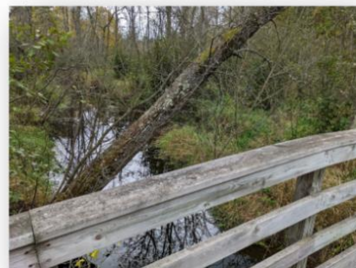
The Northeast Lakeshore TMDL:

Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids



Final
10/30/2023

Including Brown, Calumet, Door, Fond du Lac, Kewaunee, Manitowoc, Ozaukee and Sheboygan Counties, Wisconsin

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LIST OF COMMONLY USED ACRONYMS

Acronym	Definition
303(d) List	List of Impaired Waters
AM	Wisconsin's Watershed Adaptive Management Option
BMPs	Best Management Practices
CAFO	Concentrated Animal Feeding Operation
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
DATCP	Department of Agriculture, Trade, and Consumer Protection
DO	Dissolved Oxygen
FAL	Fish and Aquatic Life
FSA	Farm Service Agency
LA	Load Allocation
LAL	Limited Aquatic Life
LWCD	Land and Water Conservation Department
LFF	Limited Forage Fish
LWRM	Land and Water Resources Management
mL	Milliliters
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NCCW	Noncontact Cooling Water
NOD	Notice of Discharge
NPS Program	Nonpoint Source Pollution Abatement Program
NRCS	Natural Resources Conservation Service
PI	Phosphorus Index
POTW	Publicly Owned Treatment Works
RC	Reserve Capacity
WinSLAMM	Source Loading and Management Model
SWAT	Soil and Water Assessment Tool
TBEL	Technology-Based Effluent Limit
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TRM	Targeted Runoff Management
TSS	Total Suspended Solids
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WDNR	Wisconsin Department of Natural Resources
WisCALM	Wisconsin Consolidated Assessment and Listing Methodology
WisDOT	Wisconsin Department of Transportation
WLA	Wasteload Allocation
WPDES	Wisconsin Pollutant Discharge Elimination System
WQBEL	Water Quality-Based Effluent Limit
WQT	Water Quality Trading
WVIC	Wisconsin Valley Improvement Company
WWSF	Warm Water Sport Fish
WWTF	Wastewater Treatment Facility

1 INTRODUCTION

1.1 Background

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify waters within their boundaries that are not meeting water quality standards (Figure 1). For these waterbodies, which are defined as “impaired”, Section 303(d) further requires U.S. EPA and states to develop a Total Maximum Daily Load (TMDL) for the pollutant(s) violating or causing violations of water quality standards. A TMDL defines the assimilative loading capacity which is the maximum amount of the pollutant that a waterbody can assimilate while continuing to meet water quality standards. A TMDL also allocates the maximum allowable pollutant load between point and nonpoint sources of the pollutant.

A TMDL provides a framework for U.S. EPA, states, and partner organizations to establish and implement pollution control and management plans, with the goal of achieving “water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable (CWA § 101(a)(2)).”

This report presents TMDLs for total phosphorus (TP) and sediment (as Total Suspended Solids, TSS) for surface waters in the Northeast Lakeshore (NEL) area of Wisconsin. This TMDL is designed to both address impaired waters that are not meeting water quality standards and to protect waters from becoming impaired by establishing the assimilative loading capacity required to meet water quality standards for both listed and unlisted waters.

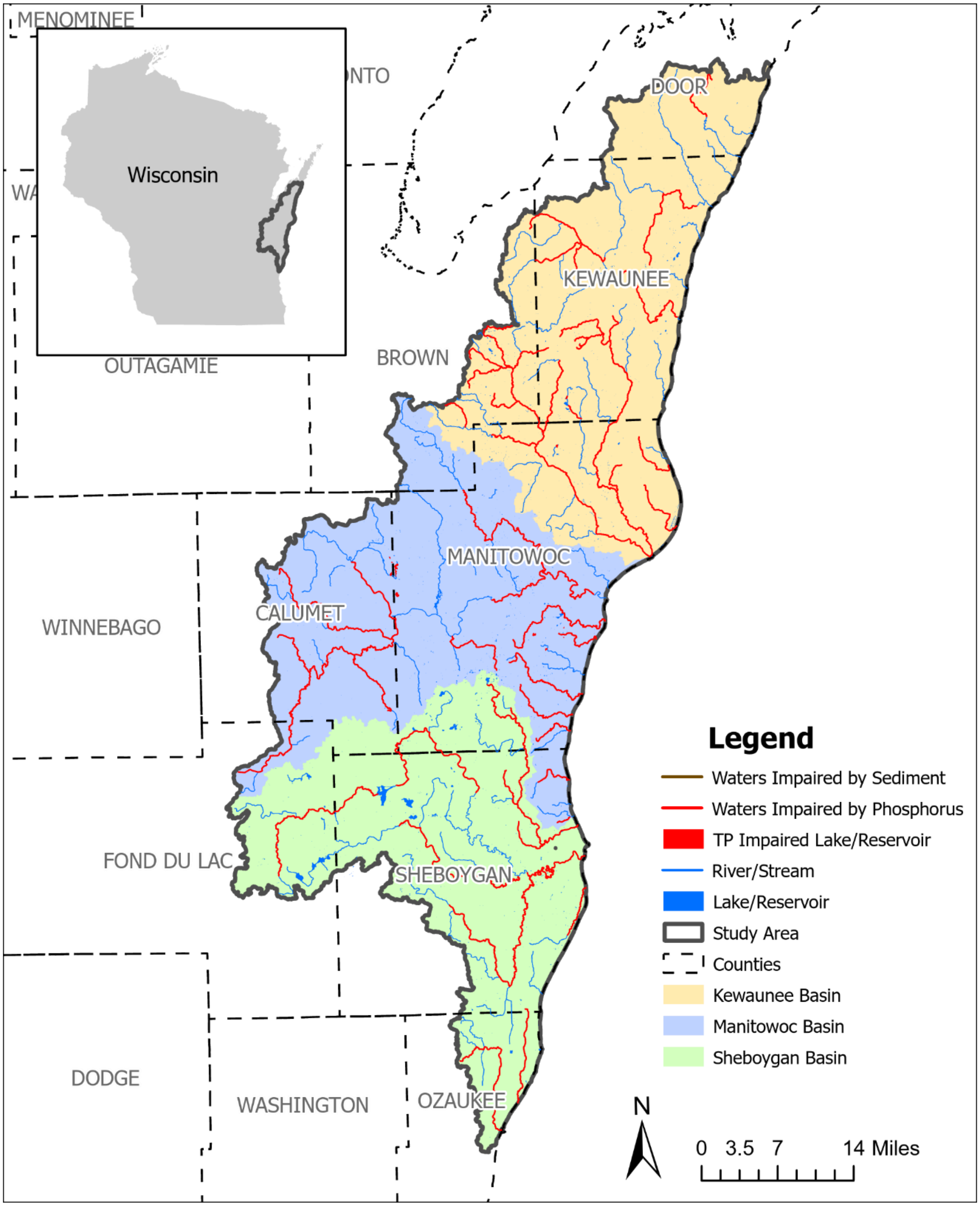

Figure 1 Location of waters impaired (303(d) Impaired Waters List for the year 2022) by phosphorus and sediment in the Northeast Lakeshore.

1.2 Problem Statement

The Northeast Lakeshore (NEL) is located along Wisconsin's eastern shoreline of Lake Michigan. Surface waters in the NEL are impaired by excessive phosphorus and sediment loading, which leads to nuisance algae growth, oxygen depletion, fish kills, reduced submerged aquatic vegetation, water clarity problems, and degraded habitat. These impairments can adversely affect fish and aquatic life, drinking water supplies, and recreation.

Although phosphorus is an essential nutrient for plant growth, excess phosphorus is a concern for most aquatic ecosystems. Under natural conditions where human activities do not dominate the landscape, phosphorus is generally in short supply and is a limiting factor for aquatic plant growth. As more phosphorus enters a waterbody, it acts to fertilize the aquatic system, allowing for more plant and algae growth. This condition of nutrient enrichment, and a transition from plant to algae-dominated primary production, is referred to as eutrophication. Eutrophication can alter the ecology of the waterbody and degrade the services it provides, including swimming, fishing, other recreational uses and supplies of clean drinking water.

A bloom of aquatic plants may also include cyanobacteria, also referred to as blue-green algae, which are harmful to fish and pose health risks to humans. Concerns associated with blue-green algae include discolored water, reduced light penetration, taste and odor problems, dissolved oxygen depletions during die-off, and toxin production. Blue-green algal blooms (particularly surface scums) are unsightly and can have unpleasant odors. This impact makes recreational use of the waterbody unpleasant and poses a problem for people who live close to the affected waterbody. Further, when algae dies, decomposition of algae cells results in depletion of dissolved oxygen in the water, which suffocates fish and other aquatic life. Depending on the severity of the low dissolved oxygen event, large fish kills can occur. Lastly, blue-green algae blooms can result in the release of toxic substances (most notably, microcystin) which can be harmful to humans, and occasionally fatal to livestock and pets. Nearly all of these effects have economic impacts on local communities as well as state and federal governments.

The NEL is also subject to excess sediment loading to surface waters. Excess sediment in streams, rivers, and lakes scatters and absorbs sunlight, reducing the amount of light available for submerged aquatic vegetation for growth and potentially increases water temperature. The loss of submerged aquatic plants is problematic because within an aquatic ecosystem they act to release dissolved oxygen, provide food and habitat for fish and other aquatic life, stabilize bottom sediments, protect shorelines from erosion, and utilize nutrients that would otherwise be available for nuisance algae growth. The combination of algae blooms from nutrient enrichment and turbidity from high sediment concentrations can result in substantial reduction of light penetration available for the growth of submerged aquatic vegetation.

Reduced water clarity also interferes with the ability of fish and waterfowl to see and catch food. Suspended sediments can also clog fish and invertebrate gills and cause respiratory stress. Prolonged periods of very high sediment concentrations can be fatal to aquatic organisms (Newcombe & Jensen, 1996). When sediments settle to the bottom of river and lakes, they can smother the eggs of fish and aquatic insects, suffocate newly hatched insect larvae, and reduce dissolved oxygen concentrations in stream bottom substrates. Settling sediments can also fill in spaces between rocks, reducing the amount of sheltered habitat available to aquatic organisms.

Sediment is also a concern because of its ability to transport phosphorus to a waterbody. Total phosphorus consists of both dissolved phosphorus, which is mostly orthophosphate, and particulate phosphorus, including both inorganic and organic forms (Sharpley, et al., 1994). Within the surface soil layer, inorganic phosphorus is typically bound tightly to soil particles. When these soil particles erode, the attached phosphorus is also carried into nearby waterbodies where it can be released and made available to fuel algal blooms.

1.3 Watershed Framework

The TMDLs presented in this report were developed using a watershed framework. Under a watershed framework, TMDLs are simultaneously completed for multiple water bodies within a TMDL subbasin.

For phosphorus, the entire NEL was divided into 319 subbasins based on natural drainage areas and individual Phosphorus TMDLs were developed for all 319 subbasins. Throughout this report, the 319 subbasins are referred to as “TMDL subbasins”.

For total suspended solid (TSS) TMDL work, the 319 natural subbasins were aggregated into 62 subbasins to simplify the calculations of pollutant allocations. See Section 4.2.2 for more details on why this was done.

The following factors were used to delineate the boundaries of TMDL subbasins in the NEL:

- The location of impaired waters on the Wisconsin 2018 303(d) Impaired Waters List;
- The location of outfalls for individually permitted dischargers of wastewater to surface waters through the Wisconsin Pollutant Discharge Elimination System (WPDES);
- Changes in Wisconsin water quality criteria (i.e., 75 to 100 µg/L TP);
- Land use patterns; and
- Hydrologic/streamflow regimes.

The TMDL subbasins are listed in Appendix B and mapped in Figure 2 and Figure 3. The drainage boundaries of TMDL subbasins were geographically delineated using topographic data acquired from the US Geological Survey (USGS; a 10-meter resolution digital elevation model).

Each of these subbasins, approximately the size of a 12-digit federal hydrologic unit code (HUC-12) watershed, has an allocated load for phosphorus based on the phosphorus criteria for the waterbodies in that subbasin (note: in some cases, subbasins were aggregated together for the purpose of TSS allocations; however, every subbasin is assigned a TP allocation). The delineation of these subbasins often directly corresponds with the spatial extent of impaired river and stream segments or the contributory drainage areas of impaired lakes; however, subbasins were also delineated for waterbodies not listed as impaired. Thus, allocations were assigned to subbasins with listed and unlisted waterbodies. The resulting system of subbasin allocations provide protection ensuring that allocated loads meet promulgated water quality criteria for all waterbodies within the subbasin as well as downstream waterbodies. If future monitoring determines that additional river or stream segments within a subbasin are impaired, these impaired segments can be added to Wisconsin's future 303(d) Impaired Waters Lists under Category 5B: impaired waters with an approved TMDL or restoration plan.

A crosswalk between the impairment listings addressed by this TMDL and the TMDL subbasins is provided in the "TMDL Subbasin" column of Appendix A Table 1.

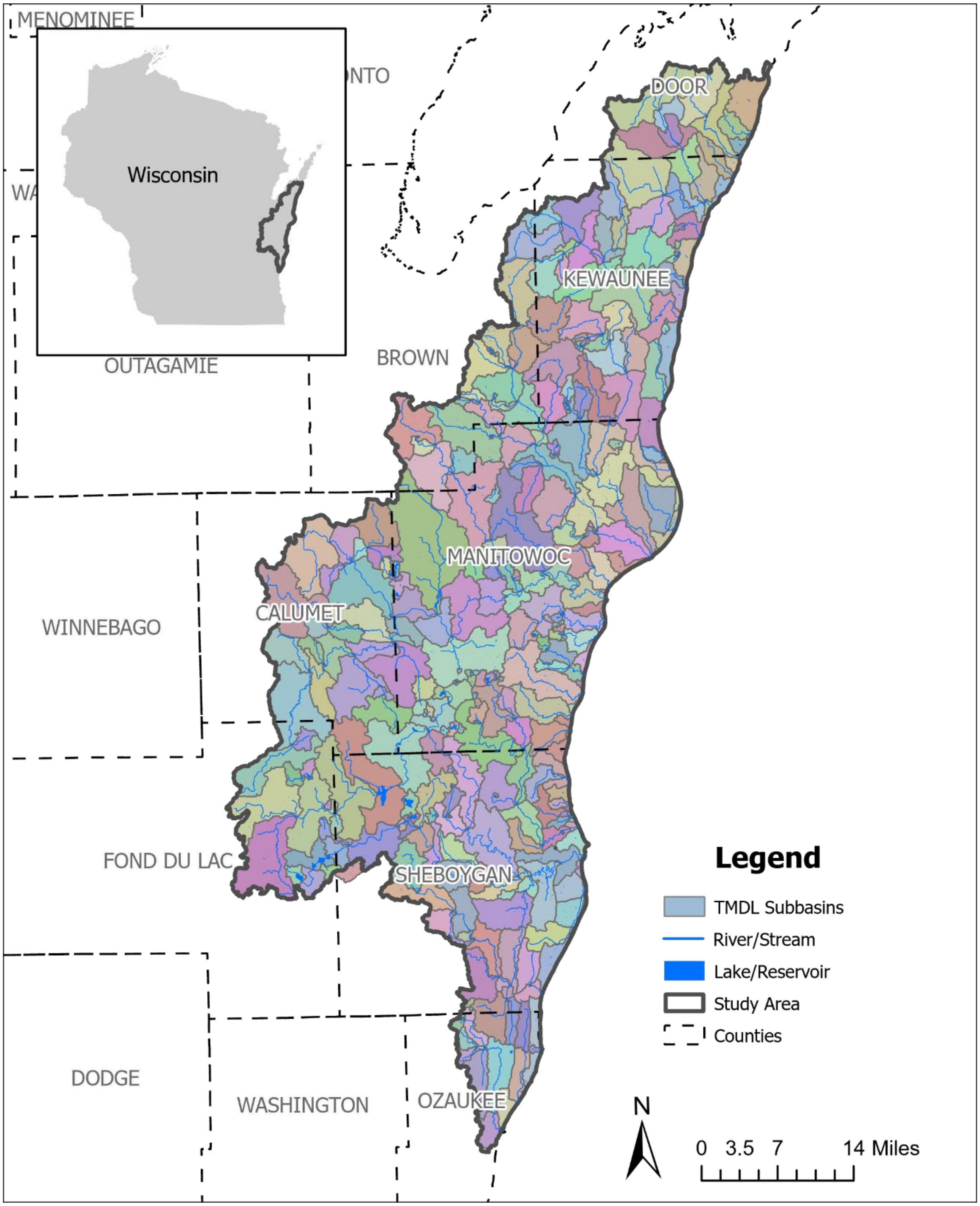

Figure 2 Map of Phosphorus TMDL subbasins.

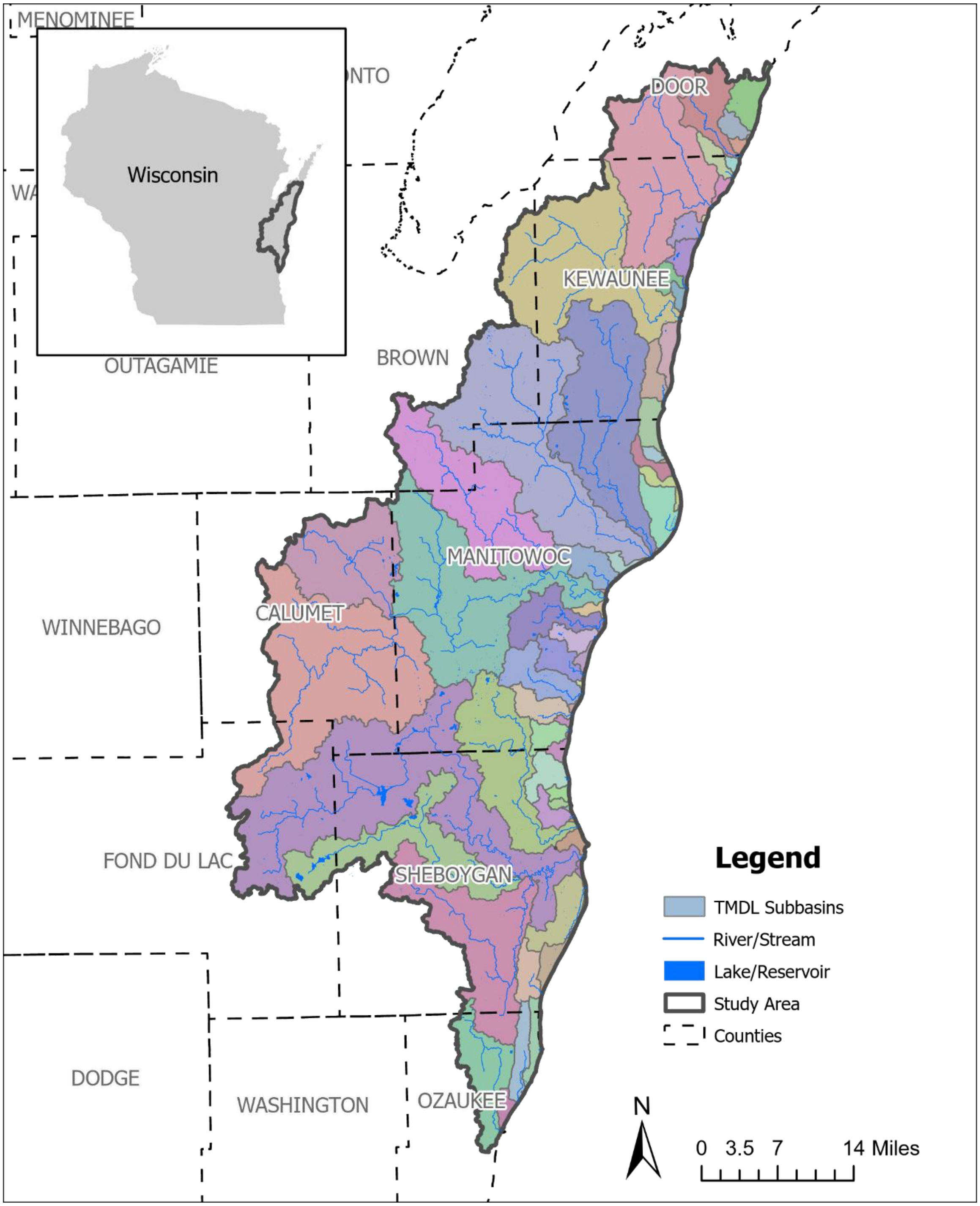

Figure 3 Map of Total Suspended Solids TMDL Subbasins.

1.4 Report Organization

This report defines the TMDLs and allocations and provides potential management actions that will help restore water quality in the NEL. The main body of the report identifies the waterbodies and pollutants addressed by the TMDL, presents applicable water quality standards, assesses pollutant sources, summarizes results of assimilative loading capacity and source allocation analysis, and discusses considerations for TMDL implementation. The main body of the report is supplemented with appendices with technical details on the analyses completed to develop the TMDLs and detailed maps and tables. The contents of these appendices are summarized in the Appendices section at the beginning of the document.

2 APPLICABLE WATER QUALITY STANDARDS AND NUMERIC TARGETS

The purpose of a TMDL is to define the maximum amount of a pollutant that a waterbody can assimilate while still attaining water quality standards. This section summarizes Wisconsin water quality standards that are relevant to the TMDLs presented in this report.

2.1 Narrative Water Quality Criteria

All waters of the State of Wisconsin are subject to the following narrative water quality criterion established in Section NR 102.04(1) of the Wisconsin Administrative Code:

“To preserve and enhance the quality of waters, standards are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all waters including the mixing zone and the effluent channel meet the following conditions at all times and under all flow conditions: (a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state, (b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the states, (c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.”

Due to excessive phosphorus and sediment loading, the segments listed in Appendix A were not meeting Wisconsin’s narrative water quality criterion for the 2022 assessment and reporting cycle. Excess phosphorus loading causes algal blooms, which may be characterized as floating scum, producing a green color, a strong odor, and an unsightly condition. Sometimes these algal blooms contain toxins which limit recreational uses of the water bodies and poses a public health concern. Excessive sediments are considered objectionable deposits. Because of the low dissolved oxygen and degraded habitat impairments caused by excess phosphorus and sediment, many designated fish and aquatic life uses are not supported in the waters of the NEL.

2.2 Numeric Water Quality Criteria

In addition to narrative criteria, numeric water quality criteria for phosphorus must be met in the NEL. Numeric criteria for phosphorus are defined in Section NR 102.06 of the Wisconsin Administrative Code (Table 1). The numeric criteria were established in 2010 and are based on relationships between phosphorus and designated use attainment in surface waters, as documented in Wisconsin Phosphorus Water Quality Standards Criteria: Technical Support Document (WDNR, 2010).

To be consistent with the criteria development methods, attainment of phosphorus criteria is assessed in streams as median TP during the growing season (May 1 through October 31) and in lakes as mean TP during the summer (June 1 through September 15). See WisCALM Guidance Document (WDNR, 2022) for additional details on assessment.

Table 1 Numeric criteria for Total Phosphorus (TP) by waterbody type.

Water Type	TP Criteria
Large Rivers	100 µg/L
Other Rivers and Streams	75 µg/L
Non-Stratified Reservoirs (hydraulic residence time ≥ 14 days)	30 µg/L
Stratified Reservoirs (hydraulic residence time ≥ 14 days)	40 µg/L
Stratified, Two-Story Fishery Lakes	15 µg/L
Stratified Seepage Lakes	20 µg/L
Stratified Drainage Lakes	30 µg/L
Non-Stratified Lakes	40 µg/L

Applicable numeric criteria for phosphorus are listed in Table 1 of Appendix A for each of the impaired waterbody segments in the NEL. Table 2 of Appendix A lists the numeric criteria for phosphorus that applies to the waterbody segment at the outlet of each TMDL subbasin.

Revisions to other administrative codes supporting phosphorus criteria implementation went into effect concurrently with changes to NR 102. Chapter NR 217 was revised to include procedures for translating numeric phosphorus criteria into water quality-based effluent limits (WQBELs) and incorporating those limits into Wisconsin Pollutant Discharge Elimination System (WPDES) permits. Chapter NR 151 revisions that also went into effect concurrently with the changes to NR 102 included new phosphorus index (P Index) performance standards addressing phosphorus from agricultural lands.

2.3 Designated Uses

Designated uses are the attainable condition specified in water quality standards for surface waters in Wisconsin. Designated uses are defined in Chapter NR 102 of Wisconsin Administrative Code. All waters of the state have the following designated uses: Fish and Aquatic Life, Recreation, Wildlife, and Public Health and Welfare. Wisconsin water quality standards establish criteria for water quality that correspond to attainment of these designated uses. All four designated uses are subject to the narrative criteria described in Section 2.1 of this report.

The Fish and Aquatic Life use also includes the numeric criteria for phosphorus described in Section 2.2 of this report. Section NR 102.04(3) of the Wisconsin Administrative Code defines the Fish and Aquatic Life use and identifies five fish and aquatic life subcategories for surface water classification (cold water communities; warm water sport fish communities; warm water forage fish communities; limited forage fish communities; limited aquatic life). All fish and aquatic life subcategories are subject to attainment of numeric phosphorus criteria except for waters with a limited aquatic life designation.

Although not explicitly addressed by this TMDL, Lake Michigan is located downstream and is one of three Wisconsin surface waters used as drinking water sources (the other two, Lake Winnebago and Lake Superior, are outside of the TMDL study area). There is no standard procedure in Wisconsin rules or guidance documents for assessing whether Lake Michigan is impaired by excessive algal growth, and therefore the lake (including nearshore areas and harbors) was excluded from this TMDL. There is also not a complete near shore model for Lake Michigan which would allow for the integration of the modeling used in this TMDL with the near shore area of Lake Michigan. However, reductions in external loading of TP to Lake Michigan would reduce the likelihood of contamination of drinking water due to excess algae growth (see WisCALM for guidance on microcystin assessment) (WDNR, 2022).

The Safe Drinking Water Act (SDWA) requires that U.S. EPA publish a list of unregulated contaminants that are known or expected to occur in public water systems in the U.S. that occur at a frequency and at levels of public health concern and where there is a meaningful opportunity for health risk reduction. Cyanotoxins are listed as unregulated contaminants and must be monitored by public water systems. This monitoring provides a basis for future regulatory determinations and actions to protect public health, when warranted. The Drinking Water Protection Act (DWPA) required U.S. EPA to develop and report to Congress a strategic plan outlining the risks to human health from drinking water provided by public water systems contaminated with algal toxins and to recommend feasible treatment options, including procedures and source water protection practices, to mitigate any adverse public health effects of algal toxins. U.S. EPA developed, and submitted to Congress, the Algal Toxin Risk Assessment and Management Strategic Plan (2015) outlining how the Agency will continue to assess and manage algal toxins in drinking water.

Drinking water programs at both the national and state levels use a multi-barrier protection approach in which source water is meeting or is as close to meeting its designated use as possible prior to treatment. Current treatment technologies employed by communities drawing water out of Lake Michigan have not shown a breakthrough of toxins; however, it is still a concern. The 1993 Milwaukee Cryptosporidiosis outbreak demonstrates that problems in treatment can occur and the August 2014 algal bloom on Lake Erie resulted in 400,000 people having to drink bottled water due to microcystins. The allocations developed in this TMDL minimize the risk of a severe algal bloom and are consistent with the multi-barrier protection approach discussed above.

2.4 Numeric Water Quality Targets

2.4.1 Total Phosphorus

In a TMDL, the water quality target is a numeric endpoint that represents the level of acceptable water quality to be achieved by implementing the TMDL. For phosphorus, the numeric targets for the TMDLs presented in this report are equal to numeric water quality criteria defined in s. NR 102.06, Wis. Adm. Code. The TP criteria for each TMDL reach are listed in Appendix B. To be consistent with the criteria development methods and procedures laid out in WisCALM, attainment of criteria is assessed in streams as the median TP during the growing season (May 1 through October 31) and in lakes as the mean TP during the summer (June 1 through September 15).

