Spring and Upper Prior Lake TMDL Implementation Plan

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Primary Authors and Contributors

Prior Lake-Spring Lake Watershed District
Nat Kale
Mike Kinney

Emmons & Olivier Resources, Inc.
Andrea Plevan
Jason Naber

Minnesota Pollution Control Agency
Chris Zadak

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Abbreviations

BMP	Best management practice
BWSR	Board of Water and Soil Resources
CIP	Capital improvement plan
DNR	Department of Natural Resources
LA	Load allocation
MDA	Minnesota Department of Agriculture
MnDOT	Minnesota Department of Transportation
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PLSLWD	Prior Lake-Spring Lake Watershed District
SWCD	Soil and Water Conservation District
SCWEP	Scott Clean Water Education Program
TMDL	Total maximum daily load
TP	Total phosphorus
TRPD	Three Rivers Park District
WLA	Wasteload allocation
WRMP	Water Resources Management Plan

1 INTRODUCTION

1.1 Background

The Federal Clean Water Act requires states to adopt water quality standards to protect the nation's waters. These standards define how much of a pollutant can be in a surface or ground water while still allowing it to meet its designated uses, such as for drinking water, fishing, swimming, irrigation, or industrial purposes. Many of Minnesota's water resources do not currently meet their designated uses because of pollution problems from a combination of point and non-point sources.

For each pollutant that causes a water body to fail to meet the state water quality standards, the Federal Clean Water Act requires that the Minnesota Pollution Control Agency (MPCA) conduct a total maximum daily load (TMDL) study. A TMDL study identifies both point and non-point sources of each pollutant that is causing a water quality impairment. Water quality sampling and computer modeling determine the pollutant reductions needed, for each pollutant source, to enable the water quality standard to be met. Individual water bodies may have several TMDLs, each one determining the limit for a different pollutant.

In 2002, Spring Lake and Upper Prior Lake were listed on Minnesota's 303(d) List of Impaired Waters for nutrient/eutrophication biological indicators (Table 1). Figure 1 and Figure 2 identify the lake and its watershed.

The following applies to both lakes:

Impaired Use: Aquatic recreation
Pollutant or Stressor: Nutrient/eutrophication biological indicators
Hydrologic Unit Code: 07020012

Table 1. TMDL Listing Information

Lake Name	Lake ID	Year Listed	Target Start/Completion	CALM Category*
Spring	70-0054	2002	2004/2010	5B
Upper Prior	70-0072	2002	2004/2010	5B

*5B: Impaired by multiple pollutants and at least one TMDL study plan (mercury, in this case) is approved by EPA

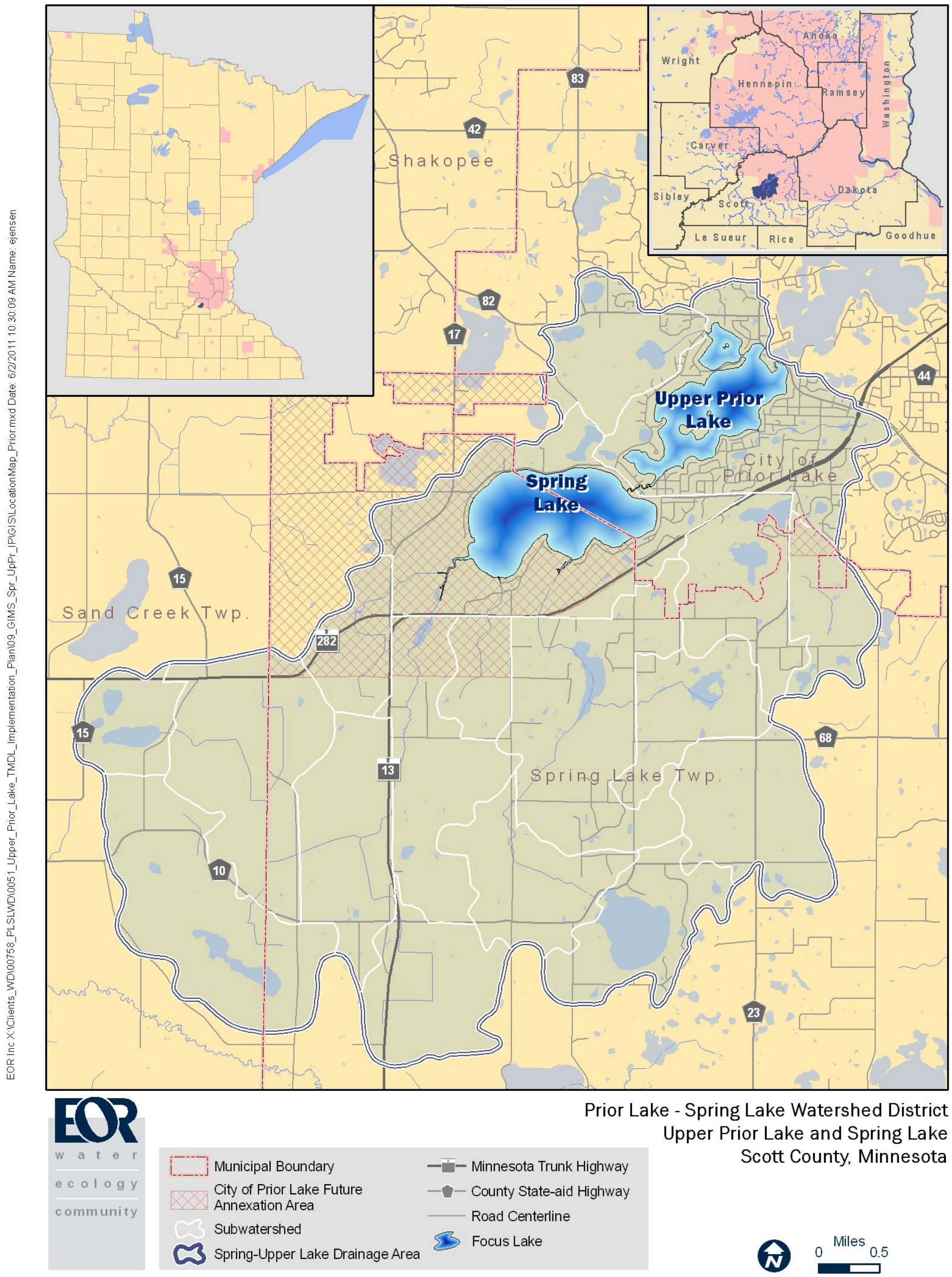

Figure 1. Spring Lake and Upper Prior Lake Watershed Location Map

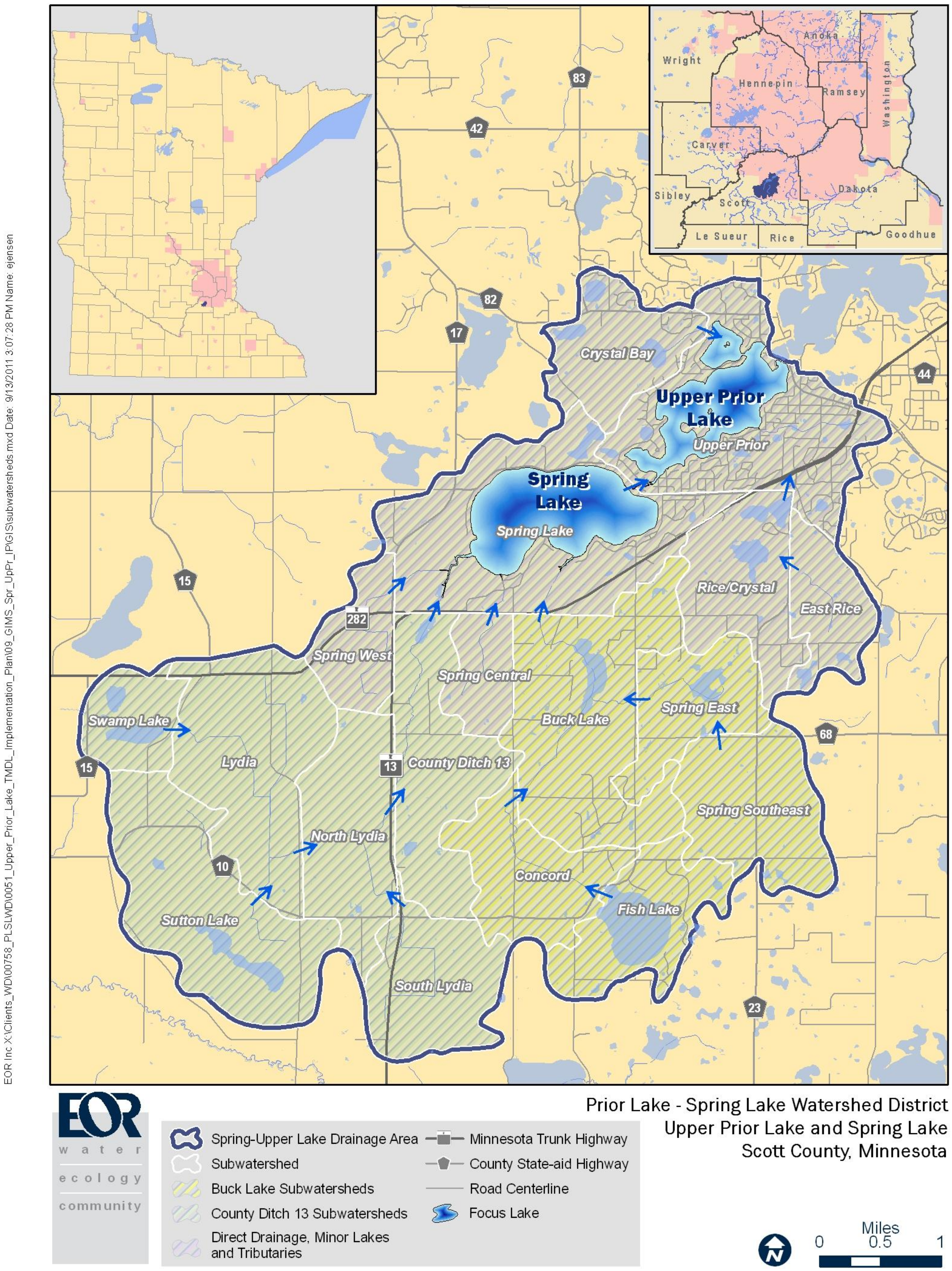

Figure 2. Spring Lake and Upper Prior Lake Subwatersheds

1.2. Existing Water Quality and Standards

Spring Lake is a eutrophic to hypereutrophic lake, and does not meet any of the three state eutrophication standards (Table 2, Figure 3). Spring Lake has a surface area of 642 acres and a watershed area of 12,670 acres (approximately 20 square miles). Its mean depth is approximately 16 feet and its maximum depth is 35 feet, classifying it as a lake (as opposed to a shallow lake) for purposes of MPCA standards.

The phosphorus loads to Spring Lake are from the following:

- Watershed runoff, from agricultural, developed, and undeveloped areas (47%)
- Internal loading within Spring Lake, including the load from rough fish and curly-leaf pondweed (49%)
- Atmospheric load and septic systems (4%)

Table 2. Spring Lake Water Quality Data Summary
1997-2006 averages were used in the TMDL

Parameter	1997 – 2006 average*	Standard
Total Phosphorus	118 µg/l	<= 40 µg/l
Chlorophyll-*a*	58 µg/l	<= 14 µg/l
Secchi Depth	1.0 m	>= 1.4 m

*Average of annual growing season mean (June – September)

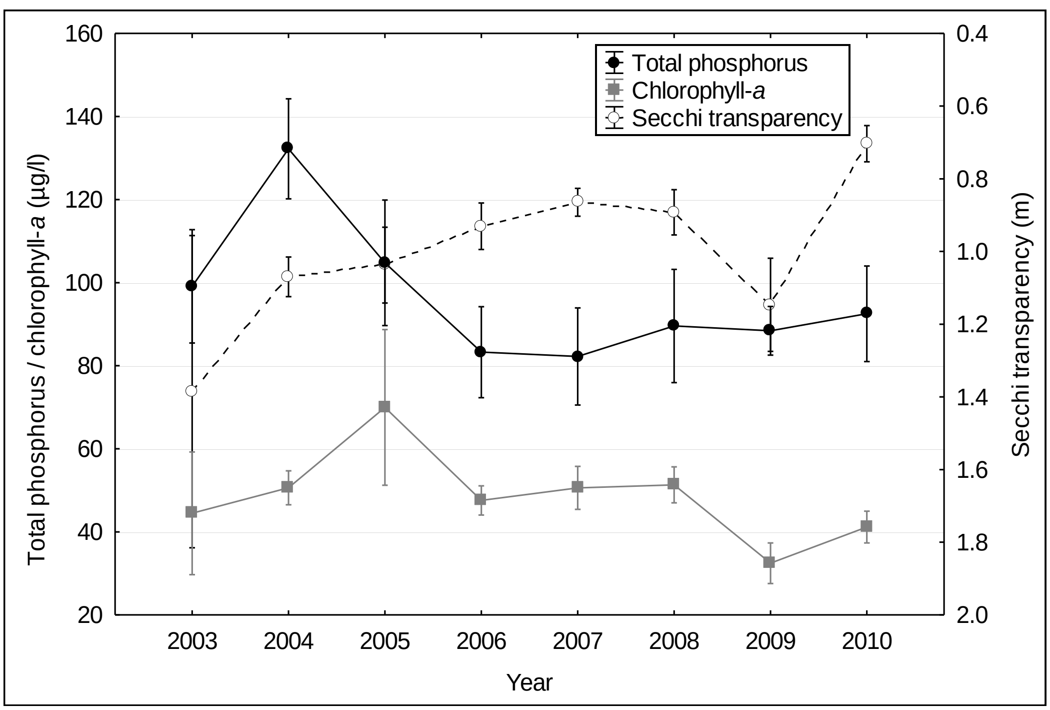

Figure 3. Spring Lake Phosphorus Concentrations, 2003 – 2010
Growing season mean +/- standard error, surface water.

Upper Prior Lake is a eutrophic to hypereutrophic lake, and barely meets one of the three state eutrophication standards (Table 3, Figure 4). Upper Prior Lake has a surface area of 337 acres and a watershed area of 16,116 acres (approximately 25 square miles). Its mean depth is approximately 11 feet and its maximum depth is 45 feet. 81% of its area is characterized as littoral, or less than 15 feet deep, which classifies Upper Prior Lake as a shallow lake.

The phosphorus loads to Upper Prior Lake are from the following:

- Loading from Spring Lake and other upstream lakes (42%), which includes watershed runoff from agricultural, developed, and undeveloped areas.
- Internal loading within Upper Prior Lake, including the load from rough fish and curly-leaf pondweed (50%).
- Direct watershed load, atmospheric load, and septic systems (8%)

Table 3. Upper Prior Lake Water Quality Data Summary
1997-2006 averages were used in the TMDL

Parameter	1997 – 2006 average*	Standard
Total Phosphorus	80 µg/l	60 µg/l
Chlorophyll-*a*	63 µg/l	20 µg/l
Secchi Depth	1.0 m	1.0 m

*Average of annual growing season mean (June – September)

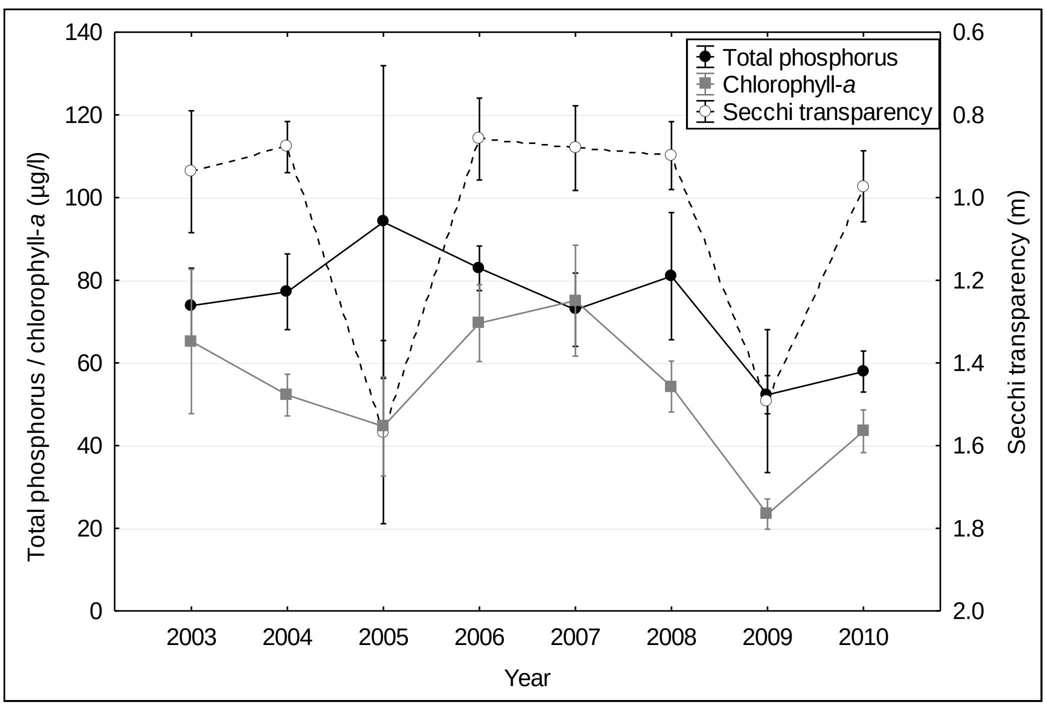

Figure 4. Upper Prior Lake Phosphorus Concentrations, 2003 – 2010
Growing season mean +/- standard error, surface water.

