Kohlman Lake
Total Maximum Daily Load
Implementation Plan

Prepared for
Ramsey Washington Metro Watershed District

April 2010
Modified July 2015

wq-iw11-01c

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BARR

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Executive Summary

This Kohlman Lake TMDL Implementation Plan is multi-faceted, with various projects put into place over the course of many years. This adaptive management approach allows for monitoring and reflection on project successes and the chance to change course if progress is exceeding expectations or is unsatisfactory. The Ramsey-Washington Metro Watershed District (District) is taking the lead on implementing the projects described in this plan, with the support of local cities, counties and other entities with property in the Kohlman Lake watershed.

Some of the projects that will help achieve the lake's overall Waste Load Allocation (WLA) have already been constructed in the Kohlman Lake watershed in 2007- the enhanced sand filter (north of Beam Avenue and east of Hwy 61) and the permeable reactive limestone barriers in Kohlman Basin. Also, The District's volume reduction rule has already proved effective in creating projects that capture and infiltrate runoff from impervious surfaces in the Kohlman Lake watershed, providing 3.7 Acre-Feet (AF) of rain gardens and other infiltration projects as of December, 2007. The District's annual volume reduction goal, as defined in the Kohlman Creek Subwatershed Infiltration Study (Barr, 2007), is 3.2 AF.

Other parts of this implementation plan are underway as well. The District is currently negotiating a project with Maplewood Mall owners that would involve the construction of several types of stormwater treatment technologies throughout the Mall's parking lot. Phase I of the project is currently underway and will be completed in 2010. Also, a plan to implement "green streets" features in residential areas of North St. Paul is currently in process. Macrophyte management is showing signs of early success in the lake and the lake's first alum treatment is scheduled for this spring.

If the District's watershed projects (constructed after 2002) are successful in achieving phosphorus reductions toward meeting the watershed's overall WLA, the cities and other entities with Municipal Separate Storm Sewer System entities (MS4s) in the Kohlman Lake watershed will be able to take credit toward achieving their WLA defined in the Kohlman Lake TMDL. If the projects implemented as a part of this plan are not ultimately successful in meeting the goals described in the Kohlman Lake TMDL report, the District will meet with all of the MS4s in the Kohlman Lake watershed to collaboratively determine future direction and to decide if additional participation by these groups is needed.

1.0 Introduction

Kohlman Lake (DNR ID 62-0006) is the most upstream of the four lakes that make up the Phalen Chain of Lakes in Maplewood, Little Canada and St. Paul, Minnesota in the Ramsey-Washington Metro Watershed District (District). The Kohlman Lake watershed comprises a total of 7,484 acres and drains portions of the St. Paul suburbs of Gem Lake, White Bear Lake, Vadnais Heights, Maplewood, North St. Paul, Little Canada, and Oakdale (Figure 1).

Kohlman Lake is located in the North Central Hardwood Forests ecoregion. The lake's historical growing season water quality (10-year average) compared to the MPCA's shallow lake eutrophication standards for this ecoregion are shown below.

Table 1 Kohlman Lake 10-Year Average Water Quality Parameters

Water Quality Parameter	MPCA Shallow Lake Eutrophication Standards (North Central Hardwood Forest Ecoregion)	Kohlman Lake 10-year (1997-2006) Growing Season (June through September) Average
Total Phosphorus (µg/L)	60 mg/L	98 mg/L
Chlorophyll *a* (µg/L)	20 mg/L	34.5 mg/L
Secchi disc (m)	1.0 m	1.0 m

Kohlman Lake is currently listed on the Minnesota Pollution Control Agency's (MPCA) 2008 303(d) Impaired Waters List due to excessive nutrients (phosphorus) and requires a Total Maximum Daily Load (TMDL) report. In 2009, the District completed a Total Maximum Daily Load (TMDL) Report for Kohlman Lake (Barr, 2010). The Kohlman Lake TMDL report has been approved by the Environmental Protection Agency.

In addition to the MPCA's shallow lake criteria, two interim goals have been defined by he District- a short term goal of 90 mg/L (by 2010), and a long term goal of 70 mg/L (by 2020). These goals are intended to be met as various watershed and in-lake improvements are implemented in a stepwise manner.

This Implementation Plan describes the activities planned by the District over the next 20 years in order to achieve the load reductions defined in the Kohlman Lake TMDL.