2.4.2 Total Suspended Solids

Numeric water quality criteria do not exist for total suspended solids in Wisconsin, but numeric water quality targets for this TMDL were developed to be protective of narrative criteria specified in s. NR 102.04(1), Wis. Adm. Code to control activities that may result in harm to fish and other aquatic life or violate water quality standards. A TSS target concentration for streams and rivers of 12 mg/L was derived by WDNR for use in this TMDL to address the effects of excess sediment loading, based on the approach and data used to develop the State TP criteria. The numeric sediment target is intended to meet the narrative criteria ("no objectionable deposits…", "…nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life") in s. NR 102.04(1) of Wisconsin Administrative Code.

There is a strong correlation of excess TSS and degraded biota and habitat in streams and rivers, supported by numerous studies and sampling results. Turbid waters created by excess TSS concentrations reduce light penetration, which can adversely affect aquatic organisms. Also, TSS can interfere with fish feeding patterns because of the turbidity. Turbidity is a cloudiness or haziness caused by the suspended sediment particles and can interfere with light penetration and sight through reduced water clarity.

Prolonged periods of very high TSS concentrations can be fatal to aquatic organisms (Newcombe & Jensen, 1996). As TSS settles to the bottom of a stream, critical habitats such as spawning sites and macroinvertebrate habitats can be covered in sediment/siltation. Excess sediment in a stream bottom can reduce dissolved oxygen concentrations in stream bottom substrates and reduce the quality and quantity of habitats for aquatic organisms. And, as stated in Section 1.2, sediment is a concern because of its ability to transport phosphorus to a waterbody via inorganic phosphorus that is bound to eroded soil particles.

WDNR investigated the correlation between TSS and stream health in Wisconsin waters with support by USGS to determine a numeric TSS target. Although U.S. EPA has not published guidance on setting water quality criteria for TSS in streams and rivers, U.S. EPA's Science Advisory Board has developed guidance for nutrient criteria which provides a framework that is equally applicable to TSS. That guidance emphasizes the use of multiple lines of evidence, relating concentrations to biotic impacts, using strong and supportable correlations between causal and response parameters.

U.S. Geological Survey Professional Paper 1754 (Robertson, Weigel, & Graczyk, 2008), provides data and statistical results that allow for identification of a TSS target, as supplemented by unpublished analysis by the paper's primary author, Dr. Dale Robertson of USGS. On Tables 11 and 15 of the USGS report, strong correlations based on the Spearman rank correlation coefficients were identified between suspended sediment concentration (SSC) and a number of biotic indices, including macroinvertebrate species, percent of individuals from the order Ephemeroptera, Mean Pollution Tolerance Value, Hilsenhoff Biotic Index, percent intolerant fish species, percent lithophilic spawners, percent suckers, and fish index of biotic integrity. Subsequent breakpoint analysis by Dr. Robertson identified SSC concentrations which best represented thresholds between reference and degraded conditions for multiple chemical and biological parameters. SSC breakpoints ranged from 3.5 to 22.25 mg/L and averaged 13.8 mg/L.

The TSS target based on Wisconsin non-wadeable streams and river data is preferred over earlier and broader analyses for a variety of reasons, including:

- All data was collected using a defined protocol and during the same year, while other studies are based on available data collected using a variety of protocols over several years.
- All the 42 non-wadeable rivers and streams are of similar size, stream order, etc., while other studies used a wide range of streams and rivers.
- Correlation to biotic impacts is considered as a stronger and more appropriate basis than a calculated pre-settlement reference condition.

Based on weighting strategies similar to what was used in the development of the phosphorus criteria, WDNR arrived at a TSS target value of 12 mg/L, expressed as the median of monthly samples collected during the growing season between May and October. The expression of the TSS target matches how the samples were collected and are intended to be used.

Breakpoint values served as the basis of selecting the numeric TSS target of 12 mg/L for TMDL development. The target is expressed as TSS (rather than SSC) to facilitate assessment of TMDL attainment because WDNR water quality monitoring programs regularly collect TSS samples and not SSC. TSS and SSC are both parameters that describe the concentration of solid-phase material suspended in the water column of a waterbody. The parameters differ in the specific laboratory procedures used for measurement. In general, SSC is analyzed by measuring the dry weight of all sediment in an entire water sample while TSS measures the dry weight of sediment within a subsample of the water sample. Comparisons of paired TSS and SSC measurements have indicated that TSS methods tend to underestimate sediment concentrations relative to SSC, particularly as larger particle sizes become more predominant in a sample. However, the exact relationship between TSS and SSC can vary significantly from one monitoring location to another.

The TSS target value of 12 mg/L is expressed as the median of monthly samples collected during the growing season between May and October. High TSS concentrations during the growing season are especially problematic because excess sediment reduces the amount of light available to submerged aquatic vegetation for growth and potentially increases water temperatures. Further, the spawning of many fish and aquatic insect species can be disrupted with high growing season sediment concentrations because settling particles can smother fish eggs and insect larvae.

2.4.3 Benefits of Achieving Numeric Targets

In addition to reduced TP and TSS concentrations in NEL surface waters, the expected water quality benefits from achieving the quality criteria, both narrative and numeric, include:

- Reduced density, frequency, and duration of nuisance algal blooms resulting in lowered health risks to humans and animals, especially pets;
- Increased dissolved oxygen concentrations that will support a more diverse and robust community of fish and other aquatic life;
- Increased water clarity/transparency due to the stabilizing effect of increased submerged aquatic vegetation;
- Improved biotic integrity index scores for fish and macroinvertebrate communities;
- Improved qualitative and quantitative aquatic habitat ratings;
- Reduced water temperatures;
- Improved pH levels;
- Increased numbers and safety of swimmers, boaters, anglers, and other recreational users.

3 WATERSHED CHARACTERIZATION

3.1 Watershed Setting

The nearly 2,000 square mile NEL is located along Wisconsin's eastern lakeshore; it runs from Sturgeon Bay to Port Washington encompassing portions of 8 counties (Brown, Calumet, Door, Fond du Lac, Kewaunee, Manitowoc, Ozaukee, and Sheboygan).

The NEL is comprised of many major river basins. For this study, three model basins are defined: the Kewaunee, the Manitowoc, and the Sheboygan Basins. The Kewaunee Model Basin is defined by the Stony, Ahnapee, Kewaunee, and Twin River Watersheds. The Manitowoc Model Basin is made up by the Manitowoc River Watershed and the Lake Michigan Tributaries. The Sheboygan Model Basin includes the Sheboygan River Watershed in addition to the Pigeon River and Lake Michigan Tributaries Watersheds.

Land use and land cover in the NEL varies substantially throughout the basins. Over half of the NEL is dominated by crop rotation made up by dairy, cash grain, and continuous corn. Another large portion of the land is utilized for hay and pasture. The remainder of the basin is made up of wetland, forest, and grassland with a small portion being urbanized. Notable urban areas in the NEL include Manitowoc, Port Washington, Sheboygan, and Two Rivers. There are several other cities and towns throughout the area.

Tables describing land use within each TMDL subbasin are provided in Appendix C.

3.2 Hydrology and Water Resources

The NEL contains a diverse network of rivers, streams, lake, wetlands, and reservoirs. The following sections describe the different categories of waterbodies addressed in this report. The NEL contains 319 subbasins which make up 10 tributary basins and were divided into three model basins to cover the three major drainage basins in the area. From north to south, they are the Kewaunee Basin, Manitowoc Basin, and Sheboygan Basin. One singular model basin could have been used for the entirety of the NEL; however, dividing the NEL into three model basins allowed for additional flexibility to adjust model parameters, which in return increases the accuracy of load estimates.

3.2.1 Kewaunee Model Basin

The Kewaunee Model Basin covers the northern portion of the NEL. The five tributary basins that make up the Kewaunee Basin are as follows:

- The Stony Creek Watershed is 34,558 acres in size and drains into Lake Michigan. It contains 79 miles of streams and rivers, 7,425 acres of lakes and 8,746 acres of wetlands.
- The Ahnapee River Watershed is 86,772 acres in size. It contains 189 miles of streams and rivers (3.3 miles are trout waters), 5,768 acres of lakes and 15,037 acres of wetlands.
- The Kewaunee River Watershed is 91,009 acres in size. It contains 295 miles of streams and rivers (11.2 miles are trout waters), 541 acres of lakes, and 7,313 acres of wetlands.
- The Twin River Basin is made up of 2 tributary basins, the East Twin River Watershed, and the West Twin River Watershed. Together, the Twin River Basin is 232,960 acres in size. They contain 676 miles of streams and rivers (2.5 miles are trout waters), 14,346 acres of lakes, and 24,371 acres of wetlands.

3.2.2 Manitowoc Model Basin

The Manitowoc Model Basin covers the central part of the NEL. The two tributary basins that make up the Manitowoc Basin are as follows:

- The Manitowoc Basin is made up of the Branch River Watershed, North Branch Manitowoc River Watershed, South Branch Manitowoc River Watershed, and Lower Manitowoc River Watershed.
- The Sevenmile – Silver Creek Watershed is 72,320 acres in size. It contains 184 miles of streams and rivers, 10,578 acres of lakes, and 4,733 acres of wetlands.

3.2.3 Sheboygan Model Basin

The Sheboygan Basin covers the southern portion of the NEL. The three tributary basins that make up the Sheboygan Basin are as follows:

- The Pigeon River Watershed is 50,560 acres in size. It contains 110 miles of streams and rivers, 770 acres of lakes, 3,150 acres of wetlands.

- The Sheboygan River Basin is 285,440 acres in size. It contains 571 miles of streams (35 miles are classified as trout waters), 5,278 acres of lakes, and 39,676 acres of wetlands.
- The Black-Sauk-Sucker Tributary Basin is 53,760 Acres in size. It contains 167 miles of streams, 14,718 acres of lakes, 3,817 acres of wetlands.

3.2.4 Inland Lakes

Numerous small lakes are distributed throughout the NEL basin. Twenty-seven of these additional lakes are addressed by this TMDL (Appendix I). These lakes are either on Wisconsin's Impaired Waters List for eutrophication-related impairments, considered potentially impaired based on available data, or were lakes over 100 acres with public access. These lakes span a wide range of surface area, mean depths, and hydrological settings. The smallest lakes are less than 30 acres (Weyers Lake, Gass Lake, Boot Lake, Round Lake, Carstens Lake) while the larger lakes cover almost 300 acres (i.e., Elkhart Lake). Mean depths range from 8 to 45 feet in the twenty-seven addressed lakes.

3.3 Ecological Landscapes

3.3.1 Northern Lake Michigan Coastal

The Northern Lake Michigan Coastal region covers the northern portion of the NEL (Figure 5). Sixty-four percent of this region is non-forested, and the primary makeup of the non-forested area is agricultural croplands. The forested areas are comprised of forested uplands and forested wetlands. The prominent cover types in the uplands are maple-basswood and aspen-birch, wetlands populated with lowland hardwoods, and with some conifer swamps. Apart from forested and agriculture land, grasslands, non-forested wetlands, and shrublands can be found throughout the ecological region.

The landscape in the region is largely composed of undulating to hilly till plains scattered with moraines and drumlins overlaying dolomitic limestone bedrock. Glacial lake plains, low sand dunes, and beach ridges can be found where interglacial and postglacial lakes once were. Upland soils are dominated by loamy sand and silt loam textures with moderately slow permeability and moderate to high available water capacity. Lowland soils are poorly drained non-acid muck, loamy till, sandy lacustrine and outwash soil types.

The continental climate of this area is defined by cold winters and warm summers, mean growing season is 140 days and the mean annual temperature is 42.8 degrees Fahrenheit. Mean annual precipitation is 31 inches while mean snowfall is 46 inches. The proximity to Lake Michigan generates high climate variability between coastal and inland areas. Growing season is extended in the areas near Lake Michigan making the peninsula a favorable area for cherry and apple farming.

3.3.2 Central Lake Michigan Coastal

The Central Lake Michigan Coastal ecological landscape encompasses a large portion of the NEL (Figure 5). Much of this landscape is in agricultural production. Apart from agriculture, the remainder of the landscape is comprised of equal parts forested uplands, forested wetlands, and non-forested wetlands. Mesic forests dominate the forested uplands, which are populated with sugar maple, American basswood, and American beech. Hardwood varieties dominate areas of large insular swamps while conifers dominate lowlands ridge-and-swale complexes along the Lake Michigan shoreline.

Multiple glacial advances and retreats created a landscape defined by till plains and moraines. Beach ridges, terraces, and dunes are present where Glacial Lake Oshkosh once existed. Coastal ridge-and-swale complexes, clay bluffs and ravines, and freshwater estuaries occur along the shore of Lake Michigan.

The climate is marked by cold winters and warm summers. Mean growing season in this area is 160 days and the mean annual temperature is 45.1 degrees Fahrenheit. Mean annual precipitation is 31 inches, while mean annual snowfall is 43 inches. Substantial rainfall and a long growing season make this area suitable for agriculture row crops, grains, hay, and pasture.

3.3.3 Southeast Glacial Plains

The Southeast Glacial Plains cover the headwaters of many of the streams and rivers in the southwestern part of the NEL (Figure 5). The primary land cover in the Southeast Glacial Plains is agriculture, the remainder includes a mix of grassland, non-forested wetland, forested upland, and forested wetland. Emergent/wet meadow is the largest wetland type and includes marshes, sedge meadows, and areas dominated by reed canary grass. Forested areas are comprised of northern and central hardwoods, lowland hardwoods, and oak-hickory.

Glaciation was the primary force that developed the landscapes found within the Southeast Glacial Plains. Moraines and till plains are common features found in the region; outwash features are common between morainal ridges. Drumlins, kames, and kettles are common as well. Soils in this area are calcareous glacial till, the textures range from sandy loam to loam or clay loam. A layer of silty loess is present across the ecological landscape with a depth ranging from 6 to 48 inches.

The mean annual growing season is 155 days, mean annual temperature is 45.9 degrees Fahrenheit, mean annual precipitation is 34 inches, and mean annual snowfall is 39 inches. The climate is suitable for row crops, small grains, and pastures.

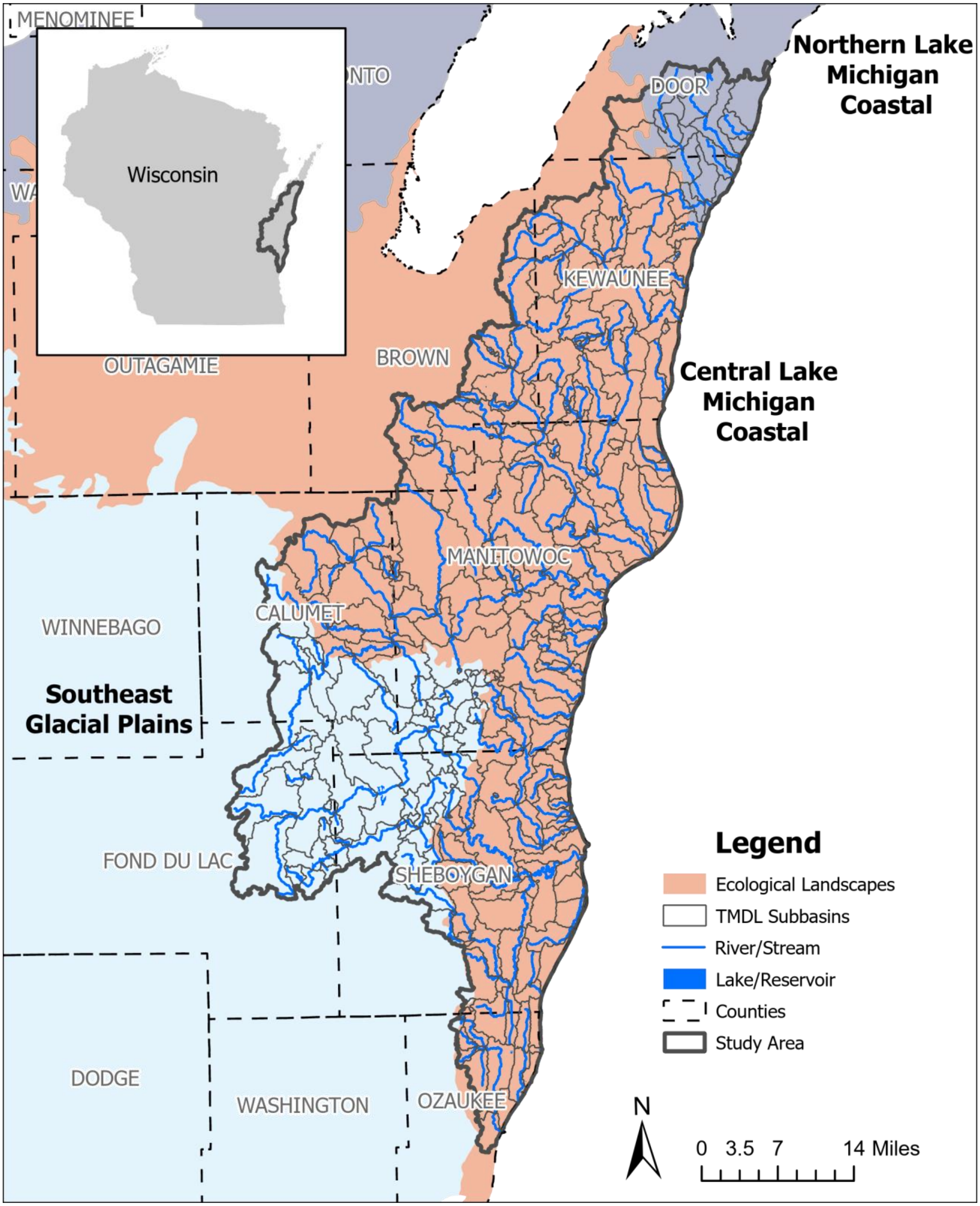

Figure 4 Ecological landscapes within the Northeast Lakeshore.

3.4 Water Quality

Phosphorus and sediment concentrations were sampled by WDNR and partner groups as part of the WDNR water quality monitoring program. The following subsections, tables, and figures summarize these water quality monitoring data. The data summary is intended to provide a general overview of the range of observed and inferred water quality throughout the TMDL area.

3.4.1 TMDL Monitoring Strategy

Part of this study, the TMDL area was monitored for the period between 2016 and 2020 (Table 2, Figure 5, and Figure 6). The TMDL monitoring plan consisted of 43 distinct sampling locations, each with one of three different uses:

- Scheduled monthly grab sampling of TP and TSS
- Scheduled bi-weekly (i.e., approximately twice monthly) grab sampling of TP and TSS paired with continuous stage or discharge monitoring for the purpose of estimating daily loads. There were five sites where a USGS streamflow gage was installed or had been installed in the past—otherwise, WDNR installed a pressure transducer data logger to collect continuous stage (see Appendix J)
- Continuous flow monitoring near a TP or TSS sampling location where conditions for the placement of a pressure transducer were more favorable than the water quality monitoring site (see Appendix J for additional details). Two nearby sites, one with flow monitoring and the other with chemistry sampling, could be paired together to estimate a daily load.

Most of the monitoring for the TMDL occurred between the years 2016 and 2019 (Figure 5). This sampling effort was augmented with long-term trend sites (Kewaunee River at Bruemmer Park, Manitowoc River at County Hwy JJ, and Sheboygan River at Esslingen Park), each of which have a USGS streamflow gage station paired with WDNR monthly chemistry sampling. Two additional project-specific sites were included at Otter Creek near Plymouth and Fisher Creek near Howards Grove, each of which had USGS gage stations paired with high-frequency chemistry sampling.

The NEL TMDL monitoring strategy is unique because it included a high density of sites (Figure 6) where grab samples were paired with continuous streamflow. This pairing was made possible through a new continuous streamflow monitoring protocol at WDNR that incorporates the use of pressure transducer data loggers for measuring continuous stream stage, an Acoustic Doppler Current Profiler for measuring streamflow during storm events, and WDNR internal modeling staff for fitting rating curves that translate pressure transducer output to streamflow. This process is described in Appendix J. Protocols for continuous streamflow estimation followed the WDNR guidance document “Guidance for Developing Flow Rating Curves” EGAD # 3200-2018-41 (Chenevert, Shupryt, Kult, & Fisch, 2018).

Table 2 List of TMDL monitoring sites and sampling plan for TMDL monitoring period between 2018 and 2020. At Long-Term Trend Sites (LTT), the sampling routine remained consistent with WDNR LTT monitoring, except sampling frequency was increased from monthly to biweekly. At all other sites not associated with LTT where flow was collected, a continuous pressure transducer collected stage data (see Appendix G for details on continuous flow monitoring/modeling). All sites where chemistry samples were collected included both total phosphorus and total suspended solids.

SWIMS Station ID	Station Name	LTT	Flow	Chem.	Freq.
153027	Ahnapee River at CTH J Forestville	N	Y	N	
10044953	Ahnapee River at Washington Road	N	N	Y	biweekly
363268	Black Creek - Hwy Bb	N	N	Y	monthly
603291	Black River at Indian Mound Rd	N	N	Y	monthly
363313	Branch River - Above Branch River Rd	N	Y	N	
10016958	Branch River - Cty J - 07600 Ft Upstream from Bridge	N	N	Y	monthly
363299	Branch River at N Union Rd (2)	N	N	Y	biweekly
10008233	Centerville Creek - Site #1 Lakeshore Dr	N	N	Y	monthly
10039193	Devils River at Hwy R	N	N	Y	monthly
10008207	East Twin River - East Twin River - Steiners Corners	N	Y	Y	biweekly
10008204	East Twin River - Hwy J	N	N	Y	monthly
10031811	Fischer Creek 400ft W of LS	N	N	Y	monthly
10034560	Fisher Creek - USGS Gauge Station	N	Y	Y	USGS study
10029954	Kewaunee River at Hillside Road	N	Y	Y	biweekly
313038	Kewaunee River DS Cth F at Bruemmer Park	Y	Y	Y	monthly
10042875	Killsnake River at County Rd Y	N	Y	N	
363291	Killsnake River at Lemke Road	N	N	Y	biweekly
83100	Manitowoc River - North Branch River View Rd	N	N	Y	monthly
363069	Manitowoc River at Cth Jj(Michigan Ave)	Y	Y	Y	monthly
363375	Manitowoc River South Branch at Lemke Road	N	Y	Y	biweekly
10020782	Manitowoc River-300 Feet Above Upper Cato Falls	N	Y	N	
10011680	Molash Creek - Molash Cr. at Hwy O	N	N	Y	monthly
10016717	Mud Creek - Hilltop Road	N	Y	Y	biweekly
10013310	Mud Creek- Hwy 151	N	N	Y	monthly
10049358	Mullet River at Sumac Road	N	Y	Y	biweekly
10009857	Neshota River - Neshota River at Highway Bb	N	N	Y	monthly
603304	Onion River at Ourtown Rd 5m Bi	N	Y	Y	biweekly
603316	Otter Creek at Willow Rd Near Plymouth WI	N	Y	Y	USGS study
603295	Pigeon River at Cth A -And River Rd	N	Y	Y	biweekly
603051	Pigeon River at Mill Road	N	Y	Y	biweekly
83062	Pine Creek at Quarry Rd Bridge	N	N	Y	monthly
363368	Point Creek at Centerville Road Near Newton WI	N	Y	N	
363225	Point Creek at CTH LS	N	N	Y	monthly
463070	Sauk Creek at Mink Ranch Rd (Bi)	N	Y	Y	biweekly
603296	Sevenmile Creek at CTH LS	N	N	Y	monthly
10016139	Sheboygan R. - Hwy 57 Crossing	N	Y	Y	biweekly
603095	Sheboygan River - at Sth 28 Sheboygan-Esslingen Park	Y	Y	Y	monthly
10039440	Sheboygan River at Palm Tree Rd	N	Y	Y	biweekly
363228	Silver Creek at Cth Ls (Bi Sur)	N	Y	Y	biweekly
10020779	Silver Creek-200 Feet Below Dam 100 Feet Above Bridge	N	Y	Y	biweekly
153221	Stony Creek at Rosewood Rd	N	N	Y	monthly
10030656	Sucker Creek - Sucker Brook Lane	N	N	Y	monthly
10029482	West Twin River at CTH V	N	Y	Y	biweekly

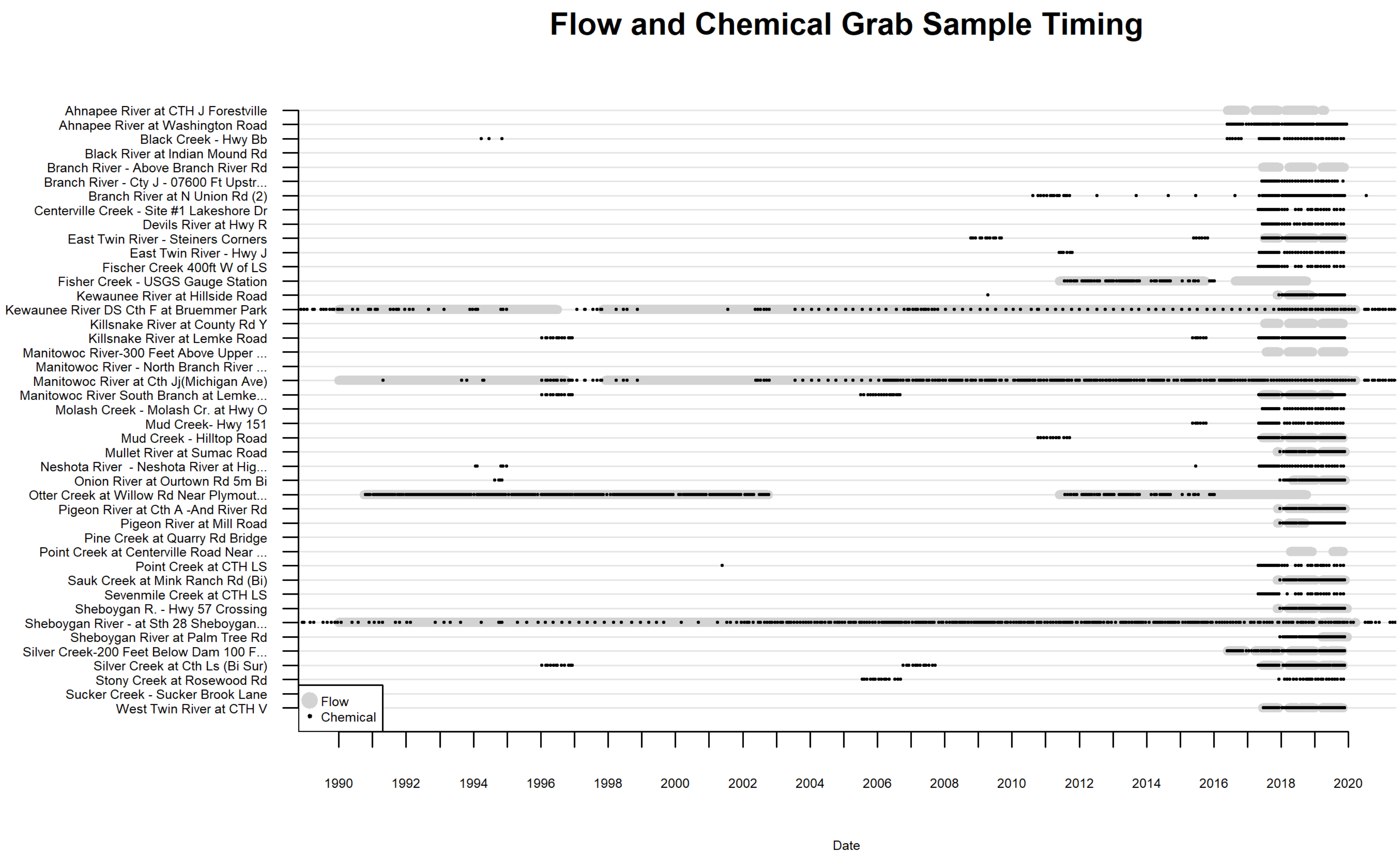

Figure 5 Timing of continuous streamflow and grab sampling.

