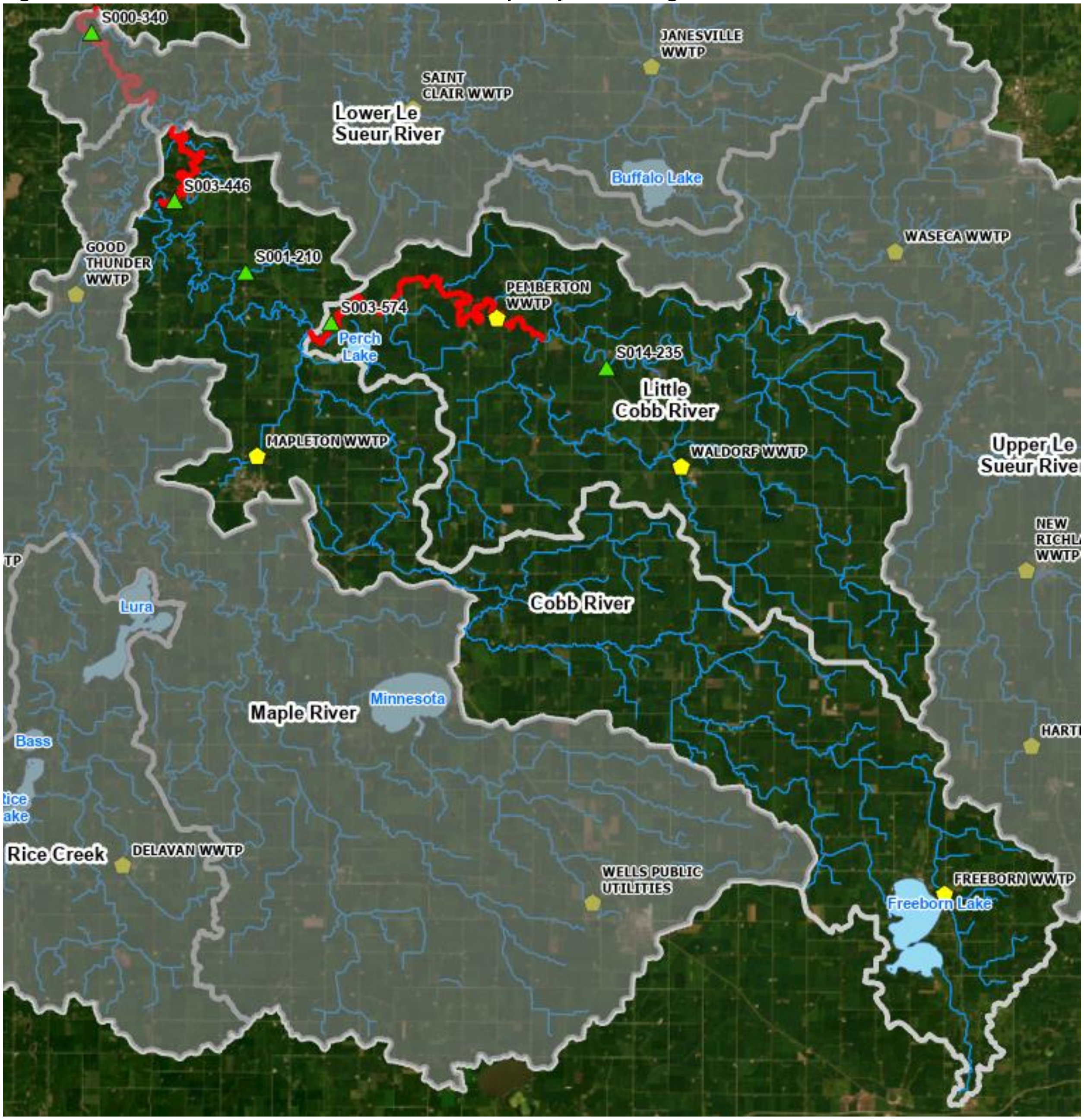


Figure 51. Monitored total phosphorus concentrations in the Little Cobb and Cobb River HUC-10 subwatersheds from upstream to downstream.

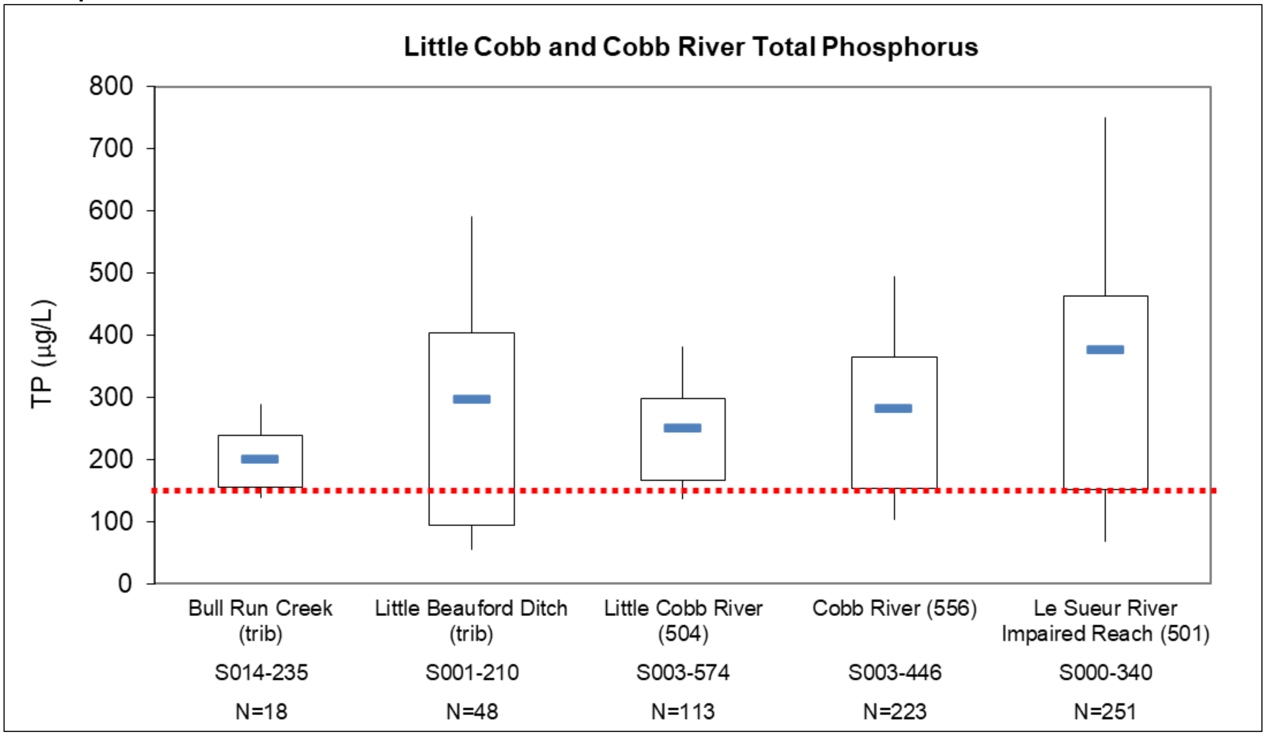


Figure 52. Monitored chl-*a* concentrations in the Little Cobb and Cobb River HUC-10 subwatersheds from upstream to downstream.

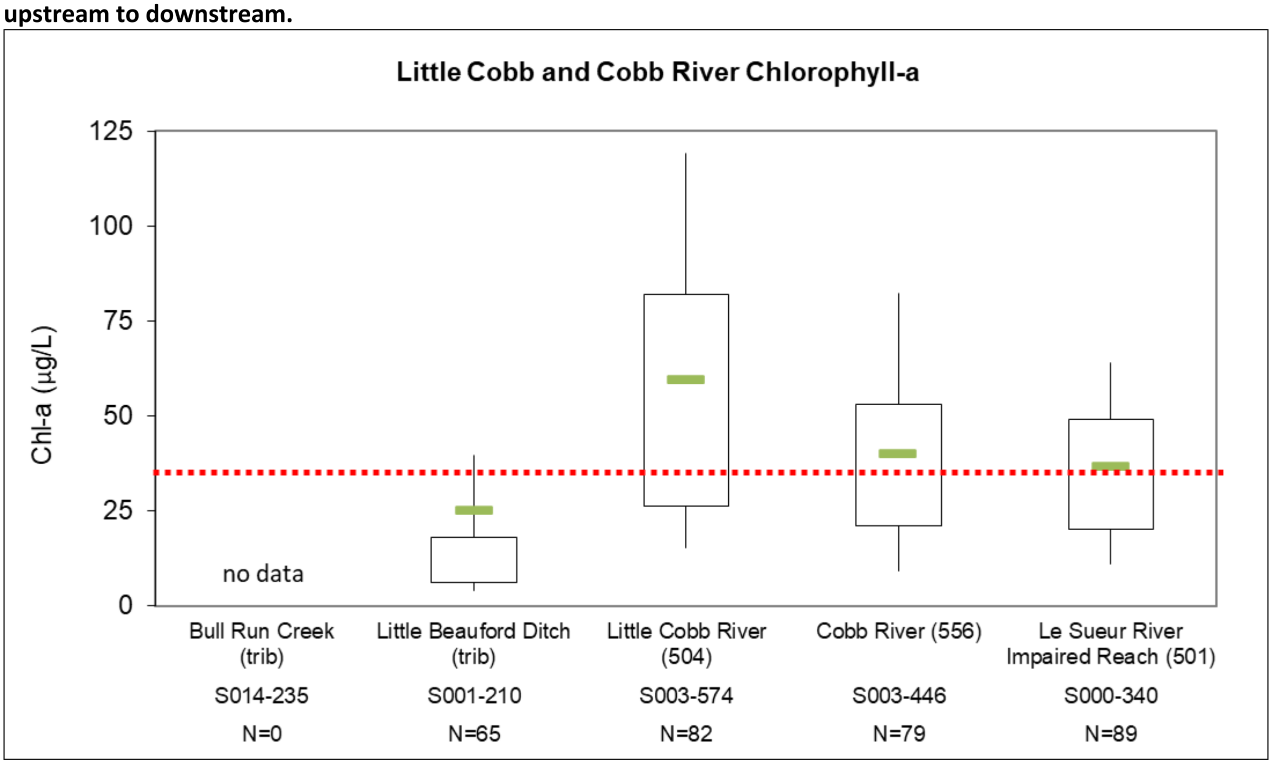


Figure 53. Monitored total suspended solids concentrations in the Maple River and Rice Creek HUC-10 subwatersheds from upstream to downstream.

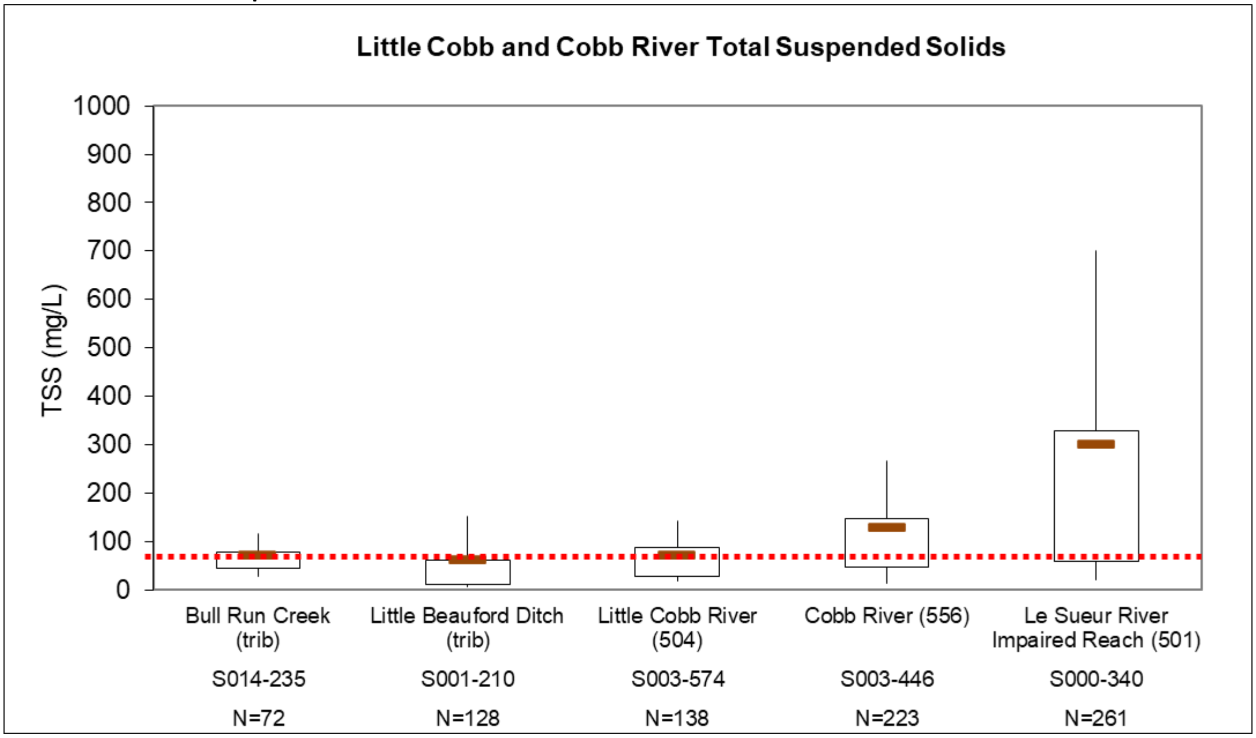


Figure 54. Upper and Lower Le Sueur River HUC-10 water quality monitoring stations and wastewater facilities.

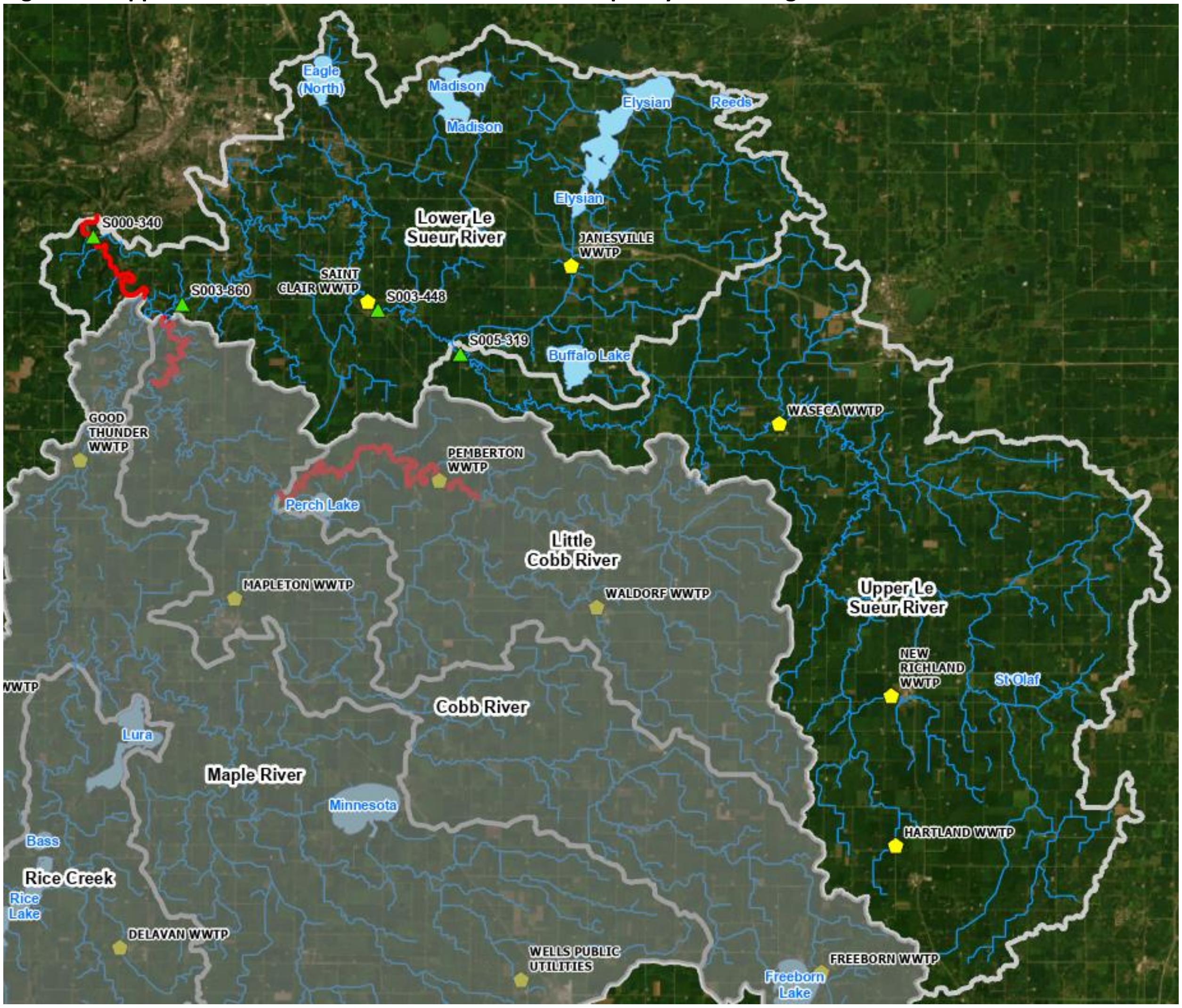


Figure 55. Monitored total phosphorus concentrations in the Upper and Lower Le Sueur River HUC-10 subwatersheds from upstream to downstream.

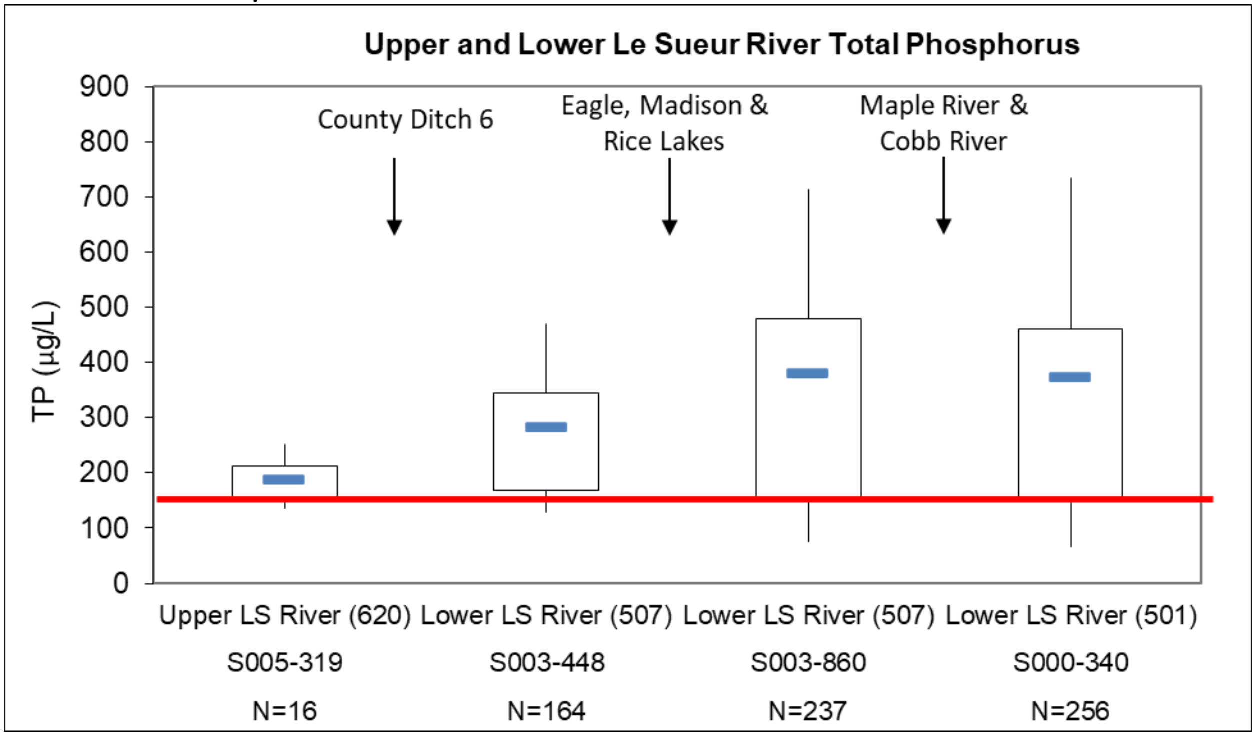


Figure 56. Monitored chl-*a* concentrations in the Upper and Lower Le Sueur River HUC-10 subwatersheds from upstream to downstream.

