South Metro Mississippi River Total Suspended Solids Total Maximum Daily Load

Minnesota Pollution Control Agency

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Glossary of Acronyms

Acronym	Full Name
BMP	Best Management Practices
EMAP	Environmental Mapping and Assessment Program
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
HUC	Hydrologic Unit Code
LA	Load Allocation
LTRMP	Long-Term Resource Monitoring Program
MCES	Metropolitan Council Environmental Services
DNR	Minnesota Dept. of Natural Resources
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer Systems
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NTU	Nephelometric Turbidity Units
RC	Reserve Capacity
SAC	Stakeholder Advisory Committee
SAP	Science Advisory Panel
SAV	Submersed Aquatic Vegetation
SWCD	Soil and Water Conservation District
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UMR	Upper Mississippi River
UMR-LP	Upper Mississippi River-Lake Pepin
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources
WLA	Waste Load Allocation
WPDES	Wisconsin Pollutant Discharge Elimination System
WWTP	Wastewater Treatment Plant

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TMDL Summary

EPA/MPCA Required Elements	Summary	TMDL Page #
Location	The impaired waterbodies encompass the Mississippi River from the confluence with the Minnesota River at River Mile 844 to River Mile 780 in upper Lake Pepin, through Lake Pepin to the Chippewa River of Wisconsin. It is in the Twin Cities Metropolitan Area and Lower Mississippi River Basin.	6
303(d) Listing Information	§ Minnesota: Mississippi River ID 07010206-501-505 and 07040001-531; Wisconsin: 89211 § Impaired Beneficial Use: Aquatic Life § Priority ranking of the waterbody: Scheduled for TMDL completion in 2009 § Original listing year: 1998 (MN); 2008 (WI) § Impairment/TMDL Pollutant(s) of Concern: Total Suspended Solids	4
Applicable Water Quality Standards/ Numeric Targets	A site-specific standard of 32 mg/L TSS summer average is to be achieved in at least five years over a 10-year period based on combined monitoring data at Lock and Dams 2 and 3.	40
Loading Capacity (expressed as daily load)	The loading capacity for the South Metro Mississippi River is calculated for five flow regimes. *See Tables 8 (annual) and 9 (daily).*	54-57
Waste Load Allocation	Individual waste load allocations (WLA) are established for wastewater treatment facilities whose effluent concentration exceeds 32 mg/L TSS. An aggregate WLA is established for National Pollutant Discharge Elimination System-regulated stormwater. *See Tables 8 (annual) and 9 (daily).*	54-57
Load Allocation	Load allocation (LA) is established for nonpoint sources. A separate allocation for natural background is estimated. *See Tables 8 (annual) and 9 (daily).*	54-57
Wastewater Reserve Capacity	Reserve capacity for specific types of wastewater treatment facilities that would not be expected to consistently treat below the TMDL water quality target is set aside. *See Tables 8 (annual) and 9 (daily).*	54-57, 66
Margin of Safety	An explicit margin of safety of 6% has been applied as part of the TMDL by setting the allowable loads to achieve a TSS target of 30 mg/L TSS summer mean rather than 32 mg/L summer mean.	64
Seasonal Variation	Seasonal variation was addressed through the use of continuous modeling over a 22-year period and by identifying load reductions that will achieve water quality standards during all seasons.	65
Reasonable Assurance	Reasonable assurance that the LA will be achieved is provided by: 1) availability of unprecedented funding from the Minnesota Clean Water Fund; 2) research and GIS that will allow targeting of high-contributing sediment sites for remediation; 3) use of existing state authorities regarding agricultural shoreland protection, drainage ditch buffers, and identifiable nonpoint sources of pollution. Reasonable assurance that the WLA will be achieved is provided by the respective NPDES permit programs.	78

(TMDL Summary cont'd)

EPA/MPCA Required Elements	Summary	TMDL Page #
Monitoring	A detailed monitoring plan has not been developed as part of this TMDL; however, general recommendations are made for continuing existing monitoring efforts and collecting new data regarding internal sources and the local tributaries.	80
Implementation	In the intervening time since the public noticing of this TMDL report a separate effort was launched and completed to create an implementation strategy document entitled "Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River". This report is briefly summarized; a copy can be accessed at http://www.pca.state.mn.us/ark8qrf. An overview of the implementation approach to be used in Wisconsin is also summarized.	71
Public Participation	A 45-member Stakeholder Advisory Committee has met at least 12 times since 2004 to oversee the development of the TSS site-specific standard and TMDL. A Science Advisory Panel chaired by the University of Minnesota Water Resources Center has reviewed the Upper Mississippi River-Lake Pepin model, endorsed the site-specific TSS standard used for the TMDL, and recommended proceeding with the TMDL. An official comment period from February 27, 2012, to May 29, 2012, was provided for the draft TMDL report and was announced via a public notice published in the Minnesota State Register. Follow-up communication with various stakeholders who commented was done resulting in revisions to the report.	82

Executive Summary

The Clean Water Act of 1972 provides a framework for assessing water quality impairments in a comprehensive fashion called the Total Maximum Daily Load (TMDL). This process calls for monitoring surface water, identifying waterbodies that exceed state standards as being impaired, and then determining the maximum loads of point and nonpoint sources of pollution that can be allowed without exceeding water quality standards. The Minnesota Pollution Control Agency (MPCA) is committed to following this process as a means of working toward achievement of water quality standards and, as feasible, broader improvements to aquatic ecosystems.

The South Metro Mississippi River Total Suspended Solids (TSS) TMDL has been under development since 2004 as a companion project to the Lake Pepin eutrophication TMDL, initiated the same year. A river model extending from Lock and Dam 1 to Lock and Dam 4 was developed to allow analysis of both turbidity and eutrophication impairments, and interactions between the two. After the model was completed in 2008, the MPCA put the issues of turbidity and eutrophication on separate tracks, starting with the development of site-specific standards and proceeding to the writing of TMDL documents. The MPCA sent the U.S. Environmental Protection Agency (EPA) a proposed site-specific TSS standard for the South Metro Mississippi in 2010, replacing the statewide turbidity standard for these reaches and providing the basis for the South Metro Mississippi TSS TMDL. The EPA gave its final approval to the proposed standard on November 8, 2010. The present TMDL applies to the TSS-impaired reach extending from River Mile 844 at the confluence with the Minnesota River to River Mile 780, in upper Lake Pepin. The TMDL addresses water quality impairment in this impaired reach, in addition to the accelerated in-filling of Lake Pepin with sediment.

The TMDL process as summarized above is narrowly focused on the attainment of water quality standards. As the current TMDL project developed, stakeholders advised – and the MPCA agreed – that the basic framework needed some augmentation to meet its large dimensions. The watershed to the South Metro Mississippi encompasses half the state of Minnesota and part of northwest and west-central Wisconsin. Within Minnesota, it includes 33 major (8-digit HUC) watersheds contributing suspended solids to the Mississippi. The MPCA and local partners are conducting turbidity TMDLs upstream on the Minnesota River and its tributaries, which contribute an average 74% of the TSS load to the South Metro Mississippi. The MPCA funded three major research projects to determine which areas and landscape features within the Minnesota River Basin are contributing the most sediment. Early results point to a steady shift from farm field- to non-field sources of sediment since the 1940s, with important implications for implementation planning.

The Mississippi River is in a league of its own in terms of size and structure. The river basin is the largest in the state. Also, the construction of Locks and Dams 2 and 3 in the 1930s resulted in the permanent inundation of a floodplain that previously had shifted from wet to dry on a seasonal basis. The new floodplain provides ideal conditions of water depth for submersed aquatic vegetation, a keystone species group that supports migratory waterfowl and fish while maintaining water clarity. However, the turbidity impairment prevents sufficient sunlight from penetrating to the river bed to allow the growth and maintenance of submersed aquatic vegetation. In a project called the Mississippi Makeover, the MPCA joined the Minnesota Department of Natural Resources and local citizens to relate the Mississippi TSS TMDL to ecosystem goals relevant to today's river. As a result, the Mississippi TSS TMDL will set the stage for reducing internal loads of sediment caused by wind and wave action through island-building and other river management practices undertaken by state and federal partners working to restore the ecosystem of the Upper Mississippi River (UMR).

The main finding of the Mississippi TSS TMDL study is that TSS loads from the Minnesota River Basin and other heavy-loading watersheds will need to decrease by 50% to 60% to meet the site-specific standard for turbidity in the South Metro Mississippi River. Loads from other tributaries will need to decrease by up to 20%. The steepest reductions are focused on watersheds where 80% of the sediment originates. These reductions will need to occur in years of medium and higher flows with sufficient frequency to meet a summer mean of 32 mg/L TSS in at least five summers over a 10-year period. If these conditions are met, the river should respond with a flourish of growth in submersed aquatic vegetation and a significant improvement in general ecosystem health.

As an additional benefit, the TSS load reductions would reduce the rate of sediment in-filling of Lake Pepin by about one-half. Lake Pepin, a natural impoundment of the Mississippi, is filling in with sediment at a rate much faster than in pre-settlement times. Reducing TSS loads will greatly prolong the life of this unique lake.

To make this TMDL project feasible, the MPCA plans a phased approach for implementation. This is described in a separate report entitled "Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River." A summary of this strategy report is provided in this TMDL report. In addition, State of Wisconsin's overall implementation approach is summarized as well.

The MPCA is striving to provide a balance of rigor and flexibility with the expectation that new knowledge will lead to adjustments in this large-scale and complex project.

1.0 Introduction

Section 303(d) of the Clean Water Act provides authority for completing TMDLs to achieve state water quality standards and/or designated uses. A TMDL is a calculation of the maximum amount of pollutant that a water body can receive and still meet water quality standards and/or designated uses. It is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The EPA requires the following of states for TMDL approval:

- Design TMDLs to implement applicable water quality criteria.
- Include load and WLAs.
- Consider the impacts of background pollutant contributions.
- Consider critical environmental conditions.
- Consider seasonal environmental variations.
- Include a margin of safety.
- Provide opportunity for public participation.
- Provide reasonable assurance that TMDLs can be met.

In general, the TMDL is developed according to this relationship: TMDL = WLA + LA + MOS + RC

Where:

WLA = **waste load allocation:** the portion of the TMDL allocated to existing or future point sources of the relevant pollutant.

LA = **load allocation**: the portion of the TMDL allocated to existing or future nonpoint sources of the relevant pollutant. The LA may also encompass "natural background" contributions.

MOS = **margin of safety**: an accounting of uncertainty about the relationship between pollutant loads and receiving water quality. The margin of safety can be provided implicitly through analytical assumptions or explicitly by reserving a portion of loading capacity.

RC = **reserve capacity:** an allocation for future growth related to wastewater. This is an MPCA-required element, if applicable, for TMDLs.

This TMDL report applies to five contiguous reaches that are impaired for TSS between Lock and Dam 1 and Lock and Dam 4 on the Mississippi River (Table 1 below). Impairments in this report are currently on Minnesota's proposed 2014 and Wisconsin's final 303(d) lists of impaired waters.

Table 1: South Metro Mississippi River TSS impairments

Reach and navigation pool	Assessment unit ID	Year of 303(d) listing	Affected use	Pollutant or stressor
Mississippi River - Minnesota Minnesota River to Metro Wastewater Treatment Plant (River Mile 844 to 835; Pool 2)	07010206-505	1998	Aquatic life	Total Suspended Solids
Mississippi River-Minnesota Metro Wastewater Treatment Plant to Rock Island Railroad Bridge (River Mile 835 to 830; Pool 2)	07010206-504	1998	Aquatic life	Total Suspended Solids
Mississippi River-Minnesota Rock Island Railroad Bridge to Lock and Dam 2 (River Mile 830 to 815.2; Pool 2)	07010206-502	1998	Aquatic life	Total Suspended Solids
Mississippi River-Minnesota Lock and Dam 2 to St. Croix River (River Mile 815.2 to 811.3; Upper Pool 3)	07010206-501	1998	Aquatic life	Total Suspended Solids
Mississippi River-Minnesota St. Croix River through Lake Pepin to the Chippewa River, Wisconsin (River Mile 811.3 to 764.5; Pools 3- 4)	07040001-531	1998	Aquatic life	Total Suspended Solids
Wisconsin DNR listing: Mississippi (Reach 1) Rush-Vermillion - St. Croix R to Chippewa R (Pools 3- Lower Pool 4, Lake Pepin)(River Mile 811.5 to 763.4)	892119	2008	Aquatic life	Sediment/Total Suspended Solids

1.1 Priority ranking

This report addresses the impairments indicated in Table 1. The MPCA's projected schedule for TMDL completions, as indicated on the 303(d) impaired waters list, implicitly reflects the priority ranking of this TMDL. Ranking criteria for scheduling TMDL projects include, but are not limited to: impairment impacts on public health and aquatic life; public value of the impaired water resource; likelihood of completing the TMDL in an expedient manner, including a strong base of existing data and restorability of the water body; technical capability and willingness locally to assist with the TMDL; and appropriate sequencing of TMDLs within a watershed or basin.

The MPCA is conducting the South Metro Mississippi TSS TMDL in conjunction with a TMDL for eutrophication impairment of Lake Pepin, which is a natural impoundment of the Mississippi River from River Mile 785 to River Mile 765 (from Red Wing to Wabasha). The MPCA started both TMDLs as a combined project in 2004 because they deal with interacting problems that need to be evaluated together. Suspended solids affect photosynthesis in the water column. Eutrophication produces suspended organic solids that contribute to the total amount of suspended solids.

The project received priority attention by the MPCA because of it unprecedented size and scope, and because of legal reasons. With the watershed covering half of Minnesota's land area, the TMDL for eutrophication, in particular, has implications for hundreds of point source dischargers. These implications became especially poignant when the Minnesota Center for Environmental Advocacy challenged an MPCA decision to permit a new discharge of phosphorus proposed by the cities of Annandale and Maple Lake. The legal challenge cited a provision of the

Clean Water Act [40 CFR § 122.4(i) and 122.44(d)(1)(i)] that prohibits permitting of new discharges to impaired waters before a TMDL has produced allocations applicable to such discharges. The Minnesota Supreme Court eventually upheld the Agency's permitting decisions, but the Agency developed guidance to better address these requirements. Because the TSS TMDL was being conducted in conjunction with the Lake Pepin TMDL, it received the same high priority in scheduling with a start date of 2005 and a completion date of 2009.

From the start of the TMDL project, the Agency intended to develop a site-specific standard for Lake Pepin eutrophication. However, well into the TMDL study the Agency learned that algae concentrations in Lake Pepin are strongly influenced by eutrophication activity upstream of the lake, in the Mississippi River and several major tributaries. Therefore, in 2009 the MPCA decided to incorporate the Lake Pepin site-specific standard into the development of nutrient standards for the Mississippi River and its tributaries, as part of the MPCA's triennial review of river water quality standards. Henceforth, the Agency has pursued water quality goals and TMDL developments for eutrophication and TSS on separate paths, with a site-specific standard for TSS replacing the statewide turbidity standard for the South Metro Mississippi River (Section 4.1.1 Water quality standard and numeric target).

2.0 Waterbody Description

For purposes of this TMDL, the TSS-impaired portion of the Mississippi River is designated the South Metro Mississippi River, extending from River Mile 844, at the confluence with the Minnesota River, to River Mile 780, just downstream of the confluence with the Rush River in Wisconsin, in upper Lake Pepin (Figure 1). This stretch of the Mississippi River corresponds to the 64 river miles to which the new TSS water quality standard applies (EPA, 2010). Listed reaches continue through Lake Pepin to River Mile 764.5, just upstream of the Chippewa River confluence. (Note: Wisconsin Department of Natural Resources (WDNR's) listed reach extends to River Mile 763.4.)

In its upper reach before the confluence with the Minnesota River, the Mississippi runs through a deep gorge. After four miles, it joins the Minnesota River and flows through a narrow channel within a broad floodplain cut by the Glacial River Warren about 12,000 years ago. In the 1930s, the federal government built locks and dams at River Miles 848 (Ford Dam), 815 (Lock and Dam 2 at Hastings), 797 (Lock and Dam 3 near Red Wing) and 753 (Lock and Dam 4 downstream of Wabasha). The locks and dams significantly altered the meanders and backwater wetlands of the Mississippi River and permanently inundated the floodplain behind each lock and dam. These floodplain areas, primarily from the St. Paul Barge Terminal to upper Lake Pepin, have a high potential to support emergent and submersed aquatic vegetation.

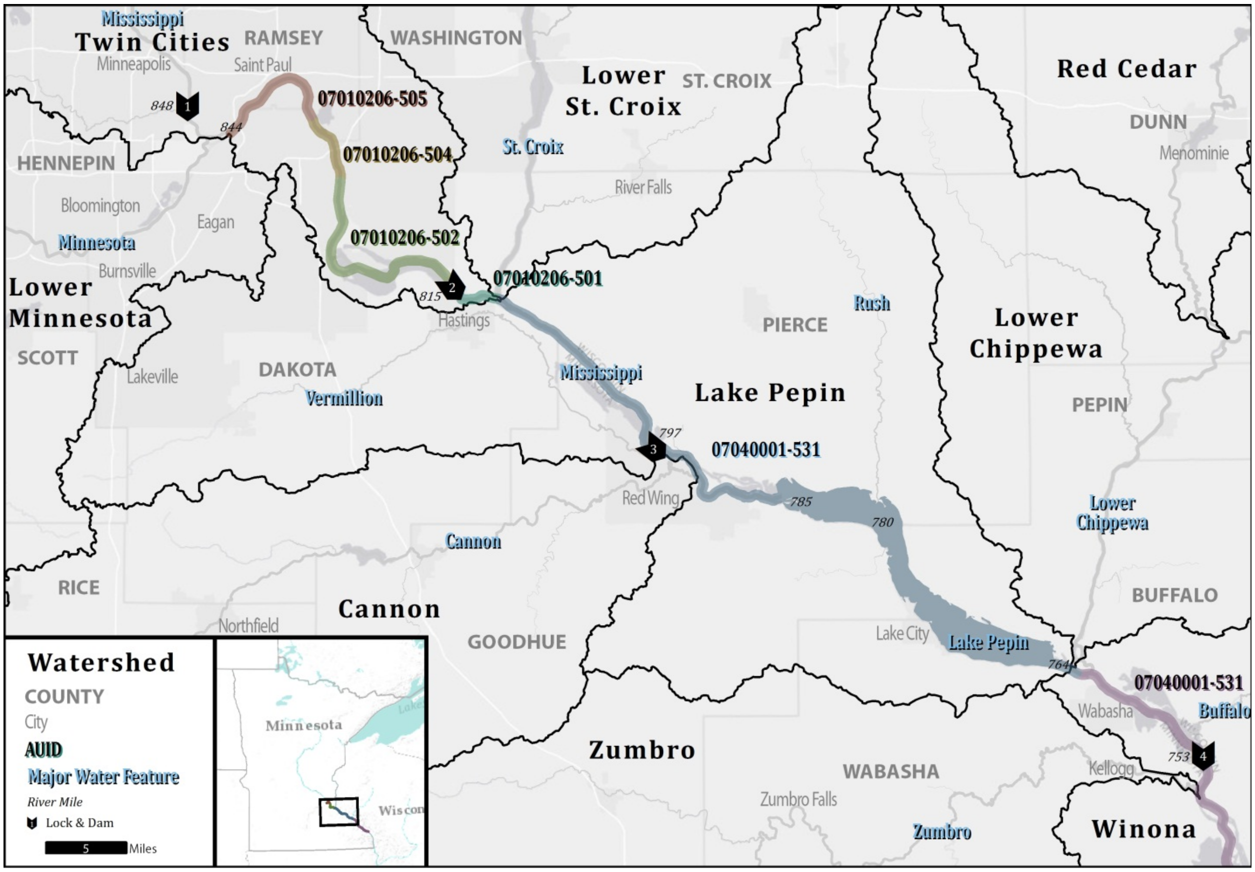
The greatest impact on TSS levels occurs at the beginning of the first listed reach, starting at the confluence of the Minnesota River at River Mile 844. This is not surprising, as the Minnesota River accounts for 75% of the TSS load to the South Metro Mississippi, on an average annual basis. TSS levels change very little at downstream monitoring sites, as the river moves through the first two listed reaches in a deep, narrow channel with limited access to slack water areas where settling of finer particles could occur. Impacts of minor tributaries and stormwater outfalls are not sufficient to exert an enduring, definable influence on TSS concentrations through these urbanized reaches of the South Metro Mississippi.

Toward the southern end of the third listed reach, just above Spring Lake and Lock and Dam 2, around River Mile 820, backwater areas begin to appear. They provide areas for sediment deposition under calm conditions and re-suspension under windy conditions.

The St. Croix River enters the Mississippi at River Mile 811.3 at the lower boundary of the fourth listed reach, providing significant dilution which results in lower TSS levels at the monitoring station at Lock and Dam 3.

Further settling out of sediment occurs as the river enters Lake Pepin at River Mile 786.2. The long-term average for TSS at this monitoring station is 46 mg/L. Just five miles downstream, at River Mile 781.2, the long-term average TSS is about half of this value, at 23.8. By this point in upper Lake Pepin, sufficient settling out of sediment occurs to bring TSS levels into conformance with the new standard of 32 mg/L. At Lock and Dam 4, downstream of Lake Pepin, annual average TSS levels are well below the standard, averaging just 8.2 mg/L TSS. These averages are based on Long-Term Resource Monitoring Program data collected at fixed stations between 1993 and 2008.

Figure 1: South Metro Mississippi River: Locks and Dams, Assessment Unit Identification Numbers



Water clarity is good in the uppermost segment of the South Metro Mississippi. At the confluence with the Minnesota River, the shape and condition of the Mississippi River change drastically. The river occupies a narrow channel flanked by a broad flood plain carved by the Glacial River Warren. The river becomes suddenly turbid as it absorbs the heavy sediment load of the Minnesota River. The U.S. Army Corps of Engineers maintains a 9 foot deep (300-600 foot-wide) navigation channel for barge traffic through periodic dredging. Habitat restoration opportunities exist in the shallower areas of the main channel, side-channels and backwaters.

In 1988 the federal government designated a 72-mile stretch of the Mississippi to be a national park. The Mississippi National River and Recreation Area (MNRRA) overlaps with the South Metro Mississippi River for 45 miles between River Mile 848 (Lock and Dam 1) and River Mile 803 between Hastings and Red Wing. The National Park Service manages the park with the goal of “preserving unimpaired” the natural and cultural resources and values of the MNRRA.

2.1 Water quality history

In the late 1920s, a federal government report indicates that where the Mississippi River broadens out to form Lake Pepin, “the shallow north end and east side of the south end have developed some of the finest areas of duck food plants in this entire region. Here wild celery, sago pondweed, clasping leaved pondweed, or red-head grass, leafy pondweed, bushy pondweed and Elodea or water-weed, which are six of the best submerged duck foods, together with numerous others, are abundant” (Uhler, 1929).

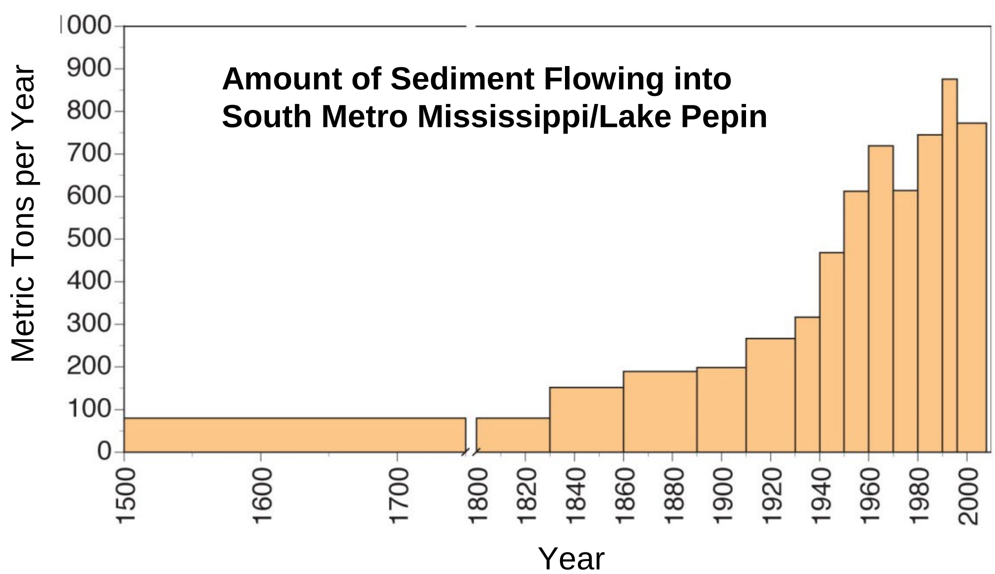
Up until the late 1920s, aquatic life appeared to remain healthy upstream of Lake Pepin despite sedimentation rates increasing by a factor of three to four times, as measured by sediment core dating techniques (Engstrom et al. 2009). Apparently, turbidity levels had yet to cross the threshold of having a significant, enduring impact on rooted aquatic vegetation.

The subsequent history of water quality in the South Metro Mississippi River is closely tied to population growth in the Twin Cities Metropolitan Area and intensified farming of the Minnesota River Basin. By 1926, untreated sewage had created a public health nuisance and very poor fish habitat in the Mississippi River. These conditions led to the development of guidelines for water quality and the construction of the Metropolitan Wastewater Treatment Plant in 1938, which resulted in major water quality improvements in the succeeding years (EPA 2000; Metropolitan Council Environmental Services, 2010).

As the urban population steadily increased, along with industry, the Clean Water Act of 1972 established new water quality standards, and pressures for improved water quality increased (MCES 2010). In the 1980s, the Metropolitan Council initiated an industrial pre-treatment program for heavy metals, initiated advanced secondary treatment at the Metro Plant, and began the separation of combined sanitary sewers and storm sewers. By the late 1980s and early 1990s, mayflies had returned to the Mississippi downstream of the Metro Plant, signifying improved water quality (Fremling 2005).

From the 1930s to 1960s, the amount of sediment flowing into the South Metro Mississippi and Lake Pepin more than doubled, from 300,000 to 700,000 metric tons per year, as measured by sediment cores in Lake Pepin (Engstrom et al. 2009). This rapid sedimentation rate has stabilized in recent decades. Figure 2 shows the increase in sediment loads over the past 500 years. Note that European settlement of Minnesota started in the early 1800s.

Figure 2: Amount of Sediment Flowing into South Metro Mississippi/Lake Pepin



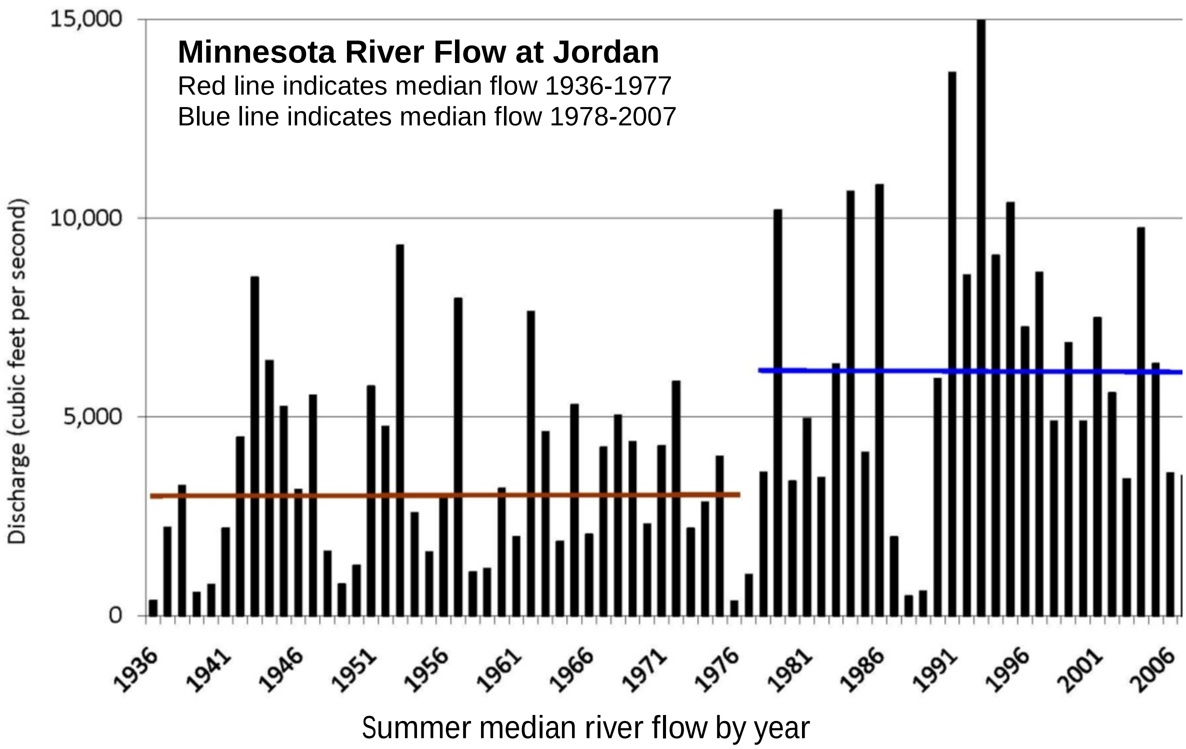
The amount of sediment, called "loads," to the South Metro Mississippi and Lake Pepin greatly increased in the middle part of the 1900s and have stabilized in recent decades, according to Lake Pepin sediment core analysis by the St. Croix Watershed Research Station of the Science Museum of Minnesota. Strata from core samples taken in 1996 and 2008 were dated to estimate historical rates of sediment accumulation. (St Croix Research Station graphic)

The 1930s to 1960s coincides with a time of major land-use changes, including:

- Significant land drainage through ditch construction and wetland loss;
- Full mechanization of farming (Tietz 1982);
- Less diversity in cropping systems; and
- Conversion of hay and grassland to soybeans.

Since 1960-1970, decade-average sediment loads to the Mississippi River, largely from the Minnesota River, have remained fairly constant. However, while total sediment loads have tended to level off, the sources of sediment that comprise the total load have undergone a dramatic shift between 1940 and 2010. In 1940, farm fields accounted for the majority – 65%– of the sediment entering waterways leading to the South Metro Mississippi and Lake Pepin (Schottler et al. 2010). The other 35% came from ravines, bluffs and stream banks. Now the proportions of sediment from these sources are the opposite, with 35% coming from farm fields and 65% coming from ravines, bluffs and stream banks (Schottler et al. 2010). This shift coincides with large increases in flow in the Minnesota River. Median river flow at Jordan has doubled over the past 80 years (Figure 3), as river flow volume as a percentage of rainfall has more than doubled, increasing from 7% to 20% (Barr Engineering 2004).

Figure 3: Minnesota River Flow at Jordan



Summer median Minnesota River flows, from June to September, have more than doubled, as measured by the U.S. Geological Survey at Jordan, Minn. Increased median flow is correlated with sustained high sediment loads to the South Metro Mississippi and an increasing proportion of non-field sediment. The red line, at left, shows the 1937-1977 median flow of 3,057 cubic feet per second; the blue line, at right, shows the 1978-2007 median flow of 6,136 cubic feet per second. (MPCA graphic)

Although the major source of sediment has shifted from fields to non-field sources, stormwater runoff from farm fields significantly affects ravines, bluffs and stream banks as sources of sediment. Field runoff contributes to increased ravine erosion as well as higher stream flows that increase shear stress on stream banks and erode the toes of bluffs, triggering increased sediment loss from these sources

(Wilcock 2009; Blann et al 2009). Recent studies indicate that sediment concentrations have decreased in the Minnesota River over the past several decades (Minnesota State University 2009; Johnson et al. 2008). There is also evidence that conservation practices have significantly reduced stream sediment from field erosion compared to what would have been the case without improvements such as residue management and conservation easements (USDA 2010). However, increased flows have served to hold TSS loads from the main stem fairly constant (Figure 2), although annual loads vary considerably (Figure 8).

Some stakeholders have proposed climate change as a main driver of increased sediment accumulation rates over the past 180 years. Historical precipitation data for Minnesota indicate that this is unlikely to be the case. The Minnesota State Climatology Office (http://climate.umn.edu/climateChange/climateChangeObservedNu.htm, last viewed September 14, 2015) reports that Minnesota aerial average precipitation has varied considerably since 1890, with an upward trend since the decade of the 1930s evident. However, no trend is perceptible over the entire period of record. The period 1895-1905 had roughly similar precipitation levels as the decade 1990-2000. Notably, rates of sedimentation in the early 1900s were only one-fifth as much as late 1900s, as measured by Lake Pepin sediment cores (Figure 2).

Some stakeholders have also suggested that precipitation events have grown more intense in recent decades, packing more erosive force than events of the past. State Climatologist Jim Zandlo answers the question as follows in the web site shown above: "…the amount of precipitation occurring as large events has been increasing for decades but about 100 years ago that fraction was similar to or even higher than what it is today." Thus, neither average precipitation or precipitation intensity are much different in recent years compared to a century ago.

Sediment levels have become five times higher in recent decades than in the 1895-1905 decade. The most likely reason lies in extensive land-use changes in largely rural parts of the Minnesota River Basin that are "primed to erode" by geology (Wilcock 2009). In combination, the clearing and draining of land for agricultural crop production over time alters the natural hydrology of watersheds through reductions in wetland storage and evapotranspiration, especially during spring and early summer when crop growth and ground cover are minimal, and precipitation levels typically high (Blann et al. 2009, page 924). Increases in stream flow, in turn, increase erosive pressure on stream banks and bluffs (Wilcock 2009).

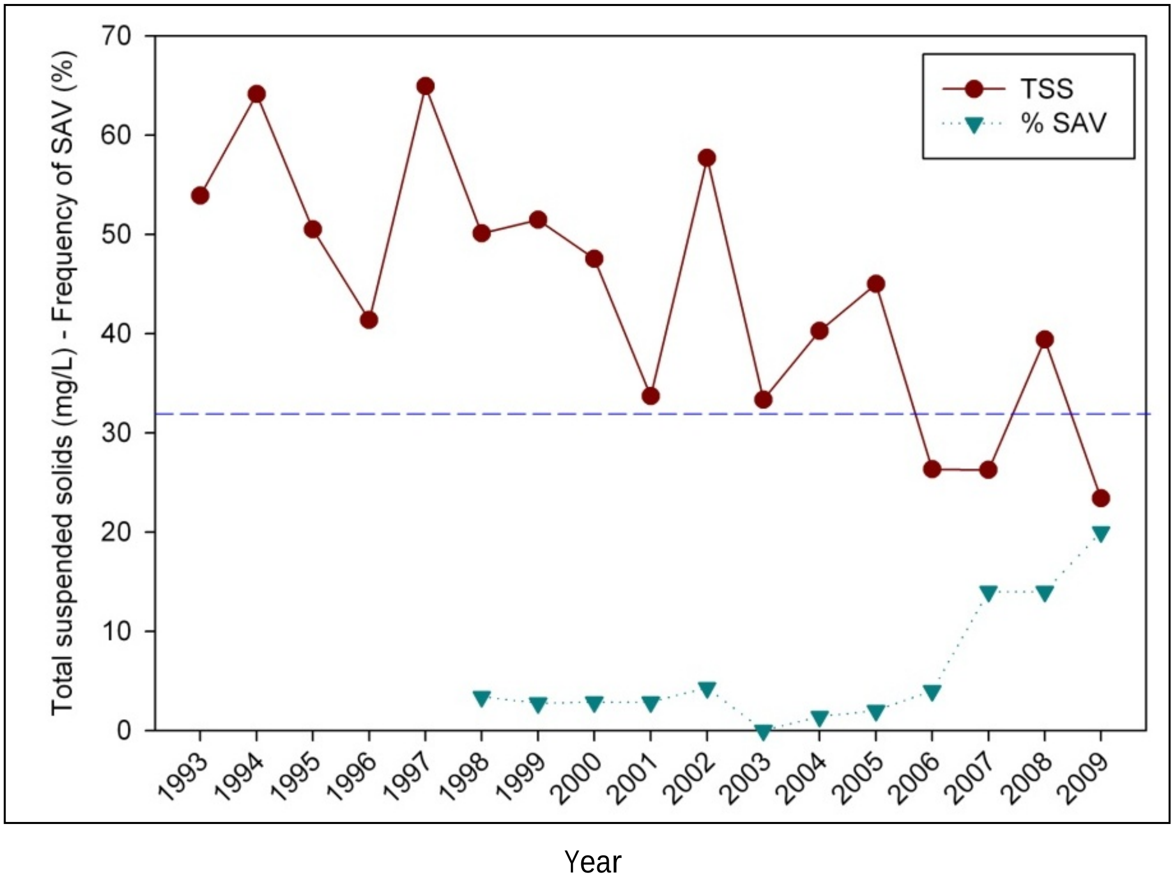
As mentioned above, an upward trend in mean annual precipitation is evident from the 1930s decade (the Dust Bowl years of record drought) to the present. Some stakeholders have suggested this upward trend in precipitation is a major contributor to increased river flows and non-field sources of sediment. However, others argue that this trend line is positive only because its origin is in an extremely dry decade. They point out that average annual precipitation from the 1940s to the 1960s, a period of rapid increase in sediment load, does not show a definite trend.

An extensive analysis was conducted to compare the effects of climate vs. land use on stream-channel erosion and sediment loading by a collaboration of research entities including the St. Croix Watershed Research Station – Science Museum of Minnesota, the University of Minnesota and three other universities (Schottler et al. 2013). Key aspects of the analysis included comparing: 1) two time periods—1940 to 1974 vs. 1975 to 2009, allowing observation of the effects of increased artificial drainage, loss of depressional areas and changing crop cover (dominated by increased soybean acreage), 2) early season (May – June; a period of minimal crop cover and typically higher stream flow) vs. late season (September – October; full crop cover, lower flow), and 3) multiple watersheds. Key conclusions and highlights include the following:

- Early season water yield (flow volume/watershed area) has increased dramatically for many of the watersheds in the study, particularly some that are the highest contributors of sediment (e.g., LeSueur, Blue Earth, Lower Redwood, Cannon, Cottonwood, Crow).
- Early season precipitation has actually been constant or has decreased since 1940. (Annual precipitation has increased over the two time periods, but by less than 15% and predominantly due to more post-June rainfall.)
- The increase in water yield is strongly correlated with the extent of drainage of depressional areas. In other words, tile drainage is very effective at doing what it is designed to do: quickly and efficiently removing water from the soil profile in the spring.
- Conversion to more soybean acreage has contributed to higher early season river flows due to that crop removing less soil moisture during that time of the year than the crop species it replaced.
- Rivers in watersheds with large increases in early season water yield have significantly widened.

During 1985-2006, the period of monitoring data used in this study, high sediment loads have led to elevated turbidity levels in the South Metro Mississippi, particularly since the flood year of 1993. This resulted in sparse submersed aquatic vegetation because poor light penetration has hampered plant growth (Sullivan et al. 2009). Shortly after this period, the river experienced a resurgence of vegetative growth in 2009 following several years of low flows during which turbidity levels remained suppressed (Figure 4). These facts underscore the empirical relationship among turbidity, TSS and aquatic vegetation. They also provide reasons for hope that the Mississippi River will achieve full support of aquatic life if the 32 mg/L TSS standard can be met in median and higher-flow years in addition to lower-flow years.

Figure 4: Level of TSS and Frequency of Vegetation in Upper Pool 4 (Lake Pepin) of the Mississippi River
TSS: Total Suspended Solids
SAV: Submersed Aquatic Vegetation



Monitoring shows that vegetation growth increased in frequency when TSS levels fell below 32 parts per million (mg/L), the site-specific standard as indicated by the dashed line, in Upper Pool 4 of the Mississippi River (Lake Pepin). Submersed aquatic vegetation was sampled at main and side channels. (Minnesota Department of Natural Resources graphic based on data from Long-Term Resource Monitoring Program of the U.S. Geological Survey)

In addition to causing aquatic life impairments in the Mississippi, high sediment loads have accelerated the sedimentation of Lake Pepin. A continuation of current rates of sedimentation would result in the in-filling of the upper third of Lake Pepin, above Frontenac, by the end of the present century, and of the entire lake within an additional 250 years (Engstrom et al. 2009). The disappearance of Lake Pepin as a sediment basin would adversely affect the Mississippi River downstream, allowing Minnesota River sediment to be carried down river as far as the Minnesota-Iowa border and beyond. This sediment would seriously impair this portion of the Mississippi, which currently sustains high-quality water to support a relatively healthy ecosystem, including extensive beds of submersed aquatic vegetation.