2.0 Description of the Water Body, Pollutant of Concern and Pollutant Sources

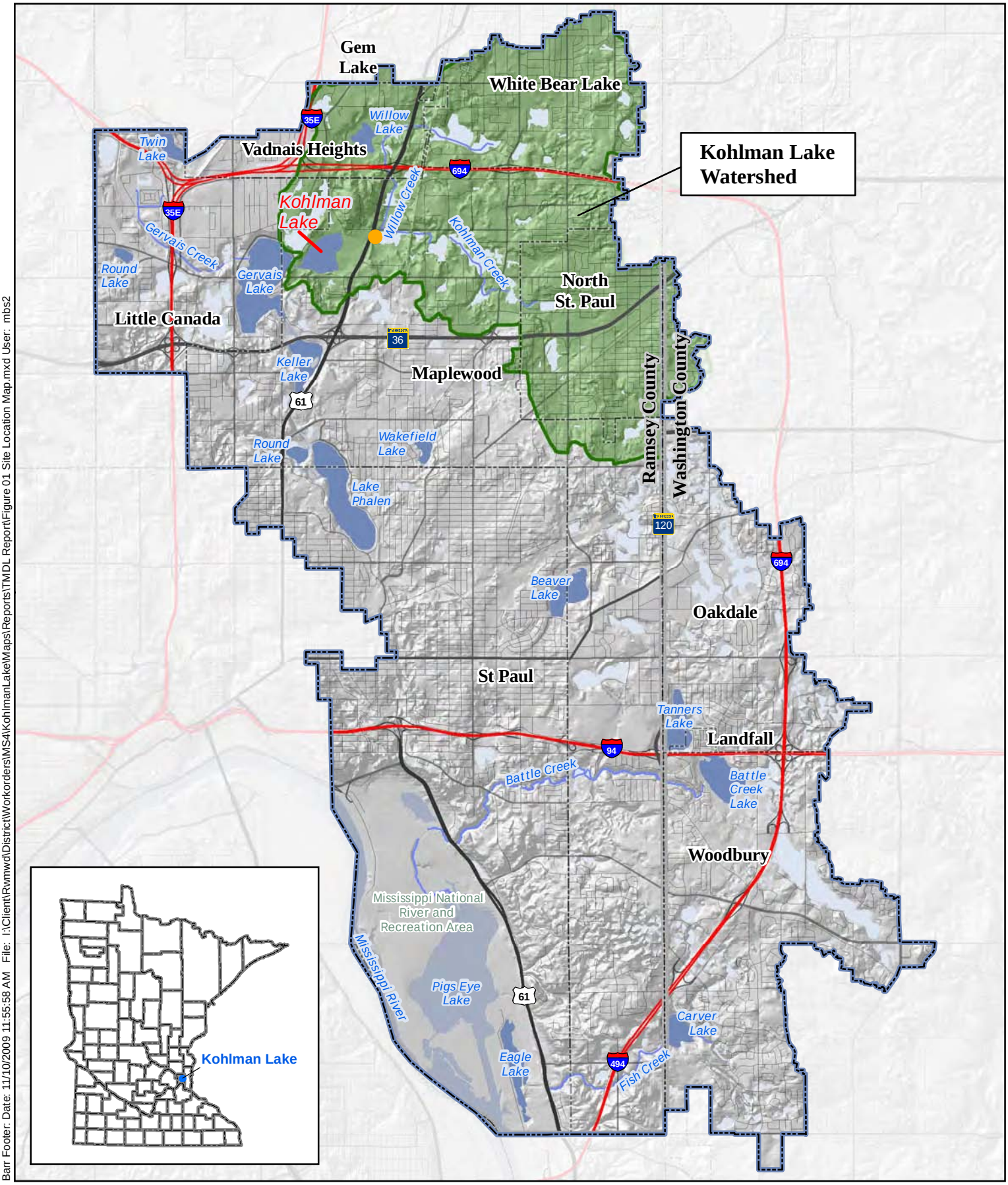
2.1 Overview of Kohlman Lake and Its Watershed

Kohlman Lake is a Minnesota Department of Natural Resources (DNR)-protected water (#62-0006) located in the city of Maplewood (Figure 2). The lake has a surface area of 74 acres, a maximum depth of approximately 9 feet, and a mean depth of 4 feet. Most of the lake is less than 6 feet deep, with the littoral area covering the entire lake surface (DNR Lake Data). By MPCA definition, Kohlman Lake is considered to be a shallow lake (a maximum depth of less than 15 feet and/or at least 80 percent of the lake less than 15 feet deep). The lake's tributary watershed area in comparison to the lake's surface area is relatively large (101:1). Kohlman Lake is a fishing lake used primarily for motor boating, canoeing, fishing, picnicking, and aesthetic viewing. Kohlman Lake provides some limited wildlife habitat.

Kohlman Lake is polymictic; it mixes multiple times throughout the year. The lake stratifies only for short periods throughout the growing season, followed by destratification that mixes the water column. At times, this mixing can entrain phosphorus that is released from the lake sediment into the water column, making more phosphorus available to algae. Another internal source of phosphorus to Kohlman Lake is curlyleaf pondweed. This macrophyte proliferates in the early-summer and dies off in mid-summer, releasing substantial amounts of phosphorus into the water column.

The Kohlman Lake watershed comprises a total of 7,484 acres (excluding the lake surface area) and drains portions of the cities of Gem Lake, White Bear Lake, Vadnais Heights, Maplewood, North St. Paul, Little Canada, and Oakdale. The Kohlman Lake watershed can be described in terms of four different "drainage districts." A drainage district is described here as a network of drainage areas whose runoff drains to a common point before entering the lake. Each Kohlman Lake drainage district is shown in Figure 3 and is described below:

- **Kohlman Lake Main Drainage District—**This 6,831-acre drainage district, located east of the lake, represents the majority of the Kohlman Lake watershed. Runoff from this drainage district flows through a series of ponds, wetlands and/or storm sewers; and, ultimately, Kohlman Basin (the wetland system directly upstream of the lake, located directly south of Beam Avenue and east of Highway 61) before reaching Kohlman Lake.



Barr Footer: Date: 11/10/2009 11:55:58 AM File: I:\Client\Rwmwd\DistrictWorkorders\MS4\KohlmanLakeMaps\Reports\TMDL Report\Figure 01 Site Location Map.mxd User: mbs2

District Legal Boundary

Kohlman Lake Watershed

Outlet of Kohlman Basin:
Flow and Water Quality Monitoring Station

0 0.5 1 2
Miles

Figure 1
SITE LOCATION MAP
Kohlman Lake
Total Maximum Daily Load Report

- **Kohlman Lake North Drainage District—**This 107-acre drainage district, north of the lake, represents a very small portion of the Kohlman Lake watershed. Runoff from this drainage district flows to a flow splitter, where low flows are routed to a wetland system that discharges to Kohlman Lake. High flows by-pass the splitter and discharge directly into Gervais Lake.
- **Kohlman Lake South Drainage District—**This 83-acre drainage district, south of the lake, also represents a very small portion of the Kohlman Lake watershed. Runoff from this drainage district is routed to two ponds, neither of which has constructed outlets—therefore, water from these ponds only flows to Kohlman Lake during high water conditions, when the ponds overtop. Under typical conditions, these ponds are landlocked.
- **Kohlman Lake Direct Drainage District—**This 463-acre drainage district consists of the area that drains directly to Kohlman Lake without passing through retention ponds or any significant pretreatment. The runoff from this area generally sheet flows directly into the lake with little or no treatment.

