Fish Lake Nutrient TMDL

Implementation Plan

November 2010

City of Eagan

wq-iw7-27c

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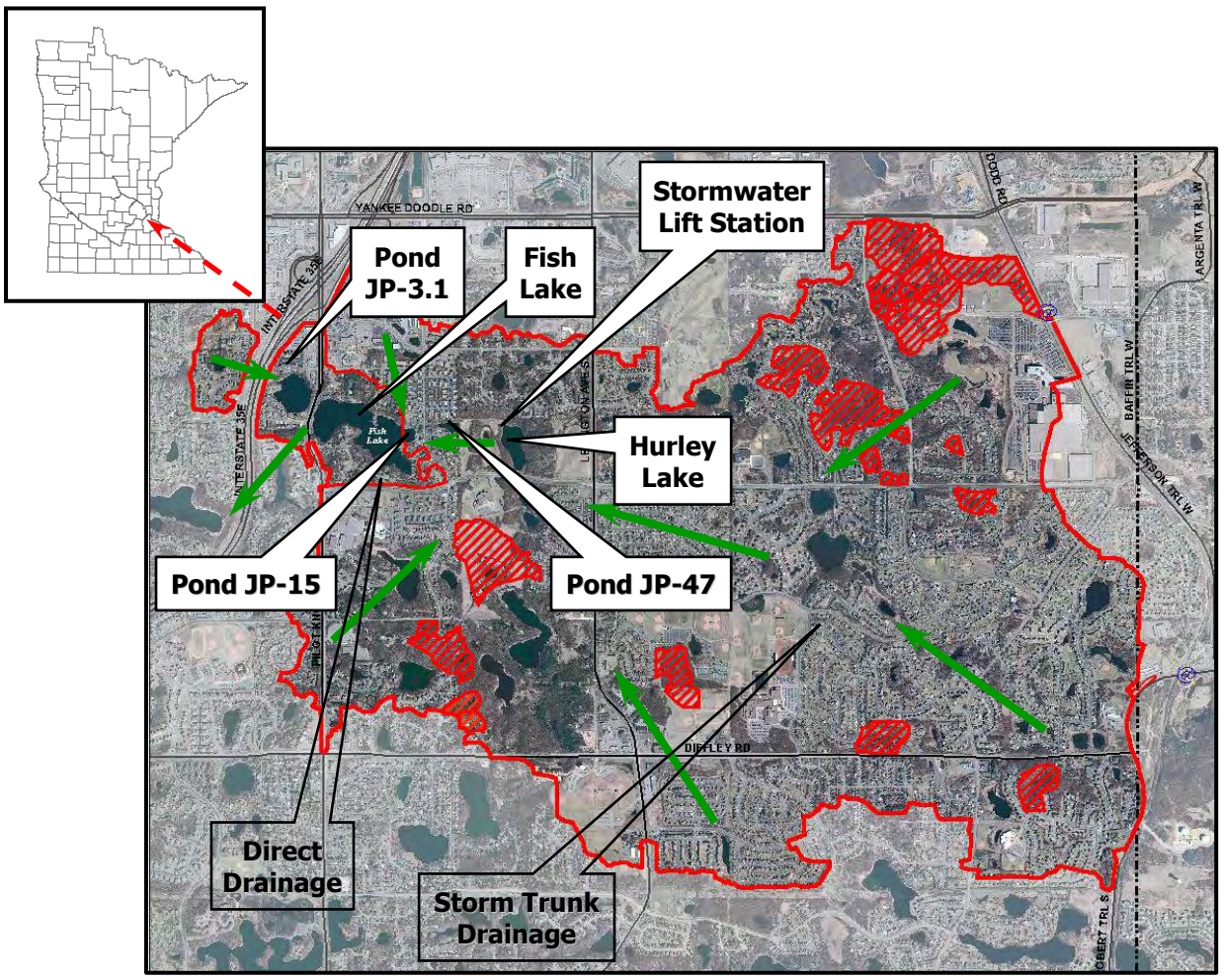
1 Introduction

1.1 BACKGROUND

Fish Lake (MDNR ID# 19-0057) is in the City of Eagan, Dakota County, Minnesota and the Gun Club Lake Watershed (HUC# 070700121110), in the southern part of the Minneapolis and St. Paul Metropolitan area (Figure 1.1). The City of Eagan (City) Water Quality & Wetland Management Plan classifies its top priority lake as Class L1, the highest management goal for which is to support swimming (City of Eagan 2007).

FIGURE 1.1 – FISH LAKE WATERSHED BOUNDARIES, SIGNIFICANT PONDS, AND GENERALIZED STORMWATER DRAINAGE (green arrows)



Note: Cross-hatched, landlocked areas do not contribute total phosphorus load to Fish Lake.

In June 2010, the City completed a Total Maximum Daily Load (TMDL) report for the Minnesota Pollution Control Agency (MPCA)—in accordance with Section 303(d) of the federal Clean Water

Act—to quantify the phosphorus reductions needed for Fish Lake to meet state standards for nutrients (City of Eagan 2010). The TMDL report was completed in cooperation with a group of stakeholders, including watershed residents as well as representatives from the City of Inver Grove Heights, Dakota County Soil and Water Conservation District, Gun Club Lake Watershed Management Organization, Metropolitan Council, Minnesota Board of Water and Soil Resources, Minnesota Department of Natural Resources (MDNR), Minnesota Department of Transportation, and MPCA. The U.S. Environmental Protection Agency approved the TMDL report in September, 2010.

This TMDL Implementation Plan (Implementation Plan) specifies activities the City will undertake to reduce phosphorus loading to Fish Lake with the goal to remove the lake from the 303(d) impaired waters list. It provides an overview of Fish Lake water quality and the results of the TMDL report; conveys guiding principles; discusses general strategies relevant to implementation; and describes proposed implementation activities.