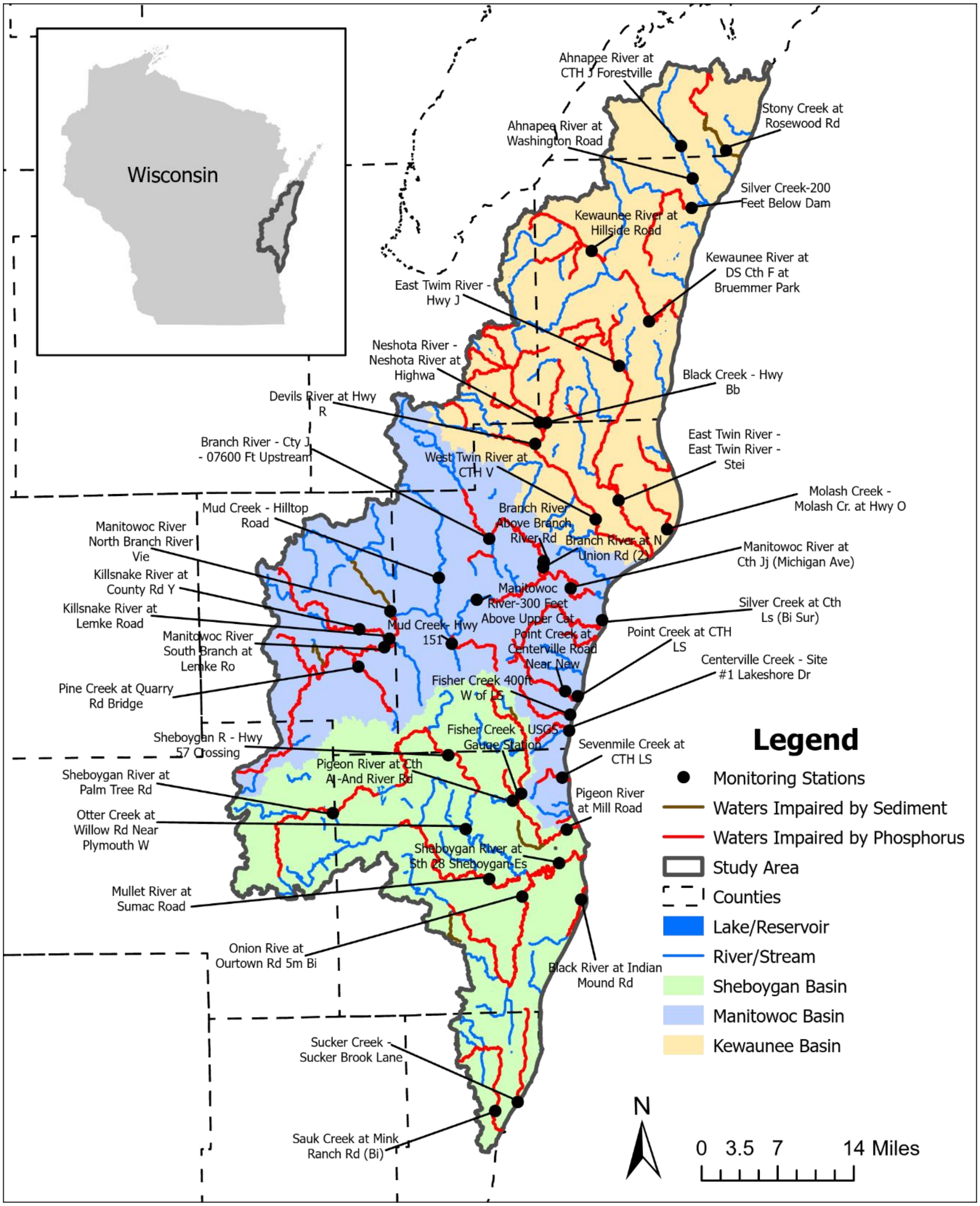

Figure 6 Map showing locations of sites where monitoring data was collected specifically for the TMDL. Priority was given to impaired waters to ensure that the SWAT watershed model aligned as closely as possible to observed data when reductions were calculated.

3.4.2 Total Phosphorus

Thirty-three monitoring sites were established for the collection of Total Phosphorus samples specifically for this TMDL. Of these 33 sites, 17 were established for the purpose of collecting samples at a biweekly frequency for load estimation. The remaining 16 were established for the purpose of analyzing chemistry independent of flow. These remaining 16 sites allows results from the TMDL watershed model (See Appendix D) to be converted from flow-weighted mean concentrations to growing season median (GSM) concentrations (Section 4.1.1). This process also served as a means for bias-correcting the watershed model and validating that it was performing well.

In addition to the sites established specifically for TMDL monitoring, five additional sites had relevant water quality sampling data that could be used in support of this TMDL. Of those five sites, three were long-term trend sites, and two were project-specific sites. At these sites, all of the continuous streamflow monitoring was compiled from a USGS gage station, and the chemical sampling was completed by both USGS and WDNR. Because the three long-term trend sites have data for the entirety of one Climate Normal (30 years, 1990–2020) and the remaining two project sites have data over periods of 5 and 12 years (Fisher Creek and Otter Creek, respectively), summaries of the sample data were considered representative of the full range of weather conditions that would allow a precise estimate of the long-term growing season median (Table 3).

Although the five additional USGS sites described above were considered representative of long-term weather conditions, the 33 TMDL-specific monitoring sites were not. During the period within which most of the TP samples were taken, the region experienced extremely wet conditions (Figure 7). Specifically, the period Aug–Oct for both years 2018 and 2019 experienced precipitation totals between 150 and 300% greater than normal (i.e., the average depth of precipitation for that season from 1991 to 2020). Therefore, it is highly likely that the GSM at most of the TMDL monitoring sites skewed higher than normal.

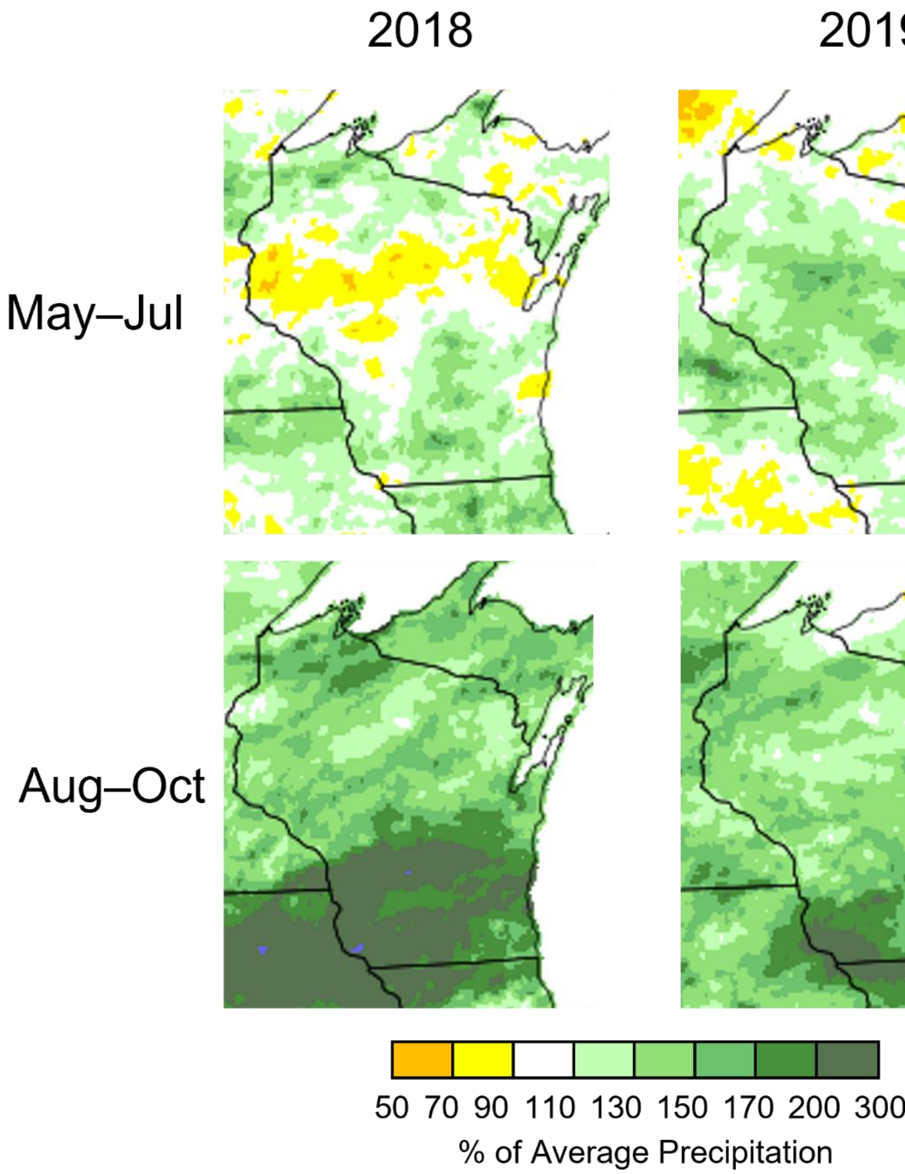

Figure 7 Maps of seasonal precipitation anomalies for the growing seasons in the years when most of the TMDL monitoring occurred. Increasing intensity of green illustrates deviation from normal conditions. For example, the darkest intensity of green describes the condition that an area has experienced 200 to 300% more depth of precipitation than a typical year averaged across the most recent thirty-year climate normal (1991–2020). The maps of rainfall were obtained from the Parameter-elevation Regressions on Independent Slopes Model (PRISM Climate Group).

3.4.2.1 PhosMER Long-Term Concentration Modeling

Due to most monitoring samples being collected during an unusual weather period, an additional model called PhosMER (Phosphorus Mixed-Effects Regression, WDNR, 2021) was used to estimate the true long-term concentration of phosphorus. The PhosMER model was developed by WDNR staff to improve the confidence that a limited number of phosphorus samples would result in a good estimate of the true GSM (WDNR, 2021). The model uses antecedent precipitation (the depth of precipitation and snowmelt that occurred within a specified time frame prior to the sampling event) and various other watershed characteristics to predict daily TP concentrations. Because TP sampling can often be limited through time, but antecedent precipitation data is available for long-term periods of record, the PhosMER model can be used to hindcast the statistical distribution and uncertainty of daily TP concentrations over long periods of time.

PhosMER model results were used to better characterize the true long-term GSM for sites that were affected by wet conditions during the 2018–2019 sampling period. The PhosMER model was fitted for all sites in Wisconsin with at least 6 samples, which included all the monitoring data collected for this TMDL. Daily concentrations were then predicted for each TMDL monitoring site. The GSM estimate was calculated across years 1990–2020. This estimate is described as the most-likely (ML) GSM in Table 3. The 90% confidence interval of this estimate was calculated by bootstrapping (a statistical procedure that resamples a single dataset to create many simulated samples for the purpose of estimating uncertainty) the PhosMER model, calculating the GSM for each bootstrap iteration, and extracting the 5^{th} and 95^{th} percentile of the range of GSM values. If the lower limit (LL in Table 3) of the 90% confidence interval exceeds the criterion at that site, there is a very high likelihood of TP impairment.

Of the 35 sites in Table 3 where a GSM was calculated directly or the PhosMER model was used to estimate it, nearly all sites showed a likely impairment. Only two sites are likely associated with a non-impaired reach: the Ahnapee River at CTH J Forestville and Stony Creek at Rosewood Road. At the onset of the development of this TMDL, the Ahnapee River was listed as impaired for TP, however it was delisted in 2022.

3.4.3 Total Suspended Solids

Every monitoring site (except for Fisher Creek which was a USGS site established for a separate study) where TP samples were collected also had samples analyzed for TSS. Similar to TP, the summary statistic used to assess water quality at each site was the growing season median (GSM). Again, like TP, the samples were taken during a time when the area experienced very wet conditions (Figure 7). However, unlike TP, there is no readily available model (e.g., PhosMER) for improving the estimate of the true GSM when samples were collected during unusual weather conditions. Therefore, the GSM estimates in Table 3 must be interpreted with caution. A value above 12 mg/L may not be indicative of impairment due to unrepresentative sampling skewing results higher when collected during wet conditions.

Table 3 Results of TMDL monitoring for total suspended solids (TSS) and total phosphorus (TP) summarized as growing season (May through October) medians (GSM) along with the number of samples (n) used to calculate them. Also listed in this table are estimates of the long-term GSM using the PhosMER (phosphorus mixed effects regression) model. The PhosMER model estimates shown here include the most likely GSM (ML), and the lower and upper limits (LL and UL) at the 90% confidence level. Values in bold are indications of a likely impairment. One asterisk next to the SWIMS ID denotes a station where enough samples were available to estimate a representative GSM (two asterisks for a long-term site).

SWIMS ID	Station Name	TSS GSM		TP GSM		PhosMER TP GSM		
		n	mg/L	n	µg/L	ML	LL	UL
153027	Ahnapee River at CTH J Forestville	57	7	57	56	60	57	64
363268	Black Creek - Hwy Bb	25	4	33	172	145	135	162
363313	Branch River - Above Branch River Rd	57	8	59	135	92	82	98
10016958	Branch River - Cty J - 07600 Ft Upstream from Bridge	22	9	22	135	100	92	110
10008233	Centerville Creek - Site #1 Lakeshore Dr	22	19	22	292	267	252	292
10039193	Devils River at Hwy R	22	4	22	144	114	105	122
10008207	East Twin River - East Twin River - Steiners Corners	48	8	54	102	89	81	97
10008204	East Twin River - Hwy J	24	4	36	99	100	92	108
10031811	Fischer Creek 400ft W of LS	22	7	22	146	152	125	199
10034560*	Fisher Creek - USGS Gauge Station	-	-	79	489	-	-	-
10029954	Kewaunee River at Hillside Road	29	10	29	237	198	179	230
313038**	Kewaunee River DS Cth F at Bruemmer Park	287	7	324	96	-	-	-
10042875	Killsnake River at County Rd Y	51	18	60	233	193	180	217
363069**	Manitowoc River at Cth Jj(Michigan Ave)	518	27	544	225	-	-	-
363375	Manitowoc River South Branch at Lemke Road	63	29	67	283	297	281	313
10011680	Molash Creek - Molash Cr. at Hwy O	22	2	22	189	167	155	187
10016717	Mud Creek - Hilltop Road	50	14	50	231	229	214	246
10013310	Mud Creek- Hwy 151	25	12	31	156	144	133	161
10049358	Mullet River at Sumac Road	20	8	28	111	95	88	106
10009857	Neshota River - Neshota River at Highway Bb	26	9	26	183	169	159	184
603304	Onion River at Ourtown Rd 5m Bi	109	84	116	360	250	224	286
603316*	Otter Creek at Willow Rd Near Plymouth WI	638	24	764	134	-	-	-
603295	Pigeon River at Cth A -And River Rd	22	8	30	243	222	197	259
603051	Pigeon River at Mill Road	22	8	35	240	221	197	253
363368	Point Creek at Centerville Road Near Newton WI	44	8	46	181	151	144	165
363225	Point Creek at CTH LS	44	8	46	181	150	141	163
463070	Sauk Creek at Mink Ranch Rd (Bi)	21	18	29	461	448	415	504
603296	Sevenmile Creek at CTH LS	22	17	22	180	191	182	207
10016139	Sheboygan R. - Hwy 57 Crossing	22	9	29	156	150	142	161
603095**	Sheboygan River - at Sth 28 Sheboygan-Esslingen Park	640	25	667	181	-	-	-
10039440	Sheboygan River at Palm Tree Rd	22	8	29	200	191	178	199
363228	Silver Creek at Cth Ls (Bi Sur)	53	6	58	228	164	156	181
10020779	Silver Creek-200 Feet Below Dam	55	6	55	119	105	97	115
153221	Stony Creek at Rosewood Rd	21	3	21	71	69	64	77
10029482	West Twin River at CTH V	41	7	41	113	98	84	113

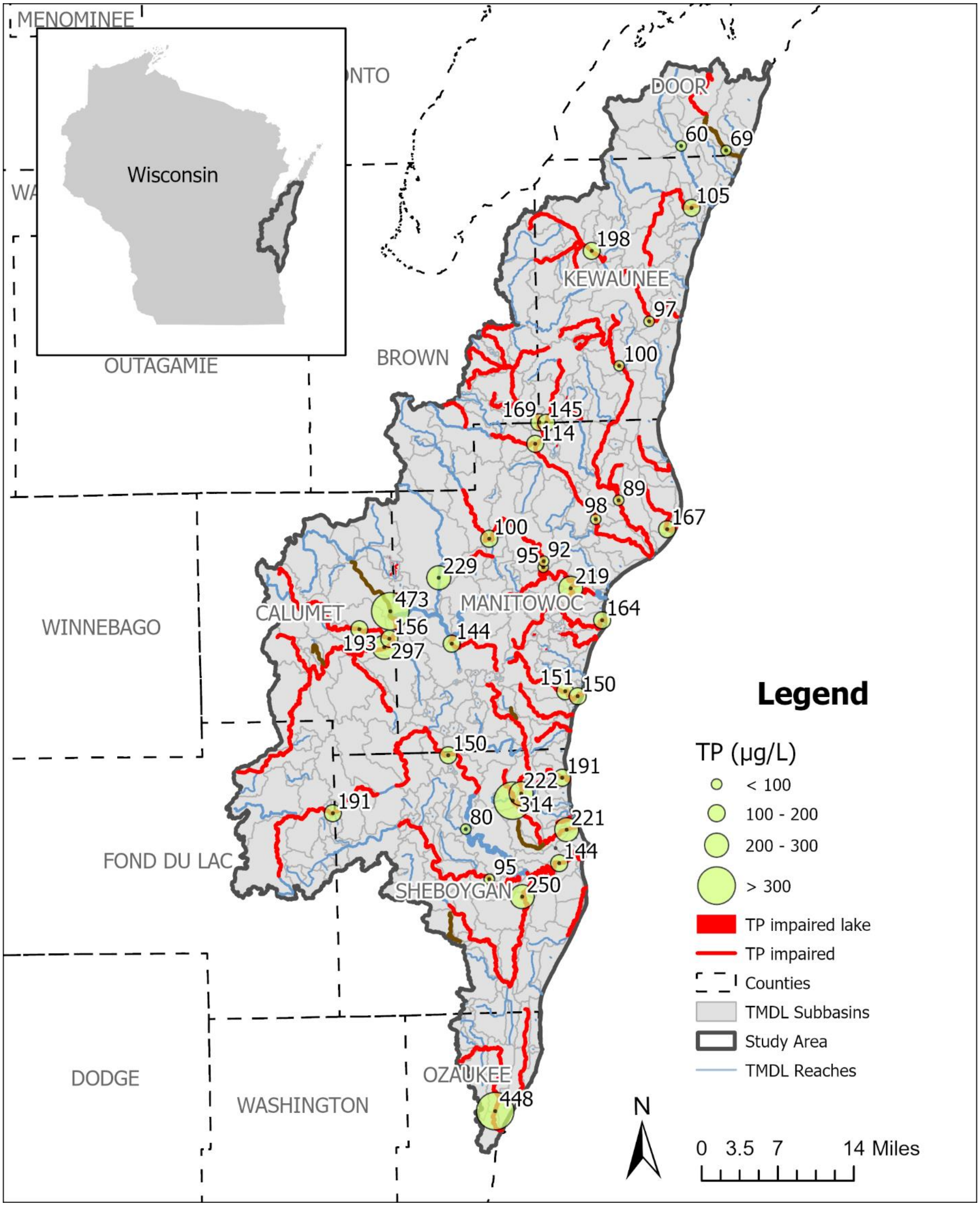

Figure 8 Map showing the most likely long-term total phosphorus concentrations at each of the TMDL monitoring sites. Values shown at each site were estimated using the PhosMER model described in Section 3.4.2.1. Source Assessment.

3.5 Review of Phosphorus and Sediment Sources

Two general types of water pollution sources exist: point source and nonpoint source. The Clean Water Act defines a point source of pollution as any discrete conveyance that discharges polluted material, such as a pipe or ditch that discharges treated effluent from a municipal wastewater treatment facility (WWTF) or stormwater runoff from a municipal separate storm sewer system (MS4) into a surface water. Nonpoint sources of pollution include any sources that do not meet the definition of a point source, such as runoff from agricultural lands. This section provides a general description of point and nonpoint sources of phosphorus and sediment to surface waters in the NEL. Section 3.6 of this report provides further discussion of how loads from each source were quantified for TMDL development. Additional information on sources of pollution to surface waters and loading mechanisms can be found in Carpenter et al. (1998), Sims (1998), and Steele et al. (2010).

3.5.1 Point Sources

Point sources of phosphorus and sediment discharge from a discrete conveyance and are regulated by WDNR under the Wisconsin Pollutant Discharge Elimination System (WPDES) program. The NEL study area also includes facilities that discharge directly to Lake Michigan; however, because the TMDL is not addressing sediment and phosphorus in Lake Michigan, these point sources are excluded. In addition, point sources discharging pollutants to groundwater only are excluded. Several subtypes of point sources are present and are described in the following paragraphs.

3.5.1.1 Publicly Owned Treatment Works

The term Publicly Owned Treatment Works (POTWs) refers to a sewage treatment plant that is owned and operated by a government entity, typically a city, town, or other local government or subject to NR 110 and NR 210, Wis. Admin. Code. POTWs receive domestic and sometimes industrial wastewater via sewer systems, treat the wastewater to reduce or remove solid and chemical contaminants, and discharge treated effluent to surface waters. Raw sewage contains very high levels of suspended solids and phosphorus. Although these levels are reduced during treatment, suspended solids and phosphorus are present in the treated effluent.

3.5.1.2 Industrial Facilities

As part of their manufacturing process, many industrial facilities generate wastewater that contains sediment/suspended solids and/or phosphorus and is treated by the industry and discharged directly into a nearby surface water. Examples include wastewaters generated during cheesemaking, power generation, equipment manufacturing, or canning fruits and vegetables.

3.5.1.3 Permitted Urban Stormwater

Urban stormwater refers to runoff that is generated from developed areas that have been affected by human development (e.g., parking lots, roads, lawns, exposed soils). These surfaces typically accumulate solid particles (dust, small rocks, plant matter, etc.) that are carried into waterbodies with stormwater. Some of these solid particles, such as soil or plant matter, also contain phosphorus. Other sources of elevated phosphorus in stormwater can include lawn fertilizers and pet waste.

Even though stormwater is driven by precipitation and fits the description of nonpoint source pollution, certain stormwater discharges to surface water are permitted under the WPDES program and are therefore considered point sources for TMDL development. Stormwater drainage systems (ditches, curbs, gutters, storm sewers, etc.) that are publicly owned and do not connect with a wastewater collection system are termed Municipal Separate Storm Sewer Systems (MS4s). Most MS4s that are in a federally designated Urbanized Area and serve populations of 10,000 or more are required to have a WPDES permit to discharge stormwater into surface waters. WPDES permits are also required for stormwater discharge from some construction sites and industrial sites. A Transportation Separate Storm Sewer System (TS4) permit has also been developed and was signed on June 30, 2018, covering Wisconsin Department of Transportation administered facilities within permitted MS4s.

3.5.1.4 Permitted Concentrated Animal Feeding Operations

A Concentrated Animal Feeding Operation (CAFO) is an agricultural operation that raises 1,000 or more animal units in confined areas. Wastewater that is generated by CAFOs is high in suspended solids and phosphorus from animal sewage and other animal production operations. Because of the potential water quality impacts from CAFOs, animal feeding operations with 1,000 animal units or more, CAFOs are required to have a

WPDES CAFO permit. These permits are designed to ensure that operations use proper planning, construction, and manure management to protect water quality from adverse impacts.

WPDES permits for CAFO facilities cover the production area, ancillary storage areas, storage areas and land application areas. Any runoff from CAFO land application activities is considered a nonpoint source and is covered in the TMDL through the load allocation. CAFOs must comply with all WPDES permit conditions which include the livestock performance standards and prohibitions in ch. NR 151, Wis. Admin. Code. Specific WPDES permit conditions for the production area specify that CAFOs may not discharge manure or process wastewater pollutants to navigable waters from the production area, including approved manure stacking sites, unless all of the following apply:

- Precipitation causes an overflow of manure or process wastewater from a containment or storage structure.
- The containment or storage structure is properly designed, constructed, and maintained to contain all manure and process wastewater from the operation, including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event for this location.
- The production area is operated in accordance with the inspection, maintenance and record keeping requirements in s. NR 243.19, Wis. Admin. Code.
- The discharge complies with surface water quality standards.

For ancillary service and storage areas, CAFOs may discharge contaminated stormwater to waters of the state provided the discharge complies with groundwater and surface water quality standards. The permittee shall take preventive maintenance actions and conduct periodic visual inspections to minimize the discharge of pollutants from these areas to surface waters. For CAFO outdoor vegetated areas, the permittee shall also implement the following practices:

- Manage stocking densities, implement management systems and manage feed sources to ensure that sufficient vegetative cover is maintained over the entire area at all times.
- Prohibit direct access of livestock or poultry to surface waters or wetlands located in or adjacent to the area unless approved by the Department.

3.5.2 Nonpoint Sources

Nonpoint sources of pollution include any sources that do not meet the definition of a point source. Nonpoint source pollution is typically driven by watershed runoff, or the movement of water over the land surface and through the ground into waterbodies, though other types of nonpoint source pollution exist. The following paragraphs describe nonpoint sources of phosphorus and sediment in the NEL.

3.5.2.1 Agricultural Runoff

High levels of sediment and phosphorus in agricultural runoff can stem from multiple sources. Chemical fertilizer and/or animal manure contains phosphorus, a critical plant nutrient, and are often applied to cropland to support crop growth. The phosphorus in chemical fertilizer and manure often becomes bound to soil particles. Because agricultural lands typically have lower vegetative cover than natural areas, they are prone to erosion during runoff events. Erosion from cropland not only carries sediment into nearby surface waters but also carries phosphorus from fertilizer and manure that is attached to soil particles. Alternatively, on cropland with phosphorus saturated soils or recent fertilizer/manure applications, phosphorus can become dissolved in surface or subsurface runoff and wash into nearby waterbodies. The transport of dissolved phosphorus in subsurface agricultural runoff can be accelerated on fields with tile drainage systems, which act as a conduit between subsurface water and adjacent drainage channels.

Phosphorus and sediment loading also occurs from areas where livestock are raised. As noted in Section 3.5.1, CAFOs are permitted under the WPDES program. Smaller, nonpermitted animal feeding operations fall under nonpoint and can contribute phosphorus and sediment to adjacent waters because of leakage of animal sewage from covered facilities and from sediment erosion or wash-off of manure from outdoor feedlots, barnyards, and grazing areas. The NPS Program has mechanisms through WDNR, DATCP, and County Land and Water Departments in place to work with producers to reduce and minimize such discharges.

3.5.2.2 Non-Permitted Urban Runoff

Developed areas are significant sources of phosphorus and sediment. Loading magnitudes typically increase with greater intensity of development. For example, runoff from areas with a high proportion of impervious surfaces tends to have high sediment and phosphorus concentrations because any dust, plant debris, pet/wildlife waste, or other material deposited on the surface is carried into nearby waters without being filtered through soil. Roads, driveways, rooftops, parking lots, and other paved areas in cities, suburban, and rural areas therefore all act as phosphorus and sediment sources. Other unpaved areas with disturbed soils (gravel or dirt roads, trails, paths, construction sites, etc.) also contribute high levels of sediment and attached phosphorus to surface waters. Vegetated spaces such as lawns, golf courses, and parks typically have lower phosphorus and sediment loading than impervious areas since soil particles are held in place by plant roots and precipitation can infiltrate the soil. However, loading from these areas is generally still higher than undisturbed natural lands because of lower canopy densities and a minimal plant litter layer. Phosphorus loads can be particularly high from vegetated developed lands when plant fertilizers are applied.

3.5.2.3 Background Sources

Phosphorus is a naturally occurring compound that is present in rocks, plant material, soils, and wildlife waste. Phosphorus loading is therefore expected from undisturbed forests, wetlands, and other natural areas. However, these areas contribute significantly lower loads per unit acre than agricultural and developed areas since runoff volumes and phosphorus concentrations are reduced with a more extensive plant canopy, leaf litter layer, and soil infiltration and percolation. These same factors also reduce soil erosion and sediment loading from undeveloped vegetated lands.

An additional background source of phosphorus and sediment loading to large, open waterbodies is atmospheric deposition. Dust and plant material in the atmosphere can be deposited to a lake or reservoir surface from the wind during dry periods or carried by precipitation. In developed watersheds, this typically represents a small fraction of phosphorus and sediment loading.