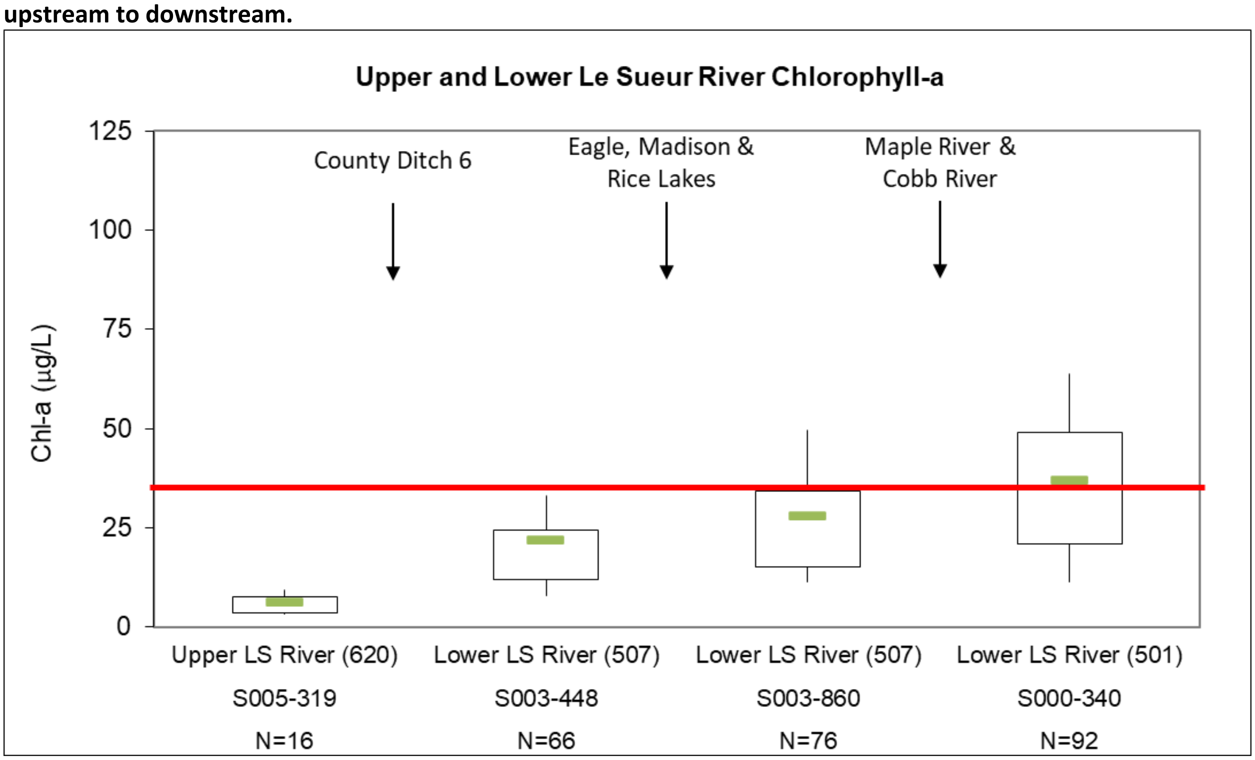
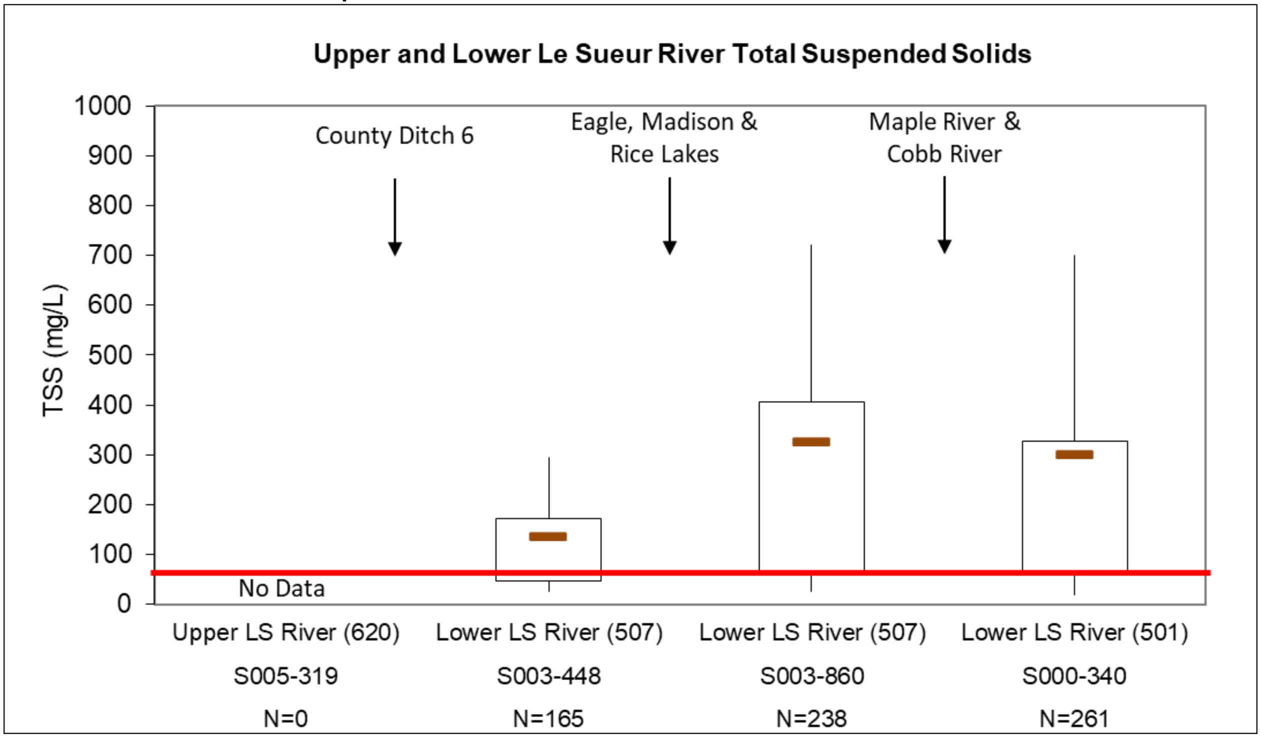


Figure 57. Monitored total suspended solids concentrations in the Upper and Lower Le Sueur River Creek HUC-10 subwatersheds from upstream to downstream.



Appendix C. Guidance for documentation of compliance with MS4 TP WLAs for Le Sueur River reach 501

Permit overview

This supplement to the *Le Sueur River Watershed TMDL Report* is to assist the MS4 permittees assigned WLAs in this TMDL with future MS4 General Permit applications. Assuming the current 2020 MS4 General Permit requirements remain the same or similar for TP WLAs in the 2025 MS4 General Permit, during the 2025 General Permit reapplication, the permittees must determine if they are meeting their assigned TP WLA for Le Sueur River reach 501.

- If a permittee is meeting the WLA, they must:
    - Document all structural stormwater BMPs that have been implemented in order to achieve the WLA
    - Provide estimated reductions
- If a permittee is not meeting their TP WLA at the time of permit reissuance, they must:
    - Submit a compliance schedule that includes proposed BMPs for the permit cycle and the planned implementation year for each BMP
    - Provide a cumulative estimate of load reductions
    - Develop a long-term strategy for continuing progress toward assigned WLAs

Le Sueur River reach 501 TMDL information

As discussed in Section 4.5.4.2, the approximated WLA area of each MS4 was divided by the total area of the watershed minus the BCs to represent the percent coverage of the permitted MS4 within the impairment watershed (Table 21).

The target watershed runoff phosphorus contribution in the TMDL scenario (Table 23) is based on a concentration (141 µg/L). This target represents the MS4 runoff contribution at the outlet of Reach 501 and includes phosphorus fate, transport, and losses in the impaired reach and stream network upstream of the impaired reach. If a model that does not account for in-channel processes and losses is used to model the MS4 area(s) for Reach 501 TMDL compliance, a correction factor should be applied to account for phosphorus losses in the stream channels downstream of the MS4 area(s).

On average, the HSPF model estimates that 14% of the phosphorus delivered from the subwatersheds containing the MS4s in the Lower Le Sueur River HUC-10 (i.e., Eagle Lake, Blue Earth County, MnDOT, South Bend Township, and Mankato City and Township) is lost before it reaches Reach 501. Therefore, if a watershed loading model is used for these MS4 areas that does not account for in-channel processes and losses in the downstream drainage network, a correction factor of 0.86 should be applied to evaluate compliance with this TMDL's MS4 runoff concentration target (141 µg/L TP). For the subwatersheds containing the city of Waseca MS4 areas, the HSPF model estimates that 46% of the phosphorus is lost before reaching Reach 501 and therefore a correction factor 0.54 should be used for these areas (Table 29).

Table 29. TP correction factor and target concentrations for MS4s covered in this TMDL.

MS4(s)	Target runoff concentration at impaired reach (µg/L)	P loss Correction factor	Target runoff concentration at MS4 (µg/L)
Mankato City, Mankato Township, Eagle Lake City, MnDOT, South Bend Township	141	0.86	164
Waseca City	141	0.54	261

MS4 regulated area: Le Sueur River reach 501

The seven currently permitted MS4s in the Le Sueur River Watershed are regulated under three different parts of Minn. R. 7090.1010, so it is necessary to distinguish what the regulated area is for each. However, because the regulated areas are subject to change, the entire jurisdictional area of the MS4 regulated cities and townships within the Le Sueur River Watershed (minus BCs from the Cycle 1 TMDL for Eagle Lake (North)) were used to develop the WLA mass loads for reach 501 (Table 21,

Table 23). Using the entire jurisdictional boundary acknowledges that any future stormwater conveyance within a municipality's boundary may be MS4-regulated, depending on a jurisdiction's classification from the most recent Census (see Table 30 for Census results used in this TMDL development and analysis).

Table 30. 2020 U.S. Census results and currently permitted MS4s in Le Sueur River Watershed.

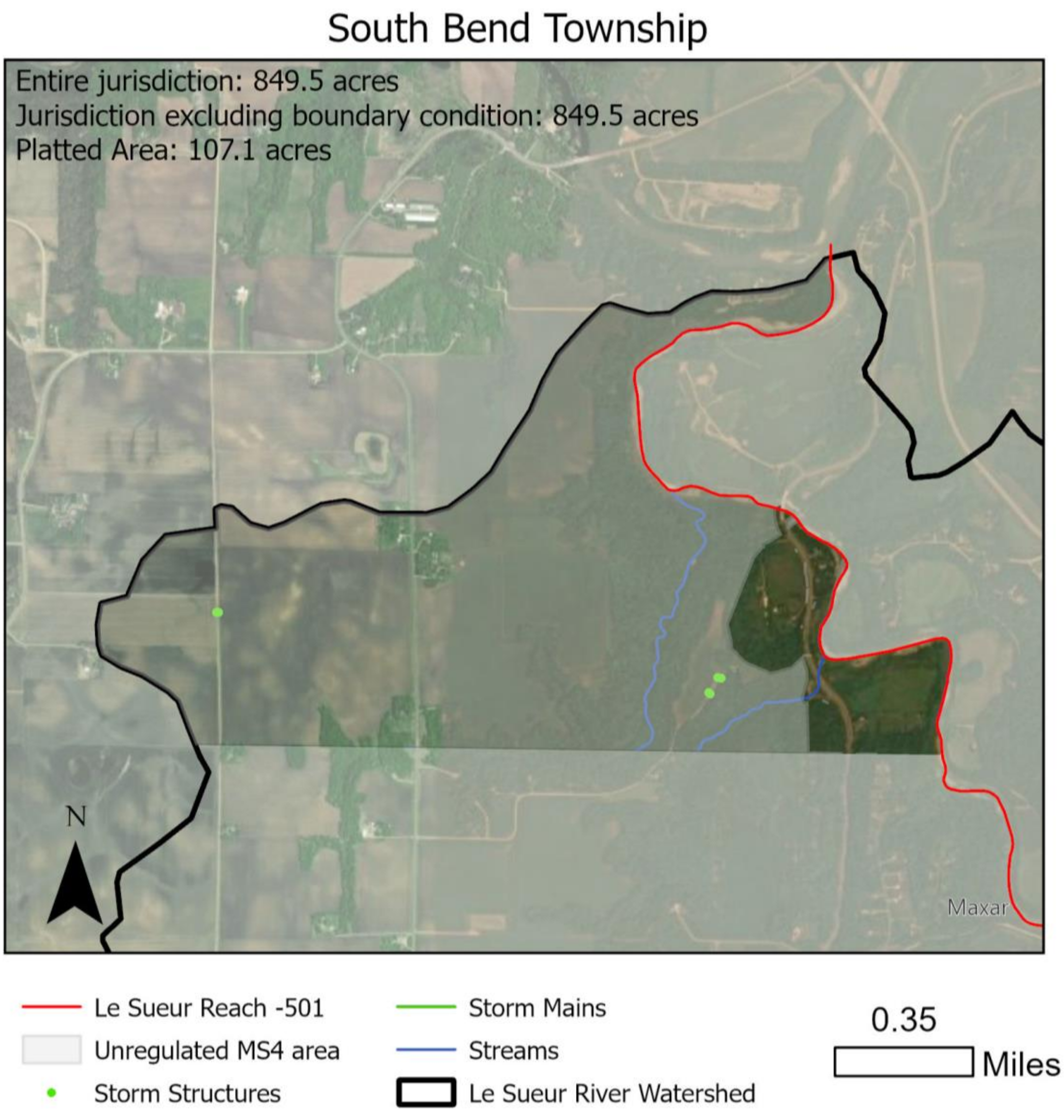
MS4 name and permit number	2020 Census Population	Within 2020 Census defined urban area?	Regulated area
Mankato Township (MS400297)	1,806	Partial	Urban and platted area
Mankato City (MS400226)	44,488	Partial	Throughout entire jurisdiction
Eagle Lake City (MS400284)	3,278	None	Platted area
South Bend Township (MS400299)	1,581	None	Platted area
Waseca City (MS400258)	9,229	Not applicable	Throughout entire jurisdiction
MnDOT ROW Outstate District (MS400180)	NA	Yes	ROW in urban area
Blue Earth County ROW (MS400276)	NA	Yes	ROW in urban area

Preliminary analysis of regulated area by MS4

South Bend Township

As of the 2020 Census results and the 2019 legislation amended in 2021 (Section 109 in Chapter 6 - MN Laws), South Bend Township is currently only regulated within platted areas. According to the Stormwater GIS files provided by the Township in September 2022, there is no stormwater conveyance within the currently platted area (as of March 2024). There is no BC included in South Bend Township's WLA area. See Figure 58.

Figure 58. South Bend Township within Le Sueur River Watershed. Green dots are stormwater structures, darker imagery is regulated, and medium imagery is South Bend Township within the impairment watershed.



TMDL WLA Compliance

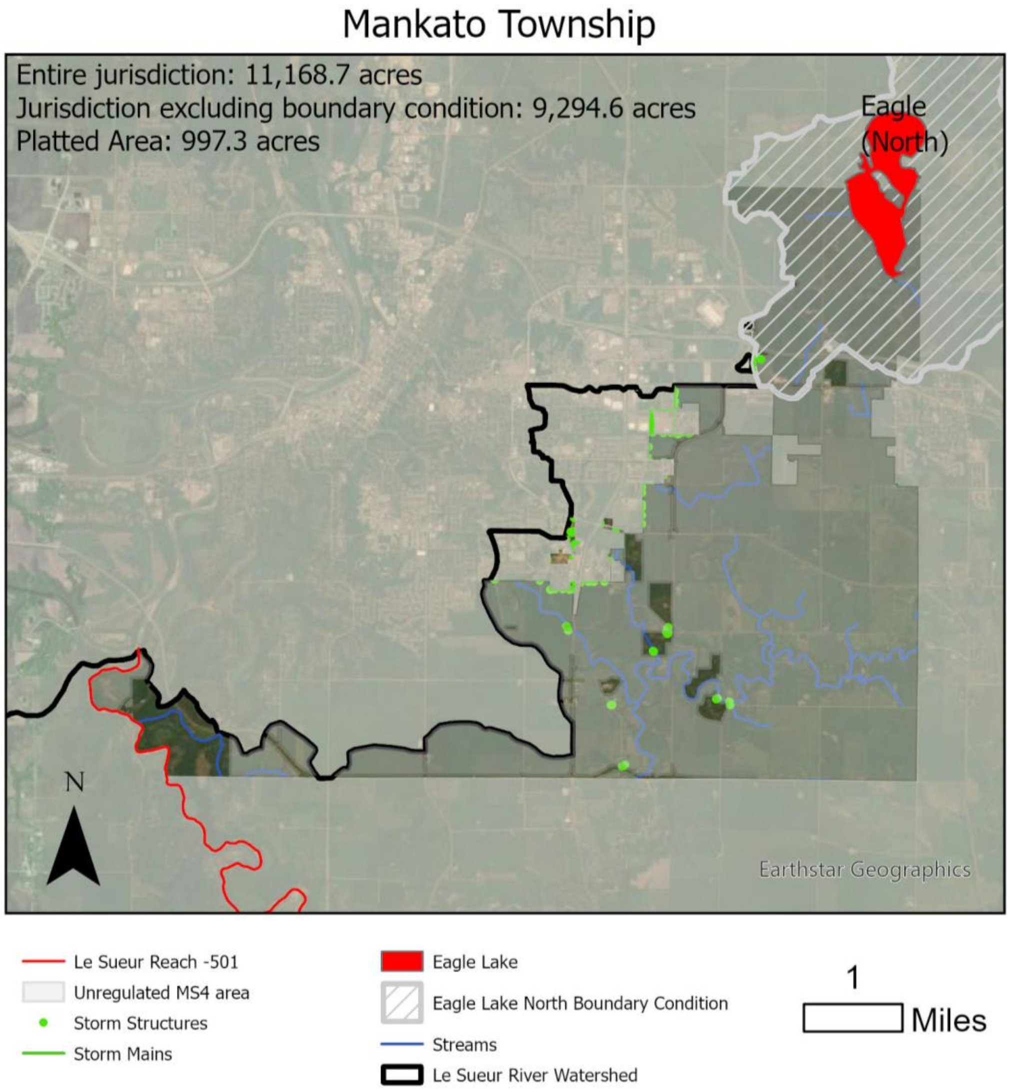
During future General MS4 permit reapplication, South Bend Township can use the following guidance to determine if they are meeting the Le Sueur River reach 501 TP WLA, at a concentration target of 164 µg/L. This analysis should only consider regulated stormwater conveyance areas at the time of permit re-issuance. The Township can utilize the Simple Estimator or other models/tools using the following approach.

- Depending on the model, use precipitation values in the appropriate time step from the TMDL period of 2012 through 2021.
  - If using the Simple Estimator:
  - Determine if there is any stormwater conveyance within the platted areas.
    - If there is not any stormwater conveyance within the regulated area, the WLA is not applicable for that permit cycle.
  - If there is stormwater conveyance within the regulated area, enter associated land uses for those areas.
  - Account for any phosphorus load reductions associated with BMP implementation since the baseline year 2016 (end of year).
  - Set mean annual precipitation to 35.56 inches/year (Column E of the Simple Estimator version 3.0). If calculating seasonal load, use 17.915 inches/season.
    - Divide resulting TP load by 365.25 if using annual precipitation, and 122 if using seasonal precipitation to find daily TP load
- If an updated version of the Simple Estimator is developed that contains a concentration field, and if the Township's runoff concentration within their regulated stormwater conveyance is less than 164 µg/L, they would be meeting the WLA.
- The Township can also calculate concentrations from the 3.0 version of the Simple Estimator by dividing TP loads by runoff volume, using the appropriate unit conversions.

