Community Assistance Planning Report No. 330

A RESTORATION PLAN FOR THE OAK CREEK WATERSHED

Chapter 5

WATERSHED GOALS AND MANAGEMENT OBJECTIVES

5.1 INTRODUCTION

As noted in Chapter I, the purpose of this plan is to provide a set of specific, targeted, and implementable recommendations to improve conditions in the watershed. The recommendations address four focus areas: water quality, recreational access and use, habitat conditions, and targeted stormwater drainage and flooding issues. In addition, this plan addresses the status of the Oak Creek Mill Pond and the associated dam, considering their relationship to multiple focus areas. This plan is designed to serve as a practical guide for managing water quality within the Oak Creek watershed and for managing the land surfaces that drain directly and indirectly to the streams of the watershed and to the Mill Pond. The improvements that would result from implementing the recommendations represent steps toward achieving the overall goal of restoring and improving the water resources of the Oak Creek watershed.

This chapter describes the goals of the plan and the management objectives to be achieved through the plan's implementation. The management objectives related to each goal consist of broad approaches or general types of actions required to meet the goal. Specifying these objectives breaks the goals down into manageable pieces, helps determine the specific steps necessary to achieve a goal, and facilitates developing measures to track progress. In some instances, specific targets are associated with a management objective. These targets estimate the level of effort that will be required to achieve a defined amount of improvement. The management objectives and targets also provide direction for developing specific policies and projects to address problems related to the focus areas of this plan in the Oak Creek watershed. Chapter 6 of this report identifies specific actions to achieve the management objectives, in the form of policies, activities, or projects.

The goals of this plan are:

1. To improve water quality in surface waters of the watershed

2. To improve instream, riparian, wetland, and upland habitat conditions in the watershed

3. To reduce the impacts of flooding and stormwater runoff problems at targeted locations in the watershed

4. To improve recreational access to and use of surface waters and riparian areas in the watershed

5.2 WATER QUALITY

Description of Problems Related to Water Quality

The existing state of surface water quality in the Oak Creek watershed is described in Chapter 4 of this report. That description documents several water quality problems that currently exist in the watershed and are briefly summarized below:

- Chronically high concentrations of fecal indicator bacteria are present in all monitored surface waters of the watershed, indicating that the water is not safe for human contact due to the potential presence of pathogens.

- Chronically low concentrations of dissolved oxygen are present in some stream reaches of the watershed. In addition, there is evidence that supersaturation of dissolved oxygen occurs in the Mill Pond and some stream reaches. Both of these conditions reduce the ability of surface waters to support fish and other aquatic organisms.

- Chronically high concentrations of nutrients that can stimulate excessive growth of plants and algae are present in surface waters.

  - Instream concentrations of total phosphorus often exceed the State’s water quality criterion. An increasing percentage of this phosphorus is present as dissolved phosphorus, which is the form most readily used by algae and aquatic plants.

  - High instream concentrations of total nitrogen are present. These concentrations usually exceed guidelines for good water quality.

- Instream concentrations of total suspended solids (TSS) are often high and contribute to sedimentation in stream channels and the Mill Pond.

- Instream concentrations of chloride are often high and have increased over time.

As described in Chapter 4, many of these and other problems are interrelated through their causes, their effects, and the pathways leading from causes to effects.

Management Objectives for Water Quality

Based on the statement of water quality problems above and the analyses in Chapter 4, there are 11 management objectives for the Oak Creek watershed related to water quality improvements:

1. Locate and eliminate sources that contribute sanitary wastewater and other human wastes to surface waters

2. Locate and eliminate anthropogenic sources that contribute fecal contamination of nonhuman origin such as pet wastes, fertilizers, trash, and leaking dumpsters

3. Locate and eliminate non-anthropogenic sources that contribute fecal contamination of nonhuman origin such as urban wildlife, soils, and decaying organic material

4. Reduce contributions of TSS and sediment to surface waters

5. Address eroding stream banks along streams of the watershed

6. Reduce contributions of organic materials to surface waters

7. Reduce contributions of total phosphorus to surface waters

8. Reduce contributions of dissolved phosphorus to surface waters

9. Reduce contributions of nitrogen compounds including ammonia, nitrate, nitrite, and organic nitrogen compounds to surface waters

10. Reduce contributions of chlorides to surface waters and groundwater

11. Continue collecting and distributing monitoring data that are adequate to evaluate the state of water quality conditions and the efficacy of management measures on a watershed scale

For the most part, these objectives are not prioritized and should be pursued simultaneously. With respect to addressing fecal contamination, highest priority should be given to finding and eliminating sources of human wastes followed by finding and eliminating anthropogenic and nonanthropogenic sources of non-human fecal contamination. This reflects the fact that the health risks associated with fecal contamination originating from human sources are considered to be higher than those originating from nonhuman sources.

Table 5.1 shows the problems that each of the water quality management objectives for the Oak Creek watershed addresses. Most of the objectives address more than one water quality problem because of the interrelations among multiple problems.

Co-Benefits from Addressing Water Quality Management Objectives

Achieving individual water quality management objectives would provide additional benefits beyond the problems the objectives are intended to address. These co-benefits fall into three broad classes: co-benefits that address other issues within the water quality focus area of this plan, co-benefits that address issues within other focus areas of this plan, and co-benefits that address other desirable outcomes that are not encompassed in the immediate goals of this plan. To some extent these co-benefits emerge through the interrelationships among causes and effects related to water quality problems and pathways leading from causes to effects that were discussed in Chapter 4 of this report.

Achieving one water quality management objective may contribute to achieving others. Actions taken to reduce contributions of an individual pollutant may also result in reductions of other pollutants because pollutants are often introduced into waterbodies together. For example, the management objectives related to reducing contributions of human wastes and fecal contamination are intended to reduce the introduction of fecal indicator bacteria and pathogens into surface waters. Because fecal wastes also contain nutrients, organic materials, and solids, achieving these objectives will also contribute to achieving several other water quality management objectives. Similarly, achieving the objective related to addressing streambank erosion will also contribute to the objectives calling for reductions in nutrient loading because soils and sediments along streambanks contain appreciable amounts of phosphorus and nitrogen compounds.

Achieving water quality management objectives may also contribute to achieving management objectives related to other goals of this plan. For instance, achieving management objectives related to reducing contributions of human wastes and fecal contamination would increase the suitability of surface waters in the watershed for human contact, helping to improve recreational access and use. Similarly, achieving objectives related to reducing contributions of nutrients, organic material, chloride, and suspended solids would help to improve the habitat quality of streams within the watershed for aquatic organisms. In addition to its importance in directing water quality management efforts, continued collection and distribution of monitoring data would also inform decisions related to the management of aquatic habitat.

Finally, achieving water quality management objectives may also contribute to achieving other desirable outcomes that are not encompassed in the immediate goals of this plan. For example, by reducing the likely exposure to waterborne pathogens, achieving management objectives related to reducing contributions of human wastes and fecal contamination would also improve human health and reduce health-related costs. Achieving these and other water quality management objectives would also contribute to:

- Improving water quality in Lake Michigan and at nearby Lake Michigan beaches
- Maintaining the suitability of Lake Michigan as a source of public water supply
- Improving water quality in downstream areas such as the other Great Lakes, the St. Lawrence River, and the Gulf of St. Lawrence
- Improving the aesthetics of streams and riparian areas, which may help maintain or increase property values

Targeted Load Reduction Goals

Several of the management objectives for the Oak Creek watershed call for reducing contribution of several pollutants to surface waters. These pollutants include phosphorus compounds, nitrogen compounds, suspended solids, and chlorides. In addition, progress on three other management objectives can be assessed by measuring loads of fecal indicator bacteria, such as fecal coliform bacteria or *Escherichia coli* (*E. coli*). For four of these pollutants, total phosphorus, TSS, total nitrogen, and fecal coliform bacteria, numerical targets for load reductions can be derived from pollutant load estimates developed as part of the regional water quality management plan update for the greater Milwaukee watersheds (RWQMPU).[1]

The RWQMPU estimated pollutant loads for total phosphorus, TSS, total nitrogen, and fecal coliform bacteria for existing 2000 conditions and several alternative and planned conditions through the use of a calibrated water quality simulation model. The planned condition that this model estimated pollutant loads for was based on planned 2020 land use. A description of the water quality simulation model is given in Appendix L.

It should be noted that much of the urban development that was anticipated to occur by 2020 in the RWQMPU has not yet occurred. A comparison of the planned 2020 land use upon which the RWQMPU was based to the planned land use shown in Chapter 3 used to develop this plan show that they anticipate that a similar percentage of land in the Oak Creek watershed will be devoted to urban land uses. Because of this, pollutant load reduction targets derived from the water quality model used in the RWQMPU are still relevant and are used as estimates of needed reductions in this plan.

The urban nonpoint pollutant load reduction targets were adjusted to account for changes in the application of NR 151 that were required by 2011 Wisconsin Act 32. These changes prohibited the WDNR from enforcing the requirement that municipal separate storm sewer systems (MS4s) reduce contributions of TSS from area of existing development by 40 percent by October 1, 2013.[2] Appendix L gives a description of the adjustments. The requirements of NR 151 are described in Chapter 2 of this report.

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[1] *SEWRPC Planning Report No. 50,* A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds, *December 2007.*

[2] *2011 Act 39 also required that any existing reductions of TSS over the required 20 percent that had already been achieved be maintained.*

In addition to presenting estimates of pollutant loads, the RWQMPU provided estimates of water quality conditions under the Existing (2000) and Recommended Plan conditions. These estimates were calculated using the calibrated water quality model. Comparison of the modeled water quality conditions under the Recommended Plan (2020) condition to those under the Existing (2000) condition provides an estimate of the degree of improvement in water quality conditions in the Oak Creek watershed that would be achieved by meeting the load reduction targets discussed below. It is important to emphasize that the goal of the RWQMPU was to develop cost-effective measures to improve water quality; it was not specifically designed to assure full compliance with water quality standards. As part of the RWQMPU planning process, an "extreme measures" alternative was developed, modeled, and analyzed.[3] This alternative examined the effects of several potential measures that went beyond what was included in the recommended plan. The model results indicated that implementation of these additional measures would have resulted in little additional improvement in water quality. Thus, it is important to note that even if the pollutant load reductions called for in the load reduction targets derived from the RWQMPU are achieved, it will probably not be sufficient to bring streams in the Oak Creek watershed into full compliance with water quality standards. It will be necessary to continue monitoring water quality and periodically reassess achievement of water quality standards and make adjustments in future plan updates as necessary to ultimately bring these waterbodies into compliance.

Targeted Reductions for Total Phosphorus

Table 5.2 shows the adjusted annual nonpoint source load reductions for total phosphorus for the Oak Creek watershed. On a watershed basis, this sets a target of reducing nonpoint source loads of phosphorus to the stream system by 2,030 pounds. This represents a reduction of about 19 percent from existing 2000 loads of 10,630 pounds. Of this reduction, 1,740 pounds would come from urban nonpoint sources, with 508 pounds of this reduction being attributable to implementation of NR 151 and 1,232 pounds of this reduction being attributable to implementation of other measures in addition to those implemented to comply with the requirements of NR 151. The remaining 290 pounds would come from rural nonpoint sources, with 50 pounds of this reduction being attributable to implementation of NR 151 and 240 pounds of this reduction being attributable to implementation of other measures.

Table 5.2 also shows adjusted nonpoint source load reductions for total phosphorus for individual subwatersheds. The reduction targets range from an annual reduction of 160 pounds in the Middle Oak Creek subwatershed to an annual reduction of 750 pounds in the North Branch Oak Creek subwatershed.

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[3] *SEWRPC Planning Report No. 50* op. cit.

Table 5.3 shows a comparison of modeled total phosphorus summary statistics under the Existing (2000) and Recommended Plan conditions. These summary statistics are estimated for 10 assessment points located within the watershed. The locations of these assessment points are shown on Map 5.1. Estimated mean concentrations of total phosphorus at these assessment points under the Existing (2000) condition ranged between 0.075 mg/l and 0.092 mg/l, with an average value of 0.084 mg/l. Under the Recommended Plan condition, estimated mean concentrations of total phosphorus ranged between 0.064 mg/l and 0.088 mg/l, with an average value of 0.076 mg/l. Estimated median concentrations of total phosphorus at these assessment points under the Existing (2000) condition ranged between 0.031 mg/l and 0.062 mg/l, with an average value of 0.043 mg/l. Under the Recommended Plan condition, estimated median concentrations of total phosphorus ranged between 0.025 mg/l and 0.064 mg/l, with an average value of 0.042 mg/l. The highest estimated mean and median concentrations under Existing (2000) conditions are present in the Oak Creek-Mill Pond assessment area. The highest mean concentrations under the Recommended Plan condition are present in the Lower Oak Creek assessment area. The highest median concentration under the Recommended Plan condition is present in the Oak Creek-Mill Pond assessment area.

Table 5.3 also shows the amount of time the model estimated that total phosphorus concentrations at each assessment point would be at or below a concentration of 0.100 mg/l. This comparison was made because the RWQMPU was developed prior to the promulgation of the State of Wisconsin's water quality criteria for total phosphorus. The value of 0.100 is a planning standard that was recommended in the initial regional water quality management plan. The estimated level of compliance with this planning standard under the Existing (2000) condition ranged between 75 percent and 83 percent, with an average level of compliance of 78.7 percent. The estimated level of compliance with this planning standard under the Recommended Plan condition ranged between 74 percent and 83 percent, with an average level of compliance of 78.9 percent. While the level of compliance with the planning standard under the recommended plan condition is similar to that under the Existing (2020) condition, the reduction in mean concentration by about 0.008 mg/l indicates a substantial reduction in phosphorus concentrations would occur under Recommended Plan condition.

At the time that the RWQMPU was prepared, the State of Wisconsin had not promulgated instream water quality criteria for total phosphorus. In the absence of a regulatory criterion, a planning standard of 0.100 mg/l was applied. Following completion of the RWQMPU, the State adopted phosphorus criteria as set forth in Chapter NR 102, "Water Quality Standards for Wisconsin Surface Waters," of the *Wisconsin Administrative Code*. Chapter NR 102 establishes the applicable total phosphorus criterion for Oak Creek and its tributaries as a concentration of 0.075 milligrams per liter (mg/l) (see Table 4.16 in Chapter 4 of this report). The degree to which the recommended RWQMPU would meet the new regulatory 0.075 mg/l water quality criterion was assessed during a subsequent effort.[4] Implementing the recommended RWQMPU components that relate to the Oak Creek watershed is anticipated to result in the following levels of compliance with water quality criteria:

- Along the mainstem Oak Creek (assessment points OK-1, 2, 4, 5, 7, 8, 9, and 10) the total phosphorus water quality criterion of 0.075 mg/l would be expected to be met from about 64 to 88 percent of the time during an average year, with the degree of compliance decreasing from upstream to downstream. The expected percentage of compliance during the average year would increase slightly downstream from the Mill Pond Dam.

- For the North Branch of Oak Creek (assessment point OK-3), the total phosphorus water quality criterion would be expected to be met about 76 percent of the time during an average year.

- For the Mitchell Field Drainage Ditch (assessment point OK-5), the total phosphorus water quality criterion would be expected to be met about 75 percent of the time during an average year.

Targeted Reductions for Total Suspended Solids

Table 5.4 shows the adjusted annual nonpoint source load reductions for TSS for the Oak Creek watershed. On a watershed basis, this sets a target of reducing nonpoint source loads of TSS to the stream system by 1,968,530 pounds. This represents a reduction of about 37 percent from existing 2000 loads of 5,305,010 pounds. Of this reduction, 1,267,540 pounds would come from urban nonpoint sources, with 659,489 pounds of this reduction being attributable to implementing NR 151 and 608,051 pounds of this reduction being attributable to implementing other measures. The remaining 700,990 pounds would come from rural nonpoint sources, with 691,070 pounds of this reduction being attributable to implementing NR 151 and 9,920 pounds of this reduction being attributable to implementing other measures.