2 DERIVATION OF TMDL ALLOCATIONS

This section is a summary of the derivation of the TMDL allocations described in the TMDL report. The methods and assumptions used to calculate the wasteload and load allocations are described here briefly. For additional information please refer to the TMDL report.

2.1 Phosphorus Loads

The phosphorus loads to the impaired lakes were determined using the following approach:

- Watershed runoff volumes were estimated with results from an XP-SWMM model that was calibrated to lake level data and measured evaporation data.
- Loads from watershed runoff were estimated using phosphorus export coefficients (mass of phosphorus per unit area), which varied based on soils, slope, and land use.
- Loads from subwatersheds that drain through select lakes were estimated using monitored in-lake concentration and modeled outflow volume.
- It was assumed that the ferric chloride treatment system at County Ditch 13 removes 30% of the total phosphorus load to it[1].

Table 4 presents the subwatershed phosphorus loading to the impaired lakes. The calculations take into account the 30% removal at the County Ditch 13 system, and were performed using 1997 – 2006 data.

[1] Barr Engineering. 2003. Final Technical Memorandum #1—County Ditch 13 Wetland and Ferric Chloride System Sediment and Phosphorus Removal Performance Assessment. Prepared for Prior Lake-Spring Lake Watershed District, Prior Lake, MN.

Table 4. Subwatershed Phosphorus Loads

Lake Watershed	Subwatershed	Area (ac)	TP Load (lb/yr)	TP Loading Rate (lb/ac-yr)
Prior	Crystal Bay*	650	219	0.34
Prior	East Rice*	444	185	0.42
Prior	Rice Crystal*	746	104	0.14
Prior	Upper Prior	1580	418	0.26
Spring	Swamp Lake°	394	155	0.39
Spring	Lydia°	1263	490	0.39
Spring	Sutton Lake°	1379	471	0.34
Spring	South Lydia°	752	377	0.50
Spring	North Lydia°	850	347	0.41
Spring	County Ditch 13°	970	367	0.38
Spring	Fish*	713	233	0.33
Spring	Concord	717	457	0.64
Spring	Spring Southeast	849	269	0.32
Spring	Spring East	602	235	0.39
Spring	Buck Lake	1474	552	0.37
Spring	Spring West	413	370	0.90
Spring	Spring Central	318	364	1.14
Spring	Spring Lake	1925	485	0.25

*Loads based on in-lake concentrations and lake outflow volume; included under “upstream lakes” load in allocation tables.
°Loads take into account 30% reduction at County Ditch 13 ferric chloride treatment system

2.2. Loading Capacity

To calculate the loading capacity, an in-lake model was developed using selected equations from Bathtub[2]. The model was calibrated to existing water quality data (1997 – 2006), and then was used to determine the phosphorus loading capacity of the lake under the state standard. The modeling approach is detailed in Section 4 of the TMDL report.

The loading capacity of the lake is the TMDL; the TMDL was then split up into wasteload allocations (WLAs) and a load allocation (LA). The margin of safety (MOS) was implicit in the TMDL calculations.

The following describes how the loading capacity for Spring Lake was allocated:

- The internal loading rate was reduced from 17 to 2 mg/m^2-day, which is a rate considered typical of mesotrophic lakes.
- The watershed load was reduced until the in-lake TP (total phosphorus) standard was met.

The following describes how the loading capacity for Upper Prior Lake was allocated:

- It was assumed that Spring Lake and other upstream lakes will meet state standards, and loads from upstream lakes were calculated accordingly. (Separate TMDL studies may be required for some of the upstream lakes.)

[2] Walker, W. W. 1996. Simplified procedures for eutrophication assessment and prediction: User manual. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

- The watershed load was held at existing conditions.
- The internal loading rate was reduced until the lake met the standard.

The TMDL was first determined in terms of annual loads. In-lake water quality models predict annual averages of water quality parameters based on annual loads. Symptoms of nutrient enrichment normally are the most severe during the summer months; the state eutrophication standards were established with this seasonal variability in mind. The annual loads were converted to daily loads by dividing the annual loads by 365.25.

2.3. Wasteload Allocations

A combination of individual and categorical WLAs was set for the regulated sources. The regulated sources include the City of Prior Lake/Spring Lake Township, Scott County, the Minnesota Department of Transportation (MnDOT), and construction and industrial stormwater. A categorical WLA is provided for the City of Prior Lake/Spring Lake Township, Scott County, construction stormwater, and industrial stormwater, and an individual WLA is provided for MnDOT.

The categorical WLA applies to the entire portion of the City of Prior Lake that is within the lakes' watersheds. The categorical WLA also applies to the areas currently in Spring Lake Township that are within the City of Prior Lake's future annexation area (as received by the City of Prior Lake on August 24, 2011). The City of Prior Lake's portion of the Spring Lake categorical WLA includes area currently within Spring Lake Township that will ultimately be annexed by the city. Until annexation occurs, Spring Lake Township is responsible for that portion of the WLA. For the foreseeable future, development within the lakesheds is anticipated to occur within the annexation area, and therefore within the WLA.

Although the MS4 (Municipal Separate Storm Sewer System) permit for MnDOT applies to its right-of-way (ROW) within the Urban Area as defined by the US Census, the ROW areas within the entire watershed were included in MnDOT's WLAs to allow for expansion of the Urban Area.

2.4. Load Allocations

One load allocation was set for each lake. The load allocation includes phosphorus sources from watershed runoff not regulated by an MS4 permit, internal loading, septic systems, and atmospheric deposition.

2.5. Allocation Summary

Table 5 and Table 6 (from Tables 5.3 and 5.4 in the TMDL report) summarize the TMDL allocations for Spring Lake and Upper Prior Lake, respectively.

Table 5. Spring Lake TMDL Allocations and Reductions Needed

Allocation type	Phosphorus source	Existing load (lb/yr)	Allocation		Reduction (lb/yr)	Reduction (%)
			(lb/yr)	(lb/day)		
WLA	MnDOT	43.8	15.9	0.04	28	64%
	City of Prior Lake Scott County Construction stormwater Industrial stormwater	1308.2	472.1	1.3	836	64%
LA	Upstream lake	63	63	0.2	0	0%
	Watershed load	3,595	636	1.7	2,959	82%
	Septic	263	0	0	263	100%
	Atmospheric	30	30	0.1	0	0%
	Internal	5,161	607	1.7	4,554	88%
Total load		*10,464*	*1,824*	*5.04*	*8640*	*83%*

Table 6. Upper Prior Lake TMDL Allocations and Reductions Needed

Allocation type	Phosphorus source	Existing load (lb/yr)	Allocation		Reduction (lb/yr)	Reduction (%)
			(lb/yr)	(lb/day)		
WLA	MnDOT	36.4	36.4	0.1	0	0%
	City of Prior Lake Scott County Construction stormwater Industrial stormwater	382.6	382.6	1.0	0	0%
LA	Upstream lake	2,179	611	1.7	1,568	72%
	Septic	4	0	0	4	100%
	Atmospheric	16	16	0.04	0	0%
	Internal	2,598	2,027	5.5	571	22%
Total load		*5,216*	*3,073*	*8.34*	*2,143*	*41%*

2.6. Individual Target Loads for Permitted Sources

The TMDL does not present individual WLAs for each of the permitted stormwater sources. To facilitate demonstration of progress towards meeting the TMDL loading goals, individual load reduction goals are presented here. Percent load reductions for all permitted stormwater sources are the same; these percent reductions will be used as individual target loads (Table 7). Construction and industrial stormwater are not included here; construction and industrial stormwater activities are considered in compliance with the WLA if they are meeting the conditions of the applicable NPDES (National Pollutant Discharge Elimination System) permit.

Table 7. Individual Target Loads for Permitted Sources

Permittee	Spring Lake TMDL Load Reduction Goal	Upper Prior Lake TMDL Load Reduction Goal
City of Prior Lake	64%	0%
Spring Lake Township	64%	0%
Scott County	64%	0%
MnDOT	64%	0%

3 IMPLEMENTATION PARTNERS

To improve the water quality within Upper Prior Lake and Spring Lake and meet the goals of the TMDL, reductions in TP loading will be needed from external and internal pollutant sources. To achieve these goals, a variety of measures will be implemented in the upcoming twenty years (See *Chapter 8: Adaptive Management*). Multiple partners will be involved in this implementation process, and a coordinated effort will be needed to successfully carry out the implementation plan.

The Prior Lake-Spring Lake Watershed District) PLSLWD will lead the coordinated effort to improve the water quality in each lake. Multiple partners will provide guidance and implement actions, as appropriate, as outlined in this implementation plan. The PLSLWD will coordinate and lead meetings with implementation partners.

The PLSLWD will work closely with a core group of partners on data collection and project implementation. These core partners include:

- City of Prior Lake
- Spring Lake Township
- Minnesota Department of Transportation (MnDOT)
- Scott County
- Scott Soil and Water Conservation District
- Minnesota Pollution Control Agency (MPCA)
- Board of Water and Soil Resources (BWSR)
- Minnesota Department of Natural Resources (DNR)

A combination of funding mechanisms will be needed to implement projects and programs identified in this plan. The PLSLWD has identified projects, programs, and capital improvements within the *Water Resources Management Plan for the Prior Lake-Spring Lake Watershed District 2010-2019* (April 2010). The City of Prior Lake and Spring Lake Township also have defined programs, projects, and capital improvements. Programs, projects, and capital improvements may be funded locally by the partners through in-kind staff time, capital improvement plans, and other mechanisms. In addition, grant funding may be pursued. A particular target for grant funding is the Minnesota Clean Water Legacy Program, which made funding available for TMDL implementation activities.

4 IMPLEMENTATION APPROACH

The approach to implementation builds on the PLSLWD Comprehensive Water Resources Management Plan, the City of Prior Lake's capital improvement program and plans, and the Spring Lake Township plans in combination with input from project partners and stakeholders. The implementation plan incorporates load reduction activities identified by the PLSLWD in their Capital Improvement Plan (CIP), load reduction activities identified by local government units in their local water management plans and CIPs, and additional projects and programs identified during implementation plan development.

This implementation plan presents a menu of options (discussed in Section 5) that can be used to meet the wasteload and load allocations of the TMDL to allow for flexibility in implementation and the adaptive management process (see *Chapter 8: Adaptive Management*).

Three steps were taken to develop the implementation plan. First, implementation activities were identified within the PLSLWD Watershed Management Plan. Second, municipal capital improvement plans, local water plans, and municipal comprehensive plans were reviewed where available. Thirdly, additional implementation activities were identified as part of the stakeholder input process.

The stakeholder input process for this implementation plan included meetings and electronic correspondence. The following organizations and municipalities were invited to participate in stakeholder input activities:

- City of Prior Lake
- Spring Lake Township
- Minnesota Department of Transportation (MnDOT)
- Scott County
- Scott Soil and Water Conservation District
- Minnesota Pollution Control Agency (MPCA)
- Board of Water and Soil Resources (BWSR)
- Minnesota Department of Natural Resources (DNR)

The following steps were taken to facilitate input from the public and project partners:

<u>March 9, 2010- PLSLWD Board Meeting</u>- Presentation of project scope of work and discussion by Board of Managers to initiate project.

<u>May 20, 2010- PLSLWD/Spring Lake Township Joint Board Meeting</u>. At this meeting, a presentation was given for the Board members, staff, and the public that detailed the results of a BMP (best management practice) assessment project conducted by the PLSLWD. The presentation covered a range of BMP options to be used in the upper watershed to reduce runoff volume and nutrient loading to Spring and Upper Prior Lakes.

February 15, 2011- PLSLWD Public Meeting. This was a public meeting held at the City of Prior Lake city hall. The purpose of the meeting was to update the public on District activities and solicit interested parties for their Citizen Advisory Committee. Topics included a range of items and particularly, water quality. BMPs and watershed management to improve water quality was a primary focus of the meeting. The TMDL and TMDL Implementation Plan were included as specific topics in the public meeting.

May 10, 2011- PLSLWD Board Meeting. A TMDL IP update was provided to the Board of Managers. The Board of Managers reviewed the project timeline in light of the prolonged TMDL approval process. With the understanding that the TMDL approval was imminent, the Board of Managers recommended the TMDL IP process be reinvigorated. Specifically, the Board requested the timeline for IP development be expedited.

August 15, 2011 - Stakeholder Input Meeting. A meeting was held with stakeholders (MS4s, agencies, etc.) to get input on the proposed TMDL IP concepts and to solicit ideas for specific projects and programs for their jurisdictions (city, township, etc.).

December 19, 2011 - Stakeholder Input Meeting. A meeting was held with MS4s to review the draft implementation plan and GIS loading tool.

February 14, 2011 - Public Input Meeting. The Prior Lake Spring Lake Watershed District will present the draft implementation plan at a public meeting prior to submittal to MPCA.

As CIPs are revised and projects are implemented, this plan will require revision to stay up to date. The PLSLWD will regularly update this plan with revised timelines, new projects and programs, and estimated load reductions from partner activities.

5 IMPLEMENTATION ACTIVITIES

The identified implementation activities are intended to reduce nutrient loads to Spring Lake and Upper Prior Lake so that the lakes will meet water quality standards. Spring Lake requires an 83% reduction in total phosphorus to meet in-lake water quality standards and Upper Prior Lake requires a 41% reduction to meet in-lake goals. The planned activities will address both the wasteload and the load reductions and are grouped into four categories: regulation, programs and projects, operation and maintenance, and education as discussed further below.

The TMDL was based on data through 2006; therefore any activities implemented during or after 2007 that lead to a reduction in phosphorus loads to the lake or an improvement in lake water quality may be considered as progress towards meeting a WLA or LA.

5.1 Regulation

State and local regulations establish standards that serve to protect and improve the water quality of lakes. These regulations typically establish standards for the management of construction sites to limit offsite transport of sediments, the management of stormwater runoff from new development and redevelopment, and the ongoing maintenance of stormwater systems. This section describes existing regulations, in addition to a plan to update the PLSLWD Rules. Regulation as is will not be tracked as load reductions to meet the TMDL, but rather the individual projects that the regulation leads to may be counted as progress towards meeting an allocation, if completion of the project results in a net reduction of phosphorus in watershed runoff.

5.1.1 PLSLWD Rules

The PLSLWD Rules, adopted in 2003, include a stormwater management rule and an erosion and sediment control rule as well as rules related to floodplain alteration, wetland alteration and buffers, bridge and culvert crossings, and drainage alterations. The stormwater management rule requires installation of permanent BMPs to control runoff rates and volumes and to result in a 60% reduction in total phosphorus from the site. The erosion and sediment control rule requires that sites under construction provide stabilization of disturbed soils and capture eroded sediments. The complete watershed rules can be found on the PLSLWD website (http://www.plslwd.org/pdf/district_rules.pdf). The PLSLWD will continue to primarily rely upon municipalities with approved Local Water Management Plans to permit new development and redevelopments into the foreseeable future. The PLSLWD will work cooperatively with Memorandum of Agreement (MOA) permitting partners through the Development Review Committees to incorporate water quality and quantity BMPs on new development and redevelopment. The PLSLWD plans to update its rules in the near future.

5.1.2 City of Prior Lake Ordinances

The City of Prior Lake has ordinances that establish standards for erosion and sediment control and stormwater management, both of which reference the City’s Public Works Design Manual from 2007. The manual defines standards for rate control, volume control, and water quality. The water quality standard is a 60% reduction in total phosphorus.