3.5.2.4 Stream Channels and Lakeshores

Under natural conditions, stream channels exist in dynamic equilibrium, with balanced erosion and deposition. Channel morphology (width, depth, slope, etc.) is in a stable state that is only altered with an extreme flow event or major disturbance to the landscape. In watersheds with urban or agricultural development, the equilibrium between channel erosion and deposition is disrupted due to altered streamflow and sediment loading patterns or artificial channel modifications. Because of these changes, the stream channel adjusts through transitional phases that can persist for years to centuries before again reaching a stable form. Channel downcutting and widening are two channel evolution phases that result in bed and bank erosion and contribute sediment and attached phosphorus to downstream waters. Conversely, when excess sediment enters a stream from the watershed or upstream reaches, sediment settles out of the water and the channel becoming increasingly shallow, which is a process known as aggradation.

Lakeshores typically exist in a similar state of equilibrium as stream channels under natural conditions, with significant erosion only occurring with extreme water level changes or major disturbances to the landscape. Accelerated lakeshore erosion can occur when human activity removes trees and other deep-rooted vegetation from the nearshore area, when water levels are artificially manipulated, and/or when high wave action is generated from boats.

3.5.2.5 Lake Internal Sources

An additional category of nonpoint source loading in lakes is the release of phosphorus from sources that are internal to the water body. When phosphorus enters a lake from external sources (e.g., runoff or point source discharges), it cycles between inorganic and organic forms in the water column and bottom sediment. The net release of phosphorus from bottom sediments into the water column can be significant in lakes where several years of high external phosphorus loading have left a legacy of stored phosphorus. Release of phosphorus from bottom sediments can occur through a variety of processes, including aerobic and anaerobic decomposition of organic sediments, release of iron-bound phosphorus under anoxic conditions, simple diffusion due to sediment-water column concentration differences, or resuspension of phosphorus-laden sediment through wind and other disturbances.

It is important to note that bottom sediments should not be considered an independent source of phosphorus to a lake. A fundamental coupling exists between loading of phosphorus from external sources and loading from bottom sediment. The magnitude of phosphorus loading from bottom sediment is largely determined by the amount held in storage in the lake due to historical external phosphorus loading.

3.6 Analysis of Baseline Phosphorus and Sediment Loading

An assessment of the magnitude of phosphorus and sediment loading by source provides a foundation for TMDL implementation. It also provides an understanding of the relative contribution of each source to total loading and establishes a starting point for the allocation of allowable pollutant loads. This section describes the analysis of phosphorus and sediment loads completed for each of the sources described in Section 3.5.

This report uses the term "baseline load" to refer to phosphorus or sediment loads that were used as the basis for determining TMDL allocations and reductions needed to meet allowable loads. It is important to note that for wastewater dischargers, baseline loads used for TMDL development often differ from actual present-day loading magnitudes. This is due to the distinction that the design flow capacities of POTWs are used in most cases, which can be substantially larger to account for wet weather peaking and future community growth.

The magnitude of baseline phosphorus and sediment loads was assessed using multiple tools and methods. One key tool used for estimating nonpoint source loadings from background sources, agricultural sources, and urban stormwater was a watershed model developed with the Soil and Water Assessment Tool (SWAT). SWAT uses information on watershed characteristics, weather records, and mathematical equations describing runoff generation and water quality processes to estimate daily watershed runoff volumes and pollutant loads (Neitsch, Williams, Arnold, & Kiniry, 2011).

The SWAT model is configured to simulate geographic differences in runoff and pollutant loading due to variation in land use, soil attributes, weather, topography, and agricultural practices. SWAT represents a basin as a collection of subwatersheds and Hydrologic Response Units (HRUs). Each HRU is a land area with a unique combination of land use, soil, and slope. The SWAT model simulates HRUs with eight major land use types: forest, wetland, pasture/grassland, continuous corn agriculture, cash grain agriculture (corn and soybean), dairy farm agriculture (corn and forage crops), non-permitted urban, and MS4 permitted urban. The SWAT model is calibrated to measurements of streamflow, phosphorus, and sediment collected in multiple streams and rivers in the basin. Appendix D of this report provides a full description of SWAT model inputs, configuration, and calibration results.

3.6.1 Nonpoint Source Delivery

When SWAT HRU pollutant loads are delivered to model reaches, there is typically some loss, mostly due to wetland, tributary deposition (in the case of phosphorus), and in-stream deposition (in the case of sediment) functions in the watershed model. The amount of delivery of HRU pollutant loads to reaches are reach-specific and are computed by comparing the sum of HRU loads in a subbasin to the loading in a reach, specifically the difference between the outgoing and incoming loads (Figure 9).

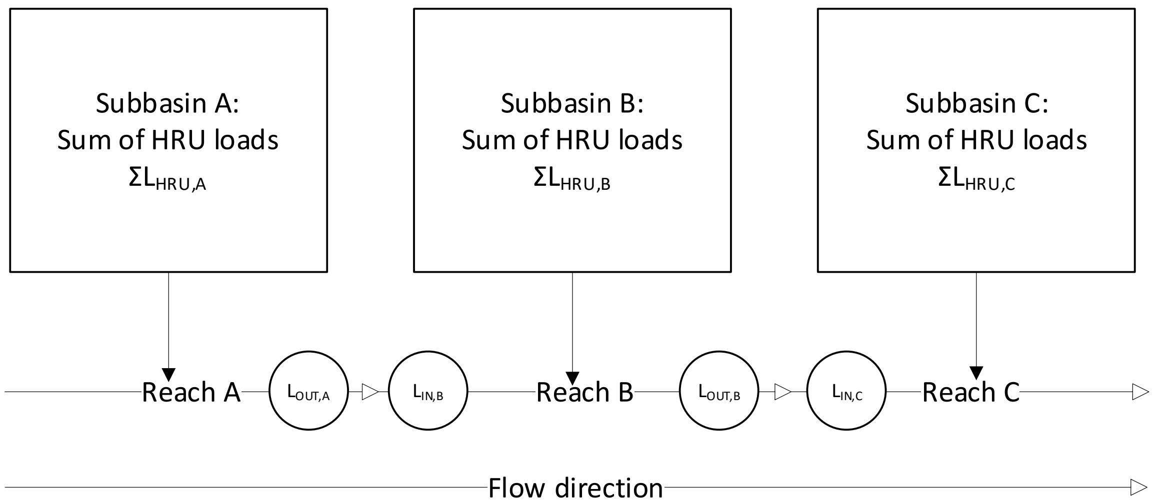

Figure 9 Schematic showing how the delivery of pollutant loads from HRUs to reaches was calculated. The letter L denotes a load.

The computation of the difference between the outgoing and incoming loads for a given reach is a way of isolating all HRU, subbasin, and reach functionality in SWAT, and quantifying only the net effect. A positive value indicates a net increase in pollutant delivery from the sum of HRU, subbasin, and reach sources. A negative value indicates net deposition in the reach (a common occurrence for sediment). The ratio between this net value and the sum of HRU loading in the subbasin represents an estimate of the delivery of pollutants from HRUs to the reach. If a point source discharges to a reach, the delivery is assumed to be 100%. The resulting equation of this concept is shown below in Equation 1:

Equation 1

$$DF_B = \frac{(L_{OUT,B} - L_{IN,B}) - \sum L_{PS,B}}{\sum L_{HRU,B}}$$

where, for reach B from the example in Figure 9, DF is the delivery factor, L is the total load, either coming IN or OUT of reach B, or the total load from point sources (PS) or SWAT HRUs in the subbasin associated with reach B.

After the transport occurs between the HRU and the reach, SWAT no longer tracks the source of the pollutant (i.e., whether it came from background or agricultural sources). To track the sources of pollutant loads in SWAT reaches, SWAT HRUs loads were calculated by multiplying HRU loads by the reach-specific delivery factor. For example, for reach B, the agricultural baseline load would be calculated as follows:

Equation 2

$$L_{AG,B} = DF * \sum L_{HRU,AG,B}$$

where $L_{HRU,AG,B}$ represents an agricultural HRU in subbasin B and DF is the deliver factor from Equation 1. This assumes the delivery fraction to be equal across nonpoint source categories (i.e., background, agriculture, non-permitted urban and, for this purpose, MS4s were considered nonpoint as well).

In cases where the net sediment load was negative (i.e., more sediment was deposited than delivered), TMDL subbasins were aggregated together. Due to the complex nature of sediment equilibrium in the SWAT reaches, smaller subbasins were aggregated into larger ones, until they were sufficiently large enough for highly variable sediment dynamics to smooth out (See Section 4.2.2).

3.6.2 POTW and Industrial Wastewater

Baseline phosphorus and sediment loads for POTWs and industrial wastewater facilities that discharge under individual WPDES permits were calculated from facility design flows, phosphorus and TSS discharge limits, and effluent monitoring data. The effluent flow rates, TP concentrations, and TSS concentrations used to estimate baseline loads from individual facilities are listed in Table 4. Baseline loads by TMDL subbasin and facility are provided in Appendix H.

Discharges can be intermittent or seasonal and specific permit conditions are on a case-by-case determination. Typical operation of some seasonal or intermittent discharges is to take advantage of higher or seasonal flows. However, some discharges such as food processors, discharge timing is based on production corresponding with harvests. The TMDL was developed to account for these variations and evaluated timing of discharges when assigning allocations. See Figure 10 for a summary of the decision rules used to calculate the flow rate of water from POTW and industrial wastewater, and for seasonal versus continuous dischargers.

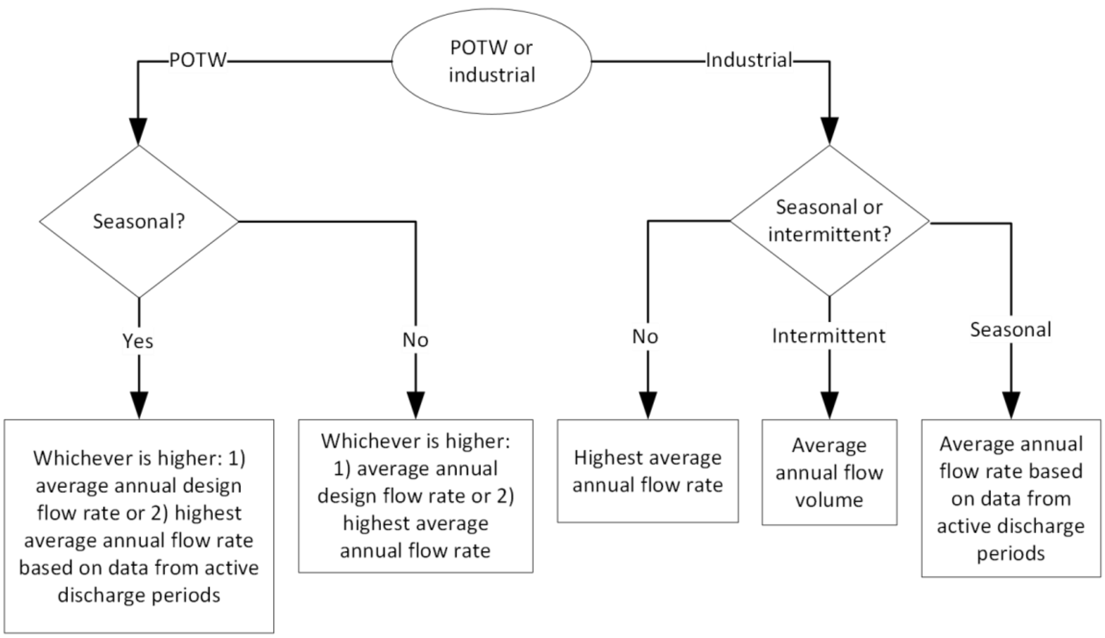

Figure 10 Decision rules for calculating baseline flow for publicly owned treatment works (POTW) and industrial wastewater dischargers. In cases where flow monitoring was used, samples were taken between 2015–2020.

During TMDL development, noncontact cooling water (NCCW) discharges were evaluated for the purposes of determining whether WLAs for phosphorus were needed to meet TMDL goals. Elevated phosphorus concentrations may be present in NCCW discharges where city water is the main source, due to the use of additives to control lead in municipal water supplies. Phosphorus WQBELs that are imposed because of this TMDL, or according to s. NR 217.13, Wis. Adm. Code, do not intend to suggest that additives in finished drinking water are not needed or should not be used. In the case of lead, additives are often needed to ensure healthy and safe drinking water. However, alternatives may need to be explored to reduce phosphorus inputs into receiving waters.

For facilities with individual permits that add phosphorus to their discharge or that use water from a public water supply that adds phosphorus, design flows and discharge concentrations were used to determine individual WLAs. For pass through systems (i.e., facilities with surface water intake structures) where phosphorus is not added, and the water is withdrawn from and discharged to the same or downstream waterbody, the baseline condition for the allocation process utilized actual discharge flows with TP concentrations set to zero to reflect that no net addition of phosphorus is occurring. This would result in an allocation of zero but allow the facility to discharge the pass-through phosphorus load.

3.6.2.1 Baseline Phosphorus Concentration

Baseline phosphorus loading was calculated by multiplying the facility's flow rate (Figure 10) by the technology-based effluent concentration limit (TBEL) for phosphorus: 1 milligram per liter, which is defined in Chapter NR 217 of the Wisconsin Administrative Code. For industrial facilities that use noncontact cooling water (NCCW), NCCW plus contact cooling water (CCW), or secondary containment water, then the average of effluent phosphorus concentrations measured at the facility's outfall from 2015 through 2020 was used instead.

3.6.2.2 Baseline Sediment Concentration

Baseline sediment loading was calculated using three different methods (see the flowchart in Figure 11) depending on whether the discharger was municipal or industrial, discharged seasonally, and/or operated as NCCW:

- The monthly average of the concentration limits for the outfall in the facility's permit
- The monthly average of the seasonal concentration limits for the outfall in the facility's permit
- The average of effluent monitoring concentration samples taken between 2015 and 2020

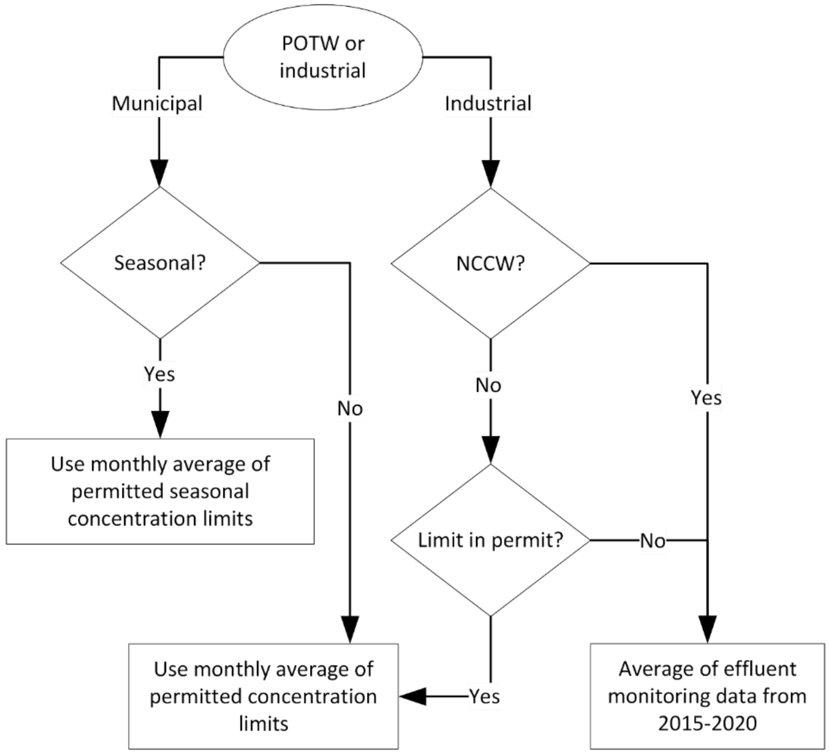

Figure 11 Decision rules for calculating baseline sediment loading for publicly owned treatment works (POTW) and industrial wastewater dischargers. NCCW includes noncontact cooling water, noncontact cooling water mixed with contact cooling water, or secondary containment water.

Table 4 Data used to estimate baseline loading for individual WPDES facility permits. Flow and concentration estimates are based on facility type, and for industrial facilities, whether the outfall is NCCW, NCCW + CCW, or secondary containment water (all collectively abbreviated below as 'NCCW').

Facility Name	Facility Type	Permit No.	Outfall No.	TMDL Reach	Flow (MGD)	Baseline TP (mg/L)	Baseline TSS (mg/L)
AGROPUR INC. - LUXEMBURG	Industrial	50237	009	K91	0.6789	1	20
ALGOMA WASTEWATER TREATMENT FACILITY	POTW	20745	001	K44	1	1	10
BAKER CHEESE FACTORY INC.	Industrial	50521	003	S97	0.2482	1	20
BELGIOIOSO CHEESE, INC. - DENMARK	Industrial	51128	007	K63	0.4755	1	20
BELGIUM WASTEWATER TREATMENT FACILITY	POTW	23353	001	S12	0.63	1	20
BEMIS MANUFACTURING COMPANY - PLANT D	Industrial, NCCW	27456	001	S30	0.4582	0.25	2.3
BRIESS MALT & INGREDIENTS CO	Industrial, NCCW	66257	001	M10	0.9916	0.08	23
BRILLION WASTEWATER TREATMENT FACILITY	POTW	20443	001	M10	0.708	1	20
CASCO WASTEWATER TREATMENT FACILITY	POTW	23566	001	K96	0.179	1	10
CEDAR GROVE WASTEWATER TRTMNT FACIL	POTW	20711	001	S9	0.4	1	20
CEDAR VALLEY CHEESE, INC	Industrial	51535	011	S20	0.0864	1	10
CHILTON WASTEWATER TREATMENT FACILITY	POTW	22799	002	M20	1.189	1	12.5
CLARKS MILLS SANITARY DISTRICT	POTW	36030	001	M14	0.018	1	60
DENMARK WASTEWATER TREATMENT FACILITY	POTW	21741	001	K9	0.725	1	20
FORESTVILLE WASTEWATER TREATMENT FACILITY	POTW	28894	001	K52	0.1194	1	30
GIBBSVILLE SANITARY DISTRICT	POTW	31577	001	S22	0.0658	1	30
HILBERT WASTEWATER TREATMENT FACILITY	POTW	21270	001	M28	0.326	1	20
HOLY FAMILY CONVENT WASTEWATER TREATMENT FAC	Note: Subject to NR 110 and NR 210	28142	001	M8	0.042	1	30
HOWARDS GROVE WASTEWATER TRTMT FAC	POTW	21679	001	S41	0.4467	1	10
JOHNSONVILLE LLC	Industrial	1759	002	S44	0.5077	1	8
JOHNSONVILLE LLC	Industrial, NCCW	1759	003	S44	0.003	0.05	3.5
KEWAUNEE WASTEWATER TREATMENT FACILITY	POTW	20176	001	K31	0.5395	1	30
KIEL WASTEWATER TREATMENT FACILITY	POTW	20141	001	S46	1.43	1	12.5
KOHLER COMPANY POWER SYSTEMS AMERICAS	Industrial	795	001	M79	0.0293	1	4.8
KOSSUTH SANITARY DISTRICT NO. 2 WWTF	POTW	35874	001	K88	0.0406	1	20
LAKELAND UNIVERSITY	POTW	29335	004	S44	0.083	1	30
LAKESIDE FOODS, INC. - BELGIUM PLANT	Industrial	817	004	S12	0.0825	1	20
MARIBEL WASTEWATER TREATMENT FACILITY	POTW	61051	002	K65	0.048	1	20
MORRISON SANITARY DISTRICT NO 1	POTW	36773	001	M47	0.0522	1	20
MOUNT CALVARY WASTEWATER TREATMENT FACILITY	POTW	35963	001	S100	0.1952	1	20
NEW HOLSTEIN WASTEWATER TREATMENT FACILITY	POTW	20893	001	M44	1.33	1	20

Facility Name	Facility Type	Permit No.	Outfall No.	TMDL Reach	Flow (MGD)	Baseline TP (mg/L)	Baseline TSS (mg/L)
NEW ORGANIC DIGESTION LLC	Industrial, NCCW	64629	006	K8	0.0007	0.09	4.1
NEWTON MEATS AND SAUSAGE	Industrial, NCCW	42650	001	M4	0.0006	0.04	2.4
ONION RIVER WASTEWATER COMMISSION	POTW	36811	001	S104	0.1577	1	30
OOSTBURG WASTEWATER TREATMENT PLANT	POTW	22233	001	S19	0.44	1	20
PLASTICS ENGINEERING COMPANY	Industrial, NCCW	66681	101	S86	0.0139	0.23	2
PLYMOUTH UTILITIES WWTF	POTW	30031	001	S34	1.9332	1	14
POLY VINYL COMPANY INC	Industrial, NCCW	66699	001	S27	0.0665	0.28	2.1
POTTER WASTEWATER TREATMENT FACILITY	POTW	29025	001	M26	0.0442	1	20
REEDSVILLE WASTEWATER TREATMENT FACILITY	POTW	21342	002	M25	0.3073	1	20
ROCKLAND SD1 WASTEWATER TREATMENT FACILITY	POTW	22802	001	M25	0.025	1	60
SARTORI COMPANY-WEST MAIN BUILDING	Industrial	41904	001	S34	0.1425	1	2.3
ST CLOUD VILLAGE UTILITY COMMISSION	POTW	26867	001	S48	0.17	1	60
ST NAZIANZ WASTEWATER TREATMENT FACILITY	POTW	22195	001	M23	0.2	1	10
TILLAMOOK WISCONSIN LLC	Industrial	27618	001	M48	0.2687	1	20
VALDERS WASTEWATER TREATMENT FACILITY	POTW	21831	001	M15	0.2777	1	20
WALDO WASTEWATER UTILITY	POTW	22471	001	S94	0.1	1	30
WHITELAW WASTEWATER TREATMENT FACILITY	POTW	22047	001	M66	0.1323	1	20
WISCONSIN POWER AND LIGHT EDGEWATER GEN. STATION	Industrial, NCCW	1589	014	S10	0.0008	0.01	1.4

3.6.3 Permitted Municipal Separate Storm Sewer Systems (MS4s)

Ten municipalities with WPDES MS4 stormwater permits have all or a portion of their permitted area within the NEL. Five municipalities are covered under general permits and five are covered under individual permits. In addition, the counties of Fond du Lac, Ozaukee, and Sheboygan have a portion of their regulated area within the NEL. The regulated area of cities and villages with MS4 permits is defined as their entire incorporated area. The regulated area of towns and counties with MS4 permits is defined as the area served by their MS4 system within the permitted urbanized area boundary. Figure 12 shows the location of the regulated area of permitted MS4s.

The SWAT model was used to calculate phosphorus and sediment loading from urban sources regulated under a WPDES MS4 permit. As part of SWAT model setup, maps of municipal boundaries for cities, villages, and towns with MS4 permits and US Census urbanized areas were overlain with land cover data to define SWAT HRUs with permitted MS4 urban land cover. These HRUs represented areas where runoff and pollutant loading from urban and developed land cover was regulated by a MS4 permit. Table 5 lists the area in acres of permitted MS4s within TMDL subbasins.

Baseline loading for MS4 permitted sources was determined from SWAT predictions of monthly phosphorus and sediment loading from HRUs with permitted MS4 urban land cover in the model. SWAT loads for permitted MS4 urban HRUs were reduced by 20% for TSS and by 15% for TP to define baseline conditions used in the allocation process. These reductions were applied to be consistent with performance standards for existing development defined in WPDES MS4 permits and required under chapters NR 216 and NR 151 of Wisconsin Administrative Code. The reduction relationship between TP and TSS is not 1:1 because of the portioning between phosphorus attached to sediment and the soluble phosphorus in the urban runoff. For municipalities not meeting this baseline condition, any potential TMDL reductions are additive to the NR 151 reductions.

SWAT results provided values of TP and sediment loads from permitted MS4 urban sources in each model subwatershed, however, results did not differentiate between loads generated from individual municipalities. An area-weighting approach was therefore used to estimate phosphorus and sediment loading for individual MS4 permittees by proportionally dividing permitted MS4 loads per model subwatershed among the MS4 permitted municipalities located in each subwatershed.

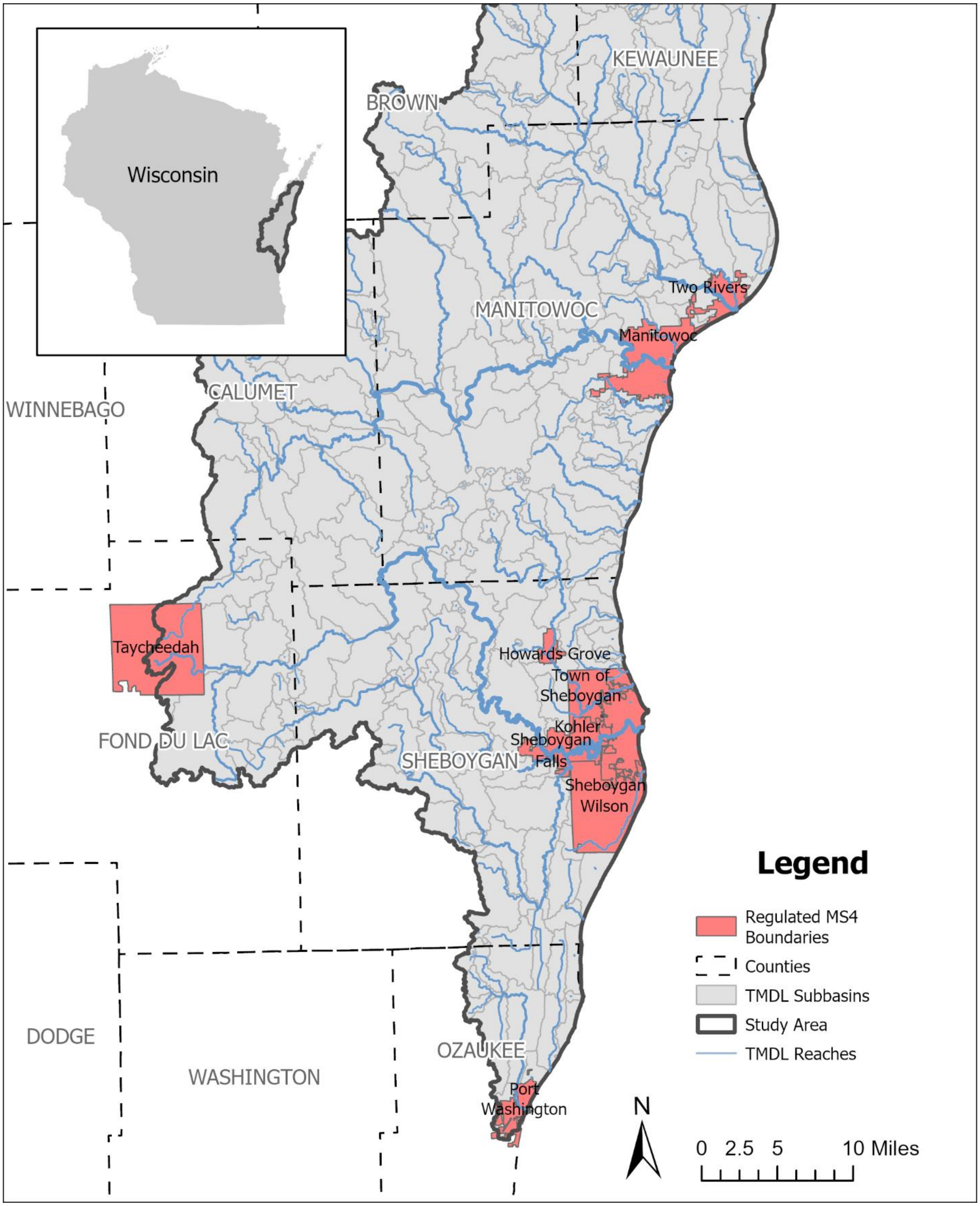

Figure 12 Geographic Extent areas of permitted MS4s in the Northeast Lakeshore TMDL area.

Table 5 List of permitted MS4s within the Northeast Lakeshore basins.