Table 5.4 also shows adjusted nonpoint source load reductions for TSS for individual subwatersheds. The reduction targets range from an annual reduction of 276,100 pounds in the Upper Oak Creek subwatershed to an annual reduction of 711,300 pounds in the North Branch Oak Creek subwatershed.

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[4] *S. McLellan, H. Bravo, M.G. Hahn, with contributions from K. Kratt and J. Butcher,* Climate Change Risks and Impacts on Urban Coastal Water Resources in the Great Lakes, *Final Report to the National Oceanic and Atmospheric Administration Sectoral Applications Research Program, October 29, 2013.*

Table 5.5 shows a comparison of modeled TSS summary statistics under the Existing (2000) and Recommended Plan conditions at 10 assessment points throughout the watershed. The locations of these assessment points are shown on Map 5.1. Estimated mean concentrations of TSS at these assessment points under the Existing (2000) condition ranged between 11.0 mg/l and 22.9 mg/l, with an average value of 16.4 mg/l. Under the Recommended Plan condition, estimated mean concentrations of TSS ranged between 7.1 mg/l and 15.7 mg/l, with an average value of 10.8 mg/l. Estimated median concentrations of TSS at these assessment points under the Existing (2000) condition ranged between 6.7 mg/l and 9.0 mg/l, with an average value of 7.6 mg/l. Under the Recommended Plan condition, estimated median concentrations of TSS ranged between 4.2 mg/l and 6.4 mg/l, with an average value of 5.0 mg/l.

Targeted Reductions for Fecal Coliform Bacteria

Table 5.6 shows the adjusted annual nonpoint source load reductions for fecal coliform bacteria for the Oak Creek watershed. On a watershed basis, this sets a target of reducing nonpoint source loads of fecal coliform bacteria to the stream system by 1,292 trillion cells annually. This represents a reduction of about 46 percent from existing 2000 loads of 2,792 trillion cells. Of this reduction, 1,229 trillion cells would come from urban nonpoint sources, with 162 trillion cells of this reduction being attributable to implementing NR 151 and 1,067 trillion cells of this reduction being attributable to implementing other measures. The remaining 63 trillion cells would come from rural nonpoint sources, with an increase of 4 trillion cells being attributable to implementing of NR 151 and a reduction of 67 trillion cells being attributable to implementing other measures.

Table 5.6 also shows adjusted nonpoint source load reductions for fecal coliform bacteria for individual subwatersheds. The reduction targets range from an annual reduction of 157 trillion cells in the Upper Oak Creek subwatershed to an annual reduction of 385 trillion cells in the North Branch Oak Creek subwatershed.

Table 5.7 shows a comparison of modeled fecal coliform bacteria summary statistics under the Existing (2000) and Recommended Plan conditions calculated over the entire year. These summary statistics are estimated for 10 assessment points located throughout the watershed. The locations of these assessment points are shown on Map 5.1. Estimated mean concentrations of fecal coliform bacteria at these assessment points under the Existing (2000) condition ranged between 4,905 cells per 100 ml and 15,506 cells per 100 ml, with an average value of 7,994 cells per 100 ml. Under the Recommended Plan condition, estimated mean concentrations of fecal coliform bacteria ranged between 2,603 cells per 100 ml and 8,662 cells per 100 ml, with an average value of 4,427 cells per 100 ml. Estimated geometric mean concentrations of fecal coliform bacteria at these assessment points under the Existing (2000) condition ranged between 541 cells per 100 ml and 2,700 cells per 100 ml. Under the Recommended Plan condition, estimated geometric mean concentrations of fecal coliform bacteria ranged between 346 cells per 100 ml and 1,550 cells per 100 ml. The highest estimated mean and geometric mean concentrations under both conditions were present in the Lower Oak Creek assessment area.

Table 5.7 also shows estimates of the degree of compliance with the State's former water quality criteria for fecal coliform bacteria at each assessment point under both conditions. Two estimates are given: the percent of time that concentrations of fecal coliform bacteria would be at or below the single-sample criterion of 400 cells per 100 ml and the number of days per year that the geometric mean of fecal coliform bacteria concentrations would be at or below the geometric mean criterion of 200 cells per 100 ml. The estimated level of compliance with the single-sample criterion under the Existing (2000) condition ranged between 17 percent and 66 percent, with an average level of compliance of 47 percent. The estimated level of compliance with the single-sample criterion under the Recommended Plan condition ranged between 39 percent and 67 percent, with an average level of compliance of 56 percent. The estimated level of compliance with the geometric mean criterion under the Existing (2000) condition ranged between zero days per year and 70 days per year, with an average level of compliance of 30 days per year. The estimated level of compliance with the geometric mean criterion under the Recommended Plan condition ranged between 13 days per year and 123 days per year, with an average level of compliance of 60 days per year.

Table 5.8 shows a comparison of modeled fecal coliform bacteria summary statistics under the Existing (2000) and Recommended Plan conditions calculated over the 153-day May through September swimming season. These summary statistics are estimated for 10 assessment points located throughout the watershed. The locations of these assessment points are shown on Map 5.1. Estimated mean concentrations of fecal coliform bacteria at these assessment points under the Existing (2000) condition ranged between 2,101 cells per 100 ml and 6,370 cells per 100 ml, with an average value of 3,351 cells per 100 ml. Under the Recommended Plan condition, estimated mean concentrations of fecal coliform bacteria ranged between 1,079 cells per 100 ml and 3,218 cells per 100 ml, with an average value of 1,725 cells per 100 ml. Estimated geometric mean concentrations of fecal coliform bacteria at these assessment points under the Existing (2000) condition ranged between 179 cells per 100 ml and 1,079 cells per 100 ml. Under the Recommended Plan condition, estimated geometric mean concentrations of fecal coliform bacteria ranged between 89 cells per 100 ml and 593 cells per 100 ml. The highest estimated mean concentrations under both the Existing (2000) and Recommended Plan conditions were present in the Lower Oak Creek assessment area. The highest estimated geometric mean concentrations under both conditions were also present in the Lower Oak Creek assessment area.

Table 5.8 also shows estimates of the degree of compliance with the State's water quality criteria for fecal coliform bacteria during the swimming season at each assessment point under both conditions. Two estimates are given: the percent of time that concentrations of fecal coliform bacteria would be at or below the single-sample criterion of 400 cells per 100 ml and the number of days out of 153 that the geometric mean of fecal coliform bacteria concentrations would be at or below the geometric mean criterion of 200 cells per 100 ml. The estimated level of compliance with the single-sample criterion during the swimming season under the Existing (2000) condition ranged between 27 percent and 84 percent, with an average level of compliance of 63 percent. The estimated level of compliance with the single-sample criterion during the swimming season under the Recommended Plan condition ranged between 61 percent and 84 percent, with an average level of compliance of 75 percent. The estimated level of compliance with the geometric mean criterion during the swimming season under the Existing (2000) condition ranged between zero out of 153 days and 59 out of 153 days, with an average level of compliance of 24 out of 153 days. The estimated level of compliance with the geometric mean criterion during the swimming season under the Recommended Plan condition ranged between five out of 153 days and 93 out of 153 days, with an average level of compliance of 44 out of 153 days.

Effective May 1, 2020, the basis of Wisconsin's recreational use water quality criteria was changed from concentrations of fecal coliform bacteria to concentrations of the bacterium *Escherichia coli* (*E. coli*). The modeling for the RWQMPU did not include estimation of *E. coli* concentrations. It is anticipated that future monitoring for fecal indicator bacteria will focus on *E. coli.* Because *E. coli* is one species in the fecal coliform bacteria group, it should still be possible to use the load reduction targets derived from the RWQMPU modeling to guide restoration efforts in the Oak Creek watershed. As part of the development of the Milwaukee River Basin total maximum daily load (TMDL), researchers at the University of Wisconsin-Milwaukee developed translator ratios based on concentrations in the Kinnickinnic, Menomonee, and Milwaukee Rivers and the Milwaukee Harbor Estuary to estimate concentrations of *E. coli* from those of fecal coliform bacteria.[5] This work found that a range of translator ratios between 0.5875 and 0.65 *E.coli* to 1.0 fecal coliform bacteria encompassed the majority of *E. coli* to fecal coliform bacteria ratios observed under different conditions. As an example, applying this translator to a reduction target for a fecal coliform bacteria load of 50 trillion cells per year indicates that the load of *E. coli* should be reduced by between about 29.4 trillion and 32.5 trillion cells per year,

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[5] *D.K. Dila and S.L. McLellan, "Translator Development for Bacterial Indicator TMDLs, revised July 2016," Appendix E in: Milwaukee Metropolitan Sewerage District,* Total Maximum Daily Loads for Total Phosphorus, Total Suspended Solids, and Fecal Coliform: Milwaukee River Basin, Wisconsin, Report, *March 19, 2018.*,

Targeted Reductions for Total Nitrogen

Table 5.9 shows the adjusted annual nonpoint source load reductions for total nitrogen for the Oak Creek watershed. On a watershed basis, this sets a target of reducing nonpoint source loads of nitrogen to the stream system by 26,110 pounds annually between 2000 and 2050. This represents a reduction of about 27 percent from existing 2000 loads of 97,110 pounds. Of this reduction, 7,830 pounds would come from urban nonpoint sources, with 2,247 pounds of this reduction being attributable to implementing NR 151 and 5,583 pounds of this reduction being attributable to implementing other measures. The remaining 18,280 pounds would come from rural nonpoint sources, with 17,180 pounds of this reduction being attributable to implementing NR 151 and 1,100 pounds of this reduction being attributable to implementing other measures.

Table 5.9 also shows adjusted annual nonpoint source load reductions for total nitrogen for individual subwatersheds. The reduction targets range from an annual reduction of 2,560 pounds in the Middle Oak Creek subwatershed to an annual reduction of 7,810 pounds in the North Branch Oak Creek subwatershed. Table 5.10 shows a comparison of modeled total nitrogen summary statistics under the Existing (2000) and Recommended Plan conditions. These summary statistics are estimated for 10 assessment points located within the watershed. The locations of these assessment points are shown on Map 5.1. Estimated mean concentrations of total nitrogen at these assessment points under the Existing (2000) condition ranged between 1.07 mg/l and 1.57 mg/l, with an average value of 1.23 mg/l. Under the Recommended Plan condition, estimated mean concentrations of total nitrogen ranged between 0.81 mg/l and 1.00 mg/l, with an average value of 0.82 mg/l. Estimated median concentrations of total nitrogen at these assessment points under the Existing (2000) condition ranged between 0.98 mg/l and 1.41 mg/l, with an average value of 1.20 mg/l. Under the Recommended Plan condition, estimated median concentrations of total nitrogen ranged between 0.71 mg/l and 0.94 mg/l, with an average value of 0.833 mg/l. The highest estimated mean and median concentrations under both Existing (2000) and Recommended Plan conditions are present in the Lower Mitchell Field Drainage Ditch assessment area.

Impacts of TMDLs on Load Reduction Targets

As discussed in Chapter 4 of this report, three streams in the Oak Creek watershed are considered impaired waters pursuant to the Federal Clean Water Act (CWA). The mainstem of Oak Creek has impairments related to contributions of total phosphorus, chloride, and an unknown pollutant, while both the North Branch of Oak Creek and the Mitchell Field Drainage Ditch have impairments related to contribution of chloride. When a waterbody is listed as impaired, the CWA requires that a TMDL be developed for the waterbody for those pollutants causing or contributing to the impairments. A TMDL consists of a scientific determination of the maximum amount of a pollutant waterbody can assimilate while still meeting water quality standards. It also includes allocations of portions of that assimilative capacity to various sources that contribute the pollutant to the waterbody. In practical terms, this can include requirements for load reductions for sources such as wastewater treatment plants, industrial dischargers, municipal separate storm sewer systems, and nonpoint source pollution from urban and rural areas. When a TMDL is completed for the Oak Creek watershed, the pollutant load reductions presented in this plan shall be superseded by the load reductions included in the TMDL for those pollutants addressed by the TMDL.

5.3 HABITAT

Description of Problems Related to Habitat Conditions

The existing state of instream and terrestrial habitat in the Oak Creek watershed is described in detail in Chapter 4 of this report. That description documents several problems that currently lead to reduced quality of aquatic and terrestrial habitat in the watershed and are briefly summarized below:

- Urbanization and prior agricultural development have significantly altered surface and groundwater hydrology contributing to many of the problems summarized below.

- Stream channels throughout the watershed have been highly modified contributing to many of the problems summarized below.

- Many stream reaches in the watershed have been disconnected from their floodplains. This disconnection confines flow and increases peak flow velocities and volumes, streambank erosion, and the accumulation of sediment.

- The flashiness of streamflow in the watershed increases erosion of stream beds and banks and reduces the suitability of instream habitat for aquatic organisms.

- Excessive streambank erosion is present in some areas the watershed. This degrades habitat for aquatic organisms and has potential to threaten vital infrastructure.

- Poor diversity of instream habitat in some stream reaches in the watershed limits the quality of aquatic communities.

- The coverage, connectivity, and widths of riparian buffers in the watershed is insufficient to provide good habitat for aquatic and terrestrial organisms and protect water quality.

- Invasive plant and insect species have degraded the quality of waterways, riparian areas, wetlands, and uplands in the watershed.

- Passage impediments such as road crossings, drop structures, large debris jams, and the Mill Pond dam restrict migration of fish and other aquatic organisms throughout the watershed, limiting their access to refuge areas (e.g., summer heating can lead to thermal stress), feeding, and/or breeding habitat and contributing to poor abundance and diversity.

- Projections of future conditions indicate that average water temperatures in Oak Creek are likely to increase by about 2°C by the end of the 21st century due to climate change, resulting in changes to the biological communities that Oak Creek and its tributaries are able to support.

- Accumulation of trash and debris has degraded the aesthetics of streams and riparian areas and can harm wildlife and aquatic organisms.

Management Objectives for Habitat Quality

Based on the statements of habitat quality problems given above and the analyses given in Chapter 4, there are 12 management objectives for this plan related to habitat improvements:

1. Re-establish and maintain natural surface water hydrology to the extent practicable

2. Re-connect stream channels, floodplains, and adjacent wetlands

3. Protect and preserve environmentally sensitive areas such as designated Natural Areas, wetlands, and environmental corridors

4. Protect, expand, restore, and connect riparian buffer areas

5. Protect areas with high groundwater recharge potential and prevent groundwater contamination

6. Remove or modify instream passage impediments that restrict aquatic organism access to a variety of habitats

7. Protect and restore the diversity and quality of instream habitat

8. Protect, restore, and expand terrestrial wildlife habitat, and increase connections among various habitats

9. Control, manage, and/or remove non-native and invasive species in waterbodies, riparian areas, wetlands, and uplands

10. Reduce or mitigate the negative physical, chemical, and biological impacts on aquatic and terrestrial ecosystems caused by climate change

11. Address excessive erosion of streambanks

12. Remove trash and debris within stream channels and riparian areas

Co-benefits from Addressing Habitat Management Objectives

Achieving individual habitat management objectives would provide additional benefits beyond the problems the objectives are intended to address. These co-benefits fall into three broad classes: co-benefits that address other issues within the habitat focus area of this plan, co-benefits that address issues within other focus areas of this plan, and co-benefits that address other desirable outcomes that are not encompassed in the immediate goals of this plan.