Mankato Township

As of 2020 Census results and the 2019 legislation amended in 2021 (Section 109 in Chapter 6 – MN Laws), Mankato Township is currently regulated within 2020 Census defined urban areas and platted areas. According to the Stormwater GIS files provided by the Township in September 2022, there is some stormwater conveyance within the currently platted area (as of March 2024). There are 1,874.1 acres inside the Eagle Lake BC, and so these areas were removed before calculating Mankato Township's WLA for reach 501. See Figure 59.

Figure 59. Mankato Township within Le Sueur River Watershed. Green dots are stormwater structures, darker imagery is regulated MS4 area, and medium imagery is Mankato Township within the impairment watershed.



TMDL WLA Compliance

During future General MS4 permit reapplication, Mankato Township can use the following guidance to determine if they are meeting the Le Sueur River reach 501 TP WLA, at a concentration target of 164 µg/L. This analysis should only consider regulated stormwater conveyance areas at time of permit re-issuance. The Township can utilize the Simple Estimator or other models/tools using the following approach.

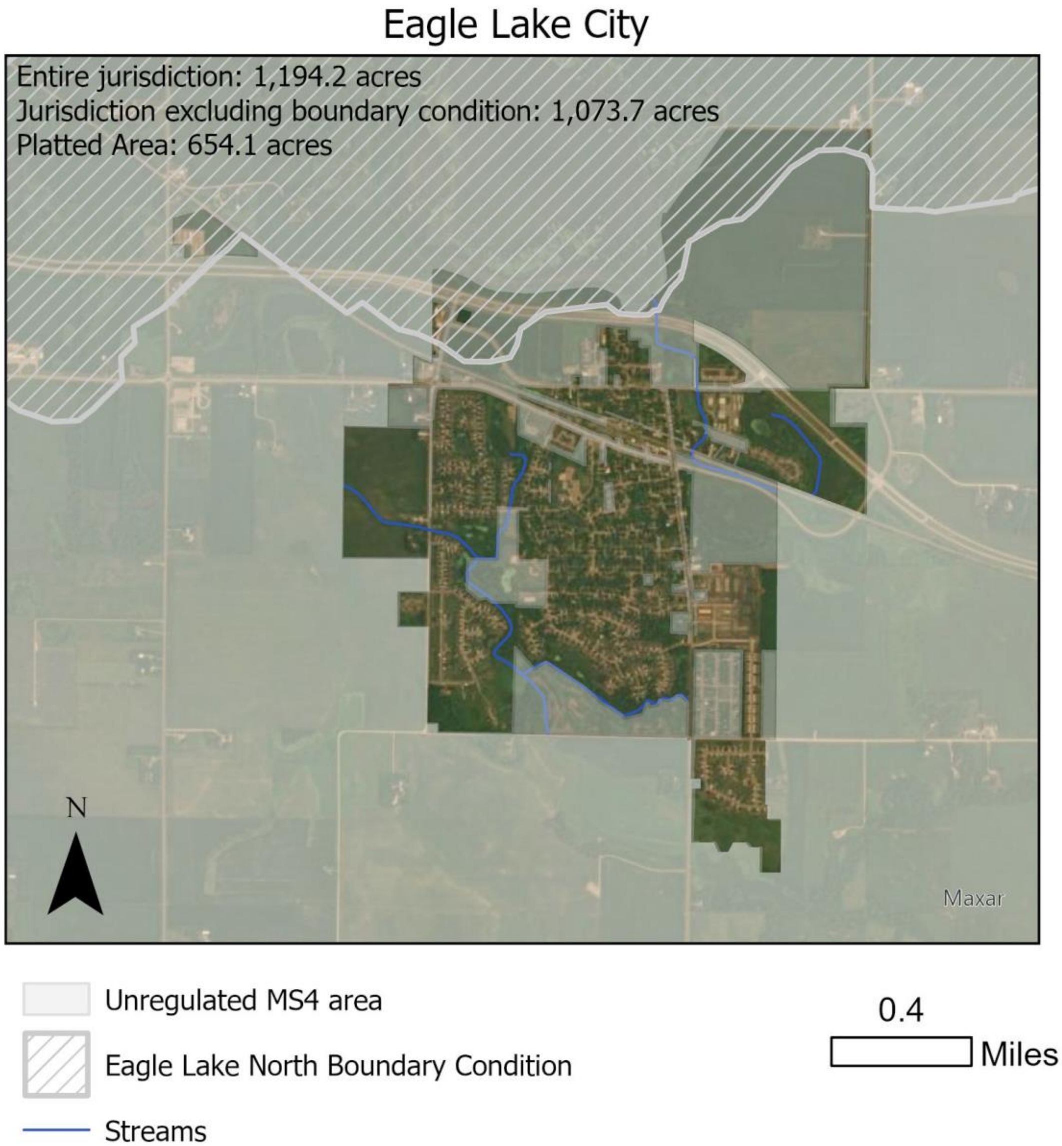
- Depending on the model, use precipitation values in the appropriate time step from the TMDL period of 2012 through 2021.
- If using the Simple Estimator:
  - Identify conveyance within the platted and urban areas, outside the Eagle Lake BC.

  - If there is stormwater conveyance within the regulated areas, enter associated land uses for those areas.
  - Account for any phosphorus load reductions associated with BMP implementation in regulated areas since the baseline year 2016 (end of year).
  - Set mean annual precipitation to 35.56 inches/year (Column E of the Simple Estimator version 3.0). If calculating seasonal load, use 17.915 inches/season.
    - Divide resulting TP load by 365.25 if using annual precipitation, and 122 if using seasonal precipitation to find daily TP load.
- If an updated version of the Simple Estimator is developed that contains a concentration field, and if the Township's runoff concentration within their regulated stormwater conveyance is less than 164 µg/L, they would be meeting the WLA.
- The Township can also calculate concentrations from the 3.0 version of the Estimator by dividing TP loads by flow, using the appropriate unit conversions.

Eagle Lake City

As of 2020 Census results and the 2019 legislation amended in 2021 (Section 109 in Chapter 6 - MN Laws), Eagle Lake City is currently regulated within platted areas. No information regarding stormwater structures is available for Eagle Lake City, but a majority of the city is platted, and it is assumed there are stormwater conveyances within the platted areas. There are 120 acres inside the Eagle Lake BC, and so these areas were removed before calculating Eagle Lake City's WLA for reach 501. See Figure 60.

Figure 60. Eagle Lake City within Le Sueur River Watershed. Darker imagery is regulated, and medium imagery is Eagle Lake City within the impairment watershed. No stormwater structure information available.



TMDL WLA Compliance

If they remain a permitted MS4 during future General MS4 permit reapplications, Eagle Lake City can use the following guidance to determine if they are meeting the Le Sueur River reach 501 TP WLA, at a concentration target of 164 µg/L. This analysis should only consider regulated stormwater conveyance areas at time of permit re-issuance. The City can utilize the Simple Estimator or other models/tools using the following approach.

- Depending on the model, use precipitation values in the appropriate time step from the TMDL period of 2012 through 2021.
- If using the Simple Estimator:

- Identify conveyance within the platted and urban areas, outside the Eagle Lake BC.
- If there is stormwater conveyance within the regulated areas, enter associated land uses for those areas.
- Account for any phosphorus load reductions associated with BMP implementation in regulated areas since the baseline year 2016 (end of year).
- Set mean annual precipitation to 35.56 inches/year (Column E of the Simple Estimator version 3.0). If calculating seasonal load, use 17.915 inches/season.
  - Divide resulting TP load by 365.25 if using annual precipitation, and 122 if using seasonal precipitation to find daily TP load.

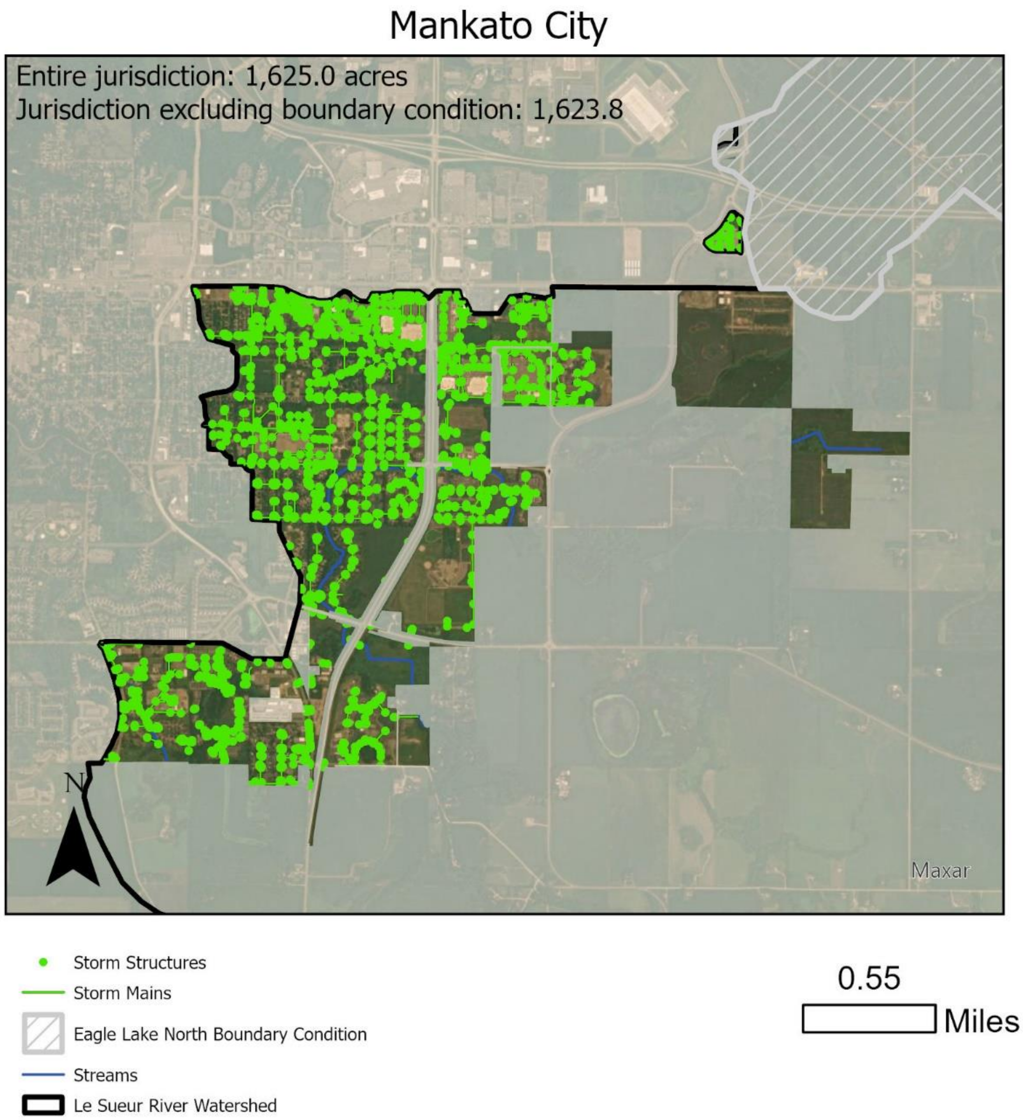
- If an updated version of the Simple Estimator is developed that contains a concentration field, and if the City's runoff concentration within their regulated stormwater conveyance is less than 164 µg/L, they would be meeting the WLA.
- The City can also calculate concentrations from the 3.0 version of the Estimator by dividing TP loads by runoff volume, using the appropriate unit conversions.

If Eagle Lake City is no longer regulated under the MS4 General Permit, none of the above is required.

Mankato City

Due to population, the city of Mankato is regulated throughout its entire jurisdiction. It is largely 2020 Census defined urban area. There are 1.2 acres inside the Eagle Lake BC, and these areas were removed before calculating Mankato City's WLA for reach 501. See Figure 61.

Figure 61. City of Mankato within Le Sueur River Watershed. Stormwater structures in green, the entire municipality is regulated area.



TMDL WLA Compliance

During future General MS4 permit reapplication, the City of Mankato can use the following guidance to determine if they are meeting the Le Sueur River reach 501 TP WLA, at a concentration target of 164 µg/L. This analysis should only consider regulated stormwater conveyance areas at time of permit re-issuance. The City can utilize the Simple Estimator or other models/tools using the following approach.

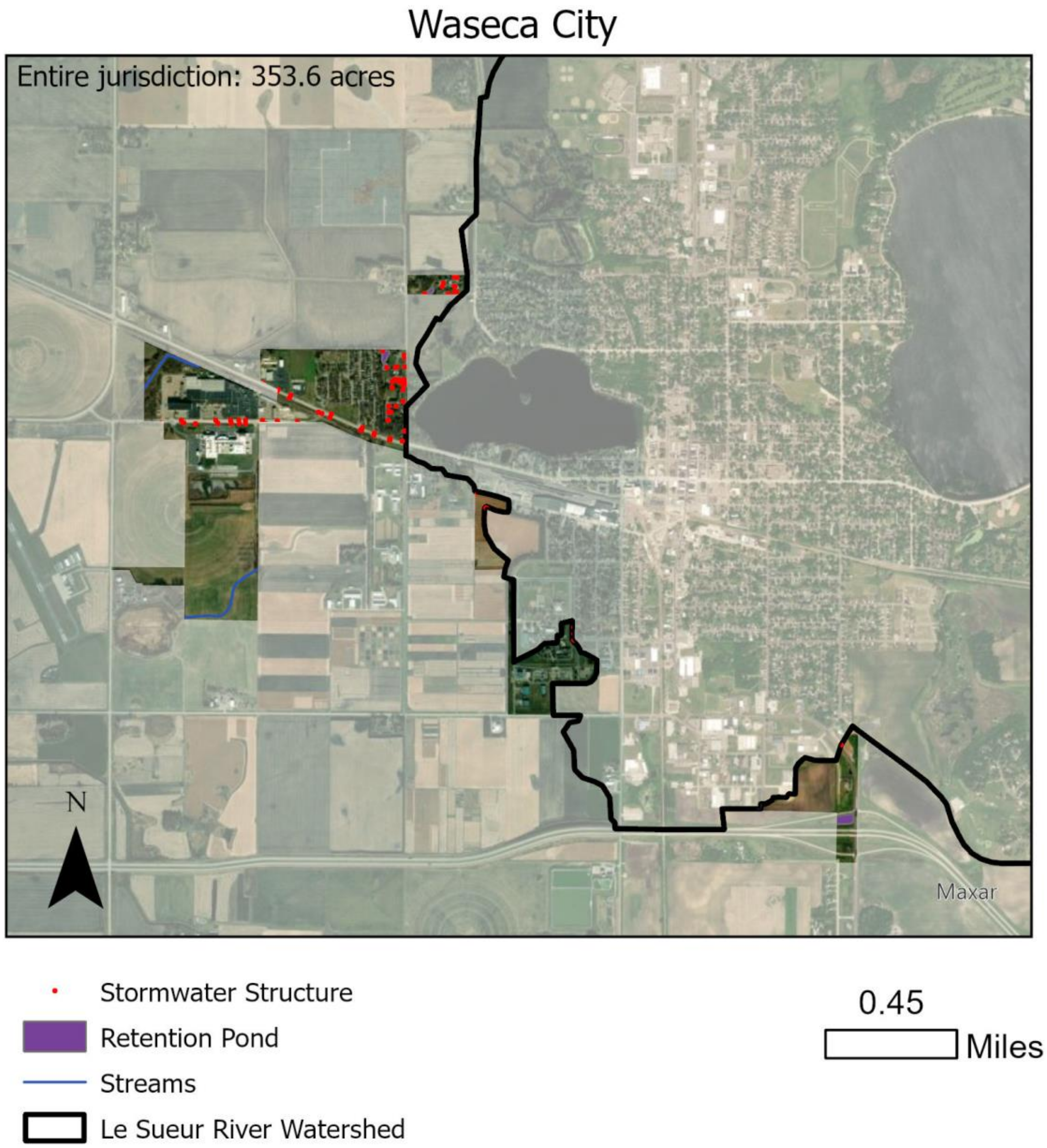
- Depending on the model, use precipitation values in the appropriate time step from the TMDL period of 2012 through 2021.
- If using the Simple Estimator:
  - Identify conveyance within the municipal boundaries of the City, outside the BC.
  - Enter appropriate land uses within City limits.

    - Account for any BMPs since the baseline condition of 2016 (end of year).
    - Set mean annual precipitation to 35.56 inches/year (Column E of the Simple Estimator version 3.0). If calculating seasonal load, use 17.915 inches/season.
        - Divide resulting TP load by 365.25 if using annual precipitation, and 122 if using seasonal precipitation to find daily TP load.
- If the City's daily TP load multiplied by the correction factor is less than or equal to 1.62 lbs/day, they are meeting the WLA.
- If an updated version of the Simple Estimator is developed that contains a concentration field, and if the City's runoff concentration within their regulated stormwater conveyance is less than 164 µg/L, they would be meeting the WLA.
- The City can also calculate concentrations from the 3.0 version of the Estimator by dividing TP loads by runoff volume, using appropriate unit conversions.

Waseca City

Waseca is regulated through its entire jurisdiction due to population and discharging to impaired waters. However, most of the city is in the Cannon River Watershed. There is no BC included in Waseca's WLA area. The portion within the Le Sueur River Watershed is pictured in Figure 62.

Figure 62. Waseca City within Le Sueur River Watershed. Stormwater structures shown as red dots. Retention ponds are purple.



TMDL WLA Compliance

During future General MS4 permit reapplication, the City of Waseca can use the following guidance to determine if they are meeting the Le Sueur River reach 501 TP WLA, at a concentration target of 261 µg/L. This analysis should only consider regulated stormwater conveyance areas at time of permit re-issuance. The City can utilize the Simple Estimator or other models/tools using the following approach.

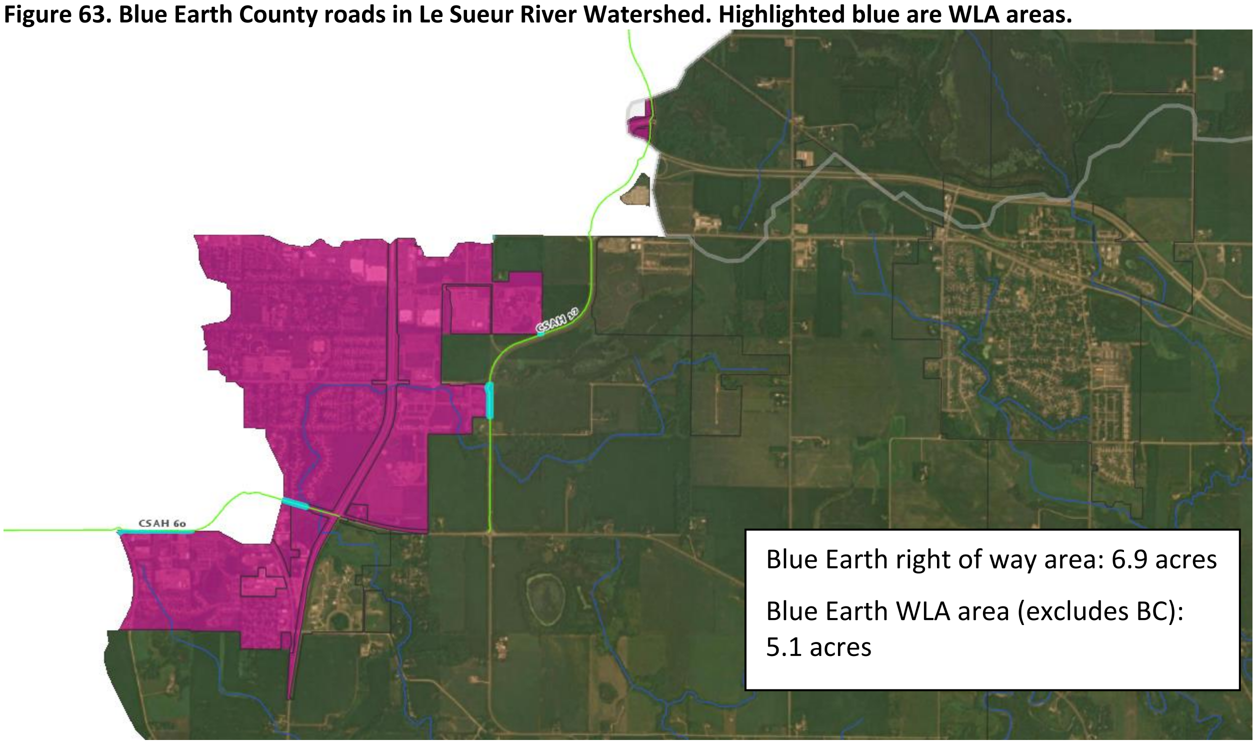
- Depending on the model, use precipitation values in the appropriate time step from the TMDL period of 2012 through 2021.
- If using the Simple Estimator:

- Enter land uses within the municipal boundaries of the City, in the Le Sueur River Watershed.
  - Account for any BMPs since the baseline condition of 2016 (end of year).
  - Set mean annual precipitation to 35.56 inches/year (Column E of the Simple Estimator version 3.0). If calculating seasonal load, use 17.915 inches/season.
  - Divide resulting TP load by 365.25 if using annual precipitation, and 122 if using seasonal precipitation to find daily TP load.
- If the city's daily TP load multiplied by the correction factor is less than or equal to 0.35 lbs/day, they are meeting the WLA.
- If an updated version of the Simple Estimator is developed that contains a concentration field, and if the City's runoff concentration is less than 261 µg/L, they would be meeting the WLA.
- The City can also calculate concentrations from the 3.0 version of the Estimator by dividing TP loads by runoff volume, using appropriate unit conversions.