5.1.3 County Regulations

5.1.3.1 Animal Feeding Operations

Minnesota Rule 7020 promulgated by the MPCA governs animal feeding operations. Scott County accepted delegation of the Feedlot Program from the MPCA on January 22, 2002.

5.1.3.2 Septic Systems

Scott County Ordinance #4 governs Subsurface Sewage Treatment Systems in the Upper Prior Lake and Spring Lake drainage areas.

5.1.3.3 Erosion and Sediment Control and Construction of Stormwater BMPs

Scott County issues permits on behalf of the townships. Chapter 6 of the county's zoning ordinance (ordinance #3) addresses stormwater management, erosion control, and wetlands.

5.1.3.4 Planned Unit Development

Scott County introduced a Planned Unit Development process during their 2030 Comprehensive Plan process that allows greater flexibility for developers in exchange for increased public values, including regional stormwater facilities, natural area corridors, and wetland restoration. The PLSLWD is interested in working with Scott County to alleviate any potential disincentives to natural resource restoration on land that is not scheduled for redevelopment in the short term that this process may create.

5.1.4 State Regulations

5.1.4.1 NPDES MS4 Permits

MS4s are defined by the Minnesota Pollution Control Agency (MPCA) as conveyance systems owned or operated by an entity such as a state, city, town, county, district, or other public body having jurisdiction over disposal of stormwater or other wastes. A conveyance system includes ditches, roads, storm sewers, stormwater ponds, etc. Certain MS4 discharges are regulated by NPDES/SDS permits administered by the MPCA. The MS4 General Permit (MNR040000) issued in 2006 expired on May 31, 2011; permittees are expected to operate under the conditions of the expired permit until the new permit is approved. The new permit is currently under development.

Projects that result in a net reduction of phosphorus loads to either lake that are within an area that is regulated by the MS4 permit will count as progress towards meeting the WLA of that entity (i.e. City of Prior Lake, Spring Lake Township, Scott County, or MnDOT). Until the WLA is met, all entities that are part of the WLA (categorical or individual) will need to show progress towards meeting the WLA.

5.1.4.2 NPDES Construction Permits

Construction sites can contribute substantial amounts of sediment and phosphorus to watershed runoff. The NPDES/SDS Construction Stormwater Permit (MNR100001) administered by the MPCA requires that all construction activity disturbing areas equal to or greater than one acre of land must obtain a permit and create a Stormwater Prevention Pollution Plan (SWPPP) that outlines how runoff pollution from the construction site will be minimized during and after construction. Construction stormwater permits cover construction sites throughout the duration of the construction activities, and the level of on-going construction activity varies.

To meet the WLA for construction stormwater, construction storm water activities are required to meet the conditions of the Construction General Permit under the NPDES program and properly select, install and maintain all BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

5.1.4.3 NPDES Industrial Permits

The NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR50000) applies to facilities with Standard Industrial Classification Codes in 29 categories of industrial activity with the potential for significant materials and activities to be exposed to stormwater. Significant materials include any material handled, used, processed, or generated that when exposed to stormwater may leak, leach, or decompose and be carried offsite. The permit identifies a phosphorus benchmark monitoring value for facilities within certain sectors that are known to be phosphorus sources.

To meet the WLA for industrial stormwater, industrial storm water activities are required to meet the conditions of the industrial stormwater general permit or General Sand and Gravel general permit (MNG49) under the NPDES program and properly select, install and maintain all BMPs required under the permit.

5.2 Programs and Projects

Municipalities and other local and regional governments implement projects and capital improvements that are intended to reduce nutrient loads to local lakes. These projects include the planning and construction of BMPs, management of in-lake conditions, and other activities to address watershed loads. Planned projects are summarized below.

5.2.1 PLSLWD Projects

These projects include efforts to decrease the watershed load and the internal load of Spring and Upper Prior Lake. Detail on the selection of internal load management options is presented in *Appendix A: Options for reducing internal loading of P in Spring Lake and Upper Prior Lake*.

5.2.1.1 Infiltration Enhancement Pilot Project

The District plans to complete a feasibility study and several commercial and residential development projects demonstrating various soil enhancement methods and techniques for preserving and improving soil permeability to enhance infiltration.

5.2.1.2 Storage and Infiltration Projects

The District cost-shares or funds small projects to reduce runoff, increase infiltration, and reduce pollutant loading and transport directly to Spring and Upper Prior Lakes. PLSLWD provides grants for the implementation of water management projects on private property. Projects can be shoreline restoration, rain gardens, or innovative projects.

5.2.1.3 Spring Lake Internal Load Management Project

Based on the clear presence of internal loading in Spring Lake due to anoxic conditions in the hypolimnion and its apparent negative influence on water quality, in addition to the substantial reduction in internal loading needed to meet the TMDL allocations, an alum treatment in Spring Lake is recommended. An alum treatment done in the same year that the lake has also been treated for curly-leaf pondweed could have the added benefit of improving conditions for native plants to flourish.

5.2.1.4 Highway 13 Wetland Treatment System and Desiltation Pond Operation, Maintenance, & Enhancement

Operate the treatment system and provide routine and periodic maintenance to maintain design efficiency. It is likely that the system will be substantially modified within the next few years due to issues that have been raised recently by the MPCA about the system’s permit.

5.2.1.5 Shoreline Restoration Plan and Implementation

Identify opportunities for shoreline restoration, complete demonstration projects, and provide incentives to lakeshore property owners to plant shoreline buffers and create new habitat.

5.2.1.6 Aquatic Vegetation Management

The District plans to document the use of individual herbicide treatments on both Spring Lake and Upper Prior Lake so that the patterns of macrophyte growth can be better understood. Herbicide treatments by individual homeowners may be having a negative effect on water quality through eliminating plant species that are desirable in terms of water quality.

<u>Spring Lake</u>: Curlyleaf pondweed has remained at low densities since herbicide treatments were stopped after 2006, and treatments are not needed at this time. Aquatic macrophyte surveys should continue to be completed twice annually: one in the spring (before die-off of curly-leaf pondweed) to evaluate the extent of the curly-leaf pondweed, and one in August or September to evaluate the extent of native vegetation.

<u>Upper Prior Lake</u>: Annual macrophyte surveys should be completed on Upper Prior Lake to track the curly-leaf pondweed distribution and density, and the effect that anticipated water quality improvements in Spring Lake might have on Upper Prior Lake should be evaluated in five years. The analysis will help determine the need for future herbicide treatments on Upper Prior Lake.

5.2.1.7 Rough Fish Management

- Carp tracking study: Develop and implement a program to tag and complete recapture surveys to assess the carp population estimate.
- Carp habitat investigation and evaluation of management options: Assess potential carp habitat within the District to determine areas where carp populations are likely highest, and document observations and anecdotes about carp movement within the watershed. As District staff and consultants frequently visit locations throughout the District, a coordinated effort should be made to document observations. Evaluate potential carp rearing sites through use

of wetland habitat assessment and hydrologic data evaluation. Evaluate connectivity of sites to lakes.

- Explore the use of fish barriers, specifically one-way barriers to carp migration, and the opportunities for carp removal from the system. Remove rough fish and install barriers as necessary.
- Evaluate effectiveness of management practices through periodic recapture surveys.

5.2.1.8 Identify and Mitigate Channel Erosion

Work with the SWCD (Soil and Water Conservation District) to identify potential soil erosion on channels in the upper watershed, and identify options for stabilization projects.

5.2.1.9 Wetland Restoration and Wetland Bank

Projects to restore key wetlands to increase storage, improve habitat, and create a wetland bank to mitigate future wetland loss in the watershed.

5.2.1.10 Evaluate and Implement Buck Lake Channel Storage

Evaluate cost and feasibility of creating storage in the Buck Lake channel

5.2.1.11 Tree and Native Vegetation Planting

PLSLWD and Scott SWCD can provide incentives for planting new trees and native plants to reduce runoff volume and pollutant transport by increasing evapotranspiration.

5.2.1.12 PLSLWD-City of Prior Lake Partnership Projects

Retrofit water quality and volume mgmt BMPs. Undertake research studies.

5.2.1.13 Property Tax Incentive

The District plans to coordinate with government agencies to explore the feasibility of property tax incentives for stormwater management BMPs, primarily targeted at agricultural lands.

5.2.2 City of Prior Lake Projects

5.2.2.1 Targeted Intensive Street Sweeping

Targeted use of street sweeping to remove sediment and organic debris from the watershed before it is able to wash into ponds, wetlands, or the lakes.

5.2.2.2 Innovative P load reductions

Develop and use new management methods and innovative technologies (such as replacing polyphosphate corrosion inhibitor used in domestic water supply; pond sediment P inactivation) to reduce P load through water quality system or from municipal operations.

5.2.3 Spring Lake Township

5.2.3.1 Sunset Avenue Sewer Project

Installation of municipal sewer to mitigate failing septics.

5.2.3.2 Low Impact Design Standards

Adoption of low impact design (LID) standards for all new development.

5.2.4 Scotty County

5.2.4.1 County Road 12 Construction

The reconstruction of County Road 12 (primarily in the direct drainage to Spring Lake) has been spaced over two phases, the first of which has been completed and the second of which is scheduled for 2013. The City of Prior Lake, the PLSLWD, and Scott County partnered on the installation of BMPs to treat regional water in addition to right-of-way water in the first phase, and plan to implement a similar partnership in the second phase.

5.2.4.2 Public Works Facility Stormwater BMPs

In 2012-2013 Scott County plans to install a number of stormwater improvement retrofits at the Public Works facility, which drains through the County Ditch 13 subwatershed to Spring Lake.

5.2.4.3 Spring Lake Regional Park

Spring Lake Regional Park will be developed for active recreation in the next few years. While current loading from the area is modeled to be fairly low, this still presents an opportunity to integrate BMPs, potentially with some educational benefit.

5.2.5 Minnesota Department of Transportation

MnDOT is responsible for the drainage areas of Highways 13 and 282, and is also not included in the categorical WLA with other MS4 permittees. Water quality improvement projects conducted in these drainage areas by MnDOT will be accounted for separately from efforts by other entities.

5.3 Operation and Maintenance

Municipalities and counties are responsible for the operation and maintenance (O&M) of their local infrastructure including stormwater management systems and roadways. O&M of practices that are already existing needs to be continued to maintain baseline conditions. For BMPs constructed prior to 2006, if O&M activities are increased to levels beyond the 2006 baseline conditions, the improvements can be used to demonstrate progress towards meeting a WLA or LA. For BMPs constructed after 2006, O&M activities are expected and can not be counted separately from the BMP itself. The BMP can be used to demonstrate progress towards meeting a WLA or LA only if the expected O&M activities are occurring in order to maintain BMP performance.

O&M activities for the City of Prior Lake and the PLSLWD are summarized here.

5.3.1 Prior Lake-Spring Lake Watershed District Operation and Maintenance

See Highway 13 Wetland Treatment System and Desiltation Pond, O&M, in Section 5.2.1.4.

5.3.2 City of Prior Lake Operation and Maintenance

5.3.2.1 Sump Manhole Maintenance

Removal of sediment from sump manholes to prevent it from reaching waterbodies. Maintain current levels and increase capacity within the City of Prior Lake.

5.3.2.2 Water Quality System O&M

Maintain current levels and increase capacity within the City of Prior Lake.

5.3.2.3 Volume Control System O&M

Maintain current levels and increase capacity within the City of Prior Lake.

5.3.3 Scotty County Operation and Maintenance

5.3.3.1 Public Works Drainfield

The use of the drainfield at Scott County Public Works was discontinued in 2010.

5.3.3.2 Hazardous Waste Facility

The Scott County Hazardous Waste Facility accepts a large variety of wastes that might otherwise end up in surface water, including chemicals that could contribute phosphorus to surface waters.

5.4 Education

Education efforts support projects and operations and maintenance by engaging the public, building support for water quality improvement efforts, and changing behaviors that impact water quality. Education efforts can be counted as making progress towards achieving a WLA or LA if they lead to demonstrable reductions in phosphorus load to a system or other improvements to lake water quality, such as installation of a rain garden or an improvement to shoreline vegetation.

5.4.1 Scott Clean Water Education Program

Educational efforts within the Upper Prior Lake and Spring Lake watersheds are primarily lead and coordinated by the Scott Clean Water Education Program (SCWEP). SCWEP is a partnership of local government organizations in Scott County that educates and informs residents about ways to improve the quality of lakes and rivers. SCWEP runs an educational program that delivers information about lawn care practices and impacts, and plans educational programs to engage the general public, municipal staff, businesses and elected officials. Partners include Credit River Township, Jackson Township, the City of Prior Lake, the PLSLWD, the City of Savage, Scott County, Scott Soil and Water Conservation District, Scott Watershed Management Organization, Spring Lake Township and the Vermillion River Watershed Joint Powers Organization. It is staffed by members of the Scott Soil and Water Conservation District. SCWEP is the primary method each partner uses to meet the education requirements of the annual MS4 report.

5.4.2 PLSLWD Educational Efforts

5.4.2.1 Innovative Water Management and Demonstration Projects

Demonstration projects or innovative BMPs that exceed District requirements.

5.4.2.2 Information and Education Program

Continue the District's program to provide: 1) written and electronic educational materials for a variety of audiences; 2) a web site with useful tools; and 3) outreach to property owners on both a group and one-on-one basis.

5.4.2.3 Conservation Drainage Pilot Project

Complete inventory of drain tile systems, construct conservation drainage structure pilot project and conduct monitoring.

5.4.2.4 Research

Investigate or contribute to research investigations that increase District understanding of and identify feasible options to address problems of interest.

5.4.2.5 Prior Lake-Savage Area School District Partnerships

Provide expanded education and outreach activities. Partner on demonstration and study projects.

5.5 Overall Implementation Plan

The estimated cost, phosphorus load reduction, timeline for implementation, and project partners are presented for each implementation action (Table 8). The phosphorus load reduction for each type of project is defined as minimal, moderate, or significant, respective to the other projects identified for the lake. Specific TP load removal for projects that address meeting the WLA should be determined on a project by project basis using the process outlined in Chapter 6.3.

Table 8. Overall Implementation Plan

Principle Entity	Name of Effort	Project Description	Project Partners	Subwatershed		Estimated P Load Reduction (from existing conditions)	Estimated Volume Reduction	Estimated Costs (in $1,000)					Allocation Tracking			
				Spring	Upper Prior			2011	2012	2013	2014	2015 →	Categorical WLA - MS4: Prior Lake	Categorical WLA - MS4: Spring Lake Twp.	Individual WLA MnDOT	LA
	REGULATION															
PLSLWD	PLSLWD Rules and Standards Revisions	Revise PLSLWD rules to incorporate new standards for water quality and volume management.	PLSLWD, CPL, SLT, SC	X	X	Moderate	Moderate	$20	$0	$0	$0	$20	X	X	X	X
PLSLWD	Permitting, Plan Review and Compliance	Work cooperatively with MOA permitting partners through the Development Review Committees to incorporate water quality and quantity BMPs on new development and redevelopment. Evaluate local plans as they are revised and make equivalency determinations.	PLSLWD, CPL, SLT, SC	X	X	Minimal	Minimal	$40	$25	$25	$25	$125	X	X	X	X
	PROGRAMS AND PROJECTS															
PLSLWD	Infiltration Enhancement Pilot Project	Completion of a feasibility study and commercial and residential development projects demonstrating various soil enhancement methods and techniques for preserving and improving soil permeability to enhance infiltration.	PLSLWD	X	X	Minimal	Moderate	$20	$0	$0	$0	$0	X	X		
PLSLWD	Storage and Infiltration Projects	Cost-share or fund small projects to reduce runoff, increase infiltration, and reduce pollutant loading and transport directly to Spring and Upper Prior Lakes.	PLSLWD	X	X	Moderate	Significant	$25	$25	$25	$25	$125	X	X		X
PLSLWD	Spring Lake Internal Load Management Project	Alum treatment.	PLSLWD	X		Significant	N/A	$0	$0	$0	$400-1,400 ($150 budgeted)	$0				X
PLSLWD	Highway 13 Wetland Treatment System and Desiltation Pond Operation, Maintenance, & Enhancement	Operate the treatment system and provide routine and periodic maintenance to maintain design efficiency.	PLSLWD	X		Minimal**	N/A	$75	$25	$25	$25	$125	X	X		X
PLSLWD	Shoreline Restoration Plan and Implementation	Identify opportunities for shoreline restoration, complete demonstration projects, and provide incentives to lakeshore property owners to plant shoreline buffers and create new habitat.	PLSLWD		X	Moderate	Minimal	$10	$10	$10	$10	$50				X
PLSLWD	Aquatic Vegetation Management	Evaluate use of individual herbicide treatments. Monitor aquatic vegetation twice annually and evaluate need for treatment. Treat as needed.	PLSLWD	X	X	Moderate	N/A	$21	$21	$8	$16	$89				X
PLSLWD	Rough Fish Management	Complete a carp tracking study, carp habitat investigation,and evaluation of management options. Remove rough fish and install barriers as necessary.	PLSLWD	X	X	Significant	N/A	$20	$30	$30	$80	$85				X
PLSLWD	Identify and Mitigate Channel Erosion	Work with the SWCD to identify potential soil erosion on channels in the upper watershed, and identify options for stabilization projects.	PLSLWD	X		Moderate	Minimal	$4	$4	$4	$4	$20				X
PLSLWD	Wetland Restoration and Wetland Bank	Projects to restore key wetlands to increase storage, improve habitat, and create a wetland bank to mitigate future wetland loss in the watershed.	PLSLWD	X	X	Moderate	Significant	$50	$0	$50	$0	$100	X	X		X
PLSLWD	Evaluate and Implement Buck Lake Channel Storage	Evaluate cost and feasibility of creating storage in the Buck Lake channel	PLSLWD	X		Moderate	Significant	$0	$0	$200	$0	$0				X