Achieving one habitat management objective may contribute to achieving others. Habitat consists of a complex association of physical, chemical, geographic, and biotic factors that allow for the survival and reproduction of organisms. Thus, actions taken to improve one factor making up habitat may also contribute to improvement in other factors. For example, achieving the management objective related to re-connecting stream channels, floodplains, and adjacent wetlands also contributes to achieving objectives related to re-establishing natural surface water hydrology, preserving and improving groundwater recharge, reducing stream bed and bank erosion, and reducing negative impacts of climate change on ecosystems. Similarly, achieving the management objective to protect and preserve environmentally sensitive areas also contributes to achieving management objectives related to protecting riparian buffer areas, protecting the diversity and quality of instream habitat, and protecting terrestrial wildlife habitat.

Achieving habitat management objectives may also contribute to achieving management objectives related to other goals of this plan. For instance, achieving the management objective related to re-connecting stream channels, floodplains, and adjacent wetlands also contributes to achieving objectives related to reducing inputs of nutrients, sediment, and other pollutants into surface waters and preserving and increasing recreational and educational opportunities. Achieving the objective related to removing passage impediments to aquatic organisms contributes to improving recreational opportunities by improving the quality of the fishery. It may also contribute to reducing flooding by addressing structures that lack the capacity to pass high flows.

Finally, achieving habitat management objectives may also contribute to achieving other desirable outcomes that are not encompassed in the immediate goals of this plan. For example, achieving the objective to protect, expand, restore, and connect riparian buffers would also contribute to reducing urban heat island effects, sequestering carbon which helps to mitigate climate change, and maintain and increase biodiversity. Similarly, addressing excessive erosion of streambanks would also protect vital public infrastructure. Removing trash and debris from stream channels and riparian areas would also improve the aesthetics of the watershed, improve the public's valuation of the waterways, and increase the value of nearby property.

5.4 WATER QUANTITY

Description of Problems Related to Targeted Stream and Stormwater Flooding

The existing state of flooding problems in the Oak Creek watershed, including specific areas of concern regarding stream and stormwater is described in Chapter 4 of this report and briefly summarized below:

- There are several remaining insurable structures impacted by the regulatory FEMA flood elevations, and they are scattered throughout the Oak Creek watershed.

- Additional stream flooding locations were provided by stakeholders, and these predominantly occur in the lower portion of the Oak Creek mainstem. Impacts included public and private property flooding, flooding at the South Milwaukee High School grounds, and potential impacts to sanitary sewer lift stations in South Milwaukee.

- There are numerous road crossings impacted by the regulatory FEMA flood elevations for Oak Creek, located predominantly on the mainstem of Oak Creek. Some of these road crossings are overtopped for events as small as the 10-percent-annual-probability (10-year recurrence interval) event.

- Stormwater flooding areas were also provided by stakeholders. These areas were spread throughout the watershed and include streets, public property, and private property.

- Storm event flows in streams of the Oak Creek watershed are flashy due to large amounts of impervious surfaces and the dominance of direct connections from the local storm sewer systems.

Management Objectives for Targeted Stream and Stormwater Flooding

Based on the statements of flooding problems given above and the analyses given in Chapter 4, there are seven management objectives related to the reduction of flooding impacts:

1. Acquire (through a voluntary process) and remove the remaining insurable structures in the regulatory Oak Creek floodplain as opportunities arise

2. Protect public infrastructure and private property from stream and stormwater flooding

3. Elevate or modify road crossings impacted by the regulatory floodplain

4. Reconnect streams in the Oak Creek watershed to their floodplains

5. Protect and expand riparian buffers to allow stream floodwaters to spread out and slow down

6. Retain rainfall runoff onsite to mitigate stream and stormwater flooding

7. Maintain sufficient undeveloped land in the watershed for infiltration and flood storage

For the most part, these objectives are not prioritized and should be pursued simultaneously, however, achievement of some of the objectives may reduce the need to pursue others.

Co-Benefits from Addressing Targeted Stream and Stormwater Flooding Management Objectives

Achieving individual targeted stream and stormwater flooding management objectives would provide additional benefits beyond the problems the objectives are intended to address. These co-benefits fall into three broad classes: co-benefits that address other issues within the targeted stream and stormwater flooding focus area of this plan, co-benefits that address issues within other focus areas of this plan, and co-benefits that address other desirable outcomes that are not encompassed in the immediate goals of this plan.

Achieving individual targeted stream and stormwater flooding management objectives may contribute to achieving others. For example, achieving the management objective related to re-connecting stream channels to their floodplains would increase the retention of floodwater.

Achieving targeted stream and stormwater flooding management objectives may also contribute to achieving management objectives related to other goals of this plan. For instance, achieving the management objective related to voluntarily acquire and remove the remaining insurable structures from the floodplain would also make additional land available for riparian habitat and recreational use, contributing to achieving objectives related to achieving habitat and recreational access and use goals. Similarly, achieving the management objective related to retaining rainfall runoff onsite would contribute to protecting groundwater recharge. It would also reduce inputs of pollutants into surface waters, contributing to meeting management objectives related to improving water quality.

Finally, achieving targeted stream and stormwater flooding management objectives may also contribute to achieving other desirable outcomes that are not encompassed in the immediate goals of this plan. For example, achieving the objective to protect public infrastructure and private property from stream and stormwater flooding will improve safety, lower insurance costs, reduce the tax burden, and improve property values.

Descriptions of Problems at the Mill Pond and Dam

The historical and existing conditions for the Oak Creek Mill Pond and dam are described in Chapter 4 of this report. That description documents specific areas of concern related to the condition of the Mill Pond and dam as it relates to flooding, water quality, habitat, and recreational access and use and are briefly summarized below:

- The sluice gate that is required to dewater the pond for dam maintenance is inoperable due to sediment accumulation and lack of regular operation of the gate

- The Mill Pond was not designed to provide flood storage but for recreational and aesthetic purposes. Under the current configuration of the dam, the regulatory FEMA floodplain indicates that the adjacent Oak Creek Parkway would be flooded during the 1-percent-annual-probability event

- Sediment accumulation in the Mill Pond has become excessive, creating islands in the pond and very shallow water depths that have adversely impacted water quality, habitat, aquatic species, and recreation

- The dam is a full barrier to fish and aquatic organism passage between Lake Michigan and the upstream Oak Creek watershed

- The Mill Pond warming house has not been utilized to its full potential due to the diminished recreational opportunities at the pond

Management Objectives for the Mill Pond and Dam

Based on the descriptions of problems given above and the evaluation given in Chapter 4, there are six management objectives related to the Mill Pond and dam for this plan:

1. If the dam is not removed, provide a way to dewater the pond for dam maintenance

2. If the dam is not removed, evaluate an emergency spillway design to improve safety at and downstream of the dam structure and lower flood elevations in the pond area

3. Manage sediment more effectively in the Mill Pond area

4. Enhance recreational opportunities in the Mill Pond area

5. Improve habitat quality for aquatic and terrestrial wildlife in the Mill Pond area

6. Evaluate aquatic organism passage through the Mill Pond and dam area as a part of potential improvements

These objectives are not prioritized, but their implementation depends on what alternatives are considered for the Mill Pond and dam. Chapter 6 will include a discussion of alternatives for the Mill Pond and dam area.

Co-Benefits from Addressing Mill Pond and Dam Objectives

Achieving individual Mill Pond and dam management objectives would provide additional benefits beyond the problems the objectives are intended to address. These co-benefits fall into three broad classes: co-benefits that address other Mill Pond and dam objectives, co-benefits that address issues within other focus areas of this plan, and co-benefits that address other desirable outcomes that are not encompassed in the immediate goals of this plan.

Achieving individual Mill Pond and Dam objectives may contribute to achieving others. For example, achieving the management objectives related to improving habitat quality in the Mill Pond area and providing aquatic organism passage would also enhance recreational opportunities in the Mill Pond area.

Achieving Mill Pond and dam objectives may also contribute to achieving management objectives related to other goals of this plan. For instance, achieving the management objectives related to providing a way to dewater the pond for dam maintenance and managing sediment more effectively in the Mill Pond area would contribute to improving water quality as well as improving aquatic habitat in the mainstem of Oak Creek downstream of the dam.

Finally, achieving Mill Pond and dam objectives may also contribute to achieving other desirable outcomes that are not encompassed in the immediate goals of this plan. For example, by enabling more frequent maintenance of the dam, achieving the objective to provide a way to dewater the pond will enhance public safety. In addition, providing aquatic organism passage would contribute to maintaining or improving the quality of the fishery in Lake Michigan by providing additional spawning and rearing habitat for fish such as walleye, smallmouth bass, largemouth bass, northern pike, white sucker, and rock bass that spawn in tributary streams.

5.5 RECREATIONAL ACCESS AND USE

Description of Findings and Issues Related to Recreational Use and Access

The existing state of recreational facilities and access as well as the results of public and observational surveys of recreational uses that the public currently practices in the Oak Creek watershed are described in Chapter 4 of this report. Several findings and issues related to recreational use and access that currently exist in the watershed are briefly summarized below:

- Major recreational uses of the watershed include walking, hiking, biking, and fishing
- The public has expressed a desire for improved quality and increased extent of trails within the watershed
- The Milwaukee County Parks has proposed adding about six miles of trails to the Oak Leaf Trail system within the watershed
- The public has expressed a desire for educational signage
- The recreational fishery upstream from the Mill Pond Dam is of poor quality

It should be noted that much of the riparian area adjacent to the mainstem of Oak Creek and some of its tributaries is publicly owned. This presents a unique opportunity to provide the public with close access to these streams and the associated riparian areas.

Management Objectives for Recreational Use and Access

Based on the statement of issues related to recreational use and access and the analyses given in Chapter 4, there are three management objectives for the Oak Creek watershed related to recreational use and access:

1. Continue development of trails and recreational corridors within the Oak Creek watershed to provide an interconnected trail system within the watershed that provides access to the streams of the watershed and to local, County, and regional trail systems within adjacent watersheds
2. Improve fishing access along the mainstem of Oak Creek

3. Provide educational signage along trails within the watershed

Co-Benefits from Addressing Recreational Use and Access Management Objectives

Achieving individual recreational use and access management objectives would provide additional benefits beyond the problems the objectives are intended to address. These co-benefits fall into three broad classes: co-benefits that address other issues within the recreational use and access focus area of this plan, co-benefits that address issues within other focus areas of this plan, and co-benefits that address other desirable outcomes that are not encompassed in the immediate goals of this plan.

Achieving individual recreational use and access management objectives may contribute to achieving others. For example, achieving the management objective related to continued development of trails and recreational corridors within the watershed would also serve to improve fishing access along the mainstem of Oak Creek and its major tributaries.

Achieving recreational use and access management objectives may also contribute to achieving management objectives related to other goals of this plan. For instance, achieving the management objective related to providing educational signage along trails within the watershed would help to make the public more aware of issues and efforts related to water quality, flooding, and habitat. This would promote behaviors that can contribute to improvements in conditions related to these focus areas.

Finally, achieving recreational use and access management objectives may also contribute to achieving other desirable outcomes that are not encompassed in the immediate goals of this plan. For example, achieving the management objective related to continued development of trails and recreational corridors within the watershed will increase the public’s opportunities for exercise and outdoor recreation, leading to improvements in human health and reductions in health-related costs. In addition, achieving recreational use and access management objectives helps turn community attention toward the surface waters of the watershed. This helps to create a sense of place, which can help promote economic development. The surface waters of the watershed can be a destination and attract multiple uses such as housing, retail businesses, restaurants, performing arts facilities, and recreation. All of these activities benefit from an attractive setting. Achieving this can lead to the watershed having more visitors who tend to spend money on things like food and lodging without adding stress to larger infrastructure.

Community Assistance Planning Report No. 330

A RESTORATION PLAN FOR THE OAK CREEK WATERSHED

Chapter 5

WATERSHED GOALS AND MANAGEMENT OBJECTIVES

TABLES

#254753 – CAPR-330 Table 5.1 Management Objectives for Water Quality
300-4010
KJM/LKH/JEB/mid
8/25/20, 10/5/20, 10/22/20

Table 5.1
Water Quality Problems Addressed by Management Objectives for the Oak Creek Watershed

Management Objective	Fecal Bacteria	Dissolved Oxygen	Nutrients	Suspended Solids	Chloride
Locate and eliminate sources that contribute sanitary wastewater and other human wastes to surface waters	X	X	X	--	--
Locate and eliminate anthropogenic sources of fecal contamination of nonhuman origin to surface waters	X	X	X	--	--
Locate and eliminate non-anthropogenic sources of fecal contamination of nonhuman origin to surface waters	X	X	X	--	--
Reduce contributions of total suspended solids and sediment to surface waters	--	X	X	X	--
Address eroding streambanks along streams of the watershed	--	X	X	X	--
Reduce contributions of other organic material to surface waters	--	X	X	--	--
Reduce contributions of total phosphorus to surface waters	--	X	X	--	--
Reduce contributions of dissolved phosphorus to surface waters	--	X	X	--	--
Reduce contributions of nitrogen compounds to surface waters	--	X	X	--	--
Reduce contributions of chloride to surface waters and groundwater	--	--	--	--	X
Continue collecting and distributing monitoring data that are adequate to evaluate the state of water quality conditions and the efficacy of management measures on a watershed scale	X	X	X	X	X

Source: SEWRPC

#254042 – CAPR-330 Table 5.2 - Total Phosphorus Load Reduction Targets
300-4010
LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20

Table 5.2
Annual Reductions in Nonpoint Source Loads of Total Phosphorus Required by the RWQMPU Adjusted for Changes in NR 151

		Annual Reduction in Loads of Phosphorus (pounds)						
		Urban Sources			Rural Sources			
Subwatershed	**Assessment Areas**	NR 151-Related	Other Reductions	Subtotal	NR 151-Related	Other Reductions	Subtotal	**Total**
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	58	112	170	50	10	60	230
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	52	98	150	-70[a]	80	10	160
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	199	271	470	20	0	20	490
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	180	520	700	-10[a]	60	50	750
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	19	231	250	60	90	150	400
	Total	508	1,232	1,740	50	240	290	2,030

[a] *In certain limited cases, relatively minor anomalies in loads may occur among the modeled conditions upon which the load reductions presented in this table are based. Those anomalies might indicate a slight increase in loads under the recommended plan, relative to the revised 2020 baseline. In those cases, it may be assumed that no significant change in loads occurs among those various conditions. Since it was not always possible to explicitly represent certain components of the recommended plan in the water quality model, adjustments were made to model parameters that served as surrogates for the actual water pollution control measure being represented. In the sense that those modifications sometimes alter parameters in the revised 2020 baseline model, in limited cases, representation of a measure in the recommended plan model may have a side effect of introducing small, relatively insignificant anomalies in the comparative results.*

Source: SEWRPC

#254043 – CAPR-330 Table 5.3 - Modeled Total Phosphorus Summary Statistics
300-4010
LKH/JEB/mid
3/9/20, 10/6/20, 10/22/20

Table 5.3
Modeled Total Phosphorus Summary Statistics from the RWQMPU for the Oak Creek Watershed