Permitted MS4	Subbasin	Area (acres)
Village of Howards Grove	S41	562
Village of Howards Grove	S42	406.4
Village of Howards Grove	S105	471.7
Village of Kohler	S24	973.6
Village of Kohler	S25	22.3
Village of Kohler	S27	2311.3
Village of Kohler	S43	195.8
Village of Kohler	S86	37.7
City of Manitowoc	K1	10.8
City of Manitowoc	M7	1162.6
City of Manitowoc	M8	108
City of Manitowoc	M10	3630.4
City of Manitowoc	M11	273.3
City of Manitowoc	M36	2548.2
City of Manitowoc	M37	818.6
City of Manitowoc	M63	478.7
City of Manitowoc	M78	40.5
City of Manitowoc	M90	539.2
City of Manitowoc	M91	145.3
City of Manitowoc	M92	1752.7
City of Manitowoc	M99	30.7
City of Port Washington	S1	2224.1
City of Port Washington	S2	14.4
City of Port Washington	S110	823.9
City of Sheboygan	M41	143.4
City of Sheboygan	S10	1964
City of Sheboygan	S11	510.3
City of Sheboygan	S24	3123.2
City of Sheboygan	S27	112.7
City of Sheboygan	S40	144.1
City of Sheboygan	S86	680.4
City of Sheboygan	S106	2374.5
City of Sheboygan	S107	598.9
City of Sheboygan	S108	121.2
City of Sheboygan Falls	S24	224.1
City of Sheboygan Falls	S25	621.4
City of Sheboygan Falls	S26	568.5
City of Sheboygan Falls	S27	697.6
City of Sheboygan Falls	S28	6.8
City of Sheboygan Falls	S29	284.2
City of Sheboygan Falls	S30	1139.4
Town of Sheboygan	M40	61.2
Town of Sheboygan	M41	774.1
Town of Sheboygan	M42	1081
Town of Sheboygan	M97	8.1
Town of Sheboygan	S10	7.5
Town of Sheboygan	S24	831.9
Town of Sheboygan	S27	60.6
Town of Sheboygan	S40	308

Permitted MS4	Subbasin	Area (acres)
Town of Sheboygan	S43	404.7
Town of Sheboygan	S86	1493.2
Town of Sheboygan	S105	1496.8
Town of Sheboygan	S106	263.7
Town of Taycheedah	M43	4388.5
Town of Taycheedah	S100	6423.3
City of Two Rivers	K1	1805.5
City of Two Rivers	K2	1099.4
City of Two Rivers	K23	326.1
City of Two Rivers	K87	7
City of Two Rivers	K95	78.1
City of Two Rivers	K112	143.8
City of Two Rivers	M90	686.6
Town of Wilson	S10	1262.1
Town of Wilson	S11	2953
Town of Wilson	S24	31.6
Town of Wilson	S25	390.2
Town of Wilson	S27	4922.7
Town of Wilson	S28	1.8
Town of Wilson	S107	51.2
Town of Wilson	S108	714.1

Baseline loads for permitted MS4s by TMDL subbasin and municipality are listed in Appendix H. The values reported in Appendix H are derived from the SWAT model using the process described above and represent loads from permitted MS4s that are delivered to a TMDL subbasin outlet after subbasin-level delivery. These values are significantly lower than loads that could be estimated from alternative urban water quality models that do not simulate the same degree of routing. For example, the Source Loading and Management Model (WinSLAMM), commonly used by Wisconsin municipalities for stormwater management planning, simulates direct export of pollutants from urban lands and effects of various treatment. This difference, however, does not impact implementation which is conducted using a percent reduction framework as outlined in both MS4 TMDL Implementation Guidance (WDNR, 2014) and in the MS4 permit.

A municipality is deemed in compliance with the TMDL wasteload allocations for TSS and TP if the overall percent reductions listed in Table 4 of Appendices K and L, for TP and TSS respectively, are met. The approach of using a percent reduction framework is consistent with NR 151, Wis. Admin. Code, and allows the use of WinSLAMM and other urban runoff models to evaluate compliance with the TMDL without the added complications of matching wasteload allocations that are calculated using different models with different rainfall files and differing capacities to route pollutants.

3.6.4 Stormwater and Wastewater General Permits

WDNR authorizes certain stormwater and wastewater discharges under a set of general WPDES permits. Unlike individual WPDES permits, the general permits are not written to reflect site-specific conditions of a single discharger but rather are issued to cover multiple dischargers with similar operations and types of discharges. These general permits vary in requirements for chemical monitoring, inspection frequency, and plan development. Examples of discharges that can be covered by WPDES general permits include:

- Stormwater discharge from construction sites;
- Stormwater discharge from industrial sites;
- Discharge of noncontact cooling water from industrial facilities;
- Discharge of construction site pit and trench dewatering wastewater to surface waters or seepage systems;

- Discharge from facilities that wash equipment, vehicles, and other objects outside.

Note that individual WPDES permits can be issued for the above examples if they are determined to be a significant source of pollution. A complete list of wastewater general permit categories can be found on the WDNR Wastewater website[1].

Baseline phosphorus loads for stormwater general permittees located within an MS4 boundary were included in the MS4 baseline load described in Section 3.6.3. Baseline phosphorus loads for all other stormwater and wastewater general permittees were set to 1% of the reducible (i.e., anthropogenic sources, everything besides natural background) allowable loads in the subbasin, set aside in the same manner as reserve capacity. The assumption of 1% of the reducible allowable load was based on the number and typical types of facilities present within the watersheds and best professional judgment of the TMDL development team. General permit baseline loads are reported by TMDL subbasin in Appendix H. Note, the approach of using 1% of the reducible allowable loads provided a more consistent result across the study area than using approaches in other TMDLs of using a percentage of the nonpermitted urban load.

3.6.5 Permitted Concentrated Animal Feeding Operations

There are 69 CAFOs in the TMDL area that are covered under the WPDES general permit for CAFOs (Table 6; Figure 13). Any runoff from CAFO land application activities is considered a nonpoint source and is included as nonpoint source agricultural loads derived from the SWAT model. The number of cattle and the extent of the production area associated with a CAFO were used together to derive an estimate of manure spreading rates that were used in the SWAT model (see Appendix F).

[1] https://dnr.wi.gov/topic/wastewater/generalpermits.html

Table 6 List of permitted CAFOs in the TMDL area.

CAFO Name	Permit No.	County
3D Dairy	63274	Fond du Lac
Anatevka Dairy	66125	Sheboygan
Augstian Farms	63274	Kewaunee
Badger Pride Dairy	64190	Manitowoc
Blue Royal Farms	64637	Manitowoc
Blue Royal Valley Dairy	64203	Manitowoc
Calf Source	61697	Brown
Cedar Springs Dairy	66087	Manitowoc
Clarks Mills Dairy	65137	Manitowoc
Collins Dairy	65145	Brown
Da Ran Dairy	59579	Kewaunee
Dairy Dreams	62057	Kewaunee
Dairyland Farm	59552	Brown
Dallman East River Dairy	63681	Calumet
Deer Run Dairy	63789	Kewaunee
DenMar Acres	65650	Brown
Drake Dairy	63827	Sheboygan
Ebert Dairy Enterprises	62235	Kewaunee
El Na Farms	63061	Kewaunee
Fitz Pine Dairy Farm	65226	Manitowoc
Goeser Dairy	64645	Sheboygan
Grotegut Dairy Farm	56847	Manitowoc
Halls Calf Ranch	65013	Kewaunee
Hanke Farms	63169	Sheboygan
Heims Hillcrest Dairy	64131	Kewaunee
Highland Crossing Dairy	63151	Sheboygan
Hoslum Irish and Holsum Elm	61620	Calumet
J & J Pickart Dairy	63274	Fond du Lac
J C Maurer and Sons	64726	Sheboygan
Johnson Hill Farm	65111	Manitowoc
Kane Family Farm	65195	Brown
Kinnard Farms	59536	Kewaunee
Kocourek Bros Partnership	65871	Manitowoc
Kostechka Dairy	63894	Manitowoc
Legend Farms Dairy	66265	Kewaunee
Lisowe Acres	64840	Fond du Lac
Majestic Medows Dairy	64874	Sheboygan
Maple Leaf Dairy	58602	Manitowoc
Melichar Road Acres	64866	Ozaukee
Mueller Range Line Dairy	66095	Manitowoc
Orthland Dairy Farm	65731	Manitowoc
Otto Farms	63274	Manitowoc
Pagels Ponderosa	59374	Kewaunee
Paulus Dairy Main Farm	65927	Ozaukee
Quonset Farms	63568	Sheboygan
Redtail Ride Dairy	62979	Fond du Lac
Rivers Edge Dairy	65960	Calumet
Robinway Dairy	66231	Manitowoc
Rockland Dairy	61786	Sheboygan
Rolling Hills Dairy Farm	62707	Kewaunee
Rustic Wagon Wheel Dairy	66354	Manitowoc
S & S Jerseyland Dairy	62863	Door
Sandway Farms	66346	Kewaunee
Schneider Farms INC	65978	Calumet
Seidls Mountian View Dairy	63665	Kewaunee
Shilo Dairy	62693	Calumet
Siemers Holstein Farm	58572	Manitowoc
Soaring Eagle Dairy	63096	Manitowoc
Stahl Bros. Dairy	61999	Kewaunee
Strutz Farm	64017	Manitowoc
Sunny Slope Dairy	66206	Manitowoc
The Cattle Corner	64157	Brown
Twin Cities Vue Dairy	66338	Manitowoc
United Vision Dairy	64319	Manitowoc
Wakker Dairy Farm	63673	Kewaunee
Wayside Dairy	61948	Brown
Wenzel Hilltop Dairy	63274	Calumet
Wolfgang Dairy	61808	Manitowoc
Zirbel Dairy Farms	64360	Brown

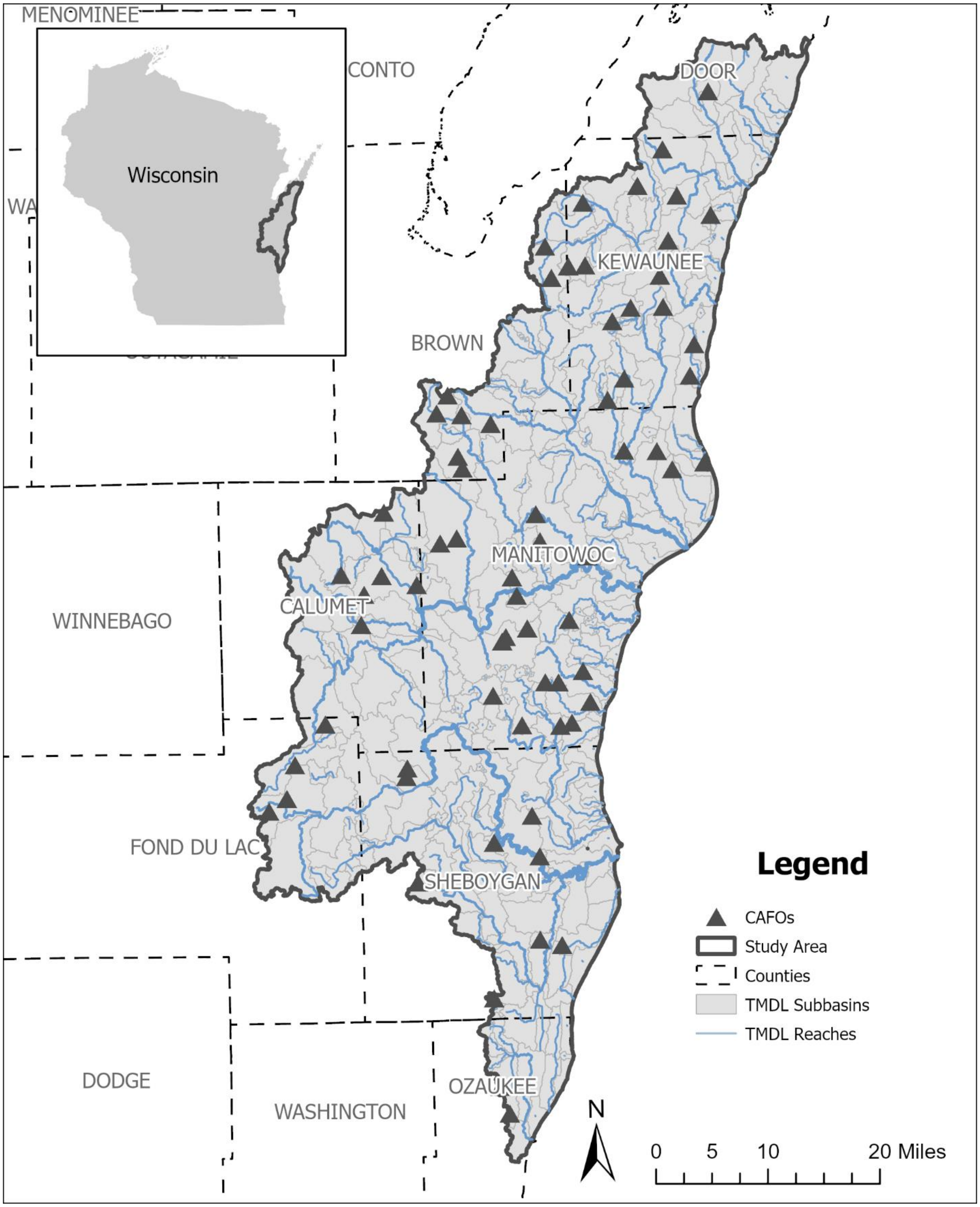

Figure 13 Concentrated Animal Feeding Operations (CAFOs) in the TMDL area that are covered under the WPDES general permit for CAFOs. Points on the map are an approximation of the operation's main location; points located outside of the TMDL area may have production areas within the TMDL area.

3.6.6 Agricultural Runoff

Baseline phosphorus and sediment loads from agricultural lands were calculated using SWAT simulation results for the period January 2012 through December 2019. SWAT outputs for agricultural HRUs were adjusted to account for any delivery between upland sources and TMDL reaches (see Section 3.6.1).

The SWAT model was configured to simulate runoff and pollutant loading from two different agricultural land use types: cash grain agriculture (corn and soybean, or continuous corn) and dairy farm agriculture (corn and forage crops). SWAT allows users to input specific management operations associated with each agricultural land use type. Agricultural operation settings include the type(s) of crops planted and rotation schedule, chemical fertilizer application rates and timing, manure application rates and timing, and tillage intensity and timing.

Agricultural operation settings were determined based on significant input from county land and water conservation departments (LWCDs). LWCD staff were asked to provide information on typical farming practices in their county and responses were translated into 16 unique agricultural operation tables for input to SWAT (See Appendix E). Due to limitations imposed by the scale of the watershed modeling effort, operations could not be developed for each and every unique farm in the TMDL area. However, the 16 agricultural operation classes reflect typical farming behaviors in the TMDL area while capturing variation in factors that have the greatest impact on runoff volumes, soil erosion, and phosphorus loading. Details on the SWAT configuration and the agricultural management classes used can be found in Appendices D, E, F, and G. Baseline agricultural nonpoint source loads by TMDL subbasin are reported in Appendix H.

3.6.7 Non-Permitted Urban Runoff

Baseline phosphorus and sediment loads from non-permitted urban lands (i.e., developed areas outside of permitted MS4s) were calculated using SWAT simulation results for the period January 2012 through December 2019. SWAT outputs for non-permitted urban HRUs were adjusted to account for any channel routing simulated in the model (see Section 3.6.1). The SWAT model was configured to simulate runoff and pollutant loading from two different urban land use types: developed low-density and developed high-density. Phosphorus loading to streams and rivers from septic systems was not explicitly simulated in the SWAT model. Septic loading to streams and rivers is instead assumed to be factored into SWAT estimates of non-permitted urban loading. Baseline non-permitted urban loads by TMDL subbasin are reported in Appendix H.

3.6.8 Background Sources

Baseline phosphorus and sediment loads from forests and wetlands were calculated using SWAT simulation results for the period January 2012 through December 2019. SWAT outputs for forest, grassland, and wetland HRUs were adjusted to account for any channel routing simulated in the model (see Section 3.6.1). The SWAT model was configured to simulate runoff and pollutant loading from three different natural/background land use types: forests, grasslands, and herbaceous wetlands. The calibrated SWAT parameters for these HRUs reflect the presence of undisturbed vegetative cover, an established plant litter layer, and other factors that result in low phosphorus and sediment loading relative to other land use types. Baseline background loads by TMDL subbasin are reported in Appendix H.

3.6.9 Stream Channels

The presence and magnitude of phosphorus and sediment loading from stream channel erosion is dependent on the amount of sediment entering a stream reach and local reach characteristics such as width, depth, and slope that determine whether channel aggradation or degradation occurs. Stream channels were simulated in the SWAT model using the Simplified Bagnold Equation, which allows deposition of sediment and phosphorus depending on stream velocity. Deposition of phosphorus was minimal in SWAT simulations—the small amount of phosphorus that was deposited in stream channels was implicitly aggregated with other SWAT depositional functions (e.g., wetlands) in the nonpoint source delivery factor discussed in Section 3.6.1. However, deposition of sediment can vary greatly from reach to reach, even more so than phosphorus which is generally treated as a conservative pollutant in SWAT's channel routing. Some low-gradient reaches acted as net sediment sinks in the model. Due to the complex nature of sediment equilibrium in the SWAT reaches, smaller subbasins were aggregated together into larger ones (see Section 4.2.2 for further details), until they were sufficiently large enough for the highly variable sediment dynamics to smooth out.

3.7 Summary of Baseline Phosphorus and Sediment Loading

This section provides a general summary of baseline TP and TSS loads in the TMDL area estimated from the methods described in the preceding section. Detailed tables of baseline loads summarized by TMDL subbasin are provided in Appendix H. A map of the three regions is provided in Figure 1.

Table 7 Summary of baseline annual pollutant (Poll., TP=Total Phosphorus, TSS=Total Suspended Solids) loads by source for the three regions (Reg., K=Kewaunee, M=Manitowoc, S=Sheboygan, Tot.=all three combined) mapped in Figure 1. Some source categories have been abbreviated for fit: NPU=non-permitted urban, IP=individual permit, GP=general permit.

Poll.	Reg.	Background		Nonpoint Source				Point Source						Total
				NPU		Agriculture		MS4		IP		GP		
		lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.	%	lbs.
TP	K	12,429	6.3	1,424	0.7	171,616	86.7	135	0.1	11,371	5.7	991	0.5	197,965
	M	12,988	5.4	2,046	0.9	208,665	86.8	1,003	0.4	14,762	6.1	858	0.4	240,322
	S	17,125	5.5	4,054	1.3	263,046	84.8	3,234	1.0	21,669	7.0	936	0.3	310,064
	Tot.	42,542	5.7	7,525	1.0	643,326	86.0	4,372	0.6	47,801	6.4	2,786	0.4	748,351
		tons	%	tons	%	tons	%	tons	%	tons	%	tons	%	tons
TSS	K	1,032	6.7	120	0.8	13,958	91.1	11	0.1	72	0.5	134	0.9	15,327
	M	1,166	6.5	183	1.0	16,296	91.0	80	0.4	134	0.7	54	0.3	17,912
	S	834	4.4	241	1.3	17,448	92.3	139	0.7	125	0.7	116	0.6	18,903
	Tot.	3,032	5.8	544	1.0	47,701	91.5	230	0.4	331	0.6	304	0.6	52,141

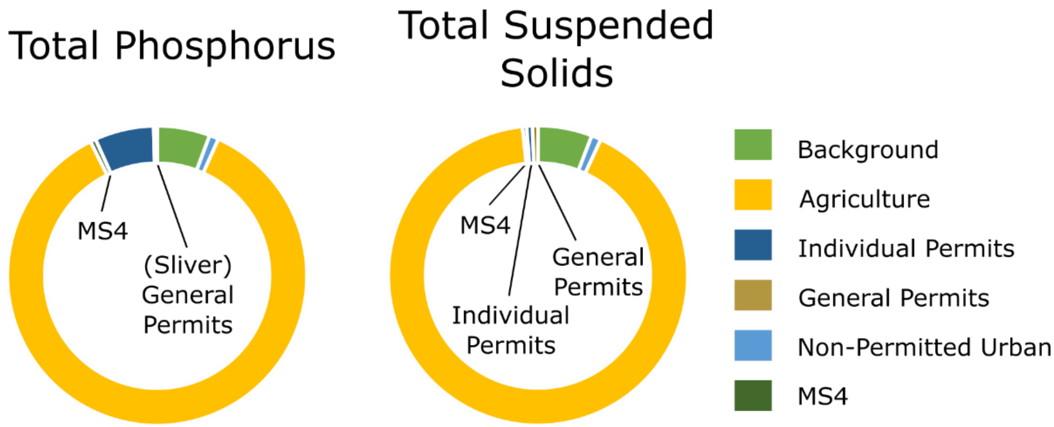

Figure 14 Pie charts displaying total phosphorus and total suspended solids loading by source for the TMDL area.

4 DETERMINATION OF ASSIMILATIVE LOADING CAPACITY

The pollutant assimilative loading capacity of a waterbody is defined as the amount of a pollutant that the waterbody can assimilate and still meet water quality criteria and standards. By definition, a TMDL is a daily assimilative loading capacity; however, loading capacities can also be calculated for time periods other than daily if the effects of a pollutant manifest themselves over longer periods. This section describes how phosphorus and sediment loading capacities were calculated for TMDL subbasins.

4.1 Phosphorus Assimilative Loading Capacity

Separate methods were applied to calculate the phosphorus assimilative loading capacity of subbasins with a river or stream reach at their outlet versus subbasins with a lake or reservoir at their outlet. Each method is summarized in the following subsections.

4.1.1 Stream and River Reaches, FWM/GSM Ratio Method

Wisconsin’s stream/river total phosphorus criteria are assessed as growing-season (May–October) median (GSM) concentrations (see Section 2.2). Although the SWAT model was run with a daily time step, predicted daily TP concentrations are not as accurate as monthly or annual flow-weighted mean (FWM) values. To establish annual TP loads that will meet these criteria, a method is required to translate GSM concentrations to flow-weighted mean concentrations. FWM is higher than GSM in streams where TP concentration increases with discharge and where there is little seasonal variation. In contrast, GSM may be higher than FWM in streams where TP exhibits a strong seasonal pattern that peaks in summer and is independent of discharge. We assume that the FWM/GSM ratio for a given tributary will remain constant as TP concentrations change because the underlying hydrologic drivers of the ratio will not change very much. The FWM/GSM ratio for a tributary can be used to estimate the TP loading that will meet TP criteria—they do not change the criteria themselves.

To determine appropriate FWM/GSM ratios for TMDL development, FWM and GSM concentrations were estimated for 32 stream monitoring sites. For each station, the annual FWM was extracted from the SWAT model. GSMs were estimated from monitoring data adjusted to control for the influence of antecedent precipitation on TP concentration (WDNR PhosMER model). PhosMER was chosen to estimate GSMs for 3 reasons:

- NR 102.07(1)(c) notes that PhosMER can be used for refining TP assessments.
- It has the capacity to estimate long-term GSMs for sites where long-term sampling records are not available.
- It can be used to estimate the uncertainty of a long-term GSM estimate.

Because of its capacity for estimating uncertainty in long-term GSMs, the PhosMER model was chosen as a means of applying an implicit margin of safety. To estimate the uncertainty of the GSM estimate, a statistical method called “bootstrapping” (a statistical procedure that resamples a single dataset to create many simulated samples for the purpose of estimating uncertainty) was used. The PhosMER model was bootstrapped by refitting it 200 times—with each new iteration the model table was shuffled (resampling with replacement) to simulate slightly different conditions. Each iteration generated a new set of daily TP concentrations, and each time a new GSM was calculated across those daily predictions. This process resulted in a distribution of GSM values at each site. The higher bound of the 90% confidence interval (the 95th percentile rank value) was chosen as the representation of GSM.

FWM/GSM ratios resulting from these GSM estimates ranged from 0.52 (Molash Creek—mile 1.1 to headwaters) to 3.34 (Otter Creek) with a median of 1.48 (Table 8). For assimilative loading capacity analysis, ratios for the 32 monitoring sites were applied to the TMDL subbasin in which the site was located, and nearby subbasins with similar hydrology, topography, and land use.

After determining appropriate FWM / GSM ratios, the phosphorus assimilative loading capacity was initially calculated for headwater TMDL subbasins as:

Equation 3

$$Loading\ Capacity = Q_{mean} * TP_{crit} * (FWM/GSM)$$

where Q_{mean} is the mean annual flow in the subbasin, TP_{crit} is the total phosphorus criterion for the subbasin (75 µg/L for headwater subbasins), and FWM/GSM is the conversion factor described in the preceding paragraphs. The phosphorus assimilative loading capacity for non-headwater subbasins was then calculated using the above equation minus the assimilative loading capacity of all upstream subbasins. Phosphorus loading capacities for each TMDL subbasin are reported in Appendix K.

Table 8 Ratios used to convert flow-weighted mean (FWM) total phosphorus concentrations to growing-season medians (GSM). FWM concentrations were derived from the SWAT model (total phosphorus load divided by total water load). GSM concentrations were estimated using the WDNR PhosMER model. Although the most likely GSM concentrations are shown in this table, to establish an implicit margin of safety, the upper 90% confidence limit of PhosMER GSM concentrations were used instead. A higher GSM values results in a lower FWM/GSM ratio and thereby lower loading capacities for stream reaches (see Equation 3).

SWIMS Station ID	Station Name	Reach	FWM SWAT (µg/L)	GSM Most Likely (µg/L)	GSM Margin of Safety (µg/L)	FWM/GSM Most Likely (unitless)	FWM/GSM Margin of Safety (unitless)
10029482	West Twin River at CTH V	K3	269	98	113	2.76	2.38
10008207	East Twin River - East Twin River - Steiners Corners	K4	188	89	97	2.12	1.93
10039193	Devils River at Hwy R	K5	209	114	122	1.83	1.71
363268	Black Creek - Hwy Bb	K7	300	145	162	2.07	1.85
10009857	Neshota River - Neshota River at Highway Bb	K8	342	169	184	2.02	1.86
10008204	East Twin River - Hwy J	K24	210	100	108	2.11	1.95
313038	Kewaunee River DS Cth F at Bruemmer Park	K32	268	97	105	2.77	2.55
10029954	Kewaunee River at Hillside Road	K39	263	198	230	1.33	1.14
10020779	Silver Creek-200 Feet Below Dam 100 Feet Above Bridge…	K47	114	105	115	1.08	0.99
153027	Ahnapee River at CTH J Forestville	K52	106	60	64	1.78	1.65
153221	Stony Creek at Rosewood Rd	K54	43	69	77	0.62	0.55
10011680	Molash Creek - Molash Cr. at Hwy O	K95	98	167	187	0.59	0.52
363225	Point Creek at CTH LS	M3	274	150	163	1.83	1.68
363228	Silver Creek at Cth Ls (Bi Sur)	M7	267	164	181	1.63	1.48
363069	Manitowoc River at Cth Jj(Michigan Ave)	M11	252	219	237	1.15	1.06
363299	Branch River at N Union Rd (2)	M12	276	95	111	2.91	2.48
363313	Branch River - Above Branch River Rd	M12	276	92	98	3	2.83
363291	Killsnake River at Lemke Road	M16	241	156	216	1.55	1.11
363375	Manitowoc River South Branch at Lemke Road	M17	349	297	313	1.17	1.12
10013310	Mud Creek- Hwy 151	M23	266	144	161	1.84	1.65
10016717	Mud Creek - Hilltop Road	M25	170	229	246	0.74	0.69
10016958	Branch River - Cty J - 07600 Ft Upstream from Bridge	M32	261	100	110	2.6	2.37
603296	Sevenmile Creek at CTH LS	M38	304	191	207	1.59	1.47
463070	Sauk Creek at Mink Ranch Rd (Bi)	S2	423	448	504	0.94	0.84
603095	Sheboygan River - at Sth 28 Sheboygan-Esslingen Park	S27	247	144	151	1.71	1.64
603304	Onion River at Ourtown Rd 5m Bi	S28	385	250	286	1.54	1.35
10049358	Mullet River at Sumac Road	S31	204	95	106	2.14	1.92
603295	Pigeon River at Cth A -And River Rd	S41	368	222	259	1.66	1.42
10034560	Fisher Creek - USGS Gauge Station	S42	462	314	399	1.47	1.16
10016139	Sheboygan R. - Hwy 57 Crossing	S45	165	150	161	1.1	1.03

SWIMS Station ID	Station Name	Reach	FWM SWAT (µg/L)	GSM Most Likely (µg/L)	GSM Margin of Safety (µg/L)	FWM/GSM Most Likely (unitless)	FWM/GSM Margin of Safety (unitless)
10039440	Sheboygan River at Palm Tree Rd	S48	249	191	199	1.3	1.25
603051	Pigeon River at Mill Road	S86	361	221	253	1.64	1.43
603316	Otter Creek at Willow Rd Near Plymouth WI	S102	282	80	85	3.54	3.34

4.1.2 WiLMS Lake Modeling Methods

The phosphorus assimilative loading capacity of each lake and reservoir addressed in this TMDL study was calculated based on results from lake response models. A response model estimates a lake's water column phosphorus concentration given its morphological attributes, inflow volume, and phosphorus loading. Loading capacities for 27 lakes (20 of which are impaired for TP) were calculated. Criteria pertaining to the selection of lakes included in the TMDL, which included all lakes listed as impaired, can be found in Appendix I.