Principle Entity	Name of Effort	Project Description	Project Partners	Subwatershed		Estimated P Load Reduction (from existing conditions)	Estimated Volume Reduction	Estimated Costs (in $1,000)					Allocation Tracking			
													Categorical WLA - MS4		Individual WLA MnDOT	LA
				Spring	Upper Prior			2011	2012	2013	2014	2015 →	Prior Lake	Spring Lake Twp.		
PLSLWD	Encourage Planting Trees and Native Plants	Partner with Scott SWCD and other agencies and organizations to provide incentives for planting new trees and native plants to reduce runoff volume and pollutant transport by increasing evapotranspiration	PLSLWD	X	X	Minimal	Moderate	$5	$5	$5	$5	$25	X	X		X
PLSLWD	PLSLWD-City of Prior Lake Partnership Projects	Retrofit water quality & volume management BMPs. Undertake research studies.	PLSLWD, CPL	X	X	Moderate	Moderate	$50	$35	$50	$50	$50	X	X		X
CPL	Targeted Intensive Street Sweeping	Targeted use of street sweeping to remove sediment and organic debris from the watershed before it is able to wash into ponds, wetlands, or the lakes.	CPL	X	X	Moderate	N/A	$75	$75	$75	$75	$75	X			
CPL	Innovative P load reductions	Develop and use new management methods and innovative technologies (such as replacing polyphosphate corrosion inhibitor used in domestic water supply; pond sediment P inactivation) to reduce P load through water quality system or from municipal operations.	PLSLWD, CPL, UMN	X	X	Moderate	N/A		$70	$70	$70	$70	X			
SLT	Sunset Avenue Sewer Project	Installation of municipal sewer to mitigate failing septics	SLP, SC, PLSLWD	X		Minimal	N/A	$25		$380				X		
SLT	Low impact design standards	Adoption of LID standards for all new development	SLT, SC, PLSLWD	X	X	Moderate	Moderate	$8						X		
PLSLWD	Property Tax Incentive	Tax incentives to install BMPs, primarily in ag areas	PLSLWD, SC, SLP	X		Moderate	Moderate	$5	$5					X		X
	OPERATION AND MAINTENANCE*															
CPL	Sump manhole maintenance, maintain current levels and increase capacity	Removal of sediment from sump manholes to prevent it from reaching waterbodies.	CPL	X	X	Minimal	N/A	$10	$10	$10	$10	$10	X			
CPL	Water quality system operation and maintenance, maintain current levels and increase capacity		CPL	X	X	Moderate	Moderate	$430	$40	$400	$40	$350	X			
CPL	Volume control system operation and maintenance, maintain current levels and increase capacity		CPL	X	X	Minimal	Moderate	$30	$30	$30	$30	$30	X			
	EDUCATION															
SWCD, PLSLWD	Scott Clean Water Education Program (SCWEP)	A partnership of local government organizations in Scott County that educates and informs residents about ways to improve the quality of lakes and rivers.	PLSLWD, CPL, SC, SLT	X	X	Minimal	Minimal	$16	$16							
PLSLWD	Innovative Water Management and Demonstration Projects	Demonstration projects or innovative BMPs that exceed District requirements.	PLSLWD, CPL	X	X	Moderate	Moderate	$50	$50	$50	$50	$250	X	X	X	X
PLSLWD	Information and Education Program	Continue the District's program to provide: 1) written and electronic educational materials for a variety of audiences; 2) a web site with useful tools; and 3) outreach to property owners on both a group and one-on-one basis.	PLSLWD, CPL, SLT, SC	X	X	Moderate	Moderate	$50	$52	$53	$55	$275	X	X		X

Principle Entity	Name of Effort	Project Description	Project Partners	Subwatershed		Estimated P Load Reduction (from existing conditions)	Estimated Volume Reduction	Estimated Costs (in $1,000)					Allocation Tracking			
				Spring	Upper Prior			2011	2012	2013	2014	2015 →	Categorical WLA - MS4: Prior Lake	Categorical WLA - MS4: Spring Lake Twp.	Individual WLA MnDOT	LA
PLSLWD	Conservation Drainage Pilot Project	Complete inventory of drain tile systems, construct conservation drainage structure pilot project and conduct monitoring.	PLSLWD	X		Minimal	Moderate	$15	$10	$5	$5	$5				X
PLSLWD	Agricultural Outreach and Incentives	Work with the SWCD to cost-share incentives to reduce agricultural pollutant loading and soil loss.	PLSLWD, SC	X		Moderate	Minimal	$30	$30	$30	$30	$150				X
PLSLWD	Research	Investigate or contribute to research investigations that increase District understanding of and identify feasible options to address problems of interest.	PLSLWD, CPL	X	X	Minimal	Minimal	$10	$10	$10	$10	$50	X	X		X
PLSLWD	Prior Lake-Savage Area School District Partnerships	Provide expanded education and outreach activities. Partner on demonstration and study projects.	PLSLWD	X	X	Moderate	Moderate	$10	$10	$10	$10	$50	X	X		X

* O&M of practices that are already existing needs to be continued to maintain baseline conditions. For BMPs constructed prior to 2006, if O&M activities are increased to levels beyond the 2006 baseline conditions, the improvements can be used to demonstrate progress towards meeting a WLA or LA. For BMPs constructed after 2006, O&M activities are expected and can not be counted separately from the BMP itself. The BMP can be used to demonstrate progress towards meeting a WLA or LA only if the expected O&M activities are occurring in order to maintain BMP performance.
** Note that the County Ditch 13 $FeCl_3$ facility currently provides significant load reduction to Spring Lake; however, as this load reduction was included in the TMDL calculations, the reduction from *existing* conditions will be minimal.

6 TRACKING PROGRESS TOWARDS MEETING TMDL ALLOCATIONS

The overall schedule for the implementation of the Spring Lake and Upper Prior Lake TMDL is 2012-2031. A summary of the milestones discussed in this section is provided in Table 9.

6.1 Milestones

Milestones for both the PLSLWD and the communities are based on the current planning schedule. Both the PLSLWD and the communities are required by State Statute to update their planning documents on a 10-year cycle. The PLSLWD updates their water resources management plan, which contains a watershed implementation plan and capital improvement plan. The communities update their comprehensive plans and local water plans. The local water plans are required to be consistent with the PLSLWD water resources management plan. Municipal and county comprehensive plans include existing and future land use designations.

At each of the milestones, the five-year review of the TMDL implementation plan (see Section 8.3) will provide input to determine the level of effort needed in the next planning cycle.

6.1.1 Watershed District Milestones

The PLSLWD Plan, adopted in 2010, outlines a 10-year implementation plan and capital improvement plan. A review of the projects that have been implemented and the improvement in lake water quality should be completed in 2017 (approximately five years after completion of this TMDL implementation plan). The PLSLWD will continue to update their water resources management plan every 10 years. During each of these plan development processes, the five-year review of the TMDL implementation plan (see Section 8.3) will provide input to determine the level of effort needed in the next planning cycle. The PLSLWD will include implementation activities within their future water resources management plans to help achieve the goals of the TMDL. A review of the lake water quality should take place annually as part of the PLSLWD Monitoring Report.

6.1.2 Community Milestones

The City of Prior Lake is required to prepare a local water plan for areas within the PLSLWD. Scott County prepares a local water plan for unincorporated areas within its jurisdiction. Local water plans will typically have a 10-year implementation schedule over which the planned actions will take place. During local water plan development, the five-year review of the TMDL implementation plan (see Section 8.3) will provide input to determine the level of effort needed in the next planning cycle. By 2017, municipalities will also be updating their overall comprehensive plans and future land use plans (2040) to provide to the Metropolitan Council. At that time, a review of future development patterns should be completed to determine where re-development will be taking place and to identify key areas for further water quality treatment and implementation activities. Municipalities are required by the Metropolitan Council to update their comprehensive plans every 10 years.

In addition, each regulated MS4 will need to comply with MS4 permit requirements as updated every five years.

Table 9. TMDL Implementation Milestones

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
City of Prior Lake Surface Water Management Plan					PLSLWD Plan		**TMDL Implementation Plan** Expected MS4 permit reissue City of Prior Lake and Spring Lake Twp. local water plan					Review TMDL Implementation Plan Expected MS4 permit reissue Municipal comprehensive plan			PLSLWD Plan		Review TMDL Implementation Plan Expected MS4 permit reissue City of Prior Lake and Spring Lake Twp. local water plan					Review TMDL Implementation Plan Expected MS4 permit reissue			PLSLWD Plan	
							Annual water quality review as part of PLSLWD Monitoring Report (2012–2031)																			
							Annual report for MS4 permittees (2012–2031)																			
							Implementation of projects to meet TMDL goals and water quality standards (2012–2031)																			

6.2 MS4 Permit

The regulatory link between a regulated MS4 community and a TMDL WLA is the MS4 permit. In May 2011, the MPCA released the draft permit, "General permit authorization to discharge stormwater associated with small municipal separate storm sewer systems under the National Pollutant Discharge Elimination System / State Disposal System (NPDES / SDS) permit program." Until the permit is approved, the regulated communities continue to operate under the conditions of the expired permit.

6.3 Accounting for Phosphorus Load Reduction Activities

To ensure consistency between the technical approach used to develop the TMDL and the technical approach used to track phosphorus load reduction activities, this section provides guidance for accounting for load reduction activities. While multiple methods for estimating phosphorus reduction from management activities are valid, model inputs and outputs should be coordinated as much as possible to avoid directly comparing modeling results that are derived from two distinct approaches.

Load reductions from BMPs implemented on the landscape will be estimated based on the watershed loading model from the TMDL, which used existing land use, soil, and slope, combined with phosphorus loading factors. A map is provided with this implementation plan in GIS shapefile format, referred to here as the "GIS tool," that provides phosphorus loading rates throughout the watershed.

6.3.1 Development of GIS Tool

The TMDL report included estimates of the phosphorus load (in pounds per year) that reaches Spring and Upper Prior lakes in watershed runoff based on a model that combined land use, soil characteristics, and slope. Using various data sources, Geographic Information System (GIS) inventories were compiled of the three characteristics, then overlaid on one another. Each unique combination of characteristics was assigned a phosphorus loading factor, or pounds of phosphorus delivered to the receiving waterbody per acre per year (Table 10).

Table 10. Watershed Phosphorus Loading Rates

Loading Class	Slope (%)	Delivery Potential	P Loading Factor (lbs/ac/yr)
	<8	Low	0.5
	<4	Moderate -High	1.1
	>8	Low	1.1
General Agriculture	>4	Moderate - High	1.6
	<8	Low	0.5
	<4	Moderate -High	0.6
	>8	Low	0.6
Non-row Crops	>4	Moderate - High	1.0
Parks	NA	NA	0.1
	<4	Low	0.9
	<4	Moderate -High	2.2
	>4	Low	2.2
	>4	Moderate - High	3.1
Corn-Soybean	>8	Low	3.1
Forested	NA	NA	0.1
	<4	Low-Moderate	0.1
	<4	High	0.2
	>4	Low-Moderate	0.2
	>4	High	0.9
Pasture	>8	Low-Moderate	0.9
Commercial	NA	NA	0.9
Industrial	NA	NA	0.9
Institutional	NA	NA	0.7
High Density Urban	NA	NA	0.9
Low Density Urban/Undeveloped non-forested	NA	NA	0.1
Medium Density Urban	NA	NA	0.7
Transportation	NA	NA	0.9
Water	NA	NA	0.0
Wetland	NA	NA	0.0

By multiplying the number of acres in the watershed within each unique combination of land use/slope/soil by the loading factor associated with that unique combination, then summing the result, the TMDL study arrived at a total number of pounds of phosphorus delivered to the receiving water body per year. These values were originally derived from EPA document 440/5-80-011, and modified slightly to match in-stream concentrations in County Ditch 13 measured in 1999 and 2002. Given that those two years had higher than average runoff volumes, a load factor was developed for every year between 1998 and 2006, based on the volume of runoff as compared to 1999. The average load factor was 0.583, meaning that, on average, the runoff volume to lakes in the District was 58.3% of the volume in 1999. The total watershed loads to Spring and Prior lakes were determined by multiplying the calculated pounds of phosphorus by the average year load factor (0.583).

The loads from Fish, Crystal, and Arctic Lakes were derived not from the above watershed load estimate, but rather by multiplying the volume of water leaving the lake by the average measured total phosphorus concentration.

6.3.2 Use of GIS Tool for Load Reduction Accounting

To determine the load reduction provided by a given BMP, the following steps should be performed by the entity looking to count the BMP as progress made towards achieving their allocation:

1) Determine the drainage area affected by the BMP. This includes the subwatershed(s) housing the BMP, as well as any subwatersheds that drain to that subwatershed.
2) Add up the load to the receiving waterbody in the drainage area, by clipping the GIS loading tool with the drainage area of the BMP.
3) Calculate the load percent reduction provided by the BMP. This could be in any acceptable model, including P8, PondNet, etc. If a model is being used, make sure that the phosphorus load to the BMP in the model is calibrated to the phosphorus load as provided using the GIS tool.
4) Multiply the drainage area load by the percent reduction.
5) If the BMP is located in the drainage area of the County Ditch 13 ferric chloride treatment system, the phosphorus removal of that system must be taken into account. The load reductions attributed to the BMP should be multiplied by 0.7 to account for that removal. (On average, 30% of the phosphorus would have been removed by the $FeCl_3$ system without the BMP.)
6) If the BMP is located in the watershed of Crystal Lake (Rice/Crystal and East Rice subwatersheds in Figure 2), the natural attenuation of phosphorus within the lake must be taken into account. The load reductions attributed to the BMP should be multiplied by 0.84 to account for the 14% phosphorus attenuation[3] within Crystal Lake. The estimated attenuation within other lakes is less than 10% and will not be accounted for.

This procedure has the benefits of being relatively simple, maintaining consistency with the modeling approach from the TMDL study, and allowing for flexibility in implementing BMPs and measuring benefits.

Loading from subsurface sewage treatment systems (SSTS) are not included in the GIS tool. If a proposed practice addresses loads from a failing septic system within the watershed, 4.2 lb/yr of phosphorus can be counted towards meeting the LA for each failing system that is upgraded and can be considered to be conforming. The septic system load in the TMDL was based on 4.2 lb/yr per system and an assumed 10% failure rate. The TMDL report accounts for 627 septic systems that drain to Spring Lake and 9 systems that drain to Upper Prior Lake.

Load reductions from in-lake BMPs will be tracked based on considering the internal load estimates presented in the TMDL report (see Table 5 and Table 6 from this implementation plan) and applying percent reductions for each in-lake practice, based on literature values or best professional judgment.

[3] Load attenuation factor was calculated as follows: (modeled load to lake - modeled load out of lake) / (modeled load to lake), as a percent.

7 MONITORING

An important component of the TMDL process is follow-up monitoring. This monitoring will help determine whether the implementation actions have improved water quality. In addition, monitoring will help determine the effectiveness of various BMPs and indicate when adaptive management should be initiated. The goal of the monitoring plan is to assess the effectiveness of source reduction strategies for attaining water quality standards and designated uses.

7.1 Current Monitoring Activities

7.1.1 Lakes

Spring Lake and Upper Prior Lake are both monitored by multiple agencies over the course of the growing season (April through October). The PLSLWD coordinates the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) on the lakes. Additionally, PLSLWD contracts with the Three Rivers Park District (TRPD) to provide in-depth profile sampling.