		Mean Concentration (mg/l)		Median Concentration (mg/l)		Percent Compliance with Recommended Planning Standard for Phosphorus (0.1 mg/l)	
Assessment Point	**Assessment Area**	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan
OK-1: Oak Creek at W. Ryan Road (east crossing)	Upper Oak Creek	0.075	0.064	0.031	0.025	83	83
OK-2: North Branch Oak Creek Above Confluence with Oak Creek	Lower North Branch Oak Creek	0.084	0.072	0.032	0.030	78	80
OK-3: Oak Creek at S. Howell Avenue	Middle Oak Creek	0.086	0.074	0.032	0.029	79	80
OK-4: Oak Creek at E. Forest Hills Avenue	Middle Oak Creek	0.081	0.071	0.032	0.029	79	81
OK-5: Oak Creek Above Confluence with Mitchell Field Drainage Ditch	Middle Oak Creek	0.083	0.076	0.033	0.032	79	78
OK-6: Mitchell Field Drainage Ditch Above Confluence with Oak Creek	Lower Mitchell Field Drainage Ditch	0.076	0.070	0.046	0.046	84	82
OK-7: Oak Creek at S. Pennsylvania Avenue	Lower Oak Creek	0.091	0.088	0.056	0.058	76	75
OK-8: Oak Creek at 15th Avenue	Lower Oak Creek	0.091	0.088	0.058	0.060	76	74
OK-9: Oak Creek at Parkway	Lower Oak Creek-Millpond	0.092	0.085	0.062	0.063	75	76
OK-10: Oak Creek at Parkway	Grant Park Ravine	0.078	0.070	0.046	0.044	78	80

Source: SEWRPC

#254044 – CAPR-330 Table 5.4 - Total Suspended Solids Load Reduction Targets
300-4010
LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20

Table 5.4
Annual Reductions in Nonpoint Source Loads of Total Suspended Solids Required by the RWQMPU Adjusted for Changes in NR 151

		Annual Reduction in Loads of Total Suspended Solids (pounds)						
		Urban Sources			Rural Sources			
Subwatershed	**Assessment Areas**	NR 151-Related	Other Reductions	Subtotal	NR 151-Related	Other Reductions	Subtotal	**Total**
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	96,866	33,354	130,220	145,530	350	145,880	276,100
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	102,033	38,727	140,760	284,940	670	285,610	426,370
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	151,009	130,481	281,490	19,590	0	19,590	301,080
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	250,056	296,484	546,540	162,020	2,740	164,760	711,300
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	59,525	109,005	168,530	78,990	6,160	85,150	253,680
	Total	659,489	608,051	1,267,540	691,070	9,920	700,990	1,968,530

Source: SEWRPC

#254045 – CAPR-330 Table 5.5 - Modeled Total Suspended Solids Summary Statistics
300-4010
LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20

Table 5.5
Modeled Total Suspended Solids Summary Statistics from the RWQMPU for the Oak Creek Watershed

		Mean Concentration (mg/l)		Median Concentration (mg/l)	
Assessment Point	**Assessment Area**	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan
OK-1: Oak Creek at W. Ryan Road (east crossing)	Upper Oak Creek	13.7	7.9	7.8	4.6
OK-2: North Branch Oak Creek Above Confluence with Oak Creek	Lower North Branch Oak Creek	22.9	15.7	9.0	6.4
OK-3: Oak Creek at S. Howell Avenue	Middle Oak Creek	20.9	13.7	8.5	5.9
OK-4: Oak Creek at E. Forest Hills Avenue	Middle Oak Creek	14.9	9.9	7.9	5.3
OK-5: Oak Creek Above Confluence with Mitchell Field Drainage Ditch	Middle Oak Creek	14.1	9.4	7.2	4.7
OK-6: Mitchell Field Drainage Ditch Above Confluence with Oak Creek	Lower Mitchell Field Drainage Ditch	11.0	7.1	7.0	4.2
OK-7: Oak Creek at S. Pennsylvania Avenue	Lower Oak Creek	14.9	9.9	7.3	4.8
OK-8: Oak Creek at 15th Avenue	Lower Oak Creek	15.9	10.7	7.3	4.8
OK-9: Oak Creek at Parkway	Lower Oak Creek-Millpond	16.0	10.4	6.7	4.3
OK-10: Oak Creek at Parkway	Grant Park Ravine	19.6	13.2	7.4	5.1

Source: SEWRPC

#254046 – CAPR-330 Table 5.6 - Fecal Coliform Bacteria Load Reduction Targets
300-4010
KJM/LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20, 12/7/2020

Table 5.6
Annual Reductions in Nonpoint Source Loads of Fecal Coliform Bacteria Required by the RWQMPU Adjusted for Changes in NR 151

		Annual Reduction in Loads of Fecal Coliform Bacteria (trillion cells)[a]						
		Urban Sources			Rural Sources			
Subwatershed	**Assessment Areas**	NR 151-Related	Other Reductions	Subtotal	NR 151-Related	Other Reductions	Subtotal	**Total**
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	29	125	154	1	2	3	157
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	24	143	167	-5[b]	34	29	197
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	64	233	297	0	0	0	297
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	57	318	376	-8[b]	17	9	385
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	-12[a]	248	235	8	14	21	256
	Total	162	1,067	1,229	-4[a]	67	63	1,292

[a] *Effective May 1, 2020 Wisconsin's recreational use water quality criteria changed from using fecal coliform bacteria to* E. coli. *Load reduction targets for* E. coli *can be estimated from the targets for fecal coliform bacteria given in this table using the translator ratios developed for the Milwaukee River Basin TMDL.*

[b] *In certain limited cases, relatively minor anomalies in loads may occur among the modeled conditions upon which the load reductions presented in this table are based. Those anomalies might indicate a slight increase in loads under the recommended plan, relative to the revised 2020 baseline. In those cases, it may be assumed that no significant change in loads occurs among those various conditions. Since it was not always possible to explicitly represent certain components of the recommended plan in the water quality model, adjustments were made to model parameters that served as surrogates for the actual water pollution control measure being represented. In the sense that those modifications sometimes alter parameters in the revised 2020 baseline model, in limited cases, representation of a measure in the recommended plan model may have a side effect of introducing small, relatively insignificant anomalies in the comparative results.*

Source: SEWRPC

Table 5.7
Modeled Fecal Coliform Bacteria Annual Summary Statistics from the RWQMPU for the Oak Creek Watershed[a]

		Mean Concentration (cells per 100 ml)		Percent Compliance with Single Sample Standard (<400 cells per 100 ml)		Geometric Mean Concentration (cells per 100 ml)		Days of Compliance with Geometric Mean Standard (<200 cells per 100 ml)[b]	
Assessment Point	Assessment Area	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan
OK-1: Oak Creek at W. Ryan Road (east crossing)	Upper Oak Creek	4,905	2,603	66	67	541	346	65	123
OK-2: North Branch Oak Creek Above Confluence with Oak Creek	Lower North Branch Oak Creek	4,987	2,722	57	60	611	385	60	108
OK-3: Oak Creek at S. Howell Avenue	Middle Oak Creek	10,233	5,436	55	58	1,191	729	17	36
OK-4: Oak Creek at E. Forest Hills Avenue	Middle Oak Creek	7,953	4,447	51	56	1,041	648	20	46
OK-5: Oak Creek Above Confluence with Mitchell Field Drainage Ditch	Middle Oak Creek	7,666	4,289	49	55	1,105	664	18	40
OK-6: Mitchell Field Drainage Ditch Above Confluence with Oak Creek	Lower Mitchell Field Drainage Ditch	6,917	3,966	31	62	1,442	775	0	13
OK-7: Oak Creek at S. Pennsylvania Avenue	Lower Oak Creek	7,729	4,358	49	56	1,190	696	13	35
OK-8: Oak Creek at 15th Avenue	Lower Oak Creek	15,506	8,662	17	39	2,700	1,550	6	13
OK-9: Oak Creek at Parkway	Lower Oak Creek-Millpond	7,401	4,091	51	57	993	526	26	68
OK-10: Oak Creek at Parkway	Grant Park Ravine	6,643	3,696	48	52	752	404	70	118

[a] *Within the water quality models for the recommended plan condition, the detection and elimination of illicit discharges to storm sewer systems and control of urban source pathogens, including those in stormwater runoff, are represented using stormwater disinfection units. Such units were initially considered as a recommended approach to the treatment of runoff, but were eliminated from further consideration based on comments from the RWQMPU Technical Advisory Committee. However, the use of such units is considered to be appropriate as a surrogate representation of the varied and as yet undetermined means that would be applied to detect and eliminate illicit discharges and to control pathogens in urban stormwater runoff. Those units explicitly address the control of bacteria in stormwater runoff, and, based on the way that bacteria loads are represented in the calibrated model, they also implicitly provide some control of bacteria that may reach streams through illicit connections that contribute to baseflow.*

[b] *Out of 365 days.*

Source: SEWRPC

#254049 – CAPR-330 Table 5.8 - Modeled Fecal Coliform Bacteria Swim Season Summary Statistics
300-4010
LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20

Table 5.8
Modeled Fecal Coliform Bacteria Swimming Season Summary Statistics from the RWQMPU for the Oak Creek Watershed[a,b]

		Mean Concentration (cells per 100 ml)		Percent Compliance with Single Sample Standard (<400 cells per 100 ml)		Geometric Mean Concentration (cells per 100 ml)		Days of Compliance with Geometric Mean Standard (<200 cells per 100 ml)[c]	
Assessment Point	**Assessment Area**	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan
OK-1: Oak Creek at W. Ryan Road (east crossing)	Upper Oak Creek	2,102	1,079	84	84	256	181	47	82
OK-2: North Branch Oak Creek Above Confluence with Oak Creek	Lower North Branch Oak Creek	2,561	1,289	74	76	289	192	44	71
OK-3: Oak Creek at S. Howell Avenue	Middle Oak Creek	4,750	2,382	72	76	555	355	15	30
OK-4: Oak Creek at E. Forest Hills Avenue	Middle Oak Creek	3,103	1,672	69	75	463	308	17	35
OK-5: Oak Creek Above Confluence with Mitchell Field Drainage Ditch	Middle Oak Creek	3,019	1,595	66	73	497	309	15	32
OK-6: Mitchell Field Drainage Ditch Above Confluence with Oak Creek	Lower Mitchell Field Drainage Ditch	2,906	1,590	27	80	806	411	0	5
OK-7: Oak Creek at S. Pennsylvania Avenue	Lower Oak Creek	3,136	1,657	66	74	543	320	11	28
OK-8: Oak Creek at 15th Avenue	Lower Oak Creek	6,370	3,218	31	61	1,079	593	6	12
OK-9: Oak Creek at Parkway	Lower Oak Creek-Millpond	3,061	1,502	71	76	388	189	21	50
OK-10: Oak Creek at Parkway	Grant Park Ravine	2,504	1,262	71	74	179	89	59	93

[a] *Within the water quality models for the recommended plan condition, the detection and elimination of illicit discharges to storm sewer systems and control of urban source pathogens, including those in stormwater runoff, are represented using stormwater disinfection units. Such units were initially considered as a recommended approach to the treatment of runoff but were eliminated from further consideration based on comments from the RWQMPU Technical Advisory Committee. However, the use of such units is considered to be appropriate as a surrogate representation of the varied and as yet undetermined means that would be applied to detect and eliminate illicit discharges and to control pathogens in urban stormwater runoff. Those units explicitly address the control of bacteria in stormwater runoff, and, based on the way that bacteria loads are represented in the calibrated model, they also implicitly provide some control of bacteria that may reach streams through illicit connections that contribute to baseflow.*

[b] *The swimming season is taken as May 1 through September 30.*

[c] *Out of 153 days.*

Source: SEWRPC

#254050 – CAPR-330 Table 5.9 - Total Nitrogen Load Reduction Targets
300-4010
LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20

Table 5.9
Annual Reductions in Nonpoint Source Loads of Total Nitrogen Required by the RWQMPU Adjusted for Changes in NR 151

		Annual Reduction in Loads of Total Nitrogen (pounds)						
		Urban Sources			Rural Sources			
Subwatershed	**Assessment Areas**	NR 151-Related	Other Reductions	Subtotal	NR 151-Related	Other Reductions	Subtotal	**Total**
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	117	143	260	3,770	10	3,780	4,040
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	188	132	320	5,530	-10	5,520	5,840
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	1,052	878	1,930	630	0	630	2,560
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	701	2,599	3,300	4,300	210	4,510	7,810
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	191	1,830	2,020	2,950	890	3,840	5,860
	Total	2,247	5,583	7,830	17,180	1,100	18,280	26,110

Source: SEWRPC

#254051 – CAPR-330 Table 5.10 - Modeled Total Nitrogen Summary Statistics
300-4010
LKH/JEB/mid
6/9/20, 10/6/20, 10/22/20

Table 5.10
Modeled Total Nitrogen Summary Statistics from the RWQMPU for the Oak Creek Watershed

		Mean Concentration (mg/l)		Median Concentration (mg/l)	
Assessment Point	**Assessment Area**	Existing (2000)	Recommended Plan	Existing (2000)	Recommended Plan
OK-1: Oak Creek at W. Ryan Road (east crossing)	Upper Oak Creek	1.52	0.88	1.38	0.82
OK-2: North Branch Oak Creek Above Confluence with Oak Creek	Lower North Branch Oak Creek	1.32	0.91	1.18	0.80
OK-3: Oak Creek at S. Howell Avenue	Middle Oak Creek	1.37	0.88	1.24	0.80
OK-4: Oak Creek at E. Forest Hills Avenue	Middle Oak Creek	1.34	0.86	1.17	0.76
OK-5: Oak Creek Above Confluence with Mitchell Field Drainage Ditch	Middle Oak Creek	1.32	0.89	1.15	0.78
OK-6: Mitchell Field Drainage Ditch Above Confluence with Oak Creek	Lower Mitchell Field Drainage Ditch	1.57	1.00	1.41	0.94
OK-7: Oak Creek at S. Pennsylvania Avenue	Lower Oak Creek	1.38	0.98	1.25	0.92
OK-8: Oak Creek at 15th Avenue	Lower Oak Creek	1.30	0.96	1.18	0.90
OK-9: Oak Creek at Parkway	Lower Oak Creek-Millpond	1.26	0.95	1.14	0.91
OK-10: Oak Creek at Parkway	Grant Park Ravine	1.07	0.81	0.98	0.71

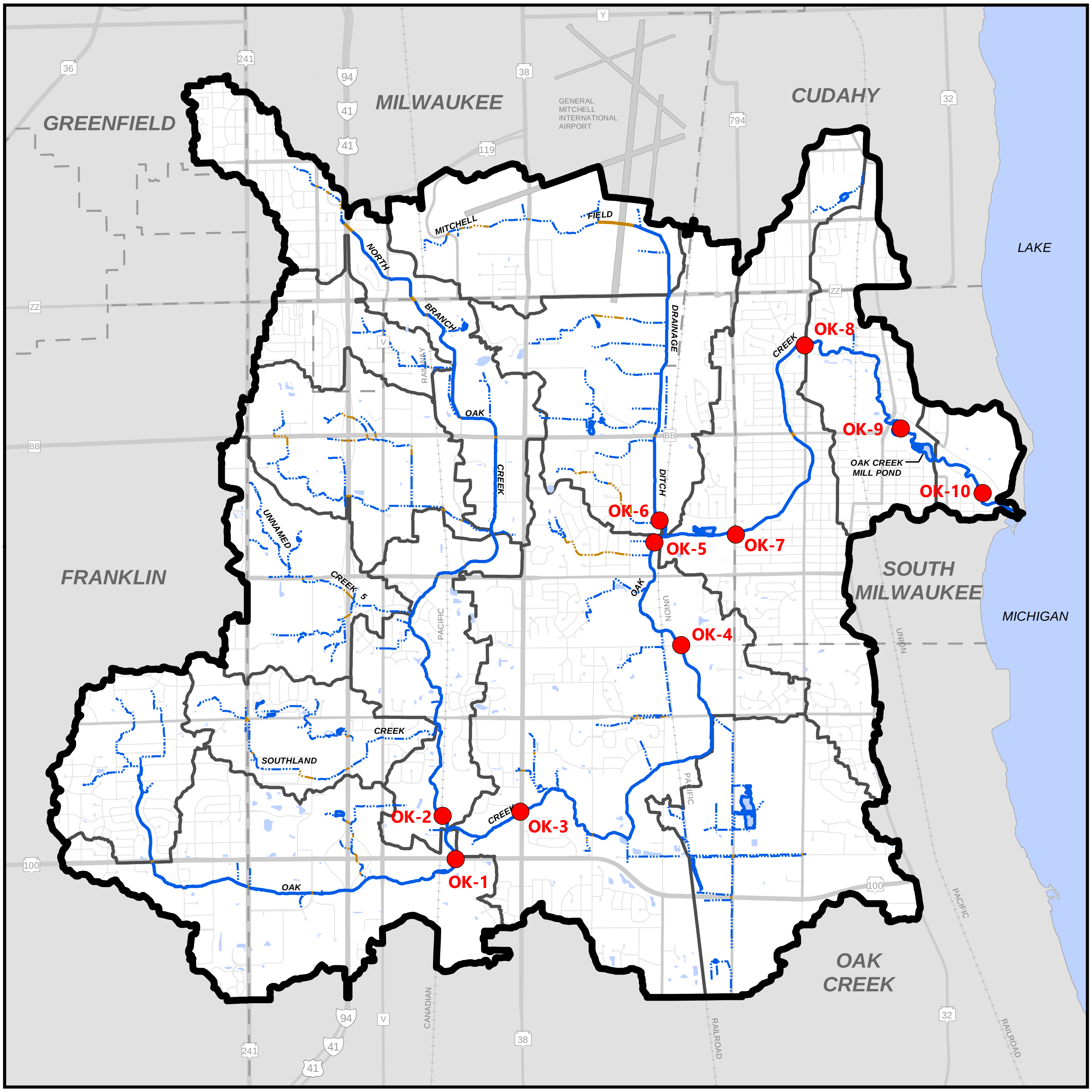
Source: SEWRPC

Chapter 5

WATERSHED GOALS AND MANAGEMENT OBJECTIVES

MAPS

Map 5.1
Locations Used to Evaluate Water Quality in the Modeling of Oak Creek for the Regional Water Quality Management Plan Update