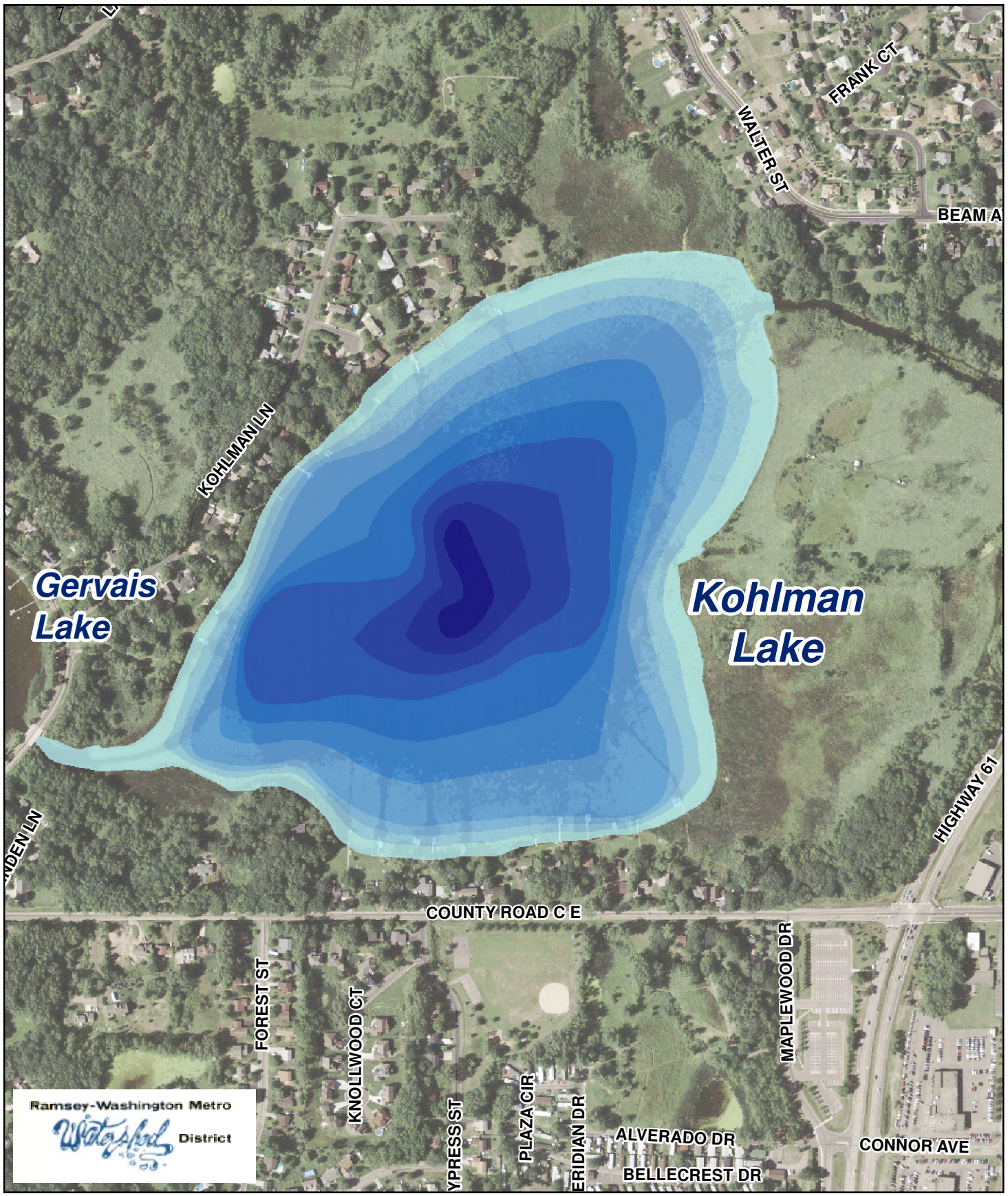
2.2 Kohlman Lake Pollutant of Concern and Pollutant Sources

The pollutant of concern in Kohlman Lake is phosphorus, measured as Total Phosphorus (TP). The Phalen Chain of Lakes' largest source of phosphorus is stormwater runoff from its tributary watershed.

The land uses in the Kohlman Lake tributary watershed can be summarized as follows:

- Low Density Residential (1-4 units per acre) 40.8%
- Natural/Park/Open/Agricultural 20.8%
- Commercial 8.9%
- Wetland 8.9%
- Institutional 5.2%
- High Density Residential (> 8 units per acre) 5.1%
- Industrial/Office 4.3%
- Highway 3.5%
- Open Water (including Kohlman Lake itself) 2.5%

In Kohlman Lake, other phosphorus sources are significant in affecting water quality-internal loads of phosphorus from the lake sediment and senescing macrophytes (curlyleaf pondweed). Carp excretion is also expected to contribute significantly to the lake's internal phosphorus load, although only rough, highly variable estimates of the TP load due to carp in Kohlman Lake have been made to date.