Blue Earth County

Blue Earth County's MS4 is regulated within the 2020 Census Defined Urban Area (pink in image). CSAH 60 and CSAH 12 are the county roads that intersect the Urban Area and the Le Sueur River Watershed. There are 1.8 acres inside the Eagle Lake BC, and so these areas were removed before calculating Blue Earth County's WLA for reach 501. WLA areas for reach 501 are highlighted in blue in Figure 63.

Figure 63. Blue Earth County roads in Le Sueur River Watershed. Highlighted blue are WLA areas.



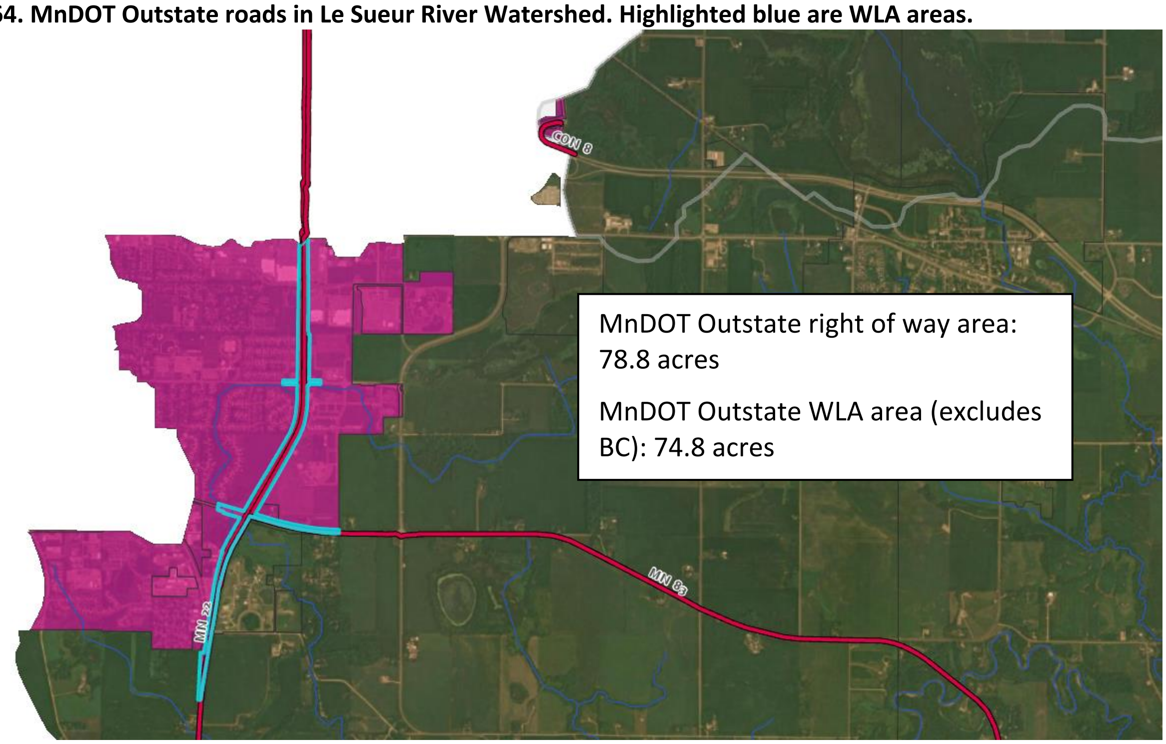
TMDL WLA Compliance

Blue Earth County is not a significant contributor to the impairment in Reach 501 and has limited opportunity for load reduction within the WLA area. Therefore, recognizing the effort required to document loads and reductions from 0.001% of the watershed area, Blue Earth County can meet their TMDL obligations by reviewing the WLA area for any opportunities for BMP implementation and exploring possible BMP collaborations with the City of Mankato. These efforts must be documented in subsequent MS4 Permit applications and annual reporting.

MnDOT Outstate

MnDOT Outstate's MS4 is regulated within the 2020 Census Defined Urban Area (pink in image). MN 22, MN 83, and Con 8 are the State Agency owned roads that intersect the Urban Area and the Le Sueur River Watershed. Four acres are inside the Eagle Lake BC, and so these areas were removed before calculating MnDOT's WLA for reach 501. WLA areas for reach 501 are highlighted in blue in Figure 64.

Figure 64. MnDOT Outstate roads in Le Sueur River Watershed. Highlighted blue are WLA areas.



TMDL WLA Compliance

During future General MS4 permit reapplication, MnDOT Outstate can use the following guidance to determine if they are meeting the Le Sueur River reach 501 TP WLA, at a concentration target of 164 µg/L. This analysis should only consider regulated stormwater conveyance areas at time of permit re-issuance. MnDOT can utilize the Simple Estimator or other models/tools using the following approach.

- Depending on the model, use precipitation values in the appropriate time step from the TMDL period of 2012 through 2021.
- If using the Simple Estimator:

  - Enter land uses within state owned right of way within the latest Urban Area as determined by the Bureau of Census in the Le Sueur River Watershed, outside the Eagle Lake BC.
  - Account for any BMPs since the baseline condition of 2016 (end of year).
  - Set mean annual precipitation to 35.56 inches/year (Column E of the Simple Estimator version 3.0). If calculating seasonal load, use 17.915 inches/season.
  - Divide resulting TP load by 365.25 if using annual precipitation, and 122 if using seasonal precipitation to find daily TP load.
- If the MnDOT's daily TP load multiplied by the correction factor is less than or equal to 0.07 lbs/day, they are meeting the WLA.
- If an updated version of the Simple Estimator is developed that contains a concentration field, and if MnDOT's runoff concentration is less than 164 µg/L, they would be meeting the WLA.
- MnDOT can also calculate concentrations from the 3.0 version of the Estimator by dividing TP loads by runoff volume, using appropriate unit conversions.

Other TP TMDLs in Lower Minnesota Basin

In addition to the phosphorus WLA for the Le Sueur River reach 501 TMDL, there are other downstream phosphorus TMDL WLAs assigned to the MS4 permittees of this watershed.

Lake Pepin TMDL

All permittees discussed in Appendix C were assigned a phosphorus MS4 WLA in the Lake Pepin TMDL; this MS4 WLA is expressed as a unit area loading rate and applies to all regulated MS4s in the Lake Pepin Watershed (MPCA 2021b). In future MS4 permit applications, permittees will be expected to document whether they are meeting their phosphorus WLAs in the Lake Pepin TMDL.

The Lake Pepin TMDL is based on data from 1985 through 2006. In order to determine WLA compliance for Pepin, the permittees can use a similar process as above, but should use mean average rainfall from the 1985–2006 period, and a unit area load of 0.35 lb/ac-year, instead of a concentration.

Lower Minnesota River Dissolved Oxygen TMDL

Permittees also have TP WLAs for the *Lower Minnesota River Dissolved Oxygen TMDL* (MPCA 2004). That TMDL assigned a target reduction of 30% from the baseline low flow condition of 1988. Compliance can be documented by determining if BMPs put in place since 1988, using precipitation values for August and September of 1988, achieve a 30% reduction in phosphorus loads from impervious surfaces.

Appendix D. Phosphorus Effluent Limit Review: Minnesota River Basin

DATE : 12/20/2017

TO : File

FROM : Dennis Wasley
Effluent Limits Unit
Environmental Outcomes and Analysis Division

PHONE : 612-749-9569

SUBJECT : Phosphorus Effluent Limit Review: Minnesota River Basin

Version : 5.2

Table of contents

Executive summary

This memorandum will explain why additional phosphorus reductions are needed within the Minnesota River Basin from some wastewater treatment facilities (WWTFs). Over 75% of the WWTFs in the Basin can meet limits outlined in this memorandum if they maintain their current discharge during the critical summer season (i.e. June to September). Since 2000, WWTFs within the Minnesota River Basin have made significant reductions in phosphorus being discharged to the Minnesota River. These reductions were a result of partnership, hard work, and a common goal to protect and improve our state's water resources. Thank you for being a big part of these efforts. However, despite this progress more needs to be done.

The Minnesota River has high levels of algae on average. Algae are an important part of the food web of rivers, but too much is not good. When algal levels are high, only the toughest species of fish and aquatic insects can survive. And, the smelly and murky water makes canoeing and swimming on the river unpleasant.

High levels of the nutrient phosphorus are needed to produce large algal blooms. In 2015, the Minnesota Pollution Control Agency (MPCA) adopted rules which included standards (targets) for total phosphorus (TP) and algae in rivers. Now, when TP levels and algal levels are too high, the MPCA is required by law to develop a plan to reduce levels of TP, which will reduce algal levels to desirable levels. The entire length of the Minnesota River from near Granite Falls to the Mississippi River has too much phosphorus and algae (Executive summary figure 1). All the watersheds in the Minnesota River Basin contribute to high phosphorus and algae levels in the Minnesota River except for the three farthest upstream watersheds that contribute the problem of high phosphorus and algae in Lac Que Parle Lake. As of today's date, five watershed reviews have been completed for local river eutrophication issues. Only one facility in these watersheds have needed more restrictive mass limits than those presented in this memorandum for the Minnesota River. Marshall and ADM Corn Processing – Marshall will also have concentration limits to protect the Redwood River. Their mass limits will be the same as listed in this memorandum.

For a healthier Minnesota River, phosphorus reductions need to be made by both point and non-point sources. Phosphorus contributions from both sources vary depending on weather and river conditions. During periods of high precipitation, non-point sources such as erosion and agriculture contribute most of the phosphorus going into the Minnesota River. During periods of lower precipitation, when the Minnesota River is at low flow, point sources such as WWTFs contribute most of the phosphorus going into the Minnesota River.

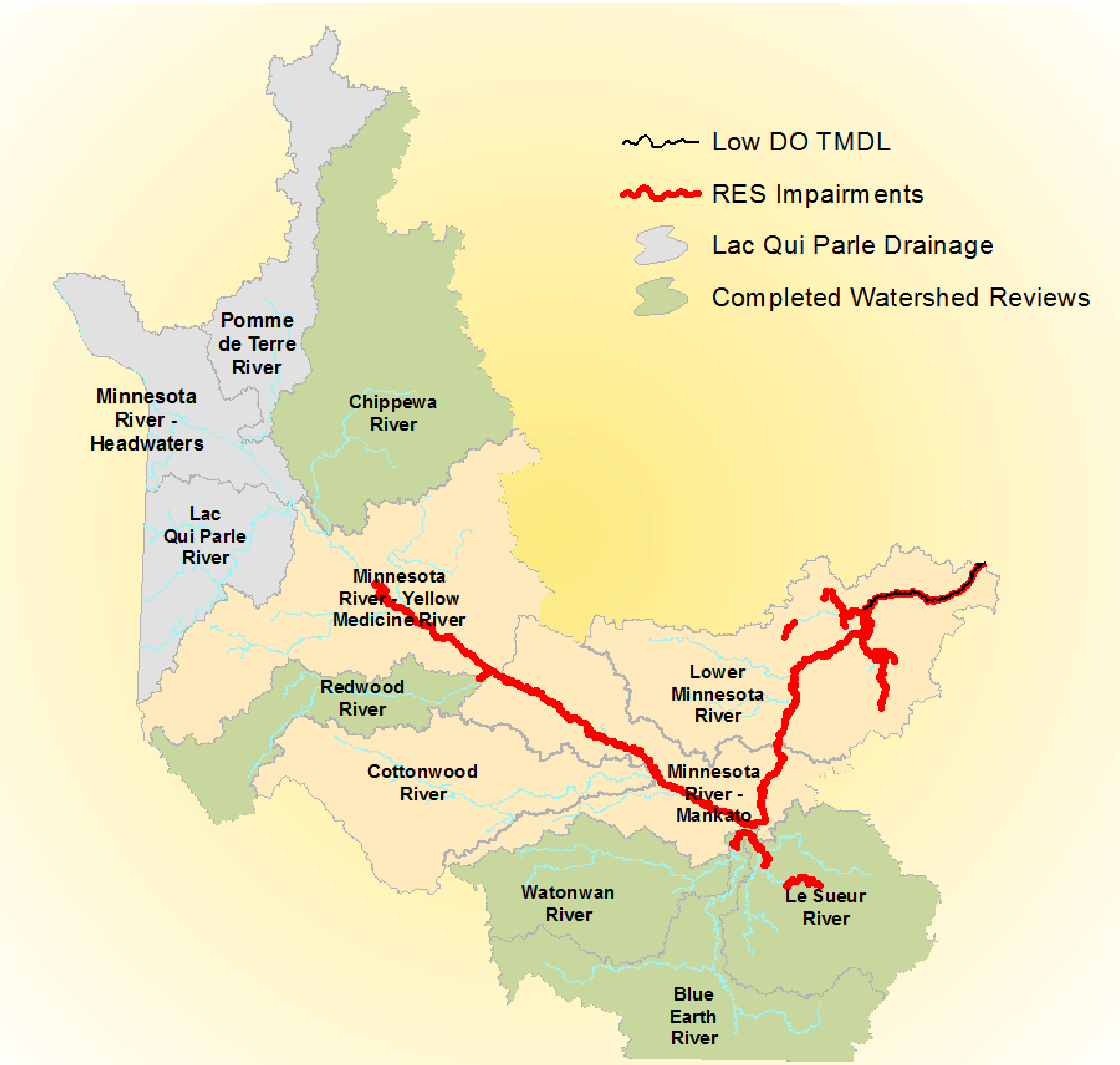
There are many sources of TP to the Minnesota River. The MPCA used a complex computer program (i.e., computer model) to determine how to meet the TP target for the Minnesota River. This model included reductions of TP from non-point sources such as stormwater from cities, runoff from fields, and streambank erosion. The model also included the numerous WWTFs throughout the large drainage area of the Minnesota River Basin. The model did not include the three watersheds upstream of Lac que Parle Lake. Limits for the WWTFs based on the model results are one of several management actions in the Minnesota River Basin needed to achieve a cleaner Minnesota River.

The MPCA worked with the U.S. Environmental Protection Agency for over two years on developing its procedures for implementing effluent limits to meet the phosphorus standards for rivers. In June of 2016, the Minnesota Court of Appeals affirmed a process for setting limits that was the same as the process used for the limits outlined in this memorandum[1].

There are several important details for the new river eutrophication based TP limits (Executive summary table 1). First, the limits only apply from June through September. Second, the limits are mass based which allow the facility to discharge at a higher concentration if their flows are well below design flow. As an individual facility grows, they will have to reduce the concentration of their effluent limit to meet the mass limit. Third, the new limits will have a monthly limit and a long-term goal. The limit is the highest monthly mass the facility can discharge during a summer month. The limit is twice the long-term goal and allows for the inherent variability in WWTF effluent. The long-term goal will be included in the permit text. Complying with the limit each month

[1] MCEA vs. MCES and MPCA https://mn.gov/law-library-stat/archive/ctapun/2016/opa151622-061316.pdf

should result in the facility achieving the long-term goal as an average of all summer months over a 5-yr permit cycle. Each facility will need to look at the variability in their TP concentration and effluent flow during summer to assess if their facility can meet the proposed TP mass limits for river eutrophication standards. The MPCA has developed flow and concentration charts for each WWTF to help the operator identify what concentration they need to achieve at a given flow rate to comply with the monthly and long-term mass goals.



Executive summary figure 1. Rivers in Minnesota River Basin that exceed river eutrophication standards for both phosphorus and algae. Green watersheds have completed river eutrophication reviews for local rivers.

Executive summary table 1. Total phosphorus limits for continuously discharging WWTFs in the Minnesota River Basin. Limits for state discharge restrictions are not included in this table (e.g. 1.0 mg/L for expansions).

Facility	AWWDF (mgd)/MDF (mgd)	Lake Pepin Limit (kg/yr)	Lake Pepin daily load (kg/day)	RES monthly mass limit (kg/day)	RES mass long-term goal (kg/d)
Delhi WWTP	0.01	70	0.19	0.20	0.10
Delft Sanitary District WWTP	0.01	28	0.08	0.10	0.04
Saint George District Sewer System	0.01	32	0.09	0.10	0.04
La Salle WWTP	0.02	73	0.20	0.20	0.10
Chippewa Valley Ethanol Co*	0.031	43		*	*
Prinsburg WWTP	0.05	264	0.72	0.80	0.36
Vernon Center WWTP	0.06	284	0.78	0.80	0.39
Comfrey WWTP	0.08	245	0.67	1.00	0.50
Waldorf WWTP	0.10	464	1.27	1.30	0.64
Lafayette WWTP	0.10	459	1.26	1.30	0.63
Wabasso WWTP	0.11	544	1.49	1.60	0.75
Franklin WWTP	0.12	556	1.52	1.60	0.76
POET Biorefining - Lake Crystal	0.13	179	0.49	1.00	0.49
Morton WWTP	0.13	638	1.75	1.80	0.88
Granite Falls Energy LLC	0.13	182	0.50	1.00	0.50
Dairy Farmers of America – Winthrop**	0.14	193	0.53	1.10	0.53
Kerkhoven WWTP	0.15	725	1.99	2.10	0.99
Maynard WWTP	0.15	740	2.03	2.10	1.01
Darling international	0.15	83	0.23	0.48	0.23
Trimont WWTP	0.19	899	2.46	2.60	1.23
Walnut Grove WWTP	0.20	280	0.77	1.00	0.48
St Clair WWTP	0.21	293	0.80	1.10	0.51
Sacred Heart WWTP	0.24	327	0.90	1.20	0.57
Welcome WWTP	0.26	359	0.98	1.30	0.62
Amboy WWTP	0.29	396	1.09	1.40	0.68
Cologne WWTP	0.33	449	1.23	1.60	0.77
Starbuck WWTP	0.35	414	1.13	1.80	0.83
Morgan WWTP	0.36	496	1.36	1.80	0.86
Clara City WWTP	0.46	636	1.74	2.30	1.10
Lake Crystal WWTP	0.59	815	2.23	3.00	1.41
MG Waldbaum	0.599	571	1.56	3.29	1.56
New Richland WWTP	0.6	829	2.27	3.00	1.43
Del Monte Foods	0.77	325		2.00	0.95
Springfield WWTP	0.78	1,078	2.95	3.90	1.86
Truman WWTP	0.78	1,078	2.95	3.90	1.86
Granite Falls WWTP	0.80	1,105	3.03	4.00	1.91
Arlington WWTP	0.81	926	2.54	4.00	1.92
Le Center WWTP	0.82	1,138	3.12	4.10	1.96
Belle Plaine WWTP	0.84	1,160	3.18	4.20	2.00

Facility	AWWDF (mgd)/MDF (mgd)	Lake Pepin Limit (kg/yr)	Lake Pepin daily load (kg/day)	RES monthly mass limit (kg/day)	RES mass long-term goal (kg/d)
Renville WWTP	0.85	1,178	3.23	4.30	2.03
Norwood Young America WWTP	0.91	1,254	3.44	4.50	2.17
Montgomery WWTP	0.97	1,337	3.66	4.80	2.31
Blue Earth WWTP	0.98	1,354	3.71	4.90	2.34
Olivia WWTP	0.98	1,354	3.71	4.90	2.34
Benson WWTP	0.99	1,361	3.73	4.90	2.35
Jordan WWTP	1.29	1,425	3.90	3.80	1.81
Madelia WWTP	1.31	1,448	3.97	3.90	1.84
Redwood Falls WWTP	1.32	1,460	4.00	3.90	1.85
Winnebago WWTP	1.70	1,879	5.15	5.00	2.39
New Prague WWTP	1.83	1,523	7.57	5.40	2.57
MRVPUC WWTP	1.84	2,036	5.58	5.40	2.59
Southern MN Beet Sugar	2.26	1,135		13.47	6.42
Rahr Malting Co	2.41	3,329	9.12	11.00	5.24
MA Gedney Co	2.50	292	0.80	19.9***	9.5
ADM Corn Processing - Marshall	2.64	3,647	9.99	11.10	5.30
Saint James WWTP	2.96	3,271	8.96	8.70	4.16
Montevideo WWTP	3.0	3,316	9.08	8.80	4.21
Waseca WWTP	3.5	3,868	10.60	10.30	4.91
Fairmont WWTP	3.9	4,310	11.81	11.50	5.48
Saint Peter WWTP	4.0	4,421	12.11	11.80	5.62
Marshall WWTP	4.5	4,973	13.63	13.30	6.32
New Ulm WWTP	6.77	7,482	20.50	20.00	9.51
Willmar WWTP	7.5	8,289	22.71	22.10	10.53
Mankato WWTP	11.25	12,434	34.07	33.20	15.80

*Compliance schedule to eliminate surface discharge
**Allocation for process water, has 1.0 mgd non-contact cooling water outfall
***Actual summer limit for MA Gedney is 19.9 kg/day as a monthly average due to the periodic nature of the discharge. This is equivalent to 2.5 mgd at 1.0 mg/L with the “2.1” monthly limit multiplier. This facility is a seasonal discharger that does not discharge in July and September.