OK-10 ASSESSMENT POINTS

OAK CREEK WATERSHED BOUNDARY

ASSESSMENT AREA BOUNDARIES

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

INTERMITTENT STREAM

INTERMITTENT STREAM (ENCLOSED)

SURFACE WATER

N

0 0.25 0.5 1 Miles

Source: SEWRPC

Community Assistance Planning Report No. 330

A RESTORATION PLAN FOR THE OAK CREEK WATERSHED

Appendix L

WATER QUALITY SIMULATION MODEL AND POLLUTANT LOADS FROM THE RWQMPU

RELATIONSHIP OF THE OAK CREEK WATERSHED RESTORATION PLAN TO THE REGIONAL WATER QUALITY MANAGEMENT PLAN

As noted previously in this report, the Oak Creek watershed restoration plan builds on the framework established under the 2007 SEWRPC regional water quality management plan update (RWQMPU) for the greater Milwaukee watersheds.[1] Chapter 2 of this watershed restoration plan summarizes 1) the recommendations of the RWQMPU as they relate to the Oak Creek watershed and 2) the status of implementation of those recommendations within the watershed. This appendix summarizes the water quality modeling analyses conducted under the RWQMPU and describes how the modeling results for the Oak Creek component of the recommended RWQMPU can be applied directly to estimate water quality improvements that would be expected from implementation of the recommended watershed restoration plan set forth in Chapter 6 of this report.

[1] *SEWRPC Planning Report No. 50,* A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds, *December 2007 and* Amendment to the Regional Water Quality Management Plan for the Greater Milwaukee Watersheds, *May 2013.*

WATER QUALITY MODELING

Under the RWQMPU, a comprehensive, watershed-based, calibrated and validated U.S. Environmental Protection Agency (USEPA) HSPF continuous simulation model was developed to simulate pollutant loads and instream water quality conditions in the streams of the Oak Creek watershed.[2] This model has been used extensively across the country to develop water quality restoration plans through the Federal Clean Water Act Total Maximum Daily Load (TMDL) Program. The HSPF model is particularly suited to modeling water quality conditions in the Oak Creek watershed because it:

- Can be used on watersheds with both rural and urban land uses
- Can be used to simulate all of the constituents of interest for the RWQMPU
- Allows long-term continuous simulations to predict hydrologic and water quality variability
- Provides adequate temporal resolution to facilitate a direct comparison to water quality standards
- Simulates surface runoff and subsurface flows
- Simulates receiving stream water quality processes in addition to land surface loads

Under the RWQMPU, the HSPF model was applied to estimate pollutant loads and instream pollutant concentrations over a 10-year simulation period representing meteorological conditions from 1988 through 1997.[3] The HSPF model of the Oak Creek watershed was applied to represent then-existing year 2000 land use conditions and also planned year 2020 (baseline) land use conditions. Water quality conditions were simulated and evaluated at 10 assessment points along the Oak Creek mainstem and tributaries (see Map 5.1 in Chapter 5 of this report).

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[2] *U.S. Environmental Protection Agency, Environmental Research Laboratory,* Hydrological Simulation Program-Fortran, User's Manual for Release 12, *Athens Georgia, March 2001.*

[3] *This simulation period was selected because it was determined to be representative of the long-term precipitation statistics as measured at the National Weather Service Milwaukee Mitchell International Airport weather station for the 63-year period from 1940 through 2002.*

WATER QUALITY RESULTS OF THE RWQMPU MODELING ANALYSES

Under the RWQMPU, alternative plans were developed to represent different approaches to improving water quality under planned 2020 land use conditions through combinations of point pollution source controls and implementation of agricultural and urban best management practices and green infrastructure.

Four of the five pollutants identified for abatement under this watershed restoration plan—total suspended solids, total phosphorus, total nitrogen, and fecal coliform bacteria—were modeled under the RWQMPU along with several other pollutants.[4] The pertinent water quality indicators used to compare the plans are set forth in Table L.1. The RWQMPU alternative plans were evaluated as to their ability to cost-effectively meet a set of planning objectives related primarily to water quality management, land use development, and outdoor recreation and open space preservation.

The recommended RWQMPU plan was synthesized from the most effective components of the alternatives, and it consists of a combination of point source controls and urban and rural nonpoint source controls. The USEPA HSPF water quality model developed to represent recommended plan conditions explicitly accounted for the following rural and urban nonpoint source pollution control measures:

- Reducing soil erosion from cropland to the tolerable soil loss rate as determined by the U.S. Natural Resources Conservation Service
- Establishing riparian buffers with a minimum width of 75 feet on each side of streams
- Converting 10 percent of existing cropland to wetland or prairie conditions
- Expanding oversight of private onsite wastewater treatment systems
- Implementing nonagricultural (urban) performance standards established by the State of Wisconsin in Chapter NR 151, “Runoff Management,” of the *Wisconsin Administrative Code*

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[4] *The fifth pollutant considered under this planning effort is chloride. Chloride loads and concentrations were not computed by the RWQMPU water quality model.*

- Establishing coordinated programs to detect and eliminate illicit discharges to storm sewer systems and to control urban-sourced pathogens that are harmful to human health

- Infiltrating residential roof drain runoff in rain gardens, or similar green infrastructure practices at 30 percent of the homes in the study area

These measures are also generally included in the recommended watershed restoration plan described in Chapter 6. Thus, the degree to which implementation of the watershed restoration plan described in the chapter would be expected to improve instream water quality can be inferred from the comprehensive water quality modeling results set forth in the report documenting the regional water quality management plan for the greater Milwaukee watersheds[5] and briefly summarized in the next paragraph.

Implementation of the recommended RWQMPU plan, and of the recommended watershed restoration plan which is set forth in Chapter 6 of this report and which adds detail to the RWQMPU recommendations, would be expected to result in significant reductions in instream mean and median concentrations of total suspended solids,[6] total phosphorus,[7] and total nitrogen[8] and in mean and geometric mean concentrations of fecal coliform bacteria. Relative to then-existing year 2000 conditions, implementation of the recommended plan would be expected to result in significant improvements in the levels of compliance with the geometric mean standard for fecal coliform bacteria, and generally more modest increases in the level of compliance with the single sample standard along the mainstem of Oak Creek and many tributaries.[9]

The load reductions required to achieve recommended RWQMPU conditions, and which have been adopted as reduction targets under this watershed restoration plan, are set forth in Tables 5.2, 5.4, 5.6, and 5.9 in Chapter 5 of this report.

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[5] *SEWRPC Planning Report No. 50,* op. cit. *and* Amendment to the Regional Water Quality Management Plan for the Greater Milwaukee Watersheds, *May 2013.*

[6] *See Table 5.5 in Chapter 5 of this report.*

[7] *See Table 5.3 in Chapter 5 of this report.*

[8] *See Table 5.10 in Chapter 5 of this report.*

[9] *See Tables 5.7 and 5.8 in Chapter 5 of this report.*

ADJUSTMENT OF MODELED LOADS TO DEVELOP POLLUTANT LOAD REDUCTION TARGETS

Numerical targets for some of the pollutants selected for reductions by this watershed restoration plan can be derived from the results of the RWQMPU model. These targets and the reductions in mean and median instream pollutant concentrations derived from the water quality simulation model used in the RWQMPU are presented and discussed in Chapter 5 of this report.

The RWQMPU made recommendations whose implementation would act to reduce contributions of phosphorus, TSS, fecal coliform bacteria, and total nitrogen. These recommendations were summarized, and the status of their implementation was reviewed in Chapter 2 of this report. The RWQMPU also included estimates of pollutant loads of these water quality constituents to the stream system that would occur under three sets of conditions.[10] These conditions include:

- Existing condition: Representing watershed conditions as of the year 2000
- Revised 2020 Baseline condition: The condition projected to occur in 2020 under planned 2020 land use conditions, assuming full implementation of the urban stormwater runoff performance standards set forth in Chapter NR 151, "Runoff Management," of the *Wisconsin Administrative Code,* but without implementation of the recommendations of the RWQMPU

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[10] *SEWRPC Planning Report No. 50,* op. cit. *and* Amendment to the Regional Water Quality Management Plan for the Greater Milwaukee Watersheds, *May 2013*.

- Recommended Plan condition: The condition projected to occur under planned 2020 land use conditions, assuming full implementation of both the urban stormwater runoff performance standards set forth in NR 151 and the recommendations of the RWQMPU[11]

These estimates were made using the calibrated and validated water quality simulation model described above.[12] The estimated pollutant loads associated with each of these three conditions are given in Tables L.2 through L.5. Maps L.1 though L.8 show comparisons of the estimated existing condition pollutant loads and per acre pollutant loads among the subwatersheds of the Oak Creek watershed.

It is important to note that for total phosphorus, TSS, fecal coliform bacteria, and total nitrogen the portion of the pollutant loads contributed by point sources is quite low under all three conditions described above. On a whole watershed basis, point sources are estimated to have contributed less than 1 percent of the total phosphorus load, less than 0. 1 percent of the TSS load, less than 1 percent of the fecal coliform bacteria load and less than 1 percent of the total nitrogen load under both the Existing (2000) condition and the Recommended Plan (2020) condition. Given that point sources are estimated to contribute these small percentages of the loads of these pollutants, the management objectives and targets for this watershed restoration plan should focus on nonpoint sources. The reductions in nonpoint source loads between the Existing (2000) condition and the Recommended Plan (2020) condition that are envisioned in the RWQMPU define targets to be met in order to improve water quality conditions in the Oak Creek watershed.

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[11] *The RWQMPU included pollutant load estimates for two additional conditions: A Revised 2020 Baseline condition with a five-year level of protection to control against sanitary sewer overflows (five-year LOP) and an Extreme Measures condition. In the Oak Creek watershed, the estimated pollutant loads under the Revised 2020 Baseline with a five-year LOP condition were identical to the estimated pollutant loads under the Revised 2020 Baseline condition. The Extreme Measures condition examined a level of nonpoint source controls in excess of the levels envisioned under the recommended plan and envisioned the virtual elimination of phosphorus from discharges of industrial noncontact cooling water. In the Oak Creek watershed at most locations, the degree of compliance with applicable water quality standards under the Extreme Measures condition, as estimated by the calibrated water quality simulation model, was similar to the degree of compliance under the Recommended Plan condition, although more significant improvements in compliance were indicated for fecal coliform bacteria.*

[12] *The calibrated and validated water quality model is described in more detail, and its results are presented and discussed in SEWRPC Planning Report No. 50, op. cit. The results presented here incorporate revisions made to Planning Report No. 50 in a May 2013 plan amendment that corrected errors in the calculation of mean and median concentrations of total phosphorus and total nitrogen at some water quality assessment locations.*

The RWQMPU targets were refined in two ways for the Oak Creek watershed restoration plan. First, the load estimates from the three conditions were used to estimate how much of the pollutant load reductions envisioned in the RWQMPU would result from implementation of the NR 151 stormwater runoff performance standards and how much would result from other elements of the recommended plan. Second, the load reductions were adjusted to account for changes in the application of NR 151 that have been made since the RWQMPU was completed.

The developed urban area performance standard for municipalities set forth in Section NR 151.13 requires that municipalities with Wisconsin Pollutant Discharge Elimination System (WPDES) stormwater discharge permits reduce the amount of TSS in stormwater runoff from areas of existing development that were in place as of October 1, 2004, to the maximum extent practicable, by 20 percent by March 10, 2008 and by 40 percent by October 1, 2013. In addition, other sections of NR 151 require that all construction sites that have one acre or more of land disturbance must achieve an 80 percent reduction in the sediment load generated by the site. With certain limited exceptions, those sites required under NR 151 to have construction erosion control permits must also have post-development stormwater management practices to reduce the TSS load from the site by 80 percent for new development, 40 percent for redevelopment, and 40 percent for infill development occurring prior to October 1, 2012. After October 1, 2012, infill development will be required to achieve an 80 percent reduction. An action by the State Legislature has changed the application of these performance standards. As a result of 2011 Wisconsin Act 32, the WDNR is prohibited from enforcing the 40 percent reduction in TSS load from areas of existing development.

The impact of this is that the load reductions from urban nonpoint sources as represented under the RWQMPU modeling need to be adjusted to account for the change in application of the developed urban area performance standard. This was done on a subwatershed basis using the existing 2000 land use and the planned land use (see Tables 3.8 through 3.11 in Chapter 3 of this report) to estimate the portions of urban lands within each subwatershed under the Recommended Plan (2020) condition that represent:

- Existing development that would have been subject to the 40 percent TSS reduction requirement

- New development that is subject to the 80 percent TSS reduction requirement, redevelopment that is subject to the 40 percent TSS reduction requirement, and infill development that is subject to a 40 percent TSS reduction requirement prior to October 1, 2012 and an 80 percent TSS reduction requirement after October 1, 2012

To adjust the urban nonpoint source load reductions for the changes in the application of NR 151, the portion of the NR 151-related load reductions that are attributable to existing development was estimated for each subwatershed. This portion of the pollutant load reduction was reduced by half. In order to maintain the recommended levels of water quality improvement envisioned under the RWQMPU, the amount of this reduction was added to the “other reductions” categories for urban nonpoint sources in the pollutant load reduction target tables given in Chapter 5 of this report.