7.1.1.1 CAMP

Volunteers monitor Upper Prior Lake and Spring Lake for the CAMP program between April and October, twice per month. The following parameters are collected and analyzed (all at the surface of the water):

- Temperature
- Secchi depth
- Chlorophyll (*a*, *b*, and *c*)
- Pheophytin
- Total phosphorus
- Kjeldahl nitrogen

7.1.1.2 Three Rivers Park District

Spring Lake and Upper Prior Lake are sampled biweekly during the growing season (typically end of April through mid-October). The following parameters are collected and analyzed:

- Temperature (meter intervals)
- Dissolved oxygen (meter intervals)
- pH (meter intervals)
- Specific conductance (meter intervals)
- Secchi depth
- Chlorophyll *a* (surface)
- Total phosphorus (surface, 1 meter from bottom, or middle of water column)
- Orthophosphorus, dissolved (surface, 1 meter from bottom, or middle of water column)
- Total nitrogen (surface)

7.1.2 Watershed

Beginning in 2009 the PLSLWD contracted with Scott SWCD and others for an expanded stream monitoring effort consisting of continuous stage recorders and water quality grab sampling, in addition to synoptic monitoring at multiple sites, consisting of measurements from a multi-parameter sonde.

7.1.3 BMPs

A major identified contributor of TP to Spring Lake is County Ditch 13. The PLSLWD constructed a ferric chloride ($FeCl_3$) injection and desiltation pond system just upstream of the County Ditch 13 inlet to Spring Lake in 1997, and has operated the system intermittently since then. The PLSLWD injects ferric chloride at a dosing rate based on flow and excavates the accumulated sediment when the desiltation fills to a predetermined capacity; thus far, the pond has been excavated once.

Based on a 2010 evaluation by EOR, the combined injection and desiltation system is effective at removing significant loads of TP under low-flow conditions, and less effective under high flow conditions. The TMDL study assumes a 30% average removal efficiency for the system (Section 4.3.2 of the TMDL report).

7.2 Planned Monitoring Activities

7.2.1 Lakes

Continue with biweekly monitoring of both Spring and Upper Prior Lakes during the growing season, including nutrients, chlorophyll, clarity, dissolved oxygen, temperature, pH, and conductance (see details in Section 7.1.1.2). The District also intends to continue to facilitate monitoring done by volunteers through the CAMP program (Section 7.1.1.1).

Aquatic macrophyte surveys should be completed twice annually: one in the spring (before die-off of curly-leaf pondweed) to evaluate the extent of the curly-leaf pondweed, and one in August or September to evaluate the extent of native vegetation.

7.2.2 Watershed

As management practices are initiated within the watershed, stage and water quality sampling should be rotated between site locations designed to evaluate loads from those subwatersheds.

A major farm operator within the upper watershed has been approved to be included in the Discovery Farms program. Field level monitoring will be conducted, starting in 2012. These data will inform future watershed modeling updates.

7.2.3 BMP performance

BMP performance monitoring should be conducted on a suite of BMPs as they are installed in the watershed, to help assess the effectiveness of the implementation plan in meeting the TMDL targets. Monitoring should address multiple types of BMPs, such as volume reduction practices (including rain gardens), agricultural practices, and retrofits. Data from BMP performance monitoring can be used to inform phosphorus reduction estimates of installed practices.

In addition to the monitoring of the ferric chloride treatment system that is required under the MS4 General Permit, one to two years of performance monitoring should be completed on the treatment system after the upcoming maintenance and improvements are completed. Recognizing that the treatment system is likely to be modified within the next few years due to issues that have been raised recently by the MPCA about the system's permit, but not currently knowing the details of the modified system, the following are monitoring recommendations assuming the current system.

Monitoring results may inform potential dosing modifications to maximize performance. Phosphorus parameters should include total phosphorus, total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP, a measure of dissolved ortho-phosphorus, which is dissolved inorganic phosphorus). Sampling should occur upstream (site CD-2) and downstream (site CD-3) of the treatment system. To evaluate performance of the desiltation basin versus performance of the ferric chloride injection system, monitoring should occur at times when the dosing station is being operated and when it is not being operated. Monitoring should occur throughout the entire monitoring season.

8 ADAPTIVE MANAGEMENT

8.1 Role of PLSLWD

The Prior Lake-Spring Lake Watershed District was established in 1970 for the general purposes of conserving the waters and natural resources of the watershed. The Watershed District has developed implementation activities to further the goals and policies set forth in their Water Resources Management Plan (WRMP). In general, the Plan identifies preservation and improvement of the quality of the water resources in the watershed as a high-priority goal, with the management of runoff volumes discharged to the outlet-restricted lakes an equally high priority.

In order to accomplish the aquatic resource management goals established in the WRMP, the District has established several programs that track implementation projects, monitor, and adapt for optimization if needed. More specifically, the District has and will continue to coordinate with regulated MS4s communities within their jurisdiction on implementation projects that provide water quality benefits to Spring and Upper Prior Lakes. The District's monitoring activities are evaluated annually to ensure that appropriate data are being collected to assess the effectiveness of these projects and trends in water quality.

As projects are implemented throughout the contributing drainage area and within the impaired lakes, the District will use scientific information to assess where to focus upcoming projects. This on-going assessment and resultant changes to the implementation approach is referred to as adaptive management.

8.2 Interim Goals

Since substantial load reductions and changes in in-lake phosphorus cycling will need to occur to meet water quality goals, interim goals are identified to help determine if incremental water quality improvements will be enough to stay on the trajectory of meeting in-lake water quality goals.

Interim goals are based on two measures: 1) completion of the recommended projects and actions in this implementation plan over the next five years, and 2) a positive trend in lake water quality conditions as measured over the next five years. See the following section (8.3) for guidance on the five-year water quality review.

8.3 TMDL Tracking through Five-Year Reviews

Five-year reviews will occur throughout the period of implementation to evaluate the impact that the implementation actions have on overall water quality in the lake. The five-year reviews will contain the following components:

1) Evaluate in-lake monitoring data, with a focus on trends in TP, chlorophyll-*a*, and Secchi transparency. Changes will be determined by evaluating trends in annual means and standard errors.
2) Evaluate in-lake biological data to determine if changes to in-lake phosphorus cycling have occurred primarily through reductions in curly-leaf pondweed coverage and density, and reductions in benthic fish communities.
3) Analyze watershed monitoring data to evaluate if watershed loads have decreased.
4) Evaluate BMP performance. Document O&M activities.
5) Review practices and programs that have been implemented in the five-year period. Estimate the phosphorus reductions achieved from these practices and programs and compare to the TMDL load reduction goals. Load reductions can be tracked using Table 11 and Table 12.

Table 11. Spring Lake TMDL Tracking

Allocation type	Phosphorus source	Existing load (lb/yr)	Reduction Needed (lb/yr)	Reduction Needed (%)	Reductions achieved (lb/yr)
WLA	MnDOT	43.8	28	64%	
	City of Prior Lake	1308.2	836	64%	
	Scott County				
	Construction stormwater				
	Industrial stormwater				
LA	Upstream lake	63	0	0%	
	Watershed load	3,595	2,959	82%	
	Septic	263	263	100%	
	Atmospheric	30	0	0%	
	Internal	5,161	4,554	88%	
	Total load	*10,464*	*8,640*	*83%*	

Table 12. Upper Prior Lake TMDL Tracking

Allocation type	Phosphorus source	Existing load (lb/yr)	Reduction Needed (lb/yr)	Reduction Needed (%)	Reductions achieved (lb/yr)
WLA	MnDOT	36.4	0	0%	
	City of Prior Lake	382.6	0	0%	
	Scott County				
	Construction stormwater				
	Industrial stormwater				
LA	Upstream lake	2,179	1,568	72%	
	Septic	4	4	100%	
	Atmospheric	16	0	0%	
	Internal	2,598	571	22%	
	Total load	*5,216*	*2,143*	*41%*	

The following questions will lead the discussion of water quality in the five-year reviews.

If in-lake water quality shows an **improving trend**, are the improvements enough to stay on track to meet the interim goals and eventual achievement of water quality standards?

- If yes, then continue with implementation as planned.
- If no:
    - Is it because implementation of projects and programs was not enough?
    - Is it because water quality goals are not feasible and should be re-evaluated?

If in-lake water quality shows **no trend**:

- Is it because implementation of projects and programs was not enough? If so, then increase level of implementation and review again in five years.
- Were the correct sources being targeted? If not, then re-focus implementation efforts toward correct sources.
- Is it because water quality goals are not feasible and should be re-evaluated? Water quality goals should only be re-evaluated if two consecutive five-year reviews show no improving trend in response to a sufficient level of implementation.

If in-lake water quality shows a **trend of degradation**, the questions in the "no trend" box will be asked, in addition to the following:

- Are there new phosphorus sources? If so, identify new sources and management actions to address them.
- Has there been a change in watershed condition? If so, then develop management actions to mitigate negative changes.
- Has there been a change in the in-lake biological communities (fish, zooplankton, algae, macrophytes)? If so, then develop management actions to mitigate negative changes.

The five-year reviews will produce a report that the communities can use during their local planning process (see Section 6.1).

APPENDIX A: OPTIONS FOR REDUCING INTERNAL LOADING OF P IN SPRING LAKE AND UPPER PRIOR LAKE

651 Hale Avenue North Oakdale, Minnesota 55128 telephone: 651.770.8448 facsimile: 651.770.2552 www.eorinc.com

Date | November 9, 2011

To | Nat Kale

cc | Mike Kinney

From | Andrea Plevan

Regarding | Options for reducing internal loading of P in Spring Lake and Upper Prior Lake

The purpose of this memo is to evaluate the options to address internal loading in Spring Lake and Upper Prior Lake and to outline an internal loading management approach for inclusion in the Spring Lake and Upper Prior Lake TMDL Implementation Plan, currently being developed.

Internal loading sources

Internal loading within Spring and Upper Prior Lake was identified as a source of total phosphorus (TP) in the lakes. The following is a summary from the draft TMDL report of the internal loading sources.

Spring Lake

- Sediment disturbance from carp: Carp have been found in DNR fisheries surveys, and the carp population is likely underestimated in their surveys. Carp forage in the bottom sediments of lakes, which stirs up the sediments and releases phosphorus from the sediments to the water column. Their foraging also likely reduces water clarity and disturbs rooted vegetation.
- Curly-leaf pondweed: Curly-leaf pondweed has been present in Spring lake since the 1980s. In 2000, it was present at 98% of the points sampled during a vegetation survey and reached nuisance levels at many of the locations. There was a moderate diversity of other aquatic plants in the lake. PLSLWD completed herbicide treatments annually from 2002 through 2006 to control curly-leaf pondweed. The TMDL report presents survey results that indicate that stem densities of curly-leaf pondweed decreased between 2002 and 2007. Curly-leaf pondweed is an invasive species that dies off in May or June, releasing phosphorus to the water column at a time when it can be used to fuel algal growth.
- Shoreline: There have been no shoreline surveys of Spring Lake, which would provide information on the quality of the shoreline in terms of its ability to filter pollutants from the watershed and its role as a nutrient source.
- Release from sediments due to anoxia: Under oxic conditions, phosphorus is bound to sediments on the lake bottom. When the bottom waters are low in oxygen (anoxia), the phosphorus is released from the sediments to the water. If the lake is stratified, this phosphorus remains in the hypolimnion until fall turnover, when the phosphorus mixes with the entire water column. The internal load was estimated in the TMDL report to be approximately 5,000 pounds per year, or half of the total phosphorus load to Spring Lake.

Upper Prior Lake

- Sediment disturbance from carp: Carp have been found in DNR fisheries surveys. Carp forage in the bottom sediments of lakes, which stirs up the sediments and releases phosphorus from the sediments to the water column. Their foraging also likely reduces water clarity and disturbs rooted vegetation.
- Curly-leaf pondweed: Curly-leaf pondweed is present in Upper Prior Lake. There is a low diversity of other plants, and plants in general are present only up to a depth of four to six feet. Curly-leaf

pondweed is an invasive species that dies off in May or June, releasing phosphorus to the water column at a time when it can be used to fuel algal growth.

- Shoreline: There have been no shoreline surveys of Upper Prior Lake, which would provide information on the quality of the shoreline in terms of its ability to filter pollutants from the watershed and its role as a nutrient source.
- Release from sediments due to anoxia: The internal load was estimated in the TMDL report to be approximately 2,500 pounds per year, or half of the total phosphorus load to Upper Prior Lake.

Internal loading treatment options

The TMDL report calls for an 88% reduction (4,554 lbs) in internal loading in Spring Lake, and a 22% reduction (571 lbs) in internal loading in Upper Prior Lake.

The following options are recommended for Spring and/or Upper Prior Lake. Data used here were received from PLSLWD in July 2011, and were collected by Three Rivers Park District (on behalf of PLSLWD) and through the Citizen's Assisted Monitoring Program (CAMP).

Herbicide treatments targeted at curly-leaf pondweed

In 2001, the PLSLWD developed a plan to manage the aquatic macrophytes in Spring Lake (*Aquatic Plant Management Program for Spring Lake, Scott County*, 2001). Herbicide treatments to control curly-leaf pondweed on Spring Lake started in 2002 and continued through 2006. Annual surveys of curly-leaf pondweed in that period indicate that the treatments were effective at reducing stem densities (Figure 1). Water quality monitoring data suggest that this reduction in curly-leaf pondweed may have led to an improvement in water quality in the lake, with average total phosphorus concentrations between 84 µg/l and 92 µg/l from 2006 to 2010, after a peak of 133 µg/l in 2004, and chlorophyll-*a* concentrations reaching a low of 32 µg/l in 2009 (Figure 2).

Seasonal changes in phosphorus and chlorophyll concentrations also suggest that the herbicide treatments may have had a positive effect on the lake. In 2003, during the second year of herbicide treatment and when stem densities were still relatively high (Figure 1), there was a pulse of high in-lake phosphorus concentrations during the second half of May. This high phosphorus was accompanied by a high chlorophyll concentration and poor transparency on June 2 (Figure 3). While die-off of curly-leaf pondweed in May could have caused this pattern, other nutrient inputs could have caused it as well. This pattern of a pulse of phosphorus and resulting high chlorophyll and poor transparency was not observed in later years (2007-2009). See Figure 4 for the 2008 data; note that 2010 data (see Figure 8) show a small pulse of phosphorus in June and could indicate a resurgence of curly-leaf pondweed.

Curlyleaf pondweed has remained at low densities since the treatments were stopped after the 2006 treatment (Figure 1), and treatments are not needed at this time. Aquatic macrophyte surveys should continue to be completed twice annually: one in the spring (before die-off of curly-leaf pondweed) to evaluate the extent of the curly-leaf pondweed, and once in August or September to evaluate the extent of native vegetation. The native macrophyte community is important in that it stabilizes the sediments, uses nutrients that could otherwise be used by algae, and provides habitat for plankton and fish, among other functions.

Aquatic vegetation has been managed in Upper Prior Lake in the past. In 2006, a treatment program was developed that evaluated the effect of two different herbicides on the aquatic vegetation in the lake. Aquathol and 2,4-D were used in test plots to treat curly-leaf pondweed and Eurasian watermilfoil (EWM). Aquathol was somewhat successful at controlling curly-leaf pondweed, and there were no substantial negative impacts to the native plant community. There have not been any more herbicide applications on Upper Prior Lake since then.

A 2011 curly-leaf pondweed survey in Upper Prior Lake found several locations with light to moderate growth. The *Upper and Lower Prior Lakes Curlyleaf Pondweed Assessment for 2011*(Blue Water Science) recommended that approximately 10 to 15 acres in Mud Bay (of Upper Prior Lake) may need to be treated in the future. While there were locations with moderate growth in 2011, in lakes like Upper Prior Lake that have curly-leaf pondweed but a low diversity of native plants, reducing the densities of curly-leaf pondweed often leads to increased algal growth and poorer transparency. Individual lakeshore owners can individually treat areas along their shoreline; these treatments typically occur in May and June and are not selective to curly-leaf pondweed. These herbicide treatments may be having a negative effect on water quality through eliminating plant species that are desirable in terms of water quality. The District should document the use of individual herbicide treatments on both Spring Lake and Upper Prior Lake so that the patterns of macrophyte growth can be better understood.

Annual macrophyte surveys should be completed on Upper Prior Lake to track the curly-leaf pondweed distribution and density, and the effect that anticipated water quality improvements in Spring Lake might have on Upper Prior Lake should be evaluated in five years. The analysis will help determine the need for future herbicide treatments on Upper Prior Lake.