Details of column headings

Lake Pepin limit: Annual mass limit for Lake Pepin. Since 2010, these limits have been included reissued NPDES permits.

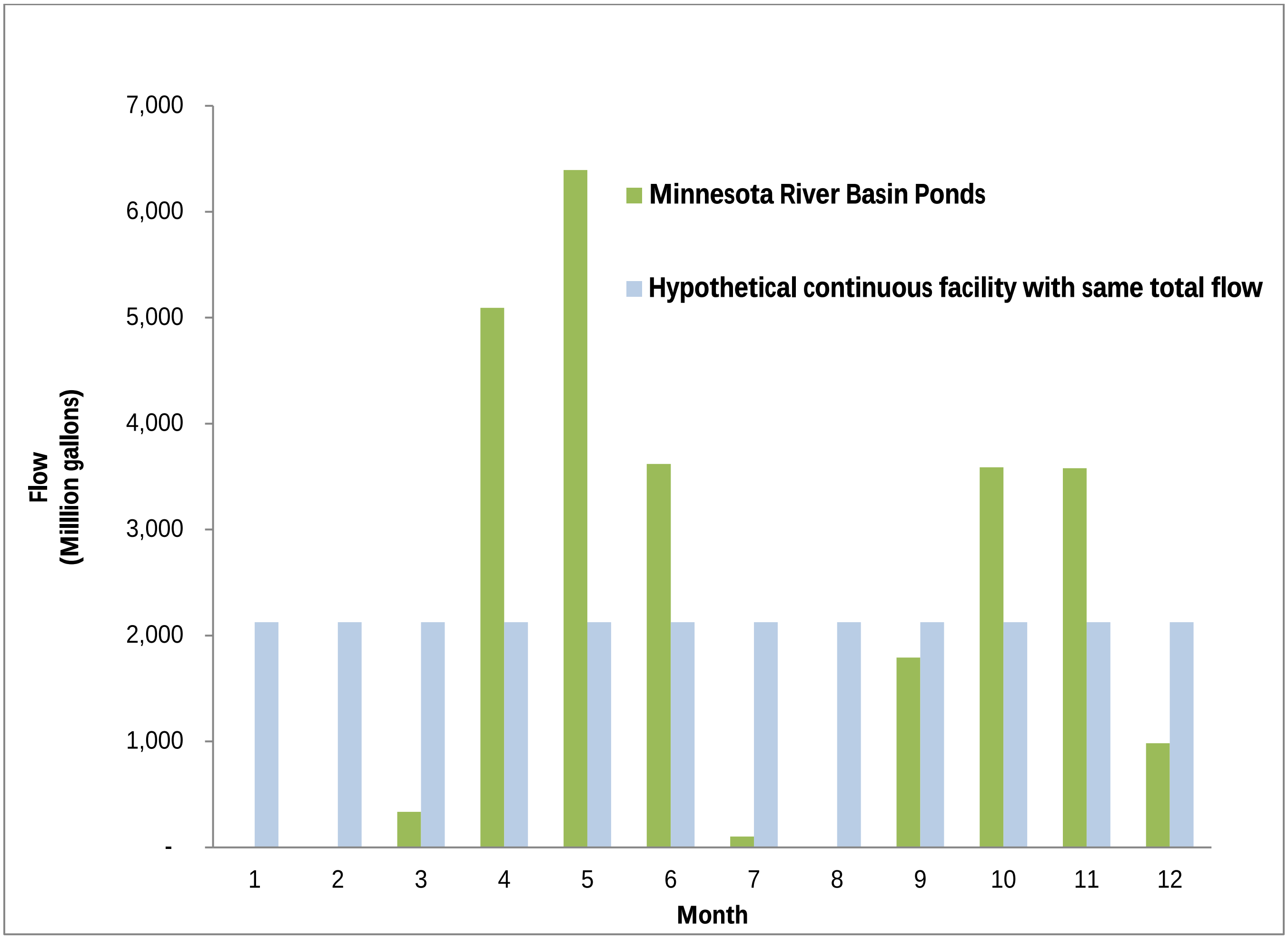
Lake Pepin daily load: This is simply the annual mass divided by 365 days. It is not a limit in permits.

RES monthly mass limit: This is the highest monthly mass a facility can discharge during summer. This allows for effluent variability due to fluctuations in flow and concentration at the facility.

RES mass long-term goal: This is the long-term summer average mass that the facility can discharge in kilograms per day. This number will be included in the permit text.

Stabilization ponds and river eutrophication standards

Stabilization ponds in the Minnesota River can only discharge during a small portion of the June through September summer season for river eutrophication standards. They are allowed to discharge during the first 15 days of June and the last 15 days of September. In general, the pond facilities discharge more often in June when river flows are high and algal grow conditions are not favorable (Executive summary figure 2). In September, the pond facilities discharge less when river flows tend to be lower and algal grow conditions are more favorable. All of the ponds in the Minnesota Basin as a group have less impact on summer river conditions than a hypothetical continuous discharge discharging at the same total overall flow and concentration. The pond facilities in the Minnesota River Basin were issued annual Lake Pepin based limits. June through September limits for pond facilities will be assessed in the local watershed memorandums.



Executive summary figure 2. Total actual flow from all stabilization ponds in Minnesota River Basin by month from 2004 to 2014.

Introduction

The Minnesota River from the outlet of Lac qui Parle Reservoir to the Minnesota River at Fort Snelling has multiple reaches that exceed river eutrophication standards (RES) (Executive summary figure 1, Appendix A). The previous memo for the Minnesota River Basin found that the Lake Pepin WQBELs for facilities in the Minnesota River Basin are sufficient to meet RES in the mainstem of the Minnesota River (Wasley, 2013). Since the time of the original memo, implementation procedures for RES have been completed (Wasley, draft). The remainder of this memorandum will summarize HSPF model outputs and actual monitoring data for three major mainstem watersheds in the Minnesota River Basin (Tetra Tech, 2009). The WWTF loads in the HSPF model serve as a wasteload allocation (WLA) and are translated into to "permitted" mass loads, which are based on a percentage of facility design flow and a concentration multiplier. Categorical water-quality based effluent limits (WQBELs) established in this memorandum are based on the mainstem of the Minnesota River. Resources are not available at this time to run additional HSPF models. Local rivers and lakes may require more restrictive limits for some WWTFs in the Minnesota River Basin. Local resources will be examined in local watershed reviews.

This memorandum will establish monthly total phosphorus (TP) mass limits for continuously discharging municipal facilities and industrial facilities with effluent concentrations greater than 1.0 mg/L. Stabilization ponds and facilities discharging below 1 mg/L were included in the original HSPF model. Both of these facility types need to maintain existing loads to meet RES in the Minnesota River. Lake Pepin WQBELs for stabilization ponds in the Minnesota River Basin are sufficient to meet RES in the mainstem of the Minnesota River. The capacity of stabilization of ponds to avoid the June through September discharge window will be encouraged via updated permit language encouraging this practice. It is particularly important to minimize discharges in September when river flows are typically lower.

The mainstem of the Minnesota River in the Lower Minnesota River Watershed requires the most restrictive effluent limits of the three-mainstem watersheds exceeding RES based on HSPF model outputs. Limits derived for facilities upstream of Shakopee, Minnesota will be applied throughout the basin except for the three upper most watersheds: Lac qui Parle River Watershed, Minnesota River – Headwaters Watershed, and Pomme de Terre River Watershed. Modeling in the Minnesota River low dissolved oxygen TMDL established Lac qui Parle Dam as an upstream boundary for contributions to the lower river. Limits for WWTFs discharging downstream of Shakopee will be based on Lake Pepin.

Outline of 5 step implementation procedures for RES in the Minnesota River Basin

Step 1 – Water quality data review

A review of monitoring data indicates that a several reaches of the Minnesota River are RES in all three major watersheds downstream of Lac Que Parle Lake (Executive summary figure 1, Appendix A). Both the cause variable (i.e. TP) and response variable (i.e. chlorophyll-a) are well above the applicable standards for the south river nutrient region (TP = 0.150 mg/L and Chl-a = 35µg/L).

Step 2 – Reasonable potential analysis

The example reasonable potential analysis in the RES implementation procedures is difficult to apply to a large River like the Minnesota River given the multitude of compliance points for RES that already exceed the standard and very large number of WWTFs. Thus, the Minnesota Pollution Control Agency (MPCA) chose to use a conservative approach like that for Lake Pepin. Basically, all the facilities discharging at a concentration greater than 0.150 mg/L to the Minnesota River Basin downstream of the Lac qui Parle Dam contribute to the RES exceedances on the River.

Step 3 – Calculate wasteload allocation

The wasteload allocation is based off HSPF Scenarios 4 and 5 which both meet the 0.150 TP RES at the critical 80 % exceeds flow at both Jordan and St. Peter on the Minnesota River Mainstem. The flow-weighted WLA concentration is 0.64 mg/L for continuously discharging facilities.

Step 4 – Convert WLA to effluent limits

The sensitivity analysis for the Minnesota-River Yellow Medicine Watershed revealed that there would be little change (0.002 mg/L) from applying monthly mass limits compared to monthly concentration limits. The formulas for monthly mass limits are the following:

> *Municipal facilities: WQBEL (kg/day) = WLA (mg/L) * **70% of AWWDF** * 2.1 * 3.785*
> *Industrial facilities: WQBEL (kg/day) = WLA (mg/L) * **100% of MDF** * 2.1 * 3.785*

Step 5 – Verify final limits

The limits for RES in the Minnesota River Basin will be monthly mass limits (kg/day) that apply from June through September. These limits are generally more restrictive than the 5-month total mass limits for the lower Minnesota River low dissolved oxygen TMDL. The WWTFs in the Minnesota River Basin are also located upstream of Lake Pepin. The WQBELs for Lake Pepin are annual limits (kg/yr) assessed as a 12-month moving total. Both the RES and Lake Pepin limits can be converted to a kg/day load to compare which limit is more restrictive (Executive summary table 1) The reader must remember that a monthly mass limit requires the WWTF to average roughly half the actual limit as a long-term average to insure compliance with the limit. With this in mind, the RES based limits for the Minnesota River are more restrictive from June through September than the annual Lake Pepin limits.

Minnesota River mainstem watershed overview

Lower Minnesota River Watershed: Minnesota River at Jordan

The Minnesota River at Jordan (river mile 39.4) has historically been the main modeling station for the lower Minnesota River upstream of the dredged channel near the confluence with the Mississippi River. There is a USGS gaging station at Jordan along with a long-term monitoring site sponsored by Metropolitan Environmental Services (MCES). These stations have been critical stations for calibrating the Minnesota River HSPF model (Tetra Tech. 2009). Wasley (2013) extensively examined the applicability of the Minnesota River HSPF model to setting effluent limits. This memorandum will review a portion of previous memorandum applicable to RES as of this date and offer some additional analysis.

Baseline TP conditions at Jordan clearly exceed the 0.150 mg/L RES for the Minnesota River (Table 1, Figure 1). Conditions in the river have improved at low flow in recent years, but this station is still above the RES as a long-term summer average (Figure 2). The HSPF model scenarios were developed to meet endpoints for the Minnesota River Turbidity TMDL. This TMDL requires BMPS beyond those included in Scenario 4 of the HSPF model. Reducing turbidity will be extremely important to reducing high flow TP concentrations in the Minnesota River. Comparing HSPF model runs 4 and 5 illustrates the large contribution of non-point sources since continuous point sources are set at actual flows and 1 mg/L in each scenario. Scenario 4a illustrates that complete removal of point sources will not achieve RES as a long-term summer average. Both Scenario 4 and 5 both meet RESs at the 80% exceeds flow while only Scenario 5 meets the standard as a long-term average.

Table 1. HSPF modeled Long-term summer average total phosphorus for the Minnesota River at Jordan.

Scenario	Average summer TP (mg/L)	Description
Baseline	**0.274**	Historical conditions from 1993-2006
4	**0.213**	Level 4 non-point reductions with continuous point sources at 1.0 mg/L
4a	**0.206**	Level 4 non-point reductions with continuous point sources at 0.0 mg/L
5	**0.142**	Level 5 non-point reductions with continuous point sources at 1.0 mg/L

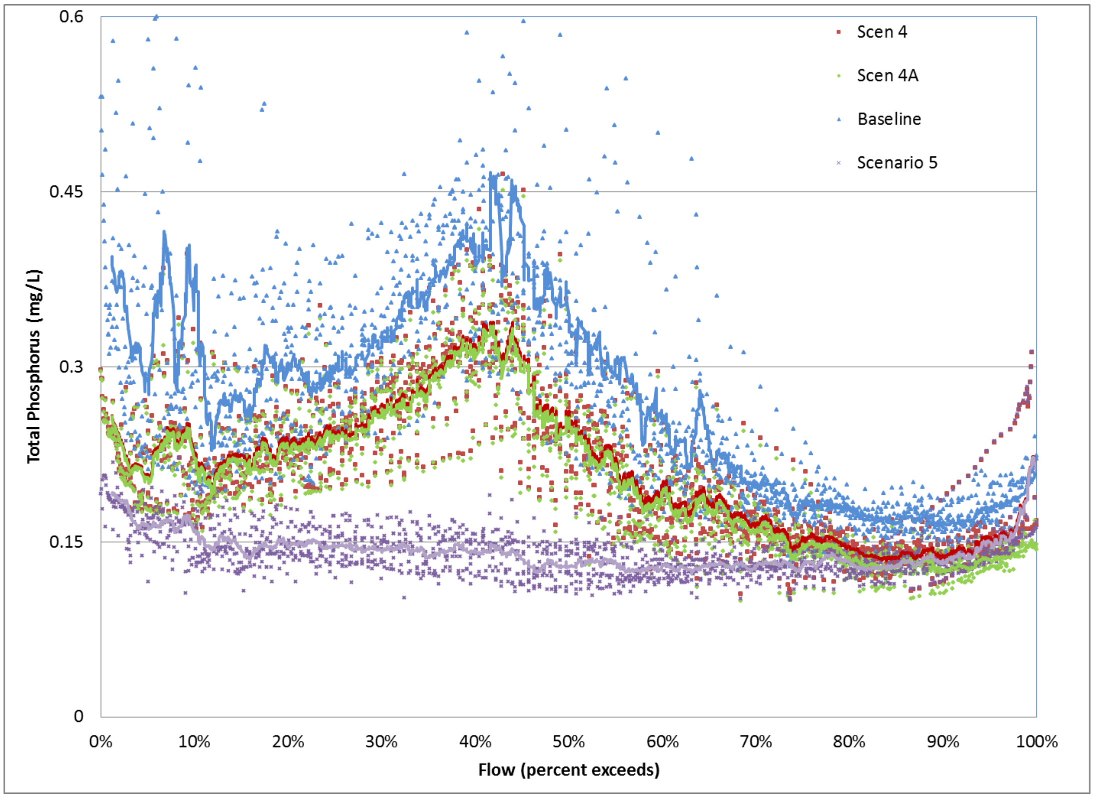


Figure 1. Daily summer (June-Sept) total phosphorus predicted by HSPF for the Minnesota River at Jordan from 1993 – 2006. Note TP data is arranged by flow (percent exceeds) for the Minnesota River based on the summer flow from 1993-2006. See Table 1 for description of scenarios. Lines represent moving average for scenarios (n=20).

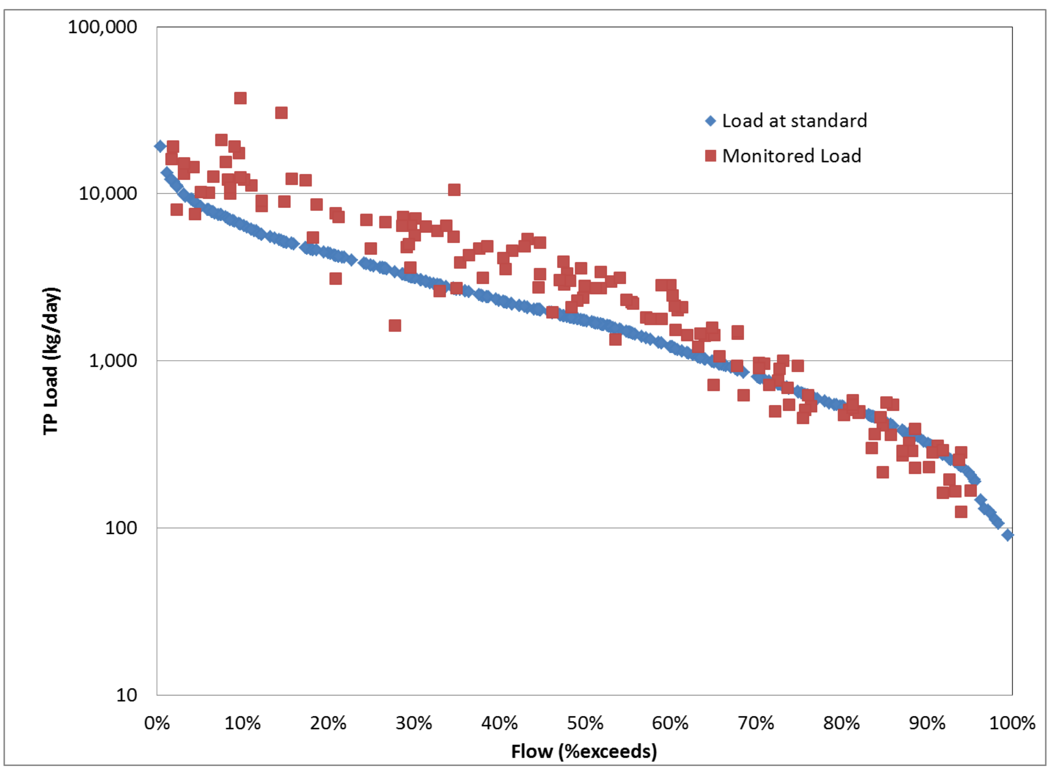


Figure 2. Daily monitored summer (June-September) total phosphorus load of the Minnesota River at Jordan (station MI-39.4) from 2002-2011. Percent exceeds flow based on 1984-2013 summer flows (Minnesota River at Jordan). Concentration at critical flow = 0.132 mg/L (n=15). Blue line represents load at RES (0.150 mg/L).

