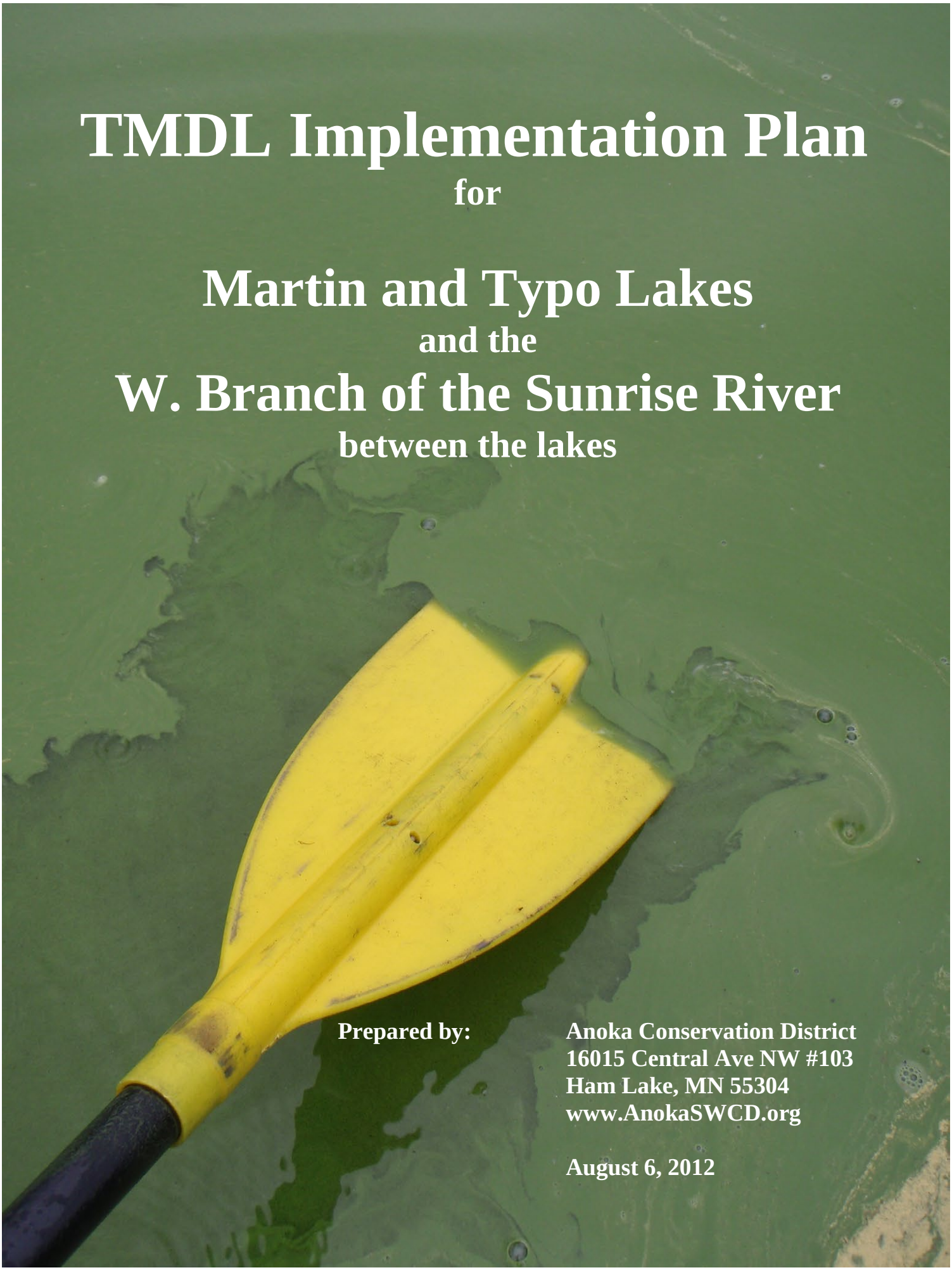

TMDL Implementation Plan
for
Martin and Typo Lakes
and the
W. Branch of the Sunrise River
between the lakes

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Cover photo is Martin Lake on June 10, 2009,
during a severe and earlier-than-usual algae bloom.