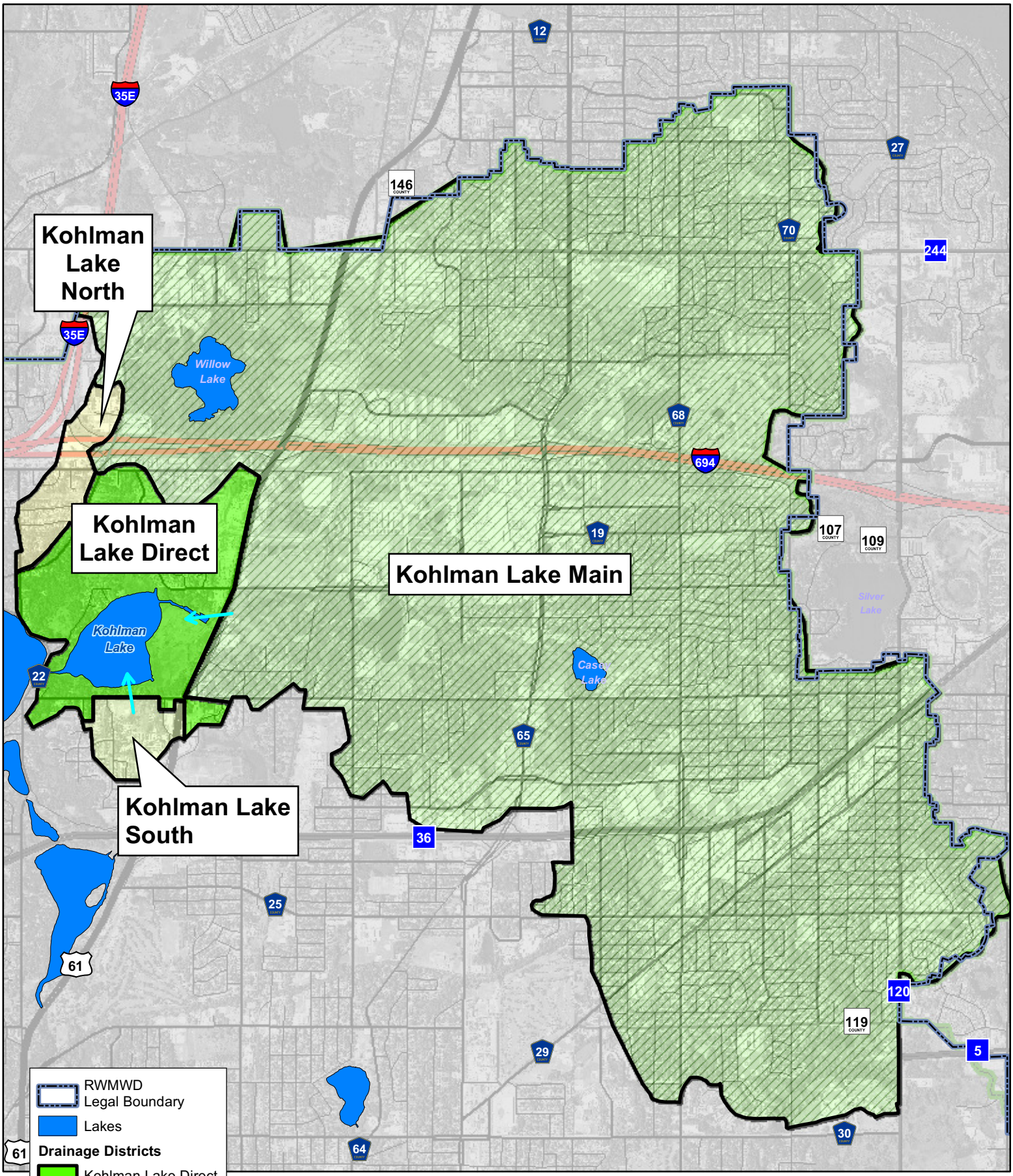
Barr Footer: Date: 6/24/2008 9:30:36 AM File: I:\Client\Rwmwd\District\Workorders\MS4\KohlmanLake\Maps\Reports\TMDL Report\Figure 02 Kohlman Lake Bathymetry.mxd User: TJA

2006 Aerial Photography

Bathymetry Depth (feet)					
9 - 9.5	8 - 9	7 - 8	6 - 7	5 - 6	4 - 5
3 - 4	2 - 3	1 - 2	0 - 1		

0 250 500 1,000
Feet

Figure 2
KOHLMAN LAKE BATHYMETRY
Kohlman Lake Total Maximum Daily Load Report



Barr Footer: Date: 6/24/2008 10:50:37 AM File: I:\Client\Rwmwd\District\Workorders\MS4\KohlmanLake\Maps\Reports\TMDL Report\Figure 03 Kohlman Lake Drainage Districts.mxd User: TJA

Figure 3
DRAINAGE DISTRICTS
Kohlman Lake
Total Maximum Daily
Load Report

3.0 Summary of the Kohlman Lake TMDL Load Allocations

The TMDL equation is defined in the Kohlman Lake TMDL report as follows:

TMDL = Wasteload Allocation (WLA) + Load Allocation (LA) + Margin of Safety (MOS) + Reserve Capacity.

For Kohlman Lake, the Load Capacity is 769 pounds (lbs) of total phosphorus (TP) per growing season.

The TMDL equation used to derive this Load Capacity for Kohlman Lake is:

Expressed as growing season (June through September) totals:

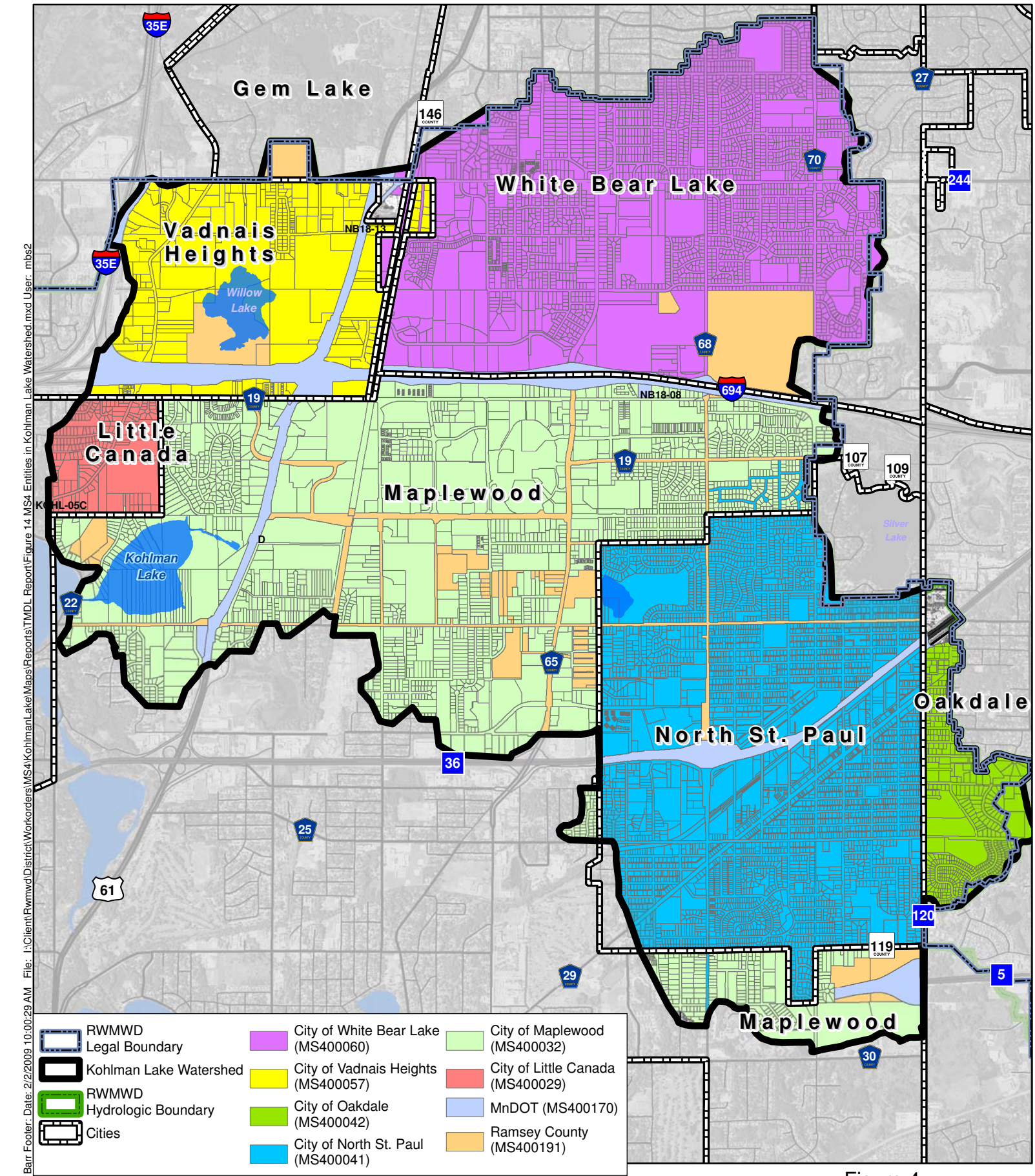
TMDL = 734 lbs. TP (WLA) + 35 lbs. TP (LA) + 0 lbs. TP (MOS) + 0 lbs. (Reserve Capacity) = 769 lbs per year