The specific projects, estimated costs, and timelines of this Implementation Plan presented in Table 3.3 are recommendations and may need to be re-evaluated annually based on available funding, adaptive management, technological advances, and economic conditions. The activities in this Implementation Plan are proposed to be implemented within the next five years. Other projects may be put in place after that time period, depending on available funding, need, and cost-effectiveness. Ultimately, the Eagan City Council will make the decisions to move projects forward.

2 Fish Lake TMDL Summary

2.1 HISTORY OF THE LAKE AND WATERSHED

The Fish Lake watershed is within a broad area of Minnesota where the last glaciers terminated and shaped the landscape, depositing ice chunks, rock, gravel, and sand as they retreated many thousand years ago. Long before European settlement, the undulating land of Eagan included many small lakes and wetlands interspersed with forest, savannah, and prairie. Farming predominated for many generations until the mid 1900s. Fish Lake was about 18 acres (ac), which is about half the size and shallower than it is today (Figure 2.1), and its watershed spanned about 120 ac.

FIGURE 2.1 – FISH LAKE AERIAL PHOTOGRAPH (1937)

Changes to the historical watershed were inevitable as urbanization began replacing agriculture in the 1960s. Many originally landlocked depressions were interconnected by storm sewer. The first storm sewer to Fish Lake was connected in 1971 to provide drainage for a small adjacent residential area (Figure 2.2). Other adjacent development expanded the historical watershed into the existing 180-ac "direct drainage" area (Figure 1.1) that contributes stormwater without routing through detention basins. In 1980, a structural outlet was installed, and in 1983, Fish Lake was incorporated into the storm trunk drainage system. These urban changes ultimately

increased the lake's maximum depth to about 30 feet (ft) and its surface area to about 30 ac (Figure 2.3). Fish Lake's watershed now encompasses about 3,300 ac—over a 26-fold increase—and little agricultural land remains in the City (Figure 1.1).

FIGURE 2.2 – FISH LAKE AERIAL PHOTOGRAPH (1974)

FIGURE 2.3 – FISH LAKE AERIAL PHOTOGRAPH (2000)

2.2 CURRENT WATER QUALITY

In 2006, under Section 303(d) of the Clean Water Act, the MPCA listed Fish Lake as impaired for aquatic recreation due to excess nutrients that stimulate algae blooms. The Fish Lake TMDL report set nutrient loads for total phosphorus (TP) because phosphorus is typically the limiting nutrient for algae, and TP is used in state standards (City of Eagan 2010). As shown in Table 2.1, City water quality monitoring data from 2002-2008 indicate moderately elevated levels of TP and chlorophyll *a*—in micrograms per liter (µg/L)—in Fish Lake as compared to state water quality standards. The lake's Secchi depth—in meters (m)—does not exceed the standard.

TABLE 2.1 – 2002-2008 FISH LAKE WATER QUALITY AND STATE STANDARDS

	Summer (June-September) Average		
	Total Phosphorus (µg/L)	Chlorophyll *a* (µg/L)	Secchi Depth (m)
Fish Lake	64.3	31.3	1.6
State Standard	≤ 60	≤ 20	≥ 1.0

Source: City of Eagan (2010)

2.3 MEETING STATE STANDARDS

Fish Lake is designated a Class 2Bd water in Minnesota and is considered a shallow lake in the North Central Hardwood Forest (NCHF) Ecoregion. Minn. Rules Ch. 7050.0150 Subp. 4 defines a shallow lake as an enclosed basin "with a maximum depth of 15 ft or less or with 80 percent or more of the lake area shallow enough to support emergent and submerged rooted aquatic plants (the littoral zone)."

Minnesota's water quality standards limit the quantity of nutrients that may enter waters of the state. Narrative standards (Minn. Rules Ch. 7050.0150 Subp. 3) specify for all Class 2 waters, "…there shall be no material increase in undesirable slime growths or aquatic plants, including algae…." Minn. Rules Ch. 7050.0150 Subp. 5 provide for determining compliance with the standards and establishing use impairments by evaluating representative measurements during the summer growing season of TP, chlorophyll *a*, Secchi depth, and other factors.

In May 2008, MPCA revised the water quality standards in Minn. Rules Ch. 7050.0222 Subp. 3, including numeric standards for Class 2Bd shallow lakes in the NCHF Ecoregion. As shown in Table 2.1, the TP, chlorophyll-*a*, and Secchi depth standards for Fish Lake are ≤ 60 µg/L, ≤ 20 µg/L, and ≥ 1.0 m, respectively. These numeric standards are designed to meet the narrative

standards for designated uses of Class 2Bd shallow lakes and therefore were used in the TMDL report.

MPCA guidance indicates, to provide adequate basis for removing a lake from the 303(d) list, one of the two following conditions relative to the numeric standards must be met for data in the most recent 10 years:

1. Measured in-lake water quality is equal to or better than the TP standard and one of the other two standards (either chlorophyll *a* or Secchi depth), or
2. Measured in-lake water quality exceeds the TP standard but is equal to or better than both the chlorophyll *a* and Secchi depth standards.

2.4 REQUIRED PHOSPHORUS LOAD REDUCTIONS

The Fish Lake TMDL reflects an in-lake TP goal of 54 µg/L, which factors an explicit Margin of Safety (MOS) of 10 percent (6 µg/L) under the Class 2Bd shallow lake standard of 60 µg/L. The TMDL is distributed into a Waste Load Allocation (WLA), a Load Allocation (LA), and a MOS, expressed as TP pounds (lb) per day and per year (yr) according to the following formula:

TMDL	=	WLA	+	LA	+	MOS
1.11 lb/day	=	0.78 lb/day	+	0.18 lb/day	+	0.15 lb/day
407 lb/yr	=	285 lb/yr	+	67 lb/yr	+	55 lb/yr

According to the TMDL, the TP load to Fish Lake will need to be reduced about 19 percent (84 lb/yr) from the current annual TP load estimate of 436 lb/yr to comply consistently with water quality standards during average precipitation conditions. This Implementation Plan specifies activities the City will undertake to reduce TP load with the goal to remove Fish Lake from 303(d) impaired waters list.