Implementation Plan

Requirement	Location in Document
Geographical extent of watershed (use HUC's, stream segments, etc.)	Table 1 (page 1.), Figure 1 (pg. 4)
Measurable water quality goals	Page 1.
Causes and sources or groups of similar sources	Page 1.
Description of source management measures	Page 12-26
Description of point source management	Page 23
Estimate of load reductions for nonpoint source management measures listed in b.1	Pages 12-26
Estimate of load reductions for point source management measures listed in b.2	Page 23
Estimate of costs for nonpoint sources	Pages 12-26
Estimate of costs for point sources	None
Information/education component for implementing plan and assistance needed from agencies	Page 24
Schedule for implementing nonpoint source measures	Pages 12-26
Schedule for implementing point source measures	Page 23
A description of interim measurable milestones for implementing management measures (point sources and nonpoint source)(by measure if needed)	Page 9, *though these are narrative interim goals not numeric*
Adaptive management process- that includes set of criteria- to determine progress toward attaining nonpoint source reductions	Pages 31-32
Monitoring component	Pages 25-26

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Executive Summary

Typo Lake and Martin Lake in Anoka and Isanti Counties, Minnesota (Figure 1) are on the Minnesota Pollution Control Agency's (MPCA) 303(d) list of impaired waters for excess phosphorus (P) (Table 1). Phosphorus causes algae blooms that impede swimming, fishing, and other recreation. The portion of the West Branch of the Sunrise River connecting the lakes, referred to as Typo Creek, suffers from high pH and turbidity as a result of high algal productivity in Typo Lake (Table 1). It is also on the MPCA's 303(d) list of impaired waters. From 2001 to 2009 a Total Maximum Daily Load (TMDL) study investigated the causes of these water quality problems. This report follows the TMDL report, and is an Implementation Plan of actions to achieve water quality goals.

Table 1. Impaired Waters Listings

Waterbody Name	Lake ID/AUID	Pollutant	Impaired Use	Year Listed	Target Start/Completion
Typo Lake	30-0009-00	Nutrient/ Eutrophication	Aquatic Recreation	2002	2003/2010
Martin Lake	02-0034-00	Nutrient/ Eutrophication	Aquatic Recreation	2002	2003/2010
West Branch of the Sunrise River*	07030005-563	pH	Aquatic Life	2006	2006/2010
West Branch of the Sunrise River*	07030005-563	Turbidity	Aquatic Life	2006	2006/2010

*This reach connects Typo Lake and Martin Lake. They are included in this TMDL report, but no TMDL was specifically developed for the impairments.

Restoring a swimmable, fishable, and ecologically healthy condition in these waterbodies will require substantial phosphorus reductions. Typo Lake is severely degraded, with average summertime phosphorus concentrations around 223 µg/L and strong algae blooms the entire open water season. Martin Lake is less severely degraded, but still has substantial impairments, with average summertime phosphorus concentrations around 90 µg/L. The water quality goal for Typo Lake is a 81% with a in-lake phosphorus concentration of 60 µg/L. The water quality goal for Martin Lake is a 41% phosphorus reduction to 60 µg/L.

Typical sources of phosphorus in the lakes include internal sources (rough fish, lake sediments, wind mixing, etc), watershed runoff from agricultural land and residential land, and septic systems. Additional sources include ditching of wetlands and regulated and non-regulated stormwater runoff. In addition, there is some phosphorus that is carried in precipitation.

While this TMDL Implementation Plan deals specifically with the Typo Lake and Martin Lake impairments, any improvements in the Typo Lake watershed would also improve the water quality in the West Branch of the Sunrise River (Typo Creek) which connects Typo Lake and Martin Lake. Typo Creek is currently on the MPCA's 303 d list for elevated pH and turbidity.

Typo Creek's impairments are reflective of Typo Lake's problems. The elevated pH is due to high algal productivity in Typo Lake. The turbidity (suspended solids) in Typo Creek is from both algal and non-algal turbidity in Typo Lake. Typo Lake suspended solids were on average 55% volatile (algae and other organics), with the remainder due to in-lake wind mixing. Therefore, any improvements in upstream water quality will improve the water quality in Typo Creek.