2.1.1 Pollutant of concern

In relatively shallow areas of the main channel border, side-channels, impounded areas and especially in backwaters of the permanently inundated floodplain, submersed aquatic vegetation flourished immediately following construction of the locks and dams (Fremling 2004, p. 232-3). However, in recent decades, this plant life has been scarce because of high levels of turbidity, or cloudiness, preventing sunlight from penetrating deeply enough into the water column to support and maintain photosynthetic activity. High turbidity also reduces populations of site-feeding fish species. In addition, it harms the larvae of sensitive native mussel species such as the Higgins Eye (Mike Davis, DNR, 2010). As a result, the state of Minnesota placed four reaches within the South Metro Mississippi River on the 303(d) list of impaired waters in 1998 for turbidity.

High levels of suspended solids impair the Mississippi River by shading the sunlight and reducing the potential for photosynthesis in shallower portions of the river: main channel border, side-channels, impounded areas and especially connected backwaters on the floodplain. The problem of turbidity, caused by TSS, is the pollutant of concern for this TMDL. TSS includes both inorganic, geologically derived particles, and organic particles from algae, detritus and other sources. These two components are distinguished as non-volatile and volatile suspended solids in the water quality model used to develop the TMDL (Section 5.0 Modeling Approach and Results, and Limno-Tech 2009, pp. 70-73).

3.0 Sediment Sources

"Sediment is created by the weathering of host rock and delivered to stream channels through various erosional processes, including sheet wash, gully and rill erosion, wind, landslides, dry ravel, and human excavation. In addition, sediments are often produced as a result of stream channel and bank erosion and channel disturbance," according to federal protocols (EPA 1999). The science of sediment detachment and transport to and through stream channels and networks is complex, influenced by a multitude of interacting factors such as climate and geology, gravity and friction, overlain with human disturbances to the land surface, drainage pathways and stream channels (Leopold et al. 1995:151-197).

Some sediment sources originate within the river corridor. These sources include stream banks, streambeds, and possibly floodplains and bluffs, all of which are potential sediment suppliers to a river. Algal growth and decay could be considered internal processes even though the phosphorus that drives algal production is usually from external sources such as upland areas or wastewater treatment plants.

A small portion of TSS is contributed by the resuspension of sediments deposited on the river bed, side-channels and backwater areas such as lower Pool 2. The problem is episodic, triggered by wind and wave action, and limited to areas with vast expanses of shallow, open water. This is of particular concern during summer (the peak submersed vegetation season), a time when external loads and flows are typically lower than those that occur during spring. Scientists have identified sediment from the wave action of boat traffic as a potential problem, particularly in Pool 3, where wave action from the wake of recreational boats may cause or magnify stream bank erosion (Johnson 1994; Johnson 2003). Although sediment resuspension seems relatively minor when compared to upstream loads of sediment, resuspension may often cause exceedances of the 32 mg/L TSS criterion in large expanses of backwater and impounded areas such as Spring Lake, lower Pool 2 and Wacouta Bay. These areas are likely to remain vulnerable to frequent turbid conditions unless measures are taken to reduce wind and wave action and to consolidate bottom sediments.

Other sources are external to the channel and originate from the contributing watershed area. A variety of mechanisms transport these components to the channel. The major sources of sediment are external to the South Metro Mississippi River. This TMDL report will first describe sediment sources with reference to tributary basin or watershed of origin, and then by rural and urban sources, and finally by landscape feature.

3.1 Tributary basins and watersheds

Water quality in the South Metro Mississippi is a reflection of the climate, soils, vegetation and land uses within its extensive watershed (Figure 5). Considerable variation exists across the watershed, as shown in the ecoregion map (Figure 6). Land uses vary from heavily forested to the north and east, to mainly agricultural in the south and west, to highly developed in the metropolitan region immediately upstream of Lake Pepin.

The MPCA also delineated a region called the Metroshed for the seven-county metropolitan area, with county boundaries adjusted to coincide with watershed boundaries (Figure 18). This delineation clearly distinguishes metro-area loads from the other major tributary inputs to the model domain, with the tributaries being:

- Minnesota River;
- Cannon River;
- St. Croix River;
- Upper Mississippi River; and
- Minor direct tributaries downstream of the metro region (i.e., those within the Mississippi River – Lake Pepin major watershed).

Figure 5: Major River Basins of the South Metro Mississippi Watershed

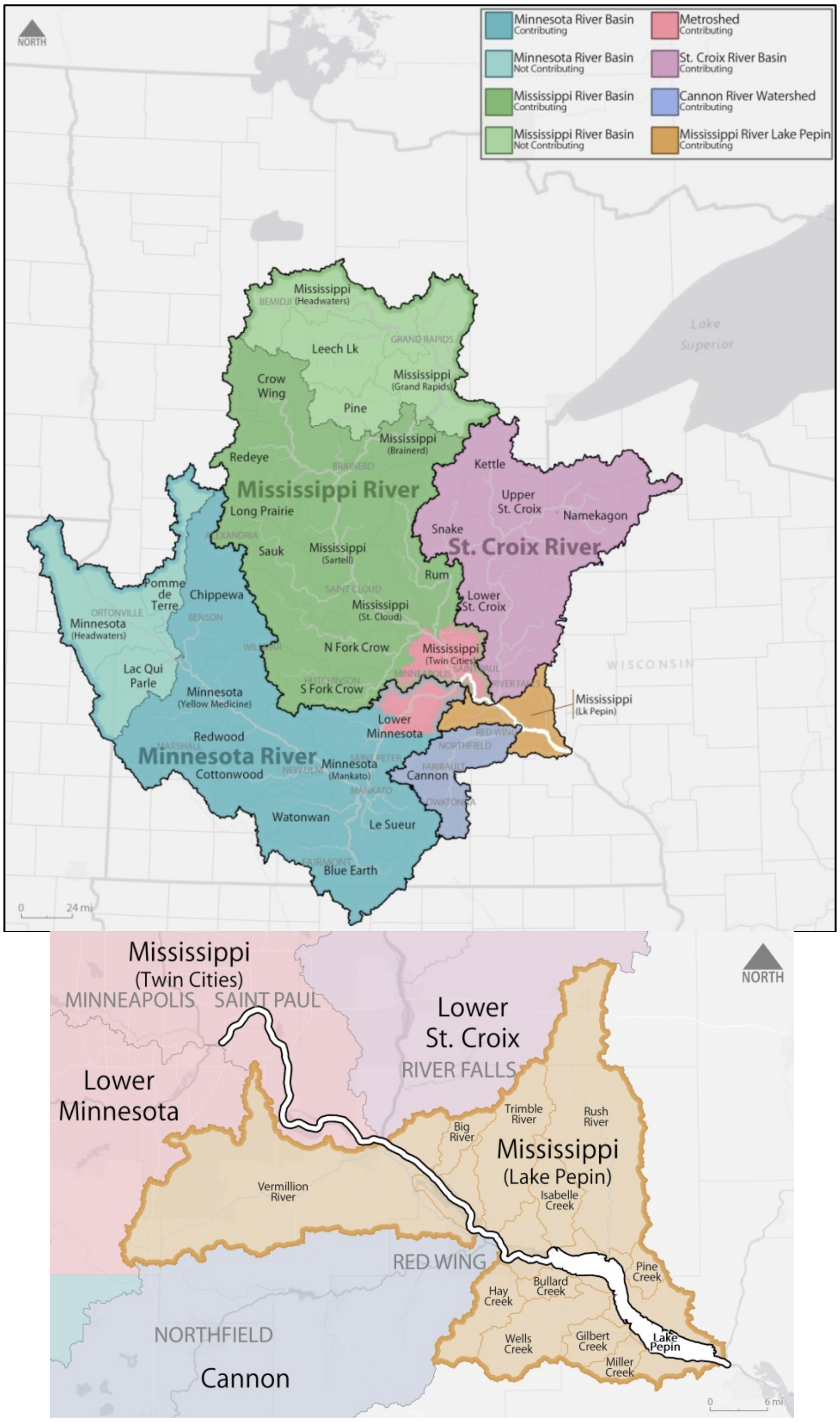
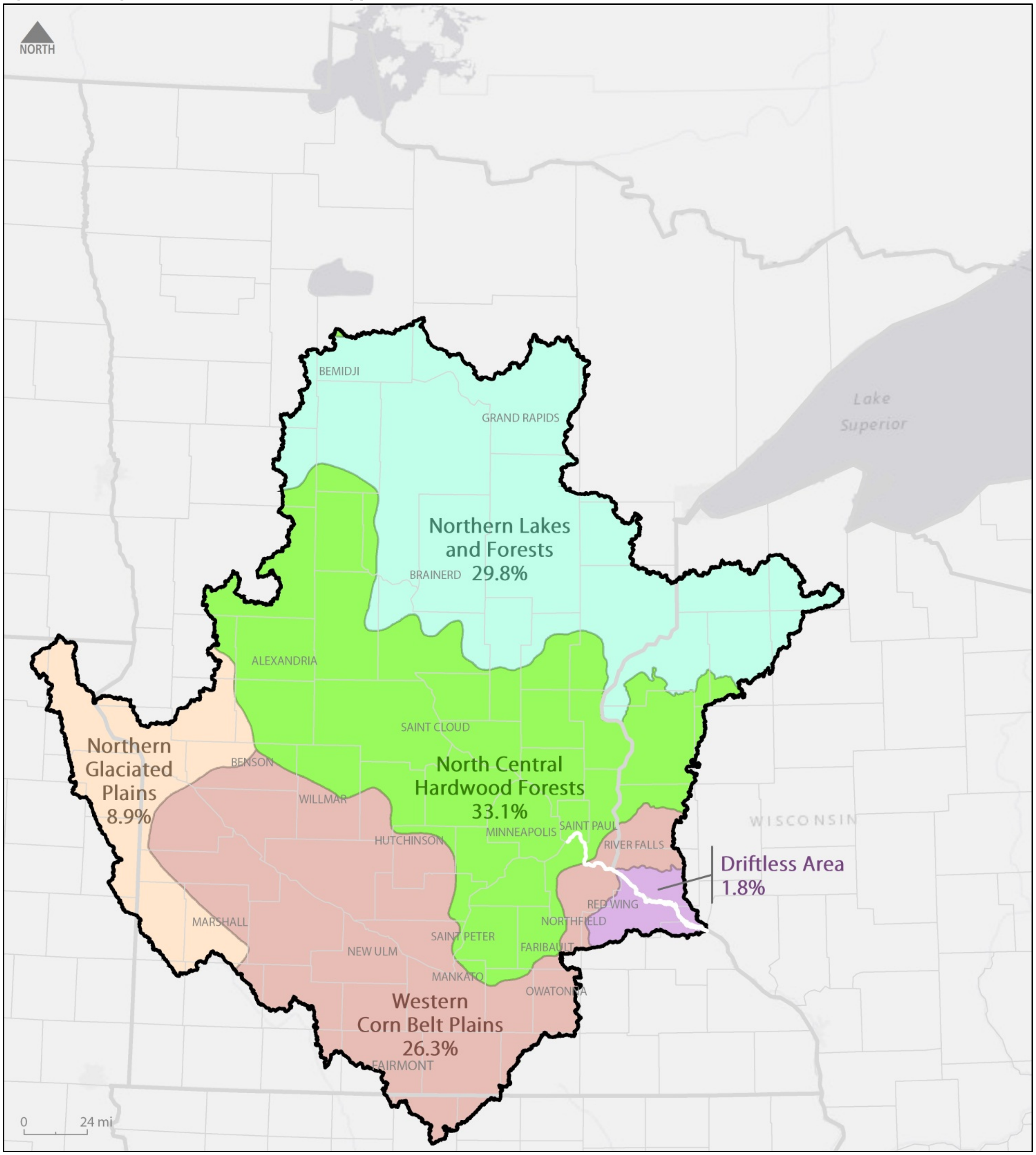
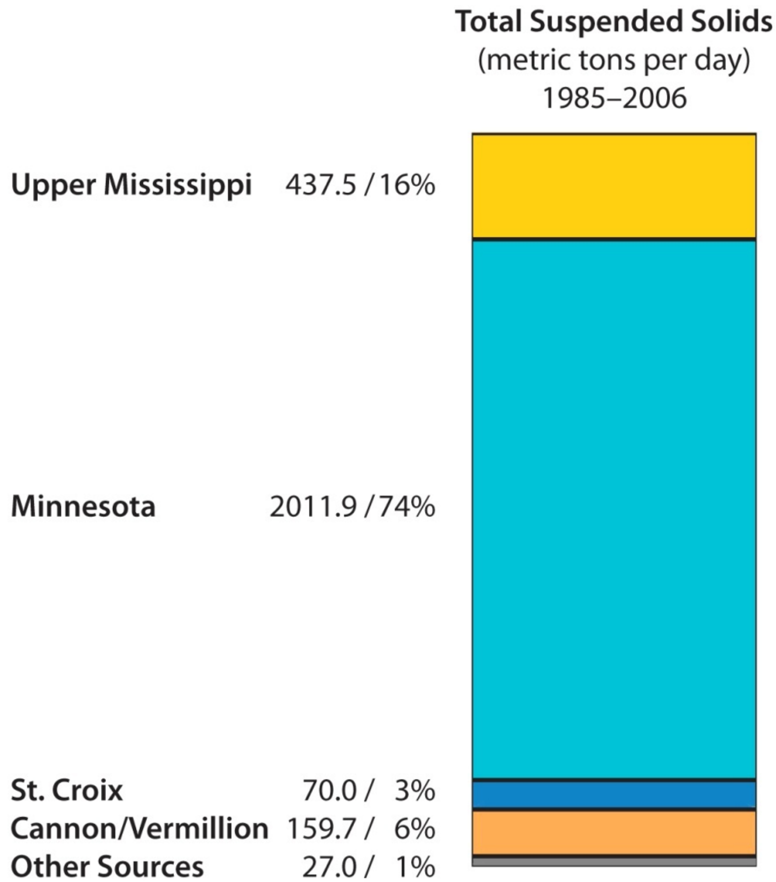


Figure 6: Ecoregions of South Metro Mississippi Watershed



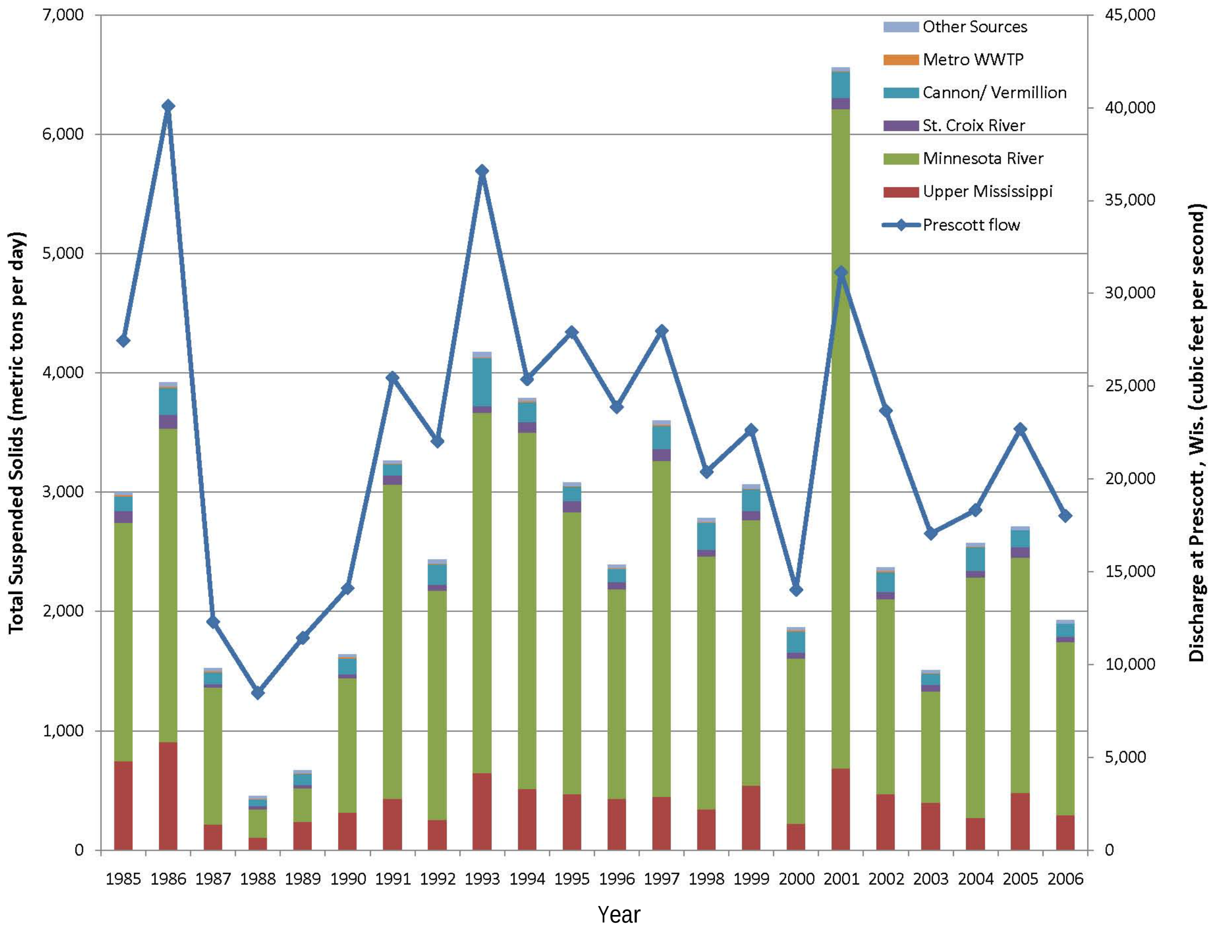
The relative contribution of sediment loads from the various tributaries are shown as a long-term average in Figure 7, and as they vary year to year in Figure 8. The Minnesota River basin dominates with a long-term average contribution of 74%. This basin is also the dominant source every year even though total sediment loads vary in response to short-term precipitation patterns and other factors.

Figure 7: Sources of Sediment by Major River Basin to the South Metro Mississippi River



The majority of sediment – 74% – in the South Metro Mississippi derives from the Minnesota River, based on river monitoring data from 1985 to 2006 that were used in the water quality model for the TMDL.
(MPCA graphic)

Figure 8: River Flow at Lock and Dam 2 and Total Suspended Solids

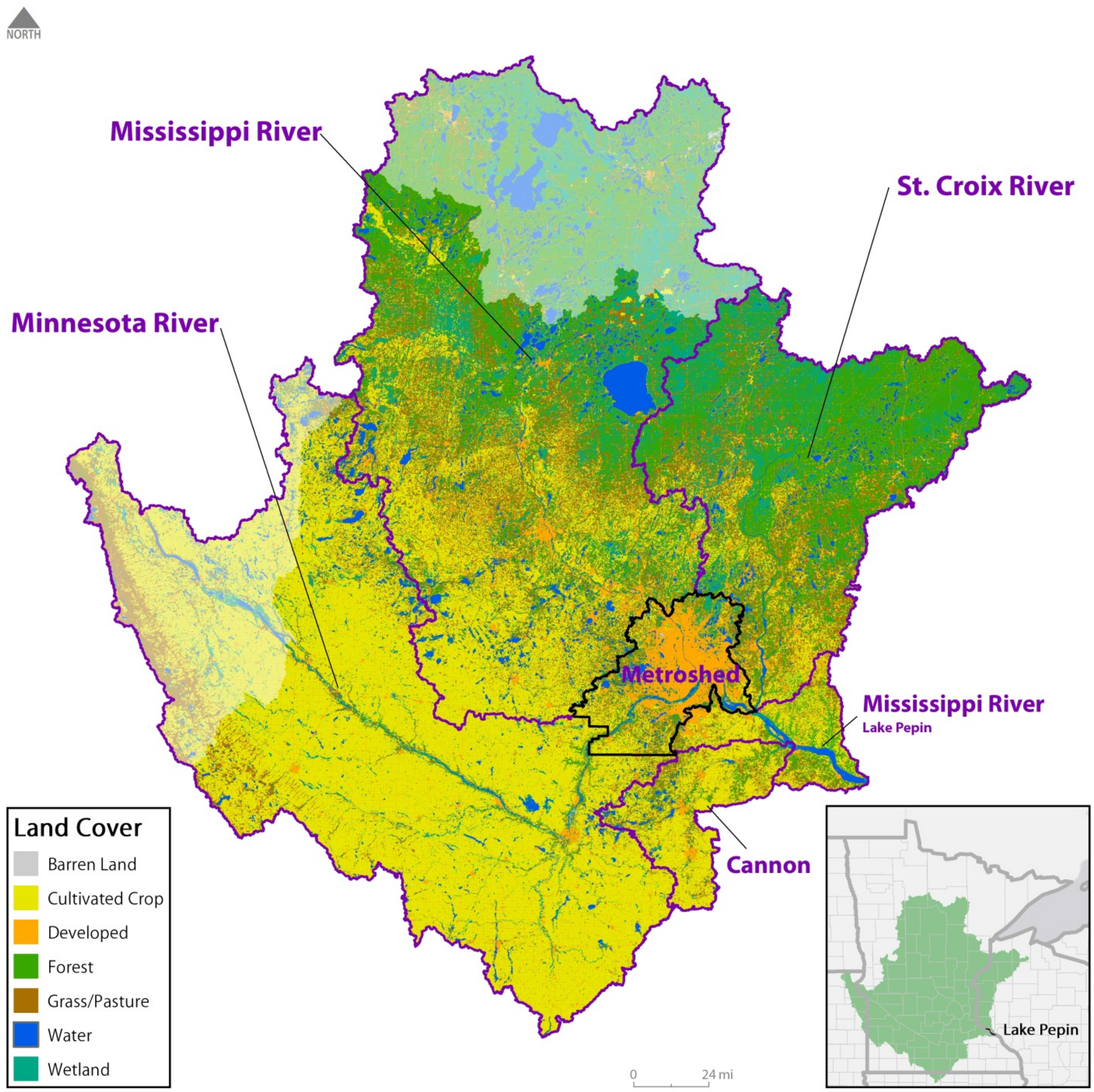


While stream flow varies considerably from year to year, as measured by the river's discharge at Lock and Dam 2 at Prescott, Wisconsin, the majority of sediment consistently derives from the Minnesota River Basin. (Limno-Tech, Inc., 2009)

South Metro Mississippi Watershed

The watershed area of the South Metro Mississippi River totals about 30 million acres, encompassing almost half of the land area of Minnesota and portions of Wisconsin, Iowa and South Dakota (Figure 9). Three major drainage basins account for the vast majority of land area and contribute the bulk of the water flow to the South Metro Mississippi River: the UMR Basin, Minnesota River Basin, and St. Croix River Basin. The three major river basins account for 96% of the flow and 95% of the drainage area measured at Lock and Dam 3 north of Red Wing (Heiskary and Vavricka 1993).

Figure 9: South Metro Mississippi Basin with National Land Cover Data



As the National Land Cover Data (NLCD, 2011) show, cultivated crops cover a significant portion of the South Metro Mississippi Basin. (MPCA graphic)

Not all areas of this large watershed contribute to the problem of turbidity, or excess TSS, found in the South Metro Mississippi River. The Minnesota River basin upstream of Lac Qui Parle and the Upper Mississippi upstream of Brainerd contribute very little suspended sediment to the Minnesota or Mississippi rivers, respectively, owing to the natural settling basins provided by riverine lakes. These areas have been lightly shaded in Figure 9, and the area subtracted from the land use statistics provided below (Table 2).

Within the “contributing” watershed, almost half of the area consists of cultivated cropland, followed by forest and grasslands and pasture in extent of land cover. The forested area is concentrated in the northern portion of the watershed, and cultivated cropland in the southern portion, with grass and pasture broadly intermingled. Developed urban land is largely concentrated in the Twin Cities Metropolitan Area, within the area designated “Metroshed.”

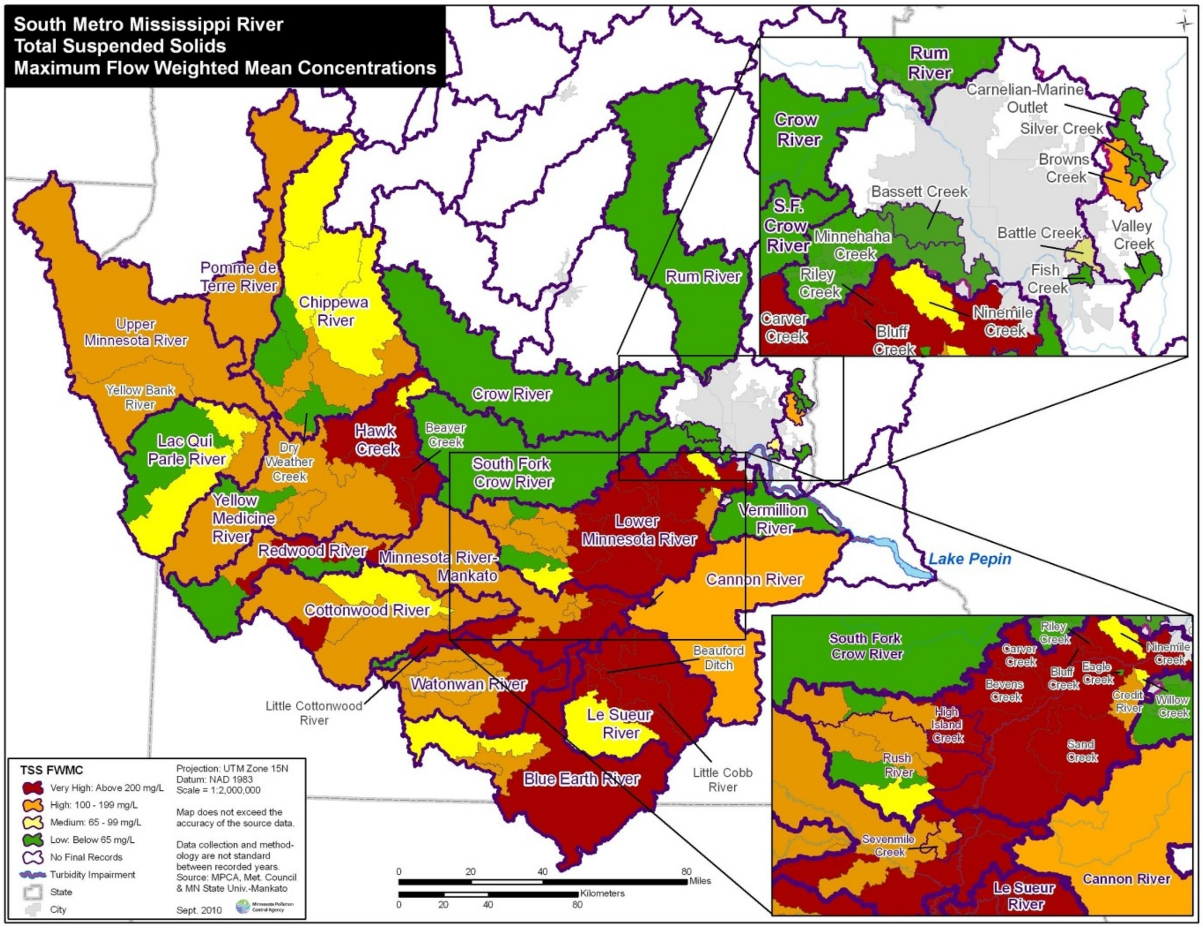
Table 2: Land cover within the South Metro Mississippi TMDL drainage area (“contributing” area only).

Land cover	UMR Basin	St. Croix River Basin	Cannon River Watershed	Mississippi River - Lake Pepin Watershed	Metroshed	Minnesota River Basin	Total
	Acres						
Barren	3,694	1,773	427	1,123	2,557	8,317	17,891
Cultivated Crop	2,601,761	468,961	569,680	311,932	195,335	6,144,507	10,292,176
Developed	527,089	285,571	80,211	82,123	502,042	476,464	1,953,500
Forest	1,789,906	2,106,932	81,720	136,598	108,497	180,895	4,404,548
Grass/Pasture	1,818,420	1,009,451	151,590	119,063	170,315	449,798	3,718,636
Water	551,547	201,298	31,124	43,899	93,959	206,608	1,128,435
Wetland	1,010,773	866,569	26,524	17,017	63,613	302,952	2,287,448
Total	8,303,189	4,940,555	941,275	711,754	1,136,319	7,769,543	23,802,635

In addition to land use and cover, the susceptibility of a landscape to erosion (and thus, delivery of sediment to rivers and streams) is affected by soil type and slope, among other factors. Finer-textured soils have slower infiltration and when rainfall rate exceeds the infiltration rate ponding or runoff occurs, depending on the slope. Within the South Metro Mississippi Watershed the areas with the greatest potential for runoff, based on soil texture and slope, include many clay- and silt-rich glacial till-derived soils of the Minnesota River Basin, the South Fork Crow River Watershed, the Cannon River Watershed and portions of the Mississippi River-Lake Pepin Watershed.

To compare sediment contributions from major sub-watersheds from throughout the South Metro Mississippi watershed, the MPCA retrieved monitoring data from a recent 10-year period, 1999 to 2008, and calculated annual flow-weighted mean concentrations for each sub-watershed. Most watersheds were monitored over a different subset of years, making direct comparison difficult. The MPCA focused on maximum annual mean TSS concentrations as a way of highlighting a watershed’s potential for high TSS. Maximum annual means for each subwatershed are shown in Figure 10, with a color code identifying very high, high, moderate and low concentration categories, and listed in Table 3. Notably, almost all the high and very high TSS watersheds are located in the Minnesota River basin. The Cannon River is the only major exception.

Figure 10: Maximum flow weighted mean concentration of TSS in South Metro Mississippi River Basin



In this map, the MPCA ranked Minnesota watersheds by their potential for high TSS, based on maximum TSS annual flow-weighted mean concentrations recorded during 1999 to 2008. (MPCA graphic)

Table 3: Maximum flow-weighted mean TSS concentrations for watersheds of the South Metro Mississippi River Basin

Watershed/Basin	Max TSS FWMC (mg/L)	Watershed/Basin	Max TSS FWMC (mg/L)
High Island Creek/Minnesota	1,223	Yellow Bank River/Minnesota	154
Le Sueur River/Minnesota	918	Browns Creek/St. Croix	153
Sand Creek/Metroshed	837	Credit River/Metroshed	137
Willow Creek/Metroshed	837	Yellow Medicine River/Minnesota	130
Cottonwood River/Minnesota	804	Nine Mile Creek/Metroshed	96
Rush River/Minnesota	792	Chippewa River/Minnesota	83
Riley Creek/Metroshed	531	Lac Qui Parle River/Minnesota	79
Bluff Creek/Metroshed	472	Battle Creek/Metroshed	66
Bevens Creek/Metroshed	429	Crow River/Upper Miss.	60
Blue Earth River/Minnesota	362	Dry Weather Creek/Minnesota	53
Redwood River/Minnesota	354	South Fork Crow River/Upper Miss.	45
Seven Mile Creek/Minnesota	331	Vermillion River/Lower Miss.	45
Hawk Creek/Minnesota	324	Silver Creek/St. Croix	42
Beaver Creek/Minnesota	300	Bassett Creek/Metroshed	37
Carver Creek/Metroshed	298	Rum River/Upper Miss.	28
Little Cottonwood/Minnesota	265	Fish Creek/Metroshed	20
Beauford Ditch/Minnesota	258	Minnehaha Creek/Metroshed	12
Little Cobb River/Minnesota	239	Valley Creek/St. Croix	11
Watonwan River/Minnesota	208	Eagle Creek/Metroshed	9
Cannon River/Lower Miss.	160	Carnelian-Marine Outlet/St. Croix	3

Source: Minnesota Pollution Control Agency

Upper Mississippi River Basin

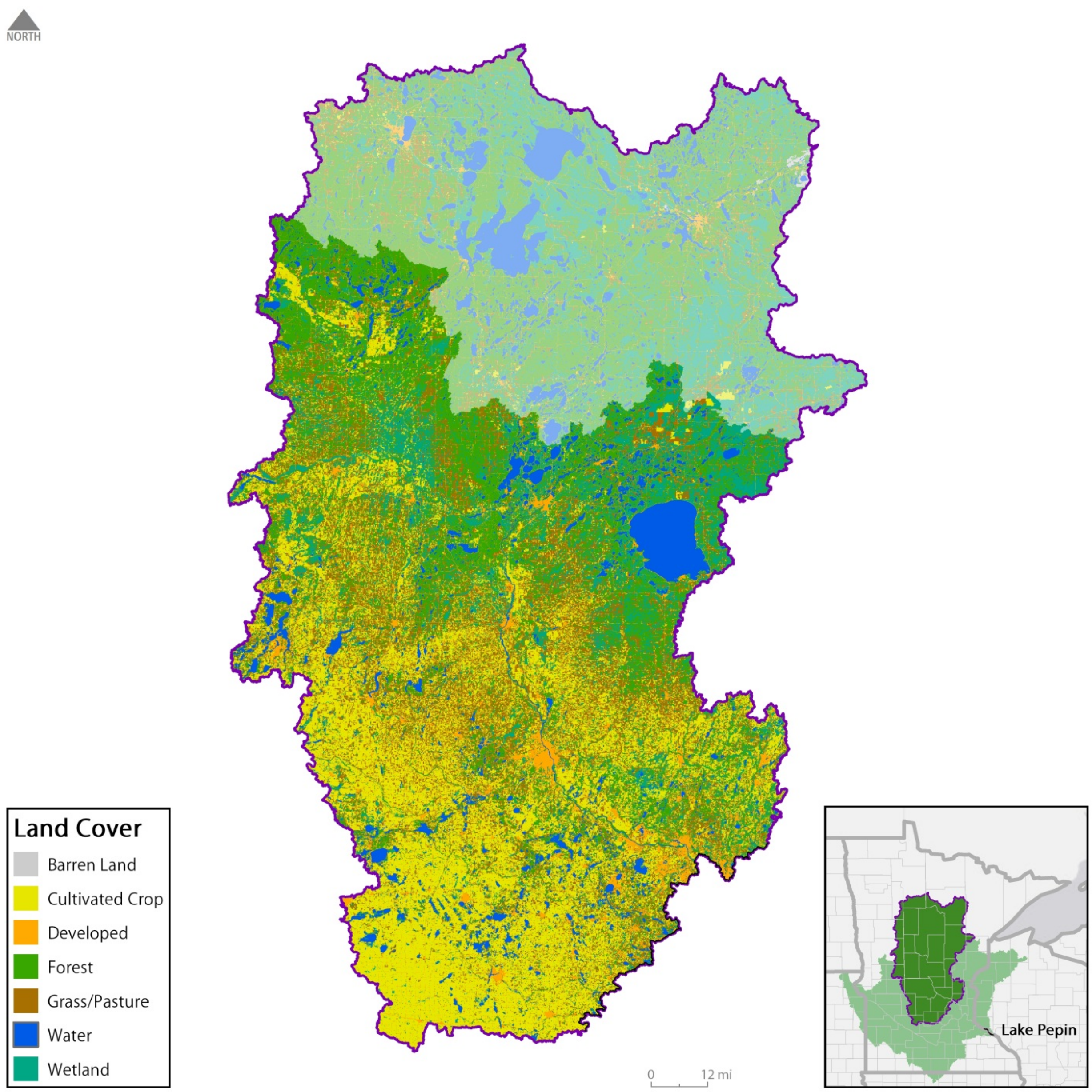
The land area that drains to Mississippi River Mile 871, near the Anoka dam, is referred to as the UMR for purposes of this study (Figure 11). This is the largest of the major drainage basins in the overall South Metro Mississippi River Watershed, accounting for 36% of its area. However, it only contributes 16% of the average annual load of TSS to the South Metro Mississippi, according to water quality monitoring data.

Its relatively low contribution of sediment stems largely from the type of land cover prevalent in the basin. As shown in Figure 6, its uppermost portion is designated the Northern Lakes and Forests Ecoregion. The Mississippi River begins near Lake Itasca and winds its way through many marshes, draining an area thick with bogs and pines, which give its waters a dark tinge from tannic acid. The Mississippi arches north, and then loops back southward, traversing numerous lakes before entering the next ecoregion, the North Central Hardwoods Forest, near Brainerd. North of Brainerd, the Upper Mississippi appears to contribute no suspended solids to the Mississippi, as repeated passage through lakes keeps its waters quite clear of suspended sediments until this point, according to MPCA monitoring.

Thereafter, gradually increasing agricultural and urban land uses in the watershed generate runoff of nutrients and sediment from tributaries such as the Sauk, Crow Wing and Crow River. In the Crow River watershed, scientists estimate that 40% of sediment in the river originates from fields, and the remainder from non-field sources such as stream banks, bluffs and ravines (Schottler et al. 2010).

In its southernmost reach, the Upper Mississippi has season average TSS levels of about 20 to 25 mg/L, well below the standard of 32 mg/L for the South Metro Mississippi. Relatively high concentrations of chlorophyll-a, at about 40 µg/L summer average, make up a small part of average TSS. Though only a small part of the sediment problem, this level of chlorophyll-a represents suspended algae and poses additional water quality issues for the river, including Lake Pepin downstream.

Figure 11: Upper Mississippi Basin with National Land Cover Data



Forests and wetlands cover the northern part of the UMR Basin while cultivated crops cover the southern portion, according to National Land Cover Data (NLCD, 2011). (MPCA graphic)

St. Croix River Basin

The St. Croix River originates in St. Croix Lake near Solon Springs, Wisconsin, from which it flows west and south more than 160 miles until it joins the Mississippi River at Prescott, Wisconsin About 80% (129 miles) of the St. Croix River forms part of the boundary between Wisconsin and Minnesota. The upper 20% of the river is entirely within Wisconsin. The watershed covers about 4.9 million acres and extends from near Mille Lacs Lake in Minnesota on the west to near Clam Lake, Wisconsin, on the east (Figure 12). About 46% of the watershed is located in Minnesota. The St. Croix Basin accounts for about 21% of the contributing area of the South Metro Mississippi River watershed, yet only 2% of the TSS load.

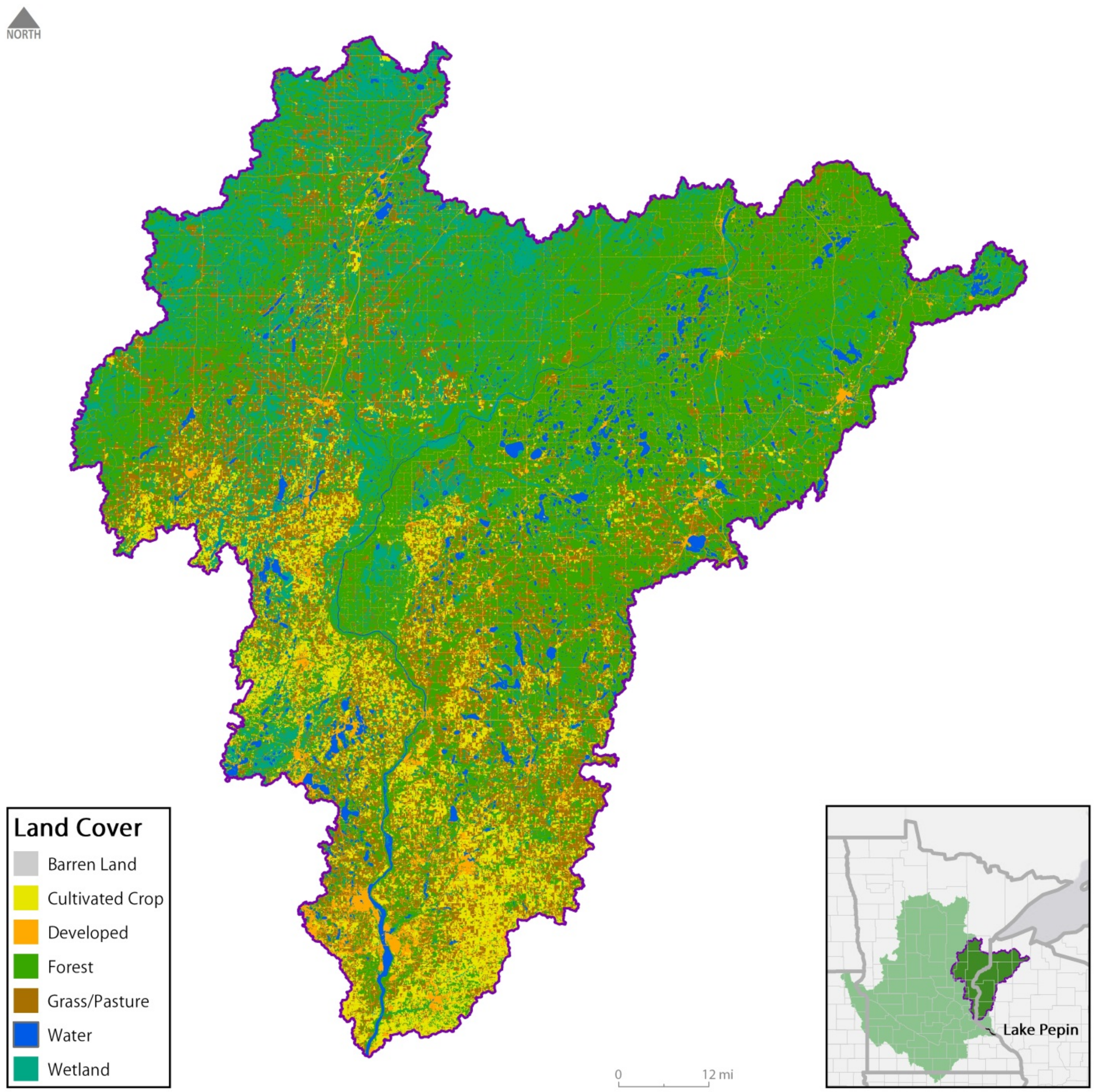
Its meager contribution of sediment to the Mississippi results from a combination of favorable land cover and riverine lakes that act as settling basins. The St. Croix River crosses three major ecoregions, originating in a region of northern spruce and pine and flowing southwesterly through hardwood forests and prairie, eventually joining the Mississippi River. The river supports 95 fish species, beaver, muskrat, and otters. Eagles, osprey, and ducks nest along the river. Insects, 41 species of fresh water mussels, and hundreds of other species of plants and animals make the St. Croix their home.