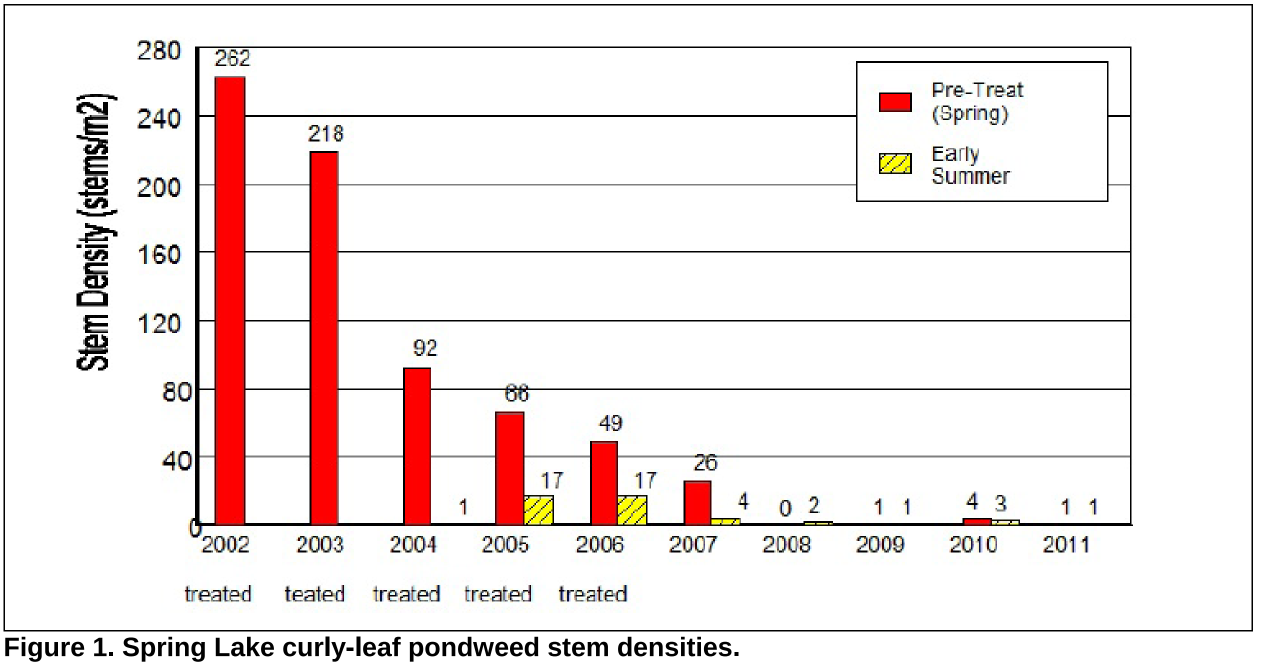

Figure 1. Spring Lake curly-leaf pondweed stem densities.
Treatment began in 2002. Figure from *Spring Lake Curlyleaf Pondweed Assessment for 2011*(Blue Water Science). Nuisance conditions are at approximately 160 stems/m^2.

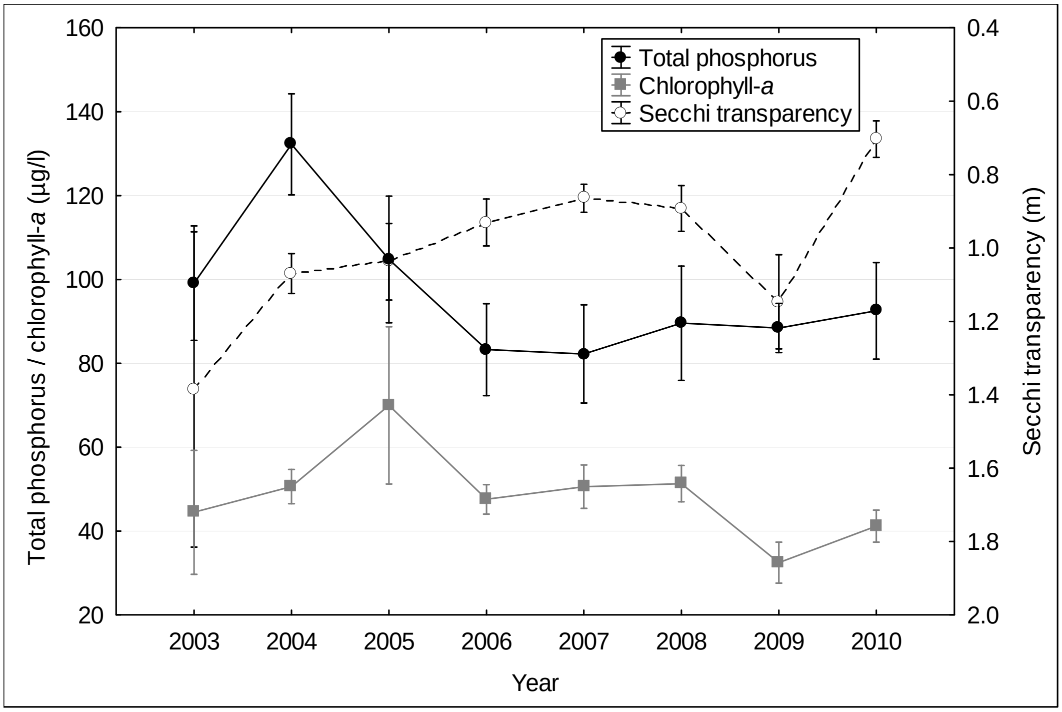

Figure 2. Spring Lake TP, chlorophyll, and Secchi transparency
Growing season mean +/- standard error, surface water.

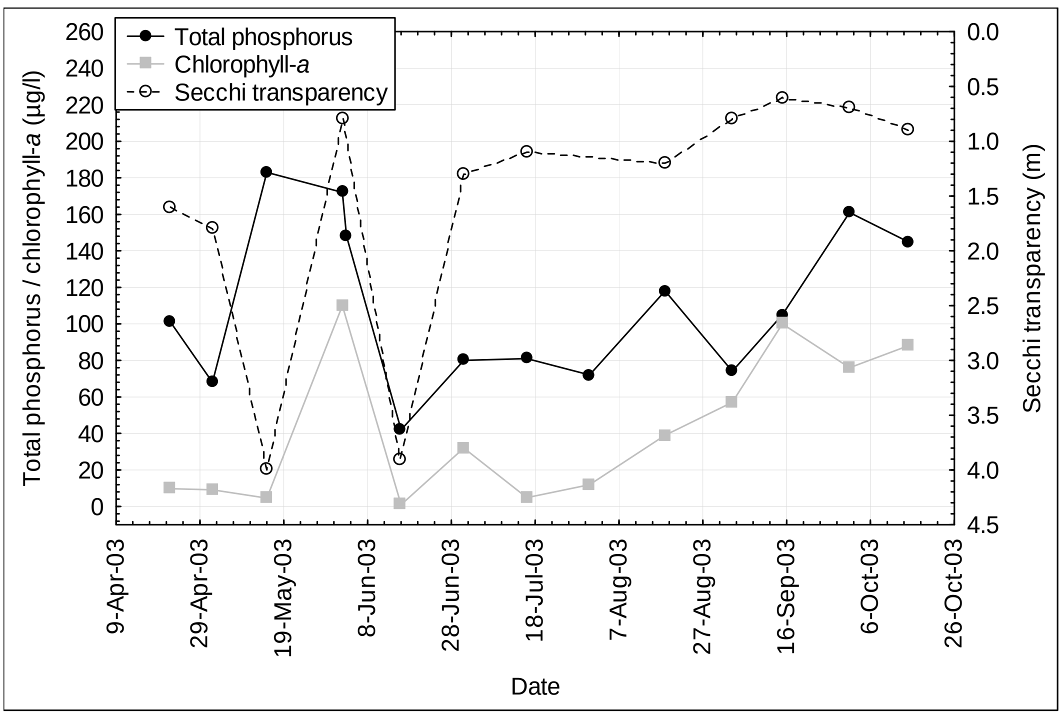

Figure 3. Total phosphorus, chlorophyll-*a*, and Secchi transparency in Spring Lake in 2003

<u>Rough fish management</u>

The disturbance of sediments from carp has been identified as a substantial component of the internal load in Spring Lake and Upper Prior Lake. Carp likely inhabit other water bodies connected to the lakes, such as County Ditch 13 and the ephemeral stream systems located in the Spring Lake watershed. With such a large area, the success of carp removal depends on understanding the carp population in the system – how many are there, which locations do they inhabit, and when? To better understand carp in the Spring Lake and Upper Prior Lake watershed, all or a combination of the following different approaches could be undertaken.

1) Carp distribution and abundance: This entails tagging carp and tracking their locations. This would provide information regarding where the carp spend time and when.
2) Carp age structure and population densities: This is a more in-depth study and entails netting carp and determining their age. The benefit of this level of study is knowledge about where they reproduce and what types of habitat they frequent at different points in their life histories.
3) Carp habitat investigation and evaluation of management options: This less resource-intensive approach would be to assess potential carp habitat within the District to determine areas where carp populations are likely highest, and document observations and anecdotes about carp movement within the watershed. As District staff and consultants frequently visit locations throughout the District, a coordinated effort should be made to document observations. Evaluate potential carp rearing sites through use of wetland habitat assessment and hydrologic data evaluation. Evaluate connectivity of sites to lakes. Explore the use of fish barriers, specifically one-way barriers to carp migration, and the opportunities for carp removal from the system.

After more information about the carp population is known, carp harvesting should be completed and the feasibility of fish barriers should be investigated.

There is also anecdotal evidence that black bullhead are abundant in Upper Prior Lake. Like carp, black bullhead are benthivorous fish that disturb bottom sediments and exacerbate internal loading.

<u>Alum treatment</u>

Spring Lake

Spring Lake undergoes thermal stratification during the growing season, in which surface waters warm up and the deeper water remains colder. Since the deeper water is more dense, this stratification is often stable through the summer. Oxygen can become depleted in the hypolimnion, which leads to release of soluble phosphorus from the sediments. When the lake overturns in August or September, this phosphorus mixes with the entire water column and is available for algal growth during the remainder of the growing season and in the following year.

This pattern is illustrated with 2008 and 2010 monitoring data. In 2008, TP concentrations start out high at the end of April, at 113 µg/l and a low transparency of 1.1 m (Figure 4). Water quality subsequently improves during May, and begins to worsen again in June. Phosphorus peaks in September, with observed concentrations as high as 209 µg/l. The increasing phosphorus concentrations lead to higher chlorophyll at the beginning of September, after which the high phosphorus does not get translated into algal growth. This is likely due to cooler temperatures that begin to limit the growth of algae. The increased phosphorus in September is due to the phosphorus that had built up in the hypolimnion throughout the summer (Figure 5); the lake experiences turnover at the beginning of September (Figure 6, Figure 7), which coincides with the drastic drop in hypolimnetic phosphorus (Figure 5), and the increase in surface water phosphorus (Figure 4).

While the high phosphorus in September and October does not lead to higher chlorophyll or poorer transparency, it remains in the lake and is available the following spring. On April 21, 2009, the first day monitored of 2009, the phosphorus concentration was 94 µg/l.

This same pattern is illustrated with 2010 data, which are provided here as another example (Figure 8 through Figure 11).

Based on the clear presence of internal loading due to anoxic conditions in the hypolimnion and its apparent negative influence on water quality, in addition to the substantial reduction in internal loading needed to meet the TMDL allocations, an alum treatment in Spring Lake is recommended. An alum treatment done in the same year that the lake has also been treated for curly-leaf pondweed could have the added benefit of improving conditions for native plants to flourish.

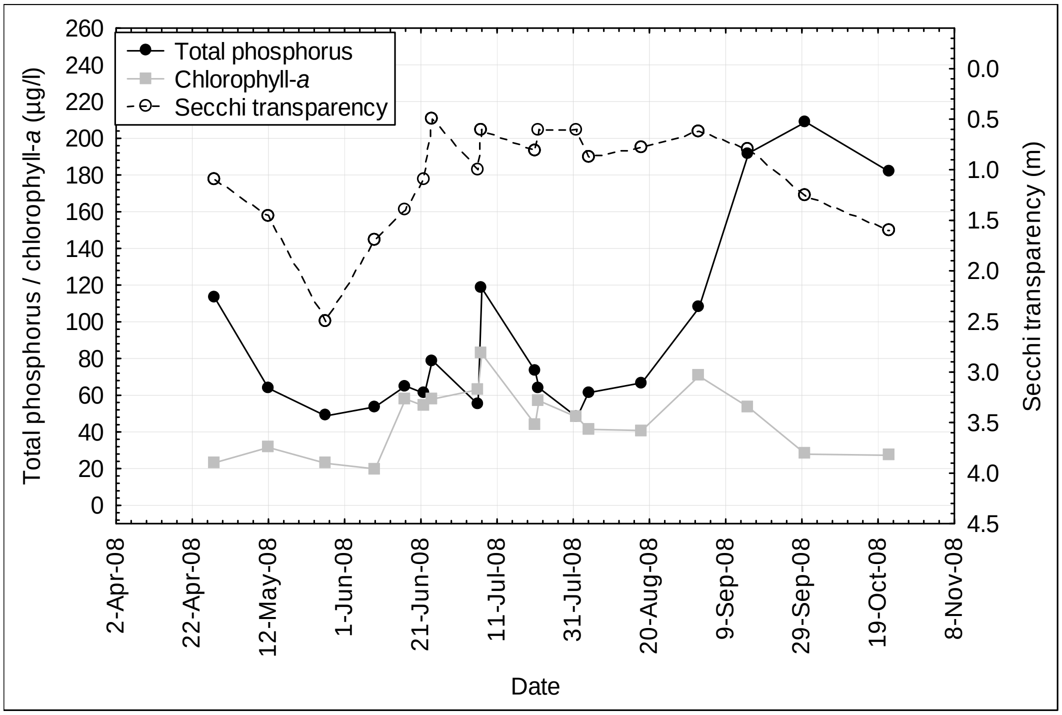

Figure 4. Surface water total phosphorus, chlorophyll-*a*, and Secchi transparency in Spring Lake in 2008

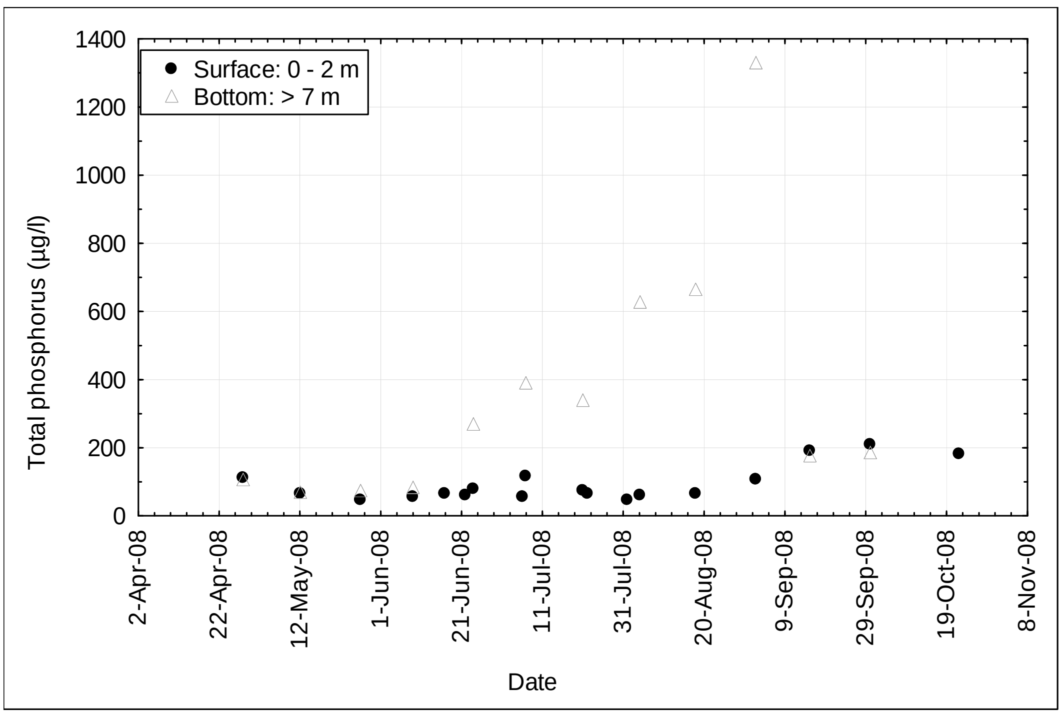

Figure 5. Surface and bottom total phosphorus concentrations in Spring Lake in 2008