Community Assistance Planning Report No. 330

A RESTORATION PLAN FOR THE OAK CREEK WATERSHED

Appendix L

WATER QUALITY SIMULATION MODEL AND POLLUTANT LOADS FROM THE RWQMPU

TABLES

Table L.1
Water Quality Indicators Used to Compare Alternative Plans in the RWQMPU

Water Quality Parameter	Indicator
Fecal Coliform Bacterial over the Entire Year	Arithmetic mean concentration of fecal coliform bacteria Proportion of time fecal coliform bacteria concentration is equal to or below the single sample criterion Geometric mean concentration of fecal coliform bacteria Days per year geometric mean of fecal coliform bacteria concentration is equal to or below the geometric mean criterion
Fecal Coliform Bacteria from May to September[a]	Arithmetic mean concentration of fecal coliform bacteria Proportion of time fecal coliform bacteria concentration is equal to or below the single sample criterion Geometric mean concentration of fecal coliform bacteria Days per year geometric mean of fecal coliform bacteria concentration is equal to or below the geometric mean criterion
Total Phosphorus	Mean concentration of total phosphorus Median concentration of total phosphorus Proportion of time total phosphorus concentration is equal to or below the recommended planning standard
Total Suspended Solids	Mean concentration of total suspended solids Median concentration of total suspended solids

[a] *This time period represents the body contact recreation season when bacteria concentrations are of the greatest interest.*

Source: SEWRPC

#254797 – CAPR-330 - Table L.2 Phosphorus Pollutant Loads from the RWQMPU
300-4010
LKH/JEB/mid
8/27/20, 10/7/20, 10/26/20

Table L.2
Average Annual Total Phosphorus Loads for the Oak Creek Watershed Taken from the RWQMPU

			Point Sources (pounds)			Nonpoint Sources (pounds)[a,b]			
Subwatershed	Assessment Areas	Condition	Industrial Point Sources	SSOs	Subtotal	Urban	Rural[c]	Subtotal	Total (pounds)
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	Existing (2000)	0	0	0	1,360	170	1,530	1,530
		Revised (2020) Baseline	0	0	0	1,270	120	1,390	1,390
		Recommended Plan (2020)	0	0	0	1,150	110	1,300	1,300
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	Existing (2000)	0	0	0	1,310	980	2,290	2,290
		Revised (2020) Baseline	0	0	0	1,230	1,050	2,280	2,280
		Recommended Plan (2020)	0	0	0	1,160	970	2,130	2,130
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	Existing (2000)	10	10	20	2,200	40	2,240	2,260
		Revised (2020) Baseline	10	10	20	1,830	20	1,850	1,870
		Recommended Plan (2020)	10	10	20	1,730	20	1,750	1,770
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	Existing (2000)	0	0	0	2,650	510	3,160	3,160
		Revised (2020) Baseline	0	0	0	2,370	520	2,890	2,890
		Recommended Plan (2020)	0	0	0	1,950	460	2,410	2,410
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	Existing (2000)	<10	0	<10	980	410	1,390	1,390
		Revised (2020) Baseline	<10	0	<10	950	350	1,300	1,300
		Recommended Plan (2020)	<10	0	<10	730	260	990	990
	Watershed Total	Existing (2000)	10	10	20	8,500	2,110	10,610	10,630
		Revised (2020) Baseline	10	10	20	7,650	2,060	9,710	9,730
		Recommended Plan (2020)	10	10	20	6,760	1,820	8,580	8,600

[a] *Certain apparent anomalies in the relationship between urban and nonpoint source loads are due to the manner in which the loads were apportioned. In those cases, the loads in the nonpoint subtotal column generally exhibit the anticipated relationships between conditions.*

[b] *In certain limited cases, relatively minor anomalies in nonpoint source pollutant loads may occur among the three conditions for which the model results are presented in this table. Those anomalies might indicate a relatively slight increased load under the recommended plan condition relative to the revised 2020 baseline. In those cases, it may be assumed that no significant change in pollutant load occurs among those conditions. Since it was not always possible to explicitly represent certain components of the recommended plan condition in the water quality model, adjustments were made to model parameters that served as surrogates for the actual water pollution control measures being represented. In the sense that these modifications sometimes alter parameters established under the revised 2020 baseline model version, in limited cases, representation of a measure in the recommended plan model may have a side effect of introducing small, relatively insignificant anomalies in the comparative results.*

[c] *For reporting purposes, certain land uses such as forests and wetlands have been categorized as rural sources even though they may exist in a predominantly urban setting.*

Source: Brown and Caldwell, Tetra Tech, Inc., and SEWRPC

#254798 – CAPR-330 - Table L.3 TSS Loads from the RWQMPU
300-4010
LKH/JEB/mid
8/27/2020, 10/7/20, 10/26/20

Table L.3
Average Annual Total Suspended Solids Loads for the Oak Creek Watershed Taken from the RWQMPU

			Point Sources (pounds)			Nonpoint Sources (pounds)[a,b]			
Subwatershed	Assessment Areas	Condition	Industrial Point Sources	SSOs	Subtotal	Urban	Rural[c]	Subtotal	Total (pounds)
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	Existing (2000)	0	0	0	663,060	156,240	819,300	819,300
		Revised (2020) Baseline	0	0	0	513,460	10,710	524,170	524,170
		Recommended Plan (2020)	0	0	0	532,840	10,360	543,200	543,200
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	Existing (2000)	0	0	0	685,780	387,670	1,073,450	1,073,450
		Revised (2020) Baseline	0	0	0	528,200	102,730	630,930	630,930
		Recommended Plan (2020)	0	0	0	545,020	102,060	647,080	647,080
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	Existing (2000)	1,930	500	2,430	974,250	23,560	997,810	1,000,240
		Revised (2020) Baseline	1,930	500	2,430	689,780	3,970	693,750	696,180
		Recommended Plan (2020)	1,930	500	2,430	692,760	3,970	696,730	699,160
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	Existing (2000)	0	0	0	1,558,560	212,030	1,770,590	1,770,590
		Revised (2020) Baseline	0	0	0	1,169,670	50,010	1,219,680	1,219,680
		Recommended Plan (2020)	0	0	0	1,012,020	47,270	1,059,290	1,059,290
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	Existing (2000)	<10	0	<10	532,620	108,810	641,430	641,430
		Revised (2020) Baseline	<10	0	<10	438,880	29,820	468,700	468,700
		Recommended Plan (2020)	<10	0	<10	364,090	23,660	387,750	387,750
		Existing (2000)	1,930	500	2,430	4,414,270	888,310	5,302,580	5,305,010
	Watershed Total	Revised (2020) Baseline	1,930	500	2,430	3,339,990	197,240	3,537,230	3,539,660
		Recommended Plan (2020)	1,930	500	2,430	3,146,730	187,320	3,334,050	3,336,480

[a] *Certain apparent anomalies in the relationship between urban and nonpoint source loads are due to the manner in which the loads were apportioned. In those cases, the loads in the nonpoint subtotal column generally exhibit the anticipated relationships between conditions.*

[b] *In certain limited cases, relatively minor anomalies in nonpoint source pollutant loads may occur among the three conditions for which the model results are presented in this table. Those anomalies might indicate a relatively slight increased load under the recommended plan condition relative to the revised 2020 baseline. In those cases, it may be assumed that no significant change in pollutant load occurs among those conditions. Since it was not always possible to explicitly represent certain components of the recommended plan condition in the water quality model, adjustments were made to model parameters that served as surrogates for the actual water pollution control measures being represented. In the sense that these modifications sometimes alter parameters established under the revised 2020 baseline model version, in limited cases, representation of a measure in the recommended plan model may have a side effect of introducing small, relatively insignificant anomalies in the comparative results.*

[c] *For reporting purposes, certain land uses such as forests and wetlands have been categorized as rural sources even though they may exist in a predominantly urban setting.*

Source: Brown and Caldwell; Tetra Tech, Inc., and SEWRPC

#254799 – CAPR-330 - Table L.4 Fecal Coliform Bacteria Loads from the RWQMPU
300-4010
LKH/JEB/mid
8/27/20 10/7/2020, 10/26/20

Table L.4
Average Annual Fecal Coliform Bacteria Loads for the Oak Creek Watershed Taken from the RWQMPU

			Point Sources (trillion cells)			Nonpoint Sources (trillion cells)[a,b]			
Subwatershed	**Assessment Areas**	**Condition**	Industrial Point Sources	SSOs	Subtotal	Urban	Rural[c]	Subtotal	**Total (pounds)**
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	Existing (2000)	0.00	0.00	0.00	354.83	7.39	362.22	362.22
		Revised (2020) Baseline	0.00	0.00	0.00	310.06	6.17	316.23	316.23
		Recommended Plan (2020)	0.00	0.00	0.00	201.08	4.16	205.24	205.24
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	Existing (2000)	0.00	0.00	0.00	394.77	96.09	490.86	490.86
		Revised (2020) Baseline	0.00	0.00	0.00	357.33	100.90	458.23	458.23
		Recommended Plan (2020)	0.00	0.00	0.00	227.44	66.76	294.20	294.20
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	Existing (2000)	0.00	9.55	9.55	612.67	0.33	613.00	622.55
		Revised (2020) Baseline	0.00	9.55	9.55	493.55	0.10	493.65	503.20
		Recommended Plan (2020)	0.00	9.55	9.55	315.86	0.10	315.96	325.51
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	Existing (2000)	0.00	0.00	0.00	735.48	39.60	775.08	775.08
		Revised (2020) Baseline	0.00	0.00	0.00	646.58	47.39	693.97	693.97
		Recommended Plan (2020)	0.00	0.00	0.00	359.89	30.36	390.25	390.25
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	Existing (2000)	0.00	0.00	0.00	505.12	36.28	541.40	541.40
		Revised (2020) Baseline	0.00	0.00	0.00	524.29	28.76	553.05	553.05
		Recommended Plan (2020)	0.00	0.00	0.00	269.75	15.19	284.94	284.94
		Existing (2000)	0.00	9.55	9.55	2,602.87	179.69	2,782.56	2,792.11
	Watershed Total	Revised (2020) Baseline	0.00	9.55	9.55	2,331.81	183.32	2,515.13	2,524.68
		Recommended Plan (2020)	0.00	9.55	9.55	1,374.02	116.57	1,490.59	1,500.14

[a] *Certain apparent anomalies in the relationship between urban and nonpoint source loads are due to the manner in which the loads were apportioned. In those cases, the loads in the nonpoint subtotal column generally exhibit the anticipated relationships between conditions.*

[b] *In certain limited cases, relatively minor anomalies in nonpoint source pollutant loads may occur among the three conditions for which the model results are presented in this table. Those anomalies might indicate a relatively slight increased load under the recommended plan condition relative to the revised 2020 baseline. In those cases, it may be assumed that no significant change in pollutant load occurs among those conditions. Since it was not always possible to explicitly represent certain components of the recommended plan condition in the water quality model, adjustments were made to model parameters that served as surrogates for the actual water pollution control measures being represented. In the sense that these modifications sometimes alter parameters established under the revised 2020 baseline model version, in limited cases, representation of a measure in the recommended plan model may have a side effect of introducing small, relatively insignificant anomalies in the comparative results.*

[c] *For reporting purposes, certain land uses such as forests and wetlands have been categorized as rural sources even though they may exist in a predominantly urban setting.*

Source: Brown and Caldwell; Tetra Tech, Inc., and SEWRPC

#244865 – CAPR-330 - Table L.5 Total Nitrogen Pollutant Loads from the RWQMPU
300-4010
LKH/JEB/mid
8/27/20, 10/7/2020, 10/26/20

Table L.5
Average Annual Total Nitrogen Loads for the Oak Creek Watershed Taken from the RWQMPU

Subwatershed	Assessment Areas	Condition	Point Sources (pounds)			Nonpoint Sources (pounds)[a,b]			Total (pounds)
			Industrial Point Sources	SSOs	Subtotal	Urban	Rural[c]	Subtotal	
Upper Oak Creek	Oak Creek Headwaters, Upper Oak Creek	Existing (2000)	0	0	0	9,180	4,910	14,090	14,090
		Revised (2020) Baseline	0	0	0	9,000	1,140	10,140	10,140
		Recommended Plan (2020)	0	0	0	8,920	1,130	10,050	10,050
Middle Oak Creek	Middle Oak Creek, Oak Creek Drainage Ditches	Existing (2000)	0	0	0	9,240	13,810	23,050	23,050
		Revised (2020) Baseline	0	0	0	8,950	8,280	17,230	17,230
		Recommended Plan (2020)	0	0	0	8,920	8,290	17,210	17,210
Lower Oak Creek	Lower Oak Creek, Lower Oak Creek-Millpond, Grant Park Ravine	Existing (2000)	340	20	360	15,280	1,010	16,290	16,650
		Revised (2020) Baseline	340	20	360	13,320	380	13,700	14,060
		Recommended Plan (2020)	340	20	360	13,350	380	13,730	14,090
North Branch Oak Creek	Upper North Branch Oak Creek, Lower North Branch Oak Creek, College Avenue Tributary, Rawson Avenue Tributary, Drexel Avenue Tributary, Southland Creek	Existing (2000)	0	0	0	17,590	8,790	26,380	26,380
		Revised (2020) Baseline	0	0	0	16,500	4,490	20,990	20,990
		Recommended Plan (2020)	0	0	0	14,290	4,280	18,570	18,570
Mitchell Field Drainage Ditch	Lower Mitchell Field Drainage Ditch, Mitchell Field Drainage Ditch-Airport	Existing (2000)	<10	0	<10	9,360	7,580	16,940	16,940
		Revised (2020) Baseline	<10	0	<10	9,060	4,630	13,690	13,690
		Recommended Plan (2020)	<10	0	<10	7,340	3,740	11,080	11,080
		Existing (2000)	340	20	360	60,650	36,100	96,750	97,110
	Watershed Total	Revised (2020) Baseline	340	20	360	56,830	18,920	75,750	76,110
		Recommended Plan (2020)	340	20	360	52,820	17,820	70,640	71,000

[a] *Certain apparent anomalies in the relationship between urban and nonpoint source loads are due to the manner in which the loads were apportioned. In those cases, the loads in the nonpoint subtotal column generally exhibit the anticipated relationships between conditions.*

[b] *In certain limited cases, relatively minor anomalies in nonpoint source pollutant loads may occur among the three conditions for which the model results are presented in this table. Those anomalies might indicate a relatively slight increased load under the recommended plan condition relative to the revised 2020 baseline. In those cases, it may be assumed that no significant change in pollutant load occurs among those conditions. Since it was not always possible to explicitly represent certain components of the recommended plan condition in the water quality model, adjustments were made to model parameters that served as surrogates for the actual water pollution control measures being represented. In the sense that these modifications sometimes alter parameters established under the revised 2020 baseline model version, in limited cases, representation of a measure in the recommended plan model may have a side effect of introducing small, relatively insignificant anomalies in the comparative results.*

[c] *For reporting purposes, certain land uses such as forests and wetlands have been categorized as rural sources even though they may exist in a predominantly urban setting.*