During the 1950s and '60s, a burgeoning population from the Twin Cities continued to push for development and increased recreational usage of the St. Croix River. Worried that continued urban stressors would put the natural resources of the watershed at risk, concerned citizens and politicians pushed for the St. Croix to be included in the original National Wild and Scenic Rivers Act. The St. Croix National Scenic Riverway, which includes the Namekagon River in Wisconsin and the upper portion of the St, Croix, was established as part of that original Act in 1968. The Lower St. Croix National Scenic Riverway was added in 1972. This park is one of the most biologically diverse national parks of the Midwest.

The states of Minnesota and Wisconsin both recognize the St. Croix is an exceptional resource, deserving of protection. Minnesota has designated the entire St. Croix and its Kettle River tributary as Outstanding Resource Value Waters. Wisconsin has designated portions of the St. Croix as Exceptional Resource Water and the remainder as an Outstanding Resource Water. Wisconsin has also declared its tributary, the Namekagon River, an Outstanding Resource Water.

There are 18 major tributaries that flow into the main stem of the St. Croix River as well as five tributaries that flow directly into Lake St. Croix. The riverine lake consists of four successive pools (north to south including Bayport, Troy Beach, Black Bass and Kinnickinnic) and discharges clear water to the Mississippi River at Prescott, Wisconsin. The long-term average annual TSS concentration is merely 4.5 mg/L at the mouth of the St. Croix River. The dilution effect of the St. Croix River results in TSS concentrations dipping from 54 mg/L at Lock and Dam 2, near Hastings, to 47 mg/L at Lock and Dam 3, near Red Wing.

Figure 12: St. Croix River Basin with National Land Cover Data



Favorable land cover, as shown by National Land Cover Data (NLCD, 2011), is one reason the St. Croix River Basin contributes so little TSS to the South Metro Mississippi. (MPCA graphic)

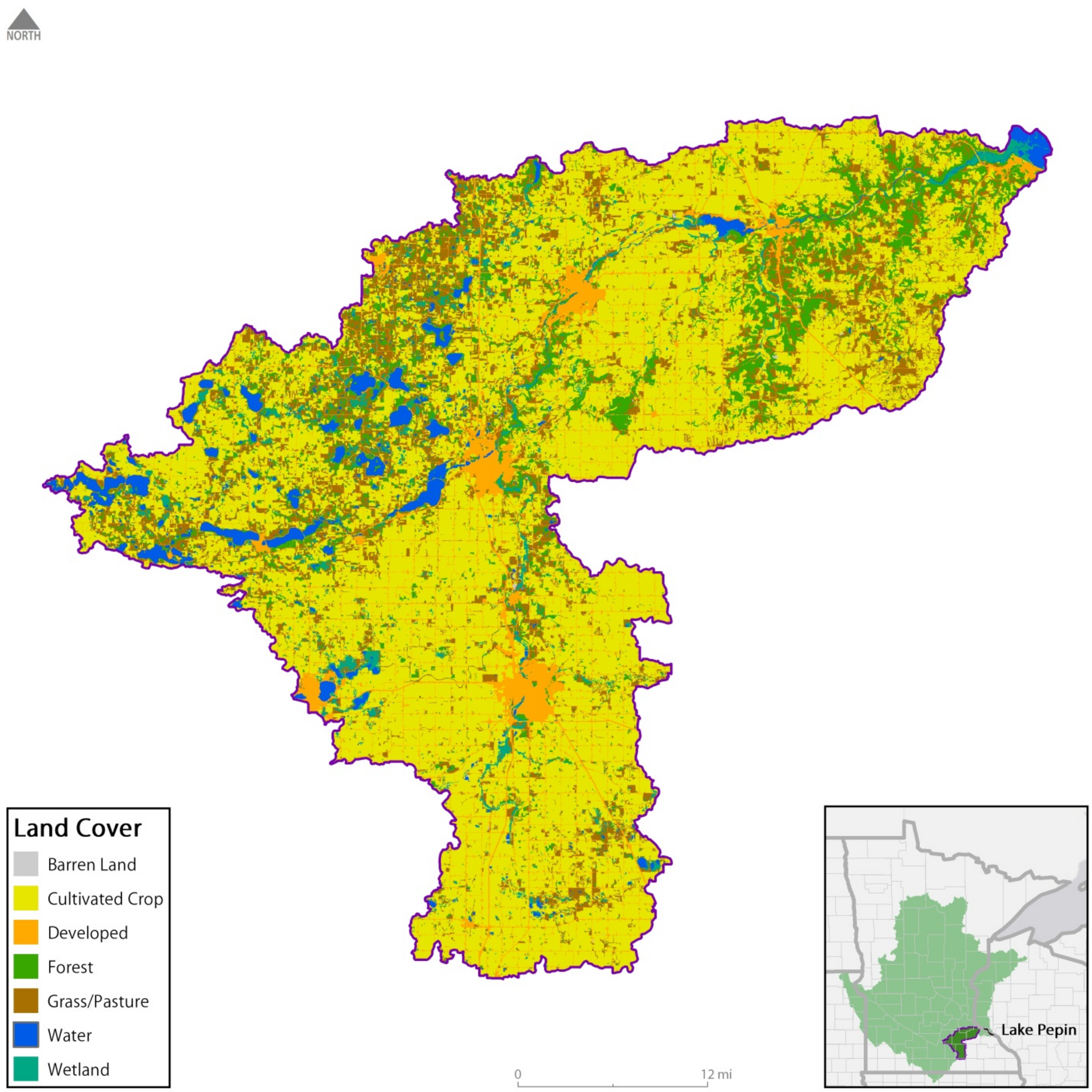
Cannon River Watershed

The Cannon River Watershed includes about 941,000 acres of primarily agricultural landscape covering portions of eight counties in southeast and south-central Minnesota (Figure 13). Because it is a relatively large watershed, the following subwatershed lobes are often referenced:

- Straight River Watershed (the largest tributary to the Cannon River);
- Upper Cannon River Watershed (headwaters and lakes region);
- Middle Cannon River Watershed; and
- Lower Cannon River Watershed (includes Cannon River from Byllesby Reservoir Dam to its mouth at the Mississippi River in Red Wing).

The long-term TSS concentration at the mouth of the Cannon River is 70 mg/L. The Cannon River accounts for about 4% of the contributing area of the greater South Metro Mississippi watershed, and about 6% of the average annual load of TSS. The major sediment producing areas are the Straight River sub-watershed, a level, rich farming area that reaches south, and several hilly tributaries that form the Lower Cannon watershed between Lake Byllesby and the mouth of the Cannon in Upper Pool 4.

Figure 13: Cannon River Basin with National Land Cover Data

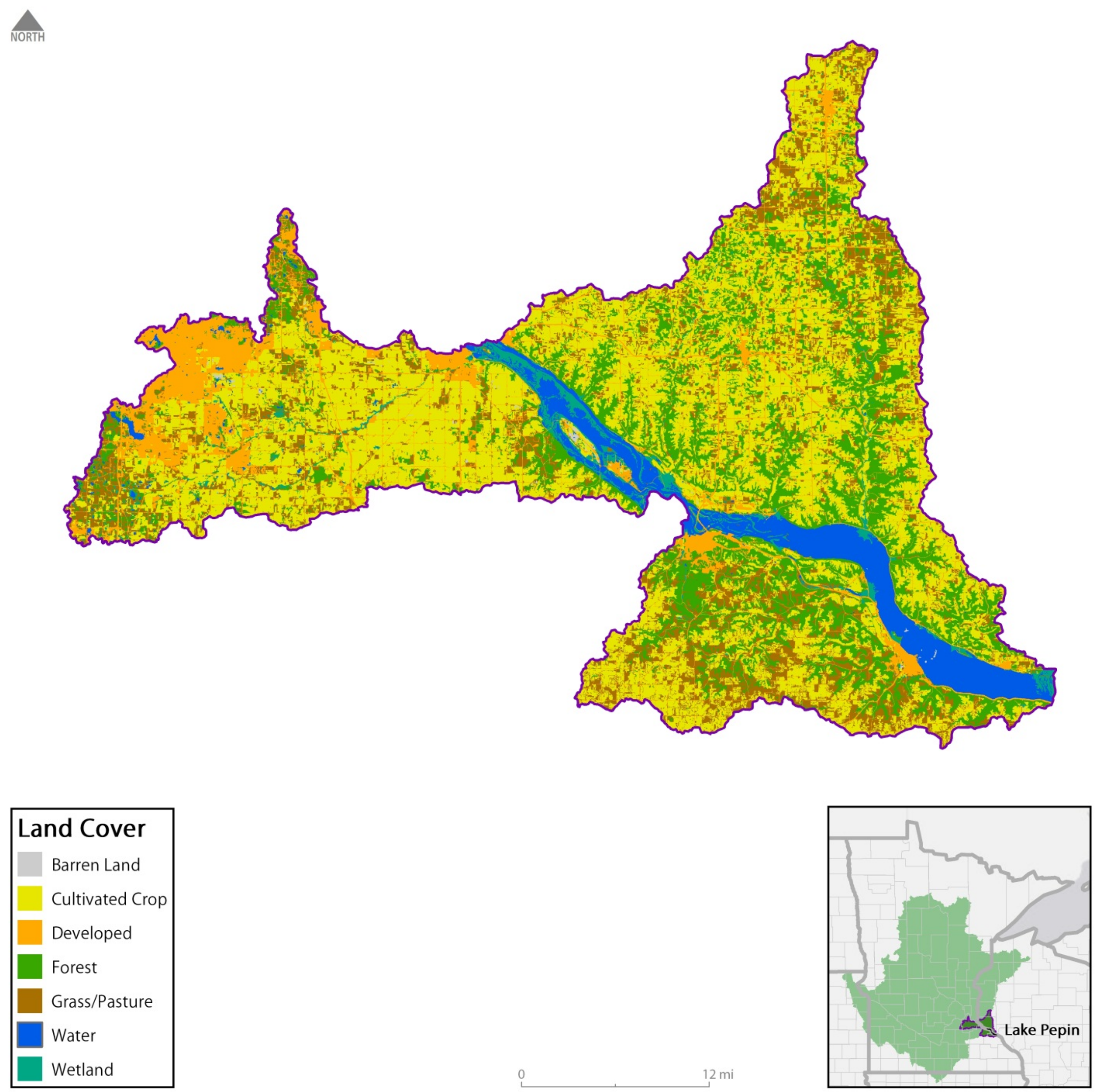


The Cannon River Basin includes a high percentage of cultivated crops, as shown by National Land Cover Data (NLCD, 2011). (MPCA graphic)

Mississippi River – Lake Pepin Watershed

Small direct tributaries to Lake Pepin, Upper Pool 4, and Lower Pool 3 comprise an area somewhat smaller than the Cannon River watershed. Monitoring data for these small tributaries are sparse, making estimates of the total TSS load difficult. The majority of land use is cultivated cropland, followed by forest, hay and grassland, with developed urban land comprising about a tenth of the land area (Figure 14). The area of greatest potential soil erosion from upland and channel sources is the steep terrain within a few miles of the Mississippi River. Further up in the watersheds, the terrain becomes more level, and land cover switches from a preponderance of forest to cropland. This traditionally dairy region has experienced a steady shift of land use from hay and pasture to increased row cropping, with only a small portion of row crops on the Minnesota side protected with adequate crop residue cover, based on county transect surveys. Ravine erosion is common in the steep karst topography sloping toward the Mississippi River corridor. Generally, tributaries from Wisconsin appear to run clearer than those on the Minnesota side of the Mississippi. As the Mississippi River flows through this region, suspended solids begin to settle out in Upper Lake Pepin, with progressively smaller particles settling out as the river flows south. The long-term TSS concentration below Lake Pepin is 12 mg/L.

Figure 14: Mississippi River – Lake Pepin Watershed with National Land Cover Data



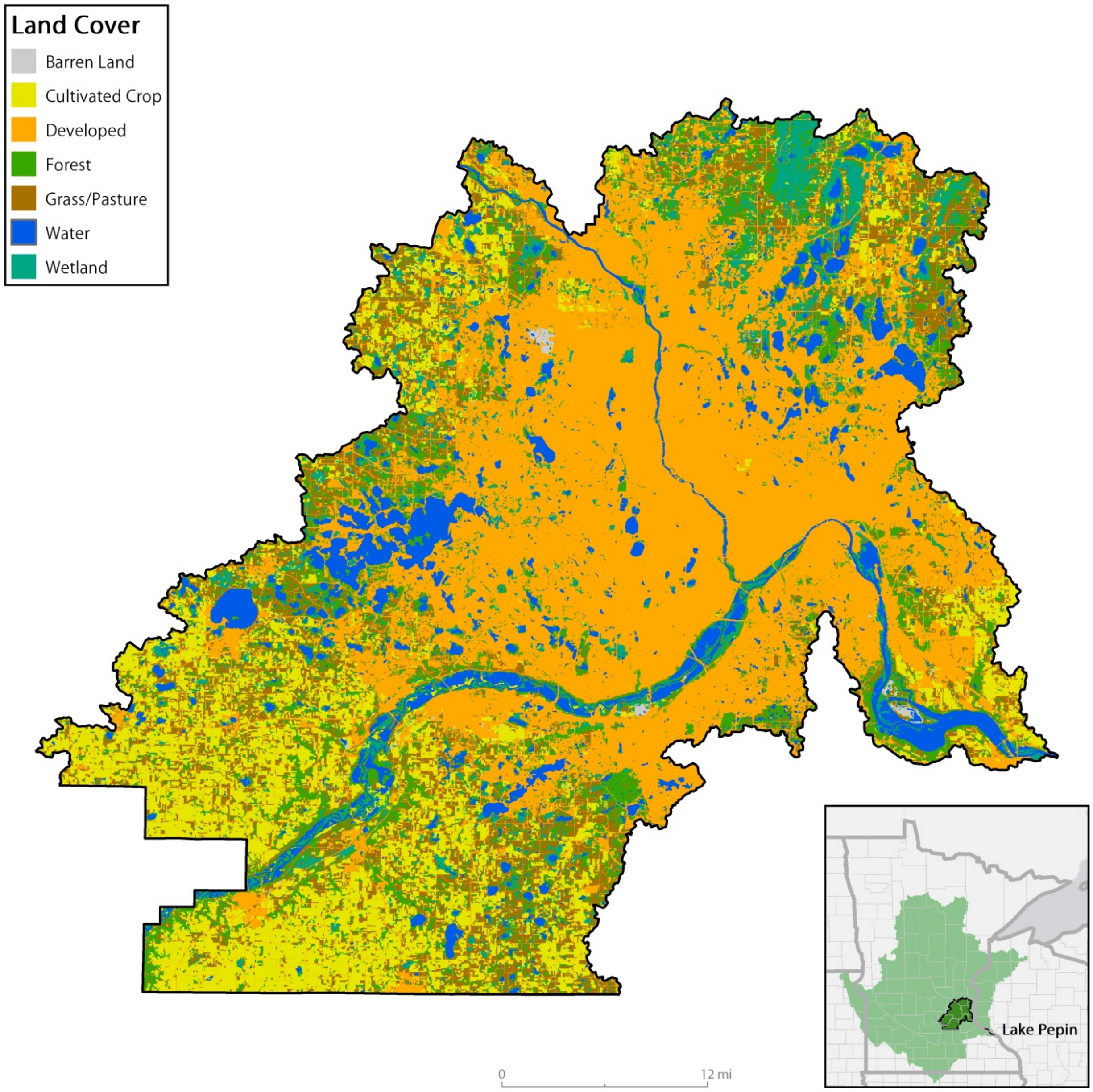
The majority of land in the Lake Pepin Basin is cultivated cropland, as depicted by National Land Cover Data (NLCD, 2011). (MPCA graphic)

Metroshed

Not all of the South Metro Mississippi Watershed is included within major tributary basins, especially where the major tributaries flow into this river segment in the Twin Cities metropolitan area. For purposes of this TMDL, the MPCA defines an area called the Metroshed to account for the area that lies outside major tributary basins in the metro area. This is where the vast majority of urban land use is concentrated. The area follows the political contours of the seven-county metropolitan region, with certain boundaries adjusted to coincide with watershed boundaries where practical. Land use is fairly evenly divided between developed urban land on the one hand, and cultivated cropland plus grassland on the other. Density of impervious surface coverage is at its maximum in the downtown areas of Minneapolis and St. Paul, becomes less dense in residential areas, and still less in its outer reaches.

Concentrations of TSS show a gradual decline as the Minnesota and Mississippi Rivers traverse the Metroshed. For example, the long-term average TSS concentration of the Minnesota River at Jordan is 141 mg/L, compared to 112 mg/L 36 miles downstream at Fort Snelling. Likewise, the long-term TSS concentration is 24 mg/L in the Mississippi River at Anoka, compared to 20 mg/L 24 miles downstream at Lock and Dam 1, in the heart of the Twin Cities metropolitan area. The TSS concentration in the South Metro Mississippi increases to 64 mg/L at River Mile 839, five miles downstream of the Minnesota River, and then progressively declines to 60 mg/L (River Mile 831), and 52 mg/L (River Mile 827) as it flows through St. Paul and the southern suburbs. The TSS concentration increases slightly to 55 mg/L at Lock and Dam 2, probably reflecting periodic resuspension of bed sediments in lower Pool 2. These averages are based on Metropolitan Council monitoring data collected from 1993 to 2009.

Figure 15: Metroshed with National Land Cover Data



Being the largest metropolitan area in Minnesota, the Metroshed has a high percentage of developed acres, as shown by National Land Cover Data (NLCD, 2011). (MPCA graphic)

Minnesota River Basin

The Minnesota River flows southeast from its source at Big Stone Lake on the South Dakota border to Mankato, then northeast to join the Mississippi River at Fort Snelling, traversing a total of 335 miles. Its drainage basin (excluding its Metroshed portion) covers about 10.3 million acres, with 7.8 million acres counted as contributing to the TSS impairment. The contributing area accounts for about 34% of the total watershed of the South Metro Mississippi River. However, this area contributes on average 74% of the TSS load to the impaired reach, making it by far the greatest single source of TSS. Thirteen major watersheds in Minnesota drain into the basin. The Lac qui Parle, Upper Minnesota and Pomme de Terre contribute little TSS as described earlier.

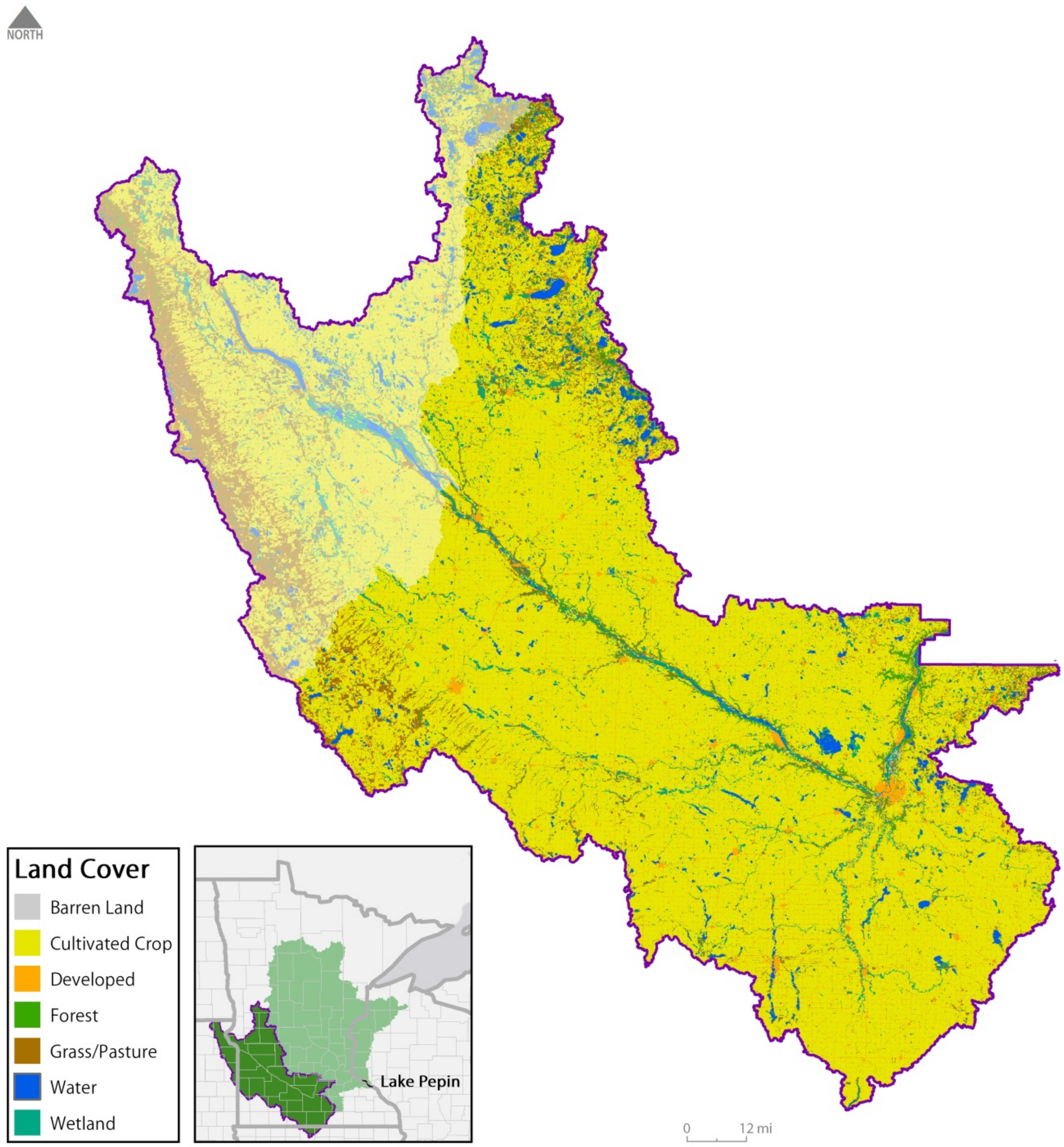
Land use, runoff and water quality change together as the river flows from west to east (Figure 16). Throughout all but the easternmost part of the basin, cultivated cropland dominates the landscape, accounting for an average of 80% of land use basin-wide.

In the lower precipitation area of the western basin, land use includes corn production, soybean production, wheat production and grazing of beef cattle. Runoff rates are relatively low, along with average TSS concentrations. Tributaries such as the Pomme de Terre and Lac Qui Parle continue to support fairly healthy beds of mussels, a sign of relatively good water quality.

As the river enters south-central Minnesota, higher average precipitation and rich, fine-textured soils favor the corn-soybean rotation, with an area of sugar beet production in the Hawk Creek watershed. Land drainage through surface ditches and pattern tiling is more intense here, and suspended sediment concentrations of the main stem grow progressively higher as the river approaches the confluence with the Blue Earth River watershed. Here, TSS concentrations jump considerably in response to the extremely high sediment loads dumped into the river from the Le Sueur and Blue Earth Rivers, which discharge through a common outlet at Mankato.

From Mankato to St. Peter, TSS concentrations tend to remain high, fed by sediment-rich water discharged from small tributaries that comprise the Middle Minnesota watershed. From St. Peter or Henderson to Jordan, TSS concentrations and loads often dip – likely a result of floodplain deposition (settling out of the water column), increased base flow from groundwater, or both (MPCA 1997). As the Minnesota River passes through the progressively more urbanized region between Jordan and Fort Snelling, a 39-mile reach, TSS concentrations and loads again tend to dip by about 20% on average, from 141 mg/L at Jordan to 112 mg/L at Fort Snelling. This is based on Metropolitan Council Environmental Services monitoring data from 1993 to 2006. This trend has been attributed to a combination of floodplain deposition and dilution by urban stormwater runoff (Gupta et al. 2011, page 37). While this lowered TSS concentration ultimately benefits Lake Pepin the depositing sediment load in this lower portion of the Minnesota River is a significant concern.

Figure 16: Minnesota River Basin with National Land Cover Data

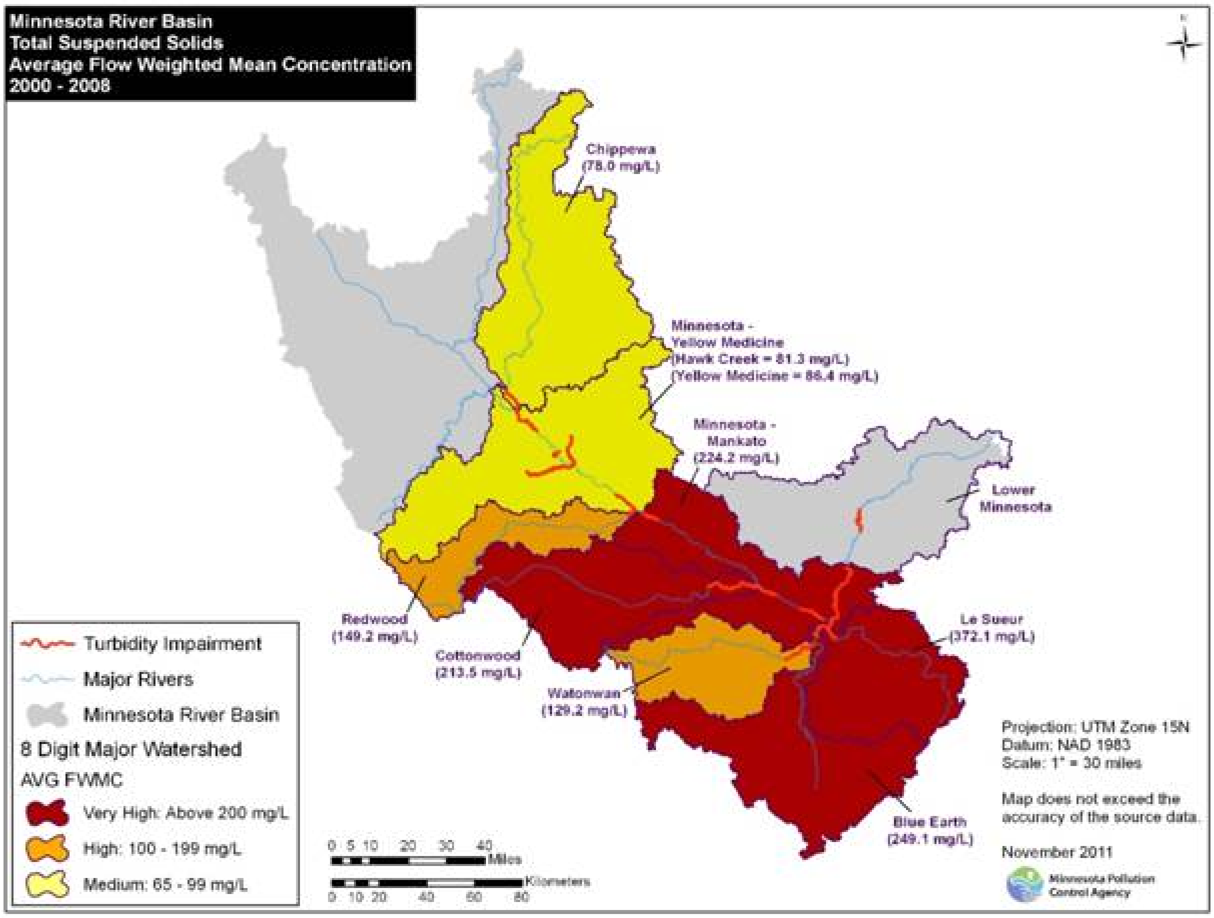


Cultivated cropland dominates the Minnesota River Basin, except in the easternmost part, according to National Land Cover Data (NLCD, 2011). (MPCA graphic)

As Figure 17 below shows, the highest contributing watersheds extend from the Blue Earth River watershed through the corridor of the Minnesota River, including direct tributaries and the lower Le Sueur River Watershed. Research has confirmed that land areas downstream of the nick points of tributaries flowing into the Minnesota River Valley are especially susceptible to erosion from stream bluffs, banks and ravines. (Nick points are where sudden breaks of slope occur in the long profile of a river. They indicate the river is forming a new, lower profile cutting first from the mouth of the river and working upstream as headward erosion takes place.)

Figure 17 below shows *average* flow-weighted mean-TSS concentrations while Figure 10 earlier shows *maximum* flow-weighted mean-TSS concentrations. Although slightly different, both figures show the high sediment contributions of the eastern side of the Minnesota River Basin.

Figure 17: Minnesota River Basin TSS Average Flow Weighted Mean Concentration



As shown by the flow-weighted average TSS concentrations, watersheds in the central Minnesota River Basin are top contributors of sediment to the Minnesota and Mississippi rivers. (MPCA graphic)

3.1.1 Urban and rural sources

Compared to rural areas, urban land uses typically have more persistent vegetative cover on pervious surfaces, such as lawns and parks, which helps reduce sediment loading. During construction, however, per-acre sediment losses can exceed that of row crop agriculture. Also, increases in the amount of impervious surface through the construction of roads, parking lots, and buildings significantly alter site hydrology by decreasing infiltration, increasing surface runoff, and decreasing travel times such that peak and total flow volumes substantially increase. The altered hydrology can also impact stream morphology, leading to unstable streams, bank and channel erosion, siltation, and habitat modification. Urbanization also leads to a loss of riparian corridor vegetation, which can increase stream temperatures, reduce filtering capacity and destabilize stream banks.

The South Metro Mississippi watershed is predominantly rural with a low percentage of acres in impervious surfaces and municipal areas, as outlined in Table 4 below. The contributing area of the South Metro Mississippi watershed in Minnesota includes 222 Municipal Separate Storm Sewer Systems

(MS4), where the National Pollutant Discharge Elimination System (NPDES) permit process regulates urban runoff. The MS4 area represents the total developed area within regulated MS4 boundaries, based on calculations using 2001 National Land Cover Data (NLCD). (Note that Table 4 is based on an estimate used for the original draft of this TMDL using data for 217 MS4s. The table is intended primarily for illustrative purposes to show the approximate amount of impervious surface and is not used for calculating allocations.)

Table 4: Impervious surfaces and municipal areas in the South Metro Mississippi Watershed

Area	Acres	Percentage of whole watershed
South Metro Mississippi Watershed in Minnesota	26,036,433	100.0%
Total Impervious Surfaces	624,490	2.4%
MS4 Impervious Surfaces	224,371	0.9%
Total MS4 Area (impervious and pervious areas)	1,665,254	6.4%
Total Municipal Areas	1,806,146	6.9%

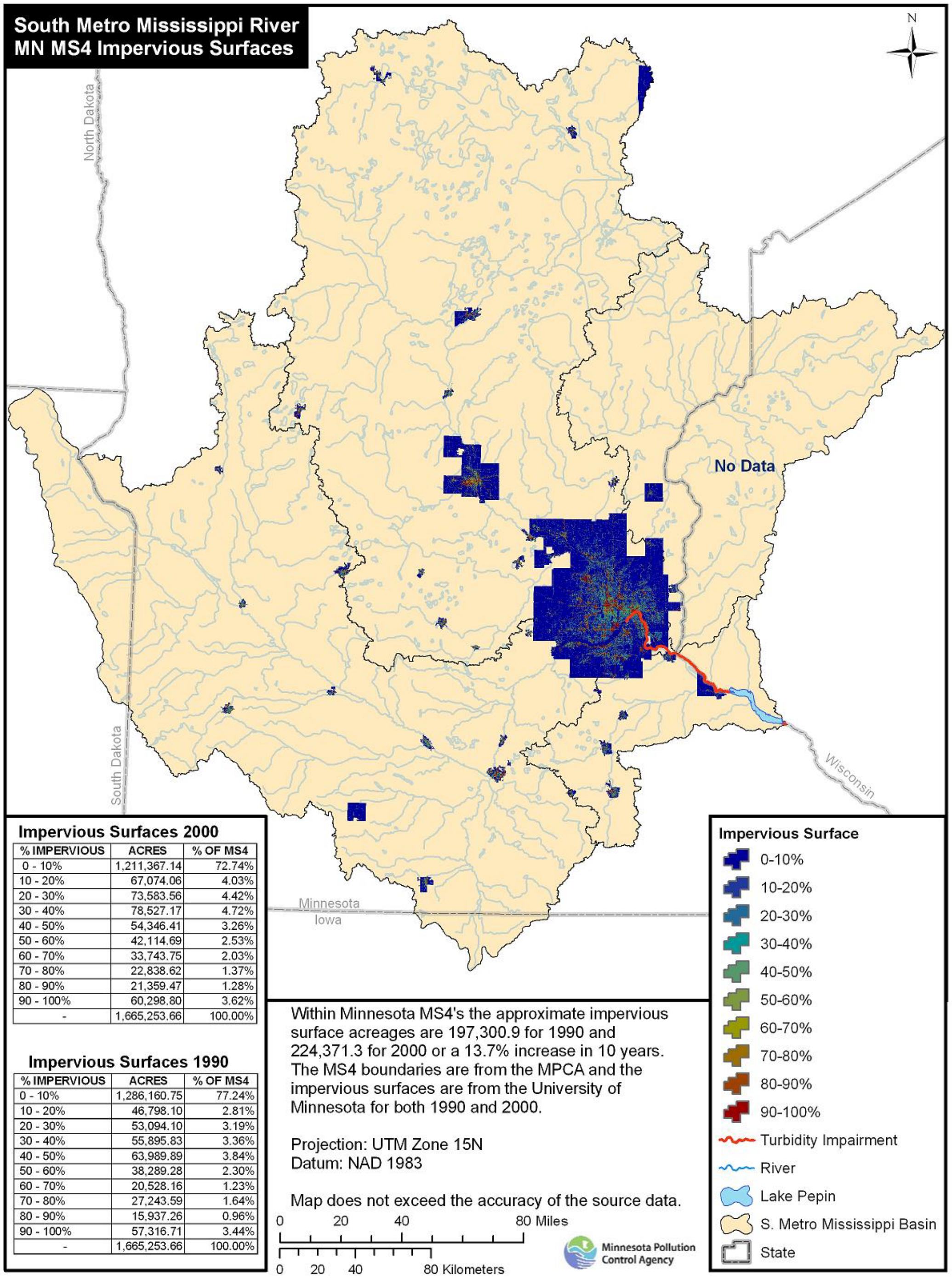
Source: MPCA and University of Minnesota

Figure 18 shows the impervious surfaces within the MS4 areas. Some areas of the watershed are experiencing increases in developed areas.

The MPCA administers programs for three types of stormwater pollution: Municipal, Construction, and Industrial:

- *Municipal* – By volume, municipal runoff is by far the major source of permitted stormwater runoff. Urban and suburban stormwater runoff, both from developing and built-out areas, carries sediment loads that can match or exceed agricultural runoff. This runoff also contributes to channel instability and streambank erosion (Barr 2004). Pollutants from stormwater runoff can include pesticides, fertilizer, oil, metals, pathogens, salt, sediment, litter and other debris (MPCA webpage 2006).
- *Construction* – The EPA estimates a soil loss of 20 to 150 tons per acre per year from stormwater runoff at construction sites (MPCA Stormwater webpage, 2006). Construction sites vary widely in the number of acres they disturb.
- *Industrial* – Industrial sites may contribute to stormwater pollution when the water comes in contact with pollutants such as toxic metals, oil, grease, de-icing salts, and other chemicals from rooftops, roads, parking lots, and from activities such as storage and material handling.

Figure 18: South Metro Mississippi River MS4 Impervious Surfaces



Impervious Surfaces 2000

% IMPERVIOUS	ACRES	% OF MS4
0 - 10%	1,211,367.14	72.74%
10 - 20%	67,074.06	4.03%
20 - 30%	73,583.56	4.42%
30 - 40%	78,527.17	4.72%
40 - 50%	54,346.41	3.26%
50 - 60%	42,114.69	2.53%
60 - 70%	33,743.75	2.03%
70 - 80%	22,838.62	1.37%
80 - 90%	21,359.47	1.28%
90 - 100%	60,298.80	3.62%
-	1,665,253.66	100.00%

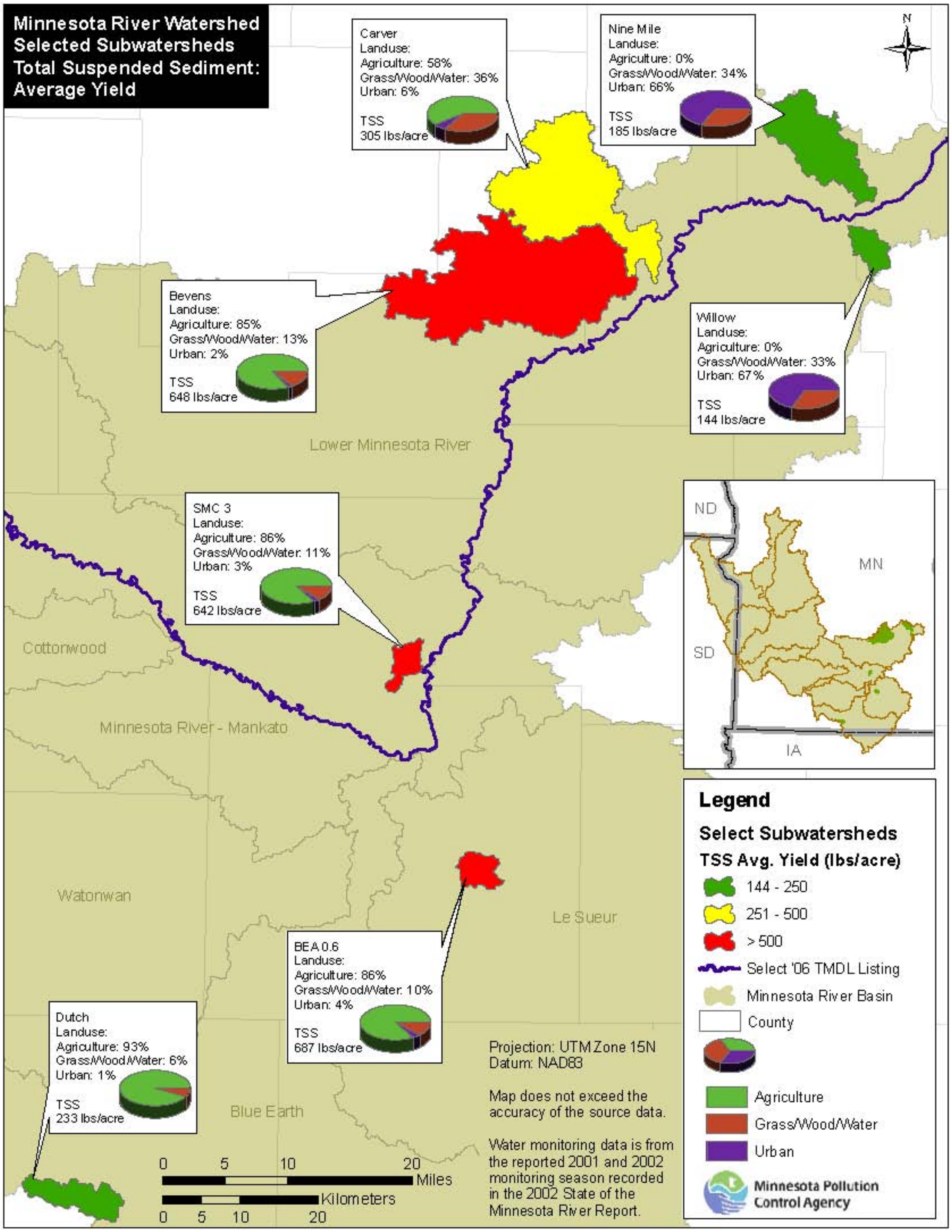
Impervious Surfaces 1990

% IMPERVIOUS	ACRES	% OF MS4
0 - 10%	1,286,160.75	77.24%
10 - 20%	46,798.10	2.81%
20 - 30%	53,094.10	3.19%
30 - 40%	55,895.83	3.36%
40 - 50%	63,989.89	3.84%
50 - 60%	38,289.28	2.30%
60 - 70%	20,528.16	1.23%
70 - 80%	27,243.59	1.64%
80 - 90%	15,937.26	0.96%
90 - 100%	57,316.71	3.44%
-	1,665,253.66	100.00%

While municipalities in the watershed include areas of concentrated impervious surfaces, the vast majority of the South Metro Mississippi remains rural. (MPCA graphic)

While urban stormwater is a source of sediment in streams and rivers in the South Metro Mississippi watershed, the majority of the watershed is rural and the majority of sediment derives from rural areas. This conclusion has been confirmed by water quality monitoring by several state and federal agencies over many years. For example, mouth-of-stream monitoring data in the relatively wet years 2001 and 2002 show that agricultural areas tend to yield more sediment per acre than urban areas in the southeastern Minnesota River basin (Figure 19). "Yield" refers to the amount per acre of sediment eroded from the land surface by runoff and delivered to a stream system. In subwatersheds with a majority of land in agricultural use, the TSS average yield ranged from 233 to 687 pounds per acre a year, compared to 144 to 185 pounds per acre for subwatersheds with a majority of land in urban use. Settling out of larger particles in the receiving stream likely accounts for the slightly higher estimate of urban runoff generated by models, compared to mouth-of-stream monitoring data. In addition, model predictions are for runoff from developed urban land, whereas most municipalities include a large area of undeveloped land as well.