2.4.1 ALLOCATIONS

In the Fish Lake watershed, the MPCA has designated the City of Eagan, the City of Inver Grove Heights, Dakota County, and the MN Department of Transportation as operators of Municipal Separate Storm Sewer Systems (MS4s) that require a National Pollutant Discharge Elimination System (NPDES) permit. The TMDL report considered all of the WLA to be associated with these MS4s because there are no wastewater discharges in the watershed (City of Eagan 2010).

As shown in Table 2.2, the WLAs for all but the City of Eagan are set to estimated existing conditions, which means these MS4s are expected not to increase TP loads into the future. This

"no-net-increase" approach is reasonable and consistent with State nondegradation policy (Minn. Rules Ch. 7050.0185), because the calculated existing TP loads from these MS4s are relatively small and insignificant. As additional data become available, WLAs for individual permitted sources may be modified, provided the overall WLA does not change.

TABLE 2.2 – TOTAL PHOSPHORUS LOAD ALLOCATIONS FOR FISH LAKE

Assigned Source	Existing TP Loading		TP Allocations		Load Reduction	Load Reduction
	(lb/yr)	(lb/day)	(lb/yr)	(lb/day)	(lb/yr)	(%)
City of Eagan (WLA)	348	.95	264	0.72	84	19
City of Inver Grove Heights (WLA)	1.0	0.003	1.0	0.003	0	-
Dakota County (WLA)	18	0.049	18	0.049	0	-
MnDOT (WLA)	1.9	0.005	1.9	0.005	0	-
Internal Loading (LA)	59	0.16	59	0.16	0	-
Atmospheric Loading (LA)	7.7	0.021	7.7	0.021	0	-
Margin of Safety (MOS)	-	-	55	0.15	-	-
Total	**436**	**1.19**	**407**	**1.11**	**84**	**19**

Source: City of Eagan (2010)

In Table 2.2, the City of Eagan is the only source with an assigned TP load reduction. By far, Eagan provides the bulk of external loading to Fish Lake and also has the greatest capability to reduce TP load within the watershed. As part of its NPDES permit to discharge stormwater (Permit #MN0069752), the City of Eagan is required to reduce its TP load 84 lb/yr, which is a 19-percent reduction from the current annual TP load estimate.

The TMDL report designated internal TP loading and atmospheric deposition as LA and assumed these TP sources will remain at existing levels (City of Eagan 2010). Thus, the TMDL assumes necessary TP load reductions to meet the in-lake water quality goal can be achieved exclusively through watershed controls.

3 Implementation Plan

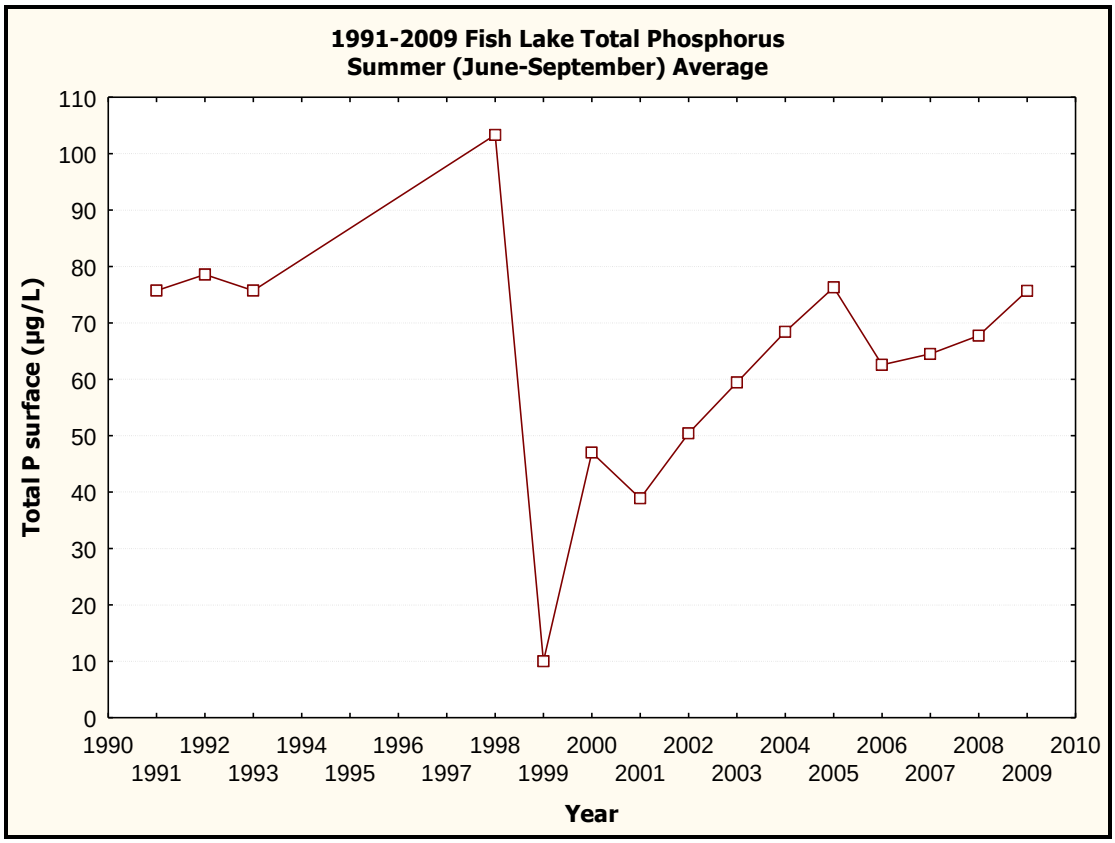
3.1 PREVIOUS PHOSPHORUS MANAGEMENT EFFORTS

The best management practices (BMPs) recommended in this Implementation Plan essentially are the culmination of historical, ongoing, and recent efforts by the City. Since adopting the first city comprehensive water quality management plan in Minnesota (City of Eagan 1990), Eagan has engaged in intense and sustained lake and watershed management in wide-ranging efforts to improve water quality by reducing in-lake TP concentrations.