This paragraph will discuss the conversion of HSPF model runs into effluent limits. Again, HSPF scenario 4 and 5 runs were based off WWTFs at actual flows and 1.0 mg/l from 1993-2006. This was for facilities with the potential to discharge above 1 mg/L. Stabilization pond facilities and facilities with TP consistently below 1.0 were included in the original HSPF scenario 4 and 5 runs at actual flows and concentrations if monitoring data was available. The mass from continuous dischargers from the outlet of Lac qui Parle Dam to Shakopee with the potential to discharge above 1 mg/L in model scenarios 4 and 5 was approximately 138.5 kg/d (Table 2). To maintain this mass at the facilities potential to discharge 70% of AWWDF for municipal facilities and 100% of maximum design flow for industrial facilities the flow-weighted mean concentration of the facilities equated to 0.64 mg/L(Table 2). The flow-weighted concentration WLA was categorically split among continuous facilities in the basin based on design flow (Table 3). Based on the sensitivity analysis for the Minnesota River – Yellow Medicine Watershed, limits will be implemented as monthly average mass limits in kg/day. The details of the sensitivity analysis will be covered in the overview of the Minnesota River – Yellow Medicine Watershed.

Table 2. Flow and concentration inputs for continuous WWTFs in the Minnesota River HSPF model and flow weighted concentration wasteload allocation based on percentage of permitted flows.

Scenario	Flow (mgd)	Concentration (mg/L)	Mass (kg/day)
HSPF scenarios 4 and 5	36.6*	1.0	138.5
RES permitted wasteload allocation	57.0	0.64	138.5

*Estimate of HSPF flows based on actual flows from 2001-2014

Table 3. Categorical mass and concentration wasteload allocation for select facilities in the Minnesota River Basin.

Category	Design flow (mgd)	100% MDF 70% AWWDF	Concentration WLA (mg/L)	Mass WLA (kg/d)
Large Industrial High Concentration (>817 kg/yr; >1.0 mg/L)	5.05	5.1	0.53	10.1
Large Municipals (<1,>0.202 mechanicals)	14.75	10.3	0.9	35.2
Municipal Major (<20,>1mgd)	56.67	39.7	0.53	79.6
Small Industrial High Concentration (<817 kg/yr and conc. > 1.0 mg/L)	0.86	0.9	1	3.3
Small Municipals (mechanical and <0.301 mgd)	1.50	1.0	2.5	9.9
Grand Total	**78.8**	**57.0**		**138.0**

Minnesota River – Mankato Watershed: Minnesota River at St. Peter

The Minnesota River –Mankato Watershed is the next upstream watershed of the Lower Minnesota River Watershed. Concentration at a representative site near the outlet of the watershed in St. Peter indicates that TP is above the RES as a long-term summer average. The HSPF model based limits for the Lower Minnesota River were also protective of the Minnesota River on average near the outlet of the Minnesota River – Mankato Watershed (Figure 3). Like the lower Minnesota, additional non-point reductions beyond scenario 4 BMPs will be needed to meet RES of 0.150 mg/L as a long-term average (Table 4).

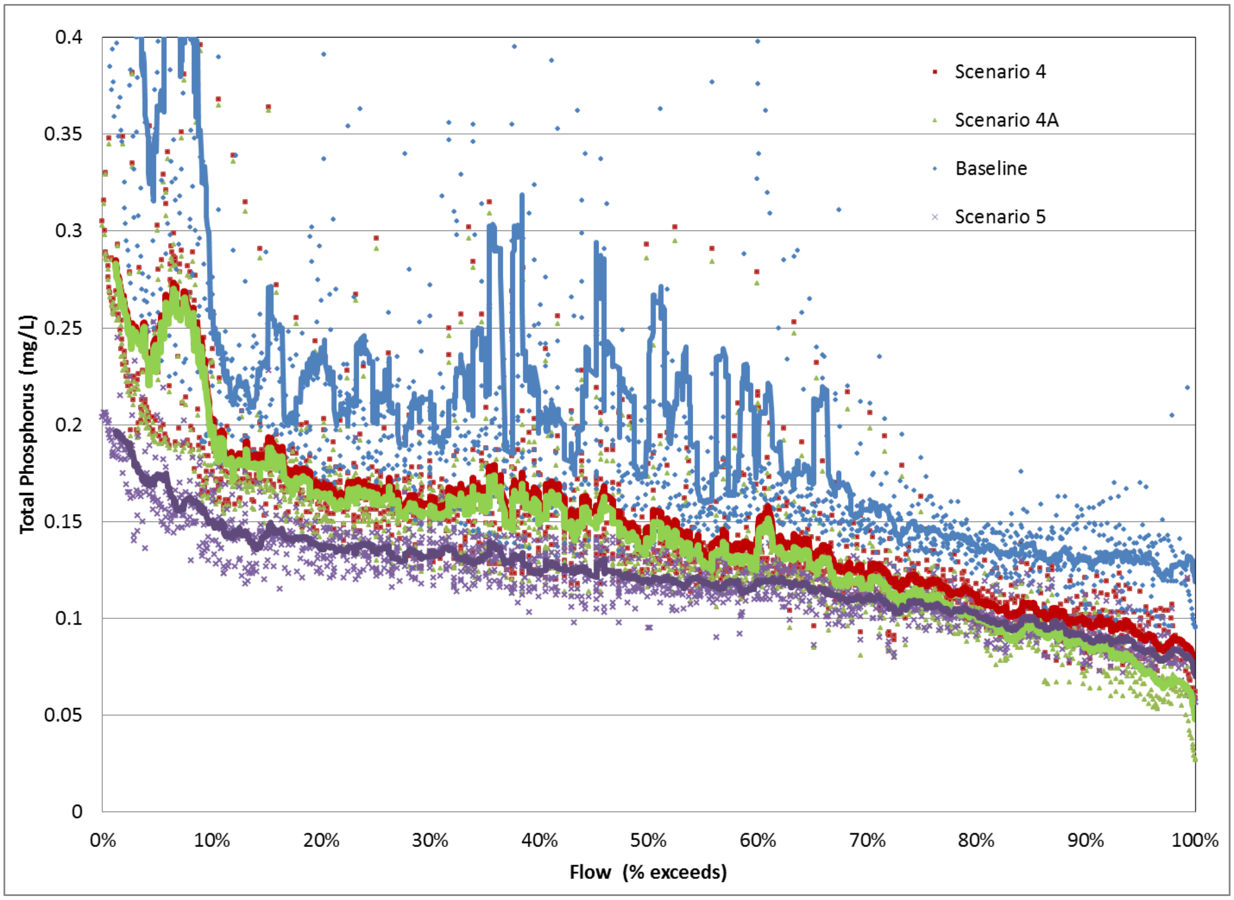


Figure 3. Daily summer (June-Sept) total phosphorus predicted by HSPF for the Minnesota River at St. Peter from 1993 – 2006 excluding 2000. Note TP data is arranged by flow (percent exceeds) for the Minnesota River based on the summer flow from 1993-2006. See Table 1 for description of scenarios. Lines represent moving average for scenarios (n=20).

Table 4. HSPF modeled Long-term summer average total phosphorus for the Minnesota River at St. Peter.

Scenario	Average summer TP (mg/L)	Description
Baseline	**0.211**	Historical conditions from 1993-2006
4	**0.155**	Level 4 non-point reductions with continuous point sources at 1.0 mg/L
4a	**0.145**	Level 4 non-point reductions with continuous point sources at 0.0 mg/L
5	**0.126**	Level 5 non-point reductions with continuous point sources at 1.0 mg/L

Minnesota River – Yellow Medicine Watershed: Minnesota River at Morton

The Minnesota River – Yellow Medicine Watershed is the next upstream watershed of the Minnesota River - Mankato Watershed. Concentration at a representative site near the outlet of the watershed in Morton indicates that TP is above the RES as a long-term summer average and at the critical 80 % exceeds flow (Figure 4). There are no readily available HSPF data for the Minnesota River at Morton. A reasonable potential equation was constructed to determine if limits based on HSPF model results for the Minnesota River at two downstream watersheds were sufficient to protect Minnesota River at Morton.

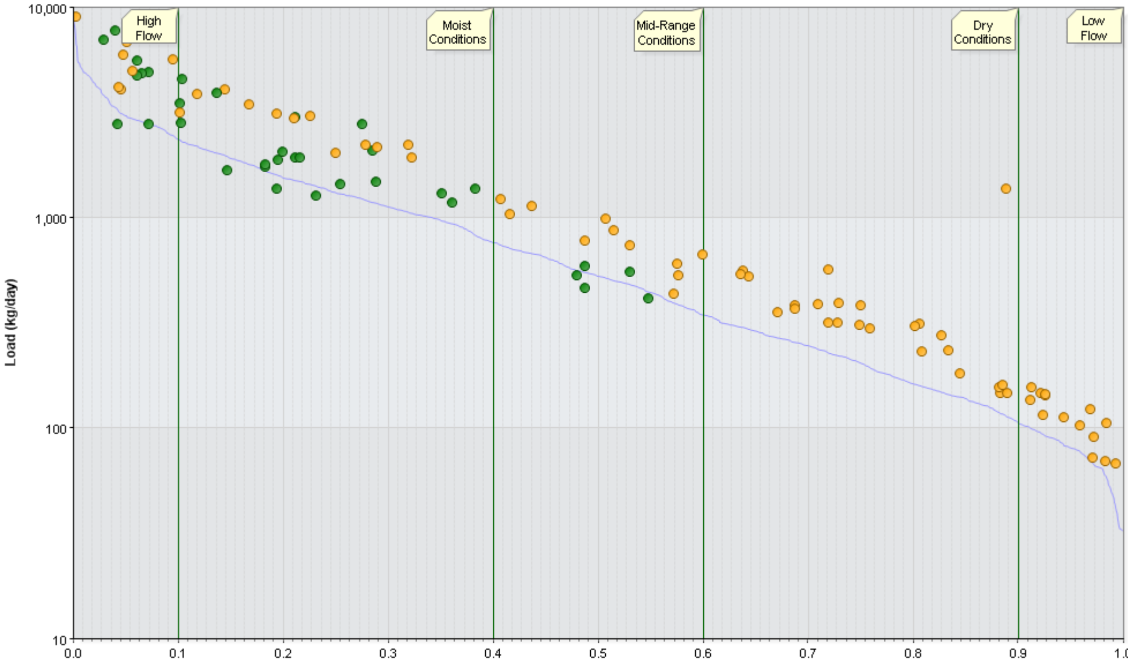


Figure 4. Monitored daily summer (June-September) total phosphorus load of the Minnesota River at Morton (station S000-145) from 2004-2013. Percent exceeds flow based on 2000-2013 summer flows (Minnesota River at Morton). Concentration at critical flow = 0.248 mg/L (n=7). Blue line represents load at RES (0.150 mg/L).

The following equation was used to calculate the reasonable potential (RP) of the continuously discharging facilities (at the WLA for the middle and lower Minnesota River) upstream of Morton to cause or contribute to a nutrient impairment in the Minnesota River (Equation 1).

Equation 1. TP concentration of Minnesota River at Morton based on permitted flow for upstream facilities.

$$Cr = \frac{QsCs + QeCe}{Qr}$$

Cr = downstream TP concentration of river at critical flow (80% exceeds flow)

Qr = downstream river flow (80% exceeds flow)

Qs = flow of river without WWTFs

Cs = concentration of river without WWTFs

Qe = design flow of WWTFs

Ce = long term effluent concentration, existing concentration limit or **concentration target of mass limit**

Qr = 292 mgd; based on permitted flow values and using Qr = Qs + Qe

Qs = 275 mgd; calculated using average daily flow from USGS gauge at the outlet of the watershed during June – September at 80% exceeds flow and subtracting upstream WWTFs' average daily flow during June – September, 2009 – 2013

Cs = 0.046 mg/L; concentration for the Minnesota River at Morton at 80% exceeds flow without WWTFs

Qe = 17.9 mgd; 70% of permitted AWWDF for municipals and 100% of MDF for industrials

Ce = 0.65 mg/L; flow-weighted concentration WLA from downstream HSPF stations

Cr = 0.083 mg/L TP

Cr_{sen} = 0.085 mg/L TP (sensitivity run)

Because the calculated Cr of 0.083 mg/L is less than the RES of 0.150 mg/L, it was determined that the limits needed for downstream reaches of the Minnesota River are protective of the Minnesota River at Morton. Given that this station is the farthest upstream station in the Minnesota River Basin exceeding RES and has 31% of continuous WWTFs by design flow, it is logical to conclude that this river reach would have the greatest potential increase in projected river concentration if summer mass limits were applied instead of concentration limits. The collective mass from the treatment plants (WLA = 44.0 kg/day) was frozen while the collective WWTF flows were reduced from 17.9 to 11.6 mgd. The maximum increase in the concentration of the river from mass only limits would result in an increase from 0.083 to 0.085 mg/L during critical low flow conditions. This slight potential shift would not result in a significant change in algal abundance in the Minnesota River at Morton. Thus, only monthly mass limits will be required during summer for RES in the Minnesota River.

Lower Minnesota River low dissolved oxygen TMDL

A low dissolved oxygen TMDL for the lower Minnesota River established individual total phosphorus allocations as kg/day for 40 WWTFs in the Minnesota River Basin (Gunderson and Klang 2004). This TMDL was designed to protect the last 22 miles of the Minnesota River from excessive BOD loading during summer from the Minnesota River upstream of Jordan, Minnesota. Historically, the BOD loading was the result of algal production in the Minnesota River driven by elevated concentration of TP. Recent reductions of TP loading from point sources in the Minnesota River Basin have been driven by a variety of permit requirements including those included in the Minnesota River Basin General Phosphorus Permit Phase I (http://www.pca.state.mn.us/index.php/view-document.html?gid=5997).

The aggregate sum of the RES based allocations assigned in this memorandum for the original 40 facilities in the low dissolved oxygen TMDL is lower than the aggregate sum of the allocations in the low dissolved oxygen TMDL (Appendix B). The low dissolved TMDL allocations were based on a universal concentration multiplier while the RES based limits were based on a categorical concentration multiplier. Thus, some of the smaller facilities actually received a higher allocation for the RES based limit even though the aggregate sum for all the facilities was approximately 60 kg/day less than the low DO TMDL. Given the that the low DO reach of the Minnesota River is downstream of all the facilities and the aggregate sum of the RES allocations is more restrictive, the RES based TP allocations will be the summer limits for all of the facilities in Executive summary table 1. Facilities will not need coverage under the Minnesota Basin Permit once they are meeting summer limits for RES.

Both the RES analysis and low DO TMDL managed smaller facilities including stabilization ponds in a similar manner. These facilities need to maintain their existing load or possibly reduce their TP load for Lake Pepin. Local watershed reviews will examine these facilities in greater detail.

Summary

This review was completed for the mainstem of the Minnesota River specifically. The primary purpose of this memorandum is to establish summer WQBELs for continuously discharging facilities in the Minnesota River Watershed for RES (Executive summary Table 1). These limits will apply from June-September as a monthly average and are based on meeting RES throughout the mainstem of the Minnesota River downstream of Lac qui Parle Dam. More restrictive TP limits may be assigned for local lakes and rivers in individual watershed reviews if mainstem limits are not sufficient for local resources.

Given the large number of WWTFs in the Minnesota River Basin downstream of Lac qui Parle Dam, a summary table was developed for all categories of TP dischargers (Table 5). Several groups of WWTFs were only briefly discussed in this memorandum. Assumptions made for these facilities will be confirmed in individual TP effluent limit reviews or watershed reviews.

Table 5. WQBELS for municipal and industrial WWTFs in the Minnesota River Basin for Lake Pepin, the Minnesota River, and the Lower Minnesota River.

Facility (AWWDF or MDF)	Components of mass limit to meet Lake Pepin WQBEL	Components of mass limit to meet downstream RES in Minnesota River*	Limit to meet low dissolved oxygen TMDL in metro Minnesota River †
Continuous > 20.0 mgd	AWWDF x 0.3 mg/L	NA, based on Mississippi. R. and Lake Pepin	NA
Continuous 1.0 – 20.0 mgd	AWWDF x 0.8 mg/L	70% AWWDF x 0.53 mg/L	Replaced by RES allocations June-Sept only
Continuous 0.2 – 1.0 mgd	AWWDF x 1.0 mg/L	70% AWWDF x 0.9 mg/L	Replaced by RES allocations June-Sept only
Continuous <0.2 mgd	AWWDF x 3.50 mg/L	70% AWWDF x 2.5 mg/L	Maintain current discharge
Stabilization ponds <0.301 mgd	AWWDF x 2.0 mg/L	AWWDF x 2.0 mg/L****	Maintain current discharge
Stabilization ponds >0.301 mgd	AWWDF x 1.0 mg/L	AWWDF x 1.0 mg/L****	Maintain current discharge
WWTFs at conc. below RES	Maintain current discharge**	Maintain current discharge**	Maintain current discharge**
Industrial Discharge with concentration > 1.0 mg/L and MDF > 1.0 mgd	MDF x 1.0 mg/L	MDF x 0.53 mg/L	Replaced by RES allocations June-Sept only
Industrial Discharge with concentration > 1.0 mg/L and MDF < 1.0 mgd	MDF x 1.0 mg/L	MDF x 1.0 mg/L	Replaced by RES allocations June-Sept only
Industrial Discharge with concentration < 1.0 mg/L	Current load x 1.15	Current load x 1.15****	Replaced by RES allocations June-Sept only
Other Industrial	Limits specified on a site specific basis	Limits specified on a site specific basis	Replaced by RES allocations June-Sept only

***Monthly mass limits includes "2.1" variability of treatment multiplier**

**Expansion of these WWTFs may be permitted assuming effluent concentration remains below RES

*** MDF = Maximum Design Flow --> common value used to evaluate industrial discharges.

****annual limits, "2.1" multiplier not included in these limits

†Phase I limits will be replaced by RES limits since RES limits are at least as restrictive as final low DO allocations

References (may not be directly cited in memorandum)

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MPCA (2016). Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List. MPCA St. Paul 69 pp. https://www.pca.state.mn.us/sites/default/files/wq-iw1-04i.pdf

MPCA (2015). Procedures for implementing river eutrophication standards in NPDES wastewater permits in Minnesota. MPCA St. Paul 41 pp. https://www.pca.state.mn.us/sites/default/files/wq-wwprm2-15.pdf

Tetra Tech. (2009). Minnesota River Basin Turbidity TMDL Scenario Report. Prepared for Minnesota Pollution Control Agency by Tetra Tech, Inc., Research Triangle Park, NC.

Wasley, D.M. (2017). Phosphorus Effluent Limit Review: Minnesota River Basin Version 5.1. MPCA St. Paul 17 pp

Appendices

Appendix A. Summer (June – September) average total phosphorus (TP) and chlorophyll-a (Chl-a) for AUIDs on the Minnesota River exceeding proposed RES. Samples collected from 2002-2011.