Figure 19: Average Yield of TSS in Minnesota River Watershed Selected Subwatersheds



This figure shows the average annual TSS loads per acre (yield) to the Minnesota River system from major tributaries in the eastern part of the basin. Subwatersheds with a majority of land in agricultural use had the highest yields or amounts of sediment per acre eroded by runoff. (MPCA graphic)

3.1.2 Sediment sources by landscape feature

Lake Pepin serves as a depositional basin where sediments from the South Metro Mississippi River watershed have accumulated over many centuries. Scientists have analyzed sediment cores from Lake Pepin to estimate historical rates of sediment deposition, as well as recent changes in sources of sediment. Sediment dating techniques show that sediment accumulation rates have increased by about a factor of 10 since European settlement (Figure 2). An estimated 80% of the sediment load is from the Minnesota River and several small Mississippi River tributaries. Recent estimates of sediment loads based on Lake Pepin core analysis correspond closely to monitored Mississippi River data at Lock and Dam 3 north of Red Wing, Minn. (Engstrom et al. 2009). That is, recent monitored sediment loads measured at Lock and Dam 3, just upstream of Lake Pepin, corresponded very closely to sediment load estimates based on interpretation of Lake Pepin sediment cores taken in 1996 and 2008.

The St. Croix Watershed Research Station of the Science Museum of Minnesota has conducted several studies to determine what percentage of Lake Pepin sediment derives from erosion of agricultural fields, how much is from non-field sources, and how these proportions have changed over time. The studies used two radioisotopes to fingerprint and apportion sources of sediment in Lake Pepin and its tributary watersheds. These studies have found that, at present, an estimated 35% of the total sediment load to Lake Pepin, as measured by sediment core samples, originates from farm field erosion (Schottler et al. 2010). This proportion has shifted from an estimated 65% field/35% non-field in 1940, in response to increased erosion from non-field sources accompanied by stabilized erosion from fields, a likely result of conservation practices applied to fields as the total acreage under row crops expanded. The proportions vary greatly among watersheds depending on topography, stream gradient, land use and precipitation. Non-field sources include ravines, stream bluffs and stream banks.

Drastic land-use changes to a river basin that is geologically predisposed to high erosion rates appear to be largely responsible for the dramatic increase in sediment loads from the Minnesota River over time. The sudden and extremely rapid southward drainage of Glacial Lake Agassiz through the River Warren channel some 11,500 years ago carved out a wide, deep valley through which the Minnesota River runs today. Since that event the tributary streams have been steadily down-cutting in their lower reaches to adjust to the new lower base level. The creation of steep valley walls around the Minnesota River main stem and the lower reaches of its tributaries “primed” the landscape to erode sediment (Wilcock 2009). As is discussed Section 6.2, these geologically created land forms are natural, but the current rate of erosion and sediment loss are not. Land clearing, the tripling of acreage in row crop production, and increased flows in the Minnesota River and its tributaries since 1940, have acted forcefully on the original landscape’s inherent potential for sediment loss, to generate progressively greater sediment loads.

Within the Minnesota River basin, the proportions of sediment originating from stream banks, bluffs and ravines vary widely by major watershed, as well as by year. Bluff erosion appears to be significant in the Blue Earth River and Le Sueur River Watersheds, the highest contributors of sediment in the Minnesota River Basin (Sekely et al. 2002; Thoma et al. 2005). The main driver of bluff erosion in the long run is erosion at the toe of the bluff (Wilcock 2009). Net stream bank erosion also appears to be a significant source of sediment in the Le Sueur watershed, as indicated by historical widening of the stream channel in response to elevated river flows (Stephanie Day, National Center for Earth Surface Dynamics, University of Minnesota, Minneapolis, personal communication). Bluff and bank erosion respond exponentially to increased stream flow, and the erosive force it generates (Charles Regan, MPCA, personal communication; Restrepo and Kjerfve, 2000).

Erosion of ravines is driven by the volume and rate of water discharged to the ravine, which is often increased by discharge from the upland drainage system (Wilcock 2009). Ravine erosion is most prominent in the catchments of deeply incised tributaries, often found on the descent down the Minnesota River escarpment. It is especially prominent in wetter years with high levels of surface runoff and tile line discharge (Patrick Baskfield, MPCA, Mankato, personal communication).

4.0 Water Quality Standards and Review of Available Data

4.1 Water quality standards

Minnesota adopted its first statewide water quality standards in 1967. The state has updated these standards by adding new standards and regulations periodically. The comprehensive Clean Water Act amendments of 1972 require states to adopt water quality standards that meet the minimum requirements of the federal Clean Water Act.

Under the Clean Water Act, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the Act's goal of "fishable and swimmable" waters. Water quality standards consist of three components: beneficial uses, numeric or narrative standards, and a non-degradation policy. Minnesota's water quality standards are summarized in Table 5 and explained in greater detail below.

Table 5: Minnesota Water Quality Standards

Component	Description
Beneficial uses	Beneficial uses are the uses that states decide to make of their water resources. The process of determining beneficial uses is spelled out in the federal rules implementing the Clean Water Act.
Numeric standards	Numeric water quality standards represent safe concentrations in water that protect a specific beneficial use. If the standard is not exceeded, the use should be protected.
Narrative standards	Narrative water quality standards are statements that prohibit unacceptable conditions in or on the water, such as floating solids, scums, visible oil film, or nuisance algae blooms. Narrative standards are sometimes called "free froms" because they help keep surface waters free from basic types of water pollution.
Nondegradation	Nondegradation is equivalent to the federal term "antidegradation." The fundamental concept of nondegradation is that lakes, rivers, and streams whose water quality is better than the applicable standards should be maintained at that high level of quality and not allowed to degrade to the level of applicable standards.

Water quality standards can be found in several Minnesota rules, but the primary rule for statewide water quality standards is Minn. R. ch. 7050. Included in this rule are the following:

- A classification system of beneficial uses for both surface and groundwater;
- Numeric and narrative water quality standards;
- Nondegradation provisions;
- Provisions for the protection of wetlands;
- Treatment requirements and effluent limits for wastewater discharges; and
- Other provisions related to protecting Minnesota's water resources from pollution.

All waters of Minnesota are assigned classes based on their suitability for the following beneficial uses:

1. Domestic consumption
2. Aquatic life and recreation
3. Industrial consumption

4. Agriculture and wildlife
5. Aesthetic enjoyment and navigation
6. Other uses
7. Limited resource value

Beneficial uses of the TSS-impaired reaches of the South Metro Mississippi River are as follows:

- Mississippi River, Metro WWTP to Rock Island Railroad Bridge: 2C, 3B, 3C, 3D, 4, 5 and 6
- All other water bodies in Table 1 (page 3) are classified as follows: 2B, 3B, 4A, 4B, 5 and 6

Subclasses referred to here are defined as follows:

- Class 2B: Aquatic life support refers to cool or warm water sport and commercial fish and associated aquatic life. Recreation support refers to aquatic recreation of all kinds, including bathing.
- Class 2C: Aquatic life support and recreation includes boating and other forms of recreation for which the water may be suitable (i.e., swimming). Class 2C waters may also support indigenous aquatic life, but not necessarily sport or commercial fish.
- Class 3B: General industrial purposes, except for food processing, with only a moderate degree of treatment. Similar to Class 1D waters of the state used for domestic consumption.
- Class 4A: Agricultural use, irrigation.
- Class 4B: Agricultural use, livestock and wildlife watering.

For conventional pollutants such as TSS, river reaches are listed as impaired if 10% or more of samples taken over the assessment period exceed the water quality standard. Based on this criterion, the Mississippi River from its confluence with the Minnesota River to the Lake Pepin inlet is shown to be impaired. The lower part of the lake was shown to be in full support of the turbidity standard of 25 nephelometric turbidity units (NTU) in place at the time of assessment. The MPCA used more than 1,000 water quality samples from a 10-year period in the assessment.

4.1.1 Water quality standard and numeric target

Through most of the period of time that this project was conducted Minnesota's numeric turbidity standard was defined as 25 NTU. The state listed five contiguous segments of the South Metro Mississippi River as impaired by turbidity in 1998, based on analysis of the 10-year period of monitoring from 1986 to 1996, which showed that 10% or more of the samples taken exceeded the state standard of 25 NTU. Tellingly, the Mississippi River above the confluence with the Minnesota River, and below Lake Pepin, was not listed as impaired (Figure 20). This points to the overwhelming influence of the Minnesota River as a sediment source, and the role of Lake Pepin as a sediment sink, for this portion of the Mississippi River.

In the course of conducting a TMDL study for these river reaches in conjunction with Lake Pepin, the MPCA confronted a confusing situation with several types of turbidity meters, each giving a different reading, used in monitoring the river over the past two decades. In 2008 the MPCA decided on a specific type of turbidity meter, used by Metropolitan Council Environmental Services at the Lock and Dam 2 monitoring site for years, as a reference point for the 25 NTU turbidity standard. The MPCA then evaluated the turbidity levels measured with this meter with reference to aquatic life use support and found the level of support wanting. Scientists have found no submersed aquatic vegetation in the Mississippi at the TSS-equivalent of the turbidity standard, which is 64 mg/L TSS. At this point, the Agency decided it was necessary to develop a site-specific standard for the South Metro Mississippi River.

In summer 2010, in close cooperation with the WDNR and Mississippi River scientists, and with public review, the MPCA developed a site-specific standard of 32 mg/L TSS summer mean (June 1 through September 30) for the Mississippi River from River Mile 844 to River Mile 780.The site-specific standard was developed after MPCA staff and the Science Advisory Panel came to realize that the statewide 25 NTU standard failed to adequately protect aquatic life in the South Metro Mississippi. After a technical paper was developed by a team of research scientists (Sullivan et al. 2009), the MPCA developed a proposed site-specific standard. Following public notice, the MPCA Citizens Board approved the standard in June 2010. Following Board approval, the EPA reviewed the standard and approved it in November 2010.

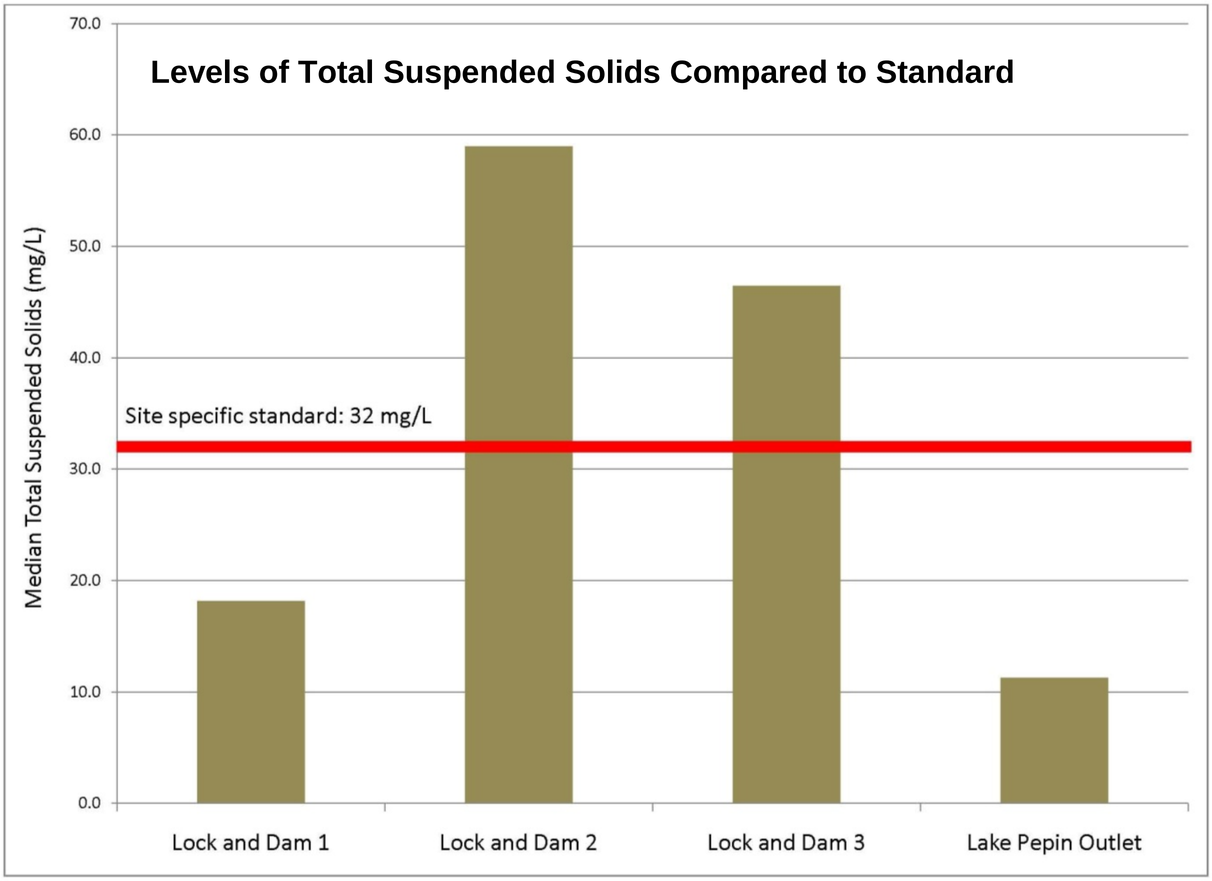
The site-specific standard replaces the turbidity standard for an approximate 64-mile reach of the South Metro Mississippi which is turbidity-impaired. This reach extends from River Mile 844 at the confluence with the Minnesota River to River Mile 780, just downstream of the confluence with the Rush River in Wisconsin, in upper Lake Pepin. The site-specific TSS standard is based on combined bi-weekly monitoring samples at Locks and Dams 2 and 3. The standard of 32 mg/L TSS is well below the equivalent value for the state turbidity standard of 25 NTU, which corresponds to 64 mg/L TSS in this part of the Mississippi River. The standard specifies that a mean value of 32 mg/L or less must be attained in at least five summers over a period of 10 years. Secondary monitoring targets that are related to the support of submersed aquatic vegetation, but are not part of the standard, include:

- Not exceeding a seasonal average of 44 mg/L TSS in more than one year out of a 10-year assessment period; and
- Attaining a submersed aquatic vegetation monitoring survey frequency of 21% using the EPA's Environmental Mapping and Assessment Program protocol.

The portion of the Mississippi River in this TMDL forms a boundary between Minnesota and Wisconsin from the confluence with the St. Croix River to the confluence with the Chippewa River. Wisconsin does not have numeric river standards for turbidity or TSS, but lists this reach of the Mississippi as impaired by suspended sediment that is suppressing the growth of submersed aquatic vegetation and filling in Lake Pepin at an accelerated pace. Wisconsin is using Minnesota's proposed TSS standard and the 21% frequency submersed aquatic vegetation target as numeric translators of this narrative standard until such time as it develops its own TSS standards for rivers.

Although the water quality standard is 32 mg/L TSS, the TMDL target is 30 mg/L TSS, measured as a season average at the same stations as will be used to measure the standard. The TMDL target is lower than the standard in order to provide an explicit margin of safety (Section 6.3 Margin of safety).

Figure 20: Levels of TSS Compared to Standard



Data from the Metropolitan Council Environmental Services and Long-Term Resource Monitoring Program show that the Mississippi River at Lock and Dam 1 – above the confluence with the Minnesota River –meets the proposed TSS standard of 32 mg/L, as does the river at Lock and Dam 4 – below Lake Pepin. The impaired reach greatly exceeds the standard, as measured at Locks and Dams 2 and 3. The bars in the chart measure the median of summer average values over the 1985-2006 period of record to correspond generally to how the MPCA will apply the site-specific standard. (MPCA graphic)

5.0 Modeling Approach and Results

5.1 Water quality models used

The complex nature of the Upper Mississippi River-Lake Pepin (UMR-LP) system requires a model that is complex in terms of process resolution and in terms of spatial and temporal resolution. The system stretches for about 90 miles and consists of three morphometrically and hydraulically distinct pools, separated by lock and dam control structures. There is considerable variability both laterally and longitudinally of the system bathymetry, including channels, shoals, deltas, and impoundments. In addition, several islands throughout the system complicate the hydraulics.

To support the TMDLs for TSS and nutrient-chlorophyll-*a* impairments in Pools 2, 3, and 4 (River Miles 848 to 765) of the UMR, the MPCA worked with the project's Science Advisory Panel and a consultant to develop a linked hydrodynamic-sediment transport-water quality model. This model, called the UMR - Lake Pepin Water Quality Model (UMR-LP model), applies to UMR from Lock and Dam 1 through Lock and Dam 4 below Lake Pepin.

The consultant – Limno-Tech, Inc. – adapted and upgraded a hydrodynamic water quality model developed by the Metropolitan Council Environmental Services and Hydra-Qual, Inc., in the 1990s. The ECOMSED-RCA model was successfully calibrated and then used to evaluate the effect of specific load and flow reductions on the TMDL endpoints including turbidity, phosphorus, chlorophyll, and Secchi transparency. The model is central to the development of the TSS and eutrophication TMDLs. The main processes characterized in the model include:

- The growth and decay of algae in response to alternative nutrient inputs, temperature, flow, and light conditions; and
- The level of turbidity, TSS, sediment deposition, and Secchi transparency in the river as affected by loadings and resuspension of sediment and by growth cycles of algae.

Details of the model, its data set, and calibration can be found in Limno-Tech, Inc.'s modeling report (2009).

The overall project approach followed the EPA's Draft Guidance on the Development, Evaluation, and Application of Regulatory Environmental Models (EPA 2003). Based on this guidance, the general approach to model development and application adhered to the following steps in the regulatory environmental modeling process:

1. Problem specification;
2. Model framework selection and formulation;
3. Model development;
4. Model evaluation; and
5. Model application.

An important component of this project was adhering to an open modeling process throughout the project that involved continual interaction with all stakeholders at each step in the process. Another important part of the open modeling approach was ongoing peer review of the entire modeling process by a Science Advisory Panel (SAP) consisting of academic and government scientists and MPCA staff familiar with the system under study.

The UMR-Lake Pepin modeling framework consists of modified versions of two public domain models:

- ECOMSED hydrodynamic/sediment transport model; and
- Row-Column AESOP (RCA) water quality model.

The two models operate on the same computational grid, and hydrodynamic and sediment transport predictions from the ECOMSED model are linked directly to the RCA model to inform the water quality simulation. The "ECOM" component of the ECOMSED modeling framework is used to simulate three-dimensional and time-dependent hydrodynamic behavior in the UMR from Lock and Dam 1 to Lock and Dam 4. As a complementary module to the "ECOM" hydrodynamic module, the "SED" component of the overall ECOMSED framework is used to simulate the transport and fate of cohesive and non-cohesive sediments, which together constitute non-volatile suspended solids. Advective/dispersive transport and deposition and resuspension processes are simulated for cohesive sediments, which represent clays, fine and medium silts, and associated organic material. Likewise, transport and deposition/resuspension is simulated for a non-cohesive sediment class, which typically represents medium to coarse sands.

The basic RCA framework includes a suite of state variables to represent carbon, nitrogen, phosphorus, silica, oxygen, and algal dynamics, and it is configured to interface directly with the ECOMSED model, including linkage of hydrodynamic, water temperature, and sediment transport results. The RCA framework includes a simulation of water column processes affecting water quality. It also includes a coupled sediment diagenesis sub-model that simulates the cycling of detrital material and nutrients in the surface sediments and subsequent impacts on near-bed sediment oxygen demand and release of dissolved nutrients, including dissolved inorganic phosphorus.

The MPCA made every effort to incorporate all available data for the UMR system during the model development and calibration/confirmation process. The UMR system has a long history of abundant water quality and biological data collected over the past 22 years by federal, state, and local government agencies. Within Pools 2 and 3, the MCES has collected a majority of the monitoring data, while the USGS through its LTRMP has collected a majority of the data in Pool 4. Other agencies that regularly collect data within the UMR system include the U.S. Army Corps of Engineers (USACE), the MPCA, the Minnesota Department of Natural Resources (DNR), and the WDNR.

With 22 years of data available for the UMR-Lake Pepin system, the MPCA and Limno-Tech decided to use half of the data for model calibration and half for confirmation. The model was calibrated using monitoring data for 1996-2006, and the monitoring data from 1985-1995 was used as a confirmation dataset. Both the calibration and confirmation data sets included a low flow and a high flow year. The calibration period included the:

- Intense low-flow monitoring program conducted in 2006 (10^{th} percentile summer, from June to September) flow at Lock and Dam 2 at Hastings, Minnesota.
- The 86^{th} percentile annual high flow at Lock and Dam 2 at Hastings, Minnesota in 2002.

The earlier confirmation period included the 1st percentile summer flow in 1988 and the highest annual flow on record in 1993. It was important to test the model's ability to simulate the system response over the full range of flow conditions because high flows represent the critical conditions for TSS, while low flows represent the critical conditions for nutrient-stimulated phytoplankton growth.

Results of this iterative calibration/confirmation process included:

- Complete listings of calibration parameters;
- Graphical presentations of the calibrated model;
- Comparison with system data along with a presentation of model-data comparisons for the confirmation period;
- Metrics used to quantitatively evaluate the model calibration/confirmation; and
- Diagnostic analyses of the modeling results with regard to important features of the system behavior.

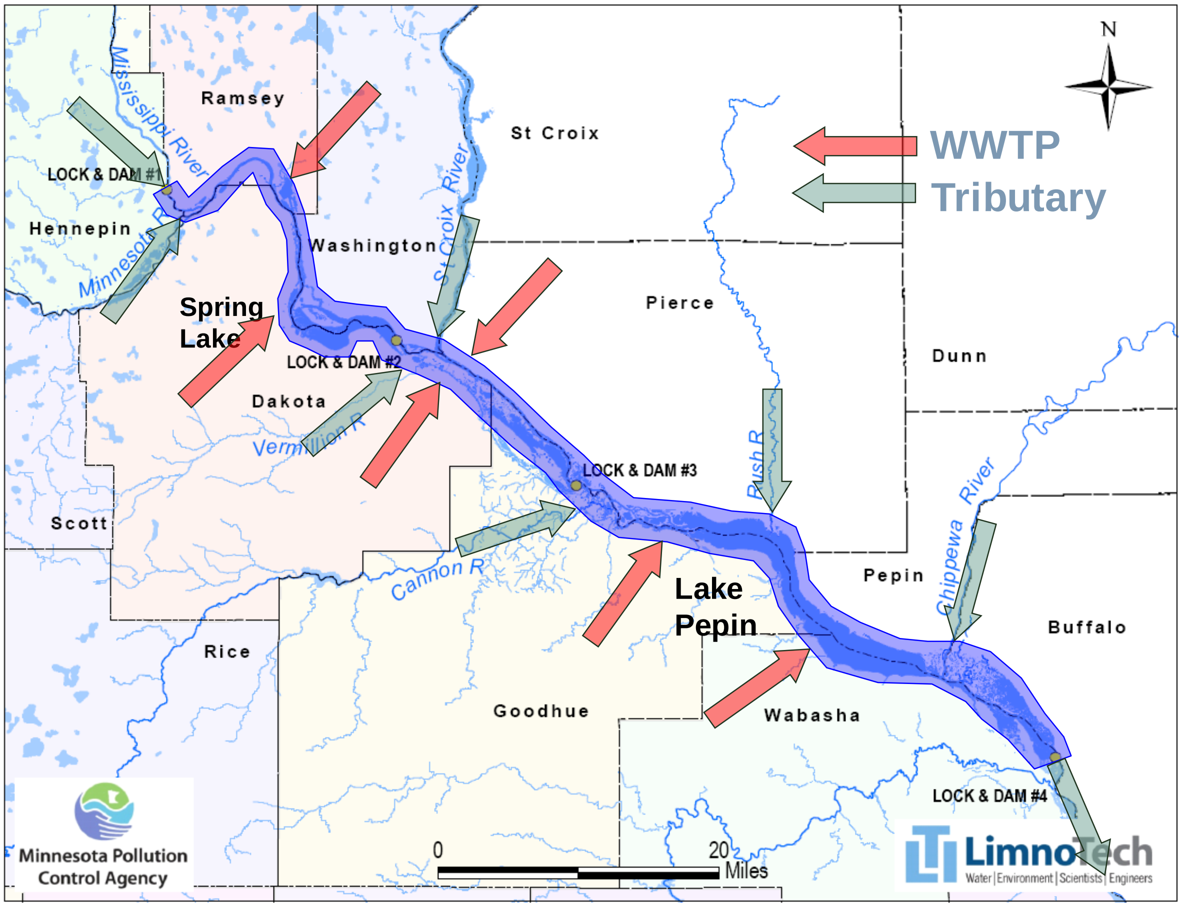
The MPCA and Limno-Tech, Inc. found the overall model performance for the calibration period and confirmation periods to be quite good, especially given the complexity of the model framework and the extent of the model domain.

Once achieving the best possible model parameterization, Limno-Tech, Inc. conducted a suite of model application runs to provide a computation of the sediment and nutrient load-response relationships to support the TMDL process. Limno-Tech developed a Management Analysis Tool to help the MPCA and stakeholders to visualize and compare the results of 21 different load reduction scenarios in relation to TMDL targets for chlorophyll-*a*, total phosphorus, Secchi depth, and TSS.

The simulation and accounting of sediment bed properties is a critical component of the SED sediment transport module. The ECOMSED requires the specification of sediment type, such as cohesive or non-cohesive, and other physical properties, including particle size distribution and deposition- and erosion-related process coefficients. Exchange between the water column and the underlying sediment bed may occur through settling/deposition and resuspension processes. A detailed treatment of these sediment transport processes is provided in the HQI user's manual for ECOMSED version 1.3 (HydroQual 2002). The rate of mass deposition to the bed for cohesive and non-cohesive suspended solids is dictated by a particle settling rate, the local water column suspended sediment concentration, and a probability of deposition term. Resuspension of cohesive or non-cohesive material from the sediment bed to the overlying water column may result from elevated shear stresses caused by either elevated near-bed velocities during high-flow events and/or wind-generated waves. The sediment type assigned to each horizontal model grid was consistent with the original model developed by HQI.

The UMR-LP model responds to inputs from upstream watersheds and direct discharges from major wastewater treatment facilities to the Mississippi (Figure 21). The MPCA, MCES, DNR and Limno-Tech, Inc., assembled water quality monitoring data from 1985 to 2006 to serve as inputs to the model.

Figure 21: Inputs to the South Metro Mississippi



The UMR-LP model used inputs from the several tributary and direct wastewater inputs to the system. (Limno-Tech Inc. graphic)

5.1.1 Load reduction scenarios

In order to attain the site-specific standard of 32 mg/L, Limno-Tech Inc. ran 21 scenarios to represent a wide range of conditions ranging from historical baseline to moderate reductions to extreme reductions approximating pre-settlement conditions (90% load reductions from tributaries with zero direct wastewater discharges). This approximates pre-settlement TSS loads estimated from Lake Pepin sediment cores, which are 10 times less than current average TSS loads (Engstrom and Almendinger, 2000; Engstrom et al., 2009, Kelley and Nater, 2000). Table 6 lists the scenarios. The results of the modeling scenarios are described by Limno-Tech Inc. (2009).

Each of scenarios 1-19 called for equal percent reductions of TSS, Total Phosphorus (TP), and algae from the points of input to the model. These model scenarios do not account for possible interactions among the three variables in the tributaries as each is reduced, as might occur in practice, which would have required complex modeling of each tributary. Of the initial 19 scenarios, number 17 did the best job of meeting the water quality standard with the minimum load reductions from contributing tributaries. Scenario 17 called for reductions of 50% from current TSS loads from the Minnesota River, Cannon River and internal resuspension, together with 20% reductions from the other six sources in the model. Not only did Scenario 17 appear to meet the TSS standard; with its phosphorus reductions, it also appeared to meet the proposed standard for total phosphorus in Lake Pepin. Thus, the MPCA viewed Scenario 17 as the basic solution to the TSS impairment on the South Metro Mississippi River.

However, in response to comments from the Science Advisory Panel, the MPCA conducted two additional model runs, using the output of a Minnesota River basin model, to test the effect of seasonal variability in load reductions.

In scenarios 20-21, Limno-Tech attempted to link upstream modeling of the Minnesota River to the South Metro Mississippi modeling system. For these two scenarios, Limno-Tech used the results of Scenario 4 from a Hydrologic Simulation Program Fortran (HSPF) model for the Minnesota River as input, at the Jordan monitoring station, for a channel model developed by the U.S. Army Corps of Engineers for the lower segment of the Minnesota River, from Jordan to Fort Snelling at the mouth of the Minnesota River. The results from the river channel model, CE Qual W2, were subsequently fed into the ECOMSED-RCA model developed by Limno-Tech, to carry forward Scenario 4 loads of TSS to the main stem Mississippi River. Scenario 4 of the HSPF model incorporated the following set of practices (Tetra Tech, 2009):

- Increase perennial vegetation to 20% of the watershed, targeting erosive areas downstream of nick points in the Blue Earth and Le Sueur watersheds, in particular.
- Implement conservation tillage on 75% of land with slopes greater than 3%, along with cover crops to reduce spring runoff.
- Eliminate all surface tile inlets.
- Follow University nutrient management recommendations.
- Use of drop structures on ravines to achieve 30%-40% sediment loading reduction.
- Use controlled drainage on cropland with less than 1% slope, along with two-stage ditch design, storing the first inch of field and urban runoff for at least 24 hours.
- Stabilize stream banks and bluffs by reducing stream flow and scour.

The HSPF model predicted that Minnesota River Scenario 4 would result in TSS load reductions at Jordan in the range of 40% to 60%, depending on the year and the season. Results on average were close to what is called for by the South Metro Mississippi TSS TMDL. Therefore, the model output was used as a refinement of South Metro Mississippi Scenario 17, providing more detail on the timing and extent of sediment loads at Jordan based on the above set of practices. Linkages to the CEQUAL W2 model, and subsequently with ECOMSED-RCA, proved problematic, however. Differences among the three models made linkage difficult and the results inconclusive. However, the MPCA believes that Scenario 4 of the HSPF model provides a general indication of the types and magnitude of land use changes required to meet the load requirements for the Minnesota River as indicated in Scenario 17.

Table 6: TSS Load Reduction Scenarios Evaluated by UMR-LP Model

Scenario	Load Reduction	UMR / MR Load	Upper Miss. River				Minnesota River					St. Croix		Cannon		Other Tribs		WWTPs			
No.	Scenario	Reductions	Hist	20%	50%	90%	Hist	20%	50%	80%	90%	Hist	20%	Hist	50%	Hist	20%	Hist	Permit	Red.	Rem.
1	Historical Tributary & WWTP Loads	(none)	x				x					x		x		x		x			
2	Tributary Load Reductions with Permitted WWTP Loads	(none)	x				x					x		x		x			x		
3		20% / 20%		x				x					x		x		x		x		
4		20% / 50%		x					x				x		x		x		x		
5		20% / 80%		x						x			x		x		x		x		
6		50% / 20%			x			x					x		x		x		x		
7		50% / 50%			x				x				x		x		x		x		
8		50% / 80%			x					x			x		x		x		x		
9	Tributary Load Reductions with Reduced WWTP Loads	(none)	x				x					x		x		x				x	
10		20% / 20%		x				x					x		x		x			x	
11		20% / 50%		x					x				x		x		x			x	
12		20% / 80%		x						x			x		x		x			x	
13		50% / 20%			x			x					x		x		x			x	
14		50% / 50%			x				x				x		x		x			x	
15		50% / 80%			x					x			x		x		x			x	
16	"Natural Background" Case	90% / 90%				x					x		x		x		x				x
17	Tributary Load Reductions with Reduced Pool 2 Resuspension	20% / 50%		x					x				x		x		x			x	
18		50% / 80%			x					x			x		x		x			x	
19		90% / 90%				x					x		x		x		x				x
20	Minnesota River TSS Reductions Based on HSPF "Scenario 4"	20% / ~50%		x			HSPF "Scenario 4" + CE-QUAL-W2						x		x		x		x		
21		20% / ~50%		x									x		x		x			x	

Reductions in TP and TSS ranging from 10% to 90% from historical baseline were evaluated for each major tributary and source area. Each scenario is defined by which cells are filled with an "x." For example, Scenario 17 includes a 20% TSS reduction in the Upper Mississippi, St. Croix and other tributary rivers; 50% reduction in the Minnesota and Cannon rivers; and reductions in TSS from wastewater treatment plants. The column "Other tribs" refers to the following small tributaries: Vermillion, Hay Creek and Wells Creek in Minnesota and the Trimbelle River, Isabelle Creek, and Rush River in Wisconsin. Under WWTPs, the columns refer to Historical Loads (Hist), Permitted Loads ("Permit"), Reduced Loads ("Red.") and Removal of Loads ("Rem.").

5.1.2 Relationships to other TMDLs within the South Metro Mississippi Watershed

The discussion below describes significant related TMDLs nested within the South Metro Mississippi Watershed. Further accounting of some of the significant upstream load reductions is described in section 6.0. It should be understood that there may be multiple allocations (including for the different flow regimes) for some waterbodies and that the most conservative allocation applies in terms of permits or other tracking.

Lower Mississippi River Basin

- The Lower Cannon River Turbidity TMDL, completed in 2007, requires TSS load reductions of 39% at average flow, and 76% to 82% reductions at high and very high flows. Thus, it is more restrictive than the 50% TSS load reduction requirement of the South Metro Mississippi River.
- The Lower Vermillion Turbidity TMDL, approved in 2009, specifies allocations of TSS for two modes. In mode 1, the Vermillion is inundated by Pool 3 of the Mississippi, and the TMDL simply calls for meeting the allocations of the South Metro Mississippi TMDL for this reach. In mode 0, at lower flows, the Lower Vermillion, a 36% reduction in TSS load was required (50% from internal sources and 32% from local tributaries). The goals are set to make local water quality better in that slow, resuspension-dominated system. This approach does not translate directly to a “load reduction” at the outfall point(s) of the Lower Vermillion system. In conclusion, the allocations specified in the Lower Vermillion turbidity TMDL are more restrictive than the 20% reduction required in the South Metro Mississippi TMDL.

Minnesota River Basin

- A total of 18 impaired turbidity reaches are encompassed in the Minnesota River Basin Turbidity TMDL above the city of Jordan. Nine of the impairments are on the main stem, and nine at the mouths of major tributaries to the main stem, including the major sources of TSS to the Mississippi River, the Blue Earth and Le Sueur Rivers. A detailed analysis with the HSPF (Hydrologic Simulation Program Fortran) watershed model concluded that the total load of sediment delivered to the larger rivers of the Minnesota River basin would need to decrease up to 90% for certain watersheds under high flow conditions. This load-reduction requirement is *more restrictive* than the South Metro Mississippi TSS TMDL, which calls for 50% TSS load reductions from the Minnesota River at average and lower flows, and 60% load reductions at high and very high flows, as measured at Ft. Snelling in St. Paul.
- The Carver Creek and Bevens Creek Turbidity TMDLs were approved in 2012. The Carver Creek TMDL estimates 86%, 77% and 20% reductions for very high, high and mid-range flow, respectively; the Bevens Creek TMDL estimates 83% and 73% at the very high and high flow, respectively.
- The Bluff Creek Turbidity TMDL, approved in 2013, estimates an overall TSS load reductions of 88%.

Upper Mississippi River Basin

A 20% reduction in TSS load from the Upper Mississippi, upstream of Lock and Dam 1, is required to meet the allocations in the South Metro Mississippi TSS TMDL. Three turbidity TMDL projects have been completed in the UMR basin.

- A turbidity TMDL for the lower portion of Elk River was approved as part of the Elk River Watershed TMDLs in 2012. The primary contributor of the turbidity in the reach was algae associated with the Big Elk Lake nutrient impairment rather than inorganic suspended solids. As such, the TMDL will be met through total phosphorus reductions and TSS reductions are not identified in the TMDL.
- Excess sediment has been identified as a significant stressor in several reaches of the Sauk River and its tributaries. A WRAPS report will be developed that will include required TMDLs, but it is not clear yet if a turbidity/TSS TMDL will be completed for the biological impairments. Implementation strategies are likely to identify the need for sediment reduction, but no comparison of reductions to the South Metro TMDL needs has been made. A turbidity TMDL has been completed for small tributaries in the middle portion of the watershed.
- The North Fork and Lower Crow River TMDL was approved in 2013 and included turbidity impairments. The TMDL for the lower reach calls for 40%, 90%, and 40% reductions at the very high, high, and mid-range flow duration categories of the load duration curve. A further analysis of the estimated load reduction that would result for achieving this TMDL was recently conducted by MPCA staff using output from HSPF modeling done on this river. This analysis was done for the years 2000-2006. This analysis revealed that on average the load that would be reduced would exceed 32 metric tons per year, which is the needed reduction for the entire UMR Basin for the South Metro Mississippi TSS TMDL. (The load reduction that would result should the TMDL be revised at some point in the future to be in line with the new TSS standards proposed for adoption in Minnesota is somewhat less clear. This is due to the guidance associated with the rulemaking not designating a specific TSS level for the Lower Crow (it suggests use of a “blended” standard considering the differing standards assigned to its upstream tributaries). Using some assumptions staff approximates that load reductions from the Lower Crow would still address the bulk (at least 75%) of the needed 32 metric tons per year reduction.)

St. Croix River Basin

An eutrophication TMDL for Lake St. Croix requires substantial reductions in sediment-attached phosphorus from urban and rural portions of the basin, to achieve a 27% reduction in total phosphorus loads to the lake. Because the St. Croix River contributes very low TSS levels to the Mississippi, it is not required to reduce its TSS load from current levels to meet the South Metro Mississippi TSS TMDL. The eutrophication TMDL for Lake St. Croix thus is *more restrictive* than the South Metro Mississippi TSS TMDL.

6.0 TMDL Development and Determination of Allocations

The TSS TMDL for the South Metro Mississippi River watershed is presented in this section of the report. The MPCA used the calibrated UMR-LP model to determine the allocations necessary to achieve the TMDL target. The modeling period was based on the same weather and hydrologic conditions as the calibration period, Jan. 1, 1995, to Dec. 31, 2006, with the following locations used as assessment points:

- Mississippi River at Lock and Dam 2 (River Mile 815 near Hastings); and
- Mississippi River at Lock and Dam 3 (River Mile 797 near Red Wing).

Scenario 17 showed that TSS load reductions of 50% from the Minnesota and Cannon Rivers, combined with 20% reductions from other major tributaries could achieve the site-specific standard of a long-term summer average of 32 mg/L TSS. Since the modeling analysis was conducted, the Agency has further refined the site-specific standard to apply to a moving 10-year period of data as an averaging period, and evaluated how to meet the standard under the most critical, high-flow conditions. The MPCA made two main adjustments to Scenario 17 to serve as a basis for the TMDL allocations:

- First, for the St. Croix River, the Agency will require no TSS load reduction from current levels because its TSS concentration remains well below the site-specific standard of 32 mg/L. The St. Croix River helps to dilute – not increase – the TSS concentration of the Mississippi River. The vast majority of sediment in the St. Croix River settles out in Lake St. Croix before discharging to the Mississippi River. In addition, see discussion in section 5.1.2 regarding the eutrophication TMDL for Lake St. Croix and likely removal of TSS associated with that.
- Second, the Agency will require additional TSS load reductions from the Minnesota River – 60% instead of 50% – during high and very high flows in non-winter months in order to meet the water quality standard in each of the 10-year periods evaluated from 1985-2006. In the model, only additional reductions from the Minnesota River were effective in meeting the standard during the most challenging decades of high water flows when TSS concentrations are at their peak. This additional reduction far outweighs the TSS load contributed by the St. Croix River.