Table 9 Lake loading capacities for lakes addressed by the TMDL. Modeling approaches are described in Appendix I.

Lake	WBIC	Reach	Loading capacity (lbs)
Becker	77300	M61	92.8
Big and Little Gerber	56600	S72	142.5
Boot	77600	M59	206.9
Bullhead	68300	M57	35.6
Carstens	66800	M55	105.7
Cedar	45100	S57	112.8
Crystal	45200	S58	56.4
Elkhart	59300	S55	299.6
English	68100	M56	61.8
Gass	67100	M54	30.7
Harpt	84600	K68	93
Hartlaub	67200	M53	149.9
Horseshoe	64200	S64	96.7
Jetzers	62700	S71	12
Little Elkhart	46000	S63	56.8
Long	77500	M60	74.2
Pigeon	64000	S60	67.8
Round	68600	M58	92.2
Shea	85400	K70	75.6
Shoe	46700	S80	15.6
Silver	67400	M8	104.8
Tuma	87900	K81	6.4
West Alaska	94300	K77	40.3
Weyers	49400	M52	27.7
Wilke	58000	S59	194
Wolf	60800	S62	493.1

Loading capacities were calculated using a custom version of the Wisconsin Lake Modeling Suite (WiLMS) (WDNR, 2003). The WiLMS model contains a variety of empirical lake response models. Lakes are represented as a single zero-dimensional, completely mixed body of water with no horizontal or vertical variability in water quality. For this study, water and phosphorus inputs derived from SWAT model estimates were entered as annual amounts and predicted lake TP concentrations were summer averages for the years being modeled.

Because many of the lakes in this area have small, internally draining watersheds, in some cases external loading had to be adjusted proportional to the difference between the TMDL subbasin size and a more precisely drawn watershed using LiDAR digital elevation models. Additionally, depending on whether the lake was impaired and how the initial model results aligned with available monitoring data, five different lake modeling approaches were developed to cover the variety of different observed lake responses and associated divergences in assimilative loading capacity calculation methods. The above divergences in modeling approaches are described in Appendix I. Loading capacities for the 27 modeled lakes are listed in the corresponding tables found in Appendix I. TMDL allocations for the 27 lakes are included in the corresponding reach allocations listed in Appendix K.

4.2 Sediment Assimilative Loading Capacity

Sediment loading capacities were calculated in the same manner as phosphorus with two exceptions:

- FWM/GSM ratios were calculated only at the three long-term trend (LTT) sites (Kewaunee River at Bruemmer Park, Manitowoc River at County Hwy JJ, and Sheboygan River at Esslingen Park).
- Watershed boundaries were aggregated to reduce the complexity of instream sediment dynamics.

Each of these two exceptions are described below.

4.2.1 Stream and River Reaches TSS FWM/GSM Exception

To translate FWM concentrations to the GSM standard, a conversion factor was applied that equaled the ratio between FWM and GSM (FWM/GSM) as described in Section 4.1.1. However, in the case of TSS, instead of using the PhosMER model to estimate GSM, the GSM was calculated directly as the median of all samples taken between the months of May and October. For each LTT site, a long, frequent, and unbiased sampling record existed; therefore, the median of TSS samples was representative of the true long-term median. FWM/GSM ratios for TSS for the three LTT sites are shown in Table 10.

Table 10 Ratios used to convert flow-weighted mean (FWM) sediment concentrations to growing-season medians (GSM). FWM concentrations were derived from the TMDL SWAT model (total phosphorus load divided by total water load). GSM concentrations were calculated from sample data collected between May and October.

SWIMS Station ID	Station Name	Reach	FWM SWAT (µg/L)	GSM (µg/L)	FWM/GSM (µg/L)
313038	Kewaunee River Cth F at Bruemmer Park	K32	27.7	6	4.6
363069	Manitowoc River at Cth JJ (Michigan Ave)	M11	39.7	33	1.2
603095	Sheboygan River at Sth 28 Sheboygan…	S27	31	16	1.9

4.2.2 TSS Subbasin Aggregation Exception

To calculate the TSS TMDL, 319 subbasins were aggregated to 62 (Figure 3). The purpose of this aggregation was to reduce the complexity of instream sediment dynamics from reach-to-reach. Initial phases of TSS TMDL calculations revealed that many reaches in the SWAT watershed model with low stream gradient captured more sediment than they delivered (i.e., sediment “sinks”) when averaged across the model time period. This resulted in net negative delivery factors and allocations. If a reach, on average, captures more sediment than it delivers, that excess load is deposited on the streambed. Impairment listings due to sediment pollution are intended to address both suspended sediment in the water column as well as the deposited sediment on the streambed—both manifestations of excessive sediment pollution can result in biological degradation. For the purpose of calculating the TSS TMDL, aggregating subbasins together balances upstream sediment dynamics, and simplifies the TMDL calculation.

4.2.3 Lakes

None of the lakes addressed in this report are present on the Wisconsin 2022 303(d) Impaired Waters List with TSS identified as the cause of impairment. Furthermore, currently, there are insufficient methods available to determine a numeric target for TSS in lakes.

4.3 Critical Conditions

A TMDL must consider critical conditions for pollutant loading and their effects on water quality as part of the analysis of assimilative loading capacity. Wisconsin’s phosphorus criteria are assessed during the growing season (May through October) in streams and rivers and the summer (June 1 through September 15) in lakes. These periods can be considered critical conditions for the water quality effects of phosphorus loading because they are times when the biological responses to excess phosphorus are strongest due to temperature, flow, and sunlight conditions that are conducive to excessive plant growth. Similarly, the water quality target for sediment is expressed as a growing season (May through October) TSS concentration. High TSS concentrations during the growing season are especially problematic because excess sediment can impair aquatic habitat and potentially increases water temperatures. Further, the spawning of many fish and aquatic insect species can be disrupted with high growing season sediment concentrations because settling particles can smother fish eggs and insect larvae.

Although critical conditions for assessment of phosphorus and sediment occur during the summer and growing season, critical conditions for phosphorus and sediment loading include the entire year. The entire year is included because phosphorus and sediment entering a waterbody during non-growing season months can be stored over time and released during the growing season. Loading capacities and TMDL allocations for phosphorus and sediment were therefore calculated on an annual basis, with methods described in the preceding sections to translate annual loads to growing season or summer concentration targets (i.e., FWM/GSM ratios for stream and river reaches; lake response models for lakes).

5 POLLUTANT LOAD ALLOCATIONS

The objective of a TMDL is to allocate loads among pollutant sources so that appropriate control measures can be implemented, and water quality criteria can be achieved. Wasteload allocations (WLAs) are assigned to point source discharges regulated by WPDES permits and nonpoint source loads are assigned load allocations (LAs), which include both anthropogenic and natural background sources of a given pollutant.

TMDLs must also include a margin of safety (MOS) to account for the uncertainty in predicting how well pollutant reduction will result in meeting water quality standards, and account for seasonal variations. A reserve load capacity (RC) is also included in the TMDL to account for future discharges, changes in discharges, and other sources not defined through the TMDL study.

This TMDL includes allocations for both TP and TSS. TP allocations are based on the current promulgated criteria, and TSS allocations are based on numeric water quality targets that are protective of narrative criteria specified in Wisconsin Administrative Code NR 102.04(1).

5.1 TMDL Equation

A TMDL is expressed as the sum of all individual WLAs for point source loads, LAs for nonpoint source loads, reserve capacity for future and increased discharges, and an appropriate MOS, which takes into account uncertainty:

$$TMDL = \sum WLA + \sum LA + MOS + RC$$

$\sum WLA$ is the sum of wasteload allocations (point sources), $\sum LA$ is the sum of load allocations (nonpoint sources), MOS is the margin of safety, and RC is the reserve capacity.

5.2 Allocation Approach

Load and wasteload allocations were developed for the following source types:

Load allocations:

- Background sources (e.g., forests and wetlands)
- Agricultural sources
- Non-permitted urban areas (NPUs)

Wasteload allocations:

- Individual WPDES permittees (WW, MS4, CAFO)
- General WPDES permittees (WW, stormwater, CAFO)

The phosphorus load allocation approach involves several steps:

- Determining baseline loadings from all sources
- Determining the reductions needed to meet local water quality criteria
- Determining the reserve capacity allocation
- Checking the point source concentrations and adjusting, if needed

The specifics of determining the baseline loadings for each source type are described in the following sections. Allocations for background sources were set equal to their baseline loads. Before allocating loads to other source types, the background load was subtracted from the total allowable reach load because it cannot likely be reduced further; the remaining load is considered “controllable”.

The allocation process depends on whether the baseline reach load is greater than or less than the allowable reach load. Each case is presented below and visualized in Figure 15 and Figure 16.

Case 1: Reach baseline load greater than the reach allowable load.

Using the reach allowable load, the background load is first subtracted to derive the controllable load. The reserve capacity is set to 5% of the controllable load. After the reserve capacity is subtracted from the controllable load, the remaining controllable load is reduced so that the sum of background, controllable load, and reach capacity are equal to the reach load capacity. The GP load was set to 1% of the allowable controllable load in the subbasin.

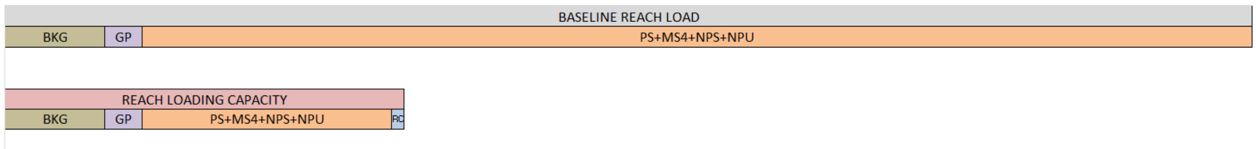

Figure 15 Allocation approach when baseline load is above allowable load.

Case 2: Reach baseline load less than or equal to reach allowable load.

Since the baseline reach load is less than the reach allowable load, no load reductions are required to meet local water quality criteria. The reserve capacity is set to 5% of the reach controllable load (individual point source, MS4, NPS, & NPU) and added to the baseline reach load. The GP load was set to 1% of the allowable controllable load in the subbasin.

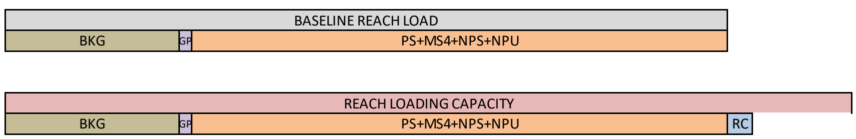

Figure 16 Allocation approach when baseline load is below allowable load.

5.3 Load Allocations

In general, loads are reduced by reach from upstream to downstream based on the local reach allowable load. Controllable loads are reduced with equal percent reduction across sources. Specifically, the fraction of the controllable load that is allocated to each source category is equal to its fraction of the baseline load as calculated over the 12-year model simulation period. These fractions were calculated separately for each reach. This method assigns responsibility for attaining water quality targets in proportion to each source's current contribution to the excess load.

After load allocations are calculated for a reach, a check is done to determine if any of the permitted wastewater facilities have received an allocation that puts their equivalent effluent concentration below the local water quality criterion (TP) or water quality target (TSS).

Allocations must not exceed established regulations. CAFO wasteload allocations are set to zero because CAFOs must comply with all authorized discharge and overflow requirements described in the WPDES CAFO General and Individual Permits. In accordance with the CAFO General Permit, overflow events from CAFOs are allowable due to precipitation related overflows from CAFO storage structures which are properly designed, constructed, operated, and maintained in accordance with CAFO permits. Discharges from such overflows are allowable only if they do not cause or contribute to a violation of water quality standards. Discharges that do not meet the requirements outlined above are considered a permit violation and subject to stepped enforcement procedures.

Allocations were calculated separately for each source or source type in each TMDL reach on an annual basis. Due to the more variable nature of sediment delivery from reach to reach (e.g., high-gradient streams may act as sources during periods of high flow, and low-gradient streams may act as sinks during periods of low flow), the subbasins that were used to calculate TP allocations were aggregated (therefore reduced in number) to a coarser scale to smooth out this variation. Therefore, phosphorus and sediment allocations are reported by two different sets of stream reaches/subbasins. The phosphorus and sediment allocations by reach and source type are presented in Appendices K and L, respectively. Baseline phosphorus and sediment loads are presented in Appendix H.

5.3.1 Background Sources

Baseline background loads (forest, grassland, and wetlands) were determined from the SWAT model results. Allocations for background sources are equal to the baseline background load for that TMDL reach (i.e., no load reduction from baseline). Details regarding the modeling conditions used to determine baseline loads from background sources can be found in the SWAT model report (Appendix D).

5.3.2 Agricultural and Non-Permitted Urban Sources

Baseline agricultural phosphorus and sediment loads were calculated from the cropland areas including dairy and cash grain rotations based on existing management conditions used in the SWAT calibrated model (i.e., baseline loads were set equal to existing loads). Details regarding the modeling conditions used to determine baseline loads from agricultural lands can be found in the SWAT model report (Appendix D). Agricultural sources received allocations proportional to their contribution to the total controllable baseline load for each reach over the 12-year model period. Total annual phosphorus and sediment load allocations for agricultural sources can be found in Appendices K and L, respectively.

Baseline loads for non-permitted urban areas were calculated from the non-background and non-agricultural land covers outside of a permitted MS4 municipal boundary as determined in SWAT. Non-permitted urban sources received allocations proportional to their contribution to the total controllable baseline load for each reach over the 12-year model period. Details regarding the modeling conditions used to determine baseline loads from non-permitted urban areas can be found in the SWAT model report (Appendix D). Total annual phosphorus and sediment load allocations for non-permitted urban areas can be found in Appendices K and L, respectively.

5.4 Wasteload Allocations

5.4.1 Permitted Municipal and Industrial Wastewater Discharges

Wasteload allocations for municipal and industrial wastewater discharges covered by an individual WPDES permit were calculated from baseline loads and reductions determined using the steps described in Section 5.2. Wasteload allocations for municipal and industrial wastewater discharges covered by an individual WPDES permit are listed in Appendix K for TP and in Appendix L for TSS.

Section 40 CFR 122.45 (d), s. NR 212.76 (4), and s. NR 205.065 (7), Wis. Adm. Code, specifies that unless impracticable, permit effluent limits must be expressed as weekly and monthly averages for publicly owned treatment works and as daily maximums and monthly averages for all other continuous discharges. A continuous discharge is a facility that discharges 24 hours per day on a year-round basis except for temporary shutdowns for maintenance or other similar activities (s. NR 205.03 (9g), Wis. Adm. Code).

The WDNR has demonstrated the impracticability of expressing WQBELs for TP as specified in 40 CFR 122.45 (d)[2]. The impracticability demonstration indicates that WQBELs for TP shall be expressed as a monthly average, if the TP WQBEL is equivalent to a concentration value greater than 0.3 mg/L, and as both a six-month average and a monthly average, if the TP WQBEL is equivalent to a concentration value less than 0.3 mg/L. In the latter case, the monthly average limit is three times the

[2] https://dnr.wisconsin.gov/sites/default/files/topic/Wastewater/JustificationPaper_Impracticability.pdf

calculated six-month TP WQBEL. This will be implemented pursuant to the WPDES permit process.

For non-continuous discharges, methods for converting WLAs into permit limits should be determined on a case-by-case basis. For example, some discharges do not occur continuously and often vary from year to year, depending on weather conditions or production processes. In these cases, it may be appropriate to express limits by season or as a total annual amount. In many cases, using shorter term limits (daily, monthly) might have the effect of unduly limiting operational flexibility and, since TMDLs are required to be protective of critical conditions, a seasonal or annual limit would be consistent with the TMDL and protective of water quality. This will be implemented pursuant to the WPDES permit process.

Discharges covered by individual permits that have surface water intake structures are allowed to pass through the phosphorus that is present due to the water supply but are expected to remove any excess that is added or concentrated in their discharge to meet their wasteload allocation.

For phosphorus, the mass allocation contained in the TMDL will be expressed as a mass limit. In many cases, dischargers already have a concentration limit for phosphorus, based on the technology-based effluent limit (TBEL) requirements in ch. NR 217, Wis. Adm. Code, and these limits will be retained in subsequent WPDES permit reissuances.

For sediment, the TSS allocation contained in the TMDL will be expressed as a mass limit. In many cases, dischargers will also receive a concentration limit for TSS, based on TBEL requirements in ch. NR 210, Wis. Adm. Code, or applicable effluent limit guidelines for industrial discharges. Since standard wastewater treatment processes such as grit removal and primary and secondary clarification, which are necessary to reduce wastewater TSS levels to 12 mg/L, will have removed settable material that would contribute to sedimentation, wastewater discharges at or below 12 mg/L will not contribute to sediment impairments. Contributions to turbidity, a condition that is related to concentration and not mass, would also be absent at 12 mg/L effluent concentrations.

5.4.2 General Permits

WPDES general permits address stormwater discharges from industrial facilities and construction sites and wastewater discharges that are considered to not be significant contributors of pollution. Wasteload allocations for stormwater general permittees located within an MS4 boundary are included in the MS4 WLA. As described in Section 3.6.4, baseline TP and TSS loads for all other stormwater and wastewater general permittees were estimated by TMDL subbasin as 1% of the allowable controllable load in the subbasin. The wasteload allocations for these general permits were set aside with no reduction from baseline values.

Some NCCW discharges in this TMDL area are covered by a general permit (WI-0044938). Similar conditions are assumed for these facilities as for those with individual permits. That is, for facilities that use water from a public water supply, it is assumed that phosphorus will be present in the NCCW if added by the water supply. Discharges covered by general permits that have surface water intake structures are assumed to have no net addition. Similar to individual permit holders, general permittees have applicable effluent limits calculated and are issued compliance schedules.

NCCW facilities covered under the general permit and located in watersheds with approved TMDLs are required to submit quarterly monitoring results for TP and TSS. These monitoring results will be used to track the total mass allocation used by NCCW facilities in each watershed. If through the increased monitoring and tracking it is determined that sufficient allocation has not been set aside for NCCW facilities, facilities may be switched to individual permits with discharge requirements placed in the permit sufficient to meet TMDL allocations and/or reserve capacity may be used to increase the WLA for general permits, where need is demonstrated.

5.4.3 Permitted Municipal Separate Storm Sewer Systems

As described in the description of the SWAT model in Section 3.6.3, there are 10 permitted MS4s within the NEL that receive wasteload allocations under this TMDL project. Baseline MS4 loads were determined from the NEL SWAT model. SWAT model results were adjusted for defining baseline conditions to reflect a 20% TSS reduction, consistent with requirements in ch. NR 216 and NR 151, Wis. Admin. Code, and a corresponding 15% reduction in TP. The reduction relationship between TP and TSS is not 1:1 because of the portioning between phosphorus attached to sediment and the soluble phosphorus in the urban runoff.

There may be MS4s in the basin that have already implemented practices that achieve an annual average TSS reductions of greater than 20% or TP reduction of greater than 15%. While these individual modeled results have not been included in the TMDL analysis, these above-baseline reductions will be credited towards meeting water quality targets established in the WPDES permits regulating these municipalities.

Wasteload allocations for MS4 permittees were calculated using the steps described in Section 5.2, with baseline loads reduced according to the percentage reduction required for all controllable sources to achieve calculated loading capacities. Wasteload allocations for permitted MS4s are listed in Appendix K for total phosphorus and in Appendix L for sediment.

Stormwater discharge from Wisconsin Department of Transportation (WisDOT) land areas were not covered by a WPDES permit when the TMDL analysis was conducted; however, a WPDES permit has been developed for WisDOT. This permit, referred to as the TS4 permit, along with the conditions of a memorandum of understanding with WDNR, will be used to implement the TMDL requirements for WisDOT discharges. A section of the MS4 permit is dedicated to the implementation of the TMDL requiring WisDOT to comply with the TMDL allocation set forth in this TMDL.

The specific TS4 allocation is included in the allocation for each MS4 with WisDOT area. At the time the watershed modeling was conducted for this TMDL, sufficient detail did not exist to partition out the TS4 allocation and assign an explicit allocation. Please refer to the MS4 TMDL Implementation Guidance for details on how to partition the allocation (WDNR, 2014).

5.4.4 Concentrated Animal Feeding Operations

The production area, storage areas, and ancillary service areas for CAFOs have been assigned a WLA of zero based on WPDES permit conditions that do not allow discharges that cause or contribute to a violation of water quality standards. In addition to the previously listed requirements, a CAFO may not discharge any pollutants from the production area to a 303(d)-listed surface water if the pollutants discharged are related to the cause of the impairment. For this TMDL study, these pollutants include TP and TSS; however, surface waters may be listed as impaired for additional pollutants such as bacteria.

CAFOs must comply with all WPDES permit conditions which include the livestock performance standards and prohibitions in ch. NR 151, Wis. Admin. Code. These WPDES permit conditions have been translated into a WLA of zero. WPDES permit conditions for the production area specify that CAFOs may not discharge manure or process wastewater pollutants to navigable waters from the production area, including approved manure stacking sites, unless all the following apply:

- Precipitation causes an overflow of manure or process wastewater from a containment or storage structure.
- The containment or storage structure is properly designed, constructed and maintained to contain all manure and process wastewater from the operation, including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event for this location.
- The production area is operated in accordance with the inspection, maintenance and record keeping requirements in s. NR 243.19, Wis. Admin. Code.
- The discharge complies with surface water quality standards.

For ancillary service and storage area, CAFOs may discharge contaminated storm water to waters of the state provided the discharges comply with groundwater and surface water quality standards. The permittee shall take preventive maintenance actions and conduct periodic visual inspections to minimize the discharge of pollutants from these areas to surface waters. For CAFO outdoor vegetated areas, the permittee shall also implement the following practices:

- Manage stocking densities, implement management systems and manage feed sources to ensure that sufficient vegetative cover is maintained over the entire area at all times.
- Prohibit direct access of livestock or poultry to surface waters or wetlands located in or adjacent to the area unless approved by the Department.

Any runoff from CAFO land application activities is considered a nonpoint source and is covered in the TMDL through the load allocation.

Reserve capacity, if available, (see Section 5.6) and water quality trading can be used to off-set phosphorus or TSS loads associated with a surface water discharge as part of an approved alternative manure treatment system.

5.5 Margin of Safety

The margin of safety (MOS) can be implicit (incorporated into the TMDL analysis through conservative assumptions) or explicit (expressed in the TMDL as a portion of the loadings) or a combination of both. An implicit margin of safety has been incorporated into the TMDLs presented in this report. The implicit MOS is based on the following aspects of the assimilative loading capacity and allocation analysis. The primary means of applying an implicit MOS was by setting FWM/GSM ratios used for assimilative loading capacity analysis (Section 4.1.1) to conservative values as described below. GSM concentrations were estimated using the PhosMER model that predicts daily phosphorus concentrations. Confidence in PhosMER model estimates can be calculated through statistical cross-validation. An estimate of growing season median at the upper 90% confidence limit of bootstrapped predictions was chosen (i.e., the implicit margin of safety is set to a value that gives us 90% certainty that FWM load estimates from SWAT will result in meeting water quality criteria). Higher estimates of growing season median would result in lower values of FWM/GSM due to the larger-valued denominator. A lower value of FWM/GSM would in turn decrease allowable load and wasteload allocations and increase percent reductions. Section 3.6.9 notes that TP and TSS loading from streambank erosion is not explicitly modeled in this study but is factored into baseline loading estimates for other nonpoint source categories (agriculture, urban, etc.). This approach represents an implicit margin of safety in nonpoint source allocations because WDNR plans to encourage practices specifically aimed at reducing streambank erosion while also attaining allocations for land-based sources.

5.6 Reserve Capacity

Reserve capacity is a means of setting aside a portion of the assimilative loading capacity to allow for future growth. Inclusion of reserve capacity in a TMDL is optional but history has shown it to be sound public policy. Reserve capacity was included in the TMDL to account for future discharges, changes in current discharger loading, and other sources not defined through TMDL development. To calculate the reserve capacity in each TMDL subbasin, the natural background load and general permit baseline loads were subtracted from the total allowable load, and then the reserve capacity was set as 5% of the remaining controllable load. Reserve capacity allocations are listed in Appendix K for total phosphorus and in Appendix L for sediment.

This provides reserve capacity for potential new or expanding dischargers in headwater sections of the basin. In addition, reserve capacity accumulates from contributing subbasins moving down through the basin making more available for dischargers located on larger downstream rivers. This approach affords dischargers greater flexibility in where they can locate, minimizes impacts on existing dischargers, and is consistent with the observed practice of larger dischargers locating on larger bodies of water.

Reserve capacity is intended to provide wasteload allocation for new or expanding wastewater (industrial or municipal) dischargers, GPs that maybe switched to individual permits, and CAFOs that add a surface water outfall as the result of a manure treatment system. Reserve capacity may be applied to general permittees if it is determined, through analysis of discharge monitoring data, that the amount set aside for GPs is not enough to cover the actual discharge amount from existing, new, or expanding discharges. Refer to “TMDL Implementation Guidance for Wastewater Permits” for process details.

Reserve capacity is not required for new or expanding permitted MS4s. For new or expanding permitted MS4s, the mass associated with the load allocation for the nonpermitted, undeveloped, or agricultural land, that is now part of the permitted MS4, is transferred to the wasteload allocation with a percent reduction in pollutant load assigned to the new or expanding permitted MS4 area consistent with the reductions stipulated in the TMDL for the subbasin. Refer to TMDL Guidance for MS4 Permits (WDNR, 2014) and corresponding addendums for process details.

For CAFOs, the TMDL assigns the production area a wasteload allocation of zero; however, reserve capacity may be available to cover a new or expanding surface water discharge resulting from a manure treatment system. If reserve capacity is not available, the mass resulting from a treatment system discharge must be offset through water quality trading. This offset can be generated through reductions in pollutant loads associated with modifications in manure applications to fields resulting from the treatment system or changes in the CAFO’s operation. Fields receiving manure from the CAFO are covered by the nonpoint load allocation.

Baseline loads from municipal wastewater treatment plants were calculated using the design flow of the facility, which is typically greater than existing flows therefore, because none of the facilities exceed their design flows, the allocations for these point sources should account for some future growth in many communities.

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

A demonstration of need should include an evaluation of conservation measures, recycling measures, and other pollution minimization measures. New dischargers must evaluate current available treatment technologies and expanding dischargers should evaluate optimization of their existing treatment system and evaluation of alternative treatment technologies. In addition to evaluation of treatment options, an expanding discharger must demonstrate that the request for reserve capacity is due to increasing productions levels or industrial, commercial, or residential growth in the community.

If the Department determines that a new or expanding discharger qualifies for reserve capacity, the reserve capacity, if available, will be distributed using the procedures outline below.

New Discharger: For a new discharger, calculate the water quality based effluent limit (WQBEL) per ch. NR 217 for phosphorus and chs. NR 102 or NR 106, Wis. Adm. Code, for other pollutants. If there is no water quality based effluent limit available for the pollutant, apply the TMDL reductions consistent with the applicable subbasin to the baseline condition used in the TMDL. Baseline conditions, consisting of concentration and flows, are set for different pollutants and classes of dischargers, and are summarized in Section 4. If the discharger can meet the resulting limit with available technology, then the limit is translated into a mass and this mass becomes the amount of reserve capacity allocated to the discharger. If the discharger is unable to meet the limit with available technology, then more reserve capacity, up to a maximum cap, can be allocated to the discharger. The maximum cap is calculated based on the facility's flow and the highest concentration for a similar type of facility and treatment system.