Watershed (AUID)	TP standard (µg/L)	Chl-a standard (µg/L)	Count Chl-a	Chl-a average (µg/l)	Count TP	TP (µg/l)
Minnesota R. – Yellow Medicine R. (07020004-509)	150	40	12	72	12	197
Minnesota R. Mankato (07020007-501)	150	40	99	69	110	243
Minnesota R. Mankato (07020007-503)	150	40	13	74	13	194
Minnesota R. Mankato (07020007-505)	150	40	73	62	83	223
Minnesota R. Mankato (07020007-514)	150	40	12	76	82	238
Lower Minnesota R. (07020012-503)	150	40	12	93	12	198
Lower Minnesota R. (07020012-505)	150	40	27	64	33	215

Appendix B. Total phosphorus mass allocations for the Minnesota River Low dissolved oxygen TMDL and allocations for river eutrophication standards.

Count	Permittee		Permit number	Low DO kg/day	RES kg/day
1	Blue Earth	WWTP	MN0020532	2.60	2.34
2	Darling International		MN0002313	0.59	0.23
3	Fairmont	WWTP	MN0030112	10.40	5.48
4	Trimont	WWTP	MN0022071	0.91	1.23
5	Welcome	WWTP	MN0021296	0.68	0.62
6	Winnebago	WWTP	MN0025267	4.51	2.39
7	Benson	WWTP	MN0020036	2.60	2.35
8	Montevideo	WWTP	MN0020133	7.98	4.21
9	Starbuck	WWTP	MN0021415	0.73	0.83
10	Del Monte	WWTP	MN0001171	2.92	0.95
11	Springfield	WWTP	MN0024953	2.10	1.86
12	Walnut Grove	WWTP	MN0021776	0.55	0.48
13	Clara City	WWTP	MN0023035	1.23	1.1
14	Willmar	WWTP	MN0025259	13.95	10.53
15	Amboy	WWTP	MN0022624	0.73	0.68
16	New Richland	WWTP	MN0021032	1.60	1.43
17	St Clair	WWTP	MN0024716	0.55	0.51
18	Waseca	WWTP	MN0020796	9.30	4.91
19	Granite Falls	WWTP	MN0021211	2.46	1.91
20	Olivia	WWTP	MN0020907	1.46	2.34
21	Redwood Falls	WWTP	MN0020401	3.51	1.85
22	Renville	WWTP	MN0020737	2.42	2.03
23	Sacred Heart	WWTP	MN0024708	0.50	0.57
24	Lake Crystal	WWTP	MN0055981	1.55	1.41
25	Mankato	WWTP	MN0030171	24.72	15.8
26	New Ulm	WWTP	MN0030066	9.90	9.51
27	St Peter	WWTP	MN0022535	7.62	5.62
28	Arlington	WWTP	MN0020834	1.78	1.92
29	Cologne	WWTP	MN0023108	0.87	0.77
30	Henderson	WWTP	MN0023621	0.96	*
31	Le Center	WWTP	MN0023931	2.23	1.96
32	Le Sueur Cheese	WWTP	MN0066494	2.10	*
33	Le Sueur/MRVPUC	WWTP	MN0022152	2.37	2.59
34	Milton G Waldbaum		MN0060798	1.50	1.56
35	Norwood Young America	WWTP	MN0024392	1.37	2.17
36	ADM		MN0057037	18.24	5.3
37	Marshall	WWTP	MN0022179	13.22	6.32
38	Madelia	WWTP	MN0024040	3.47	1.84
39	St James	WWTP	MN0024759	7.89	4.16
40	Truman	WWTP	MN0021652	2.10	1.86
			Total	176.2	113.6

*****Facility no longer exists

Appendix E. Phosphorus Effluent Limit Review for the Le Sueur River Watershed

DATE :	Dec 21, 2017
TO :	File
FROM :	Matt Lindon Effluent Limits Unit Environmental Analysis an Outcomes and Division
PHONE :	651-757-2530
SUBJECT :	Phosphorus Effluent Limit Review for the Le Sueur River Watershed
VERSION :	1.5 Corrected the WLA for St. Clair WWTP (was previously listed as 0.53 kg/d) 1.4 Added executive summary updated WLA total for watershed 1.3 Wasteload allocation (WLA) values were added to Table 4 for pond facilities. Pond WLAs are consistent with limits to protect Lake Pepin but are expressed as a long-term daily average increment 1.2 Added Freeborn and Pemberton.

Table of contents

Executive summary

This memorandum will explain why additional phosphorus reductions are needed within the Le Sueur River Watershed from some wastewater treatment facilities (WWTFs). Most WWTFs in the watersheds can meet limits outlined in this memorandum if they maintain their current discharge during the critical summer season (i.e. June to September). These two watershed are within the Minnesota River Basin. Since 2000, WWTFs within the Minnesota River Basin have made significant reductions in phosphorus being discharged to the Minnesota River. These reductions were a result of partnership, hard work, and a common goal to protect and improve our state's water resources. Thank you for being a big part of these efforts. However, despite this progress more needs to be done.

The Minnesota River as well as river reaches in the Le Sueur River Watershed have high levels of algae on average. Algae are an important part of the food web of rivers, but too much is not good. When algal levels are high, only the toughest species of fish and aquatic insects can survive. And, the smelly and murky water makes canoeing and swimming on the river unpleasant.

High levels of the nutrient phosphorus are needed to produce large algal blooms. In 2015, the Minnesota Pollution Control Agency (MPCA) adopted rules which included standards (targets) for total phosphorus (TP) and algae in rivers. Now, when TP levels and algal levels are too high, the MPCA is required by law to develop a plan to reduce levels of TP, which will reduce algal levels to desirable levels.

For a healthier Minnesota River and Le Sueur River, phosphorus reductions need to be made by both point and non-point sources. Phosphorus contributions from both sources vary depending on weather and river conditions. During periods of high precipitation, non-point sources such as erosion and agriculture contribute most of the phosphorus going into the Minnesota River. During periods of lower precipitation, when the Minnesota River is at low flow, point sources such as WWTFs contribute most of the phosphorus going into the Minnesota River.

There are many sources of TP to Le Sueur River. The MPCA used a complex computer program (i.e., computer model) to determine how to meet the TP target across the Minnesota River. This model included reductions of TP from non-point sources such as stormwater from cities, runoff from fields, and streambank erosion. The model included the numerous wastewater treatment facilities (WWTFs) in the Le Sueur watershed.

The MPCA worked with the U.S. Environmental Protection Agency for over two years on developing its procedures for implementing effluent limits to meet the phosphorus standards for rivers. In June of 2016, the Minnesota Court of Appeals affirmed a process for setting limits that was the same as the process used for the limits outlined in this memorandum[1].

There are several important details for the new river eutrophication based TP limits (Executive summary table 1 and 2). First, the River Eutrophication limits only apply from June through September. Second, the limits are mass based which allow the facility to discharge at a higher concentration if their flows are well below design flow. As an individual facility grows, they will have to reduce the concentration of their effluent limit to meet the mass limit. Third, the new limits will have a monthly limit and a long-term goal (waste Load Allocation /WLA). The limit is the highest monthly mass the facility can discharge during a summer month. The limit is twice the long-term goal and allows for the inherent variability in WWTF effluent. The long-term goal will be included in the permit text. Complying with the limit each month should result in the facility achieving the long-term goal as an average of all summer months over a 5-yr permit cycle. Each facility will need to look at the variability in their TP concentration and effluent flow during summer to assess if their facility can meet the proposed TP mass limits for river eutrophication standards. The MPCA has developed flow and concentration charts for each WWTF to help the operator identify what concentration they need to achieve at a given flow rate to comply with the monthly and long-term mass goals.

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[1] MCEA vs. MCES and MPCA https://mn.gov/law-library-stat/archive/ctapun/2016/opa151622-061316.pdf

Stabilization ponds

While many ponds may have RP for the Minnesota and the Le Sueur River, the risk that they may exceed the Minnesota River RES WLA on average after an annual Lake Pepin limit is applied is less than for a continuous facility for two reasons. First, ponds cannot discharge during much of the summer. Second, during early and late summer periods in which ponds can discharge, data demonstrate that summer (June – September) discharge only occurs 25% of the time. In the Lake Pepin drainage area, for instance, ponds only discharge during 5 of 122 summer days, on average.   As such, there is a low probability that a pond discharge may occur during the growing season, regardless of concentration, which minimizes the environmental impact.

Executive Summary Table 1. Phosphorus limit and permit actions for Le Sueur River Watershed waste water facilities

Facility	Permit ID	Permit Action/Limit	SDR Limit mg/L	Lake Limit[1] kg/y	River WLA[2] Kg/d	River Limit[3] kg/d
Amboy WWTP	MN0022624	Limits	-	**396**	0.68	1.4
Delavan WWTP[4]	MNG580109	Limit	-	**149**	-	-
Freeborn WWTP[4]	MNG580018	Limit	-	**98**	-	-
Good Thunder WWTP[4]	MNG580206	Limit	-	**227**	-	-
Hartland WWTP[4]	MNG580102	Limit	-	**124**	-	-
Janesville WWTP[4]	MNG580025	Limit	-	**471**	-	-
Mapleton WWTP (Cobb)[4]	MN0021172	Limit	-	**561**	-	-
New Richland WWTP	MN0021032	Limits	-	**829**	1.43	3.0
Pemberton WWTP[4]	MNG580075	Limit	-	**146**	-	-
St Clair WWTP	MN0024716	Limits	-	**293**	0.51	1.1
Waldorf WWTP (Little Cobb)	MN0021849	Limits	-	**464**	0.25	0.53
Waseca WWTP	MN0020796	Limits	-	**3,868**	4.91	10.3
Wells-Easton-MN. Lake WWTP[4]	MN0025224	Limits	-	**1,202**	-	-

1- Limit based on Lake Pepin TMDL- 12 Month Rolling Total
2- Waste Load allocation needs to be meet as a long term average
3- Recommended effluent limit to meet RES in the Le Sueur Earth River
4- Stabilization Pond

Introduction

This purpose of this memorandum is to evaluate the need for additional total phosphorus (TP) effluent limits in wastewater permits within the Le Sueur River Watershed (LSRW). The focus is primarily on water quality based effluent limits (WQBELs). Currently, there are nineteen national pollutant discharge elimination system (NPDES) permitted facilities in the watershed, hereafter referred to as The Facilities (Table 4). Since 2008, the Minnesota Pollution Control Agency (MPCA) has set effluent limits for wastewater treatment facilities (WWTFs) upstream of lakes and reservoirs consistent with lake eutrophication standards (LES). MPCA is on the process of formally adopting river eutrophication standards (RES), which are considered in conjunction with LES. A full explanation of the implementation of LES and RES can be found in guidance (Wasley, 2014).

Federal law [40 CFR 122.44(d)] restricts mass increases upstream of impaired waters and states that all NPDES dischargers that have the reasonable potential (RP) to cause or contribute to downstream impaired waters are required to have a water quality based effluent limit (WQBEL).The following analysis will examine RP for both river reaches and downstream lakes. In Rivers, the process used to determine RP and derive WQBELS is defined in guidance (Wasley 2014). For lakes, permittees are found to have RP for TP if: 1) they discharge upstream of a nutrient impaired waterbody, 2) they discharge at TP concentrations greater than the ambient target, and 3) there is no geographical barrier capable of trapping a significant mass of nutrients between the outfall and the impairment. Lake eutrophication computer models are then used to derive Lake Eutrophication based limits.

Located in south central Minnesota, the Le Sueur River flows 111 miles through a gently rolling landscape. Most of the land cover is upland farmland until it cuts down through high bluffs to the Blue Earth River. Tributaries from Steele and Faribault Counties also flow into the Le Sueur. A total of 711,838 acres drain to the Le Sueur, and an extensive ditch and tile system facilitates movement of water throughout the watershed. Several streams (a total of 1,201 miles) flow to the Le Sueur, with its major tributaries being the Cobb and Maple rivers. Once covered with hardwood forests and long-grass prairies, the vast majority of the watershed is now planted with crops such as corn and soybeans or used for livestock production. Lakes and wetlands currently comprise 3% of the watershed. About 89% of the wetlands have been drained since European settlement. Water monitoring shows some modest improvements in water quality in the Le Sueur River over the past 10 years, though several sections of the river and its streams continue to suffer from many problems, including turbidity, low dissolved oxygen, and excess nutrients. The LSRW is a major source of sediment and nutrients to the Minnesota River.

Limits for wastewater dischargers within the LSRW will first be evaluated at the outlet of the major watershed. Then, these limits will be evaluated at other subwatersheds within the LSRW to insure that recommended RES-based limits are sufficiently restrictive. Finally, limits for other downstream waters, including reservoirs, are evaluated.

River eutrophication based effluent limits

The process for reviewing TP limits in the LSRW major watershed is as follows. First, a five-step process is used to evaluate limits at the outlet of the major watershed for all 13 applicable wastewater dischargers (Figure 1). Methods are consistent with guidance (Wasley 2014). It is assumed that limits set to meet downstream water quality in Lake Pepin are included in permits. Next, LSRW major watershed limits are then analyzed in select sub watersheds to determine whether any need to be more restrictive to meet more proximate water quality needs.

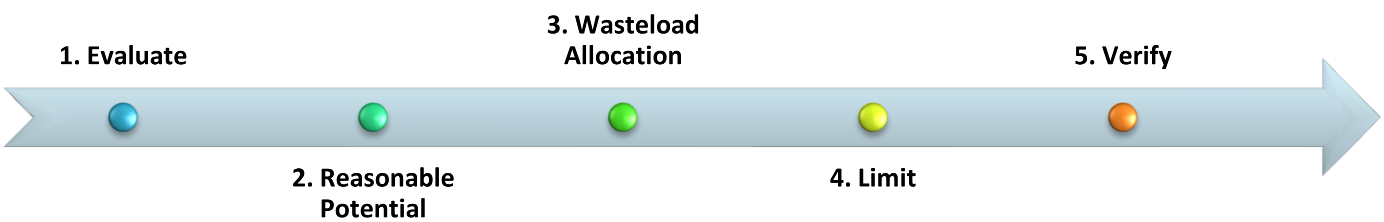

Figure 1. General process for RES analysis and NPDES permittee limit determination

River eutrophication evaluation – Step 1

The Le Sueur River Watershed is located in the South River Eutrophication Region. The TP and chlorophyll-a (Chl-a) standards for the South RER are 0.150 mg/L and 0.035 mg/L, respectively. Five river reaches within the LSRW have eutrophication monitoring data over the past 10 years (Figure 2, Table 1). Of the five reaches, all exceed the TP criterion under summer average conditions, but only three reaches also exceed the Chl-a response criterion. Sites with both TP and Chl-a excursions include the Little Cobb River, The Cobb River and the Le Sueur River at the outlet of the major watershed (Table 1). Because Chl-a is not exceeded at Little Beuford Ditch and Le Sueur River (CD 6 to Cobb R), reasonable potential (RP) is conducted the next downstream site, the outlet of the LSRW.

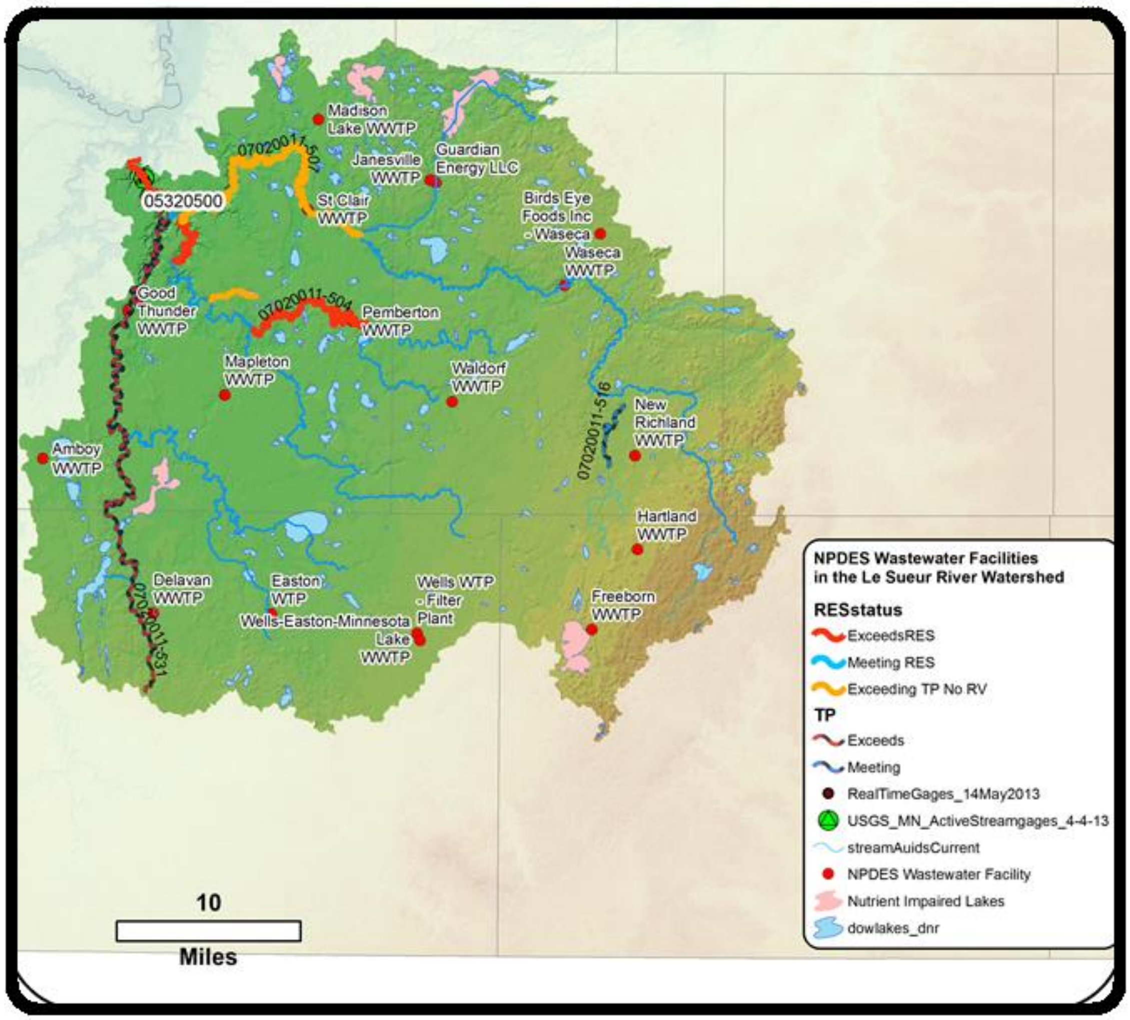

Figure 2. Le Sueur River reaches phosphorus concentrations

Table 1: Summary of ambient eutrophication data at river reaches within the Le Sueur River Watershed.

AUID	Reach Name	Chl-a Count	TP Count	Chl-a mg/L	TP mg/L
07020011-501	Le Sueur River	87	118	0.038	0.262
07020011-503	Little Beauford Ditch	65	94	0.025	0.210
07020011-504	Little Cobb River	86	120	0.059	0.245
07020011-507	Le Sueur River CD 6 to Cobb R	142	197	0.025	0.249
07020011-556	Cobb River	79	115	0.040	0.239

Water quality at low flow

A load duration curve was developed to analyze loading to the watershed during various flow conditions (Figure 3). Point sources can have a disproportionate impact on receiving waters during low flow conditions. Such conditions typically occur during summer months (June – September) when flow is equal to the 80th percentile flow exceedance (when, on average, 80% of the flow exceeds the respective flow value, Wasley, 2013). The load duration curve representing historical water quality from 1994 – 2014 indicates water quality meets RES under low flow conditions at the outlet of the Le Sueur River Watershed (Figure 3). Phosphorus concentrations are high under high flow, which is characteristic of nonpoint source dominated systems.