This implementation plan contains a menu of phosphorus reduction strategies. These strategies are focused on shifting from a turbid, algae-dominated state to clearer water with more macrophytes. Multiple strategies, directed at multiple phosphorus sources, will be needed in concert to achieve water quality improvements. Phosphorus reduction strategies include:

- controlling phosphorus exports from ditched wetlands around Data Creek and County Ditch 20 west of Typo Lake,
- controlling rough fish,
- establishing a stronger aquatic plant community in the lakes,
- eliminating non-compliant septic system in lakeshore areas,
- treating storm water runoff that drains directly to the Martin Lake,
- strengthening development Best Management Practices (BMPs) in the local regulatory and decision-making structure,
- agricultural BMPs, and
- changing behaviors through education and social marketing.

Achieving water quality standards for these waterbodies will be exceedingly difficult. Water quality improvement in these waterbodies is nonetheless a priority because of their value and because of their impact on other waterbodies downstream. Typo Lake has limited recreational value, but high potential as a wildlife lake and is the primary phosphorus source to Martin Lake. Martin Lake has many lakeshore homes and serves diverse fishing and recreational interests. These lakes are a priority not only for local residents; they impact the Sunrise River and ultimately Lake St. Croix which are also impaired.

The reader and the local implementers should keep in mind that the modeling done for the Typo Lake and Martin Lake TMDL used monitoring data from a 10 year period (1998 to 2007); it has set 2007 as its baseline year. Therefore, any BMPs or other practices put into place after 2007 were not taken into account in the modeling. So, any BMP that was put on the ground after 2007 will be given credit towards their wasteload or load allocation.