Determination of the wasteload allocation available to a new discharge will depend on the type and condition of the immediate receiving water. Limitations for new discharges to Outstanding Resource Waters shall be based on s. NR 207.03(3), Wis. Adm. Code. Limitations for new discharges to Exceptional Resource Waters which are not needed to prevent or correct either an existing surface or groundwater contamination situation, or a public health problem shall be based on s. NR 207.03(4)(b), Wis. Adm. Code. For all other new discharge situations, the following procedures apply to determine the appropriate mass allocation:

- Determine the mass of reserve capacity that is available in the given subbasin.
- Calculate the water quality based effluent limit (WQBEL) per s. NR 217.13(2)(a) and the associated mass limit per s. NR 217.14(3). Calculation should be based on current upstream water quality and for purposes of this calculation any other discharges within the given subbasin may be ignored.
- Calculate the mass load associated with the baseline condition (see Section 4) for the class of the new discharger. Then apply the TMDL reductions, consistent with the applicable subbasin, to the baseline condition to determine the resultant mass.
- Set the wasteload allocation equal to the most restrictive of the values determined by the above methods.

For a new discharge directly to a lake or reservoir, use the following procedure to determine the appropriate mass allocation:

- Determine the amount of reserve capacity that is available for the lake or reservoir. This can include unassigned reserve capacity from contributing subbasins located upstream of the lake or reservoir.
- Calculate the WQBEL per s. 217.13(3) and associated mass limit per s. NR 217.14(3).
- Set the wasteload allocation equal to the more restrictive of the values determined by the above methods.

Expanding Discharger: For an expanding discharger, reserve capacity will be allocated to cover the increased mass attributed to the facility expansion, measured as the increase in flow over the flow assumed in the TMDL baseline (see Table 1 in Section 3.6.2), minus any reductions that can be realized through optimization or economically viable treatment technologies.

If a new or expanding discharger requires more mass than what was allocated through reserve capacity the difference between the mass discharged and their allocation can be made up through an offset such as water quality trading. If there is not sufficient reserve capacity available, the discharge must be off set thru a water quality trade.

Reserve capacity should be taken equally from all subbasins upstream and in which the discharger is located. As additional demands are placed on available reserve capacity, it may become necessary to shift the location that previously assigned reserve capacity was taken, provided the total assimilative loading capacity for each subbasin is maintained. WDNR will maintain a system to track assigned reserve capacity and WDNR will notify U.S. EPA in writing of reserve capacity assignments. Once reserve capacity is no longer available, the TMDL will need to be re-evaluated to see if additional assimilative capacity has become available since the original TMDL analysis due to changes in flow or implementation of the reductions prescribed in the TMDL. This can be a very lengthy process and may not result in additional allocations.

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. U.S. EPA will be notified if a new or expanded WLA is developed.

Pursuant to s. 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. Distribution of reserve capacity does not require re-opening of the TMDL; rather, the permit process can be used for reserve capacity assignments. 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.

5.7 Seasonal Variation

TMDLs must consider seasonal variation in environmental conditions. Critical conditions for phosphorus impairments generally occur during the growing season and summer months when temperature, flow, and sunlight conditions are conducive to excessive plant growth. However, phosphorus loading throughout the entire year can contribute to high phosphorus concentrations during this critical period since phosphorus stored in stream channels and lakes can be released during the summer months. Critical loadings for TSS impairments occur during wet weather events, which result in upland and stream bank erosion. Wet weather events are prevalent in spring and summer but loading throughout the entire year can contribute to high sediment concentrations during these events since deposited sediment stored in stream channels can be resuspended into the water column during high flows.

The method used to link TP and TSS concentration targets to loading capacities is based on observed FWM/GSM ratios, which describe the relationship between annual loads and growing season (i.e., critical condition) concentrations (see Section 4.1.1). Variable allocations by season or month were therefore not developed under this TMDL study.

The methods applied for TMDL development assume that the seasonal pattern of reduced phosphorus and sediment loads will be similar to the existing pattern. For nonpoint sources, this means that actions implemented to reduce loads will need to be effective throughout the year. While this may not be true for any single practice, it is anticipated that a broad suite of practices will be used, and that the collective effects of these practices at the watershed scale will meet this assumption. Discharges from point sources have much less seasonal variation, and it is expected that any required reductions will be approximately uniformly distributed seasonally.

5.8 Climate Change

Projections of precipitation patterns and temperatures are highly variable by location, and individual climate models. The ensemble of climate model projections for Wisconsin generally shows more annual precipitation with precipitation patterns shifting toward drier summers and wetter springs and falls accompanied overall with more intense storms. The updated GLISA/NOAA predictions shows by mid-century, assuming the

RCP8.5 high emissions scenario which is the highest baseline emissions scenario corresponding with a continued rise in emissions throughout the twenty-first century, a decrease in summer precipitation amounts for the northeast portion of Wisconsin ranging between zero and 1.0 inches per season and an increase in the numbers of days with over 1-inch of precipitation from zero to 1.5 days. These changes are impossible to translate into actual daily weather events needed to drive the SWAT watershed model. NOAA is currently engaged in a multi-year process to update Atlas 14 with nonstationary approaches and statistics to project changes in rainfall design storms such as the 1-year design storm, 25-year design storm, etc. NOAA is also evaluating downscaled global models' ability to mimic extreme precipitation events at both the temporal and spatial scales. This information is not yet available and only provides design storms and not the continuous records needed to run the SWAT watershed model.

After consultation with climate change researchers at UW-Madison, the approach that has been recommended for TMDL development is to use a weather dataset from the most current climate normal period. NOAA calculates Climate Normals every 10 years covering a 30-year period. The 1991-2020 U.S. Climate Normals are the latest series of decadal Normals going back to 1950. Consistent with this approach, the Department utilized the most current dataset, 1998-2019, within the most recent Climate Normals for input into the SWAT model.

6 IMPLEMENTATION AND REASONABLE ASSURANCE

6.1 Implementation Planning

Wisconsin DNR has initiated an implementation planning process, which builds on both previous and ongoing planning and implementation efforts to control or reduce nutrient and sediment pollutants in the NEL. The implementation process will develop strategies to use most effectively existing federal, state, and county-based programs to achieve wasteload and load allocations outlined in the TMDL. The planning process will build upon recommendations and ongoing efforts, which are discussed in more detail below.

6.1.1 Nonpoint Implementation

Implementation of the load allocations are implemented through ch. NR 151, Wis. Adm. Code. Implementation of the load allocations that exceed the current performance standards in subchs. III and IV of ch. NR 151, Wis. Adm. Code, is voluntary unless adopted through ch. NR 151.005, Wis. Adm. Code.

As discussed below under Reasonable Assurance, both state and local government agencies are obligated to continue and maintain existing conservation activities and programs, including Farmland Preservation Program (administered by DATCP), NR151 agricultural performance standards, Targeted Runoff Management and Notice of Discharge grant programs (administered by WDNR). These programs are instituted by state statute and administrative code.

In addition to these existing conservation programs, the WDNR will assist partners with implementation activities and focus additional conservation and watershed conservation activities in the NEL such as Nine Key Element Plans (9KEP). As of July 202, there are five U.S. EPA approved 9KEPs in the NEL TMDL study area:

1) Upper Ahnapee River Watershed, Door County
2) Ahnapee River Watershed, Kewaunee County
3) North Branch of the Manitowoc, Calumet County
4) CalMan Lakes Watershed Management Plan, Calumet County
5) Pine Creek Watershed, Manitowoc County

In addition, one 9KEP is currently under development for portions of the Pigeon River watershed located in Sheboygan County (as of May,2023; Stantec, Sheboygan County). Focused watershed implementation projects and activities are outlined in each 9KEP. The WDNR will continue to support the implementation of these 9KEPs, and will collaborate with the respective parties to revise the 9KEPs to include the edge of field targets contained in Appendix M.

During winter/spring of 2023, WDNR nonpoint and water quality staff, using the draft TMDL, prepared the following materials to support implementation planning activities:

- Based on the SWAT modeling results, the WDNR developed agricultural baseline phosphorus loading figures/ maps and associated tables to identify, rank, and prioritize all TMDL subbasins from high to lowest agricultural phosphorus loads. These maps/figures display spatially where the high load sub-basins are located (see Figure 17 below).
- GIS files were formatted for use by County LCWDs, including sub-basin agricultural baseline phosphorus load maps. The GIS files can be overlain with existing county GIS to identify high loading agricultural or rural areas.
- WDNR developed an implementation planning supporting document to efficiently locate TMDL phosphorus and TSS results by TMDL sub-basins. Prior to the document, implementers had to review multiple documents for the information.
- WDNR updated the WDNR Watershed Restoration Viewer with the most recent NEL TMDL data. This is a web-based program that allows users to quickly identify TMDL data in relation to watershed location.

In spring 2023, WDNR nonpoint and water quality staff met with seven of the County LWCDs located in the NEL TMDL study area to review and discuss preliminary TMDL data; share and discuss the agricultural loading maps; share the GIS files; and discuss prioritization and strategy based on high load areas; and to identify any gaps or needed resources necessary for agricultural implementation.

Starting in April 2023, the WDNR collaborated with six of the County LWCDs to develop a Great Lakes Restoration Initiative (GLRI) proposal for an agricultural cropland implementation project in the NEL TMDL study area. As part of this process, the WDNR worked with LWCDs to select two to three high phosphorus loading subbasins in each county resulting in 14 to 21 (2-3 subbasins per county multiplied by 7 counties equals 14 to 21) subbasins in which a contractor will be selected to conduct analysis using the EVAAL (Erosion Vulnerability Assessment for Agricultural Lands) model developed by WDNR. More information about EVAAL can be found at: https://dnr.wisconsin.gov/sites/default/files/topic/Nonpoint/EVAAL_Fact_Sheet_v1_0.pdf

Results from the EVAAL analysis will used to identify potential critical fields that may be more prone to runoff or higher pollutant delivery within each of the selected subbasins. Identified fields can then be prioritized for the installation of cropland BMPs achieving greater reductions.

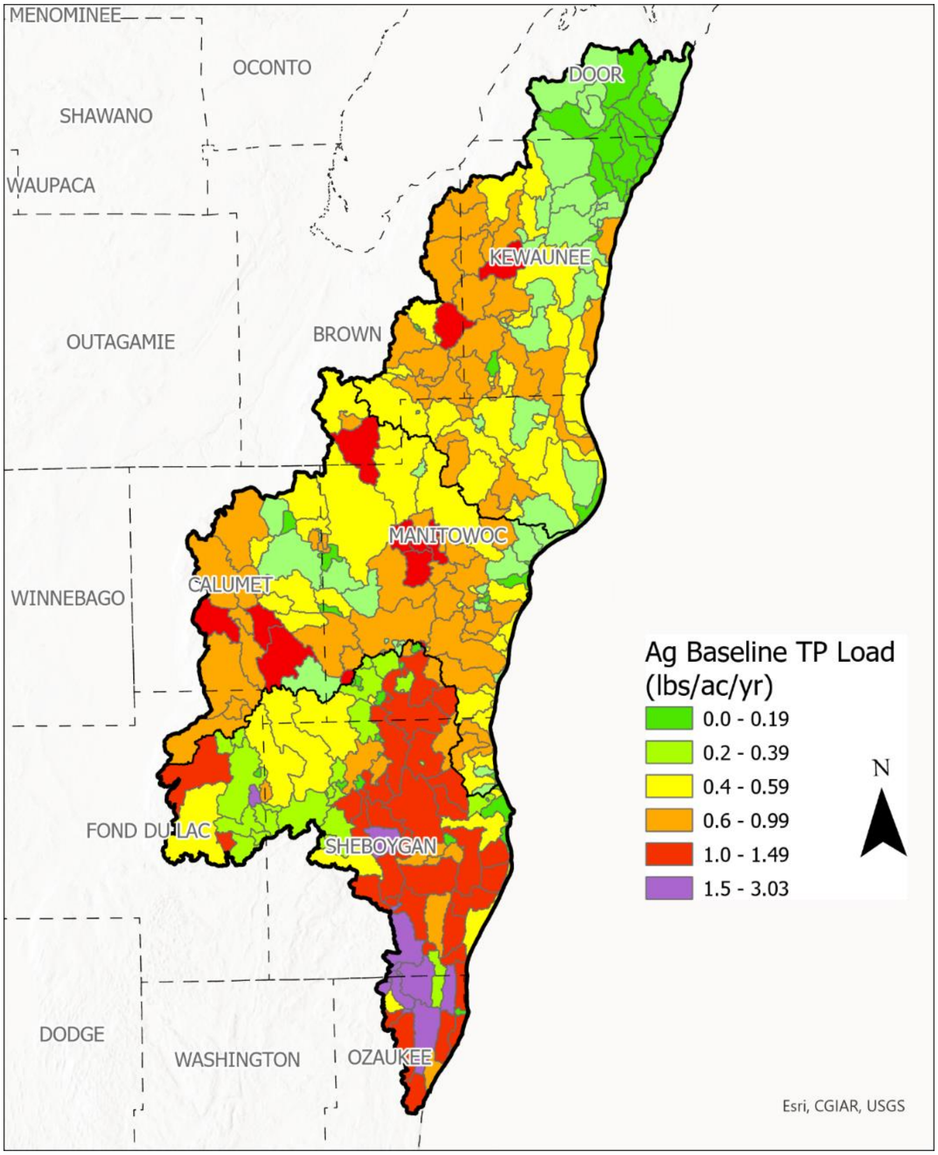

Figure 17 SWAT baseline loading results used to prioritize subbasins.

6.1.2 Point Source Implementation

The NEL TMDL expresses wasteload allocations for TP as maximum annual loads (pounds per year) and maximum daily loads (pounds per day), which equal the maximum annual loads divided by the number of days in the year. As described in the "TMDL Implementation Guidance for Wastewater Permits" (WDNR, 2020), total phosphorus

WQBELs for wastewater discharges covered by the NEL TMDL should be derived in a similar manner as methods used for Lower Fox, Wisconsin River, and Upper Fox and Wolf River Basin TMDL discharges. That is, consistent with the impracticability demonstration, TP limits should be expressed as a monthly average when wasteload allocations equate to a TP effluent concentration greater than 0.3 mg/L, and as a six-month average and monthly average equal to 3 times the six-month average when WLAs equate to a TP effluent concentration equal to or less than 0.3 mg/L.

The NEL TMDL establishes TP wasteload allocations to reduce the loading in the entire watershed including WLAs to meet water quality standards for tributaries. Therefore, WLA-based WQBELs are protective of immediate receiving waters and limit calculators will not need to include TP WQBELs derived according to s. NR 217.13, Wis. Adm. Code.

Since wasteload allocations are expressed as annual loads (lbs./yr.), permits with TMDL-derived monthly average permit limits should require the permittee to calculate and report rolling 12-month sums of total monthly loads for TP. Rolling 12-month sums can be compared directly to the annual wasteload allocation.

The above guidance for expressing TMDL wasteload allocations as permit limits is based on U.S. EPA’s statistical method for deriving water quality-based effluent limits as presented in 5.4 and 5.5 of the Technical Support Document for Water Quality-based Toxics Control (EPA, 1991).

Required by the Clean Water Act, reasonable assurances provide a level of confidence that the wasteload allocations and load allocations in TMDLs will be implemented. This TMDL will be implemented through enforcement of existing regulations, financial incentives, and various local, state, and federal water pollution control programs. The following subsections describe some of the activities, programs, requirements, and institutional arrangements that will provide reasonable assurance that this TMDL will be implemented and that the water quality goals should be achieved.

6.2 Reasonable Assurance for Point Sources

WDNR regulates point sources through the WPDES permit program. Individual permits are issued to municipal and industrial wastewater discharges. General permits are issued to some classes of industries or activities that are similar in nature, such as noncontact cooling water and certain stormwater discharges. After the WLAs presented in this report have been state and federally approved, reissued permits must contain conditions consistent with the wasteload allocations.

Individual permits issued to municipal and industrial wastewater discharges will include discharge limits consistent with the approved wasteload allocations. For phosphorus, the mass allocation contained in the TMDL will be expressed as a mass limit. In cases where the resulting mass limit is equivalent to a concentration approaching the criteria of the waterbody itself (0.3 mg/L or less), the discharge limit will be expressed as both a monthly average and a six-month average. In many cases, discharges will also continue to receive a concentration limit for TP, based on the TBEL requirements in ch. NR 217, Wis. Adm. Code. For sediment, the TSS allocation contained in the TMDL will be expressed as a mass limit. In many cases, dischargers will also continue to receive a concentration limit for TSS, based on TBEL requirements in ch. NR 210, Wis. Adm. Code, or applicable effluent limit guidelines for industrial discharges.

Dischargers with general WPDES permits will be evaluated to determine if additional requirements are necessary to ensure that discharges remain consistent with TMDL goals. This could include issuing individual WPDES permits to facilities that currently hold general permits.

WDNR regulates stormwater discharges from certain MS4s, industries, and construction sites under WPDES permits issued pursuant to Chapter NR 216, Wis. Adm. Code. WDNR also established developed urban area, construction site, and post-construction performance standards under NR 151, Wis. Adm. Code, which are implemented through stormwater MS4 and construction site permits. When the TMDL WLAs have been state and federally approved, WDNR will incorporate permit conditions into stormwater permits consistent with the TMDL WLAs. Existing programs that detect and eliminate illicit discharges will continue to be implemented by municipalities. WPDES permit conditions already require monitoring and elimination of discovered discharges.

WDNR and appropriate state agencies will monitor and enforce CAFO permit requirements so that CAFOs are operated and maintained to prevent discharges as required by their WPDES permit.

6.3 Reasonable Assurance for Nonpoint Sources

To attain the TMDL reduction goals, management measures must be implemented and maintained over time to control phosphorus and sediment loadings from nonpoint sources of pollution. Wisconsin's Nonpoint Source Pollution Abatement Program (NPS Program), described in the state's Nonpoint Source Program Management Plan (WDNR, 2021), outlines a variety of financial, technical, educational, and enforcement programs, which support implementation of management measures to address nonpoint source pollution. WDNR and the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) coordinate statewide implementation of the NPS Program. The NPS Program includes core activities and programs, which are a high priority and the focus of WDNR and DATCP's efforts to address NPS pollution; these programs include those described in the following sections.

6.3.1 Statewide Agricultural Performance Standards & Manure Management Prohibitions

Adopted in 2002 and updated in 2010, Chapter NR 151, Wis. Adm. Code, establishes runoff management performance standards and prohibitions for agricultural and non-agricultural facilities and practices. These standards are intended to be minimum standards of performance necessary to achieve water quality standards, as described in Chapter 281.16, Wis. Stat. Implementing the performance standards and prohibitions on a statewide basis is a high priority for the NPS Program and requires having adequate WDNR staff and financial resources to meet the NR 151 implementation and enforcement procedures (NR 151.09 and 151.095). In particular, the implementation and enforcement of agricultural performance standards and manure management prohibitions, listed below, throughout the TMDL area will be critical to achieve the necessary nonpoint source load reductions. Such effort will require having adequate amounts of cost share funding to cover the cost for meeting TMDL NPS reductions. In addition, DNR relies on LWCDs to implement NR 151 locally meaning in addition to funding for cost share, LWCDs need adequate staffing and financial support to fund staff.

- Tillage setback: A setback of 5 feet from the top of a channel of a waterbody for the purpose of maintaining stream bank integrity and avoiding soil deposits into state waters. Tillage setbacks greater than 5 feet but no more than 20 feet may be required, if necessary, to meet the standard. Harvesting of self-sustaining vegetation within the tillage setback is allowed.

- Phosphorus Index (PI): A limit on the amount of phosphorus that may run off croplands and pastures as measured by a phosphorus index with a maximum of 6, averaged over an eight-year accounting period, and a PI cap of 12 for any individual year. The PI is measured in pounds per acre per year.
- Process wastewater handling: a prohibition against significant discharge of process wastewater from milk houses, feedlots, and other similar sources.
- Meeting TMDLs: A standard that requires crop and livestock producers to reduce discharges, if necessary, to meet a load allocation specified in an approved Total Maximum Daily Load (TMDL) by implementing targeted performance standards specified for the TMDL area using best management practices specified in ch. ATCP 50, Wis. Adm. Code. If a more stringent or additional performance standard is necessary to meet water quality standards, it must be promulgated by rule before compliance is required. Before promulgating targeted performance standards to implement a TMDL, the Department must determine, using modeling or monitoring, that a specific waterbody or area will not attain water quality standards or groundwater standards after substantial implementation of the existing NR 151 performance standards and prohibitions.
- Sheet, rill, and wind erosion: All cropped fields shall meet the tolerable (T) soil erosion rate established for that soil. This provision also applies to pastures.
- Manure storage facilities: All new, substantially altered, or abandoned manure storage facilities shall be constructed, maintained, or abandoned in accordance with accepted standards, which includes a margin of safety. Failing and leaking existing facilities posing an imminent threat to public health or fish and aquatic life or violate groundwater standards shall be upgraded or replaced.
- Clean water diversions: Runoff from agricultural buildings and fields shall be diverted away from contacting 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).
- Nutrient management: Agricultural operations applying nutrients to agricultural fields shall do so according to a nutrient management plan (Each nutrient management plan must be designed to limit or reduce the discharge of nutrients to waters of the state for the purpose of complying with state water quality standards and groundwater standards. In addition, for croplands in watersheds that contain

impaired surface waters, a plan must be designed to manage soil nutrient concentrations so as to maintain or reduce delivery of nutrients contributing to the impairment of impaired surface waters. ATCP 50.04 c additional requirements for all nutrient management plans. This standard does not apply to applications of industrial waste, municipal sludge or septage permitted under other WDNR programs provided the material is not commingled with manure prior to application. 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
- 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.

WDNR, DATCP, and the county Land and Water Conservation Departments (LWCDs) will work with landowners to implement agricultural and non-agricultural performance standards and manure management prohibitions to address sediment and nutrient loadings in the TMDL area.

Some landowners voluntarily install BMPs to help improve water quality and comply with the performance standards. Cost-sharing funds, provided via state or federal funds, may or may not be available for many of these BMPs. Wisconsin statutes, and the NR 151 implementation and enforcement procedures of NR 151.09 and 151.095, requires that farmers in noncompliance with the agricultural performance standards must be offered at least 70% cost-sharing funds for BMP installation before they can be required to comply with the agricultural performance standards and prohibitions. If cost share money is offered, those in violation of the standards are obligated to comply with the rule. The amount of cost sharing funds available for use by LWCD's, DATCP and WDNR will require implementing the performance standards and prohibitions throughout the TMDL area over time. DATCP's Farmland Preservation Program requires that any agricultural land enrolled in the program must be determined to be in compliance with the performance standards by no later than 2020 to continue receive tax credits associated with the program.

6.3.2 WDNR Cost-Sharing Grant Programs

The counties and other local units of government in the TMDL area may apply for grants from WDNR to control NPS pollution and, over time, meet the TMDL load allocation. The WDNR supports NPS pollution abatement by administering and providing cost-sharing grants to fund BMPs through various grant programs, including, but not limited to:

- The Targeted Runoff Management (TRM) Grant Program
- The Notice of Discharge (NOD) Grant Program
- The Urban Nonpoint Source & Storm Water Management Grant Program
- The Lake Planning Grant Program
- The Lake Protection Grant Program
- The River Planning & Protection Grant Program

Under the recently adopted NR 193, Wis. Admin. Code, the lake planning, lake protection and river planning, and protection grant programs have all been rolled into one “Surface Water Grant”—more information can be found on the Wisconsin DNR Surface Water Grant web page[3].

Many of the counties and municipalities in the TMDL area have a track record of participating in these NPS related grant programs.

6.3.3 Targeted Runoff Management (TRM) Grant Program

Targeted Runoff Management (TRM) grants are provided by the WDNR to control nonpoint source pollution from both urban and agricultural sites. A combination of state General Purpose Revenue, state Bond Revenue, and federal Section 319 Grant funds is used to support TRM grants. The grants are available to local units of government (typically counties) and targeted at high-priority resource problems. TRM grants can fund the design and construction of agricultural and urban BMPs. Some examples of eligible BMPs include livestock waste management practices, some cropland protection, and streambank protection projects. These and other practices eligible for funding are listed in s. NR 154.04, Wis. Adm. Code.

[3] https://dnr.wisconsin.gov/aid/SurfaceWater.html or search “WDNR Surface Water Grants”

Revisions to ch. NR 153, Wis. Adm. Code[4], which governs the program, took effect on January 1, 2011, and modified the grant criteria and procedures, increasing the state's ability to support performance standards implementation and TMDL implementation. Since the calendar year 2012 grant cycle, projects may be awarded in four categories:

	TMDL	Non-TMDL
Small Scale	Implements a TMDL Agricultural or urban focus	Implements NR 151 performance standards Agricultural or urban focus
Large Scale	Implements a TMDL Agricultural focus only	Implements NR 151 performance standards Agricultural focus only

Section 281.65(4c), Wis. Stats., defines additional priorities for Targeted Runoff Management Projects as follows:

- TRM projects must be targeted to an area based on any of the following:
- Need for compliance with established performance standards.
- Existence of impaired waters.
- Existence of outstanding or exceptional resource waters.
- Existence of threats to public health.
- Existence of an animal feeding operation receiving a Notice of Discharge.
- Other water quality concerns of national or statewide importance.
- Projects are consistent with priorities identified by WDNR on a watershed or other geographic basis.
- Projects are consistent with approved county land and water resource management plans.

The maximum cost-share rate available to TRM grant recipients is up to 70 percent of eligible costs (maximum of 90% in cases of economic hardship), with the total of state funding not to exceed established grant caps. TRM grants may not be used to fund projects to control pollution from sources permitted under Wisconsin law. Grant application materials are available on the WDNR web site[5].

6.3.4 Notice of Discharge (NOD) Grants Program

Notice of Discharge (NOD) Project Grants, also governed by ch. NR 153, Wis. Adm. Code, are provided by WDNR and DATCP to local units of government (typically

[4] http://legis.wisconsin.gov/rsb/code/nr/nr153.pdf
[5] http://dnr.wi.gov/aid/targetedrunoff.html

counties). A combination of state General Purpose Revenue, state Bond Revenue, and federal Section 319 Grant funds are used to support NOD grants. The purpose of these grants is to provide cost sharing to farmers who are required to install agricultural best management practices to comply with Notice of Discharge requirements. Notices of Discharge are issued by the WDNR under ch. NR 243 Wis. Adm. Code (Animal Feeding Operations - http://legis.wisconsin.gov/rsb/code/nr/nr243.pdf), to small and medium animal feeding operations that pose environmental threats to state water resources. The project funds can be used to address an outstanding NOD, or an NOD developed concurrently with the grant award.

Both state agencies work cooperatively to administer funds set aside to make NOD grant awards. Although the criteria for using agency funds vary between the two agencies, WDNR and DATCP have jointly developed a single grant application that can be used to apply for funding from either agency. The two agencies jointly review the project applications and coordinate funding to assure the most cost-effective use of the available state funds. Funding decisions must consider the different statutory and other administrative requirements each agency operates under. Grant application materials are available on the WDNR web site at: http://dnr.wi.gov/Aid/NOD.html.

6.3.5 Surface Water Grants: Lake Management Planning

The WDNR provides grants to eligible parties to collect and analyze information needed to protect and restore lakes and their watersheds and develop lake management plans. Section 281.68, Wis. Stats., and ch. NR 193 Wis. Adm. Code, provide the framework and guidance for WDNR's Lake Management Planning Grant Program. Grant awards may fund up to 66% of the cost of a lake planning project. Grant awards cannot exceed $25,000 per grant for large-scale projects. Eligible planning projects include:

- Gathering and analysis of physical, chemical, and biological information on lakes.
- Describing present and potential land uses within lake watersheds and on shorelines.
- Reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, sanitation, or pollution control or surface use.
- Assessments of fish, aquatic life, wildlife, and their habitats. Gathering and analyzing information from lake property owners, community residents, and lake users.

- Developing, evaluating, publishing, and distributing alternative courses of action and recommendations in a lake management plan.

Grants can also be used to investigate pollution sources, including nonpoint sources, followed by incorporation into the lake management plan of strategies to address those sources. Investigation can involve many types of assessment, including determining whether the water quality of the lake is impaired. A plan approved by WDNR for a lake impaired by NPS pollution should incorporate the U.S. EPA's "Nine Key Elements".