A diagnostic/feasibility (D/F) study concluded over half of the TP load to Fish Lake is in "storm trunk drainage" via the Hurley Lake lift station through Ponds JP-47 and JP-15 (City of Eagan 1994), as illustrated in Figure 1.1. The D/F study proposed a number of alternative BMPs, including an alum-dosing facility that was built at the lift station in 1998 with funding from MPCA's Clean Water Partnership (CWP) program. The facility's purpose is to reduce TP load by adding alum (aluminum sulfate) to stormwater where it binds with TP and other substances as an inert sludge. Through the 1995-2000 Fish Lake CWP Project, the City operated the alum-dosing facility on a trial basis between 1998 and 2000 (Macbeth and Storland 2002).

An analysis of Fish Lake water quality data from 1991 to 2009 clearly indicates the alum-dosing facility met its intended purpose and strongly suggests a residual positive benefit in 2001, a year after the 3-year trial period. As shown in Figure 3.1, Fish Lake TP decreased (statistical significance: $p < .05$) from 1991 to 2001, but those gains apparently were lost thereafter. From 2002 to 2009, Fish Lake TP increased (statistical significance: $p < .05$), and TP levels in 2009 were similar to those in 1991.

FIGURE 3.1 – 1991-2009 FISH LAKE TOTAL PHOSPHORUS, SUMMER AVERAGE



Continuing its historical efforts, the City implemented other BMPs during the 1995-2000 CWP Project, including public information and education, street sweeping, aquatic plant management, detention basin management, and lake water quality monitoring. Public information and education programs focused on: 1) recognizing the connection between the storm drainage system and the lake; 2) the importance of keeping vegetative materials, fertilizers, and chemical wastes away from streets and driveways; and 3) proper application and reduced use of fertilizers containing phosphorus (Macbeth and Storland 2002). Priority street sweeping removed debris each spring and fall from areas that directly drain to the lake. To reduce internal TP loading and limit direct and indirect impacts by macrophytes on recreational suitability, the City: 1) lowered the lake in winter 1995-1996 in an attempt to reduce curlyleaf pondweed (CLPW) re-growth by freezing and 2) mechanically harvested CLPW and other excessive macrophytes in the summer. The City required stormwater detention basins be incorporated into new developments in the watershed. Lake water quality, macrophyte distribution and abundance, and stormwater quality were monitored to evaluate the effectiveness of Eagan's comprehensive water quality program.

City staff visited retail businesses in 2006 to educate about and assess compliance with local regulations for the sale and display of lawn fertilizers. This outreach effort found retailers to be in compliance with city code and at least generally knowledgeable about state law that restricts use of fertilizers with phosphorus under certain conditions. Staff also discovered no fertilizers with phosphorus were available in the City; retailers apparently had responded to state law by no longer carrying these products. The Eagan City Council publicly recognized each "business watershed steward" for supporting lake water quality.

3.2 RECOMMENDED PHOSPHORUS MANAGEMENT STRATEGIES

The TMDL assumes the water quality goal for Fish Lake can be achieved exclusively by reducing TP load from watershed runoff. This Implementation Plan regards an alum treatment system as the most effective BMP for ultimately removing the lake from the 303(d) impaired waters list. The City believes necessary TP reductions can be accomplished solely by an alum treatment system, but comprehensive lake and watershed management is the City's ongoing, 20-year tradition. Thus, controlling external (watershed) loads as well as reducing internal TP recycling in the lake by employing a variety of BMPs will enable the City to meet TMDL requirements and local goals and expectations with much higher probability and public acceptance.

The City may operate the alum treatment system at a significantly reduced level over the long term (i.e., 10-plus years) or discontinue system operation if it can implement infiltration-type activities at a watershed-wide scale. The City will assess BMP effectiveness and apply lessons learned to guide future actions toward achieving lake water quality goals, consistent with adaptive management principles outlined in the TMDL report and discussed in more detail in Section 3.4.

Table 3.1 summarizes proposed TP load reductions that may be necessary to meet the water quality goal for Fish Lake. The City is proposing efforts to control TP recycling in the lake, as discussed in Section 3.2.3, even though the TMDL assigns no internal TP load reduction.

Implementation strategies and estimated project costs for each item in Table 3.1 are detailed in the following sections. The projects, costs, and timelines are recommendations the City may need to re-evaluate based on available funding, adaptive management, technological advances, and economic conditions. This Implementation Plan is proposed to be executed within the next five years, and other BMPs may be initiated after that time period, depending on need, cost-effectiveness, and funding. Ultimately, the Eagan City Council will make the decisions to move projects forward.

TABLE 3.1 – TOTAL PHOSPHORUS LOAD REDUCTIONS FOR FISH LAKE

Phosphorus Source	Proposed Phosphorus Reduction (lb/yr)
Storm Trunk Drainage through JP-47 and JP-15	81
Direct Drainage	3
Internal Loading	31
Total	**115**

3.2.1 STORM TRUNK DRAINAGE THROUGH JP-47 AND JP-15

The TMDL report concluded about 76 percent of the TP load to Fish Lake is via storm trunk drainage through Ponds JP-47 and JP-15 (City of Eagan 2010), as illustrated in Figure 1.1. The CWP Project concluded alum dosing rates between 4 and 6 milligrams per liter (mg/L) were optimal and most cost effective for good removal (about 60 percent) of TP from this source (Macbeth and Storland 2002). Pilgrim and Brezonik (2005) reported the 2000 dosage of 8 mg/L in May – June was effectively 4 mg/L in July – August because a large storm in July (11 inches in 3 hours) triggered twice the flow by lift station pumps. Pilgrim and Brezonik (2005) concluded a dosage of 6 mg/L or greater is necessary for significant TP reduction (about 90 percent) but suggested no additional benefits would result with an 8 mg/L dosage. According to the TMDL report, an estimated TP removal efficiency of about 40 percent is needed to meet the goals in this TMDL (City of Eagan 2010).