Expressed in daily terms (growing season load/122)

TMDL = 6.02 lbs/day (WLA) + 0.29 (LA) +0 (MOS) + 0 (Reserve Capacity) = 6.31 lbs per day, on average, over the growing season

The Wasteload Allocation represents a 22% reduction in the external load from the entire tributary area to Kohlman Lake. The external load TP reduction efforts will be focused within the lake's "Main" drainage district - a 25% TP reduction in the "Main" drainage district is necessary to meet the entire tributary load reduction. This external load reduction will be achieved through a series of BMP implementation projects and programs sponsored by the District. Figure 4 shows the MS4s in the Kohlman Lake watershed.

The Load Allocation represents an 88% total phosphorus reduction. This will be achieved through a reduction in the lake's internal phosphorus load, by herbicide treatment of the curlyleaf pondweed and through chemical (alum) treatment to inactivate the sediment TP load.



Barr Footer: Date: 2/2/2009 10:00:29 AM File: I:\Client\Rwmwd\District\Workorders\MS4\KohlmanLake\Maps\Reports\TMDL Report\Figure 14 MS4 Entities in Kohlman Lake Watershed.mxd User: mbs2

Figure 4
MS4 ENTITIES IN KOHLMAN LAKE WATERSHED
Kohlman Lake
Total Maximum Daily Load Report

Figure 5 shows the impact of several capital improvement project (CIP) options on in-lake TP concentrations, under wet, dry and average precipitation conditions. For Kohlman Lake, reduction of phosphorus from Kohlman Basin's outflows and an in-lake treatment of the internal load are required to bring the lake's growing season TP concentration to below 60 µg/L during the wet, dry and average precipitation years modeled for the TMDL.

All of the lake concentrations (except for existing conditions) presented in Figure 5 were obtained through the modeling described in the Kohlman Lake TMDL report. The TP concentration in the lake that is achieved as a result of each management scenario is represented as a bar in order to convey the range of phosphorus concentrations predicted for the different precipitation years. The top of each bar represents the lake TP concentration during the average year of precipitation- this was the most critical condition.

There are multiple actions that are shown in Figure 5 that are needed to reduce phosphorus concentrations in Kohlman Lake to meet the MPCA's shallow lakes TMDL criteria of 60 µg/L. The District's short and long term goals are also shown on this figure. These goals are intended to be met as the watershed and in-lake improvements are implemented in a stepwise manner. The District's short term goal (90 µg/L) will be met with the implementation of:

- Permeable limestone barriers (PRB) in Kohlman Basin—designed to reduce external phosphorus loading by providing sorption sites via binding with calcium
- Enhanced sand filter (ESF) in a new commercial area upstream of Kohlman Basin—designed to reduce external phosphorus loading through physical filtration and phosphorus binding with iron
- Internal load reduction measures (INT LD) within Kohlman Lake—designed to reduce internal phosphorus loading through phosphorus binding with aluminum and curlyleaf pondweed reduction

To reach the District's long term goal of 70 µg/L, project implementation includes:

- 10 years of infiltration project implementation—designed to reduce external phosphorus loading through runoff infiltration, and, if needed,
- Hazelwood Park Pond improvements (HPP)—designed to reduce external phosphorus loading through increased biological uptake and burial in a wetland system. This project is an optional project that would be implemented if the infiltration projects are not as successful as they are hoped to be.