6.3.6 Surface Water Grants: Lake and River Protection

6.3.6.1 Lake Protection Program Overview

The WDNR provides grants to eligible parties for lake protection grants. Sections 281.69 and 281.71, Wis. Stats., and ch. NR 193, Wis. Adm. Code, provide the framework and guidance for the Lake Protection Grant Program. Grant awards may fund up to 75 percent of project costs (maximum grant amount $200,000). Eligible projects include:

- Purchase of land or conservation easements that will significantly contribute to the protection or improvement of the natural ecosystem and water quality of a lake.
- Restoration of wetlands and shorelands (including Healthy Lakes best practices) that will protect a lake's water quality or its natural ecosystem (these grants are limited to $100,000). Special wetland incentive grants of up to $10,000 are eligible for 100 percent state funding if the project is identified in the sponsor's comprehensive land use plan.
- Development of local regulations or ordinances to protect lakes and the education activities necessary for them to be implemented (these grants are limited to $50,000)
- Lake management plan implementation projects recommended in a plan and approved by WDNR.

These projects may include watershed management BMPs, in-lake restoration activities, diagnostic feasibility studies, or any other projects that will protect or improve lakes. Sponsors must submit a copy of their lake management plan and the recommendation(s) it wants to fund for WDNR approval at least two months in advance of the February 1 deadline. Plans must have been officially adopted by the sponsor and made available for public comment prior to submittal. The WDNR will review the plan and advise the sponsor on the project's eligibility and development of a lake protection grant application for its implementation. Grant application materials are available on the WDNR web site[6].

6.3.6.2 River Program Overview

The WDNR provides grants to eligible parties for river protection grants. Chapter 193, Wis. Adm. Code, provides the framework and guidance for the River Protection Grant Program. This program provides assistance for planning and management to local organizations that are interested in helping to manage and protect rivers, particularly where resources and organizational capabilities may be limited.

River Planning Grants up to $10,000 are available for:

- Developing the capacity of river management organizations,
- Collecting information on riverine ecosystems,
- River system assessment and planning,
- Increasing local understanding of the causes of river problems

River Management Grants up to $50,000 are available for:

- Land/easement acquisition,
- Development of local regulations or ordinances that will protect or improve the water quality of a river or its natural ecosystem,
- Installation of practices to control nonpoint sources of pollution,
- River restoration projects including dam removal, restoration of in-stream or shoreland habitat,
- An activity that is approved by the WDNR and that is needed to implement a recommendation made because of a river plan to protect or improve the water quality of a river or its natural ecosystem,
- Education, planning and design activities necessary for the implementation of a management project.

[6] http://dnr.wi.gov/Aid/SurfaceWater.html

The state share of both grants is 75% of the total project costs, not to exceed the maximum grant amount. Grant application materials are available on the WDNR web site[7].

6.3.7 DATCP Soil & Water Resource Management Program

DATCP oversees and supports county conservation programs that implement the state performance standards and prohibitions and conservation practices. DATCP's Soil and Water Resource Management (SWRM) Program requires counties to develop Land and Water Resource Management (LWRM) Plans to identify conservation needs. Each county Land and Water Conservation Department in the TMDL area developed an approved plan for addressing soil and water conservation concerns in its respective county. County LWRM plans advance land and water conservation and prevent NPS pollution by:

- Inventorying water quality and soil erosion conditions in the county.
- Identifying relevant state and local regulations, and any inconsistencies between them.
- Setting water quality goals in consultation with the WDNR.
- Identifying key water quality and soil erosion problems, and practices to address those 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.
- Including a multi-year work plan to achieve soil and water conservation objectives.

Counties must receive DATCP's approval of their plans to receive state cost-sharing grants for BMP installation. DATCP is also responsible for providing local assistance

[7] http://dnr.wi.gov/Aid/SurfaceWater.html

grant funding for county conservation staff implementing NPS control programs included in the LWRM plans. This includes local staff support for DATCP and WDNR programs.

The NEL TMDL provides County Land and Water Conservation Departments with the data necessary to identify and prioritize pollutant sources so that strategies can be developed and applied to reduce pollutant loads in the TMDL area over time more effectively.

6.3.8 DATCP Producer Led Watershed Protection Grants Program

To improve the quality of Wisconsin's waterways, DATCP developed and launched the first Producer Led Watershed Protection Grants Program in 2016. The new grant program included in the 2015- 17 Wisconsin state budget, was designed to give financial support to farmers willing to lead conservation efforts in their own watersheds. The DATCP grants to eligible producers provide support to farmer groups to deliver cost share programs, on-farm demonstration and research projects, and education and outreach efforts on conservation systems and on innovative practices that improve water quality

In the first-round of 2016 grants, $242,550 was awarded to 14 groups of innovative farmers throughout Wisconsin to work with resource conservation agencies and organizations to address soil and water issues tailored to their local conditions. In the latest round of grants (2023), $1,000,000 was awarded to 43 groups to continue these efforts.

6.3.9 Federal Programs

Numerous federal programs are also being implemented in the TMDL area and are expected to be an important source of funds for future projects designed to control phosphorus and sediment loadings in the NEL. A few of the federal programs include:

- Environmental Quality Incentive Program (EQIP). EQIP is a federal cost-share program administered by the Natural Resources Conservation Service (NRCS) that provides farmers with technical and financial assistance. Farmers receive flat rate payments for installing and implementing runoff management practices. Projects include terraces, waterways, diversions, and contour strips to manage agricultural waste, promote stream buffers, and control erosion on agricultural lands.

- Conservation Reserve Program (CRP). CRP is a voluntary program available to agricultural producers to help them safeguard environmentally sensitive land. Producers enrolled in CRP plant long-term, resource conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, the Farm Service Agency (FSA) provides participants with rental payments and cost-share assistance.
- Conservation Reserve Enhancement Program (CREP). CREP provides annual rental payments up to 15 years for taking cropland adjacent to surface water and sinkholes out of production. A strip of land adjacent to the stream must be planted and maintained in vegetative cover consisting of certain mixtures of tree, shrub, forbs, and/or grass species. Cost-sharing incentives and technical assistance are provided for planting and maintenance of the vegetative strips. Landowners also receive an upfront, lump sum payment for enrolling in the program, with the amount of payment dependent on whether they enroll in the program for 15 years or permanently.
- Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements RCPP combines the authorities of four former conservation programs – the Agricultural Water Enhancement Program, the Chesapeake Bay Watershed Program, the Cooperative Conservation Partnership Initiative and the Great Lakes Basin Program. Assistance is delivered in accordance with the rules of EQIP, CSP, ACEP and HFRP; and in certain areas the Watershed Operations and Flood Prevention Program.
- Great Lakes Restoration Initiative (GLRI) – administered by the U.S. EPA, GLRI provides federal funding for facilitation of Great Lakes Lakewide Action and Management Plan (LAMP) activities including nonpoint source abatement projects.

6.3.10 Water Quality Trading & Adaptive Management

Water Quality Trading (WQT) and Adaptive Management (AM) may be used by eligible municipal and industrial wastewater dischargers to demonstrate compliance with TMDL

WLAs. Both of these compliance options provide a unique watershed-based opportunity to reduce pollutant loading to streams, rivers, and lakes through point and nonpoint source collaboration. AM and WQT may also provide a new source of funding for local assistance and implementation of management measures to address nonpoint source pollution and improve water quality. The WDNR web site provides more details about water quality trading[8] and adaptive management[9].

Wasteload allocations have also been broken down into the amount needed for the subbasin to meet local water quality requirements and the amount needed to meet downstream water quality targets for lakes and reservoirs in the NEL.

6.3.11 Phosphorus Multi-discharger Variance (MDV)

The statewide multi-discharger variance (MDV) for phosphorus (s. 283.16, Wis. Stat.) extends the timeline for wastewater dischargers that have to comply with low-level phosphorus limits. In exchange, point sources commit to stepwise reductions of phosphorus in their effluent as well as helping to address nonpoint sources of phosphorus from farm fields, cities, or natural areas to implement projects designed to improve water quality.

Wisconsin's phosphorus MDV was approved by U.S. EPA on February 6, 2017 and is set to expire in 2027. WDNR is working with U.S. EPA to extend the MDV beyond 2027. MDV implementation guidance[10] is available to provide details about MDV eligibility and programmatic requirements. If a facility meets the eligibility requirements and requests and gets approval for the MDV, the WPDES permit will be modified or reissued with the following requirements:

- Reductions of effluent phosphorus: Point sources are required to reduce their phosphorus load each permit term of MDV coverage.
- *Implement a watershed project*: Point sources must implement one of the following watershed project options to help reduce nonpoint source of phosphorus pollution:
    - Implement a watershed project directly;

[8] https://dnr.wisconsin.gov/topic/Wastewater/WaterQualityTrading.html
[9] https://dnr.wisconsin.gov/topic/Wastewater/AdaptiveManagement.html
[10] https://dnr.wisconsin.gov/topic/Wastewater/phosphorus/StatewideVariance.html

- Work with a third party to implement a watershed project; or
- Make payments to a county (or counties) to be used for nonpoint source pollution control activities.

6.4 Follow-up Monitoring

A post-implementation monitoring effort will determine the effectiveness of the implementation activities associated with the TMDL. WDNR and/or its partners will monitor the waters of the NEL based on the rate of management practices installed and tracked through the implementation of the TMDL, including sites where WDNR, DATCP, and NRCS grants are aimed at mitigating phosphorus and sediment loading. Monitoring will occur as staff and fiscal resources allow until it is deemed that stream quality has responded to the point where it is meeting its codified designated uses and applicable water quality standards.

In addition, waterbodies in the NEL may be monitored on a rotational basis as part of WDNR's statewide water quality monitoring strategy to assess current conditions and trends in overall stream quality. That monitoring consists of collecting data to support a myriad of metrics contained in WDNR's baseline protocol for wadeable streams, such as the index of biological integrity (IBI), the Hilsenhoff Biotic Index (HBI), a habitat assessment tool, and several water quality parameters determined on a site-by-site basis.

WDNR will work in partnership with local citizen monitoring groups to support monitoring efforts which often provide a wealth of data to supplement WDNR data. All other quality-assured available data in the basin will be considered when looking at the effectiveness of the implementation activities associated with the TMDL.

The Department has been collecting long term trend (LTT) river monitoring at the following locations:

- Kewaunee River at County Road F
- Manitowoc River at south of Waldo Blvd
- Sheboygan River at Indiana Ave & 36th St. - Esslingen Park

Water quality samples are collected at these sites year-round (except during winter/ice conditions) on a monthly basis and include the following parameters: pH, alkalinity, conductivity, turbidity, chloride, chlorophyll a, total suspended solids, orthophosphate, total phosphorus, ammonia, nitrate + nitrite, total Kjeldahl nitrogen, and E. coli. The

Department will continue to monitor the three LTT river sites following the same protocol outlined above into the foreseeable future.

In addition to LTT river sites, the Department has been and will continue to monitor two long term trend wadeable stream sites.

- Branch River at North Union Road
- Pine Creek at County Road T

The LTT wadeable stream sites are sampled once a year (summer field season). The water quality parameters include chloride, total phosphorus, nitrate + nitrite, ammonia, total nitrogen, and total suspended solids.

In addition to these sites, 12 additional locations will be monitored. In 2023, the Department initiated a long-term volunteer surface water monitoring program in the NE Lakeshore TMDL study. Volunteers were recruited and trained to follow Department sampling protocol for the collection of monthly samples from May through October [i.e. growing season] for: TP, DRP, TSS, TN, and field measurements of turbidity and flow. Following Department protocols the samples will be shipped to the State Lab of Hygiene for analyses.

Department streams biologists selected 12 locations for the program's first year. The goal of the program is to collect meaningful data over the next 20 years, and to engage the public on water quality issues. The programmatic goal is to add additional monitoring locations and recruit additional volunteers as awareness as the program grows. As of 04/19/23, enough volunteers for the 2023 sampling season have been recruited. Monitoring will begin in May 2023. The 12 sites are:

Kewaunee Model Basin:
- Silver Creek at Willow Road
- Kewaunee River at Hillside Road
- East Twin River at Steiners Corners Road
- West Twin River at County Road V

Manitowoc Model Basin:
- Branch River at North Union Road
- South Branch Manitowoc River at Lemke Road
- Silver Creek at County Road LS
- Pine Creek at County Road T

Sheboygan Model Basin:

- Sheboygan River at State Highway 57
- Onion River at Ourtown Road
- Pigeon River at State Highway 42
- Mullet River at Sumac Road

Below is a map of the monitoring locations for the 2023 monitoring season.

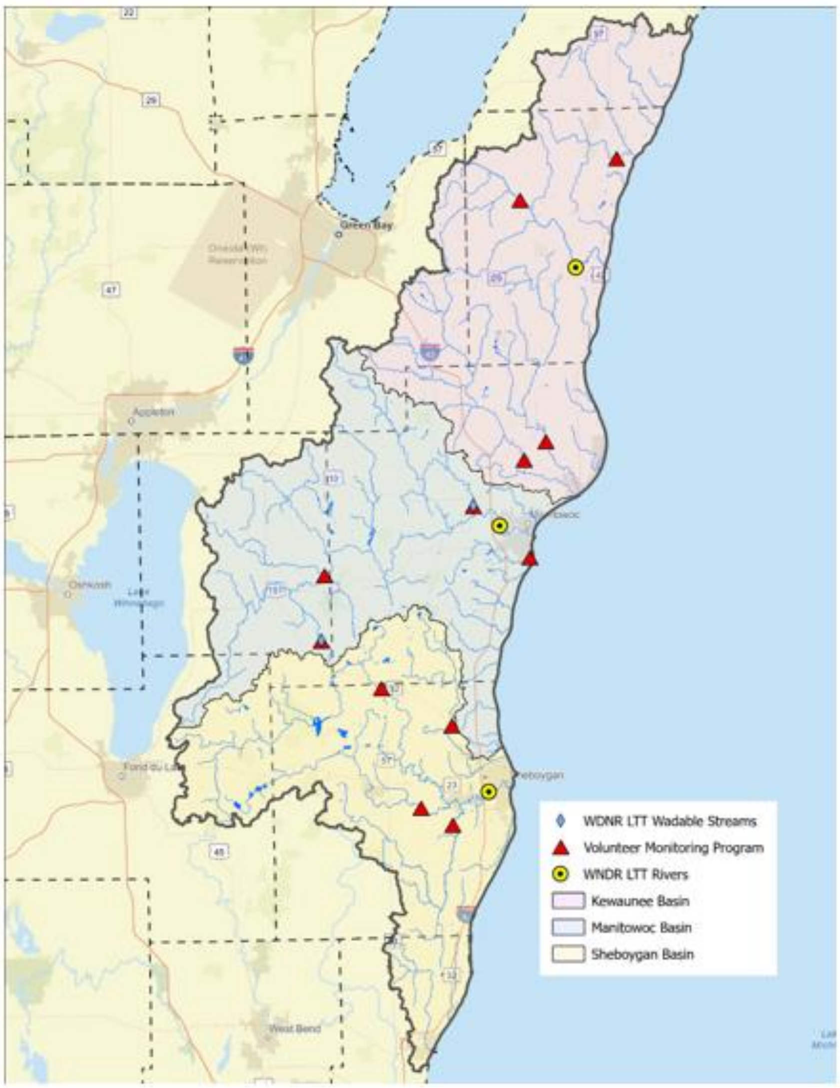

Figure 18 Surface water monitoring locations (planned for the year 2023) in the Northeast Lakeshore TMDL study area for the purpose of monitoring during the implementation phase of the project.

Watershed specific surface water monitoring will be conducted in the NEL TMDL study area as warranted. Based on the information/data received from participating implementation partners, the Department will track the level of implementation occurring throughout the NEL TMDL study area. By tracking the amount of implementation activities occurring, the Department can effectively plan the use of existing state resources and/or apply for external funds [i.e., grants] if available for monitoring activities, including staff for sample collection and/or laboratory analyses of the samples. As total phosphorus and TSS reductions goals/targets are achieved, the Department will develop and implement a watershed specific monitoring plan to evaluate water quality in relation to water quality criteria.

The Department will be responsible for de-listing any 303d waterbodies in accordance with WisCALM (https://dnr.wisconsin.gov/topic/SurfaceWater/WisCALM.html) listing and delisting requirements and may rely on biological confirmation in addition to chemical parameters. Typically, these watershed specific evaluations conducted by the Department are known as Targeted Watershed Assessments (TWA).

6.4.1 Statewide Tracking Database

Tracking the implementation of nonpoint source pollution reduction practices on the landscape is an important but often challenging component of TMDL implementation tracking and assessment. To assist in the tracking and reporting of this data the BMP Implementation Tracking System (BITS) was developed (https://dnr.wisconsin.gov/topic/nonpoint/bmptracker). BITS is a web portal that efficiently facilitates this data submission and analysis, including the spatial component. It also allows the Department to better track and demonstrate progress towards reaching nutrient reduction goals related to TMDLs, Statewide Nutrient Reduction Strategy, and other WDNR and U.S. EPA reporting requirements. BITS contains five separate modules with additional modules planned to accommodate other programs.

- Multi-Discharger Phosphorus Variance (MDV): Last updated in December of 2022, this module is for submitting information regarding nonpoint projects installed as part of the MDV program including plans and annual reports (https://dnr.wisconsin.gov/topic/Wastewater/phosphorus/StatewideVariance.html).

- Agricultural Targeted Runoff Management (TRM): This module was relapsed in March of 2021 and is used to submit final reports for TRM Grants (https://dnr.wisconsin.gov/aid/TargetedRunoff.html).
- Notice of Discharge (NOD): This module was released in August of 2021 and is used to submit final reports for NOD Grants (https://dnr.wisconsin.gov/aid/NOD.html).
- Urban Nonpoint Source Construction (UNPS-C): This module was released in September of 2022 and tracks final reports for UNPS Construction Grants (https://dnr.wisconsin.gov/aid/UrbanNonpoint.html).
- Urban Targeted Runoff Management (Urban TRM): The Urban Targeted Runoff Management (Urban TRM) module was released on Sept. 26, 2022. Use this module to submit final reports for Urban TRM grants (https://dnr.wisconsin.gov/aid/UrbanNonpoint.html).

7 PUBLIC PARTICIPATION

U.S. EPA expects full and meaningful public participation in the TMDL development process, and TMDL regulations require that states must provide opportunities for public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). U.S. EPA is required to publish a notice seeking public comment when it establishes a TMDL (40 C.F.R. §130.7(d)(2)).

WDNR believes that public outreach and meaningful stakeholder engagement throughout the TMDL development, TMDL implementation planning, and TMDL implementation process results in better outcomes and overall TMDL success. With this in mind, the WDNR has provided many ways for stakeholders to learn about the NEL TMDL and provide input in the TMDL development process, as described in the following subsections.

7.1 GovDelivery and Website

WDNR launched a NEL TMDL GovDelivery subscription list during the early in person stakeholder and listening sessions held at three separate venues in the NEL study area. The NEL TMDL GovDelivery list is used to communicate project updates, announce opportunities for technical review and input, events, and distribute the project information. The GovDelivery distribution list for the NEL TMDL includes 2,753 recipients.

The NEL TMDL website was launched at the start of the project and serves as the main location to obtain and download data, view previous webinars, and stay informed about the NEL TMDL. A link was added to the NEL TMDL website that allowed anyone to subscribe or unsubscribe at any time.

7.2 Meetings and Webinars

During the development of the NEL TMDL, the TMDL study team held multiple meetings with stakeholders to describe the TMDL effort, analysis and modeling methods, and draft model results. These meetings were originally intended to be in person; however, COVID and the necessary social distancing and other safety requirements resulted in the meetings all being held in a virtual format. Copies of presentation slides and webinar recordings can be found on the NEL TMDL website[11].

In summer 2020, the WDNR presented a series of public informational webinars to introduce development of the Soil & Water Assessment Tool (SWAT) watershed model for the NELTMDL.

- June 25, 2020, Webinar 1: TMDL process and introduction to the NEL TMDL
- July 9, 2020, Webinar 2: Water Quality Data and Impairments
- August 6, 2020, Webinar 3: Watershed Model Introduction and Data Inputs
- September 24, 2020, Webinar 4: Watershed Model Setup
- Once input was gathered and stakeholders were acquainted with the TMDL development process, the WDNR proceeded to develop the TMDL Two webinars were conducted to present the baseline loads and discuss the allocation process followed by a later webinar to review the allocation process and present draft allocations.
- March 13, 2021, Webinar: Baseline Load Results and Allocation Process
- December 16, 2021, Webinar: Allocation Process and Draft Results

An additional meeting was held with municipal wastewater treatment facilities to respond to questions and comments received during the comment period and clarify how allocations are translated into effluent limits. The meeting was held virtually via ZOOM.

- September 13, 2022, Meeting with Municipal Wastewater Treatment Facilities

In each of these meetings and webinars stakeholders were given the opportunity to ask questions and provide feedback on the meeting topics. Draft reports documenting SWAT watershed modeling and lake modeling were also posted on the NEL TMDL website for stakeholder review.

7.3 Draft Work Products and Comment Periods

The TMDL study team invited stakeholder comments on the above information and data vias a series of comment periods. Comments and feedback were incorporated into

[11] https://dnr.wisconsin.gov/topic/TMDLs/NELakeshore.html

subsequent analysis. Datasets and draft reports were posted on the NEL TMDL website. Communication of comment periods was conducted via GovDelivery.

Stakeholder review - July 2019: Comments were accepted through July 12, 2019. Data sets were revised according to stakeholder comments and updated in January 2020. Posted data included:

- Subbasin Map
- List of Impaired Waters
- Wastewater Treatment Facilities including outfall locations, flows, and effluent quality
- MS4 Maps for permitted MS4s showing the geographic extent of the MS4s

Stakeholder review - September/October 2020: A portion of the draft watershed model report detailing the SWAT watershed model developed by CADMUS, under a contract with U.S. EPA, used to quantify the baseline stream flows and pollutant loads was available for stakeholder review. Comments were accepted through October 16, 2020.

Stakeholder review – March/April 2021: The full draft watershed model report detailing the SWAT watershed model developed by CADMUS, under a contract with U.S. EPA, used to quantify the baseline stream flows and pollutant loads was available for stakeholder review. The full version of the report included model calibration, validation, and baseline loads. Comments were accepted through April 16. 2021.

Stakeholder Review – December 2021 /January 2022: The draft lake modeling report and allocation tables were posted for comment. Comments were accepted from December 17, 202, through January 21, 2022.

- Draft lake modeling report detailing how loading capacities were determined for impaired lakes.
- Draft allocation tables for total phosphorus
- Draft allocation tables for total suspended solids and sediment
- A summary by wastewater facility of wasteload allocations and the resulting equivalent effluent concentrations.

There were a significant number of comments received from the municipal wastewater treatment plants and Wisconsin Rural Water Association (https://www.wrwa.org/) during this comment period. The comments revolved around three main topics: (1) communications using GovDelivery, (2) the length of the comment period, and (3) questions over why allocations vary by reach and why allocations and effluent limits are not uniform. To address this WDNR held a meeting on September 13, 2022, with the wastewater treatment facilities to discuss their concerns and comments.

During the meeting with wastewater treatment facilities, the WDNR addressed the three main topics:

> (1) Communications using GovDelivery: The WDNR utilizes GovDelivery for stakeholder communication and GovDelivery has proven itself to be reliable method to communicate project updates to stakeholders. However, several stakeholders, mostly wastewater treatment plant operators, expressed concerns over not receiving GovDelivery messages pertaining to the December 16, 2022, webinar. WDNR conducted an investigation and determined that several internet providers blocked messages from being delivered. WDNR contacted these internet providers to ensure that GovDelivery messages would not be blocked by their respective firewalls or spam filters in the future. A test message was then sent to the wastewater treatment plant operators and no further delivery issues were noted.
>
> (2) Length of the comment period: Stakeholders expressed concern that sufficient time was not allocated for submittal of comments and that while the comment period was 40-days, it partially occurred during the Holiday period. Subsequent comment periods will be scheduled to not coincide with major Holidays.
>
> (3) Questions regarding why allocations vary by reach and why allocations and effluent limits are not uniform: A presentation stepping through the allocation process explained why wasteload and load allocations vary by subbasin. This variation can mostly be attributed to the unique assimilative loading capacity for each subbasin that varies by flow, applicable numeric criteria, and other subbasin characteristics. Next WDNR stepped through several examples translating assigned wasteload allocations for wastewater treatment plants into effluent limits using the procedures contained in s. NR 205.065(7), Wis. Adm. Code, and S. NR 212.76(4), Wis. Adm. Code: which states that WQBELs derived from TMDL

wasteload allocations shall be expressed consistent with the provisions specified in s. NR 205.065. This process is consistent with 40 CFR 122.45(d).

Another formal comment period was not set to address the topics covered during the September 13, 2022, meeting; however, wastewater treatment facilities were encouraged to contact WDNR with additional questions or concerns.

7.4 Draft TMDL Allocations and Draft TMDL Report Review

The WDNR held a webinar on January 31, 2023, to provide the public with an overview of the draft TMDL report, the draft allocations and any needed reductions, implementation, and compliance options, and to provide opportunities for additional stakeholder input. A copy of the presentation slides and a recording of the presentation slides can be found on the WDNR website. Total attendance for the meeting was ---.

Stakeholder input from the public meeting as well as written comments received during the January 31 through March 3 comment period were incorporated into the final draft of the TMDL report. The WDNR received a submittal via e-mail date March 3, 2023, containing 31 comments in a jointly signed submittal from the Environmental Law Policy Center, Alliance for Great Lakes, and Midwest Environmental Advocates. The WDNR also received suggested text edits from U.S.EPA via e-mail dated March 28, 2023. A complete summary of the comments and responses can be found in Appendix N.

7.5 Public Informational Meeting and Comment Period

Per s. NR 212.77 Wis. Admin. Code, on August 2, 2023, WDNR conducted a public informational meeting and hearing followed by a comment period. Written comments were accepted through September 1, 2023. WDNR did not receive any written comments. Verbal comments made during the informational meeting by the Environmental Law and Policy Center (ELPC) complimented WDNR on the thoroughness of the responses provided to earlier submitted comments and noted that while ELPC may not agree with all of WDNR's responses; ELPC appreciated the detailed explanations.

Verbal comments received during the public hearing, and written comments received prior to the close of the comment were considered prior to making a final approval and submittal of the TMDL Study to U.S. EPA. Written and verbal comments carry the same weight.

The hearing notice was sent out via GovDelivery and posted on the WDNR website and public hearings calendar. A copy of the official public notice is included below.

STATE OF WISCONSIN DEPARTMENT OF NATURAL RESOURCES
PUBLIC NOTICE OF INFORMATIONAL HEARING FOR THE NE LAKESHORE TOTAL MAXIMUM DAILY LOAD STUDY

The Wisconsin Department of Natural Resources is conducting a public informational hearing on August 2, 2023, at 11:00 am to provide an overview of the final draft report and receive comments on the "Northeast Lakeshore TMDL: Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids" (TMDL Study). The TMDL Study spans a portion of the Lake Michigan watershed from just south of Sturgeon Bay to Port Washington and reaches west towards Lake Winnebago covering 1,964 square miles. The TMDL report summarizes the multi-year effort which provides a blueprint for improving water quality in the tributaries, streams, rivers, and lakes within the TMDL Study area.

The public informational hearing will be held via Zoom and will be recorded.
Pre-registration is required at:
https://us02web.zoom.us/meeting/register/tZEqcOGvpz0sHtRVwD9S9ZwW8LJfo59aTTgC
Contact / Questions: Kevin Kirsch, Kevin.Kirsch@wisconsin.gov

A copy of the public hearing version of the TMDL Study will be available for review on the website (https://dnr.wisconsin.gov/topic/TMDLs/NELakeshore.html) beginning July 28, 2023. The public hearing version of the TMDL Study incorporates input and comments received during the previous review periods and the March 2023 listening session and comment period. The public informational hearing will include a presentation outlining the clarifying text added to the TMDL report which discusses climate change considerations, clarifies margin of safety assumptions, discusses dissolved reactive phosphorus, and outlines implementation planning and monitoring considerations.

Written comments will be accepted through September 1, 2023. Verbal comments, received during the public hearing, and written comments received prior to the close of the comment period will be considered prior to making a final approval and submittal of the TMDL Study to U.S. EPA. Written and verbal comments carry the same weight. A summary with response to comments shall be included in the final TMDL Study report.

Written comments can be submitted via e-mail: Kevin.Kirsch@wisconsin.gov or regular mail:

Wisconsin Department of Natural Resources
Attn: Kevin Kirsch
101 S. Webster St., P.O. Box 7921
Madison, WI 53707-7921

Reasonable accommodation, including the provision of informational material in an alternative format, will be provided for qualified individuals with disabilities upon request.

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