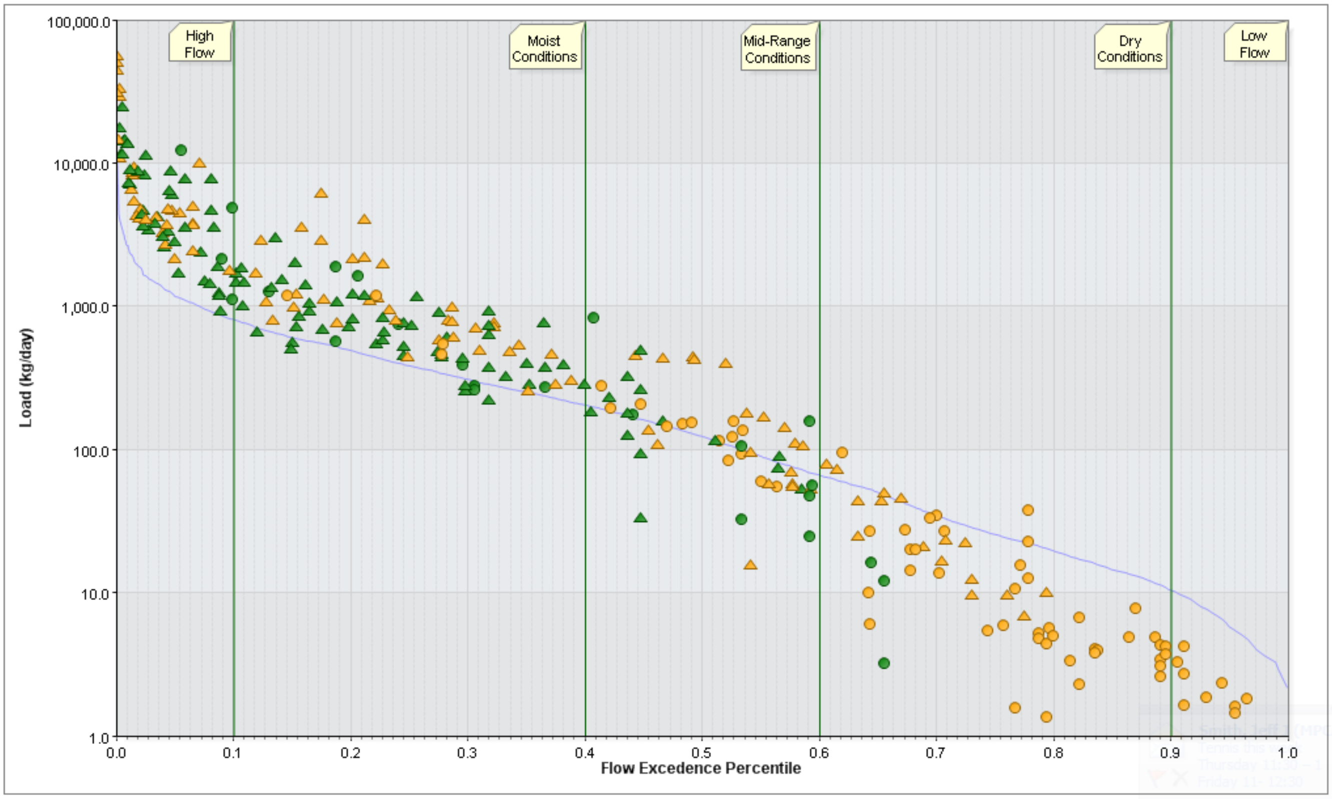

Figure 3. Le Sueur River total phosphorus load duration curve.

Reasonable potential at low flow – Step 2

The reasonable potential to cause or contribute to an excursion in river eutrophication standards is determined by estimating the ambient river TP concentration when contributing wastewater facilities are discharging at full permitted capacity (Equation 1). If the river exceeds standards, loading from contributing point sources must be reduced such that the TP criterion can be met (Step 3, Equation 2). At the critical low flow condition if point source loading were eliminated, the Le Sueur River would have an estimated TP concentration of 0.041 mg/L (Cs, Equation 1). With wastewater discharging at full permitted levels, it is estimated that the river could reach a TP concentration of 0.604 mg/L, which far exceeds RES (Equation 1). Therefore, wastewater, at current full permitted levels has the reasonable potential to cause an exceedance in standards and more restrictive limits are necessary.

Equation 1. TP concentration of primary water of interest based on permitted flow for the Facilities.

$$CrRP = \frac{(Qs * Cs) + (Qe * CeRP)}{QrRP}$$

Variable	Value	Description	Source – Reference
QrRP	39.55 mgd	flows at the outlet of the LSRW used for **r**easonable potential determination	based on permitted flow values and using Qr = Qs + Qe
Qs	34.89 mgd	flow of river without WWTFs	USGS gauge flows at the outlet of the watershed (June – Sept. at 80th percentile flow exceedance) – Actual facility flows during 80th percentile exceedance flows
Cs	0.041mg/l	concentration of river without WWTFs	(Total River Load - PS Load)/(Qs*3.785)
Qe	4.67 mgd	Facilities' flows	70% AWWDF of WWTFs
CeRP	4.84 mg/L	Flow weighted mean average effluent concentration in consideration of existing mass limits	Based on actual 2009-2013 Phosphorus discharge concentration
CrRP	0.604 mg/L	concentration of river at critical low flow with WWTF at max permitted levels (70% AWWDF, current mass or concentration limits)	Equation 1

Wasteload allocation – Step 3

In order to achieve a river TP concentration of 0.150 mg/L, wastewater dischargers cannot collectively exceed a mass of 17.06 kg/d, the gross WLA load, during the June through September summer period (Equation 2). Given that each contributing facility is a different size and that phosphorus removal is typically more economical and easier to implement at larger facilities, the gross WLA is not simply divided by the number of contributing facilities. Instead, concentration multipliers, based on facility size and type, are applied to 70% of AWWDF to achieve individual WLAs. Multipliers are modified until the mass total is at or below the gross WLA (17.06 kg/day). In total, there are 13 wastewater dischargers in the LSRW. Eight facilities are ponds that do not regularly discharge during the June through September summer window. Ponds will receive limits established on the basis of water quality in downstream Lake Pepin. These limits were developed in consideration of the discharge of over 500 other point sources. Individual WLAs for these ponds are expressed as the long-term daily average increment of their Lake Pepin Limits (Table 4). The sum of these individual WLAs, along with other facilities is less than the gross WLA for the Le Sueur River. Therefore, stabilization pond limits to protect Lake Pepin are also sufficient to protect the Le Sueur River on a long-term average basis.

Of the five remaining dischargers, one facility, Waseca WWTP, is relatively large (70% AWWDF > 1 mgd). The remaining four are small (70% AWWDF < 1 mgd). Using a WLA multiplier of 0.7 mg/L for the Waseca WWTP and 1.0 mg/L multiplier for the smaller facilities, the sum of individual WLAs equals 16.24 kg/day, which is well under 17.06 kg/day. These values are roughly compatible with existing requirements for Lake Pepin farther downstream. As such, larger multipliers were not explored.

Equation 2. Wasteload allocation for The Facilities to meet RES of 0.150 mg/L.

$$\boldsymbol{WLA = \frac{(RES * (Qs + Qe)) - (Qs * Cs)}{Qe}}$$

Variable	Value	Description	Source – Reference
RES	0.150 mg/L	*(South RER)*	
Qs		see above	
Qe		see above	
Cs		see above	
WLA Conc.	0.966 mg/L		Equation 2
WLA Load	17.06 kg/d	daily load available during the four month seasonal period of June – September to meet RES.	Based on WLA Conc. *70% AWWDF

Translating WLAs to WQBELs – Step 4

Variability of treatment, a quality inherent to wastewater effluent, is taken into consideration when translating individual WLAs into WQBELs (Table 4). Individual WLAs represent the desired long-term average condition from point sources. WLA values are converted from long-duration time periods to kilogram per day (kg/day) for ease of calculation and comparison; the kg/day unit is the "currency of trade" within the mass balance limit analysis. WLAs are translated to WQBELs using a 2.1 variability multiplier. The limit translator was developed in cooperation with EPA region 5 permitting staff and is derived from statistics within longstanding USEPA guidance (Wasley, 2014; USEPA, 1991). When facilities are operated to avoid an exceedance of WQBELs, their long-term average effluent quality will be equal to or less than the WLA. It is recommended that limits be implemented as mass values (kg/day monthly average). Mass limits may allow for operational flexibility. As well, mass limits are easier to modify, should a facility implement a water quality trade.

Mass limit sensitivity analysis

The mass limit sensitivity analysis insures that mass limits, without additional concentration limits, will not result in unintended ambient water quality consequences at current actual facility flows. The gross WLA is divided by actual flow to derive the maximum possible facility concentration at current actual average flows (Equation 3). This concentration (Cem) then replaces the reasonable potential effluent concentration (Crp) in Equation 1. In addition, the effluent flow in Equation 1 is reduced to current actual levels instead of 70% AWWDF (Qe vs. Qe_s). If the resulting river concentration CrRP is significantly higher, concentration limits should be explored. A "significant" change in water quality would equate to measurable or biologically significant difference.

At the WLA under current actual flows, the concentration of the Le Sueur River at the outlet of the watershed would be a maximum of 0.153 mg/L (Equation 4), in comparison to 0.150, the applicable RES. A 0.003 mg/L difference is neither biologically significant nor in exceedance of the uncertainty typically associated with sampling and laboratory analysis. As such, RES limits expressed, as mass values are sufficient to protect river water quality.

Equation 3. Limit Calculation

$\frac{\text{WLA}}{\text{Qea}} = \text{Cem}$ **Qea** is the 70% Max Design Flow

Cem maximum potential effluent concentration

Equation 4: Wasteload allocation using preposed limites to meet RES of 0.150 mg/L.

$$Crs = \frac{(Qs * Cs) + (Qes * Ces)}{Qrs}$$

Variable	Value	Description	Source – Reference
Qr_s	38.9 mgd	Flow at the Outlet	QS+Long term PS summer flows
Qs	34.89 mgd	flow of river without WWTFs	see above
Cs	0.041mg/l	concentration of river without WWTFs	see above
Qe_s	2.32 mgd	Facility Flows	actual average effluent flow for The Facilities June – September, 2009 – 2013
Ce_s	1.84 mg/l	River concentration	Concentration from average mass based effluent proposed limits and actual facility flow, June – September
CR_s	0.153 mg/L	Concentration in the River with actual average flows and proposed mass Limits	Equation 3

Subwatershed analysis (Cobb and Little Cobb Rivers)

Upstream of the Le Sueur River outlet station (07020011-501), there are two additional locations that require limit analysis, the Cobb and Little Cobb Rivers. Both locations have permitted wastewater dischargers within their subwatersheds (Table 2, Figure 4).

The Cobb River subwatershed has a full complement of cause (TP) and response (Chl-a) data for assessment. Flow at the Little Cobb River was estimated by making a drainage area ratio adjustment from the LSRW outlet continuous gaging site 05320330. At 80th percentile exceedance flow, TP is 0.083 mg/L and meets standards. This equates to an ambient load of 3.31 kg/day. At current actual discharge rates, point sources contribute 0.25 kg/day. Assuming 100% transport, background ambient loading equates to 3.06 kg/day (point source load – ambient measured load). If point sources are restricted to limits developed for the LSRW, the maximum permitted load equates to 4.63 kg/day and results in a maximum ambient river TP concentration of 0.116 mg/L, which is below the applicable RES (0.15 mg/L). Therefore, **TP limits developed for the outlet of the LSRW (Table 4) are also sufficient to meet local water quality needs**.

The Little Cobb River was listed in 2010 for low dissolved oxygen (DO), and a recent stressor ID report has documented low IBI scores for fish and invertebrates (MPCA, 2014). Altered hydrology, lack of physical habitat, excess suspended sediments, high nitrates, high phosphorus, and low DO were all identified as fish and invertebrate stressors. A TMDL is currently underway to determine the chemical and physical changes necessary to remediate biological conditions. At the time of writing, TP wasteload allocations (WLAs) being considered for the Pemberton and Waldorf WWTPs are either identical to or less restrictive than what is necessary for the outlet of the LSRW to meet the TP criterion (0.150 mg/L). Therefore, **TP limits developed for the outlet of the LSRW (Table 4) are sufficient to meet local water quality needs**.

Table 2: Subwatershed area and facilities

	Acres	% of LE SUEUR RIVERW	Facilities
Le Sueur River	711,116	100	All
Cobb River	198,298	27.9	Pemberton, Waldorf, Mapleton, Freeborn
Little Cob River	83,560	11.75	Pemberton, Waldorf

Figure 4. Map of the Le Sueur River watershed including the Little Cobb and Cobb River subwatersheds.

Verify – Step 5

It is generally assumed that limits set to support RES at the outlet of a major watershed will also be sufficient to protect other downstream waters. Two additional impairments downstream the LSRW merit consideration; the low dissolved oxygen impairment in the Lower Minnesota River, and Lake Pepin, a reservoir farther downstream on the Mississippi River.

The Minnesota River Basin General Phosphorus Permit (General Permit) was designed to implement conditions necessary for the Lower Minnesota River low dissolved oxygen TMDL. Restrictions applicable to facilities within the LSRW are contained in the General Permit. Permit considerations for Lake Pepin are discussed below. An analysis of the Minnesota River Basin determined the limits necessary to meet the RES standards in the mainstem of the Minnesota River in the Lower Minnesota River Watershed (Wasley 2015). These limits are applicable to some of the LSRW facilities (Table 4).

Phosphorus effluent limits for all NPDES dischargers in the Le Sueur River Watershed were analyzed on the basis of three river reaches with sufficient eutrophication cause and response data, namely total phosphorus (TP) and chlorophyll-a (Chl-a). Additional water quality samples may be collected by MPCA downstream of point sources during the next intensive watershed monitoring (IWM) cycle in 2018 and 2019. Sites may be selected on the potential for point sources to cause an exceedance in a response variable. Rivers downstream of larger continuous dischargers may have a higher response risk potential. The opposite may be true downstream of small, intermittent, or seasonal dischargers. Given that the IWM will occur during the next five-year permit cycle, it is unlikely that individual permittees will be required to collect additional ambient water quality samples as a condition within their permits. Permittees should be aware that limits may become more restrictive pending evaluation of additional data.

Lake eutrophication standard limits (Lake Pepin)

A review of lake assessments and Lake dischargers was completed to insure that discharges would be in accordance with state lake eutrophication standards (LES).There are no active NPDES discharges directly to or upstream of lakes within the Le Sueur River Watershed. However, effluent from The Facilities is discharged upstream of Lake Pepin, a reservoir on the Mississippi River. In 2002, Lake Pepin was placed on the federal Clean Water Act Section 303(d) list of impaired waters due to excess nutrients. A TMDL study is currently being developed and a significant portion of the modeling analysis has been completed. Phosphorus is the primary nutrient responsible for excess algal growth in Lake Pepin. The Facilities were all shown to have RP for TP at Lake Pepin. Therefore, The Facilities are required to have a TP WQBEL as well. It is recommended that The Facilities receive a 12-month moving total mass limit derived from a draft TMDL Wasteload Allocation (WLA), as described below (Table 4). Draft WLAs in combination with other point and nonpoint reductions are sufficient to meet draft criteria in Lake Pepin designed to support the designated uses of this water resource.

A computer reservoir model for Lake Pepin was developed by MPCA modeling consultant, LimnoTech, to evaluate site specific eutrophication criteria (criteria) and the reductions necessary to achieve these criteria (LTI, 2008). Using the best available science, draft criteria for Lake Pepin were determined to be 100 µg/L for TP and 32 µg/L for Chl-a (Heiskary and Wasley 2008). Within the model, all major sources of TP upstream of Lake Pepin were considered, and 21 separate scenarios were developed. Scenario 17 achieved compliance with the draft criteria and predicted the following TP reductions from tributaries would be necessary: 50% from the Minnesota River and Cannon River and 20% from the Mississippi River upstream of Lock and Dam 1 and the St. Croix River. Again, per Code of Federal Regulations, it was assumed that reductions would be from both point and nonpoint sources. During the modeling process MPCA, staff simultaneously developed draft WLAs compatible with scenario 17 reductions for all NPDES dischargers within the contributing watershed.

A categorical approach was used to develop individual WLAs for the draft Lake Pepin TMDL. Calculations use the general formula below.

Facility WLA = (AWWDF/MDF x categorical concentration mg/L TP x 3.785 L/gal x 365 days/yr.

Concentration categories are based on facility size and type (Table 3). Resulting Lake Pepin WLAs for individual facilities are expressed as 12-month moving total mass limits (Table 4)

Historically, Birds Eye Foods Waseca had the potential to discharge directly to Loon Lake (Lake ID 81-0015). In recent years this discharge has not occurred. In 2010, Loon Lake was placed on the federal Clean Water Act Section 303(d) list of impaired waters due to excess nutrients. If Birds Eye Foods were to commence discharging at this location, Birds Eye foods would likely receive a limit near the ambient lake water quality standard (0.09 mg/L).

Table 3. Draft WQBELS for municipal and industrial WWTFs in the GBEW Watershed for Lake Pepin.

Facility (AWWDF or MDF*)	Components of mass limit to meet Lake Pepin WQBEL
> 20.0 mgd	AWWDF x 0.3 mg/L
1.0 – 20.0 mgd	AWWDF x 0.8 mg/L
0.2 – 1.0 mgd	AWWDF x 1.0 mg/L
Ponds <0.301 mgd	AWWDF x 2.0 mg/L
Ponds <1mgd >0.302 mgd	AWWDF x 1.0 mg/L
Continuous <0.2 mgd	Maintain current discharge**
Stabilization ponds <0.2 mgd	Maintain current discharge**
WWTFs at conc. Below RES	Maintain current discharge***
Industrial Discharge with concentration > 1.0 mg/L	MDF x 1.0 mg/L
Industrial Discharge with concentration < 1.0 mg/L	Current load x 1.15
Other Industrial	Limits specified on a site specific basis

* MDF = Maximum Design Flow --> common value used to evaluate industrial discharges.
**Mass limits based on categorical concentration and AWWDF (Average Wet Weather Design Flow)
***Expansion of these WWTFs may be permitted assuming effluent concentration remains below RES

Proposed WQBELs

The following are proposed limits consistent with Minnesota's Lake and River eutrophication standards (Table 4). Ponds that have not discharged over the past 5 years during the RES seasonal window (June - September) were not considered for RES based limits. Instead, language will be included in these permits to preclude or potentially restrict discharges during the June through September summer window. Additional monitoring or future re-analysis may result in more restrictive limits for all facilities.

Table 4. Proposed phosphorus effluent limits for all dischargers within the Le Sueur River Watershed.

					Effluent Limits		
Facility Name	**Permit Number**	**Type**	**WLA[1] mg/L**	**WLA kg/day**	**Lake Pepin LES kg/y**	**Le Sueur RES[2] kg/d**	**Minnesota River RES Limit Kg/d**
Amboy WWTP	MN0022624	Domestic	1.0	0.68	**396***	**1.6**	**1.4***
Delavan WWTP	MNG580109	Pond	2.0	0.23	**149***		
Freeborn WWTP	MNG580018	Pond	2.0	0.19	**98***		
Good Thunder WWTP	MNG580206	Pond	2.0	0.43	**227***		
Hartland WWTP	MNG580102	Pond	2.0	0.23	**124***		
Janesville WWTP	MNG580025	Pond	1.0	0.90	**471***		
Mapleton WWTP (Cobb)	MN0021172	Pond	1.0	0.22	**561***		
New Richland WWTP	MN0021032	Domestic	1.0	1.43	**829***	3.34	**3.0***
Pemberton WWTP	MNG580075	Pond	2.0	0.40	**146***		
St Clair WWTP	MN0024716	Domestic	1.0	0.56	**293***	1.18	**1.1***
Waldorf WWTP (Little Cobb)	MN0021849	Domestic	1.0	0.25	**464***	**0.53***	1.3
Waseca WWTP	MN0020796	Domestic	0.7	6.49	**3,868***	13.63	**10.3***
Wells-Easton-MN. Lake WWTP	MN0025224	Pond	0.8	2.30	**1,202***		
NPDES Individual WLA Total				13.27	8,831	20.28	
Le Sueur River Gross WLA				17.06			

LES = lake eutrophication standards, all based on water quality needs of Lake Pepin; RES = river eutrophication standards
[1]wasteload allocation concentration multiplier - not intended to be used as limit in permit
[2]river eutrophication standard limit intended to be applied as kilogram per day (kg/d) monthly average limit-type.
* The more restrictive limit that will be incorporated into the facilities next permit

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