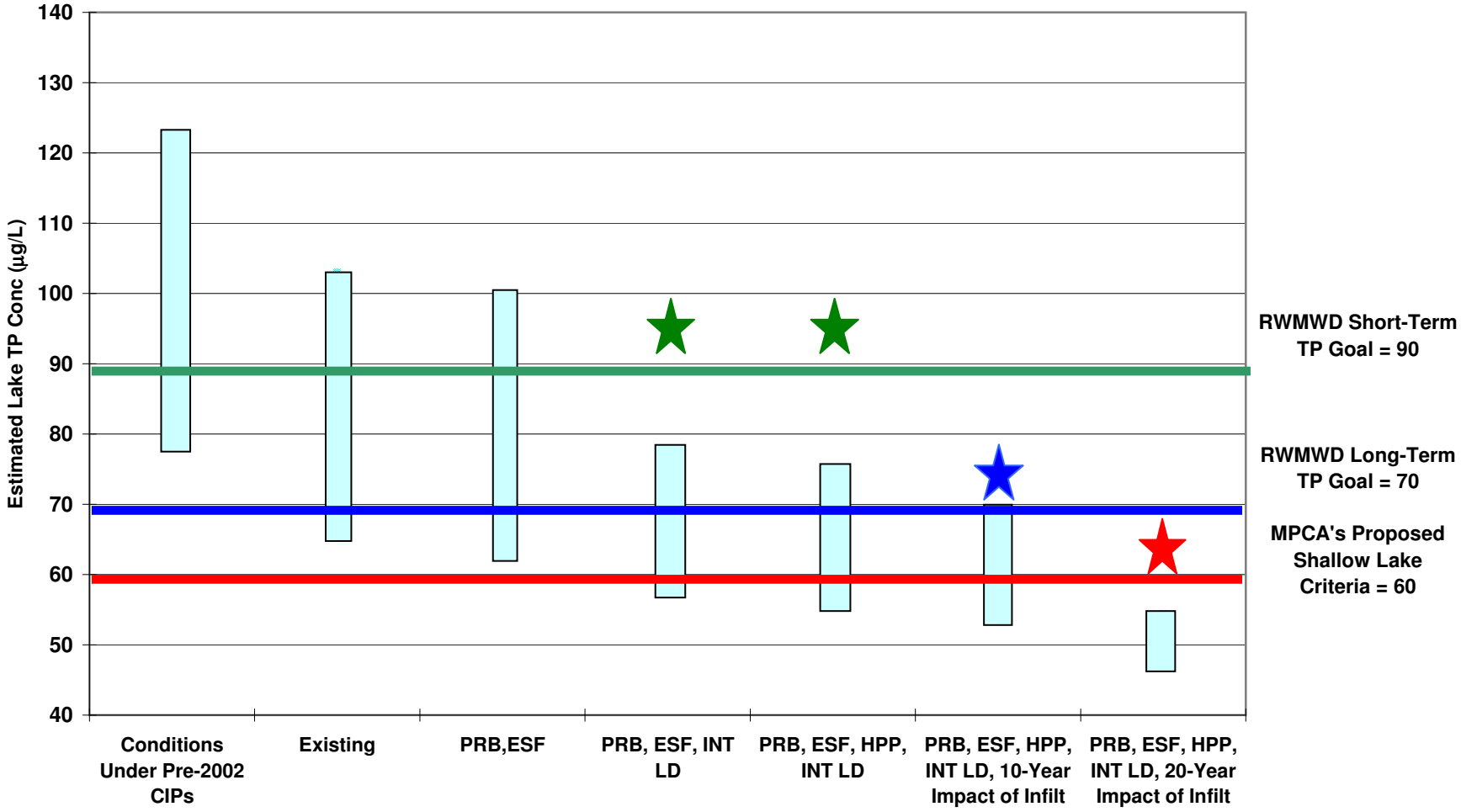
Modeling indicates that an additional 10 years of infiltration projects (20 years total) will reduce phosphorus levels in Kohlman Lake to the point that the lake is expected to meet the 60 µg/L phosphorus requirement. As Figure 5 shows, the estimated lake phosphorus concentration will meet the goals stated above under the wet, dry, and average precipitation conditions for the lake (the range shown by the bar for each condition).

Key to Abbreviations
CIPs: Capital Improvement Projects
PRB: Permeable Limestone Barrier
ESF: Enhanced Sand Filter
HPP: Hazelwood Park Pond Improvements
INT LD: 90% Reduction of Internal Phosphorus Load

Figure 5

KOHLMAN LAKE

Effect of Kohlman Basin Area Water Quality Enhancement Projects, Infiltration and Reduction of Internal Phosphorus Load on Lake TP



4.0 Kohlman Lake TMDL Implementation

4.1 Annual Load Reductions

This TMDL implementation plan focuses on reducing both external, watershed sources of phosphorus and internal, in-lake sources of phosphorus. Growing season reductions of 209 pounds (22%) from external loading and 255 pounds (88%) from internal loading sources are required to achieve the required TMDL threshold of 60 µg/L for shallow lakes. Total phosphorus load reduction (both external and internal) to Kohlman Lake will decrease overall loading by 464 pounds, or 38% over the growing season in order to achieve the overall TMDL load allocation of 769 lbs. The projects will be implemented in a stepwise manner, with some implementation of projects already having occurred prior to the creation of this Implementation Plan. It is anticipated that it will take 20 years to implement all of the projects required to achieve these annual load reductions. Watershed conditions in 2002 will serve as the baseline from which the phosphorus reductions described in this Implementation Plan will be measured.

4.1.1 External (Watershed) Sources-Reduction Goal of 209 Pounds of Phosphorus over the Growing Season

The Kohlman Creek Subwatershed Infiltration Study (Barr, 2007) identified an annual target for infiltration that would help the lake meet its TMDL goal- 63.7 acre-ft of stormwater runoff through various BMPs installed over a 20-year period (3.2 acre-ft per year). BMPs include: impervious surface reduction, infiltration basins, biofiltration basins, porous pavement and boulevard bump-outs with infiltration. In 2007, infiltration requirements as a part of the District's permitting program achieved 3.7 acre-ft of infiltrated stormwater runoff throughout the watershed. Where the permitting program falls short of the 3.2 acre-ft per year goal in future years, the District will make up the difference (to the maximum extent practicable) with retro-fit volume reduction projects. In addition, other BMPs for phosphorus removal from stormwater will also be implemented. These include the already constructed Enhanced Sand Filter and Permeable Limestone Barriers.

The following tasks describe the activities that the District plans to pursue (or has already pursued) in order to achieve the waste load (watershed load) reductions defined in the Kohlman TMDL. The District will use its own funds for many of these tasks, but will also pursue grant opportunities through the State Clean Water Partnership Funds, State Revolving Funds, Section 319 funds and other relevant federal and state funds that may be able to assist the District in its efforts.

Task 1. Identify Areas and BMPs for Potential Phosphorus Reduction in Flows through Kohlman Basin

This task involved using existing information to identify specific BMPs to reduce phosphorus entering and flowing through Kohlman Basin. This task was completed in 2006 and is described in the *Kohlman Basin Area Water Quality Enhancements Study* (Barr, 2007).

1. Responsible Parties	RWMWD
2. Timeline	Completed 2006
3. Cost	$30,000

Task 2. Kohlman Creek Subwatershed Infiltration Study

This task involved identifying an annual reduction goal, potential infiltration opportunities, and specific infiltration BMPs to reduce external loading of phosphorus to Kohlman Lake. This task was completed in 2007 and is described in the *Kohlman Creek Subwatershed Infiltration Study* (Barr, 2007).

1. Responsible Parties	RWMWD
2. Timeline	Completed 2007
3. Cost	$35,000

Task 3. Implement and Enforce the District's Infiltration Rules Within the Kohlman Lake Watershed

Through the District's permitting program, implementation projects by applicants are hoped to cumulatively infiltrate 63.7 acre-ft of stormwater runoff annually, over a 20 year period. Shortfalls, should they occur, will be made up through implementation of District-sponsored projects (to the maximum extent practicable) as identified in the Kohlman Creek Subwatershed Infiltration Study. This task started in 2007 and is ongoing.