Table 3.2 presents suggestive evidence of the effectiveness on overall Fish Lake water quality from the 1998-2000 trial operation of the alum treatment system. Pre-treatment data are from the 1991-1993 period; post-treatment data were collected in 2001.

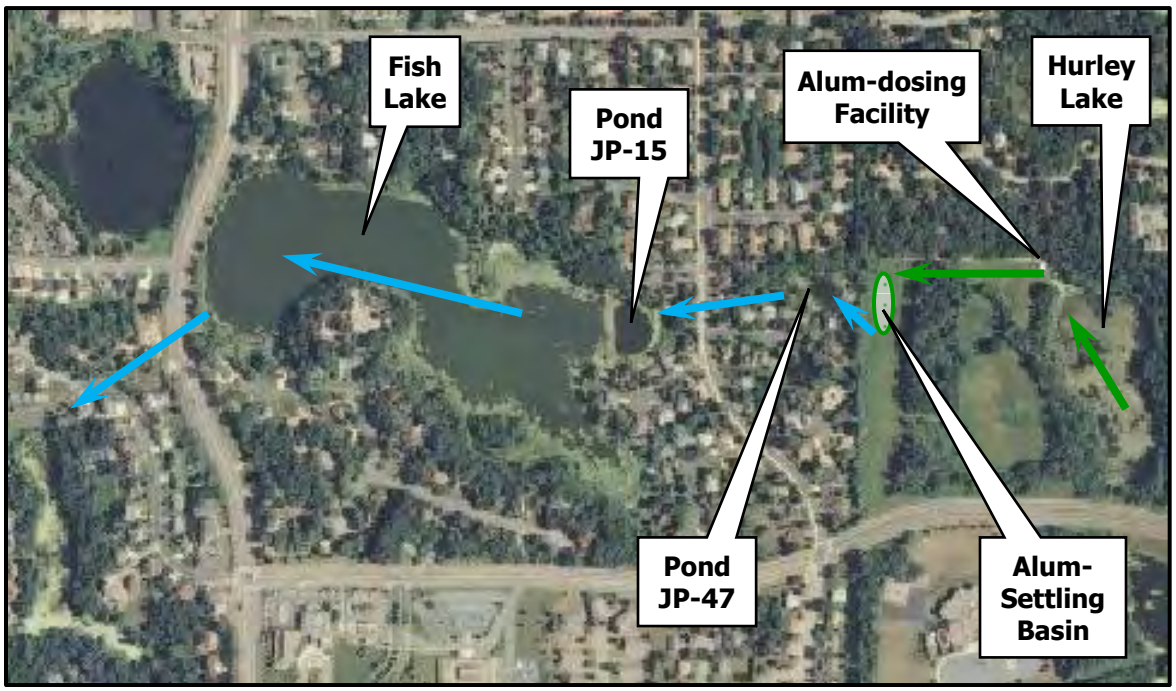
TABLE 3.2 – PRE- AND POST-ALUM TREATMENT, FISH LAKE WATER QUALITY

	Summer (June-September) Average		
Sample Period	Total Phosphorus (µg/L) (n = sample days)	Chlorophyll *a* (µg/L) (n = sample days)	Secchi Depth (m) (n = sample days)
1991-1993	76.7 (n = 21)	31.1 (n = 21)	1.5 (n = 21)
2001	38.9 (n = 8)	13.1 (n = 7)	2.1 (n = 7)

Based on combined historical evidence, the City plans to re-establish an alum treatment system to reduce 81 lb/yr of TP load to Fish Lake. The system's future performance is expected to approach its 2001 effectiveness (Table 3.2). Thus, there should be adequate basis to remove Fish Lake from the 303(d) impaired waters list within 10 years, as discussed in Section 2.3.

During the 1998-2000 trial period, Pond JP-47 temporarily accumulated alum sludge, which was subsequently removed at a cost of about $215,000. The City has since sought to construct a permanent alum-settling basin on the private land between Hurley Lake and Pond JP-47 (Figure 3.2). The City has made recent progress by acquiring easements on 3 ac of the property at a cost of about $325,000. As of this report, construction of the new settling basin and modifications to the existing facility and storm trunk system are underway and on schedule to be completed in spring, 2011. The City has budgeted $300,000 for these capital improvements since 2007.

FIGURE 3.2 – FISH LAKE ALUM TREATMENT SYSTEM AND GENERALIZED WATER FLOW (arrows)



Beginning 2011, the City expects to operate the alum treatment system annually for a minimum of 10 years. To optimize operation and maintenance of the system, the City will be using the lowest, most effective alum dosing rate over the shortest possible time period based on evaluations of lake water quality monitoring data and on ongoing experience. Dosing may occur regularly and/or intermittently as needed. The City expects to have an operations and

maintenance strategy within the first few years to guide appropriate choices regarding dosing rates and timings. This approach will not only help the City best meet the water quality goals for Fish Lake, but also minimize operating costs of the facility and reduce maintenance expenses to remove alum sludge from the settling basin. The estimated initial annual budget for the alum treatment system is $93,800, with $30,000 for facility operation, $60,000 for system maintenance, and $3,800 for system monitoring, as discussed in Section 3.3.