In summary, the TMDL calls for the set of TSS load reductions indicated below. Note that the basin reduction percentages are *overall* reductions and not applied uniformly to all sectors/sources within them; see Sections 6.1 and 6.2 for information on source/sector allocations. Also, note that the portions of the Metroshed are included within their respective river basins for the purpose of this summary.

- 60% from the Minnesota River Basin at high and very high flows; 50% at median and lower flows;
- 50% from the Cannon River Basin;
- 20% from the UMR Basin;
- 0% from the St. Croix River Basin;
- 0% from all tributaries from December to February;
- 50% from internal sources such as wind-induced resuspension; and

- 20% from local tributary loads (Mississippi River – Lake Pepin Watershed) in Minnesota and Wisconsin, including the Vermillion River, Hay Creek and Wells Creek in Minnesota, and the Trimbelle River, Isabelle Creek, and Rush River in Wisconsin.

Table 7 shows how the MPCA applied these reductions to the TSS loads by source for average river flows in order to achieve the total loading capacity for the South Metro Mississippi River. This table, as well as Tables 8 and 9, includes allocations from the Metroshed, which are made up of portions of the UMR and Minnesota River Basins. Consequently, the allocations for the UMR and Minnesota River Basins exclude Metroshed area. Also, regarding wastewater treatment plants (WWTPs) the MPCA divided permitted facilities into two categories for purposes of establishing individual WLA:

- Those discharging at concentrations above the water quality standard of 32 mg/L TSS:
    - The most common effluent limit for wastewater treatment facilities is 30 mg/L. The estimated aggregate TSS load from facilities in the first category is extremely small relative to the total TSS load from all point and nonpoint sources. Therefore, no load reductions will be required of these facilities. Their individual WLA will be calculated as loads, equal to permitted flow times permitted TSS concentration. Reserve capacity equal to 50% of the permitted load is added to the WLA of each facility in this category to account for future growth.
- Those with effluent limits at concentrations below the water quality standard:
    - The second category consists of those wastewater treatment facilities discharging TSS at concentrations below the water quality standard of 32 mg/L TSS. Discharges from these facilities provide assimilative capacity slightly beyond that which is required to offset their respective TSS loads. Thus, their discharge does not contribute to exceedances of the water quality standard of 32 mg/L TSS. On the contrary, their discharge slightly dilutes the receiving water, acting to increase its assimilative capacity. At the scale of this TMDL, the effect on assimilative capacity of the aggregate TSS load from this category of wastewater facilities will be very small at critical high and medium river flows.
    - Although these facilities are discharging at concentrations below the water quality standard of the South Metro Mississippi, they do discharge the pollutant of concern, TSS, and thus require individual WLA. The individual WLA are listed in Appendix A; the methodology for deriving them is discussed in Section 6.1.1.

Table 7: Annual allocations of TSS for average flow conditions of the South Metro Mississippi

Category	Miss R – Lake Pepin MN	Miss R – Lake Pepin WI	Metro-shed	Upper Mississippi	Minnesota	St. Croix MN	St. Croix WI	Cannon	State Totals MN	State Totals WI	Grand Total
	Metric tons/year										
Stormwater* (Construction/ Industrial)									1,189	34	1,223
Stormwater (MS4s)**	3,093	0	33,950	9,499	2,871	2,230	568	1,468	53,111	568	53,678
Wastewater Treatment Plants	673	84	23,033	9,838	4,751	2,143	758	1,040	41,477	841	42,318
Natural Background	271	232	1,416	8,646	58,403	1,383	1,651	4,559	74,677	1,884	76,561
LA	3,940	3,376	10,542	88,351	289,629	8,732	10,390	23,989	425,183	13,766	438,949
Internal Load (for Total) †											*52,602*
Wastewater Reserve Capacity††	0	4	0	44	2	0	37	1	47	41	88
Total Loading Capacity	7,976	3,696	68,942	116,377	355,656	14,487	13,404	31,057	595,684	17,134	612,818

* The MPCA and WIDNR manage industrial and construction stormwater on a statewide basis via general permits.
** Includes natural background.
† Internal loading is a subset of the total LA; see section 6.2.
†† Use of wastewater reserve capacity is described in section 6.5.

Table 8 shows the TSS allocations for the same source categories and areas as in Table 7 above, but displays five categories of river flow. Allocations by flow regime, from very high to very low, are based on historical monitoring data at Lock and Dam 2 on the Mississippi River and are based on total annual flow. It should be noted that the flows in these categories were calculated differently than has been done on the other TMDLs that use a flow duration curve approach (which uses daily flow data). In this project different selected years in the modeled long-term record were used to represent the five different flow regimes (e.g., very high flows were based on the years 1986, 1993, and 2001). This was done in order to align with the annual nature of both the TSS site-specific standard and the model used for this TMDL. We also note that the flows during those selected years for the tributaries (such as the Minnesota River) did not always show proportionate flow to the overall flow for a given year (presumably due to varying precipitation amounts by basin).

The annual values in Table 8 have been translated to average daily values (by dividing by 365 and expressing as kilograms, except for wastewater, which used a different daily calculation that is explained in section 6.1.1) and are provided in Table 9. It is not the intent of this table to imply that loading can be managed on specific days based on that day's river flow. Moreover, rainfall (particularly local rainfall) is not directly equated to river flow volume on a daily time scale (e.g., heavy rains can occur during low flow conditions and weeks of no rain can occur during high flow conditions).

The MPCA developed allocations by using the UMR-LP model, with modifications to Scenario 17 as discussed previously. Natural background is estimated as one-tenth of the current TSS loads, based on previously cited Lake Pepin sediment core interpretations. This quantity is apportioned among river basins based on their historical relative proportions of TSS to the aggregate TSS load, which have remained fairly constant over time (Kelley and Nater 2000). WLA for wastewater facilities are provided in Appendix A, and a list of permitted MS4s is provided in Appendix B.

In the model, the MPCA chose the five flow categories to distinguish between critical, average, and non-critical conditions for meeting the TMDL. The two highest flow categories (very high and high) represent the most critical conditions for meeting the TMDL. Most of the years in the most critical decade, 1993-2002, fall into these upper two flow categories. Loading for these flow categories must decrease, in order to decrease the TSS, to meet the TMDL. Meeting these load reductions requires a 60% reduction from historical TSS loads in the Minnesota River, compared to 50% reductions for average and lower flows. The lower two flow categories usually represent situations of relatively low turbidity and TSS concentrations, in which moderate TSS load reductions are needed to achieve the TMDL target.

Table 8: Annual allocations of TSS for a range of flow conditions of the South Metro Mississippi

Category	Flow condition	Miss R – Lake Pepin MN	Miss R – Lake Pepin WI	Metroshed	Upper Mississippi	Minnesota	St. Croix MN	St. Croix WI	Cannon	State Totals MN	State Totals WI	Grand Total
		Metric tons/year										
Stormwater* (Industrial/ Construction)	Very high									1,929	55	1,985
	High									1,504	43	1,547
	Moderate									1,189	34	1,223
	Low									914	26	940
	Very low									630	18	648
Stormwater (MS4s)**	Very high	5,019	0	55,087	15,412	4,659	3,619	921	2,381	86,177	921	87,098
	High	3,912	0	42,935	12,012	3,631	2,820	718	1,856	67,167	718	67,884
	Moderate	3,093	0	33,950	9,499	2,871	2,230	568	1,468	53,111	568	53,678
	Low	2,378	0	26,100	7,302	2,207	1,715	436	1,128	40,831	436	41,267
	Very low	1,639	0	17,992	5,034	1,522	1,182	301	778	28,147	301	28,448
Wastewater Treatment Plants	Very high	673	84	23,033	9,838	4,751	2,143	758	1,040	41,477	841	42,318
	High	673	84	23,033	9,838	4,751	2,143	758	1,040	41,477	841	42,318
	Moderate	673	84	23,033	9,838	4,751	2,143	758	1,040	41,477	841	42,318
	Low	673	84	23,033	9,838	4,751	2,143	758	1,040	41,477	841	42,318
	Very low	673	84	23,033	9,838	4,751	2,143	758	1,040	41,477	841	42,318
Natural Background	Very high	489	419	2,557	15,611	105,453	2,497	2,982	8,232	134,838	3,401	138,239
	High	322	276	1,684	10,281	69,446	1,644	1,963	5,421	88,798	2,240	91,037
	Moderate	271	232	1,416	8,646	58,403	1,383	1,651	4,559	74,677	1,884	76,561
	Low	193	166	1,010	6,166	41,649	986	1,178	3,251	53,255	1,343	54,599
	Very low	93	80	488	2,978	20,119	476	569	1,571	25,726	649	26,375
LA†	Very high	3,305	3,893	12,087	160,546	415,591	10,637	12,822	38,594	640,761	16,714	657,475
	High	3,069	3,336	10,160	106,274	265,979	11,348	13,173	29,673	426,503	16,509	443,012
	Moderate *Internal load (for Total)*	3,940	3,376	10,542	88,351	289,629	8,732	10,390	23,989	425,183	13,766	438,949 *52,602*
	Low	2,678	2,495	9,407	62,424	199,913	5,541	7,236	20,997	300,961	9,731	310,692
	Very low	2,029	1,891	8,657	38,086	132,121	3,012	4,676	12,632	196,538	6,568	203,105
Wastewater Reserve Capacity††	Very high	0	4	0.3	44	2	0.1	37	1	47	41	88
	High	0	4	0.3	44	2	0.1	37	1	47	41	88
	Moderate	0	4	0.3	44	2	0.1	37	1	47	41	88
	Low	0	4	0.3	44	2	0.1	37	1	47	41	88
	Very low	0	4	0.3	44	2	0.1	37	1	47	41	88
Total Loading Capacity	Very high	9,486	4,396	92,764	201,407	530,454	18,895	17,482	50,247	905,230	21,974	927,204
	High	7,976	3,696	77,812	138,405	343,807	17,955	16,612	37,990	625,495	20,392	645,887
	Moderate	7,976	3,696	68,942	116,377	355,656	14,487	13,404	31,057	595,684	17,134	612,818
	Low	5,922	2,744	59,551	85,730	248,520	10,385	9,608	26,416	437,485	12,420	449,905
	Very low	4,434	2,055	50,171	55,936	158,513	6,813	6,304	16,020	292,565	8,418	300,983

* The MPCA and WDNR manage industrial and construction stormwater on a statewide basis via general permits.
** Includes natural background.
† Internal loading is a subset of the total LA; see section 6.2.
†† Use of wastewater reserve capacity is described in section 6.5.

Table 9: Daily allocations of TSS for a range of flow conditions of the South Metro Mississippi

Category	Flow condition	Miss R – Lake Pepin MN	Miss R – Lake Pepin WI	Metroshed	Upper Mississippi	Minnesota	St. Croix MN	St. Croix WI	Cannon	State Totals MN	State Totals WI	Grand Total
		Kilograms/day										
Stormwater* (Industrial / Construction)	Very high									5,286	152	5,438
	High									4,120	118	4,238
	Moderate									3,258	94	3,351
	Low									2,504	72	2,576
	Very low									1,726	50	1,776
Stormwater (MS4s)**	Very high	13,750	0	150,923	42,226	12,764	9,914	2,523	6,524	236,102	2,523	238,625
	High	10,717	0	117,630	32,911	9,949	7,727	1,967	5,085	184,018	1,967	185,985
	Moderate	8,474	0	93,014	26,024	7,867	6,110	1,555	4,021	145,509	1,555	147,064
	Low	6,515	0	71,508	20,007	6,048	4,697	1,195	3,091	111,866	1,195	113,061
	Very low	4,491	0	49,294	13,792	4,169	3,238	824	2,131	77,115	824	77,939
Wastewater Treatment Plants	Very high	1,843	256	65,251	41,649	40,199	11,432	2,985	3,821	164,195	3,241	167,436
	High	1,843	256	65,251	41,649	40,199	11,432	2,985	3,821	164,195	3,241	167,436
	Moderate	1,843	256	65,251	41,649	40,199	11,432	2,985	3,821	164,195	3,241	167,436
	Low	1,843	256	65,251	41,649	40,199	11,432	2,985	3,821	164,195	3,241	167,436
	Very low	1,843	256	65,251	41,649	40,199	11,432	2,985	3,821	164,195	3,241	167,436
Natural Background	Very high	1,339	1,149	7,005	42,771	288,912	6,840	8,169	22,553	369,419	9,318	378,737
	High	882	757	4,613	28,167	190,263	4,505	5,379	14,852	243,281	6,136	249,417
	Moderate	742	636	3,879	23,688	160,008	3,788	4,524	12,490	204,596	5,160	209,756
	Low	529	454	2,767	16,893	114,108	2,702	3,226	8,907	145,905	3,680	149,585
	Very low	256	219	1,336	8,160	55,121	1,305	1,558	4,303	70,481	1,778	72,259
LA†	Very high	9,056	10,665	33,115	439,853	1,138,606	29,143	35,128	105,737	1,755,510	45,793	1,801,303
	High	8,409	9,140	27,836	291,163	728,708	31,089	36,090	81,296	1,168,501	45,230	1,213,731
	Moderate	10,794	9,250	28,882	242,059	793,503	23,922	28,466	65,724	1,164,885	37,715	1,202,600
	Internal load (for Total)											*144,114*
	Low	7,337	6,835	25,773	171,026	547,706	15,182	19,825	57,527	824,550	26,660	851,210
	Very low	5,560	5,182	23,719	104,345	361,976	8,253	12,812	34,607	538,459	17,993	556,453
Wastewater Reserve Capacity††	Very high	0	13	5	716	41	1	146	13	775	159	934
	High	0	13	5	716	41	1	146	13	775	159	934
	Moderate	0	13	5	716	41	1	146	13	775	159	934
	Low	0	13	5	716	41	1	146	13	775	159	934
	Very low	0	13	5	716	41	1	146	13	775	159	934
Total Loading Capacity	Very high	25,988	12,083	256,300	567,213	1,480,521	57,330	48,951	138,649	2,531,287	61,185	2,592,473
	High	21,851	10,165	215,335	394,604	969,159	54,754	46,568	105,068	1,764,890	56,851	1,821,741
	Moderate	21,853	10,155	191,031	334,134	1,001,617	45,253	37,676	86,071	1,683,217	47,925	1,731,141
	Low	16,223	7,557	165,304	250,290	708,101	34,013	27,378	73,360	1,249,795	35,008	1,284,803
	Very low	12,149	5,669	139,606	168,661	461,506	24,229	18,326	44,876	852,752	24,045	876,797

* The MPCA and WIDNR manage industrial and construction stormwater on a statewide basis via general permits.
** Includes natural background.
† Internal loading is a subset of the total LA; see section 6.2.
†† Use of wastewater reserve capacity is described in section 6.5.

6.1 Waste load allocations

The WLA for individual wastewater facilities and for the aggregate runoff from MS4s are further described in the following sections.

6.1.1 Wastewater treatment facilities

A total of 486 wastewater permits in Minnesota and 29 in Wisconsin authorize discharge to surface water in the South Metro Mississippi River watershed. Of these, 347 have effluent limits of 30 mg/L or less or do not contain the TSS effluent limits because the authorized discharges do not contain treatable quantities of the pollutant. Because this effluent concentration is less than the water quality standard of 32 mg/L, discharge from these facilities will remain below the water quality standard, thereby helping to attain and maintain the standard. These facilities are listed in Appendix A.

The MPCA has calculated the WLA for permits containing 30 mg/L calendar month average effluent limits based on the 30 mg/L effluent concentration and the facility's design flow. For facilities with a lower effluent limit that limit was used for the WLA calculation. The WLA for permits that do not contain the TSS effluent limits have been calculated based on the 32 mg/L water quality standard and the facility's design flow. The WLA for the electric services industry have been calculated only for process water flows but not for lake and river water volumes used in condenser cooling processes. These processes withdraw large volumes of water and TSS loads, and then return them to the watershed. The MPCA will apply the same WLA calculation methodology to future expanding and new dischargers permitted at 30 mg/L TSS or less. See section 6.5 below for further detail.

In the South Metro Mississippi River watershed a total of 164 wastewater permits in Minnesota and four in Wisconsin contain calendar month average TSS effluent limits exceeding 32 mg/L TSS. Most of these are controlled discharge stabilization ponds that discharge twice a year, during defined spring and fall discharge windows. Most of these facilities have calendar-month-average TSS effluent limit of 45 mg/L in Minnesota, and 60 mg/L in Wisconsin. Because these permitted effluent concentrations exceed the 32 mg/L water quality standard, these permits are not subject to the future expansion policy discussed in section 6.5 below. Individual WLA for each of these permits included 50% reserve capacity to accommodate future growth and development.

Wisconsin has several Wisconsin Pollutant Discharge Elimination System (WPDES) general permits (WGPs) used to cover specific categories of wastewater discharges (separate from stormwater general permits). The bulk of the activities covered are discharges that seep to groundwater, are intermittent in operation, or low in loading. The permits that allow some type of direct discharge to inland surface waters include:

- Carriage and Interstitial Water from Dredging Operations WI-0046558-4
- Concrete Products Operations WI-0046507-5
- Contaminated Groundwater from Remedial Action Operations WI-0046566-5
- Hydrostatic Test Water and Water Supply System Water WI-0057681-4
- Non-Contact Cooling Water, or Condensate and Boiler Blowdown WI-0044938-5
- Nonmetallic Mining Operations WI-0046515-5
- Petroleum Contaminated Water WI-0046531-4
- Pit/Trench Dewatering WI-0049344-3

- Potable Water Treatment and Conditioning WI-0046540-5
- Sanitary Sewer Overflows (SSO) from Sewage Collection Systems WI-0047341-4
- Short Duration Discharge WI-0059137-3
- Swimming Pool Facilities WI-0046523-5
- Wastewater from the Outside Washing of Vehicles, Equipment and Other Objects WI-0059153-3

The permit numbers listed are subject to change as expired permits are reissued. The Nonmetallic mining permit is currently being updated to address frac sand mining operations and will include language for implementation of TMDLs.

Given the transient nature of many of the general permits it is difficult to calculate actual or potential loads from assumed operating parameters for the WGP dischargers; however, most permits have TSS limits that are consistent with or below the TSS target concentration used for this TMDL.

For this TMDL the total allowable WGP load is estimated as 2% of the Wisconsin portion of the total wastewater WLA for individual permits. The allowable WGP load is included in the overall aggregate wastewater WLA. Facilities operating under WGPs will be screened to determine whether additional requirements may be needed to insure that the permitted activity is consistent with TMDL goals. The requirements may include issuing individual permits or other measures.

Note regarding annual and daily allocations in tables 8 and 9: daily and annual WLAs are directly related to each other for continuously discharging facilities (daily WLA x 365 days/year = annual WLA). Controlled discharge WWTPs (known as “stabilization ponds” in Minnesota or “draw and fill lagoons” in Wisconsin) are designed to hold water for 180 to 210 days and discharge it all during relatively high receiving water flow/low receiving water temperature periods in the spring and fall of the year. The daily discharge volume is much greater than their daily influent design flow and, while annual WLAs are based on the assumption that the entire annual influent flow will be discharged over the course of a 12 month period, daily WLAs are based on maximum permitted flow rates. As a result of these design conditions, daily WLAs for controlled discharge WWTPs are not 1/365th of the annual WLAs but instead reflect average load discharged for the days of actual discharge, generally 30 to 60 days per year.

6.1.2 Municipal Separate Storm Sewer Systems (MS4s)

In 1987 the Clean Water Act was amended to include provisions for a two-phase program to address stormwater runoff. In March of 2003 the second phase of the program began. Phase II includes permitting and regulation of smaller construction sites, municipalities with MS4s and industrial facilities. Per Minnesota Rule 7090, MS4s outside of urbanized areas with a population of at least 10,000 must apply for a permit as well as cities and townships with a population of at least 5,000 and discharging, or the potential for discharging, to valuable or polluted waters. The regulated entities must develop Stormwater Pollution Prevention Programs (SWPPPs) to document the BMPs they will implement to minimize pollution. NPDES Stormwater Phase II rules require permittees to implement BMPs in six areas called Minimum Control Measures. (See MPCA MS4 webpage at: http://www.pca.state.mn.us/sbiza7c)

Wisconsin has established a similar municipal separate storm sewer system permit program under Chapter NR 217, Wisconsin Administration Code. The Wisconsin communities covered by the program will need to comply with the conditions of their stormwater permits.

To calculate the WLA for regulated MS4 stormwater, the MPCA first estimated the regulated land area using 2011 National Land Cover Data (NLCD) (http://www.epa.gov/mrlc/classification.html). The NLCD includes four developed land uses. These were assumed to represent urban land use and, thus, approximate what is served by stormwater conveyances, i.e., the MS4-regulated area. The four classes are based on ranges of impervious cover, as indicated below.

Using a Geographic Information System (GIS), NLCD developed land uses were clipped using the regulated MS4 boundaries. The following acreages were determined for the South Metro Mississippi watershed:

- Developed, low intensity (20% to 49% impervious) – 255,052 acres;
- Developed, medium intensity (50% to 79% impervious) – 176,549 acres;
- Developed, high density (more than 79% impervious) – 68,837 acres; and
- Developed, open space (less than 20% impervious) – 268,007 acres.

Developed open space represents a mixture of land uses including parks, golf courses, forested areas, and similar land uses having a low percentage of impervious cover. These areas were assumed to discharge to MS4s and were therefore included in the allocation. The total 2011 developed area therefore equals 768,445 acres.

Next, the MPCA selected an allowable average sediment export rate. The primary source of information for estimating sediment export from urban areas was "Review of Published Export Coefficient and Event Mean Concentration (EMC) Data," by the Environmental Laboratory of the U.S. Army Corps of Engineers. This summary report provides an extensive list of references. The MPCA went to each of the references and extracted the data (http://el.erdc.usace.army.mil/elpubs/pdf/tnwrap04-3.pdf). Based on these data, the MPCA estimated an annual median export of 154 pounds per acre for developed land uses (which included residential, mixed residential, commercial, mixed commercial, industrial, mixed industrial, open space and mixed open space). The product of this export rate and the developed acreage above is 53,678 metric tons per year.

The allocation of 53,678 metric tons per year for average flow is an aggregate or categorical WLA, which is appropriate given the large geographic scale of this TMDL and the level of technical rigor used to approximate allocations and loads. To calculate the WLA for other flow regimes, a proportionality ratio was calculated by dividing flow at a specific flow condition by the flow at average conditions. The resulting value was multiplied by the WLA for average conditions to give the WLA for the flow condition of interest. Stormwater WLAs for the full range of flows are included in Table 8.

Minnesota

MS4s in Minnesota within the St. Croix River basin or above Lock and Dam 1 (except for the Crow River watershed) require no reduction for this TMDL. Other MS4s can evaluate compliance status for the South Metro Mississippi River TSS TMDL via monitoring, modeling or other means approved by MPCA Stormwater Program staff, with a target average loading of 154 pounds per acre per year for their MS4-regulated area. It should be noted that many of these MS4s are included in other turbidity/TSS TMDLs within the South Metro Mississippi River drainage area and are subject to the WLA in those TMDLs, which generally are as or more stringent. (These include Cannon River Watershed, Minnesota River Basin (above Jordan), Crow River, Carver and Bevens Creek, and Bluff Creek TMDLs.)

Wisconsin

MS4s in Wisconsin may evaluate compliance against the average annual export target of 154 pounds per acre using monitoring, modeling, or other means approved by the WDNR. Guidance outlining compliance options and modeling requirements for Wisconsin permitted MS4s can be found in guidance number 3800-2014-04 titled "TMDL Guidance for MS4 Permits: Planning, Implementation, and Modeling Guidance" which is available at
http://dnr.wi.gov/news/input/documents/guidance/ms4guidancefinal.pdf

Based on typical urban loading rates for Wisconsin, it is estimated that an export target of 154 pounds per acre requires on average a 40% reduction from the no controls scenario contained in ch. NR 151.13, Wis. Adm. Code. Typical no controls TSS unit area loads for municipalities in Wisconsin modeled using SLAMM version 9.4 (Source Loading and Management Model, PV & Associates, LLC) range between 243 to 275 pounds per acre under no controls with an average of 259 pounds per acre. Conditions between individual municipalities do differ resulting in variations to these loading numbers with reductions generally ranging from 37% to 44%; however, it is anticipated that a TSS reduction of 40% from no controls will meet the WLA requirements contained in this TMDL. Municipalities can refine their percent reductions compared to the no controls scenario by comparing their current loading rates to the NR 151 defined no controls scenario as outlined in guidance referenced above.

6.1.3 Construction stormwater

Both the MPCA and WDNR issue similar general permits for construction activities. For Minnesota, the MPCA issues construction permits for any construction activities disturbing:

- One acre or more of soil; or
- Less than one acre of soil if that activity is part of a *larger common plan of development or sale* that is greater than one acre; or
- Less than one acre of soil, but the MPCA determines that the activity poses a risk to water resources.

The WLAs for construction and industrial stormwater were each conservatively set at 0.1% of the TMDL and combined into one combined categorical WLA for both Minnesota and Wisconsin.

6.1.4 Industrial stormwater

Industrial sites may contribute to stormwater pollution when the water comes in contact with pollutants such as toxic metals, oil, grease, de-icing salts, and other chemicals from rooftops, roads, parking lots, and storage and material handling activities. Eleven categories of industrial activities are required to apply for NPDES permits for stormwater or certify a condition of no exposure. Examples of exposed materials that would require a facility to apply for an industrial stormwater permit include fuels, solvents, stockpiled sand, wood dust, gravel, metal and a variety of other materials.

As part of the permit requirements, the facilities must develop and implement a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP uses Best Management Practices (BMPs) designed to eliminate or minimize stormwater contact with significant materials that may result in polluted stormwater discharges from the industrial site (MPCA, Industrial Stormwater webpage, 2014). In Minnesota there are 138 facilities covered by individual and general NPDES permits that discharge only industrial stormwater. They are listed in Appendix A. See section 6.1.3 above for methodology for the WLA for this source.

6.2 Load allocations and natural background

The TMDL specifies the LAs for anthropogenic sources that are not subject to NPDES permit requirements as well as "natural background" sources. Both point and nonpoint sources are identified for each of the areas receiving TMDL allocations in Figure 22. The LA is by far the largest source of the TSS, especially in the Minnesota River. The LAs include anthropogenic or human-induced runoff from non-regulated areas such as farmland, rural residential and non-regulated MS4s.

Natural background, based on estimates of pre-European settlement loads of sediment to Lake Pepin (Engstrom et al., 2009), is consistent with definitions of natural background cited in state rule (Minn. R. 7050.0150, subp. 4): "'Natural causes' means the multiplicity of factors that determine the physical, chemical or biological conditions that would exist in the absence of measurable impacts from human activity or influence." Also, the Clean Water Legacy Act (Minn. Stat. § 114D.10, 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."

The date 1830 is used as a reference point for measuring the beginning of anthropogenic effects on the TSS loads to the Mississippi River as estimated from Lake Pepin sediment cores (Figure 2). This period is prior to European settlement, which introduced dramatic changes to the landscape discussed in Section 2.1 Water Quality History. These changes consisted primarily of converting more than 90% of native prairie and wetlands to agriculture through tillage and artificial drainage, along with the introduction of annual row crops. These changed altered a landscape that was geologically predisposed to high erosion rates. As Schottler explains, the land form that creates the potential for high erosion rates is natural, but today's high rates of erosion and sediment concentration are not natural:

> *"Because of geologic history, non-field sources such as bluffs and large ravines are natural and prevalent features in some watersheds. Consequently these watersheds are predisposed to high erosion rates. However, it would be highly inaccurate to label this phenomenon as natural. Post-settlement increases in sediment accumulation rates in Lake Pepin, the Redwood Reservoir…and numerous lakes in agricultural watersheds … clearly show that rates of sediment erosion have increased substantially over the past 150 years. Coupling these observations with the non-field sediment yields determined in this study, demonstrates that the rate of non-field erosion must also have increased. The features and potential for non-field erosion may be natural, but the rate is not." (Schottler et al., 2010, page 32)*

Starting with the finding that historical, natural background levels of sedimentation in Lake Pepin are almost 10 times less than current rates, the MPCA apportioned this total natural background load among basins in proportion to their relative contributions of sediment to Lake Pepin. Historical sediment core interpretation shows that the relative proportions of sediment contributed by each source area have remained stable over time (Kelley and Nater, 2000):

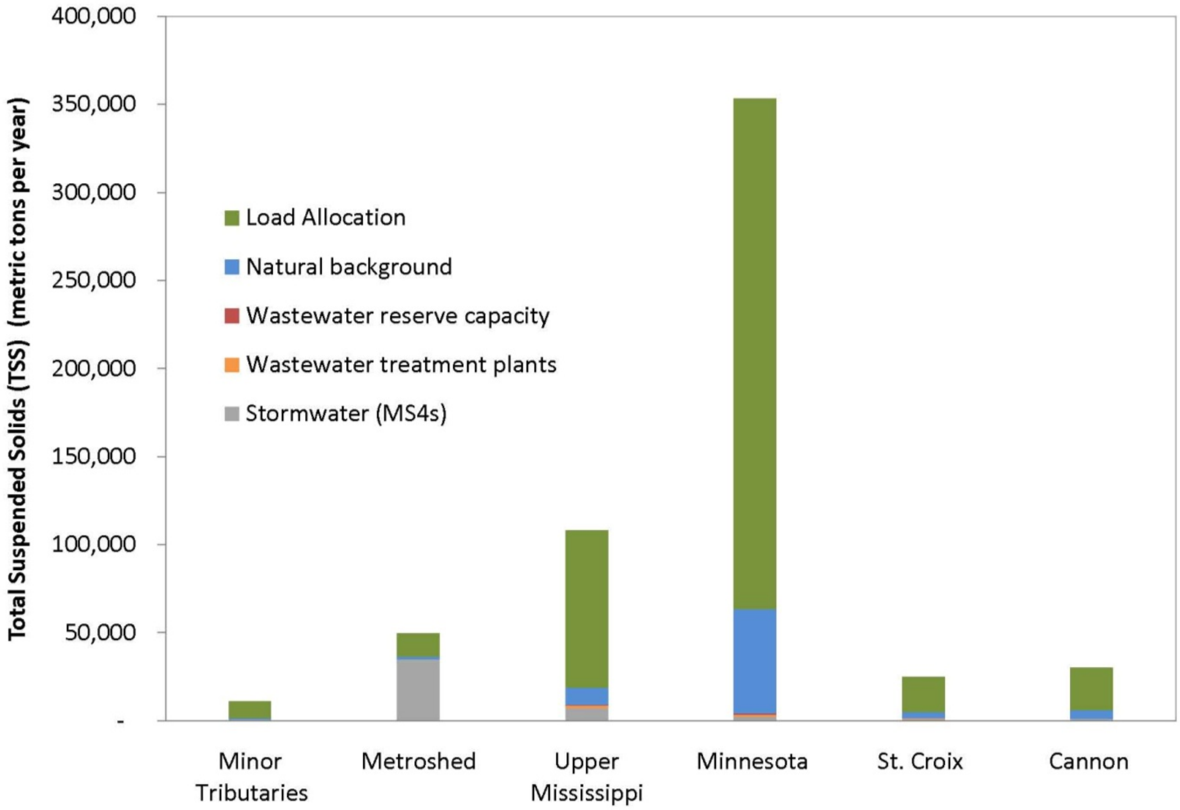
- 75% to the Minnesota River;
- 13% to the UMR;
- 6% to the Cannon River;
- 4% to the St. Croix River; and
- 2% to minor tributaries and urban areas.

Since cultivated fields and cities had not yet been established by European settlers before 1830, the period when natural background was measured, the allocation for natural background is attributable to non-field (or non-surficial) sources.

The LA exceeds natural background at all flow intervals. The MPCA made no attempt to divide the LA into subcomponents such as field, ravine, bluff, and stream bank, as more research is needed to determine these components with accuracy, a task properly undertaken at the 8-digit major watershed scale or smaller. Studies are underway that will generate some of this information.

Internal loading, i.e., resuspension of existing sediment, is also a part of the LA. It is a dynamic source of the TSS in the Mississippi River in that it varies by day due to wind and wave action and varies across the river (main channel vs. back waters). Modeling efforts for this TMDL are generally limited to quantifying sediment loads in the main channel and large backwaters such as Spring Lake. The model had sufficient resolution to account for internal loading from the upper reaches of Pool 2 through Upper Lake Pepin (area of the TSS impairment) and was done for various flow conditions. Internal LA estimates were based on modeling estimates (factoring in a 50% reduction in internal loading from existing loading) and are provided in Tables 7 through 9 as a subset of the overall LA category. Internal load is shown only in the Total column and not by basin since resuspension occurs in the pools and Lake Pepin themselves. In Tables 8 and 9 these internal LAs are depicted for only the average (or moderate) flow condition because that is the condition under which the modeling reduction scenarios were done. It is recognized, however, that internal loading occurs across all flow regimes and that efforts to achieve the needed 50% internal load reduction will benefit all flow regimes. Because of its importance in achieving the water quality goal, internal loading should be among the sources receiving priority attention in restoration funding programs.

Figure 22: Allocated Sediment Loads by River Basin and Metroshed



The nonpoint-source pollution categories of LA and natural background dominate the TMDL allocations for TSS in all areas except the Metroshed, where urban stormwater is prominent. (MPCA graphic)

6.3 Margin of safety

The Clean Water Act requires that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and WLAs and water quality. The EPA guidance explains that the MOS may be implicit, such as incorporated into the TMDL through conservative assumptions in the analysis, or explicit, such as expressed in the TMDL as loadings set aside for the MOS.

An important consideration in developing an MOS for this TMDL is to consider the nature of the water quality standard and how it is measured. The TSS standard is based on a season-average TSS concentration of 32 mg/L, to be attained in at least five years over a moving 10-year period of record. Weekly, monthly, or even annual excursions above the standard of 32 mg/L are not problematic within the context of this standard. The MOS needs to ensure that the standard will be achieved over the moving 10-year assessment period, given the TMDL allocations established for point and nonpoint sources, taking into account uncertainties in the relationship between the allocations and achievement of the standard within this timeframe. In general, the nature of the standard would not seem to call for a large margin of safety, to the extent that short-term inaccuracies in modeling are unlikely to impact season-average estimates, unless there is a significant pattern of over- or under-prediction.

The ECOMSED-RCA model was developed with 22 years of data, an exceptionally long and detailed data set which allowed 10-11 year periods for calibration and confirmation of the model, before it was used to evaluate alternative TSS reduction scenarios. In contrast to the biological measures such as zooplankton abundance, which are difficult to model with a high degree of certainty, the relationship between alternative TSS loads and TSS concentrations in the final model are quite accurate. Spatial variations in solids concentrations calculated by the model are largely controlled by the parameterizations of resuspension and settling/deposition (Limno-Tech, Inc. 2009, page 91). Separate settling velocity equations were used for the river environment and for Lake Pepin, to capture the distinct dynamics of flowing vs. calm water.

The most difficult challenge was to accurately capture sediment resuspension in lower Pool 2 (Spring Lake), a broad, shallow expanse of water which is subject to sudden spikes in TSS from wind and wave action. A "background resuspension" load was added to the ECOMSED output before linking the results to the RCA model, in the June to September period, in areas of 5 feet or less depth. Comparison of predicted vs. monitored data at Lock and Dam 3 (Limno-Tech, Inc., 2009, page 110) indicates that this adjustment successfully addressed the TSS under-prediction problem.

In fact, over-prediction of peaks in higher flow years such as 1996-1997, and 2000-2001, suggests an implicit MOS is built into the model. That is, if LAs are established to meet the water quality standard using a model that tends to over-predict peaks, which may represent the critical period for meeting the TMDL, it is possible the LAs and WLAs are higher than needed to meet the standard.

In addition to this implicit MOS provided through the model, the MPCA has provided an additional, explicit MOS equal to 6% of allocated loads. This approach, in effect, sets reductions to meet a season average of 30 mg/L TSS, which is the target set by the Upper Mississippi River Conservation Committee (UMRCC) for submersed aquatic vegetation in navigation pools downstream of Lake Pepin, which benefit from the natural sediment trapping provided by Lake Pepin (Sullivan et al., 2009). Because the restoration potential of this lower reach is higher than that of the South Metro Mississippi, the UMRCC proposed a more stringent TSS criterion. An advantage of basing the MOS on the water quality target, rather than on model variability alone, is that the MOS will be reflected in any future model modifications. Also, this basis will keep the focus on achievement of the ambient water quality standard and the aquatic life uses it protects.

6.4 Critical conditions and seasonality

The standard governing the TMDL is a summer mean concentration of 32 mg/L TSS, to be attained in at least five years over a 10-year period of record. A critical period for attaining this standard is a continuous number of wet, high-flow years that would make attaining the 32 mg/L TSS summer mean more difficult than usual. Such a period occurred during the 1990s. The UMR-LP model allows evaluation of how alternative load-reduction scenarios would have affected TSS each of these years. A critical test for the TMDL is attainment of a 32 mg/L in at least five years over the wettest 10-year period of record for which water quality data are available. The period 1993-2002 results in the highest 10-year median flow. Modeling for the TMDL indicates that the LAs will achieve the TSS standard of 32 mg/L during and leading up to the submersed aquatic vegetation growing season.

Submersed aquatic vegetation in the Mississippi River is subjected to variable light conditions throughout any growing season or series of growing seasons. Monitoring data show that submersed aquatic vegetation can withstand limited durations of high turbidity, but that prolonged turbid conditions, especially over two or more consecutive years, can impair growth and survival (Sullivan et al., 2009). The site-specific TSS standard is designed to allow vegetation to flourish even though turbidity may be periodically higher than 32 mg/L TSS. Turbidity and submersed aquatic vegetation suppression occur at moderate and higher river flows. The critical period of submersed aquatic vegetation growth is June to September. The site-specific TSS standard is designed to protect submersed aquatic vegetation from high turbidity conditions during this period. Measures taken to achieve nonpoint-source reductions called for in the LAs will also reduce TSS levels in the April to May period, which tend to be high-runoff months.

6.5 Future growth and wastewater reserve capacity

The increase in impervious areas in the form of roads, parking lots, buildings, and landscape changes due to growing population will contribute additional runoff and TSS loading unless measures are put in place to prevent that. The allocations for nonpoint sources are for all current *and* future sources. This means that any expansion of nonpoint sources will need to comply with the LA provided in this report. Additional nonpoint sources (e.g., shifting grassland to row cropland) could make meeting the TMDL more difficult over time. Therefore, continued efforts over time to prevent soil/sediment delivery to streams will be critical.

As a result of population changes and contributions from industrial wastewater discharges, flows at some wastewater treatment facilities are likely to increase over time. This increase is not likely to have an impact on any of the impaired reaches because permits authorizing the vast majority of wastewater flow in the watershed contain calendar month average TSS effluent limits at concentrations that are below the 32 mg/L water quality standard. Therefore, increased flows from most wastewater treatment facilities will add to the overall loading capacity by increasing river flows.

As demonstrated by Tetra Tech (Cleland, 2011), facilities that discharge below the water quality standard provide assimilative capacity beyond that which is required to offset their respective TSS loads. Nevertheless, these facilities are still discharging the pollutant of concern (TSS), and therefore individual WLAs are required (WLAs are listed in Appendix A; derivation methodology is described in section 6.0).

The NPDES WLAs in this TMDL are based upon current discharges. For a new or expanding (non-stormwater) NPDES-permitted facility in the watershed, permit limits will maintain discharge effluent at a concentration below the respective in-stream TSS concentration target. A new or expanding facility will increase both load and flow, as described. This effect will be most pronounced in lower flows, when conventional point sources have the greatest impact. The increased flow will effectively increase the overall assimilative capacity of the river, as the flow increase will be larger proportionally than the load increase.

Individual WLAs for permits that contain calendar month average TSS effluent limits in excess of the 32 mg/L water quality standard include 50% more than the authorized discharge load to accommodate future growth.

Controlled discharge stabilization pond WWTPs provide reliable and cost effective wastewater treatment for small communities. This type of wastewater treatment technology is often preferred for small communities due to its longevity and low operation and maintenance costs.