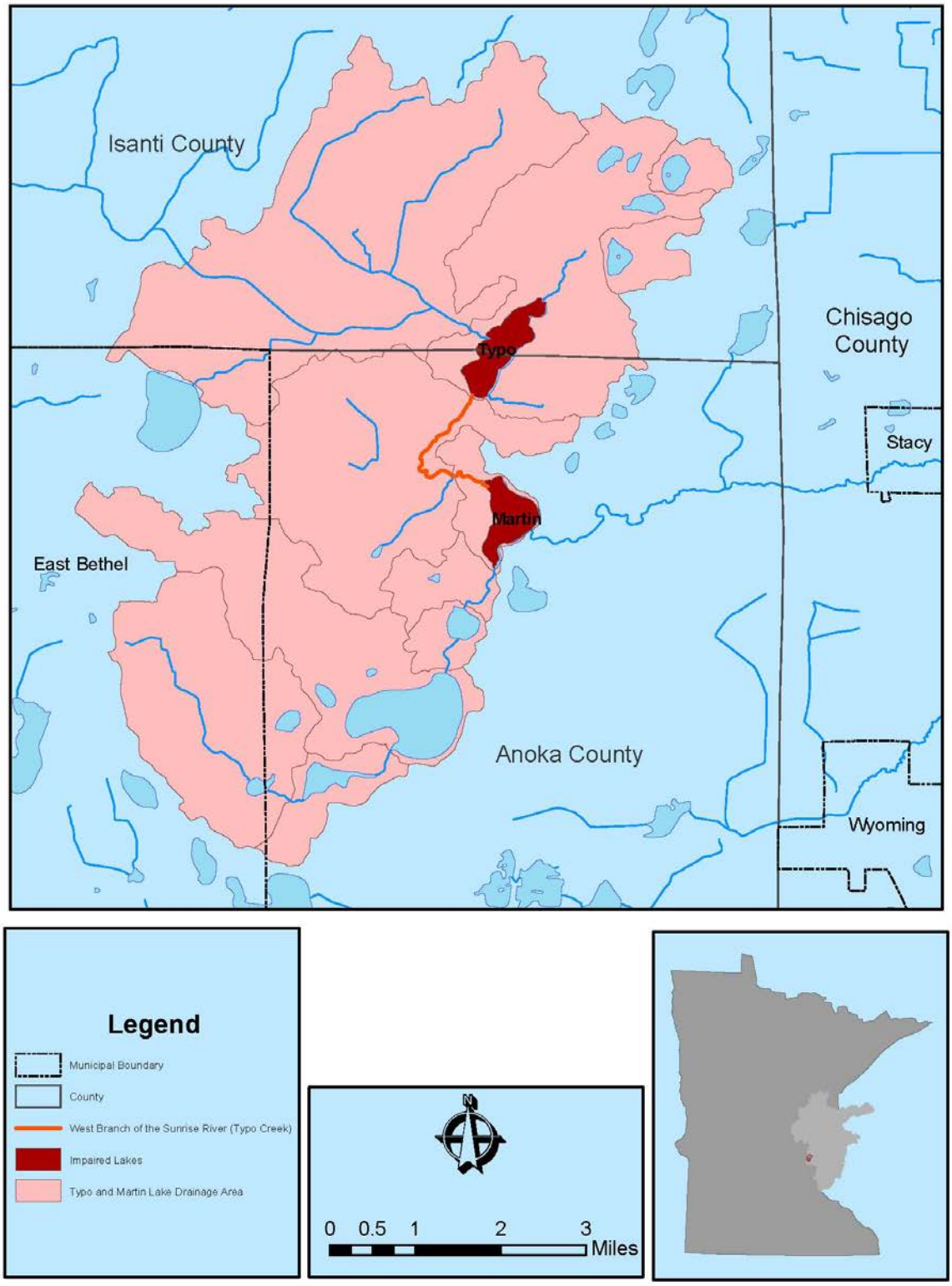


Figure 1. Martin Lake and Typo Lake TMDL Project Area

TMDL Summary

The TMDL for each lake was apportioned between the waste load allocation (WLA) and the load allocation (LA). The WLA includes loads from sites currently covered by an NPDES permit: the City of East Bethel (MS4), John Iacarella – Linwood Terrace Mobile Home Part Wastewater Treatment Facility, and construction and industrial stormwater sites. The LA includes loads from watershed runoff (rural residential land, agricultural land, lakeshore owners, etc.), subsurface sewage treatment systems (SSTS), internal loading, and atmospheric deposition.

MS4

The City of East Bethel's WLA was allocated based on the potion for their area within the Martin Lake Watershed. Their permit only regulates storm-sewered portions (current and expected future) of the regulated MS4 community. Planned land use data (Regional Planned Land Use – Twin Cities Metropolitan Area) were used in the TMDL to approximate the land areas that are regulated or will be regulated by the MS4 permit in 2020. Only those land uses that are regulated under the MS4 permit were considered to be part of regulated stormwater runoff:

- Land uses used to approximate areas regulated under the MS4 permit: single family residential, commercial, and city-owned community park and recreation.
- Land uses used to approximate areas not regulated under the MS4 permit: agricultural, rural and low density residential, open space, open water. All residential densities at or lower than 1 unit per 2.5 acres were considered low density and not regulated under the MS4 permit.

Currently, only 21 acres (Figure 2) within the City of East Bethel are regulated within the Martin Lake Watershed. The remaining portions of East Bethel within the Martin Lake watershed are not regulated by the MS4 permit.

The WLA for East Bethel was based on a phosphorus export coefficient (areal loading rate) of 0.332 lb/ac-yr. This export/areal rate is the average for Island Lake's direct watershed under both TMDL and benchmark conditions (see Martin Lake Allocations, below).

If additional portions of MS4 communities come under permit coverage in the future due to urban expansion and increased population densities, a portion of the LA will be shifted to the WLA. The allocation shifts will be based on applying the areal loading rate for the portion of the watershed in which the change occurs (i.e., Typo Lake, Island Lake, or Martin Lake direct). For the direct watershed of Martin Lake, the areal loading rate is 0.370 lb/ac-yr. As for Island Lake, this loading rate is the average for both TMDL and benchmark conditions (see again Martin Lake Allocations, below). Under Typo Lake's TMDL, its watershed's areal loading rate is considerably lower than its benchmark rate of 0.690 lb/ac-yr (see Typo Lake Allocations, below). The resulting allocated load will be shifted from the LA to the WLA. The MPCA will make these allocation shifts

MS4 permits for road authorities apply to roads within the U.S. Census Bureau Urban Area. The watersheds are currently not within the U.S. Census Bureau Urban Area. Therefore, no roads are currently under permit coverage and no WLA is assigned to the corresponding road authorities. If, in the future, the U.S. Census Bureau Urban Area extends into the watershed and these roads come under permit coverage, one of the following will occur:

- If the road under question falls under an area currently covered by a WLA, a portion of the WLA will be shifted from the municipality or township in which the roads occur. The load transfer will be made on the basis of the appropriate areal loading rate, as described above for MS4 expansions. This would result in no change in the overall WLA for the impaired receiving water.
- If the Load under question falls under an area currently covered by the LA, a portion of the LA will be shifted to the WLA. The load transfer will be made on the basis of the appropriate areal loading rate, again as described above for MS4 expansions.