The City will evaluate implementing BMPs that reduce impacts of stormwater runoff in strategic locations upstream of the Hurley Lake lift station as opportunities that are currently unknown may arise. Such BMPs could include bio-retention features and disconnections of impervious areas. The City may find it could lower operation and maintenance costs by reducing TP levels entering the system through a whole-lake alum application of Hurley Lake. Ultimately, the City may operate the alum treatment system at a significantly reduced level or no longer if water quality improvements result from infiltration-type BMPs implemented at a watershed-wide scale in the next 10-plus years. However, the costs and benefits of potential BMPs would need to outweigh the costs and benefits of continuing to operate the system.

The City's NPDES permit requires regular MS4 inspections to assess conditions of stormwater detention ponds and to conduct maintenance activities as warranted and according to a storm water pollution prevention program (SWPPP). In 2009, the City removed about 300 cubic yards of sand sediment from two stormwater inlet deltas in Pond JP-15. This work restored about 8,100 cubic ft of detention capacity to the pond and cost about $15,500. For similar efforts in 2010, the City has budgeted $250,000. Future stormwater maintenance activities will be taken indefinitely in the Fish Lake watershed.

3.2.2 DIRECT DRAINAGE

The TMDL report indicated about 8.5 percent of the TP load to Fish Lake is from the 180-ac "direct drainage" area that contributes stormwater without detention basins (City of Eagan 2010), as illustrated in Figure 1.1. To benefit lake water quality since 1992, the City has swept streets in priority watersheds to remove debris in spring and fall. The City estimates TP load will be reduced only up to 3 lb/yr by sweeping 3.4 street miles (mi) in the Fish Lake direct drainage area indefinitely into the future. However, annual water quality sweeping operations will collect about 1,000 lb/mi of street debris, thus removing about 3,400 lb/yr of inorganic and organic materials from entering Fish Lake. At a rate of about $100/mi for staff and sweeper equipment operations, this work will cost about $3,400/yr, with a sweeper replacement cost of about $18,500/yr (based on estimated 7-year replacement of $126,000), for a total of about $21,900/yr.

Lakeshore property owners play a role in reducing TP load from the direct drainage area, but again the City estimates this would be a relatively small amount. Nevertheless, the City engages with these residents through its comprehensive public involvement and education programs. Numerous public information campaigns over the years have focused on keeping grass clippings, leaves, trash, and household wastes off streets and connected impervious surfaces such as driveways and sidewalks. The City believes developing relationships with, among, and between these stakeholders engenders "watershed stewards," neighborhood leaders, and lakeshore homeowner organizations. Ideally in the future, these individuals and groups will support and facilitate participation in BMPs that reduce impacts of stormwater runoff on priority lakes such as Fish Lake. The estimated portion of this work for Fish Lake is $2,000/yr.

Prior to completion of the TMDL report, the City evaluated retrofitting bio-retention features in part of the Fish Lake direct drainage area in 2008, in coordination with its long-term street maintenance program. Although such BMPs were found to be infeasible there, the City will continue indefinitely to investigate opportunities as they arise in other locations. The City has $165,000 budgeted in 2011 to increase the volume of Pond JP-3.1 (Figure 1.1) in the direct drainage area as part of a larger project to extend Duckwood Road across I-35E. Pond JP-3.1 is significantly undersized for the area that ultimately will drain to it without sufficient stormwater detention.

3.2.3 INTERNAL LOADING

The TMDL report indicates about 13.5 percent of the total TP load to Fish Lake is from internal sources and is estimated to be 59 lb/yr (City of Eagan 2010). The City is proposing efforts to control TP recycling in the lake even though the TMDL assigns no internal TP load reduction.

Because historical, periodic external TP loading to Fish Lake has been higher than the lake's assimilative capacity, much of the excess TP has likely accumulated in the sediment. Sediment TP can be released into the water column when sediment is suspended upward by wind mixing the lake and by rough fish activity at the bottom, especially in mid to late summer when bottom dissolved oxygen levels drop below 2 mg/L. TP is also released when the heavy growths of CLPW die off in early to mid summer. These mechanisms for internal TP loading can promote nuisance algae growth.

After the lake was temporarily drawn down in winter 1995-1996, the City concluded re-growth of CLPW decreased where exposed to air freezing and where covered by ice only. In a separate experiment, all CLPW specialized shoots (i.e., turions) with sprouts were killed after being in a

freezer from 2 days to 2 months. The City followed up these investigations by approving plans and advertising for bids in 2000 to construct a new stormwater lift station and associated force main improvements on the west end (i.e., outlet) of Fish Lake. The purpose of the project was to enable the lake to be lowered up to 6 ft below normal water level in the fall every 2-3 years or as needed for CLPW control. Lakeshore residents and recreational users supported the project, but the City decided not to build it because likely construction costs (bids ranged from $100,000 to almost $250,000) were judged to outweigh potential water quality benefits.

Since 1991, the City has mechanically harvested CLPW (prior to summer die off) and other excessive macrophytes from Fish Lake to benefit water quality, recreational access, and visual aesthetics. This work will continue indefinitely into the future. Based on Lubnow and Souza (2007) and Lubnow (2010), the City will remove by plant harvesting an estimated 25 lb/yr of TP from the lake. At a rate of about $300/hr for staff and equipment operations, this work will cost about $7,200/yr.

The City's comprehensive lake and watershed management approach considers Fish Lake to be a likely significant source of TP to Blackhawk Lake, which is classified Eagan's third priority lake by the Water Quality & Wetland Management Plan (City of Eagan 2007). Thus, by controlling TP recycling in the lake, TP export should be reduced from the lake. The City has budgeted $44,000 in 2011 for a whole-lake alum treatment that will chemically inactivate sediment TP in Fish Lake and estimates internal TP load will be reduced up to 30 lb over a 5-year implementation period, or 6 lb/yr.