Minnesota

Stabilization ponds are not, however, consistently capable of achieving effluent TSS concentrations below the 32 mg/L water quality standard established for the South Metro Mississippi River. The MPCA anticipates that new controlled discharge stabilization WWTPs with the TSS effluent limits that exceed the 32 mg/L water quality standard may be built in the future by communities that do not currently have centralized wastewater treatment services and to replace small aging continuously discharging wastewater treatment facilities. Because the TSS effluent limits for these types of WWTPs will exceed 32 mg/L their permits are not subject to the procedure for new and expanding wastewater discharges described in section 6.6 below. A separate waste LA of 47 metric tons per year has been established as reserve capacity for future construction of controlled discharge stabilization pond WWTPs in Minnesota. This includes two components:

1. Upgrading unsewered communities. Reserve capacity for Minnesota unsewered communities is based on the assumption that communities with population of 100 or more that currently lack centralized wastewater collection and treatment, may build controlled discharge stabilization pond WWTPs in the future. Reserve capacity for these communities has been calculated on the assumption that WWTP design flows will be 100 gallons per capita per day. The total population of unsewered communities with 100 or more residents in the project watershed is estimated to be 7,192.

2. Conversion of continuously discharging WWTPs. It is estimated that approximately 5% of small continuously discharging WWTPs with design flows of less than 0.1 mgd may build controlled discharge stabilization pond WWTPs in the future. Reserve capacity has been established for these WWTP conversions in Minnesota by assuming that 5% of the design flow of the 22 existing WWTPs in the project area, with design flow of less than 0.1 mgd, will be converted to stabilization ponds.

Because MS4-permitted land areas can be subject to change the MPCA's Stormwater Program has outlined for TMDLs in general the potential circumstances in which transfer of watershed runoff allocations may need to occur and how load is transferred between and/or within the WLA and LA categories. These scenarios are described below.

1. New development occurs within a regulated 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 regulated MS4 acquires land from another regulated MS4. Examples include annexation or highway expansions. In these cases, the transfer is WLA to WLA.
3. One or more non-regulated MS4s become regulated. 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 Urban 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. 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.

Wisconsin

For the area of this TMDL located in Wisconsin, 5% of Wisconsin's wastewater WLA has been set aside as a reserve capacity to potentially provide WLAs for new or expanding industrial or municipal WPDES individual permit holders. This is equivalent to 41 metric tons per year. This reserve capacity is not intended to be applied to general permittees or MS4s.

If a municipality or industry wishes to commence a new discharge or expand an existing discharge within the TMDL area in Wisconsin, the permittee must submit a written notice of interest along with a demonstration of need to the WDNR. Interested dischargers will not be given reserve capacity unless they can demonstrate a need for a new or increased WLA. Examples of point sources in need of WLA would include those that are a new discharge or those that are significantly expanding their current discharge and would be unable to meet current WLAs despite optimal operation and maintenance of their treatment facility.

The WDNR will use the information provided by the permittee to determine if reserve capacity is available and then issue, reissue, or modify a WPDES permit to implement a new WLA based on application of reserve capacity. The new WLA will be used as the basis for effluent limits in the WPDES permit.

Pursuant to 40 CFR 122.41(g) and s. NR 205.07(1)(c), Wis. Adm. Code, a WPDES permit does not convey any property rights of any sort nor any exclusive privilege. All proposed reserve capacity assignments are subject to WDNR review and approval and must be consistent with applicable regulations. Reserve capacity decisions and related permit determinations are subject to public notice and participation procedures as well as opportunities for challenge at the time of permit modification, revocation and reissuance, or reissuance under chapter 283, Wis. Stats.

6.6 Procedures for new and expanding wastewater dischargers

Minnesota

The analysis summarized above demonstrates that current discharges can be expanded and new NPDES discharges can be added while maintaining water quality standards provided the permitted NPDES effluent concentrations remain below the in-stream targets. Given this circumstance, the MPCA will use a streamlined process for updating TMDL WLAs to incorporate new or expanding discharges. This process will apply to the non-stormwater facilities within Minnesota identified in Appendix A of the TMDL (in the case of expansion) and any new wastewater or cooling water discharge in the South Metro Mississippi watershed:

- A new or expanding discharger will file with the MPCA permit program a permit modification request or an application for a permit reissuance. The permit application information will include documentation of the current and proposed future flow volumes and the TSS loads.
- The MPCA permit program will notify the MPCA TMDL program upon receipt of the request/application, and provide the appropriate information, including the proposed discharge volumes and the TSS loads.

- TMDL program staff will provide the permit writer with information on the TMDL WLA to be published with the permit's public notice.
- The supporting documentation (fact sheet, statement of basis, effluent limits summary sheet) for the proposed permit will include information about the TSS discharge requirements, noting that for TSS, the effluent limit is below the in-stream TSS target and the increased discharge will maintain the TSS water quality standard. The public will have the opportunity to provide comments on the new proposed permit, including the TSS discharge and its relationship to the TMDL.
- The MPCA TMDL program will notify the EPA TMDL program of the proposed action at the start of the public comment period. The MPCA permit program will provide the permit language with attached fact sheet (or other appropriate supporting documentation) and the new TSS information to the MPCA TMDL program and the EPA TMDL program.
- EPA will transmit any comments to the MPCA permits and the TMDL programs during the public comment period, typically via e-mail. The MPCA will consider any comments provided by the EPA and by the public on the proposed permit action and the WLA and respond accordingly, conferring with the EPA if necessary.
- If, following the review of comments, the MPCA determines that the new or expanded TSS discharge, with a concentration below the in-stream target, is consistent with applicable water quality standards and the above analysis, the MPCA will issue the permit with these conditions and send a copy of the final TSS information to the EPA TMDL program. The MPCA's final permit action, which has been through a public notice period, will constitute an update of the WLA.
- The EPA will document the update to the WLA in the administrative record for the TMDL. Through this process the EPA will maintain an up-to-date record of the applicable WLA for permitted facilities in the watershed.

Wisconsin

If a discharger is proposing a new or expanded discharge of TSS to a receiving water within the TMDL drainage area located within Wisconsin, the new or expanded discharge may not discharge TSS except as follows:

1. The new or expanded discharge of TSS is allocated as part of the reserve capacity in the TMDL;
2. The discharger can demonstrate that the new or increased discharge of TSS will improve water quality or not cause and contribute to the impairment of the impaired water; or
3. The discharger can demonstrate that the new or increased TSS load will be offset through a water quality trade or other means with another discharge of TSS in accordance with Wisconsin's trading guidance and statutory requirements. The offset must be approved by the WDNR and must be implemented prior to any new or increased discharge.

Consistent with the requirements outlined above, the WDNR can include a water quality based mass limitation for the TSS consistent with the WLA and assumptions contained within the TMDL if the WDNR determines the new discharger will discharge the TSS at concentrations or loadings which may cause or contribute to exceedances of the water quality criteria in ch. NR 102.04 in either the receiving water or downstream waters. To estimate the amount of the TSS discharged by a new or expanded discharger, the WDNR may consider projected discharge information from the permit applicant and the TSS discharge information from similar sources. A new discharge includes a relocation of an outfall to different receiving water.

The WDNR will not include a schedule of compliance for new or expanded discharges of the TSS; new or expanded discharges of the TSS must meet applicable water quality criteria and the applicable TMDL mass allocations prior to discharge.

7.0 General Implementation Strategy

In the intervening time since the public noticing of this TMDL report a separate effort was launched and completed to create an implementation strategy document entitled "Sediment Reduction Strategy for the Minnesota River Basin and South Metro Mississippi River" (hereinafter, "Sediment Strategy"). It can be accessed at http://www.pca.state.mn.us/ark8qrf. Because this document now exists much of this section of the TMDL report has been revised and significantly shortened to instead provide a brief overview of the Sediment Strategy document. A separate section is provided below (Section 7.2) outlining the State of Wisconsin's overall implementation approach.

7.1 Minnesota implementation overview

7.1.1 Nonpoint sources

The Sediment Strategy is intended to establish a foundation for local watershed planning to reach sediment TMDL goals. It focuses primarily on the nonpoint portion of the contributing sources and recognizes the extensive contribution and need for emphasis on near-channel sources.

The document is structured to provide the following:

- TMDL overview and interim milestones,
- Sources of sediment,
- Strategies and actions for sediment reduction,
- Civic engagement: A key strategy for restoring and protecting the Minnesota and South Metro Mississippi Rivers, and
- Monitoring, tracking and adaptive management.

In an effort to most effectively address watersheds or subwatersheds with significant near-channel source contributions and high sediment loading rates, a series of priority initiatives have been identified. These include:

- Reduce peak flow magnitude and duration
- Flow duration and magnitude goals
- Set water storage goals by watershed
- Define effective water storage practices
- Consider hydrology and downstream waters in local watershed planning efforts
- Funding assistance
- Increase living cover
- Combine state and federal funding to for CRP-RIM partnership for water storage
- Development of a Sediment Reduction Task Force
- Stakeholder Workgroups

Included within the strategy discussion are alternatives and tools for consideration by drainage authorities, information on available tools and approaches for identifying areas of high sediment erosion as well as tracking efforts within a watershed, and additional research priorities.

While the Sediment Strategy document focuses on external loading it should be noted that several governmental entities, such as the MPCA, DNR, WDNR, U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service, will be involved in plans and efforts to decrease internal loading from wind and wave resuspension by 50% by building islands and periodic water level draw-downs. Boating restrictions also have been suggested. Islands in shallower areas with wide expanses of open water, such as lower Pool 2, can reduce wind fetch in order to cut down on sediment re-suspension. Draw-downs of the water level in a navigation pool expose the bottom sediment in shallow floodplains and areas near islands, allowing the sediment to dry and consolidate. Exposure also facilitates the growth of rooted vegetation, which reduces wind and wave erosion. Detailed plans for this work are provided in the Mississippi Makeover Project (see http://www.dakotacountyswcd.org/wshd_missmak.html).

The Sediment Strategy recognizes the hierarchical nature of implementation at various geographic scales. The South Metro Mississippi watershed includes 25 major (8-digit HUC) contributing watersheds (Figure 5). Some of these upstream watersheds include streams with turbidity/TSS impairments. The MPCA and local partners have or are developing the TMDLs and associated implementation strategies to address the majority of these upstream impairments.

The MPCA is implementing a framework to integrate its water quality management programs on a major watershed scale, a process that includes:

- Intensive watershed monitoring;
- Assessment of watershed health;
- Development of Watershed Restoration and Protection Strategy (WRAPS) documents; and
- Management of NPDES and other regulatory and assistance programs.

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

For purposes of South Metro Mississippi TMDL, major watersheds of concern are those listed in Table 10, below. Each watershed is scheduled to be addressed through a cyclical sequence of monitoring, assessment and strategy development that has been established for Minnesota's 80 major watersheds. The sequence shown here is in draft form, subject to adjustments.

Table 10: Priority watershed planning schedule

Watershed	Monitoring	Strategy Development
Le Sueur River	2008	2011
Hawk Creek	2010	2013
Watonwan River Middle Minnesota River	2013	2016
Lower Minnesota River Rush River High Island Creek	2014	2017
Redwood River Cottonwood River	2016	2019
Blue Earth River	2017	2020

7.1.2 Regulated stormwater

Minnesota

MS4 Stormwater: Under the EPA's NPDES stormwater program, the MPCA has developed rules to prevent stormwater from washing harmful pollutants into surface waters. At present, 222 cities, townships and other public entities that own and operate MS4s within the contributing area of the South Metro Mississippi River watershed are subject to NPDES permits to discharge stormwater.

The MPCA has developed guidance for addressing TMDL requirements in MS4 General Permit applications and Stormwater Pollution Prevention Program documents (http://www.pca.state.mn.us/index.php/view-document.html?gid=19465). In addition, the MPCA has developed guidance to assist permittees with meeting reporting requirements in the permit. This guidance includes detailed discussion of appropriate models and other approaches for estimating load reductions associated with implementation of stormwater BMPs (http://www.pca.state.mn.us/sbiza7c). The MS4s that are in a watershed subject to a reduction who claim to be in compliance with the target load of 154 pounds per acre per year for their MS4-regulated area have the option to demonstrate compliance via monitoring or modeling.

For new development projects, MPCA's current Phase II MS4 General Permit requires no net increase from pre-project conditions (on an annual average basis) of stormwater discharge volume, stormwater discharges of TSS, and stormwater discharges of Total Phosphorus (TP). For re-development projects, MPCA's current Phase II MS4 General Permit requires a net reduction from pre-project conditions (on an annual average basis) of stormwater discharge volume, stormwater discharges of TSS, and stormwater discharges of TP. These provisions in the MS4 permits will prevent increases in loading.

Construction Stormwater: The WLA for stormwater discharges from sites where there is construction activities reflects the number of construction sites of one or more acres expected to be active in the watershed at any one time, and the Best Management Practices (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 the State'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 Appendix A of the Construction General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. It should be noted that all local construction stormwater requirements must also be met.

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. The BMPs and other stormwater control measures that should be implemented at the industrial sites are defined in the State's NPDES/SDS Industrial

Stormwater Multi-Sector General Permit (MNR050000) or NPDES/SDS General Permit for Construction Sand & Gravel, Rock Quarrying, and Hot Mix Asphalt Production facilities (MNG490000). If a facility owner/operator obtains coverage under the appropriate NPDES/SDS General Stormwater Permit and properly selects, installs and maintains all BMPs required under the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. It should be noted that all local stormwater management requirements must also be met.

Wisconsin

The WDNR has developed guidance addressing the implementation of TMDLs in MS4 permits. A copy of the guidance can be found at: (http://dnr.wi.gov/news/input/documents/guidance/ms4guidancefinal.pdf). As outlined in the guidance, the MS4s can demonstrate compliance with the TMDL through monitoring or modeling; however, it is anticipated that modeling will be the principal compliance measure. In addition to the guidance, the TMDL requirements are outlined in both MS4 general and individual permits. A copy of the general permits can be found at: (http://dnr.wi.gov/topic/stormwater/municipal/). Permit WI-S050181-1 covers newly permitted municipalities and permit WI-S050075-2 covers municipalities that previously had permit coverage. The TMDL requirements under both permits are similar with only minor adjustments in compliance dates based on the issuance date of the permit.

For new development projects, it is anticipated that the requirements contained in ch. NR 151, Wis. Adm. Code will be sufficient, and in some cases may exceed the TSS reduction requirements of this TMDL. As discussed in the guidance, additional reductions incurred through new development can be credited toward established urban areas where appropriate

The reductions stipulated in this TMDL meet the water quality requirements for Lake Pepin. Additional TSS reductions may be required to meet local water quality needs or to meet reductions for other pollutants such as phosphorus. Such needs will be discussed with applicable municipalities prior to permit reissuance.

7.1.3 Wastewater treatment facilities

Minnesota

As explained above, wastewater treatment facilities that discharge at a concentration of 30 mg/L or less, which includes most of the larger facilities, do not cause or contribute to impairment of the South Metro Mississippi River, as they are discharging below the TSS standard of 32 mg/L TSS. Their WLAs are calculated from current permit limits and no reductions are required. Future new or expanded WLAs for wastewater facilities will be managed in accordance with the process described in Section 6.6. The bulk of those facilities that discharge at or above the TSS standard are comprised of stabilization ponds. Most of these are small facilities that discharge twice a year, typically in the March-June time frame and in the September-October time frame. The TMDL sets individual WLAs for these facilities at a level equivalent to 50% in excess of current permit limits to accommodate future growth. Thus, no reductions in TSS loads are required and procedures are in place to accommodate future increases in wastewater TSS loads.

Wisconsin

Wastewater treatment facilities with surface water outfalls or discharges to surface water will typically be handled in one of two ways depending on if the facility has a general or individual permit.

Facilities issued general permits will be deemed in compliance with their allocation provided they meet their permit requirements. In general, most permits have TSS concentration requirements equivalent to 40 mg/L measured as a daily maximum concentration. This will result in an annual average discharge less than or equivalent to the TMDL target concentration of 32 mg/L.

For individual permits, facilities will receive effluent limits based on the TMDL derived WLAs. Procedures outlined in section 6.6 apply to new discharges or increased discharges beyond what was originally allocated in the TMDL.

7.1.4 Implementation cost

Estimating costs to achieve this TMDL is a very difficult exercise due to lack of accurate estimates for current loading from all sources and variable costs among different BMPs, among other things. Given that the South Metro Mississippi River TMDL is largely an overlay TMDL with many TMDLs nested within it, it is perhaps most helpful to look at the costs estimated in the component TMDLs, as reported in either the TMDL reports themselves or the accompanying implementation plans. This is provided in Table 11 below (note that the Lower Cannon River Turbidity TMDL and the Lower Vermillion River Turbidity TMDL are not shown as those did not report costs). While these TMDLs do not account for all of the loading (and thus costs), it does represent the bulk.

Table 11: Implementation cost information from major TMDLs within the South Metro Mississippi TMDL drainage area.

Project	Cost information	Notes
North Fork Crow and Lower Crow Bacteria, Turbidity, and Low Dissolved Oxygen TMDL	$8-10M	- Estimate includes all impairments - Does not separate point and nonpoint
Carver Creek Turbidity TMDL	$18-86M total $1.5M-20M for MS4s	
Bevens Creek Turbidity TMDL	$20-91M total $1.1M-14M for MS4s	
Bluff Creek: Turbidity and Impaired Fish Biota	$5.8M Estimates 15% ($0.9M) of total for MS4s	- Estimate includes biota
Minnesota River Turbidity TMDL (draft)	$10-40M total per major watershed $173M for MS4s	- Many assumptions/caveats - Does not account for already-implemented urban BMPs

7.2 Wisconsin implementation activities: agricultural and rural nonpoint sources

Wisconsin has exclusive authority over the TMDL implementation in its territory, and will work toward achievement of the LA targets from its tributaries using its own programs, authorities and resources.

To meet the identified LA for the Wisconsin portion of the direct drainage area to the Mississippi River and the upper portion of Lake Pepin, the state of Wisconsin will implement a suite of state, federal and local programs in a coordinated manner and consistent with Wisconsin's Section 319 Nonpoint Source Management Plan. A primary focus of Wisconsin's activities will be implementation of the nonpoint source performance standards and prohibitions contained in Chapter NR 151, Wisconsin Administrative Code. The agricultural nonpoint source performance standards and prohibitions are "quasi-regulatory." That is, they may be enforced if cost share assistance is provided. However, the state of Wisconsin expects that implementation of these performance standards will be mainly achieved through voluntary compliance. The performance standards and prohibitions along with some of the primary implementation programs are described below.

7.2.1 Wisconsin performance standards and prohibitions

The Wisconsin performance standards and prohibitions are intended to be minimum standards of performance necessary to achieve water quality standards across the state. The performance standards relating to sediment control are identified by source type or intended management as follows.

- Sheet, rill, and wind erosion: All cropped fields shall meet the tolerable soil erosion rate established for that soil.
- Tillage setback: No crop producer may conduct a tillage operation that negatively impacts stream bank integrity or deposits soil directly in surface waters. No tillage operation may be conducted within 5 feet of the surface waters, and the area must be maintained within the tillage setback in adequate sod or self-sustaining vegetative cover that provides a minimum of 70% coverage.
- Phosphorus index: Croplands, pastures, and winter grazing areas shall average a phosphorus index of 6 or less over the accounting period and may not exceed a phosphorus index of 12 in any individual year within the accounting period. (Attaining the phosphorus index, for many fields, will require control of soil erosion and sediment.)
- Clean water diversions: Runoff from agricultural buildings and fields shall be diverted away from feedlots, manure storage areas, and barnyards located within water quality management areas (300 feet from a stream or 1,000 feet from a lake or areas susceptible to groundwater contamination).

Other performance standards control some sediment but are primarily intended to control nutrients and include the following:

- Nutrient management: Agricultural operations applying nutrients to agricultural fields shall do so according to a nutrient management plan.
- Manure management prohibitions:
    - No overflow of manure storage facilities;
    - No unconfined manure piles in a water quality management area;
    - No direct runoff from feedlots or stored manure into state waters; and

  - No unlimited livestock access to waters of the state in locations where high concentrations of animals prevent the maintenance of adequate or self-sustaining sod cover.
- Manure storage facilities: All new, substantially altered, or abandoned manure storage facilities shall be constructed, maintained or abandoned in accordance with accepted standards. Failing and leaking existing facilities posing an imminent threat to public health or fish and aquatic life or violating groundwater standards shall be upgraded or replaced.

7.2.2 Primary implementation programs

The following is a brief description of some of the primary implementation programs to meet the performance standards described above.

- Wisconsin Farmland Preservation Program/Working Lands Initiative: Administered by the Wisconsin Department of Agriculture, Trade and Consumer Protection, the Farmland Preservation Program provides tax credits to help preserve land in agricultural production. To receive tax credits, the land owner must certify on income tax forms that the farmland meets all performance standards and prohibitions. Compliance checks are made.
- Environmental Quality Incentives Program (EQIP): A federal Farm Bill program administered by the NRCS provides financial and technical assistance to meet program goals, including water quality and soil erosion control. Funding for this program has grown substantially over the last decade.
- County Land and Water Resource Management Plans: Under state law, counties are required to develop, submit for approval and implement county-wide management plans, including:
  - Inventorying water quality and soil erosion conditions in the county.
  - Identifying key water quality and soil erosion problems, and practices to address water quality and soil erosion problems.
  - Identifying priority farm areas using a range of criteria (e.g., impaired waters, manure management, high nutrient applications).
  - Identifying strategies to promote voluntary compliance with statewide performance standards and prohibitions, including information, cost-sharing, and technical assistance.
  - Identifying enforcement procedures, including notice and appeal procedures.
  - Developing a multi-year work plan to achieve soil and water conservation objectives.

In many ways, the county land and water resource management plan provides a coordination link at the local level for the many federal, state and local programs. Counties do receive state grants from the Department of Agriculture, Trade and Consumer Protection to implement these plans.

- Wisconsin Nonpoint-Source Management Program: The WDNR’s nonpoint-source management program provides a linkage between land management and water quality through a variety of means, such as identifying impaired waters, identifying performance standards and prohibitions, administering regulatory programs and administering a number of grant programs to assist in meeting the LAs. The performance standards and prohibitions are described above. The grant programs include, but are not limited to:
  - Targeted Runoff Management Grant Program, which gives grants for controlling nonpoint sources through a competitive process where projects related to impaired waters receive a priority.

- Notice of Discharge Grant Program for animal feeding operations.
- Urban Nonpoint Source and Storm Water Management Grant Program.
- River Planning and Protection Grant Program.

- Wisconsin Soil and Water Resource Management Program: The Department of Agriculture, Trade and Consumer Protection (DATCP) oversees and supports county conservation programs that implement the state performance standards and prohibitions and conservation practices through its Soil and Water Resource Management Program. Counties must receive the DATCP's approval of their land and water resource management plans to receive state cost-sharing grants for best management practice installation. The DATCP is also responsible for providing local assistance grant funding for county conservation staff implementing the county plans.
- Conservation Reserve Program (CRP): The Conservation Reserve Program, administered by the Farm Service Agency, is a voluntary federal Farm Bill Program available to agricultural producers to protect environmentally sensitive land. It has a number of sub-programs, such as the Continuous Sign-up CRP and the Conservation Reserve Enhancement Program. In general, producers enrolled in CRP and its sub-programs plant long-term, resource-conserving vegetation to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, participants receive rental payments and cost-share assistance.

7.3 Reasonable assurance

A TMDL needs to provide reasonable assurance that water quality targets will be achieved through the specified combination of point and nonpoint source reductions reflected in the LAs and WLAs. "When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint-source load reductions will occur ... the TMDL should provide reasonable assurances that nonpoint-source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for the EPA to determine that the TMDL, including the LA and WLAs, has been established at a level necessary to implement water quality standards," according to the EPA guidance (EPA, 1992).

In the South Metro Mississippi TSS TMDL, required point source controls will not be effective in improving water quality unless accompanied by considerable reductions in nonpoint sources. Another large TMDL project, for the Chesapeake Bay, has worked with EPA to define components of reasonable assurance and a framework for implementation (http://executiveorder.chesapeakebay.net/file.axd?file=2009%2f9%2f202(a)+Water+Quality+Draft+Report.pdf) (last viewed 7/16/2010):

- Revise tributary strategies to identify controls needed to meet the TMDL allocations.
- Evaluate existing programmatic, funding, and technical capacity to fully implement tributary strategy.
- Identify gaps in current programs and local capacity to achieve the needed controls.
- Commit to systematically fill gaps and build program capacity.
- Agree to meet specific, iterative, short-term (1-2 year) milestones.
- Demonstrate increased implementation and/or pollutant reductions.
- Commit to measure and evaluate progress at set times.
- Accept contingency requirements if milestones are not met.

For the South Metro Mississippi TMDL, the MPCA will loosely adopt the Chesapeake Bay Reasonable Assurance framework, with some modifications as follows:

- Develop strategies for the basins of the Minnesota, Upper Mississippi, and Cannon Rivers, plus direct watersheds, to meet TMDL allocations according to a phased schedule of implementation. This strategy will include how specific activities will be implemented at the appropriate scale – broad basin-wide initiatives and more specific actions for major watersheds. The MPCA staff will lead these strategies in accordance with the watershed approach.
- Evaluate existing programmatic, funding, and technical capacity to fully implement basin and watershed strategies.
- Identify gaps in current programs, funding, and local capacity to achieve the needed controls.
- Commit to systematically fill gaps and build program capacity. Agree to meet specific, iterative, short-term milestones. Demonstrate increased implementation and/or pollutant reductions.
- Commit to track/monitor/assess and report progress at set regular times – adaptive management.
- Accept contingency requirements if certain milestones are not on schedule.

Contingency requirements for this TMDL will not include ratcheting down further on point sources by reducing their WLAs, be they permitted MS4s or permitted wastewater treatment facilities. As this document attests, these are very minor sources of sediment to the South Metro Mississippi River, and further reducing their WLAs will not help to accomplish the goals of the TMDL in any measurable way.

Rather, contingency requirements to be implemented if nonpoint source targets are not met will focus on nonpoint sources themselves. They could take the form of:

- Review of statewide nonpoint source control programs and policies by state agencies and their implementation by local agencies.
- Requirements or inducements to implement existing nonpoint source authorities, including protected shoreland buffers (Minn. Stat. § 103F.201). For example, Dodge, Dakota, Goodhue, Olmsted, Wabasha, and Winona counties are working to achieve county-wide compliance using existing staff.
- Require buffers on public drainage ditches (Minn. Stat. § 103E.021) by a time certain. Six counties in the Minnesota River Basin have ordered a redetermination of benefits on all systems, which results in buffer implementation. These include Martin, Sibley, Freeborn, Steele, Redwood, and Faribault. Fourteen other counties have applied this process to selected drainage systems.
- Prohibition against excessive soil loss (Minn. Stat. § 103F.415). Fillmore, Olmsted, and Mower counties have such an ordinance in place.
- Prohibition of nuisance nonpoint source pollution (Minn. R. 7050.0210, subp. 2).
- Other existing regulatory measures that may be identified in the TMDL implementation plan.

The targeting of BMPs and ongoing research to pinpoint sediment sources and measure the effectiveness of nonpoint source remediation measures also will provide some assurance of achieving the LA of this TMDL. In addition, inter-agency work groups formed to direct the state's new Clean Water Fund will help to ensure that nonpoint source load reductions will be achieved. These groups will develop aids and guidance related to monitoring, implementation, research, and identification of measures and outcomes.

Within this framework of implementation, reasonable assurance will be provided with regard to nonpoint sources through commitments of funding, watershed planning, and use of existing regulatory authorities. The Clean Water Legacy Act (2006) provided the MPCA authority and direction for carrying out section 303(d) of the Clean Water Act, in addition to one-time funding to initiate a comprehensive 10-year process of assessment and TMDL development in Minnesota.

In November 2008, Minnesotans voted in support of the Clean Water, Land and Legacy Amendment to the state constitution. Through this historic vote, about $5.5 billion will be dedicated to the protection of water and land over the next 25 years. One third of the annual proceeds from sales tax revenue, an estimated $80 to $90 million, will be devoted to a Clean Water Fund to protect, enhance and restore water quality of lakes, rivers, streams, and groundwater. The Amendment specifies that this funding must supplement and not replace traditional funding. Approximately two-thirds of the annual proceeds will be earmarked for water quality protection and restoration.

In addition, efforts will be made to make more effective use of existing land-use authorities, as the Clean Water Legacy Act (Minn. Stat. § 114D.20, subd. 3) enjoins state agencies to "…use existing regulatory authorities to achieve restoration for point and nonpoint sources of pollution where applicable, and promote the development and use of effective non-regulatory measures to address pollution sources for which regulations are not applicable." The MPCA will seek to pursue the following policies with state and local agencies:

- Comply with 50-foot buffer required for the shore impact zone of streams classified as protected waters (Minn. Stat. § 103F.201) for agricultural land uses.
- Comply with requirements to buffer highly erodible land within the 300-foot shoreland district, as described in the state shoreland rule.
- Establish a process and timeline to ensure compliance with the requirement for a 16.5-foot buffer on agricultural drainage ditches as defined in Minn. Stat. § 103E.021.
- Review the use of excessive soil loss ordinances by counties (described in Minn. Stat. § 103F.415) and the potential benefits of applying soil loss ordinances specifying a maximum rate of "T" (the tolerable rate of soil erosion which the NRCS defines as the rate at which soil can replenish itself) to areas contributing high amounts of sediment to the South Metro Mississippi and tributary watersheds.
- Review the MPCA's authorities on the prohibition of nuisance nonpoint source pollution (Minn. R. 7050.0210, subp. 2).

Reasonable assurance for permitted sources such as stormwater and wastewater is provided primarily via compliance with the respective NPDES permit programs, which have been described in section 6.0.

7.4 Water quality monitoring plan

The monitoring plan for the South Metro Mississippi TMDL is drawn from supporting documentation for the TSS site-specific standard (Sullivan et al., 2009).

The site-specific target of 21% average submersed aquatic vegetation frequency of occurrence is based on the Environmental Mapping and Assessment Program (EMAP) sampling design for main channel and side channel borders. A roughly equivalent target for main channel borders of about 12% frequency is based on the LTRMP sampling design. These submersed aquatic vegetation targets are roughly two times existing conditions based on long-term historical estimates (1976-2008) from TSS-derived submersed aquatic vegetation frequencies.

To evaluate attainment of these submersed aquatic vegetation targets, the MPCA recommends basing the initial monitoring frequency on a minimum of at least three annual EMAP-based surveys over a five year period. To simplify the submersed aquatic vegetation monitoring design and to make it consistent with the recommended TSS monitoring described below, the attainment of the submersed aquatic vegetation target should be evaluated by focusing on the river reach extending from Lock and Dam 2 to the Rush River in upper Lake Pepin. Once the target has been consistently achieved, then the MPCA can re-evaluate the monitoring frequency.

Achieving the above submersed aquatic vegetation frequencies for main channel borders can be expected to yield improved submersed aquatic vegetation frequency of occurrence in other aquatic areas (side channels and backwaters), but these would be considered secondary targets because they were not directly linked with main channel TSS concentrations.

To achieve the above submersed aquatic vegetation targets, summer average TSS concentrations will need to decrease by about 32% (47 to 32 mg/L) from existing conditions, based on the combined monitoring data for Locks and Dams 2 and 3. The MPCA suggests that attainment be based on achieving a median and 90th percentile summer average TSS concentrations of 32 and 44 mg/L, respectively, based on combined bi-weekly monitoring at Locks and Dams 2 and 3. Attainment of the standard will be measured over a moving 10-year period. The seasonal mean TSS must be equal to or below 32 mg/L in five or more years in each 10-year period to attain the standard. The auxiliary target of 44 mg/L at the 90th percentile also will be calculated over a 10-year moving period.

The 90th percentile was derived for main channel summer average data (1998-07) for Pool 13, a desirable reference pool that was used to derive the submersed aquatic vegetation targets. This auxiliary target means that a seasonal average of 44 mg/L should be exceeded in no more than one year over a 10-year period.

Achieving these TSS standards will improve the conditions for submersed aquatic vegetation growth throughout the impaired reach and reduce the sediment in-filling of Lake Pepin.

The MPCA's major watershed load monitoring program also will be an integral component of an overall monitoring plan for this TMDL.

8.0 Public Participation Record

The MPCA built participation by stakeholders, scientists, and the general public into the TMDL process from the start. The MPCA invited a representative group of individuals to the first Stakeholder Advisory Committee in October 2004, and has involved this group in discussions ever since (Appendix C). It engaged the committee in the development of two successive TMDL work plans – the first one to guide water quality assessment, and the second to guide watershed analysis. The MPCA promptly posted both on its web site. The MPCA has also posted presentations given at committee meetings on its web site.

The Lake Pepin TMDL Science Advisory Panel was established in February 2005, in consultation with the committee and the University of Minnesota (Appendix C). The first task undertaken by the Science Advisory Panel was to advise the MPCA on the development of a Request for Proposals (RFP) for Lake Pepin (including the South Metro Mississippi) TMDL modeling. A sub-group worked on details of the RFP work plan, which the entire Science Advisory Panel reviewed before the draft was finalized. The Science Advisory Panel met subsequently on occasion to review and comment on modeling results, the last such meeting being on Oct. 8, 2008. Frequently members offered a variety of perspectives on technical issues. In addition to attendance at meetings, several Science Advisory Panel members contributed technical information as well as many hours to discussion and analysis of technical issues that arose during the development and application of the UMR-LP model.

The MPCA held three sector-specific meetings in summer 2008 with groups representing:

- Agriculture;
- Conservation and environmental protection; and
- Municipal wastewater and stormwater.

As a follow-up to this meeting, an MS4 stakeholder advisory group was formed and met three times with considerable email correspondence. It includes representatives from MS4s, their consultants, and the MPCA. About 60 were involved in the kickoff meeting, where 13 members were selected for the advisory group. Meetings typically had eight to 10 people. This group focused on choosing a strategy for linking the permit to the TMDL and setting allocations.

In addition to the stakeholder committee and science advisers, the MPCA has involved the broader public through annual forums and conferences. The MPCA held three Lake Pepin Forums in Red Wing, Minnesota, on the Mississippi River, to engage stakeholders and citizens from the immediate vicinity of the impaired waters. Three annual technical conferences on the Lake Pepin TMDL also were held in 2006, 2007, and 2008 – the first two in the Twin Cities, and the third in Mankato, for two days. The MPCA staff members have made presentations on the Lake Pepin TMDL for many organizations and audiences, including the Minnesota Association of Watershed Districts, Minnesota Association of Soil and Water Conservation Districts, Upper Mississippi River Basin Association, Upper Mississippi River Conservation Committee, and others.

In order to further strengthen local and regional ties to this large, complex TMDL project, the MPCA has contracted with Dakota County and Dakota County SWCD to coordinate "Mississippi Makeover," a project to coordinate both local land use planning and Mississippi River management with the TMDL. A stakeholder group formed for Mississippi Makeover has developed a list of environmental indicators for the project. A technical committee chaired by the DNR developed metrics, or quantitative targets, for each of these indicators. The result will be an adaptive management approach to integrating the TMDL with river management and local land use planning.

An official comment period from February 27, 2012, to May 29, 2012, was provided by the MPCA for the draft TMDL report and was announced via a public notice published in the Minnesota State Register. Comments received were considered and several revisions to the final TMDL were made. Included within this process were various meetings and other communication between the MPCA and several entities that requested a contested case hearing during the 2012 public comment period.