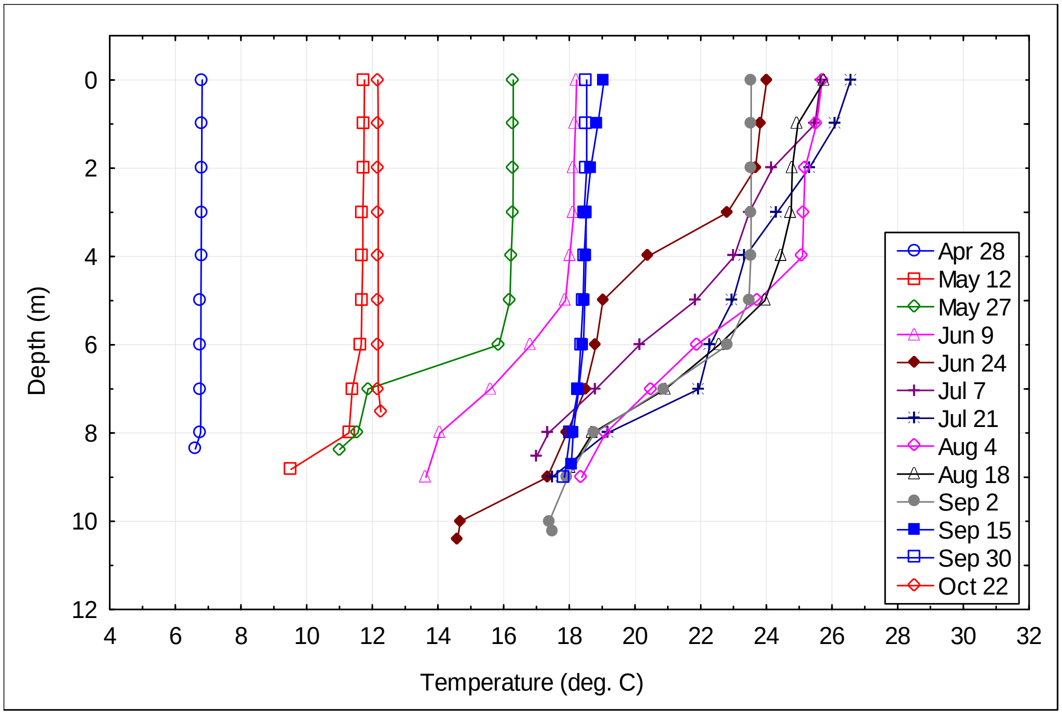

Figure 6. Temperature depth profile in Spring Lake in 2008

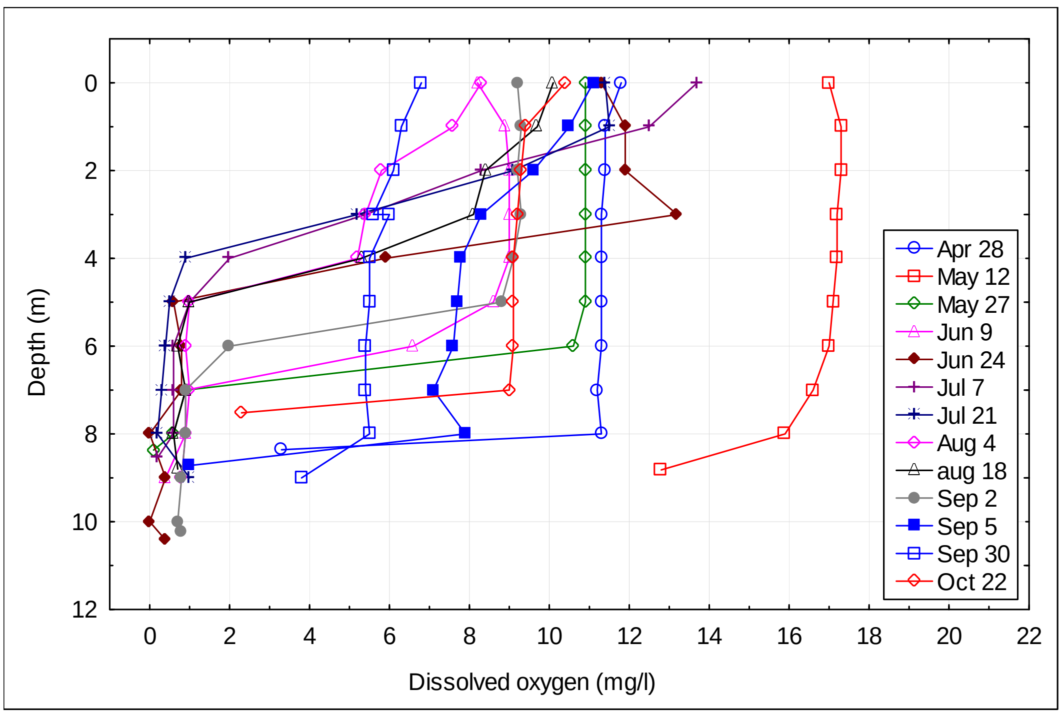

Figure 7. Dissolved oxygen depth profile in Spring Lake in 2008

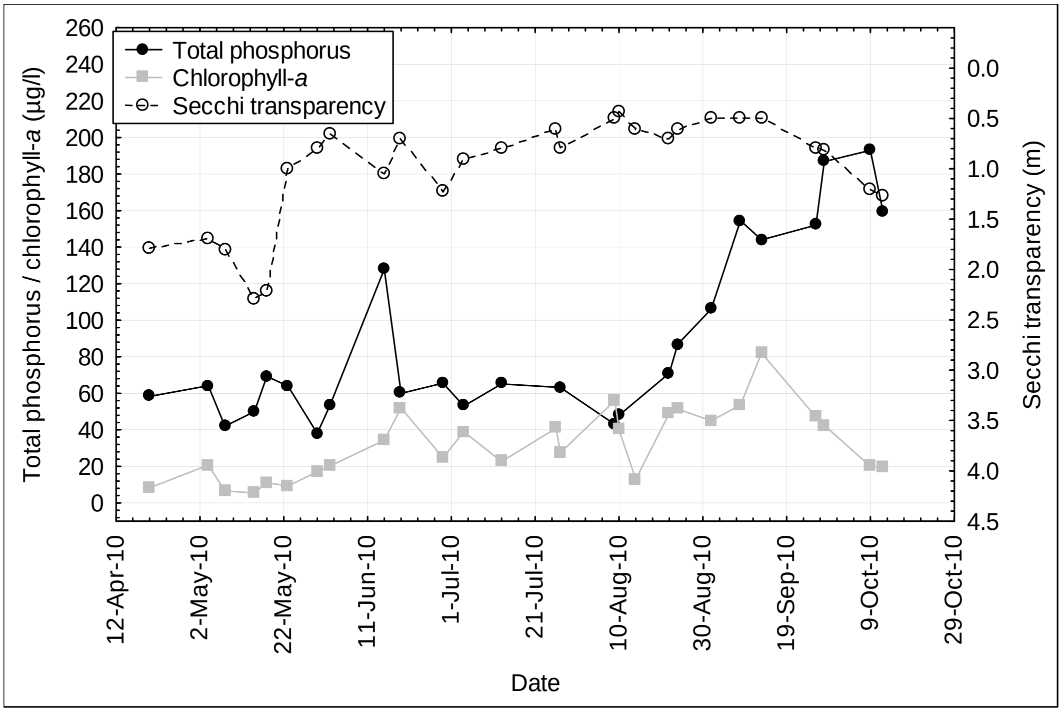

Figure 8. Surface water total phosphorus, chlorophyll-*a*, and Secchi transparency in Spring Lake in 2010

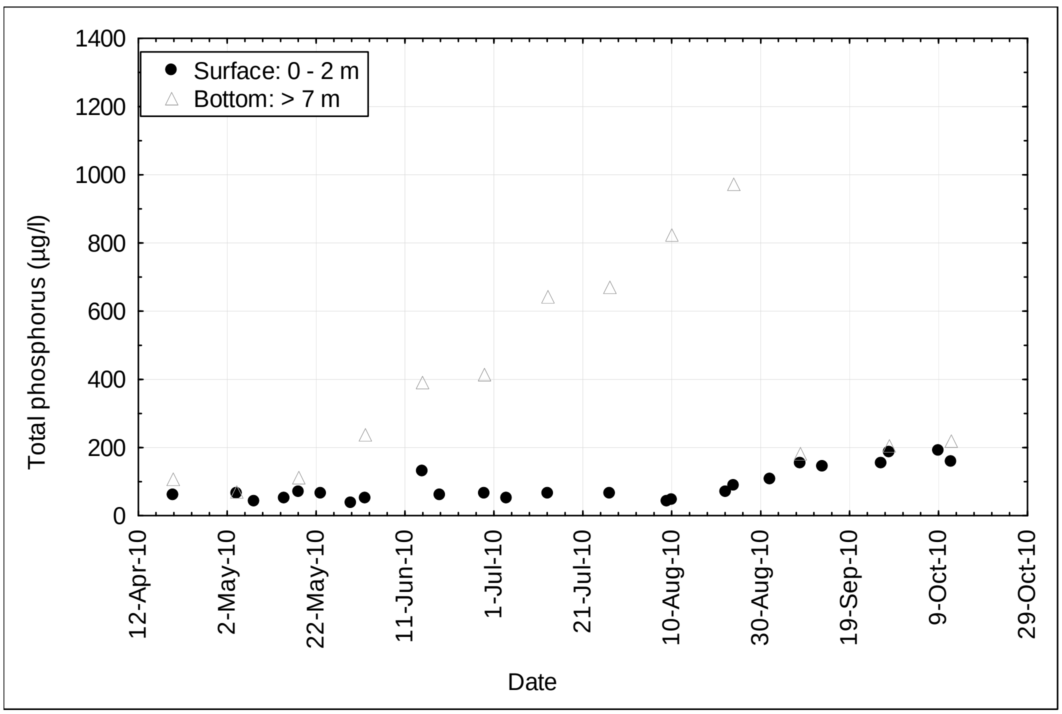

Figure 9. Surface and bottom total phosphorus concentrations in Spring Lake in 2010

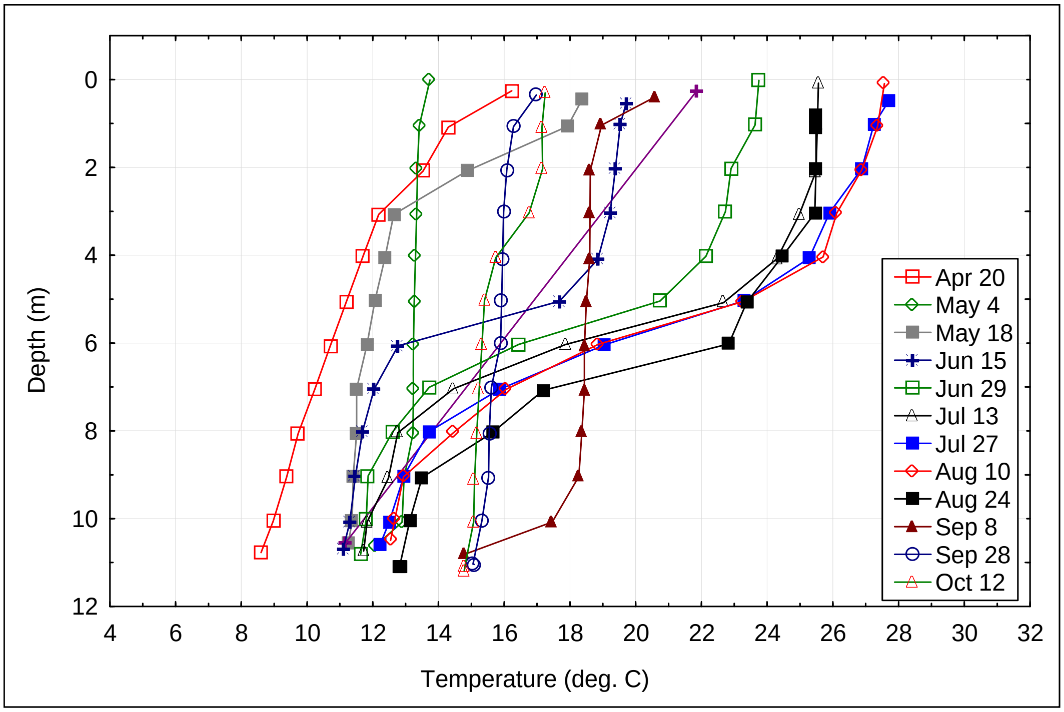

Figure 10. Temperature depth profile in Spring Lake in 2010

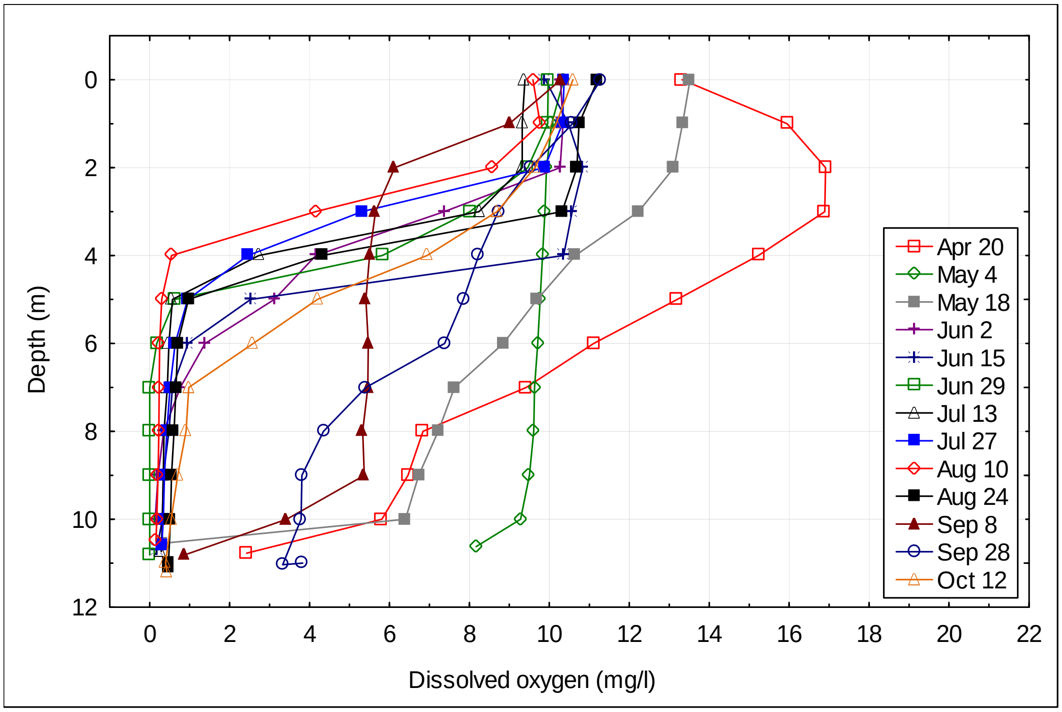

Figure 11. Dissolved oxygen depth profile in Spring Lake in 2010

Upper Prior Lake
A similar pattern is observed in Upper Prior Lake, but is not as dramatic and it applies to a much smaller area of the lake (approximately 50 to 60% of Upper Prior Lake's surface area is deeper than six feet, compared to approximately 75% in Spring Lake). Data from 2008 are shown to illustrate the pattern[1]. In 2008, water quality started out moderate, and then temporarily improved at the end of May (Figure 12). This short-term decrease in chlorophyll and increase in transparency may have been due to a healthy large-bodied zooplankton community that grazed heavily on the algae. In June, water quality worsened, and then slowly degraded until September, when an extremely high surface water phosphorus concentration was observed. The phosphorus in the bottom water also slowly increased throughout the summer, until there was a sharp decrease in hypolimnetic phosphorus in October (Figure 13), which coincided with the increase in surface phosphorus (Figure 12) and fall overturn (Figure 14 and Figure 15).

While internal loading due to anoxia in the hypolimnion is likely a source of phosphorus to Upper Prior Lake, an alum treatment is not recommended at this time. Approximately 80% of Upper Prior Lake is less than six feet deep, and curly-leaf pondweed and carp are abundant; these conditions reduce the chance of success of an alum treatment.