3.2.4 OTHER POTENTIAL IMPROVEMENTS

In addition to installing potential (i.e., opportunity-based) BMPs and indefinitely maintaining the stormwater system throughout the watershed according to Eagan's SWPPP, the City will assure no-net-increase in TP loading from future development and re-development activities through its post-construction requirements (Eagan City Code §4.33). These regulations were established in 2008 to control volume, TP, total suspended solids, and oil and grease in stormwater runoff, and to control runoff rates by specifying standards to minimize impervious surface area and maximize infiltration and retention. They also specify design requirements for detention ponds, which are considered acceptable if the BMPs available at the time of development cannot control, prevent, and minimize degradation of surface water.

3.2.5 IMPLEMENTATION PLAN SUMMARY

Table 3.3 presents a proposed schedule of BMPs for a 5-year period from 2011 to 2015. Consistent with Table 2.2, the City of Eagan is solely responsible to implement this schedule. Overall costs for implementation are estimated to be about $1,134,000, while construction costs for capital projects may reach $465,000. The BMPs, estimated costs, and timelines in Table 3.3 are recommendations for initial planning purposes and may need to be re-evaluated annually based on funding, adaptive management, technological advances, and economic conditions. Additional BMPs beyond 2015 may be implemented, depending on funding, need, cost-effectiveness, and ultimately, decision-making by the Eagan City Council.

TABLE 3.3 – 2011-2015 IMPLEMENTATION PLAN SCHEDULE

Best Management Practice	Estimated Budget by Year				
	2011	2012	2013	2014	2015
Re-establish alum treatment system	$393,800	$93,800	$93,800	$93,800	$93,800
Priority street sweeping in direct drainage area	$21,900	$21,900	$21,900	$21,900	$21,900
Comprehensive public involvement and education programs	$2,000	$2,000	$2,000	$2,000	$2,000
Increase volume of Pond JP-3.1 in direct drainage area	$165,000	-	-	-	-
Aquatic plant harvesting	$7,200	$7,200	$7,200	$7,200	$7,200
Whole-lake alum treatment	$44,000	-	-	-	-
Totals	**$633,900**	**$124,900**	**$124,900**	**$124,900**	**$124,900**
5-YR GRAND TOTAL	**$1,133,500**	**-**	**-**	**-**	**-**

3.3 MONITORING PLAN

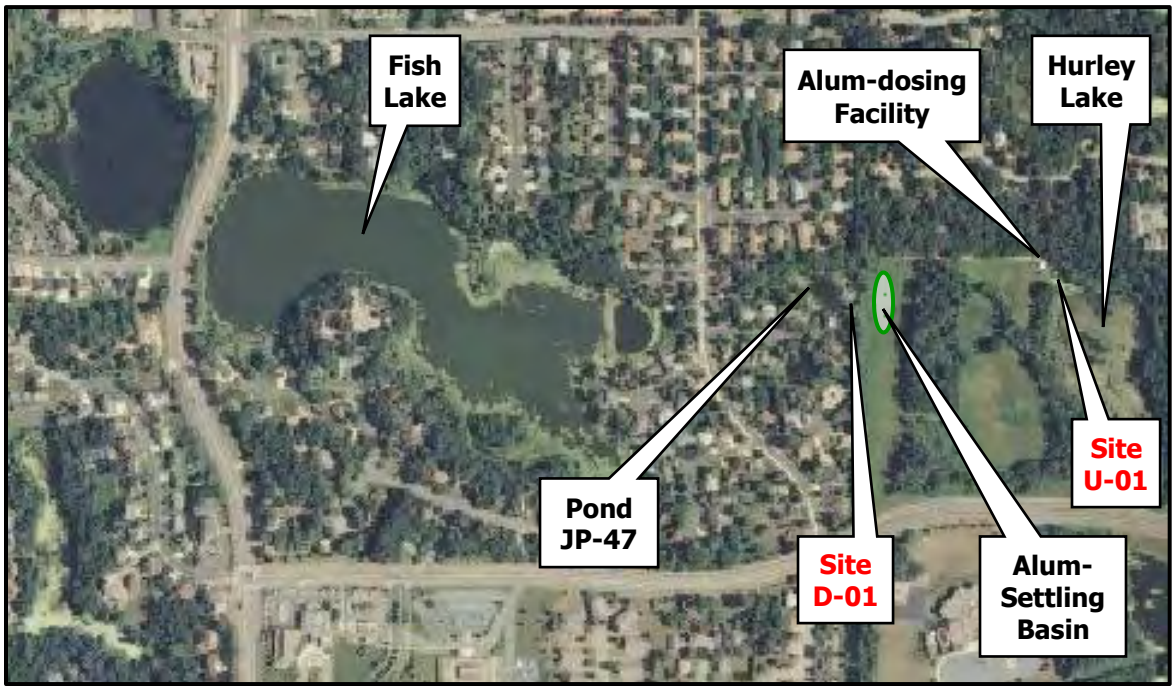
The City will report progress executing the Implementation Plan through its SWPPP Annual Report process, which includes a public meeting and submission of a report to the MPCA. Because achieving the state water quality standards in Table 2.1 is the ultimate goal of this Implementation Plan, the City will manifest the effectiveness of proposed BMPs by assessing Fish

Lake water quality through monitoring and data analysis and by applying lessons learned to guide future actions through an Adaptive Management process, as discussed in Section 3.4.

The monitoring plan includes two components: The first is routine, and the second is new. First, twice monthly between May and September, Eagan's routine monitoring program will collect from Fish Lake surface water temperature, pH, conductivity, and Secchi depth data as well as surface and bottom water samples that will be analyzed for TP and chlorophyll-*a*. Depth profiles of temperature and dissolved oxygen also will be collected. Second, the City will begin a monitoring program specifically to determine the effectiveness of the alum treatment system. To address the TMDL, data will help estimate the TP load reduction attributable to this BMP. Another objective is to maximize TP removal efficiency of the system with an optimal alum dosing rate. These are MPCA's baseline monitoring requirements. MPCA may change monitoring requirements to address variability in system operation as data are collected.