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Appendix A: Wastewater Treatment Facility Waste Load Allocations and Industrial Stormwater Facilities

A.1. Minnesota Wastewater Permits with TSS Limits ≤ 32 mg/L Eligible for Future WLA Increase

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Cannon Falls WWTP	MN0022993	Cannon	Cannon River	07040002	21,900	60.00
CenterPoint Energy - WWTS	MN0063967	Cannon	Cannon River	07040002	884	2.42
Faribault Foods - Faribault Division	MN0050491	Cannon	Cannon River	07040002	20,723	56.78
Faribault WWTP	MN0030121	Cannon	Cannon River	07040002	289,810	794.00
Genova-Minnesota Inc	MN0046957	Cannon	Cannon River	07040002	4,987	13.66
Hope - Somerset Township WWTP	MN0068802	Cannon	Cannon River	07040002	438	1.20
Hope Creamery	MN0001317	Cannon	Cannon River	07040002	707	1.94
Lakeside Foods Inc - Owatonna Plant	MN0001571	Cannon	Cannon River	07040002	13,505	37.00
Lonsdale WWTP	MN0031241	Cannon	Cannon River	07040002	28,470	78.00
Medford WWTP	MN0024112	Cannon	Cannon River	07040002	5,840	16.00
Milestone Materials - Spinler Pit	MN0063045	Cannon	Cannon River	07040002	207,229	567.75
Morristown WWTP	MN0025895	Cannon	Cannon River	07040002	8,760	24.00
Nerstrand WWTP	MN0065668	Cannon	Cannon River	07040002	1,737	4.76
Northfield WWTP	MN0024368	Cannon	Cannon River	07040002	140,890	386.00
Owatonna WWTP	MN0051284	Cannon	Cannon River	07040002	207,320	568.00
SMC - Owatonna Quarry	MN0041394	Cannon	Cannon River	07040002	24,867	68.13
Telamco Inc	MNG255064	Cannon	Cannon River	07040002	66	0.18
The Turkey Store - Faribault	MN0002500	Cannon	Cannon River	07040002	2,653	7.27
Viracon	MNG255078	Cannon	Cannon River	07040002	12,157	33.31
Waterville WWTP	MN0025208	Cannon	Cannon River	07040002	11,242	30.80
Anchor Block Co - South Plant	MN0069281	Metroshed	Lower Minnesota River	07020012	95	0.26
Anchor Glass Container	MN0003042	Metroshed	Lower Minnesota River	07020012	2,608	7.15
Apex International Manufacturing Inc	MN0067016	Metroshed	Lower Minnesota River	07020012	1,017	2.79

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Cologne WWTP	MN0023108	Metroshed	Lower Minnesota River	07020012	13,469	36.90
Cypress Semiconductor Minnesota Inc	MN0056723	Metroshed	Lower Minnesota River	07020012	53,051	145.34
Delta Air Lines Inc	MN0054194	Metroshed	Lower Minnesota River	07020012	1,186	3.25
Eden Prairie Well House 6 & 7	MNG250084	Metroshed	Lower Minnesota River	07020012	4,191	11.48
Fabcon Inc	MN0068284	Metroshed	Lower Minnesota River	07020012	341	81.60
FSI International - Lyman Blvd	MN0068781	Metroshed	Lower Minnesota River	07020012	884	2.42
Hopkins Well 4 WTP	MNG640045	Metroshed	Lower Minnesota River	07020012	8,289	22.71
Jordan WWTP	MN0020869	Metroshed	Lower Minnesota River	07020012	53,400	146.30
Kraemer Mining & Materials - Burnsville	MN0002224	Metroshed	Lower Minnesota River	07020012	787,469	2,157.45
LifeCore Biomedical LLC	MN0060747	Metroshed	Lower Minnesota River	07020012	2,072	5.68
McLaughlin Gormley King Co	MN0058033	Metroshed	Lower Minnesota River	07020012	290	0.79
Met Council - Blue Lake WWTP	MN0029882	Metroshed	Lower Minnesota River	07020012	1,739,590	4,766.00
Met Council - Seneca WWTP	MN0030007	Metroshed	Lower Minnesota River	07020012	1,572,785	4,309.00
Micron Molding Inc	MNG250097	Metroshed	Lower Minnesota River	07020012	1,105	3.03
New Prague WWTP	MN0020150	Metroshed	Lower Minnesota River	07020012	75,920	208.00
Norwood Young America WWTP	MN0024392	Metroshed	Lower Minnesota River	07020012	37,595	103.00
Pepsi Bottling Group	MN0060101	Metroshed	Lower Minnesota River	07020012	5,526	15.14
Polar Semiconductor Inc	MN0064661	Metroshed	Lower Minnesota River	07020012	5,791	15.87
Rahr Malting Co	MN0031917	Metroshed	Lower Minnesota River	07020012	216,781	593.92
Rosemount Inc - Eden Prairie	MN0054747	Metroshed	Lower Minnesota River	07020012	619	1.70
Seagate Technology LLC - Bloomington	MN0030864	Metroshed	Lower Minnesota River	07020012	1,503	4.12
Superior Minerals Co	MN0063584	Metroshed	Lower Minnesota River	07020012	2,078	5.69
Thermotech Co	MNG255072	Metroshed	Lower Minnesota River	07020012	19,894	54.50
United Sugars Corp Chaska	MNG250005	Metroshed	Lower Minnesota River	07020012	127	0.35
Xcel - Black Dog Generating Plant	MN0000876	Metroshed	Lower Minnesota River	07020012	558,815	1,531.00
Kemps Culture Facility	MNG255071	Metroshed	Mississippi River - Lake Pepin	07040001	13,263	36.34
Met Council - Empire WWTP	MN0045845	Metroshed	Mississippi River - Lake Pepin	07040001	1,184,060	3,244.00
Vermillion WWTP	MN0025101	Metroshed	Mississippi River - Lake Pepin	07040001	2,227	6.10
3M Cottage Grove Center	MN0001449	Metroshed	Mississippi River - Twin Cities	07010206	198,925	545.00

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
528 Partnership LLP Brown & Bigelow Bldg	MNG255045	Metroshed	Mississippi River - Twin Cities	07010206	221	0.61
AaCron Inc	MNG250002	Metroshed	Mississippi River - Twin Cities	07010206	31,035	85.03
Aggregate Industries - Larson Quarry	MN0030473	Metroshed	Mississippi River - Twin Cities	07010206	281,831	772.14
Aggregate Industries - Nelson Plant	MN0001309	Metroshed	Mississippi River - Twin Cities	07010206	828,915	2,271.00
Aveda Corp	MN0066524	Metroshed	Mississippi River - Twin Cities	07010206	124	0.34
BAE Systems/River Road Industrial Center	MNG255087	Metroshed	Mississippi River - Twin Cities	07010206	8,594	23.55
Boomerang Laboratories	MN0066508	Metroshed	Mississippi River - Twin Cities	07010206	442	1.21
Calco of Minneapolis	MN0059960	Metroshed	Mississippi River - Twin Cities	07010206	1,824	5.00
Captain Ken's Foods Inc	MN0059765	Metroshed	Mississippi River - Twin Cities	07010206	249	0.68
CenterPoint Energy - GWTF	MN0063126	Metroshed	Mississippi River - Twin Cities	07010206	663	1.82
CF Industries Inc - Pine Bend Terminal	MN0069418	Metroshed	Mississippi River - Twin Cities	07010206	840	2.30
Converteam/Electric Machinery Co	MN0054771	Metroshed	Mississippi River - Twin Cities	07010206	774	2.12
Covanta Hennepin Energy Resource Co LP	MN0057525	Metroshed	Mississippi River - Twin Cities	07010206	8,276	22.67
Crystal Lake Flocculation Treatment Facility	MN0069957	Metroshed	Mississippi River - Twin Cities	07010206	29,426	80.62
Cummins Power Generation Inc	MNG255029	Metroshed	Mississippi River - Twin Cities	07010206	1,105	3.03
Curwood Minnesota LLC - Minneapolis	MNG250107	Metroshed	Mississippi River - Twin Cities	07010206	3,095	8.48
Excelsior WTP	MN0041769	Metroshed	Mississippi River - Twin Cities	07010206	653	1.79
Flint Hills Resources Pine Bend LLC	MN0000418	Metroshed	Mississippi River - Twin Cities	07010206	224,110	614.00
Former Naval Industrial Reserve Ordinance Plant	MNG790159	Metroshed	Mississippi River - Twin Cities	07010206	63,661	174.41
Fridley Locke Park Filtration WTP	MN0043664	Metroshed	Mississippi River - Twin Cities	07010206	2,081	5.70
GAF Materials Corp	MN0002119	Metroshed	Mississippi River - Twin Cities	07010206	16,578	45.42
Galtier Plaza	MN0062031	Metroshed	Mississippi River - Twin Cities	07010206	1,326	3.63
Gaviidae Common	MNG255074	Metroshed	Mississippi River - Twin Cities	07010206	50,619	138.68
GE Osmonics Inc	MN0059013	Metroshed	Mississippi River - Twin Cities	07010206	9,859	27.01
General Mills Inc - E Hennepin	MN0056022	Metroshed	Mississippi River - Twin Cities	07010206	38,196	104.65
HB Fuller Co - Willow Lake	MN0051811	Metroshed	Mississippi River - Twin Cities	07010206	66,313	181.68
Hennepin County Energy Center	MN0057509	Metroshed	Mississippi River - Twin Cities	07010206	3,448	9.45
Hiawatha Metalcraft Inc	MNG250061	Metroshed	Mississippi River - Twin Cities	07010206	18,126	49.66
Honeywell Inc - Aerospace - Mpls	MN0042641	Metroshed	Mississippi River - Twin Cities	07010206	154,731	423.92

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Honeywell International Inc	MNG255088	Metroshed	Mississippi River - Twin Cities	07010206	22,989	62.98
Honeywell-Plymouth Operations	MN0063266	Metroshed	Mississippi River - Twin Cities	07010206	6,366	17.44
Hutchinson Technology Inc - Plymouth	MN0066699	Metroshed	Mississippi River - Twin Cities	07010206	177	0.48
International Market Square	MNG255061	Metroshed	Mississippi River - Twin Cities	07010206	133	0.36
International Paper - Fridley	MNG255038	Metroshed	Mississippi River - Twin Cities	07010206	93	0.25
Kwong Tung Foods Inc	MN0062723	Metroshed	Mississippi River - Twin Cities	07010206	543	1.49
Laketown Community WWTP	MN0054399	Metroshed	Mississippi River - Twin Cities	07010206	256	0.70
LSP Power - Cottage Grove Power Plant	MN0062821	Metroshed	Mississippi River - Twin Cities	07010206	35,367	96.90
Maple Hill Estates	MN0031127	Metroshed	Mississippi River - Twin Cities	07010206	1,241	3.40
Met Council - Eagles Point WWTP	MN0029904	Metroshed	Mississippi River - Twin Cities	07010206	492,750	1,350.00
Met Council - Hastings WWTP	MN0029955	Metroshed	Mississippi River - Twin Cities	07010206	111,325	305.00
Met Council - Metropolitan WWTP	MN0029815	Metroshed	Mississippi River - Twin Cities	07010206	12,996,920	35,608.00
Metal-Matic Inc	MNG255065	Metroshed	Mississippi River - Twin Cities	07010206	1,326	3.63
M-Foods Dairy LLC	MNG255067	Metroshed	Mississippi River - Twin Cities	07010206	23,873	65.40
Micom Corp	MNG255025	Metroshed	Mississippi River - Twin Cities	07010206	712	1.95
Minneapolis Water Works Fridley	MN0003247	Metroshed	Mississippi River - Twin Cities	07010206	54,020	148.00
Minntech Corp	MN0063541	Metroshed	Mississippi River - Twin Cities	07010206	5,347	14.65
New Brighton WTP - Wells 10 & 11	MNG640068	Metroshed	Mississippi River - Twin Cities	07010206	1,243	3.41
Nilfisk-Advance Inc	MN0066648	Metroshed	Mississippi River - Twin Cities	07010206	6,366	17.44
Northern Iron of St Paul LLC	MN0059277	Metroshed	Mississippi River - Twin Cities	07010206	1,105	3.03
NuStar - Roseville Terminal	MN0050318	Metroshed	Mississippi River - Twin Cities	07010206	265	0.73
NWC Ltd Partnership - Wells Fargo Center	MNG250103	Metroshed	Mississippi River - Twin Cities	07010206	53,051	145.34
Owens Corning Roofing & Asphalt LLC Mpls	MN0048810	Metroshed	Mississippi River - Twin Cities	07010206	104	0.28
Pearson Candy Co	MNG255066	Metroshed	Mississippi River - Twin Cities	07010206	884	2.42
Robinson Rubber Products Co Inc	MNG250048	Metroshed	Mississippi River - Twin Cities	07010206	2,608	7.15
Saint Croix Forge Inc	MN0069051	Metroshed	Mississippi River - Twin Cities	07010206	85	0.23
Saint Paul Park Refining Co LLC	MN0000256	Metroshed	Mississippi River - Twin Cities	07010206	62,780	172.00
St Anthony WTP	MNG640081	Metroshed	Mississippi River - Twin Cities	07010206	332	0.91
St Louis Park GWP - Reilly Tar Site	MN0045489	Metroshed	Mississippi River - Twin Cities	07010206	6,676	18.29

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
St Louis Park WTP	MNG640084	Metroshed	Mississippi River - Twin Cities	07010206	12,019	32.93
St Paul Pioneer Press - Ridder Circle	MN0054577	Metroshed	Mississippi River - Twin Cities	07010206	83	0.23
St Paul Regional Water Services McCarron	MN0045829	Metroshed	Mississippi River - Twin Cities	07010206	186,506	510.98
Stadium Village Flats	MNG790176	Metroshed	Mississippi River - Twin Cities	07010206	12,732	34.88
Tanner's Alum WTP	MN0067661	Metroshed	Mississippi River - Twin Cities	07010206	23,255	387.58
Tekna Seal LLC	MNG255036	Metroshed	Mississippi River - Twin Cities	07010206	88	0.24
TH 13/101 Design-Build Project	MNG790175	Metroshed	Mississippi River - Twin Cities	07010206	101,680	278.58
TH 61 Hastings Bridge	MNG790173	Metroshed	Mississippi River - Twin Cities	07010206	19,098	52.32
U of M - Civil Engineering Bldg 156	MN0058882	Metroshed	Mississippi River - Twin Cities	07010206	28,515	78.12
U of M - Minnesota Library Access Center	MN0063436	Metroshed	Mississippi River - Twin Cities	07010206	928	2.54
United/Children's Hospitals	MN0002968	Metroshed	Mississippi River - Twin Cities	07010206	746	2.04
USCOE Lock & Dam 2 WTP	MNG640113	Metroshed	Mississippi River - Twin Cities	07010206	124	0.34
VEECO MBE Division	MNG250093	Metroshed	Mississippi River - Twin Cities	07010206	4,686	12.84
Vision-Ease Lens - Ramsey	MN0065501	Metroshed	Mississippi River - Twin Cities	07010206	456	1.25
Waldorf Corp - A Rock-Tenn Co	MN0048984	Metroshed	Mississippi River - Twin Cities	07010206	44,430	121.73
Wayzata WTP - Plants 1 & 2	MNG640096	Metroshed	Mississippi River - Twin Cities	07010206	1,533	4.20
Xcel - Riverside Generating Plant	MN0000892	Metroshed	Mississippi River - Twin Cities	07010206	165,728	454.05
Xcel Energy - Combined Cycle Plant	MN0000884	Metroshed	Mississippi River - Twin Cities	07010206	2,227	6.10
Xcel Energy - Fifth Street Substation	MN0003301	Metroshed	Mississippi River - Twin Cities	07010206	33,157	90.84
Blue Earth WWTP	MN0020532	Minnesota	Blue Earth River	07020009	40,515	111.00
Buffalo Lake Energy LLC	MN0068063	Minnesota	Blue Earth River	07020009	21,097	57.80
Darling International Inc - Blue Earth	MN0002313	Minnesota	Blue Earth River	07020009	2,215	79.80
Fairmont Foods of Minnesota Inc	MN0001996	Minnesota	Blue Earth River	07020009	2,690	7.37
Fairmont WTP	MN0045527	Minnesota	Blue Earth River	07020009	124	0.34
Fairmont WWTP	MN0030112	Minnesota	Blue Earth River	07020009	161,695	443.00
Great River Energy Lakefield	MN0067709	Minnesota	Blue Earth River	07020009	373	1.02
Interstate Power - Fox Lake Station	MN0000957	Minnesota	Blue Earth River	07020009	47,249	129.45
Seneca Foods Corp - Blue Earth	MN0001287	Minnesota	Blue Earth River	07020009	15,418	42.24
Trimont WWTP	MN0022071	Minnesota	Blue Earth River	07020009	7,665	21.00

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Welcome WWTP	MN0021296	Minnesota	Blue Earth River	07020009	10,768	29.50
Winnebago WWTP	MN0025267	Minnesota	Blue Earth River	07020009	70,445	193.00
Benson WWTP	MN0020036	Minnesota	Chippewa River	07020005	32,368	88.68
Chippewa Valley Ethanol Co	MN0062898	Minnesota	Chippewa River	07020005	4,476	12.26
Kerkhoven WWTP	MN0020583	Minnesota	Chippewa River	07020005	6,205	17.00
Montevideo WWTP	MN0020133	Minnesota	Chippewa River	07020005	102,200	280.00
Starbuck WWTP	MN0021415	Minnesota	Chippewa River	07020005	14,491	39.70
August Schell Brewing Co	MN0022284	Minnesota	Cottonwood River	07020008	1,451	3.97
New Ulm WWTP	MN0030066	Minnesota	Cottonwood River	07020008	280,320	768.00
Springfield WWTP	MN0024953	Minnesota	Cottonwood River	07020008	32,339	88.60
Wabasso WWTP	MN0025151	Minnesota	Cottonwood River	07020008	4,672	12.80
Walnut Grove WWTP	MN0021776	Minnesota	Cottonwood River	07020008	8,395	23.00
Amboy WWTP	MN0022624	Minnesota	Le Sueur River	07020011	11,863	32.50
New Richland WWTP	MN0021032	Minnesota	Le Sueur River	07020011	24,820	68.00
St Clair WWTP	MN0024716	Minnesota	Le Sueur River	07020011	8,760	24.00
Waldorf WWTP	MN0021849	Minnesota	Le Sueur River	07020011	4,015	11.00
Waseca WWTP	MN0020796	Minnesota	Le Sueur River	07020011	144,905	397.00
Arlington WWTP	MN0020834	Minnesota	Lower Minnesota River	07020012	33,215	91.00
Dairy Farmers of America - Winthrop	MN0003671	Minnesota	Lower Minnesota River	07020012	52,604	144.12
Lafayette WWTP	MN0023876	Minnesota	Lower Minnesota River	07020012	3,942	10.80
Le Center WWTP	MN0023931	Minnesota	Lower Minnesota River	07020012	34,164	93.60
Le Sueur Cheese Co	MN0060216	Minnesota	Lower Minnesota River	07020012	8,286	22.70
MG Waldbaum Co - Gaylord	MN0060798	Minnesota	Lower Minnesota River	07020012	22,776	62.40
Montgomery WWTP	MN0024210	Minnesota	Lower Minnesota River	07020012	40,077	109.80
MRVPUC WWTP	MN0068195	Minnesota	Lower Minnesota River	07020012	76,285	209.00
New Prague WTP	MNG640117	Minnesota	Lower Minnesota River	07020012	1,409	3.86
Seneca Foods Corp - Arlington	MN0000264	Minnesota	Lower Minnesota River	07020012	8,286	22.70
Seneca Foods Corp - Montgomery	MN0001279	Minnesota	Lower Minnesota River	07020012	20,696	56.70
Winco Inc	MNG255043	Minnesota	Lower Minnesota River	07020012	159	0.44

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
ADM - Mankato	MN0061514	Minnesota	Minnesota River - Mankato	07020007	5,305	14.53
CHS Oilseed Processing - Mankato	MN0001228	Minnesota	Minnesota River - Mankato	07020007	157,287	430.92
Comfrey WWTP	MN0021687	Minnesota	Minnesota River - Mankato	07020007	3,103	8.50
Courtland WTP	MNG640025	Minnesota	Minnesota River - Mankato	07020007	84	0.23
Firmenich Inc	MNG255006	Minnesota	Minnesota River - Mankato	07020007	7,639	20.93
Hard Rock Quarries Inc	MN0067237	Minnesota	Minnesota River - Mankato	07020007	6,631	18.17
Hiniker Co	MN0064408	Minnesota	Minnesota River - Mankato	07020007	211	0.58
Lake Crystal WWTP	MN0055981	Minnesota	Minnesota River - Mankato	07020007	24,455	67.00
Mankato WWTP	MN0030171	Minnesota	Minnesota River - Mankato	07020007	466,105	1,277.00
Morgan WWTP	MN0020443	Minnesota	Minnesota River - Mankato	07020007	14,856	40.70
New Ulm Quartzite Quarries Inc	MN0061638	Minnesota	Minnesota River - Mankato	07020007	343,475	1,249.05
Northern Con-Agg LLP - Frohrip Kaolin Mine	MN0062154	Minnesota	Minnesota River - Mankato	07020007	4,145	11.36
Northern Con-Agg LLP - Redwood Falls	MN0059331	Minnesota	Minnesota River - Mankato	07020007	14,920	40.88
POET Biorefining - Lake Crystal	MN0067172	Minnesota	Minnesota River - Mankato	07020007	5,371	14.72
Saint George District Sewer System	MN0064785	Minnesota	Minnesota River - Mankato	07020007	270	0.74
Saint Peter WWTP	MN0022535	Minnesota	Minnesota River - Mankato	07020007	165,710	454.00
Unimin Corp - Kasota Plant	MN0053082	Minnesota	Minnesota River - Mankato	07020007	103,614	1,892.50
Unimin Corp - Ottawa Plant	MN0001716	Minnesota	Minnesota River - Mankato	07020007	165,783	3,406.50
Wis-Pak of Mankato Inc	MN0063029	Minnesota	Minnesota River - Mankato	07020007	10,776	29.52
Xcel - Wilmarth Generating Plant	MN0000914	Minnesota	Minnesota River - Mankato	07020007	5,749	15.75
Clara City WWTP	MN0023035	Minnesota	Minnesota River - Yellow Medicine River	07020004	19,053	52.20
Delhi WWTP	MN0067008	Minnesota	Minnesota River - Yellow Medicine River	07020004	595	1.63
Granite Falls Energy LLC	MN0066800	Minnesota	Minnesota River - Yellow Medicine River	07020004	5,471	14.99
Granite Falls WWTP	MN0021211	Minnesota	Minnesota River - Yellow Medicine River	07020004	33,215	91.00
Maynard WWTP	MN0056588	Minnesota	Minnesota River - Yellow Medicine River	07020004	6,351	17.40
Olivia WWTP	MN0020907	Minnesota	Minnesota River - Yellow Medicine River	07020004	40,552	111.10
Prinsburg WWTP	MN0063932	Minnesota	Minnesota River - Yellow Medicine River	07020004	2,256	6.18
Renville WWTP	MN0020737	Minnesota	Minnesota River - Yellow Medicine River	07020004	35,369	96.90
Sacred Heart WWTP	MN0024708	Minnesota	Minnesota River - Yellow Medicine River	07020004	9,808	26.87

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Southern Minnesota Beet Sugar - Renville	MN0040665	Minnesota	Minnesota River - Yellow Medicine River	07020004	57,019	500.00
Xcel - Minnesota Valley Plant	MN0000906	Minnesota	Minnesota River - Yellow Medicine River	07020004	43,070	118.00
ADM Corn Processing - Marshall	MN0057037	Minnesota	Redwood River	07020006	109,417	299.77
Marshall WWTP	MN0022179	Minnesota	Redwood River	07020006	186,150	510.00
Delft Sanitary District WWTP	MN0066541	Minnesota	Watonwan River	07020010	237	0.65
La Salle WWTP	MN0067458	Minnesota	Watonwan River	07020010	621	1.70
Lewisville WTP	MN0043958	Minnesota	Watonwan River	07020010	705	1.93
Madelia WWTP	MN0024040	Minnesota	Watonwan River	07020010	54,385	149.00
Milk Specialties Co (MSC)	MN0066036	Minnesota	Watonwan River	07020010	2,984	8.18
POET Biorefining - Ethanol 2000 LLP	MN0063118	Minnesota	Watonwan River	07020010	5,968	16.35
Saint James WWTP	MN0024759	Minnesota	Watonwan River	07020010	122,640	336.00
Truman WTP	MNG640129	Minnesota	Watonwan River	07020010	622	1.70
Truman WWTP	MN0021652	Minnesota	Watonwan River	07020010	32,485	89.00
ADM - Red Wing	MNG250009	Minor Tributaries	Mississippi River - Lake Pepin	07040001	6,189	16.96
Federal-Mogul Powertrain Systems	MN0001147	Minor Tributaries	Mississippi River - Lake Pepin	07040001	11,388	31.20
Lake City WWTP	MN0020664	Minor Tributaries	Mississippi River - Lake Pepin	07040001	62,926	172.40
Red Wing WWTP	MN0024571	Minor Tributaries	Mississippi River - Lake Pepin	07040001	165,710	454.00
Xcel Energy - Prairie Island Nuclear	MN0004006	Minor Tributaries	Mississippi River - Lake Pepin	07040001	426,422	1,168.28
Aitkin agri-peat Inc - Cromwell	MN0055662	St. Croix	Kettle River	07030003	178,217	488.27
Hinckley WWTP	MN0023701	St. Croix	Kettle River	07030003	28,105	77.00
Andersen Corp	MN0001724	St. Croix	Lower St. Croix River	07030005	26,083	71.46
Baytown GW Contamination Site	MNG790156	St. Croix	Lower St. Croix River	07030005	6,366	17.44
Chisago Lakes Joint STC	MN0055808	St. Croix	Lower St. Croix River	07030005	101,835	279.00
Cimarron Park WWTP	MN0050636	St. Croix	Lower St. Croix River	07030005	4,973	166.00
Forest Lake WTP	MNG640118	St. Croix	Lower St. Croix River	07030005	1,078	2.95
Harris WWTP	MN0050130	St. Croix	Lower St. Croix River	07030005	6,643	18.20
John Iacarella - Linwood Terrace Co	MN0054372	St. Croix	Lower St. Croix River	07030005	694	1.90
Met Council - St Croix Valley WWTP	MN0029998	St. Croix	Lower St. Croix River	07030005	191,990	526.00
North Branch WWTP	MN0024350	St. Croix	Lower St. Croix River	07030005	33,580	92.00

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Xcel Energy - Allen S King Generating Plant	MN0000825	St. Croix	Lower St. Croix River	07030005	1,226,710	3,360.85
Mora WWTP	MN0021156	St. Croix	Snake River - St. Croix Basin	07030004	33,215	91.00
Bertha WWTP	MN0022799	Upper Mississippi	Crow Wing River	07010106	8,206	171.80
East Gull Lake WWTP	MN0059871	Upper Mississippi	Crow Wing River	07010106	17,082	46.80
Motley WWTP	MN0024244	Upper Mississippi	Crow Wing River	07010106	26,682	73.10
Staples WWTP	MN0024988	Upper Mississippi	Crow Wing River	07010106	28,178	77.20
Alexandria Lakes Area Sanitary District	MN0040738	Upper Mississippi	Long Prairie River	07010108	123,735	339.00
Alexandria Light & Power	MNG250004	Upper Mississippi	Long Prairie River	07010108	2,122	5.81
Long Prairie Ground Water Remediation	MNG790134	Upper Mississippi	Long Prairie River	07010108	15,915	43.60
Long Prairie WWTP - Municipal	MN0066079	Upper Mississippi	Long Prairie River	07010108	75,920	208.00
Aitkin WWTP	MN0020095	Upper Mississippi	Mississippi River - Brainerd	07010104	28,580	78.30
Anderson Custom Processing Inc	MNG255005	Upper Mississippi	Mississippi River - Brainerd	07010104	5,305	14.53
BNSF RR - Former Tie Treating Plant	MN0055387	Upper Mississippi	Mississippi River - Brainerd	07010104	9,284	25.44
Brainerd WWTP	MN0049328	Upper Mississippi	Mississippi River - Brainerd	07010104	129,575	355.00
Camp Ripley - Area 22 Washrack	MN0063070	Upper Mississippi	Mississippi River - Brainerd	07010104	373	1.02
Camp Ripley WWTP	MN0025721	Upper Mississippi	Mississippi River - Brainerd	07010104	59,495	163.00
Little Falls WTP	MNG640128	Upper Mississippi	Mississippi River - Brainerd	07010104	2,984	8.18
Little Falls WWTP	MN0020761	Upper Mississippi	Mississippi River - Brainerd	07010104	99,280	272.00
Randall WWTP	MN0024562	Upper Mississippi	Mississippi River - Brainerd	07010104	7,556	20.70
Sampson Farms	MN0057533	Upper Mississippi	Mississippi River - Brainerd	07010104	12,434	34.07
Swanville WWTP	MN0020109	Upper Mississippi	Mississippi River - Brainerd	07010104	7,556	20.70
Wausau Paper Mills LLC	MN0001422	Upper Mississippi	Mississippi River - Brainerd	07010104	261,920	717.59
Avon WWTP	MN0047325	Upper Mississippi	Mississippi River - Sartell	07010201	17,484	47.90
Benton Utilities WWTP	MN0065391	Upper Mississippi	Mississippi River - Sartell	07010201	3,103	8.50
Holdingford WWTP	MN0023710	Upper Mississippi	Mississippi River - Sartell	07010201	10,111	27.70
Lake Andrew WWTP	MN0067733	Upper Mississippi	Mississippi River - Sartell	07010201	628	1.72
New Pirates Cove WWTP	MN0066109	Upper Mississippi	Mississippi River - Sartell	07010201	2,070	5.67
Order of St Benedict - Power Plant	MN0046035	Upper Mississippi	Mississippi River - Sartell	07010201	2,946	8.07
Order of St Benedict WWTP	MN0022411	Upper Mississippi	Mississippi River - Sartell	07010201	10,038	27.50

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Sartell Valves Inc	MNG255084	Upper Mississippi	Mississippi River - Sartell	07010201	4,509	12.35
Albertville WWTP	MN0050954	Upper Mississippi	Mississippi River - St. Cloud	07010203	38,690	106.00
Appert's Inc	MN0052728	Upper Mississippi	Mississippi River - St. Cloud	07010203	442	1.21
Aspen Hills WWTP	MN0066028	Upper Mississippi	Mississippi River - St. Cloud	07010203	807	2.21
Becker WWTP - Municipal	MN0025666	Upper Mississippi	Mississippi River - St. Cloud	07010203	35,186	96.40
Big Lake WWTP	MN0041076	Upper Mississippi	Mississippi River - St. Cloud	07010203	15,038	41.20
Clear Lake/Clearwater WWTP	MN0047490	Upper Mississippi	Mississippi River - St. Cloud	07010203	10,841	29.70
Elk River Municipal Utilites	MNG250016	Upper Mississippi	Mississippi River - St. Cloud	07010203	12,069	33.07
Elk River WWTP	MN0020788	Upper Mississippi	Mississippi River - St. Cloud	07010203	43,070	118.00
Geislinger & Sons Inc	MNG790169	Upper Mississippi	Mississippi River - St. Cloud	07010203	198,940	545.04
Great River Energy - Elk River Station	MN0001988	Upper Mississippi	Mississippi River - St. Cloud	07010203	4,147,518	11,363.06
Monticello WWTP	MN0020567	Upper Mississippi	Mississippi River - St. Cloud	07010203	49,640	136.00
Otsego WWTP West	MN0066257	Upper Mississippi	Mississippi River - St. Cloud	07010203	29,784	81.60
Riverbend Mobile Home Park WWTP	MN0042251	Upper Mississippi	Mississippi River - St. Cloud	07010203	2,482	6.80
Saint Cloud WWTP	MN0040878	Upper Mississippi	Mississippi River - St. Cloud	07010203	538,010	1,474.00
Xcel - Monticello Nuclear Generating Plt	MN0000868	Upper Mississippi	Mississippi River - St. Cloud	07010203	8,249	22.60
Xcel - Sherburne Generating Plant	MN0002186	Upper Mississippi	Mississippi River - St. Cloud	07010203	627,435	1,719.00
Zimmerman WWTP	MN0042331	Upper Mississippi	Mississippi River - St. Cloud	07010203	18,615	51.00
AMPI - Paynesville	MN0044326	Upper Mississippi	North Fork Crow River	07010204	12,600	34.52
Annandale/Maple Lake/Howard Lake WWTP	MN0066966	Upper Mississippi	North Fork Crow River	07010204	48,910	134.00
Buffalo WWTP	MN0040649	Upper Mississippi	North Fork Crow River	07010204	149,285	409.00
Bushmills Ethanol	MN0067211	Upper Mississippi	North Fork Crow River	07010204	6,424	17.60
Faribault Foods - Cokato	MN0030635	Upper Mississippi	North Fork Crow River	07010204	29,565	81.00
Great River Energy of Dickinson	MN0049077	Upper Mississippi	North Fork Crow River	07010204	1,243	3.41
Green Lake SSWD WWTP	MN0052752	Upper Mississippi	North Fork Crow River	07010204	36,865	101.00
Greenfield WWTP	MN0063762	Upper Mississippi	North Fork Crow River	07010204	4,125	11.30
Grove City WWTP	MN0023574	Upper Mississippi	North Fork Crow River	07010204	9,125	25.00
Litchfield WWTP	MN0023973	Upper Mississippi	North Fork Crow River	07010204	78,475	215.00
Meadows of Whisper Creek WWTP	MN0066753	Upper Mississippi	North Fork Crow River	07010204	840	2.30

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
MPCA - Paynesville GWP 4	MNG790109	Upper Mississippi	North Fork Crow River	07010204	12,732	34.88
Otsego East WWTP	MN0064190	Upper Mississippi	North Fork Crow River	07010204	45,625	125.00
Rockford WWTP	MN0024627	Upper Mississippi	North Fork Crow River	07010204	26,937	73.80
Rogers WWTP	MN0029629	Upper Mississippi	North Fork Crow River	07010204	66,065	181.00
Saint Michael WWTP	MN0020222	Upper Mississippi	North Fork Crow River	07010204	101,215	277.30
Wadena WWTP	MN0020672	Upper Mississippi	Redeye River	07010107	31,025	85.00
Braham WWTP	MN0022870	Upper Mississippi	Rum River	07010207	16,571	45.40
Cambridge WWTP	MN0020362	Upper Mississippi	Rum River	07010207	26,682	73.10
Castle Towers WWTP	MN0042196	Upper Mississippi	Rum River	07010207	4,964	13.60
Isanti Estates LLC	MN0054518	Upper Mississippi	Rum River	07010207	840	2.30
Isanti WWTP	MN0023795	Upper Mississippi	Rum River	07010207	11,242	30.80
Kraemer Mining & Materials - Mille Lacs	MN0067806	Upper Mississippi	Rum River	07010207	41,446	113.55
Premier Products Inc	MNG250082	Upper Mississippi	Rum River	07010207	191	0.52
Princeton WWTP	MN0024538	Upper Mississippi	Rum River	07010207	26,280	72.00
Saint Francis WWTP	MN0021407	Upper Mississippi	Rum River	07010207	22,338	61.20
Bel Clare Estates WWTP	MN0045721	Upper Mississippi	Sauk River	07010202	3,103	8.50
Cold Spring WWTP	MN0023094	Upper Mississippi	Sauk River	07010202	29,821	81.70
Gold'n Plump Poultry - Cold Spring	MN0047261	Upper Mississippi	Sauk River	07010202	38,617	105.80
Lake Henry WWTP	MN0020885	Upper Mississippi	Sauk River	07010202	1,657	4.54
Martin Marietta Materials Inc	MN0004031	Upper Mississippi	Sauk River	07010202	72,964	199.90
Melrose WWTP	MN0020290	Upper Mississippi	Sauk River	07010202	124,100	340.00
NuStar - Sauk Centre Terminal	MN0057771	Upper Mississippi	Sauk River	07010202	4,145	11.36
Richmond WWTP	MN0024597	Upper Mississippi	Sauk River	07010202	12,848	35.20
Sauk Centre WWTP	MN0024821	Upper Mississippi	Sauk River	07010202	36,719	100.60
AB Mauri Food Inc	MNG250099	Upper Mississippi	South Fork Crow River	07010205	132,626	363.36
Brownton WWTP	MN0022951	Upper Mississippi	South Fork Crow River	07010205	8,140	22.30
Delano WTP	MNG640123	Upper Mississippi	South Fork Crow River	07010205	6,217	17.03
Delano WWTP	MN0051250	Upper Mississippi	South Fork Crow River	07010205	91,031	249.40
Glencoe WWTP	MN0022233	Upper Mississippi	South Fork Crow River	07010205	107,675	295.00

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Hector WWTP	MN0025445	Upper Mississippi	South Fork Crow River	07010205	27,302	74.80
Hutchinson Technology Inc	MN0055506	Upper Mississippi	South Fork Crow River	07010205	5,526	15.14
Hutchinson WWTP	MN0055832	Upper Mississippi	South Fork Crow River	07010205	176,660	484.00
Lester Prairie WWTP	MN0023957	Upper Mississippi	South Fork Crow River	07010205	15,075	41.30
Mayer WWTP	MN0021202	Upper Mississippi	South Fork Crow River	07010205	17,995	49.30
Minnesota Energy	MN0063151	Upper Mississippi	South Fork Crow River	07010205	1,658	4.54
Watertown WWTP	MN0020940	Upper Mississippi	South Fork Crow River	07010205	52,195	143.00
Willmar WWTP	MN0025259	Upper Mississippi	South Fork Crow River	07010205	310,980	852.00
Winsted WWTP	MN0021571	Upper Mississippi	South Fork Crow River	07010205	33,945	93.00

Revised 2/14/2019

A.2. Minnesota Wastewater Permits with TSS Limits > 32 mg/L Not Eligible for Future WLA Increase

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Dennison WWTP	MN0022195	Cannon	Cannon River	07040002	2,335	66.00
Ellendale WWTP	MNG580014	Cannon	Cannon River	07040002	9,353	324.60
Elysian WWTP	MN0041114	Cannon	Cannon River	07040002	12,123	349.65
Geneva WWTP	MN0021008	Cannon	Cannon River	07040002	6,434	162.00
Kilkenny WWTP	MNG580084	Cannon	Cannon River	07040002	2,126	81.15
Meriden Township WWTP	MN0068713	Cannon	Cannon River	07040002	1,501	51.15
MNDOT - Heath Creek Rest Area	MN0069639	Cannon	Cannon River	07040002	560	11.70
MNDOT Straight River Rest Area	MN0049514	Cannon	Cannon River	07040002	1,119	24.00
Belle Plaine WWTP	MN0022772	Metroshed	Lower Minnesota River	07020012	39,770	923.50
Bongards' Creameries Inc	MN0002135	Metroshed	Lower Minnesota River	07020012	15,153	483.50
Hamburg WWTP	MN0025585	Metroshed	Lower Minnesota River	07020012	5,875	144.75
MA Gedney Co	MN0022446	Metroshed	Lower Minnesota River	07020012	24,150	345.00
Hampton WWTP	MN0021946	Metroshed	Mississippi River - Lake Pepin	07040001	9,419	103.50
Alden WWTP	MNG580118	Minnesota	Blue Earth River	07020009	14,827	628.50
Bricelyn WWTP	MNG580129	Minnesota	Blue Earth River	07020009	6,248	119.10
Elmore WWTP	MN0021920	Minnesota	Blue Earth River	07020009	11,750	636.00
Frost WWTP	MNG580120	Minnesota	Blue Earth River	07020009	4,495	100.35
Granada WWTP	MNG580023	Minnesota	Blue Earth River	07020009	3,693	92.40
Kiester WWTP	MNG580097	Minnesota	Blue Earth River	07020009	8,393	126.90
Northrop WWTP	MN0024384	Minnesota	Blue Earth River	07020009	4,663	201.60
Vernon Center WWTP	MN0030490	Minnesota	Blue Earth River	07020009	5,475	15.00
Walters WWTP	MN0068756	Minnesota	Blue Earth River	07020009	1,457	37.35
Clontarf WWTP	MNG580108	Minnesota	Chippewa River	7020005	2,191	54.00
Danvers WWTP	MNG580119	Minnesota	Chippewa River	07020005	2,135	48.15
Evansville WWTP	MN0023329	Minnesota	Chippewa River	07020005	9,325	191.25
Farwell Kensington Sanitary District WWTP	MNG580220	Minnesota	Chippewa River	07020005	7,115	145.50

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Hancock WWTP	MN0023582	Minnesota	Chippewa River	07020005	17,056	349.95
Hoffman WWTP	MNG580134	Minnesota	Chippewa River	07020005	14,827	630.30
Lowry WWTP	MN0024007	Minnesota	Chippewa River	07020005	4,607	107.70
Millerville WWTP	MN0054305	Minnesota	Chippewa River	07020005	3,637	64.80
Murdock WWTP	MNG580086	Minnesota	Chippewa River	07020005	3,963	81.00
Sunburg WWTP	MNG580125	Minnesota	Chippewa River	07020005	1,464	30.12
Urbank WWTP	MN0068446	Minnesota	Chippewa River	07020005	1,026	20.40
Acme-Ochs Plant	MN0061646	Minnesota	Cottonwood River	07020008	11,635	126.47
Balaton WWTP	MN0020559	Minnesota	Cottonwood River	07020008	11,470	208.50
Clements WWTP	MNG580094	Minnesota	Cottonwood River	07020008	2,331	41.57
Del Monte Corp - Plant 114	MN0001171	Minnesota	Cottonwood River	07020008	23,751	196.50
Garvin WWTP	MNG580101	Minnesota	Cottonwood River	07020008	2,005	43.20
Lamberton WWTP	MNG580100	Minnesota	Cottonwood River	07020008	18,651	333.00
Lucan WWTP	MNG580112	Minnesota	Cottonwood River	07020008	2,574	58.20
Revere WWTP	MNG580114	Minnesota	Cottonwood River	07020008	1,669	38.25
Sanborn WWTP	MNG580115	Minnesota	Cottonwood River	07020008	6,621	87.30
Sleepy Eye WWTP	MNG580041	Minnesota	Cottonwood River	07020008	65,277	1,646.85
Storden WWTP	MNG580106	Minnesota	Cottonwood River	07020008	3,262	67.35
Tracy WWTP	MN0021725	Minnesota	Cottonwood River	07020008	27,976	291.00
Wanda WWTP	MNG580126	Minnesota	Cottonwood River	07020008	1,557	45.75
Westbrook WWTP	MNG580127	Minnesota	Cottonwood River	07020008	13,988	415.65
Delavan WWTP	MNG580109	Minnesota	Le Sueur River	07020011	5,036	103.95
Freeborn WWTP	MNG580018	Minnesota	Le Sueur River	07020011	3,320	62.40
Good Thunder WWTP	MNG580206	Minnesota	Le Sueur River	07020011	7,647	181.05
Hartland WWTP	MNG580102	Minnesota	Le Sueur River	07020011	4,196	101.10
Janesville WWTP	MNG580025	Minnesota	Le Sueur River	07020011	31,799	874.05
Mapleton WWTP	MN0021172	Minnesota	Le Sueur River	07020011	37,861	915.00
Pemberton WWTP	MNG580075	Minnesota	Le Sueur River	07020011	4,942	166.50
Wells-Easton-Minnesota Lake WWTP	MN0025224	Minnesota	Le Sueur River	07020011	101,459	3,969.00

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Altona Hutterian Brethren WWTP	MN0067610	Minnesota	Lower Minnesota River	07020012	1,166	30.00
Gaylord WWTP	MNG580204	Minnesota	Lower Minnesota River	07020012	51,289	1,123.65
Gibbon WWTP	MNG580020	Minnesota	Lower Minnesota River	07020012	15,014	253.95
Starland Hutterian Brethren Inc	MN0067334	Minnesota	Lower Minnesota River	07020012	1,026	40.50
Winthrop WWTP	MN0051098	Minnesota	Lower Minnesota River	07020012	32,452	534.00
Cleveland WWTP	MNG580009	Minnesota	Minnesota River - Mankato	07020007	12,776	274.65
Evan WWTP	MNG580202	Minnesota	Minnesota River - Mankato	07020007	1,194	37.05
Fairfax WWTP	MNG580060	Minnesota	Minnesota River - Mankato	07020007	29,654	1,076.55
Franklin WWTP	MN0021083	Minnesota	Minnesota River - Mankato	07020007	10,724	29.40
Hanska WWTP	MNG580207	Minnesota	Minnesota River - Mankato	07020007	4,663	95.70
Jeffers WWTP	MNG580111	Minnesota	Minnesota River - Mankato	07020007	6,528	87.30
Morton WWTP	MN0051292	Minnesota	Minnesota River - Mankato	07020007	12,309	33.75
Nicollet WWTP	MNG580037	Minnesota	Minnesota River - Mankato	07020007	19,397	653.40
Searles WWTP	MNG580080	Minnesota	Minnesota River - Mankato	07020007	4,756	98.25
Belview WWTP	MNG580003	Minnesota	Minnesota River - Yellow Medicine River	07020004	13,739	431.70
Bird Island WWTP	MN0022829	Minnesota	Minnesota River - Yellow Medicine River	07020004	17,345	289.50
Blomkest Svea Sewer Board WWTP	MN0069388	Minnesota	Minnesota River - Yellow Medicine River	07020004	3,730	115.50
Clarkfield WWTP	MNG580093	Minnesota	Minnesota River - Yellow Medicine River	07020004	30,494	748.20
Cottonwood WWTP	MNG580010	Minnesota	Minnesota River - Yellow Medicine River	07020004	14,920	472.65
Danube WWTP	MNG580057	Minnesota	Minnesota River - Yellow Medicine River	07020004	6,248	165.00
Echo WWTP	MNG580059	Minnesota	Minnesota River - Yellow Medicine River	07020004	8,066	166.20
Hanley Falls WWTP	MNG580122	Minnesota	Minnesota River - Yellow Medicine River	07020004	3,264	62.40
Ivanhoe WWTP	MNG580103	Minnesota	Minnesota River - Yellow Medicine River	07020004	10,258	141.45
Minneota WWTP	MNG580033	Minnesota	Minnesota River - Yellow Medicine River	07020004	22,287	457.20
Pennock WWTP	MNG580104	Minnesota	Minnesota River - Yellow Medicine River	07020004	8,020	166.50
Porter WWTP	MNG580128	Minnesota	Minnesota River - Yellow Medicine River	07020004	1,772	41.55
Raymond WWTP	MNG580197	Minnesota	Minnesota River - Yellow Medicine River	07020004	7,703	361.50
Redwood Falls WWTP	MN0020401	Minnesota	Minnesota River - Yellow Medicine River	07020004	123,188	337.50
Saint Leo WWTP	MN0024775	Minnesota	Minnesota River - Yellow Medicine River	07020004	1,585	36.00