Source: Brown and Caldwell; Tetra Tech, Inc., and SEWRPC

Community Assistance Planning Report No. 330

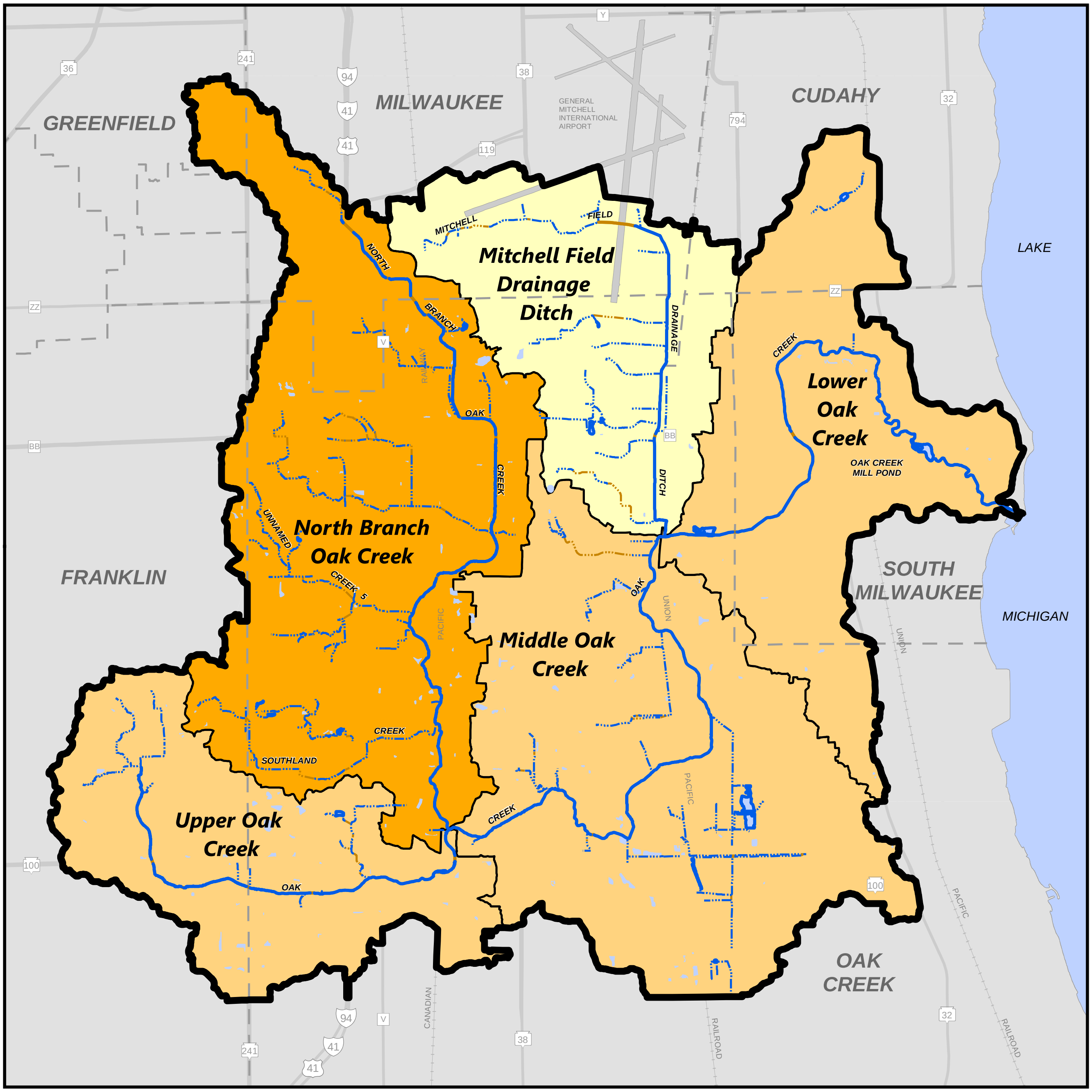
A RESTORATION PLAN FOR THE OAK CREEK WATERSHED

Appendix L

WATER QUALITY SIMULATION MODEL AND POLLUTANT LOADS FROM THE RWQMPU

MAPS

Map L.1
Estimated Average Annual Nonpoint Source Pollution Laods of Total Phosphorus in the Oak Creek Watershed



TOTAL PHOSPHORUS LOAD (lbs/yr) BY SUBWATERSHED

1,500 OR FEWER

1,501 - 3,000

3,001 - 4,500

OAK CREEK WATERSHED BOUNDARY

SUBWATERSHED BOUNDARIES

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

INTERMITTENT STREAM

INTERMITTENT STREAM (ENCLOSED)

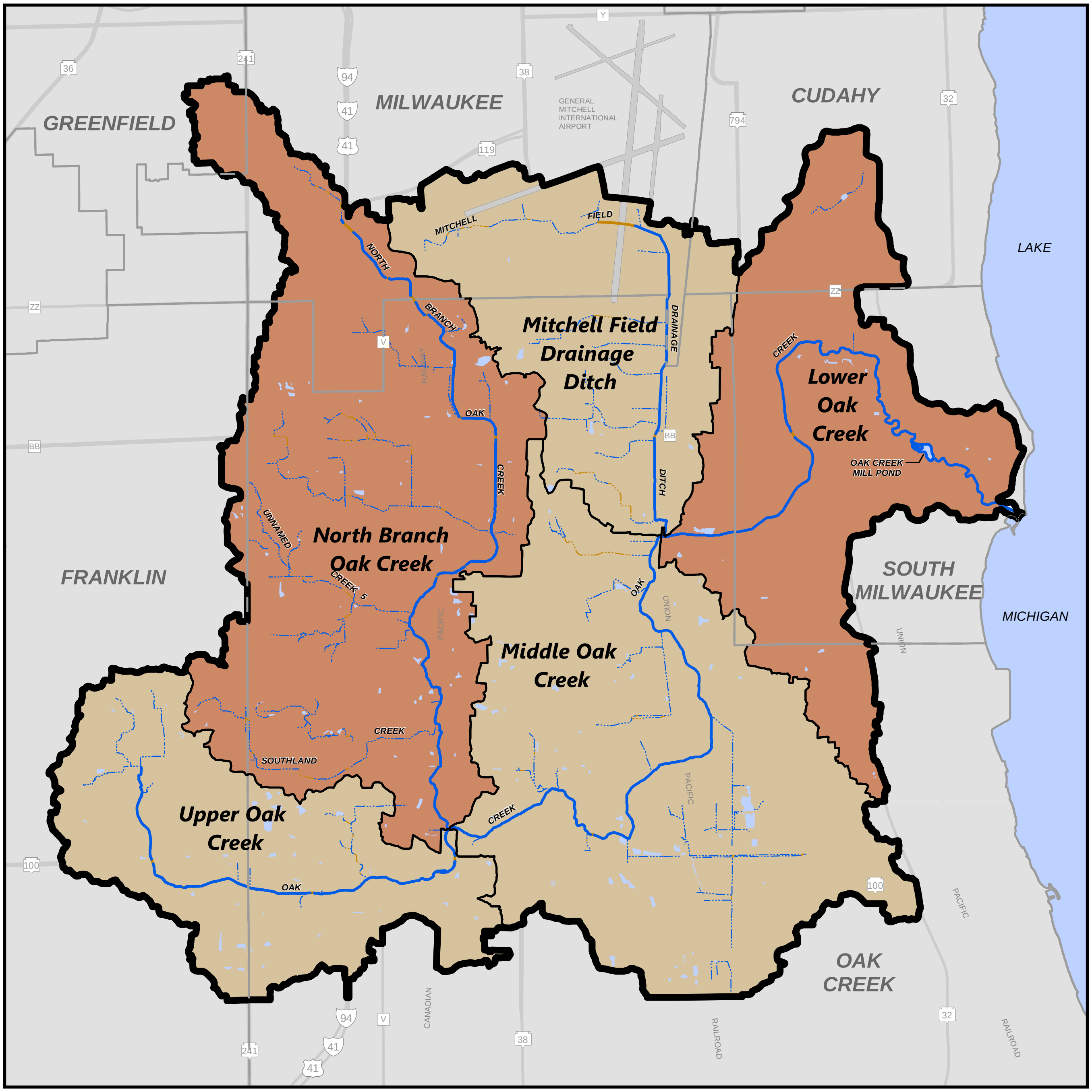
SURFACE WATER

N

0 0.25 0.5 1 Miles

Source: SEWRPC

Map L.2
Estimated Average Annual Per Acre Nonpoint Source Pollution Loads of Total Phosphorus in the Oak Creek Watershed



TOTAL PHOSPHORUS UNIT AREA LOAD (lbs/acre/yr)

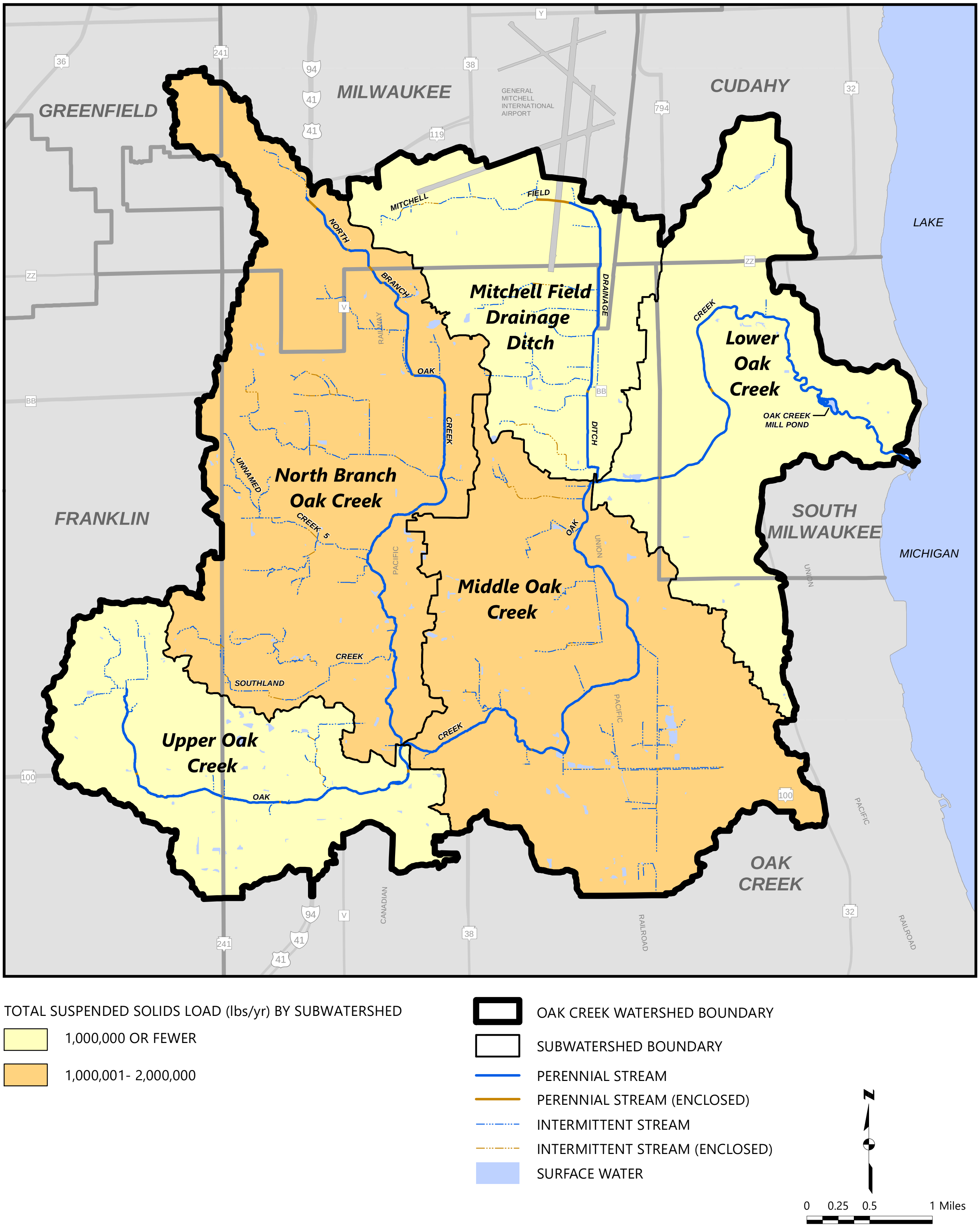
- 0.46 - 0.60
- 0.61 - 0.75

- OAK CREEK WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- PERENNIAL STREAM
- PERENNIAL STREAM (ENCLOSED)
- INTERMITTENT STREAM
- INTERMITTENT STREAM (ENCLOSED)
- SURFACE WATER

0 0.25 0.5 1 Miles

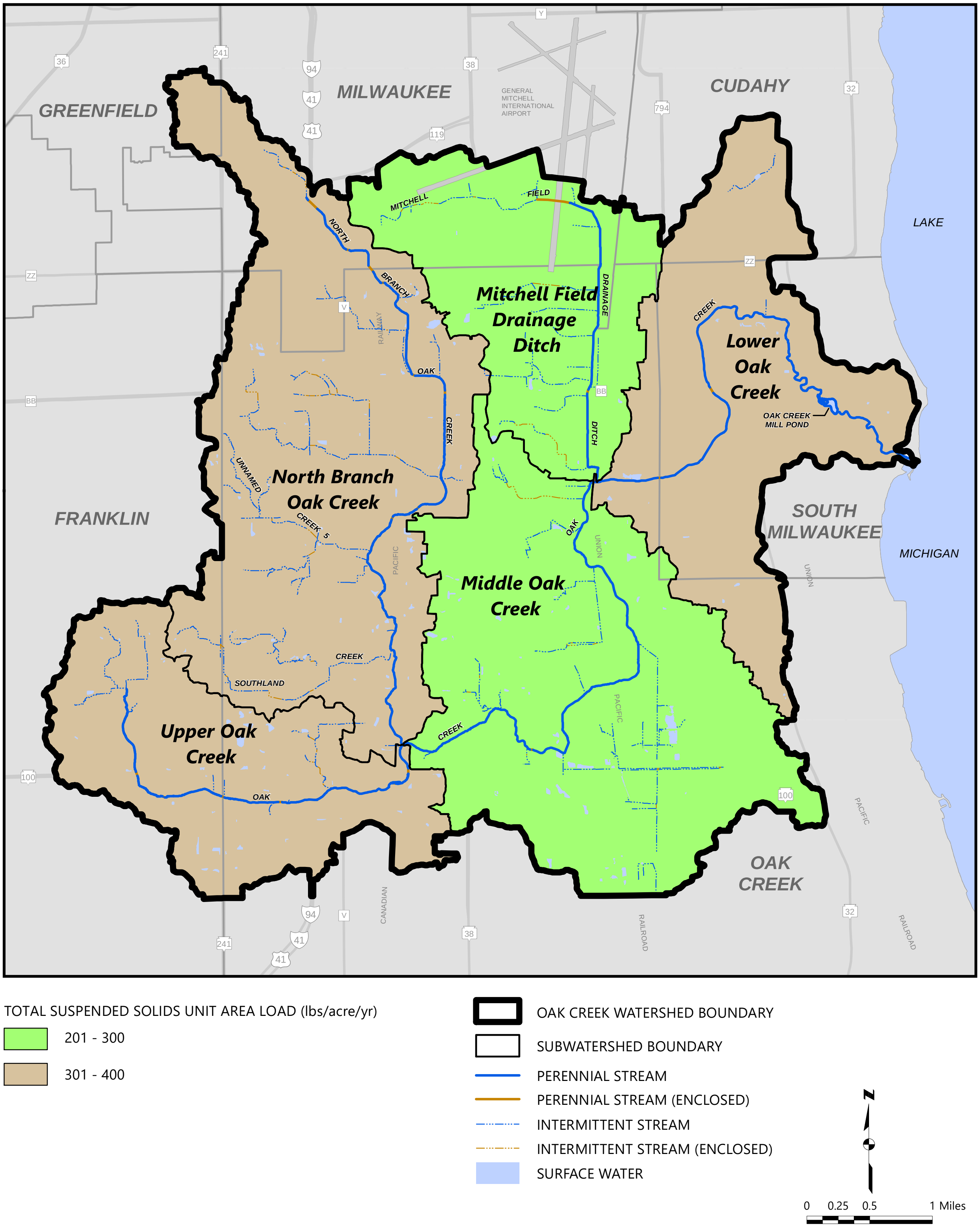
Source: SEWRPC

Map L.3
Estimated Average Annual Nonpoint Source Pollution Loads of Total Suspended Solids in the Oak Creek Watershed