[1] Data from 2008 are available from both Three Rivers Park District (TRPD) and the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). Phosphorus concentrations in the TRPD data were consistently higher than the CAMP data, and chlorophyll-a concentrations were consistently lower. The water quality patterns indicated by the data, however, were the same. For clarity in the graphs, only the TRPD data are presented here.

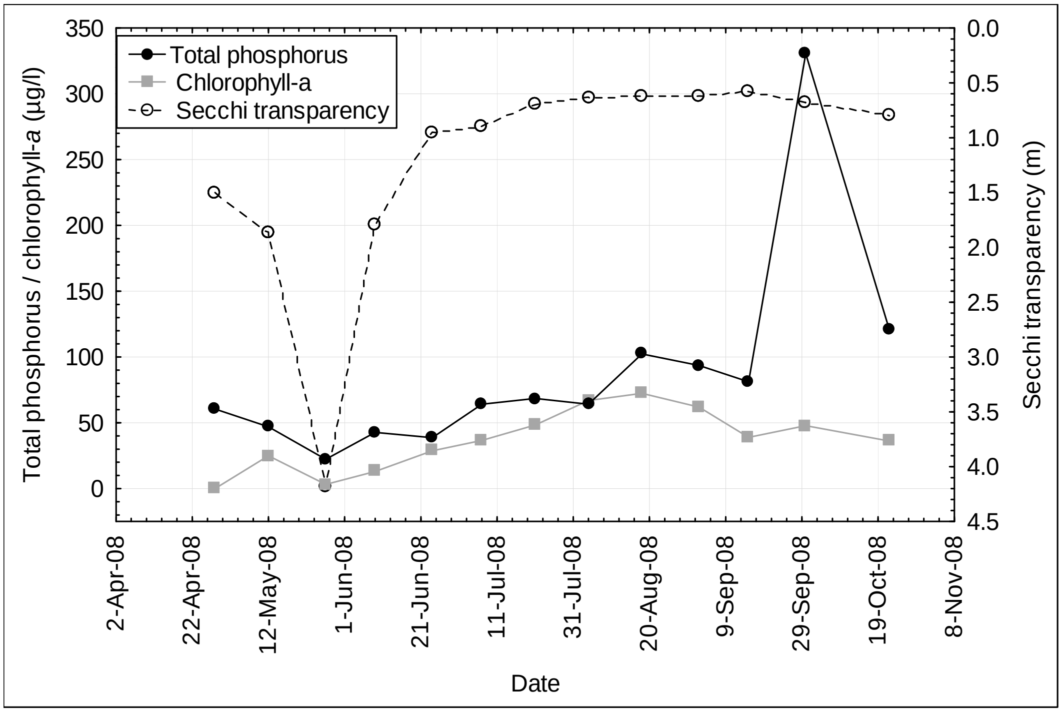

Figure 12. Surface water total phosphorus, chlorophyll-*a*, and Secchi transparency in Upper Prior Lake in 2008

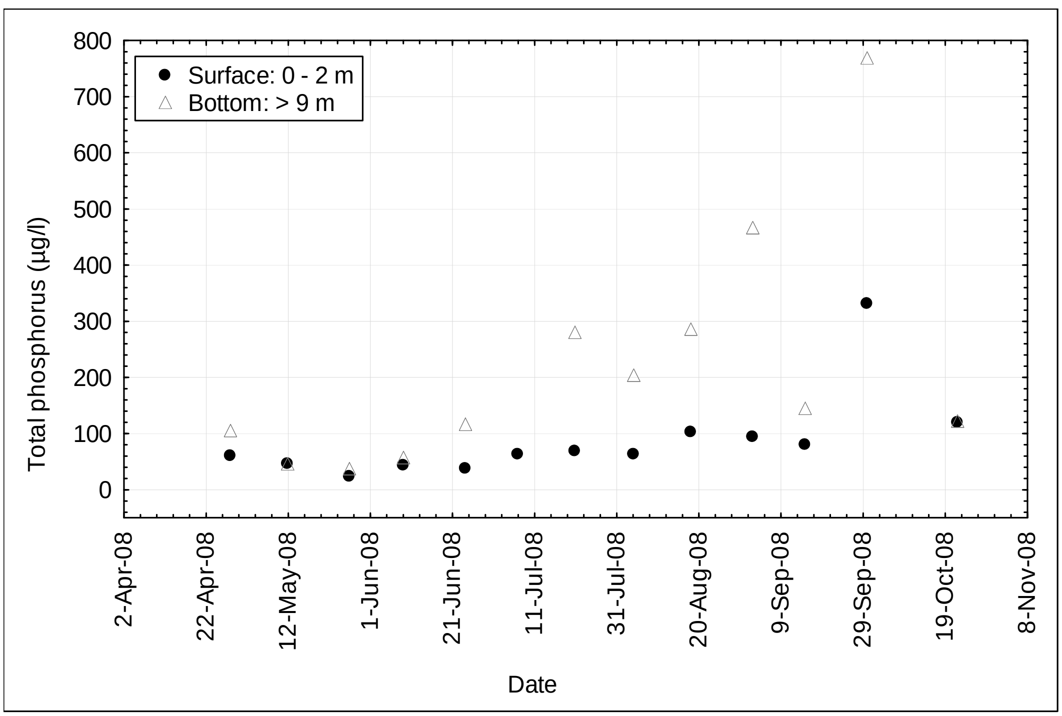

Figure 13. Surface and bottom total phosphorus concentrations in Upper Prior Lake in 2008

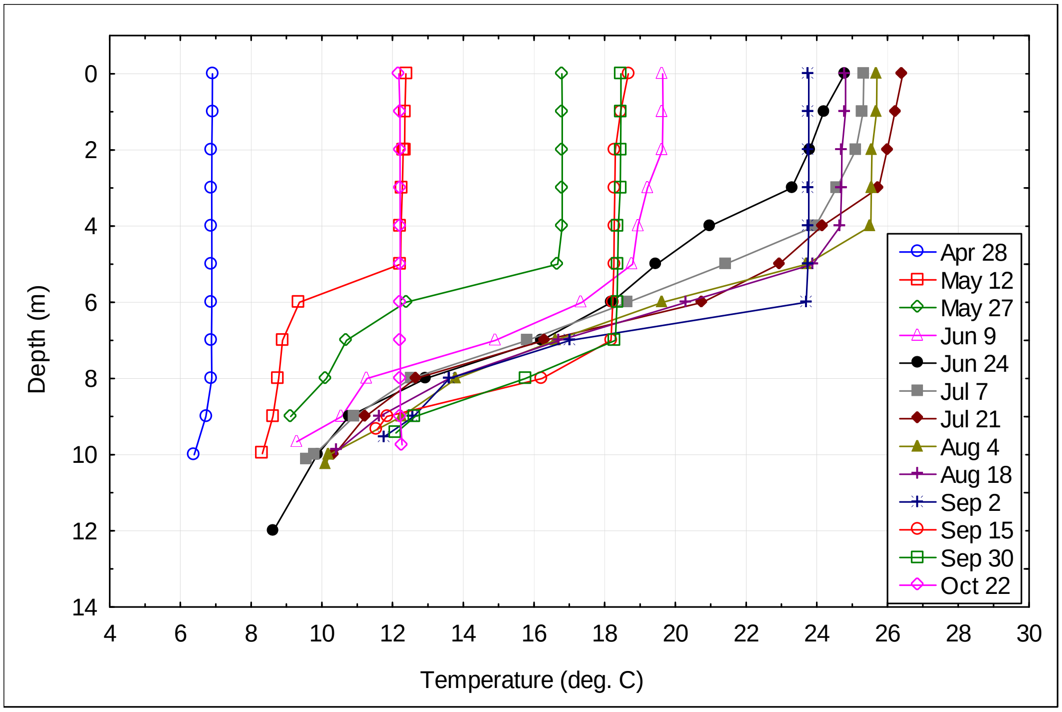

Figure 14. Temperature depth profile in Upper Prior Lake in 2008

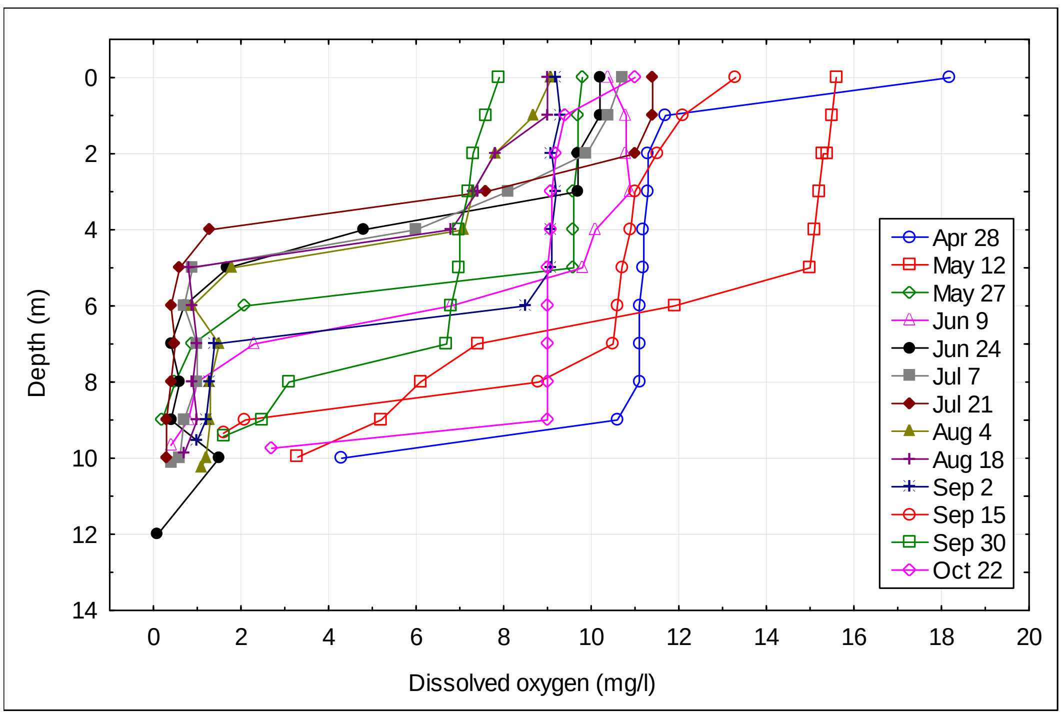

Figure 15. Dissolved oxygen depth profile in Upper Prior Lake in 2008

Regulation of motorboat activity in shallow areas

While not discussed in the TMDL report, there is anecdotal evidence that suggests that motorboat activity may be disturbing the sediments in the littoral (shallow) areas of Spring Lake and Upper Prior Lake. A large body of literature exists on the effects of motor boat activity on a wide range of lake variables, such as aquatic plant growth, shoreline erosion, and wildlife habitat. Several literature reviews already exist that summarize this body of literature (e.g., Mosisch and Arthington 1998, Asplund 2000, and Osgood 2000). Fewer studies have focused on the specific effect of motor boat activity on phosphorus release from the sediment. There is no disagreement in the literature over the fact that motor boat activity negatively impacts lake water quality and health. The focus of most recent studies has been on determining which speeds, motor size, and water depths motor boat activity has the *most* affect. There is a no-wake ordinance in place in Prior Lake, which likely provides some level of protection. A similar option could be explored for Spring Lake. A no-wake ordinance would decrease the disturbance to lake water quality caused by motorboat activity. Any investigation into the feasibility of a no-wake ordinance should consider the anticipated benefits, anticipated disadvantages, and projected costs of enforcement.

The following studies address the effect of motorboat activity on phosphorus release from lake sediments:

Asplund, T. R., and C. M. Cook. 1997. Effects of motor boats on submerged aquatic macrophytes. *Lake and Reservoir Management* 13: 1-12.

Asplund, T. R. 2000. The effects of motorized watercraft on aquatic ecosystems. Wisconsin Department of Natural Resources PUBL-SS-948-00, Madison, WI.

Beachler, M. M. and D. F. Hill. 2003. Stirring up trouble? Resuspension of bottom sediments by recreational watercraft. *Lake and Reservoir Management* 19: 15-25.

Mosisch, T. D. and A. H. Arthington. 1998. Review Article: The impacts of power boating and water skiing on lakes and reservoirs. *Lakes & Reservoirs: Research and Management* 3:1-17.

Osgood, D. 2000. Impacts of motor boats on water quality (literature review). Summarized by David Buetow, MCDEP. From: City of Davidson, North Carolina Official Website http://www.ci.davidson.nc.us/DocumentView.aspx?DID=902

Yousef, A. Y., W. M. McLellon, and H. H. Zebuth. 1980. *Water Research* 14:841-852.

Shoreland survey and shoreland improvements

Shoreline surveys of Spring Lake and Upper Prior Lake have not been recently completed. The draft TMDL implementation plan includes an item for developing a shoreline restoration plan and installing/assisting with improvement projects, and will not be further addressed in this memo.

Summary of management recommendations

Table 1 summarizes the recommended management practices to address internal loading in Spring Lake and Upper Prior Lake.

The majority of internal management practices are recommended for Spring Lake, as opposed to Upper Prior Lake, based on the larger reductions needed and the more clear evidence of sources and chance of management success. The water quality in Spring Lake is expected to improve as watershed and internal loading management practices are completed. As the water quality in Spring Lake improves, it is expected that the water quality in Upper Prior Lake will also improve. Monitoring on Upper Prior Lake should continue and a five-year evaluation should occur in 2017. The goals of this evaluation are detailed in Section 8.3 of the implementation plan. If Spring Lake improves without subsequent improvements in Upper Prior Lake, it would suggest that more attention should be paid to internal loading sources in Upper Prior Lake.

Table 1. Internal loading management approach and schedule for Spring Lake and Upper Prior Lake

Lake	Management practice		Responsible parties	Pollutant reduction	Priority	Cost	Link to PLSLWD Water Resources Management Plan	2012	2013	2014	2015	2016	2017
Spring Lake	Vegetation management	Annual macrophyte surveys	PLSLWD	--	M	$8,000/yr	4.2.4.6 ($8,000/yr)	x	x	x	x	x	5-year review of TMDL and IP
		CLP treatment if warranted		M	M	$300-$350/ac	4.2.4.7 ($5,000 in 2012, $10,000 2015-2019)						
		Document use of herbicides by individual homeowners		--	H	TBD	--	x					
	Rough fish management	Carp tracking surveys, habitat investigation and management evaluation	PLSLWD	--	H	$245,000	4.2.4.8 ($135,000 in 2011-2013)	x	x	x	x	x	
		Rough fish removal / fish barriers		H	H		4.2.4.9 ($110,000 in 2014-19)			x		x	
	Alum treatment		PLSLWD	H	H	$400,000-$1,400,000	4.2.4.2: ($150,000 in 2014)			x			
	Establishment of no-wake zone		Scott County, City of Prior Lake, Spring Lake Township, PLSLWD	M	M	TBD	--	x					
Upper Prior Lake	Vegetation management	Annual macrophyte surveys	PLSLWD	--	M	$8,000/yr	4.2.3.4 ($8,000/yr for 3 out of 5 years, to survey Upper and Lower Prior Lake)	x	x	x	x	x	
		CLP treatment if warranted		M	M	$300-$350/ac	4.2.3.5 ($5,000/yr for 3 of 5 years 2015-2019)						
		Document use of herbicides by individual homeowners		--	H	TBD	--	x					
	Rough fish management	Carp tracking surveys, habitat investigation and management evaluation	PLSLWD	H	H	[cost included in the above $245,000 Spring Lake study]	4.2.3.6 (budget included in the above $135,000 Spring Lake budget)	x	x	x	x	x	
		Rough fish removal / fish barriers	PLSLWD		H		4.2.3.7 (budget included in the above $110,000 Spring Lake budget)			x		x	
	Alum treatment		--	--	L	--	--						

Monitoring plan

Table 2 details the monitoring plan to track water quality and other internal components of Spring Lake and Upper Prior Lake.

Table 2. Monitoring plan summary for Spring Lake and Upper Prior Lake

Lake	Monitoring	Responsible parties	2012	2013	2014	2015	2016	2017
Spring Lake	Water quality (surface and hypolimnion)	PLSLWD	x	x	x	x	x	5-year review of TMDL and IP
	Aquatic macrophytes (May/Jun and Aug/Sep)	PLSLWD	x	x	x			
	Fish survey (approx every 3 yrs)	DNR		x			x	
Upper Prior Lake	Water quality (surface and hypolimnion)	PLSLWD	x	x	x	x	x	
	Aquatic macrophytes (May/Jun and Aug/Sep)	PLSLWD	x		x		x	
	Fish survey (approx every 3 yrs)	DNR		x			x	