1. Responsible Parties	RWMWD
2. Timeline	2007-2027
3. Estimated Capital Cost	$55,000 annually (on average)
4. Phosphorus Reduction	50 Pounds/Growing Season (expected minimum)

Task 4a. Design and Implement Stormwater Best Management Practices

This task involved design and construction of the Enhanced Sand Filter and Permeable Reactive Limestone Barriers. These BMPs were constructed in 2008.

1. Responsible Parties	RWMWD
2. Timeline	Completed 2008
3. Estimated Capital Cost	$395,000
4. Phosphorus Reduction	50 Pounds/Growing Season

Task 4b. Improvements to Hazelwood Park Pond to Reduce Phosphorus if Monitoring Indicates Additional Efforts are Needed

It is possible that the implementation of projects described in Task 3, Task 4a and Task 5 will provide additional reduction of phosphorus over and above 159 pounds per year. However, if that is not the case, and additional phosphorus reduction is ultimately needed to meet the 209 pound WLA, another potential capital project has been identified. A feasibility study of options to improve the water quality treatment potential of Hazelwood Park Pond (also called "Markham Pond") began in 2010.

Initial modeling efforts conducted in 2010 indicated that dredging of Markham Pond could remove 89 pounds of phosphorus per year (38 pounds for the growing season). Dredging, when combined with other restoration efforts for Markham Pond, is expected to provide significant phosphorus reduction efforts to Kohlman Lake as well as water quality improvements to Markham Pond. Depending upon the extent of the restoration effort and the number of modifications conducted, it is feasible that restoration of Makham Pond could lead to 156 pounds of phosphorus removal per year or 73 pounds during the growing season.

Strategic dredging and aeration of Markham Pond is just one implementation element of a much larger, long-term vision developed in the Markham Pond Ecological Restoration and Parkland Plan in October of 2013 for utilizing and restoring Markham Pond in Maplewood, MN. By completing the next step in the plan, the pond's ecological health will continue to improve, as will the water quality of the discharge waters, and ultimately the water quality of Kohlman Lake. The overall vision for Makham Pond was developed as a collaborative effort by the Ramsey-Washington Metro Watershed District, the City of Maplewood, the University of Minnesota, and the Department of Natural Resources. Valuable input was provided by neighboring property owners, upstream communities, and business owners. The outcome of this collaborative effort was a planned sequence of

construction/implementation projects for Markham Pond performance and water quality improvement (see project area map in Figure 1) which includes: (1) Long term carp control (underway), (2) Fish stocking (ongoing), (3) Strategic dredging, (4) In-pond flow diversion, (5) Periphyton phosphorus treatment system.

1. Responsible Parties	RWMWD
2. Timeline	2015-2017
3. Estimated Capital Cost	$914,000
4. Phosphorus Reduction (needed)	50 Pounds/Growing Season

Task 5. Implementation of Projects Defined in the Kohlman Creek Subwatershed Infiltration Study

Two projects that address this task are currently underway:

Extensive planning meetings have been held with Simon Property Group, Inc. about implementing infiltration practices (retro-fit) in key locations in the mall's parking lot. Phase I of the project (rain gardens at each of the Mall's entrances) started construction in fall of 2009 and will be completed in 2010. Phase II of the project will include a demonstration of several kinds of infiltration features (rain gardens, porous pavement, tree boxes) as well as water re-use features (cisterns) and public art all designed to teach mall visitors about stormwater and water quality concepts while providing stormwater treatment for up to 2 inches of runoff at the site. Phase III would involve implementation of infiltration throughout the remaining parts of the Mall's parking lot.

Also, the District is currently working with the City of North St. Paul to select a residential street to demonstrate "green street features" (impervious surface reduction, infiltration, traffic calming, pedestrian and bike access and urban forest revitalization). In addition, the District is working with the City of North St. Paul to create a comprehensive "Green Infrastructure Plan" that would incorporate green street features and other stormwater management features into future redevelopment projects throughout the City.

Similar projects will be pursued in the future as the District works toward completion of this task which is intended to supplement the volume reduction achieved through implementation of the District's infiltration rules.

1.	Responsible Parties	RWMWD
2.	Timeline	2007-2027
3.	Estimated Capital Cost	$5,000,000
4.	Phosphorus Reduction	59 Pounds/Growing Season

Total cost for all external source phosphorus reduction tasks over the course of 20 years: $7,474,000.

Total already spent on external source phosphorus reduction tasks by the end of 2008:
$30,000 (Task 1) + $35,000 (Task 2), + $395,000 (Task 4a) + $28,000 (Task 5) = $488,000.

4.1.2 Internal Sources—Reduction Goal of 255 Pounds of Phosphorus over the Growing Season

The reduction of internal sources of phosphorus requires a two step approach. Initially, macrophyte management of the invasive, nuisance species curlyleaf pondweed and Eurasian water milfoil will be conducted (Task 2). The reduction of curlyleaf pondweed will reduce internal phosphorus loading caused by this macrophyte. The reduction of Eurasian water milfoil and curlyleaf pondweed together is needed for the successful application of aluminum sulfate (Task 3).

The following tasks describe the activities that the District plans to pursue (or has already pursued) in order to achieve the load reductions (reduction of the lake's internal load) defined in the Kohlman TMDL. The District will use its own funds for many of these tasks, but will also pursue grant opportunities through the State Clean Water Partnership Funds, State Revolving Funds, Section 319 funds and other relevant federal and state funds that may be able to assist the District in its efforts.

Task 1. Internal Phosphorus Loading Study

This task involved determination of the sources and potential remediation measures for internal phosphorus loading to Kohlman Lake (does not include macrophyte monitoring). This task was completed in 2005 and is described in the *Internal Phosphorus Load Study: Kohlman and Keller Lakes* (Barr, 2005).