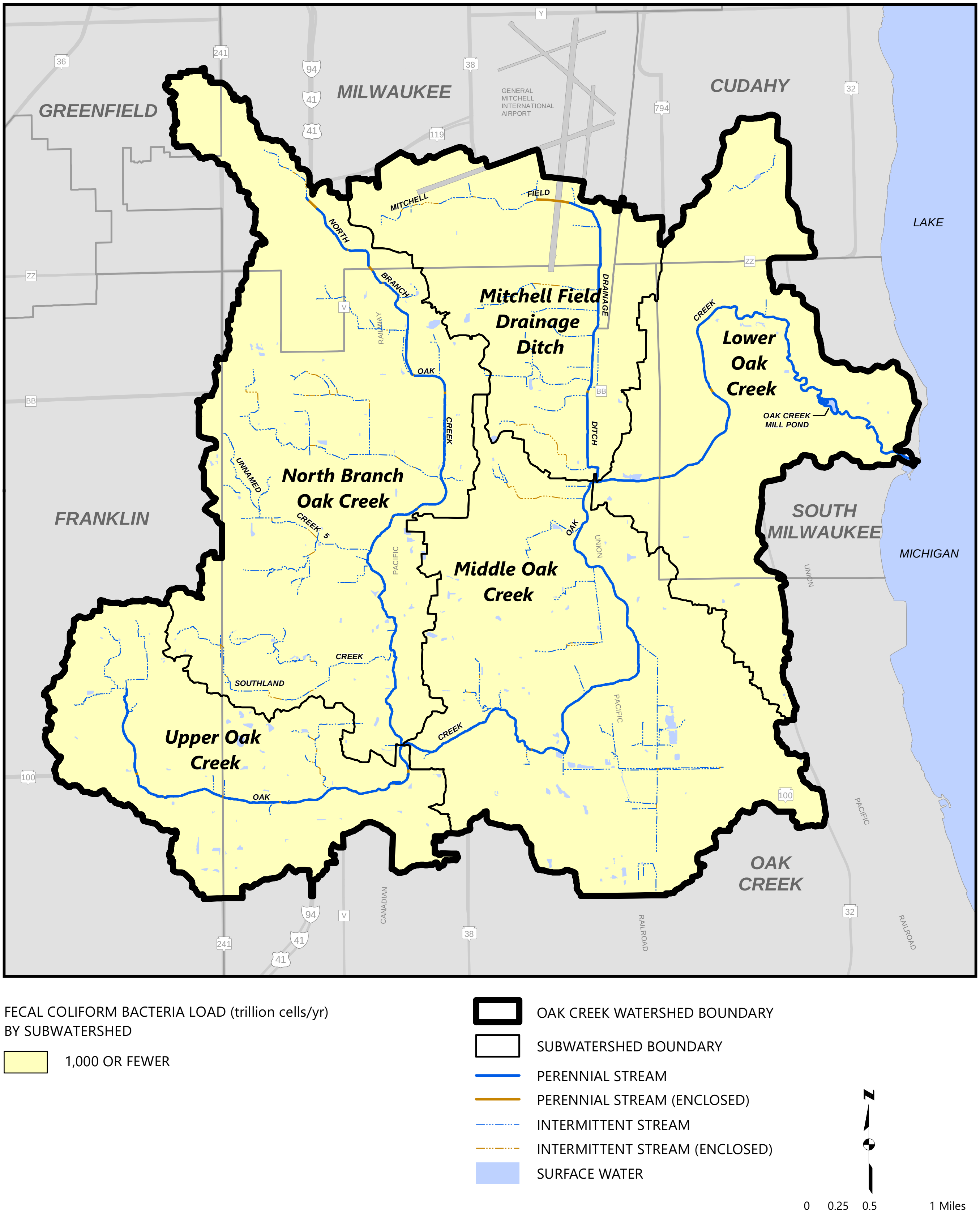
Source: SEWRPC

Map L.4
Estimated Average Annual Per Acre Nonpoint Source Pollution Loads of Total Suspended Solids in the Oak Creek Watershed



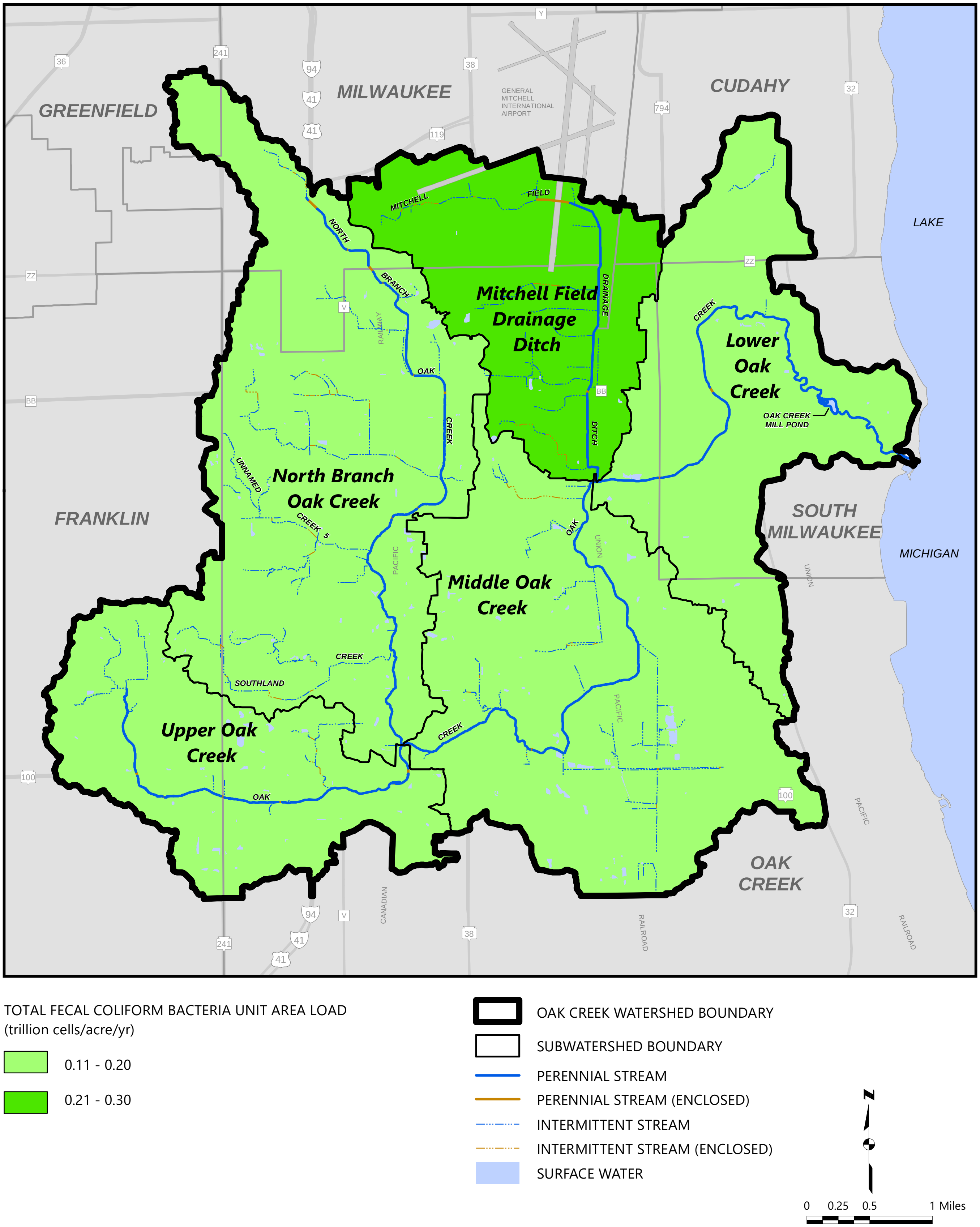
Source: SEWRPC

Map L.5
Estimated Average Annual Nonpoint Source Pollution Loads of Fecal Coliform Bacteria in the Oak Creek Watershed



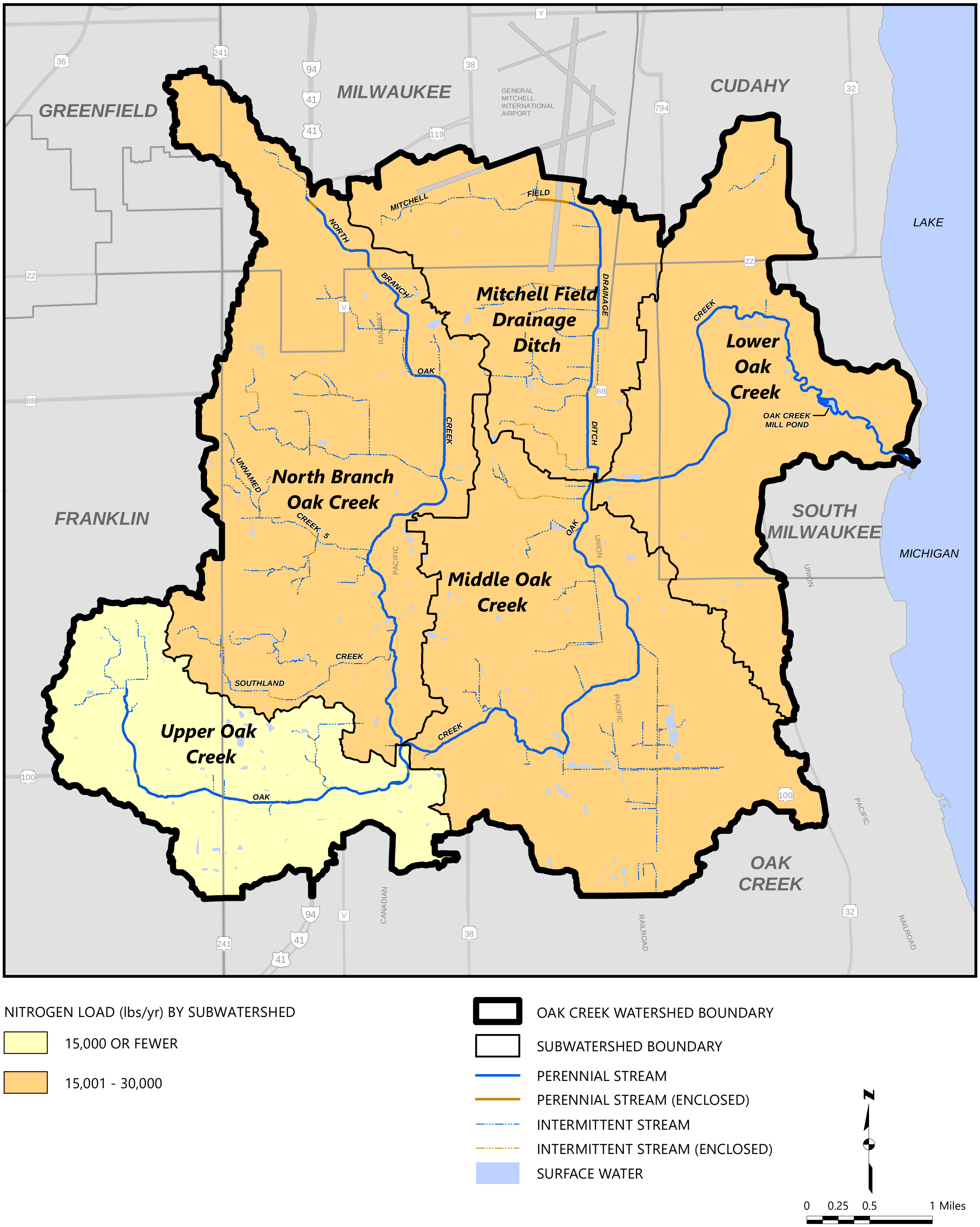
Source: SEWRPC

Map L.6
Estimated Average Annual Per Acre Nonpoint Source Pollution Loads of Fecal Coliform Bacteria in the Oak Creek Watershed



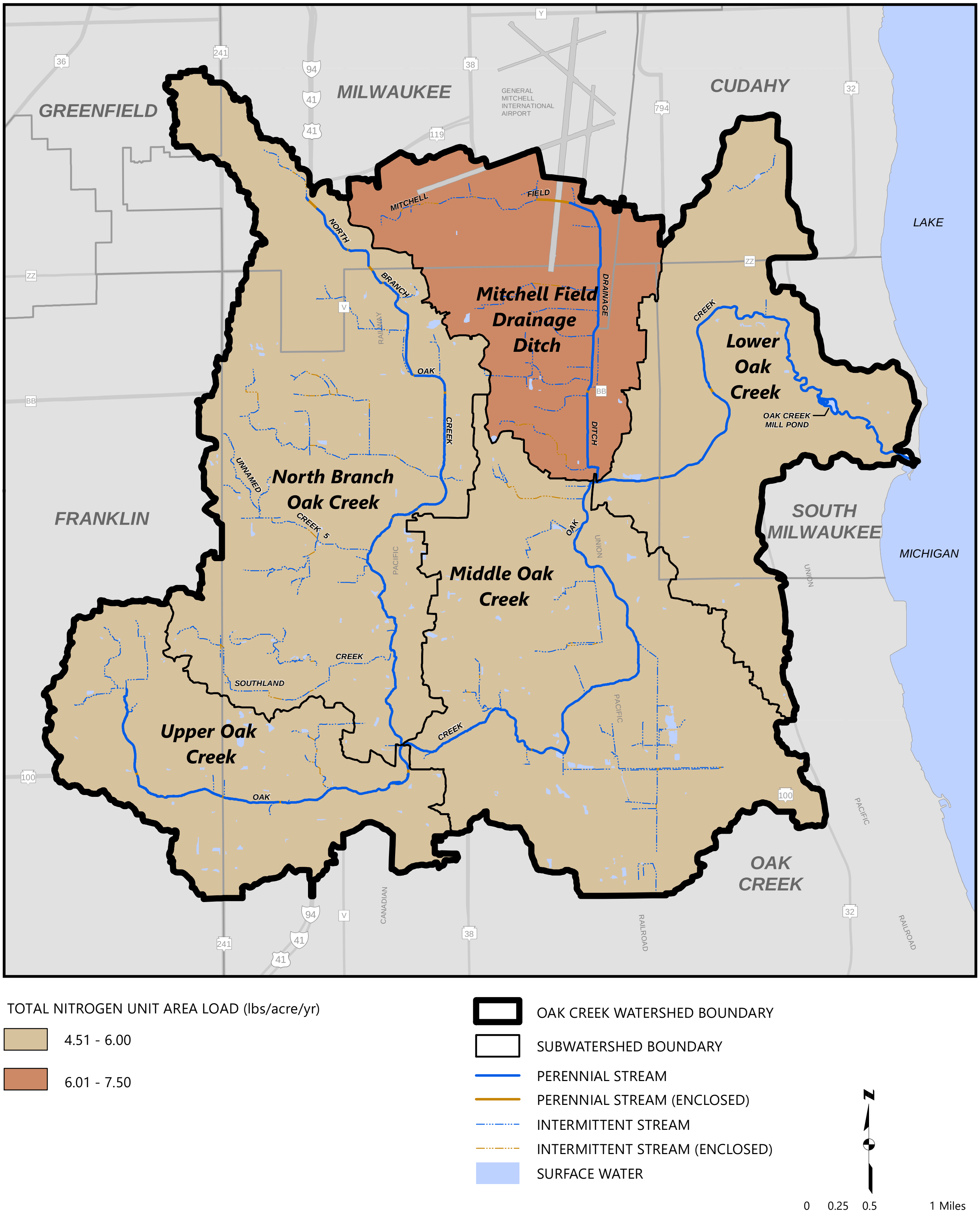
Source: SEWRPC

Map L.7
Estimated Average Annual Nonpoint Source Pollution Loads of Total Nitrogen in the Oak Creek Watershed



Source: SEWRPC

Map L.8
Estimated Average Annual Per Acre Nonpoint Source Pollution Loads of Total Nitrogen in the Oak Creek Watershed



Source: SEWRPC