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Taunton WWTP	MNG580090	Minnesota	Minnesota River - Yellow Medicine River	07020004	1,958	49.95
Wood Lake WWTP	MNG580107	Minnesota	Minnesota River - Yellow Medicine River	07020004	6,015	91.50
Ghent WWTP	MNG580121	Minnesota	Redwood River	07020006	3,450	66.00
Lynd WWTP	MNG580030	Minnesota	Redwood River	07020006	4,252	87.30
Milroy WWTP	MNG580124	Minnesota	Redwood River	07020006	3,227	63.00
Russell WWTP	MNG580062	Minnesota	Redwood River	07020006	7,833	149.70
Ruthton WWTP	MNG580105	Minnesota	Redwood River	07020006	5,306	96.45
Tyler WWTP	MNG580116	Minnesota	Redwood River	07020006	16,319	278.55
Vesta WWTP	MNG580043	Minnesota	Redwood River	07020006	3,324	66.15
Butterfield WWTP	MN0022977	Minnesota	Watonwan River	07020010	27,043	706.65
Lewisville WWTP	MN0065722	Minnesota	Watonwan River	07020010	5,595	118.50
Mountain Lake WWTP	MNG580035	Minnesota	Watonwan River	07020010	32,639	1,051.50
Neuhof Hutterian Brethren	MNG580113	Minnesota	Watonwan River	07020010	396	29.55
Odin-Ormsby WWTP	MN0069442	Minnesota	Watonwan River	07020010	2,933	76.50
Barnum WWTP	MNG580142	St. Croix	Kettle River	07030003	13,578	278.55
Finlayson WWTP	MNG580203	St. Croix	Kettle River	07030003	27,976	208.50
Kettle River WWTP	MNG580183	St. Croix	Kettle River	07030003	3,273	73.65
Moose Lake WWTP	MN0020699	St. Croix	Kettle River	07030003	46,160	1,257.00
Sandstone WWTP	MNG580213	St. Croix	Kettle River	07030003	35,716	732.00
Willow River WWTP	MN0021971	St. Croix	Kettle River	07030003	4,103	139.32
Rush City WWTP	MNG580212	St. Croix	Lower St. Croix River	07030005	37,255	940.65
Shafer WWTP	MN0030848	St. Croix	Lower St. Croix River	07030005	9,792	202.50
Shorewood Park Sanitary District	MNG580216	St. Croix	Lower St. Croix River	07030005	1,399	49.95
Taylors Falls WWTP	MNG580218	St. Croix	Lower St. Croix River	07030005	13,149	291.30
Grasston WWTP	MN0025691	St. Croix	Snake River - St. Croix Basin	07030004	3,544	99.75
Ogilvie WWTP	MN0021997	St. Croix	Snake River - St. Croix Basin	07030004	21,353	58.50
Pine City WWTP	MN0021784	St. Croix	Snake River - St. Croix Basin	07030004	69,940	1,550.25
Wahkon WWTP	MN0047066	St. Croix	Snake River - St. Croix Basin	07030004	11,284	245.10
Askov WWTP	MN0022616	St. Croix	Upper St. Croix River	07030001	4,700	112.50

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Menahga WWTP	MNG580032	Upper Mississippi	Crow Wing River	07010106	18,184	557.25
Pillager WWTP	MNG580209	Upper Mississippi	Crow Wing River	07010106	6,826	241.20
Browerville WWTP	MN0022926	Upper Mississippi	Long Prairie River	07010108	35,996	1,015.50
Carlos WWTP	MN0023019	Upper Mississippi	Long Prairie River	07010108	5,968	199.50
Clarissa WWTP	MNG580008	Upper Mississippi	Long Prairie River	07010108	9,512	234.45
Eagle Bend WWTP	MN0023248	Upper Mississippi	Long Prairie River	07010108	18,184	375.00
Garfield WWTP	MN0023515	Upper Mississippi	Long Prairie River	07010108	5,595	199.50
Miltona WWTP	MN0024155	Upper Mississippi	Long Prairie River	07010108	7,460	152.10
Flensburg WWTP	MNG580016	Upper Mississippi	Mississippi River - Brainerd	07010104	1,725	41.55
Grey Eagle WWTP	MN0023566	Upper Mississippi	Mississippi River - Brainerd	07010104	8,673	145.05
Serpent Lake WWTP	MNG580215	Upper Mississippi	Mississippi River - Brainerd	07010104	62,666	1,598.10
Sobieski WWTP	MNG580217	Upper Mississippi	Mississippi River - Brainerd	07010104	1,585	53.25
Albany WWTP	MN0020575	Upper Mississippi	Mississippi River - Sartell	07010201	51,476	1,275.00
Bowlus WWTP	MN0020923	Upper Mississippi	Mississippi River - Sartell	07010201	2,798	70.65
Rice WWTP	MN0056481	Upper Mississippi	Mississippi River - Sartell	07010201	17,252	354.90
Rich Prairie Sewer Treatment Facility	MNG580211	Upper Mississippi	Mississippi River - Sartell	07010201	21,411	553.50
Royalton WWTP	MN0020460	Upper Mississippi	Mississippi River - Sartell	07010201	16,133	44.10
Upsala WWTP	MNG580053	Upper Mississippi	Mississippi River - Sartell	07010201	4,402	162.30
Foley WWTP	MN0023451	Upper Mississippi	Mississippi River - St. Cloud	07010203	34,625	727.50
Gilman WWTP	MNG580021	Upper Mississippi	Mississippi River - St. Cloud	07010203	6,155	99.75
Atwater WWTP	MN0022659	Upper Mississippi	North Fork Crow River	07010204	18,651	312.00
Belgrade WWTP	MN0051381	Upper Mississippi	North Fork Crow River	07010204	31,146	378.00
Brooten WWTP	MN0025909	Upper Mississippi	North Fork Crow River	07010204	12,403	270.75
Cokato WWTP	MN0049204	Upper Mississippi	North Fork Crow River	07010204	67,616	185.25
Darwin WWTP	MNG580150	Upper Mississippi	North Fork Crow River	07010204	4,663	83.10
Dassel WWTP	MN0054127	Upper Mississippi	North Fork Crow River	07010204	17,532	312.00
Montrose WWTP	MN0024228	Upper Mississippi	North Fork Crow River	07010204	72,818	199.50
Paynesville WWTP	MN0020168	Upper Mississippi	North Fork Crow River	07010204	82,715	373.50
Deer Creek WWTP	MNG580180	Upper Mississippi	Redeye River	07010107	3,171	133.05

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Hewitt WWTP	MNG580024	Upper Mississippi	Redeye River	07010107	3,171	83.10
Sebeka WWTP	MN0024856	Upper Mississippi	Redeye River	07010107	18,651	241.05
Wolf Lake WWTP	MN0069205	Upper Mississippi	Redeye River	07010107	783	29.10
Foreston WWTP	MNG580017	Upper Mississippi	Rum River	07010207	4,560	172.05
Isle WWTP	MN0023809	Upper Mississippi	Rum River	07010207	18,651	307.50
MDNR Father Hennepin State Park	MN0033723	Upper Mississippi	Rum River	07010207	802	20.85
Milaca WWTP	MN0024147	Upper Mississippi	Rum River	07010207	63,319	964.35
Onamia WWTP	MNG580050	Upper Mississippi	Rum River	07010207	19,583	403.20
Pease WWTP	MNG580167	Upper Mississippi	Rum River	07010207	3,637	106.05
Freeport WWTP	MNG580019	Upper Mississippi	Sauk River	07010202	12,123	249.45
GEM Sanitary District	MNG580205	Upper Mississippi	Sauk River	07010202	7,544	156.00
Osakis WWTP	MN0020028	Upper Mississippi	Sauk River	07010202	27,323	1,138.80
Saint Martin WWTP	MN0024783	Upper Mississippi	Sauk River	07010202	3,917	112.20
Buffalo Lake WWTP	MN0050211	Upper Mississippi	South Fork Crow River	07010205	15,387	444.75
Cedar Mills WWTP	MN0066605	Upper Mississippi	South Fork Crow River	07010205	853	49.95
Cosmos WWTP	MNG580056	Upper Mississippi	South Fork Crow River	07010205	8,393	114.30
Lake Lillian WWTP	MN0021954	Upper Mississippi	South Fork Crow River	07010205	4,966	100.50
Loretto WWTP	MN0023990	Upper Mississippi	South Fork Crow River	07010205	5,688	203.70
New Germany WWTP	MN0024295	Upper Mississippi	South Fork Crow River	07010205	4,849	97.50
Seneca Foods Corp - Glencoe	MN0001236	Upper Mississippi	South Fork Crow River	07010205	69,953	1,298.45
Silver Lake WWTP	MNG580164	Upper Mississippi	South Fork Crow River	07010205	12,962	336.60
Stewart WWTP	MNG580077	Upper Mississippi	South Fork Crow River	07010205	10,631	214.50

A.3. Minnesota Permits Subject to Categorical Industrial Stormwater WLA

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8
Aggregate Industries Inc -Multiple Sites	MNG490073	Cannon	Cannon River	07040002
Castle Rock Materials	MNG490258	Cannon	Cannon River	07040002
David Spinler Construction Inc	MNG490076	Cannon	Cannon River	07040002
Kielmeyer Construction Inc	MNG490085	Cannon	Cannon River	07040002
Koch - Wood River Pipeline	MN0064700	Cannon	Cannon River	07040002
Ritchie Bros Auctioneers	MN0069256	Cannon	Cannon River	07040002
SMCCI - North Sanders/North Medford	MN0067792	Cannon	Cannon River	07040002
Tom Mariska Pit	MNG490230	Cannon	Cannon River	07040002
Tri-County Aggregate Inc	MNG490176	Cannon	Cannon River	07040002
Witte Brothers Inc	MNG490156	Cannon	Cannon River	07040002
Wondra Pit	MNG490130	Cannon	Cannon River	07040002
Zufall Pit	MNG490245	Cannon	Cannon River	07040002
Bituminous Roadways Inc	MNG490006	Metroshed	Lower Minnesota River	07020012
Bryan Rock Products Inc	MNG490080	Metroshed	Lower Minnesota River	07020012
Cargill AgHorizons - East Elevator Dredge	MN0054445	Metroshed	Lower Minnesota River	07020012
Cargill AgHorizons - West Elevator Dredge	MN0062201	Metroshed	Lower Minnesota River	07020012
City of Jordan - Mill Pond Dredge	MN0068730	Metroshed	Lower Minnesota River	07020012
Frac Master Sands LLC	MNG490201	Metroshed	Lower Minnesota River	07020012
Midwest Asphalt Corp	MNG490132	Metroshed	Lower Minnesota River	07020012
Nine Mile Creek Watershed District WW	MN0069094	Metroshed	Lower Minnesota River	07020012

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8
Prior Lk/Spring Lk Ferric Chloride WTP	MN0067377	Metroshed	Lower Minnesota River	07020012
Savage Riverport Dredge	MN0069035	Metroshed	Lower Minnesota River	07020012
Terry Bros Moon Valley LLC	MNG490243	Metroshed	Lower Minnesota River	07020012
Wm Mueller & Sons Inc - Hamburg	MNG490042	Metroshed	Lower Minnesota River	07020012
Eureka Sand & Gravel Inc - Eureka Pit	MNG490077	Metroshed	Mississippi River - Lake Pepin	07040001
Fischer Sand & Aggregate LLP	MNG490263	Metroshed	Mississippi River - Lake Pepin	07040001
Garvey Pit	MNG490221	Metroshed	Mississippi River - Lake Pepin	07040001
Kelly/Ames Mining Operation	MNG490232	Metroshed	Mississippi River - Lake Pepin	07040001
Pine Bend Paving Inc	MNG490211	Metroshed	Mississippi River - Lake Pepin	07040001
SKB/Ped Sand Pit	MNG490261	Metroshed	Mississippi River - Lake Pepin	07040001
Storlie Gravel Pit	MNG490169	Metroshed	Mississippi River - Lake Pepin	07040001
BP Pipelines North America Inc	MN0063754	Metroshed	Mississippi River - Twin Cities	07010206
CenterPoint Energy Distribution System	MN0063649	Metroshed	Mississippi River - Twin Cities	07010206
CS McCrossan Construction Inc	MNG490009	Metroshed	Mississippi River - Twin Cities	07010206
Dayton Park Properties	MN0041432	Metroshed	Mississippi River - Twin Cities	07010206
Lexington Sand LLC	MNG490210	Metroshed	Mississippi River - Twin Cities	07010206
MAC - Minneapolis/St Paul Intl Airport	MN0002101	Metroshed	Mississippi River - Twin Cities	07010206
MAC-Minneapolis/St Paul Intl Airport-GWP	MN0065404	Metroshed	Mississippi River - Twin Cities	07010206
Magellan Pipeline Co LP - Hydrostatic	MN0063304	Metroshed	Mississippi River - Twin Cities	07010206
Magellan Pipeline Co LP - Mpls Complex	MN0045896	Metroshed	Mississippi River - Twin Cities	07010206
Met Council - Minneapolis CSO	MN0046744	Metroshed	Mississippi River - Twin Cities	07010206
Met Council - St Paul CSO	MN0025470	Metroshed	Mississippi River - Twin Cities	07010206
Minneapolis Municipal Storm Water	MN0061018	Metroshed	Mississippi River - Twin Cities	07010206
Minnesota Pipe Line Co - Meter Station	MN0056472	Metroshed	Mississippi River - Twin Cities	07010206
MNDNR - Forestry	MNG490239	Metroshed	Mississippi River - Twin Cities	07010206
MPCA Leak 13456	MNG790174	Metroshed	Mississippi River - Twin Cities	07010206
Northern Con-Agg Inc	MNG490088	Metroshed	Mississippi River - Twin Cities	07010206
Northern Metal Recycling	MN0063380	Metroshed	Mississippi River - Twin Cities	07010206
Saint Paul Department of Public Works/Asphalt Plt	MNG490034	Metroshed	Mississippi River - Twin Cities	07010206

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8
St Paul Municipal Storm Water	MN0061263	Metroshed	Mississippi River - Twin Cities	07010206
St Paul Port Authority-Southport Barge Slip Dredge	MN0056081	Metroshed	Mississippi River - Twin Cities	07010206
Tiller Corp	MNG490010	Metroshed	Mississippi River - Twin Cities	07010206
Twin City Tanning LLP	MN0068411	Metroshed	Mississippi River - Twin Cities	07010206
US Air Force Reserve/934th Airlift Wing	MN0052141	Metroshed	Mississippi River - Twin Cities	07010206
Viking Gas Transmission	MN0060755	Metroshed	Mississippi River - Twin Cities	07010206
Xcel Energy Hydrostatic Testing	MN0060089	Metroshed	Mississippi River - Twin Cities	07010206
Faribault County Public Works	MNG490154	Minnesota	Blue Earth River	07020009
Hanel Pit	MNG490236	Minnesota	Blue Earth River	07020007
Valero Renewable Fuels Co LLC - Welcome Plant	MN0068161	Minnesota	Blue Earth River	07020009
Charles Kotten	MNG490248	Minnesota	Cottonwood River	07020008
Dallenbach Gravel Pit	MNG490094	Minnesota	Cottonwood River	07020008
Highwater Ethanol LLC	MN0068586	Minnesota	Cottonwood River	07020008
Leavenworth Silage Co	MN0049905	Minnesota	Cottonwood River	07020008
Blue Earth County Highway Department	MNG490235	Minnesota	Le Sueur River	07020011
Irvine Sand & Gravel	MNG490253	Minnesota	Le Sueur River	07020011
Jansen-Hard Rock Quarries Inc	MNG490228	Minnesota	Le Sueur River	07020011
Heartland Corn Products	MN0062561	Minnesota	Lower Minnesota River	07020012
Max Johnson Trucking Inc	MNG490260	Minnesota	Lower Minnesota River	07020012
Sibley Aggregates Inc	MNG490061	Minnesota	Lower Minnesota River	07020012
Traxler Construction Inc	MNG490268	Minnesota	Lower Minnesota River	07020012
Hoffman Construction - Cambria Pit	MNG490233	Minnesota	Minnesota River - Mankato	07020007
Magellan Pipeline Co LP - Mankato	MN0059811	Minnesota	Minnesota River - Mankato	07020007
Mankato-Kasota Stone Inc - Multi-Site	MNG490178	Minnesota	Minnesota River - Mankato	07020007
MR Paving/Valley Asphalt Products	MNG490037	Minnesota	Minnesota River - Mankato	07020007
OMG Midwest Inc/Southern MN Construction Co Inc	MNG490131	Minnesota	Minnesota River - Mankato	07020007
Rehnelt Excavating LLC	MNG490236	Minnesota	Minnesota River - Mankato	07020007
Vetter Stone Co	MNG490173	Minnesota	Minnesota River - Mankato	07020007
WW Blacktopping Inc	MNG490184	Minnesota	Minnesota River - Mankato	07020007

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8
Broich Mine	MNG490137	Minnesota	Minnesota River - Yellow Medicine River	07020004
Chippewa Co Highway Dept - Miller Pit	MNG490146	Minnesota	Minnesota River - Yellow Medicine River	07020004
Duininck Bros Inc - Aggregate	MNG490046	Minnesota	Minnesota River - Yellow Medicine River	07020004
Gordy Serbus & Sons Gravel LLC	MNG490117	Minnesota	Minnesota River - Yellow Medicine River	07020004
Lincoln County Highway Department	MNG490203	Minnesota	Minnesota River - Yellow Medicine River	07020004
D & G Excavating Inc	MNG490067	Minnesota	Redwood River	07020006
Magellan Pipeline Co LP - Marshall	MN0059838	Minnesota	Redwood River	07020006
McLaughlin & Schulz Inc	MNG490019	Minnesota	Redwood River	07020006
Anderson Pit	MNG490240	Minnesota	Watonwan River	07020010
Bituminous Materials LLC - Faribault	MNG490004	Minor Tributaries	Mississippi River - Lake Pepin	07040001
Flint Hills RPB Airport & Wisconsin Pipelines	MN0064696	Minor Tributaries	Mississippi River - Lake Pepin	07040001
Glander Sand & Gravel -James Haglund Pit	MNG490122	Minor Tributaries	Mississippi River - Lake Pepin	07040001
River City Asphalt Inc	MNG490149	Minor Tributaries	Mississippi River - Lake Pepin	07040001
Xcel - Red Wing Generating Plant	MN0000850	Minor Tributaries	Mississippi River - Lake Pepin	07040001
Sheryl's Construction Inc - Isle	MNG490199	St. Croix	Kettle River	07030003
Stafne Construction & Aggregate LLC	MNG490162	St. Croix	Kettle River	07030003
Chisago County Highway Department	MNG490147	St. Croix	Lower St. Croix River	07030005
Blum Sand & Gravel	MNG490188	St. Croix	Snake River - St. Croix Basin	07030004
Cemstone Products Co	MNG490133	St. Croix	Snake River - St. Croix Basin	07030004
Knife Lake Sand & Gravel	MNG490216	St. Croix	Snake River - St. Croix Basin	07030004
Miller Pit	MNG490193	St. Croix	Snake River - St. Croix Basin	07030004
Pine City Township Gravel Pit	MNG490167	St. Croix	Snake River - St. Croix Basin	07030004
North Pine Aggregate - Fogt Rock Quarry	MNG490222	St. Croix	Upper St. Croix River	07030001
David Barrett Construction	MNG490120	Upper Mississippi	Crow Wing River	07010106
Long Construction Inc	MNG490074	Upper Mississippi	Crow Wing River	07010106
Rodney E Lof Co	MNG490180	Upper Mississippi	Crow Wing River	07010106
Central Specialties Inc	MNG490071	Upper Mississippi	Long Prairie River	07010108
Lakes Area Paving & Striping Inc	MNG490219	Upper Mississippi	Long Prairie River	07010108
Long Prairie WWTP - Industrial	MN0020303	Upper Mississippi	Long Prairie River	07010108

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8
Anderson Brothers Construction Co	MNG490001	Upper Mississippi	Mississippi River - Brainerd	07010104
Crow Wing County Highway Department	MNG490198	Upper Mississippi	Mississippi River - Brainerd	07010104
Gun Lake Sand & Gravel LLC	MNG490099	Upper Mississippi	Mississippi River - Brainerd	07010104
Kingsway Construction Inc	MNG490192	Upper Mississippi	Mississippi River - Brainerd	07010104
Marvin Tretter Inc	MNG490269	Upper Mississippi	Mississippi River - Sartell	07010201
South Side Sand & Gravel	MNG490223	Upper Mississippi	Mississippi River - Sartell	07010201
Tri-City Paving Inc	MNG490039	Upper Mississippi	Mississippi River - Sartell	07010201
TTWOS Granite Supply Quarry LLC	MNG490165	Upper Mississippi	Mississippi River - Sartell	07010201
Annandale Rock Products Inc	MNG490022	Upper Mississippi	Mississippi River - St. Cloud	07010203
J & B Mining	MNG490191	Upper Mississippi	Mississippi River - St. Cloud	07010203
Knife River Central Minnesota	MNG490003	Upper Mississippi	Mississippi River - St. Cloud	07010203
Kolles Sand & Gravel Inc	MNG490241	Upper Mississippi	Mississippi River - St. Cloud	07010203
MTD Excavating Gravel Pit	MNG490217	Upper Mississippi	Mississippi River - St. Cloud	07010203
Rock Solid Land Co LLC	MNG490244	Upper Mississippi	Mississippi River - St. Cloud	07010203
Saldana Excavating & Aggregates/Granite	MNG490166	Upper Mississippi	Mississippi River - St. Cloud	07010203
Schmidt Gravel Mine/Schuer Inc	MNG490148	Upper Mississippi	Mississippi River - St. Cloud	07010203
Veit Co - Rogers	MNG490183	Upper Mississippi	Mississippi River - St. Cloud	07010203
Fehn Companies Inc	MNG490204	Upper Mississippi	North Fork Crow River	07010204
Hardrives Inc	MNG490083	Upper Mississippi	North Fork Crow River	07010204
Omann Brothers Inc - St Michael	MNG490259	Upper Mississippi	North Fork Crow River	07010204
Prior Lake Aggregates Inc	MNG490250	Upper Mississippi	North Fork Crow River	07010204
Ottertail Aggregate Inc	MNG490254	Upper Mississippi	Redeye River	07010107
Wadena Asphalt Inc	MNG490041	Upper Mississippi	Redeye River	07010107
Helmin Construction Inc	MNG490218	Upper Mississippi	Rum River	07010207
Northern Lights 2009-2010 Zone EF	MN0069396	Upper Mississippi	Rum River	07010207
Cold Spring Granite - Plants	MN0062481	Upper Mississippi	Sauk River	07010202
Cold Spring Granite Co	MNG490143	Upper Mississippi	Sauk River	07010202
Mid Continent Asphalt	MNG490023	Upper Mississippi	Sauk River	07010202
Winter Sand & Gravel	MNG490224	Upper Mississippi	Sauk River	07010202

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8
Alliance Pipeline LP	MN0064068	Upper Mississippi	South Fork Crow River	07010205
Willmar Municipal Utilities Power Plant	MN0069663	Upper Mississippi	South Fork Crow River	07010205

A.4. Wisconsin Wastewater Permits with TSS Limits ≤ 32 mg/L Eligible for Future WLA Increase

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Baldwin WWTP	WI0026891	Minor Tributaries	Rush-Vermillion	07040001	23,348	63.97
Bay City	WI0061255	Minor Tributaries	Rush-Vermillion	07040001	6,051	16.58
Ellsworth Coop Creamery	WI0022942	Minor Tributaries	Rush-Vermillion	07040001	7,875	21.57
Ellsworth WWTP	WI0021253	Minor Tributaries	Rush-Vermillion	07040001	15,888	43.53
Pepin WWTP	WI0022811	Minor Tributaries	Rush-Vermillion	07040001	4,940	13.54
Prescott WWTP	WI0022403	Minor Tributaries	Rush-Vermillion	07040001	21,096	57.80
Advanced Food Products	WI0039781	St. Croix	Lower St. Croix River	07030005	17,728	48.57
Amani Sanitary District	WI0031861	St. Croix	Lower St. Croix River	07030005	1,326	3.63
Amery, City of	WI0020125	St. Croix	Lower St. Croix River	07030005	22,173	60.75
Burnett Dairy Cooperative	WI0039039	St. Croix	Lower St. Croix River	07030005	9,325	25.55
Clayton, Village of	WI0036706	St. Croix	Lower St. Croix River	07030005	3,606	9.88
Clear Lake, Village of	WI0023639	St. Croix	Lower St. Croix River	07030005	16,744	45.87
Frederic	WI0029254	St. Croix	Lower St. Croix River	07030005	15,335	42.01
Hudson WWTF	WI0024279	St. Croix	Lower St. Croix River	07030005	134,699	369.04
Lakeside Foods, INC. New Richmond	WI0002836	St. Croix	Lower St. Croix River	07030005	4,360	24.22
Luck, Village of	WI0021482	St. Croix	Lower St. Croix River	07030005	15,086	41.33
New Richmond WWTF	WI0021245	St. Croix	Lower St. Croix River	07030005	71,701	196.44
Osceola, Village of	WI0025020	St. Croix	Lower St. Croix River	07030005	31,084	85.16
River Falls WWTP	WI0029394	St. Croix	Lower St. Croix River	07030005	131,383	359.95
Somerset WWTF	WI0030252	St. Croix	Lower St. Croix River	07030005	15,542	42.58
St Croix Falls, City of	WI0020796	St. Croix	Lower St. Croix River	07030005	20,557	56.32

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Star Prairie WWTF	WI0060984	St. Croix	Lower St. Croix River	07030005	6,383	17.49
T. Thompson Hatchery	WI0049191	St. Croix	Lower St. Croix River	07030005	97,613	267.43
WI DNR Osceola Fish Hatchery	WI0004197	St. Croix	Lower St. Croix River	07030005	48,906	133.99
WI DNR St Croix Falls Hatchery	WI0004201	St. Croix	Lower St. Croix River	07030005	15,208	41.67

A.5. Wisconsin Wastewater Permits with TSS Limits > 32 mg/L Not Eligible for Future WLA Increase

Name	Permit Number	Tributary Watershed	Major Watershed	HUC-8	WLA (kg/year)	WLA (kg/day)
Maiden Rock	WI0032361	Minor Tributaries	Rush-Vermillion	07040001	2,860	34.07
Webster, Village of	WI0028843	St. Croix	Upper St. Croix River	07030001	10,569	173.73
Deer Park WWTF	WI0025356	St. Croix	Lower St. Croix River	07030005	6,341	104.24
Grantsburg, Village of	WI0060429	St. Croix	Lower St. Croix River	07030005	47,248	776.68

Appendix B: Regulated MS4 List

MS4ID	Name
MNR040000	Minnesota Phase II MS4s
WI-S050075-1	Wisconsin Phase II MS4s
*	Albertville MS4
MS400264	Alexandria City MS4
MS400073	Andover City MS4
MS400001	Anoka City MS4
MS400066	Anoka County MS4
MS400222	Anoka Technical College MS4
MS400223	Anoka-Ramsey Community College MS4
MS400074	Apple Valley City MS4
MS400002	Arden Hills City MS4
*	Baldwin Township MS4
MS400231	Baxter City MS4
*	Bayport City MS4
MS400067	Benton County MS4
MS400249	Big Lake City MS4
MS400234	Big Lake Township MS4
MS400075	Blaine City MS4
MS400005	Bloomington City MS4
*	Blue Earth County MS4
MS400266	Brainerd City MS4
MS400068	Brockway Township MS4
MS400006	Brooklyn Center City MS4
MS400007	Brooklyn Park City MS4
MS400238	Buffalo city of MS4
MS400069	Burns Township MS4

MS4ID	Name
MS400076	Burnsville City MS4
MS400250	Cambridge City MS4
MS400206	Capitol Region WD MS4
MS400077	Carver City MS4
MS400070	Carver County MS4
MS400078	Centerville City MS4
MS400171	Century College MS4
MS400008	Champlin City MS4
MS400079	Chanhassen City MS4
MS400080	Chaska City MS4
MS400009	Circle Pines City MS4
MS400010	Columbia Heights City MS4
MS400172	Coon Creek WD MS4
MS400011	Coon Rapids City MS4
MS400081	Corcoran City MS4
MS400082	Cottage Grove City MS4
MS400131	Credit River Township MS4
MS400012	Crystal City MS4
MS400132	Dakota County MS4
MS400254	Dakota County Technical College MS4
MS400083	Dayton City MS4
MS400013	Deephaven City MS4
MS400084	Dellwood City MS4
MS400014	Eagan City MS4
*	Eagle Lake City MS4
MS400087	East Bethel City MS4
MS400015	Eden Prairie City MS4
MS400016	Edina City MS4
MS400089	Elk River City MS4

MS4ID	Name
MS400237	Elko-New Market City MS4
MS400135	Empire Township MS4
MS400017	Excelsior City MS4
MS400239	Fairmont City MS4
MS400018	Falcon Heights City MS4
MS400233	Faribault City MS4
MS400090	Farmington City MS4
MS400175	Federal Medical Center MS4
MS400262	Forest Lake MS4
MS400019	Fridley City MS4
MS400020	Gem Lake City MS4
MS400252	Glencoe City MS4
MS400021	Golden Valley City MS4
MS400091	Grant City MS4
MS400022	Greenwood City MS4
MS400092	Ham Lake City MS4
*	Hanover City MS4
MS400240	Hastings City MS4
MS400136	Haven Township MS4
MS400138	Hennepin County MS4
MS400198	Hennepin Technical College Brooklyn Pk - MS4
MS400199	Hennepin Technical College Eden Prairie MS4
MS400023	Hilltop City MS4
MS400024	Hopkins City MS4
MS400094	Hugo City MS4
MS400248	Hutchinson City MS4
MS400095	Independence City MS4
MS400096	Inver Grove Heights City MS4
MS400224	Inver Hills Community College MS4

MS4ID	Name
*	Isanti City MS4
MS400140	Jackson Township MS4
*	Lake City MS4
MS400098	Lake Elmo City MS4
MS400142	Laketown Township MS4
MS400099	Lakeville City MS4
MS400025	Landfall City MS4
MS400026	Lauderdale City MS4
MS400143	Le Sauk Township MS4
MS400027	Lexington City MS4
MS400028	Lilydale City MS4
MS400100	Lino Lakes City MS4
MS400253	Litchfield City MS4
MS400029	Little Canada City MS4
MS400227	Little Falls City MS4
MS400101	Long Lake City MS4
MS400030	Loretto City MS4
MS400144	Louisville Township MS4
MS400031	Mahtomedi City MS4
MS400226	Mankato City MS4
*	Mankato Township MS4
MS400102	Maple Grove City MS4
MS400103	Maple Plain City MS4
MS400032	Maplewood City MS4
MS400241	Marshall City MS4
MS400104	Medicine Lake City MS4
MS400105	Medina City MS4
MS400033	Mendota City MS4
MS400034	Mendota Heights City MS4

MS4ID	Name
MS400201	Metropolitan State University - MS4
MS400146	Midway Township MS4
MS400147	Minden Township MS4
MN0061018	Minneapolis Municipal Storm Water
MS400182	Minnehaha Creek WD MS4
MS400177	Minnesota Correctional-Lino Lakes MS4
MS400179	Minnesota Correctional-St Cloud MS4
*	Minnesota Correctional - Stillwater MS4
*	Minnesota State University – Mankato MS4
MS400036	Minnetonka Beach City MS4
MS400035	Minnetonka City MS4
MS400106	Minnetrista City MS4
MS400170	MNDOT Metro District MS4
MS400180	MNDOT Outstate District MS4
MS400261	Montevideo City MS4
MS400242	Monticello City MS4
MS400274	Morris City MS4
MS400108	Mound City MS4
MS400037	Mounds View City MS4
*	Morris City MS4
MS400207	Mpls Community/Technical College MS4
MS400038	New Brighton City MS4
MS400039	New Hope City MS4
MS400228	New Ulm City MS4
MS400040	Newport City MS4
*	Nicollet County MS4
MS400255	Normandale Community College MS4
MS400260	North Branch City MS4
MS400205	North Hennepin Community College - MS4

MS4ID	Name
MS400229	North Mankato City MS4
MS400109	North Oaks City MS4
MS400041	North St Paul City MS4
MS400271	Northfield City MS4
MS400110	Oak Grove City MS4
*	Oak Park Heights City MS4
MS400042	Oakdale City MS4
MS400111	Orono City MS4
MS400043	Osseo City MS4
MS400243	Otsego City MS4
MS400244	Owatonna City MS4
MS400044	Pine Springs City MS4
MS400112	Plymouth City MS4
MS400113	Prior Lake City MS4
MS400189	Prior Lake-Spring Lake WSD MS4
MS400115	Ramsey City MS4
MS400191	Ramsey County Public Works MS4
MS400190	Ramsey-Washington Metro WD MS4
MS400235	Red Wing City MS4
MS400236	Redwood Falls City MS4
MS400193	Rice Creek WD MS4
MS400045	Richfield City MS4
MS400046	Robbinsdale City MS4
*	Rogers City MS4
MS400117	Rosemount City MS4
MS400047	Roseville City MS4
MS400048	Sartell City MS4
MS400118	Sauk Rapids City MS4
MS400153	Sauk Rapids Township MS4

MS4ID	Name
*	Sauk River WD MS4
MS400119	Savage City MS4
MS400154	Scott County MS4
MS400120	Shakopee City MS4
MS400155	Sherburne County MS4
MS400121	Shoreview City MS4
MS400122	Shorewood City MS4
*	Skyline City MS4
*	South Bend Township MS4
*	South Central College - North Mankato Campus MS4
MS400049	South St Paul City MS4
MS400196	South Washington WD MS4
MS400050	Spring Lake Park City MS4
MS400156	Spring Lake Township MS4
MS400123	Spring Park City MS4
MS400051	St Anthony Village MS4
*	St Augusta City MS4
MS400124	St Bonifacius City MS4
MS400052	St Cloud City MS4
MS400197	St Cloud State University MS4
MS400204	St Cloud Technical College - MS4
*	St Francis City MS4
MS400125	St Joseph City MS4
MS400157	St Joseph Township MS4
MS400053	St Louis Park City MS4
MS400246	St Michael City MS4
MS400202	St Paul Community & Technical College - MS4
MN0061263	St Paul Municipal Storm Water
MS400054	St Paul Park City MS4

MS4ID	Name
MS400245	St Peter City MS4
MS400159	Stearns County MS4
MS400259	Stillwater City MS4
MS400055	Sunfish Lake City MS4
MS400056	Tonka Bay City MS4
MS400212	U of M-Twin Cities Campus MS4
MS400057	Vadnais Heights City MS4
MS400217	Valley Branch WD MS4
MS400126	Victoria City MS4
MS400232	Waconia City MS4
MS400127	Waite Park City MS4
MS400258	Waseca City MS4
MS400160	Washington County MS4
MS400161	Watab Township MS4
MS400058	Wayzata City MS4
MS400162	West Lakeland Township MS4
MS400059	West St Paul City MS4
MS400060	White Bear Lake City MS4
MS400163	White Bear Township MS4
MS400061	Willernie City MS4
MS400272	Willmar City MS4
MS400128	Woodbury City MS4
MS400129	Woodland City MS4
*	Wyoming City MS4
WI-S050075-2 (31431)	River Falls, City, Wisconsin
WI-S050075-2 (37192)	University of Wisconsin at River Falls
WI-S050181-1 (52320)	Hudson, Wisconsin
WI-S050181-1 (52317)	St. Joseph, Town, Wisconsin

*Minnesota MS4s designated after the 2010 census have not yet been assigned individual MS4 identification numbers.

Appendix C: Stakeholder Advisory Committee and Science Advisory Panel

Stakeholder Advisory Committee

Last name	First name	Affiliation
Baumann	Jim	Wisconsin Dept of Natural Resources
Beckwith	John	Natural Resources Conservation Service
Blue	Suzanne	Mississippi River Citizen Comm.
Boody	George	Land Stewardship Project
Campe	John	Mississippi River Citizen Comm.
Commerford	Steve	Minnesota Soybean
Enblom	Jack	Minnesota Dept of Natural Resources
Everett	Les	University of Minnesota
Fisher	Loyal	Minnesota Association of Soil and Water Conservation Districts
Flood	Rebecca	Minnesota Pollution Control Agency
Formo	Warren	Minnesota Agriculture & Water Resource Coalition
Garletz	Annalee	Assn. of Minnesota Counties
Geske	Jeremy	Minnesota Farm Bureau
Grawe	Robin	Mississippi River Citizen Comm.
Haake	Barbara	Rice Creek Watershed District
Johnson	Craig	League of Minnesota Cities
Johnson	Scott	Minnesota Dept of Natural Resources
Jordahl	Marilyn	Minnesota Dept. of Transportation -O.E.S.
Larson	Cathy	Metropolitan Council
Legvold	David	Dakota County farmer
Lutjen	Mark	Lake City Marina
Peterson	Mark	Audubon
Nelson	Dean	Minnesota Wastewater Operators Association

Stakeholder Advisory Committee continued

Last name	First name	Affiliation
Noren	James	U.S. Army Corps of Engineers
Olson	Craig	Mississippi River Citizen Comm.
Peterson	Mark	Audubon Society
Peterson	Thom	Minnesota Farmers Union
Preisler	Dave	Minnesota Pork Producers Association
Rebuffoni	Dean	Sierra Club
Robertson	Mike	Minnesota Chamber of Commerce
Russell	Trevor	Friends of Mississippi River
Scott	Mary Gail	Metropolitan Council Environmental Services
Sigford	Kris	Minnesota Center of Environmental Advocacy
Snyder	Doug	Mississippi River WMO
Hokanson	David	Upper Mississippi River Assoc.
Tiedeken	Nick	Minnesota Dept. of Transportation -O.E.S.
Trowbridge	Annette	U.S. Fish and Wildlife Service
Reetz	Gaylen	Minnesota Pollution Control Agency
Vagle	James	Builders Association of Twin Cities
Wege	Gary	U.S. Fish and Wildlife Service
Wills	Craig	Prairie Island Indian Community
Weirens	Dave	Minnesota Board of Water and Soil Resources
Weller	Lark	National Park Service
White	Deanna	Clean Water Action Alliance

Science Advisory Panel

Last name	First name	Affiliation
Sleeper	Faye	University of Minnesota Water Resources Center
Ahmad	Khalil	Minnesota Pollution Control Agency
Arnold	Bill	University of Minnesota Civil Engineering
Brooks	Ken	University of Minnesota Forest Resources
Burdis	Rob	Minnesota Dept of Natural Resources
Cooper	Pete	Natural Resources Conservation Service
Engstrom	Dan	Science Museum of Minnesota-St. Croix Watershed Research Station
Everett	Les	University of Minnesota Water Resources Center
Heiskary	Steve	Minnesota Pollution Control Agency
Hendrickson	Jon	U.S. Army Corps of Engineers
Henningsgaard	Bruce	Minnesota Pollution Control Agency
Jennings	Carrie	Minnesota Geological Survey
Kiesling	Richard	U.S. Geological Survey
Knoff	Michael	U.S. Army Corps of Engineers
Larson	Cathy	Metropolitan Council Environmental Services
Munir	Hafiz	Minnesota Pollution Control Agency
Mulla	David	University of Minnesota Soil, Water & Climate
Polasky	Steve	University of Minnesota Applied Economics
Randall	Gyles	University of Minnesota Waseca
Sands	Gary	University of Minnesota Biosystems & Agriculture Engineering
Senjem	Norm	Minnesota Pollution Control Agency
Stefan	Heinz	University of Minnesota Civil Engineering
Sterner	Bob	University of Minnesota Ecology, Evolution & Behavior
Sullivan	John	Wisconsin Dept of Natural Resources
Swackhamer	Deb	University of Minnesota Water Resources Center
Thorson	Randy	Minnesota Pollution Control Agency
Vondracek	Bruce	U.S. Geological Survey S Minnesota Cooperative Fish & Wildlife Research Unit

Science Advisory Panel continued

Last name	First name	Affiliation
Wilson	Bruce N.	University of Minnesota Bio Ag Engineering
Zimmerman	Bob	City of Moorhead