1.	Responsible Parties	RWMWD
2.	Timeline	Completed 2005
3.	Cost	$20,000

Task 2. Macrophyte Management to Control Curlyleaf Pondweed and Eurasian Water Milfoil

This task involves treating Kohlman Lake with herbicide to limit the growth of curlyleaf pondweed and Eurasian water milfoil, to limit internal phosphorus loading from curlyleaf pondweed, and to prepare the lake for Task 3 – Inactivation of sediment phosphorus. The macrophyte management plan required for this task was completed in 2005 and is described in the *Kohlman Lake Aquatic Plant Mangement Plan* (Barr, 2008). The first whole lake treatment of herbicide was conducted in April, 2008. The second whole treatment of herbicide was conducted in April, 2009. Spot treatments are planned for spring, 2010.

1. Responsible Parties	RWMWD
2. Timeline	2008-2010 (whole lake treatment) 2010-2011 (spot treatment)
3. Estimated Capital Cost	$300,000
4. Phosphorus Reduction	78 Pounds/Growing Season

Task 3. Inactivation of Sediment Phosphorus

Based on current sediment phosphorus data for Kohlman Lake, this task involves designing and applying an alum application to inactivate phosphorus in the sediment and reduce internal phosphorus loading. The first application is planned for spring of 2010.

1. Responsible Parties	RWMWD
2. Timeline	2010 and 2014
3. Estimated Capital Cost	$266,000
4. Phosphorus Reduction	177 Pounds/Growing Season

Task 4. Identify the Potential for Fisheries Management and Carp Control

This task involves the conducting of research, in cooperation with the University of Minnesota, on carp populations in Kohlman Lake and the potential effects on in-lake phosphorus dynamics. This task also involves the distribution of information to the public on the status of the fishery, and in particular carp, in Kohlman Lake. Results will be used to evaluate the need and methods for carp population reduction and the water quality and fisheries management benefits. University of Minnesota staff began studying Kohlman Lake's carp population in 2009.

1. Responsible Parties	RWMWD
2. Timeline	2009-2010
3. Estimated Cost	$350,000

Total cost for all internal source phosphorus reduction tasks: $936,000

Total already spent on external source phosphorus reduction tasks by the end of 2008:
$20,000 (Task 1) + $50,000 (Task 2) = $70,000.

4.1.3 Overall Cost Estimate for Implementation

The grand total cost estimate for implementing the recommendations in this TMDL, including tasks that address both external and internal source phosphorus reductions is $8,410,000. By the end of 2008, $558,000 of this total had already been spent.

4.2 MS4 Responsibilities

The District will initially take the lead role in implementing projects to achieve the WLA defined in this TMDL. However, cities and other MS4s in the Kohlman Lake Watershed are expected to fulfill their existing responsibilities in storm water management to help meet the goals of this TMDL. Specifically, cities and other MS4s in the Kohlman Lake Watershed will:

- Continue to implement volume reduction BMPs on all City projects to comply with District rules.

- Look for opportunities to implement voluntary projects to reduce runoff wherever possible, taking advantage of the District's cost-share program for water quality improvements.

- Continue to implement their Storm Water Pollution Prevention Plans (SWPPPs) and to improve their public works maintenance practices wherever possible. This work is facilitated through the District Public Works Forum and District sponsored and co-sponsored training and education programs.

If the District's watershed projects (constructed after 2002) are successful in achieving phosphorus reductions toward meeting the lake's overall WLA, the cities and other entities with Municipal Separate Storm Sewer System entities (MS4s) in the Kohlman Lake watershed will be able to take credit toward achieving their WLA defined in the Kohlman Lake TMDL. If the projects implemented as a part of this plan are not ultimately successful in meeting the goals described in the Kohlman Lake TMDL report, the District will meet with all of the MS4s in the Kohlman Lake watershed to collaboratively determine future direction and to decide if additional participation by these groups is needed. In the interim, the District will keep the MS4s informed about project implementation in the Kohlman Lake watershed on a regular basis through TMDL status meetings and reports. Each MS4 can cite the District reports about Kohlman Lake TMDL project implementation in their SWPPPs.

5.0 Monitoring Plan to Track Implementation Effectiveness

The water quality in Kohlman Lake has been monitored for over 50 years, and will continue to be monitored for the foreseeable future. The RWMWD, with assistance from Ramsey County, will continue to monitor the water quality in the lake annually. The typical Ramsey County lake sampling protocol is to visit the lakes 6 to 8 times between May and September (about every 3 weeks.) The following water quality parameters are measured at each visit. All parameters except Secchi disc and chlorophyll *a* are measured at various depths in the water column (every 1 to 2 meters.)

- Secchi disc
- Dissolved Oxygen
- Temperature
- Total Phosphorus
- Soluble Reactive Phosphorus
- Chlorophyll *a*
- Total Particulate Matter
- Organic Particulate Matter
- pH
- Turbidity
- Chlorides
- Total Alkalinity
- Total Hardness
- Specific Conductivity

Also, it will be important to monitor the long-term effectiveness of all of the different projects being constructed in the Kohlman Lake Watershed. A new permanent continuous flow monitoring and water quality sampling station has recently been installed at the outflow point of Kohlman Basin, just upstream of the culvert that carries Kohlman Basin outflows under Hwy 61 to Kohlman Lake. Now that a specific phosphorus reduction goal has been set for Kohlman Basin outflows (25 percent), this monitoring station and the P8 models created for the area as a part of the Phalen Chain of Lakes

Strategic Lake Management Plan (and used again for the Kohlman Lake TMDL study) can be used to determine whether or not the reduction goal has been met in any given time period.

The comparison between future monitoring data and P8 results can be conducted as follows:

1. Using monitoring results (continuous flow and water quality sampling data), calculate the annual load (or the load over some other time period) of phosphorus leaving Kohlman Basin.
2. Run the P8 model of Kohlman Basin for same time period and calculate the load that the model predicts for pre-project conditions.
3. Compare the two loads, and calculate the percent reduction that was achieved over the time period of interest.

Individual BMPs will be monitored as well. For example- the inflows and outflows from the enhanced sand filter are now being monitored to track the filter's effectiveness.

After the first 10 years of project implementation and monitoring, a comprehensive analysis will be conducted to determine if the implemented projects are achieving the required reductions in phosphorus to Kohlman Lake. Even though the watershed baseline conditions are defined as 2002 conditions, this analysis will be conducted in 2016 (as opposed to 2012) in order to allow for 10 years of the implementation of the District's volume reduction rule.

6.0 References

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