Alum treatment system monitoring will occur at two sites, one immediately upstream of the dosing facility (U-01) and one immediately downstream of the alum-settling basin (D-01), as shown in Figure 3.3. At both sites, grab samples will be analyzed for TP, dissolved phosphorus, total aluminum, dissolved aluminum, and pH. Flow also will be monitored at both sites or at only one site if it is demonstrated to be representative of both.

FIGURE 3.3 – MONITORING SITES FOR FISH LAKE ALUM TREATMENT SYSTEM



The City will collect data between April and October for the first two years according to the monitoring frequencies indicated in Table 3.4. Sampling at U-01 will occur only when the lift station is pumping, and sampling at D-01 will occur only when the alum-settling basin is discharging to Pond JP-47. If possible, sample data will be flow-weighted to monitor the effectiveness of the system when the highest proportion of the load is sent through the dosing facility. The City may request MPCA's TMDL staff to accept modifications to this monitoring plan (e.g., narrower monitoring time span and reduced monitoring frequencies) once the alum treatment operation has been optimized after the first two years.

TABLE 3.4 – FISH LAKE ALUM TREATMENT SYSTEM MONITORING

Site	Parameter	Frequency
Upstream of dosing facility (U-01)*	Total Phosphorus (µg/L)	Weekly
	Dissolved Phosphorus (µg/L)	Weekly
	Total Aluminum (µg/L)	2 X month
	Dissolved Aluminum (µg/L)	2 X month
	pH	2 X month
	Flow	Daily
Downstream of alum-settling basin (D-01)**	Total Phosphorus (µg/L)	Weekly
	Dissolved Phosphorus (µg/L)	Weekly
	Total Aluminum (µg/L)	2 X month
	Dissolved Aluminum (µg/L)	Weekly
	pH	Weekly
	Flow	Daily

*** *Monitoring only when lift station pumping*

**** *Monitoring only when basin discharging to Pond JP-47*

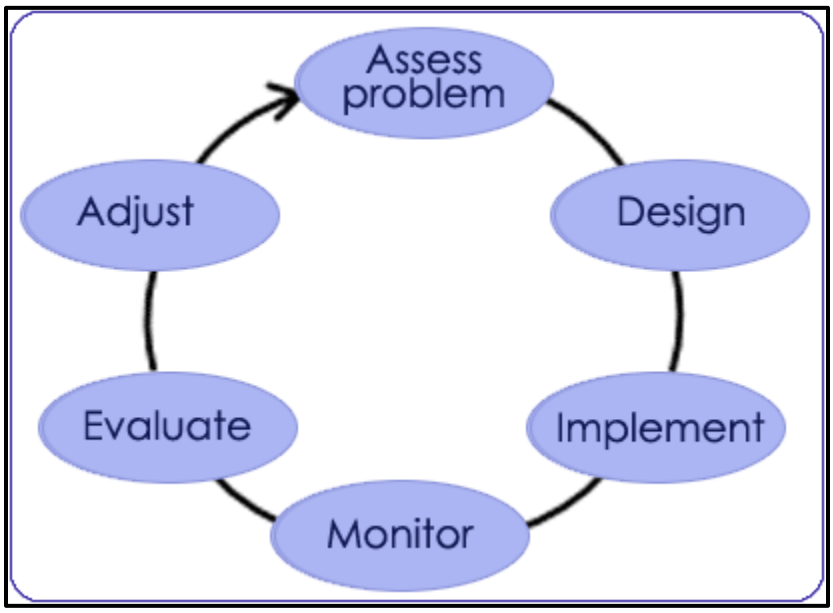
3.4 ADAPTIVE MANAGEMENT

The City believes the TP load reduction for the TMDL (Table 2.2) is achievable and can be accomplished within a relatively short period of time, primarily by regularly operating the re-established alum treatment system. However, there is a reasonable degree of uncertainty about how the new, revised system will function until the City has attained sufficient experience operating it. It is also unclear how or whether additional BMPs proposed in this Implementation Plan and potentially in the future will reduce TP loads and ultimately facilitate Fish Lake achieving

state water quality standards. Finally, it is unknown if measurable water quality improvements could result from infiltration-type BMPs implemented at a watershed-wide scale that would thereby significantly reduce or completely eliminate the need for the City to operate the alum treatment system in the future.

The City will employ the Adaptive Management approach as it executes this Implementation Plan. As depicted in Figure 3.4, Adaptive Management is a systematic and cyclical process with the goal to reduce over time the amount of uncertainty by feedback monitoring. Although not a "trial and error" process, Adaptive Management provides some flexibility through ongoing "learning by doing" and vice versa. According to Allan and Stankey (2009), the challenge using the Adaptive Management approach is determining an appropriate balance between gaining additional knowledge to improve future management and using current knowledge to achieve the best short term outcome. Basically, Adaptive Management is about taking action to improve progress toward desired outcomes.

FIGURE 3.4 – ADAPTIVE MANAGEMENT PROCESS



In 2014 (fourth year of the 2011-2015 implementation period), the City will reconvene the stakeholders group to review monitoring data, evaluate project progress, and determine if this Implementation Plan should be amended. Part of this process will be to evaluate if monitoring data sufficiently support removing Fish Lake from the 303(d) list, as discussed in Section 2.3. If amendments to the Implementation Plan are warranted, the City will work with the stakeholders

group and the MPCA to obtain MPCA approval to revise both the Implementation Plan and incorporate those changes in the City's next 5-year NPDES Permit from 2016 to 2021. Other projects that may come from this review process may be put in place, depending on available funding, need, and cost-effectiveness. Ultimately, the Eagan City Council will make the decisions to move projects forward.

4 References Cited

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