These WLA and LA shifts will be made by the MPCA.

Municipal and Industrial Wastewater Treatment Systems

The Linwood Terrace Mobile Home Park WWTF (Permit No. MN0054372) has a permitted daily phosphorus discharge limit of 0.06 kg/d (48 lb/yr, or 0.13 lb/day), which was used to establish their WLA for the Martin Lake TMDL.

Load Allocations

One load allocation was set for each lake. The load allocation includes all sources of phosphorus that do not require NPDES permit coverage, including watershed runoff, internal loading, atmospheric deposition, and any other identified loads as described in the phosphorus source inventory. The WLAs for stormwater were first calculated; the WLAs and the margin of safety (MOS) were then subtracted from the loading capacity (TMDL) to generate the LA for each lake.

In the TMDL report, the WLAs and the LAs are presented in terms of phosphorus loading per day. The percent reductions were presented only to provide further information. A summary of the TMDLs, WLAs, and LAs is provided in Table 2.

Table 2. TMDL TP Allocation Summary

Lake and Standard	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)
Typo Lake (60 µg/L)	4.5	0.013	4.0	0.45
Martin Lake (60 µg/L)	12	0.26	10	1.2

Typo Lake Allocations

An 81% reduction in phosphorus load is required for Typo Lake to meet the TMDL. The water to Typo Lake does not contain any permitted sources other than potential construction and industrial stormwater permits. Anticipated phosphorus from these types of permitted projects were estimated by applying permit numbers in the region during recent years to the land area of the Typo Lake watershed. In this way we can set a realistic estimate of phosphorus loading from permitted sources in the future (WLA).

Based on expected future land use, no regulated MS4 boundaries are expected to include any of the Typo Lake drainage area. Therefore, the only WLA for Typo Lake is for construction and industrial stormwater.

Table 3. Typo Lake WLA Allocations

Source	Permit #	WLA	
		lb/yr	lb/day
Construction Stormwater	MNR100001	2.3	0.0064
Industrial Stormwater	MNR50000 (No current regulated sources)	2.3	0.0064
Total		**4.6**	**0.013**

Table 4. Typo Lake LA Allocations

Source	LA	
	lb/yr	lb/day
Direct Watershed Non-Regulated Load	1,078	2.95
SSTS	0	0
Internal	303	0.83
Atmospheric	78	0.21
Total	**1,459**	**4.0**

Martin Lake Allocations

Overall, a 41% reduction in total load to Martin Lake is needed to meet the TMDL. The watershed to Martin Lake (including the Typo Lake Watershed and Island Lake Watershed) contains the permitted sources of the City of East Bethel MS4, John Iacarella – Linwood Terrace Mobile Home Park WWTP, and potential construction and industrial stormwater permits. Each was given a separate WLA. The WLA for the City of East Bethel MS4 are based on the percent of the developable area of the watershed it covers and the modeled watershed load. Linwood

Terrace MHP WWTP was modeled using their existing permitted load. Their WLA is based on what is currently in their permit.

Typo Lake does drain through Martin Lake on its way to the Sunrise River and ultimately the St. Croix River. Therefore, the water quality in Martin Lake is highly dependent on the water quality of Typo Lake - so dependent that it was estimated that approximately 65% (13.1 lbs/day) of the watershed load to Martin Lake is from Typo Lake.

Table 5. Martin Lake WLA Allocations

Source	Permit #	WLA	
		lb/yr	lb/day
Construction Stormwater	MNR100001	20	0.055
Industrial Stormwater	MNR50000	20	0.055
MS4 Stormwater, East Bethel (MS4 ID MS400087)	MNR04000	7.0	0.019
Wastewater Discharger, John Iacarella - Linwood Terrace Mobile Home Park WWTF	MN0054372	47	0.13
Total		**94**	**0.26**

Table 6. Martin Lake LA Allocations

Source	LA	
	lb/yr	lb/day
Direct Watershed	1,790	4.9
Island Lake Watershed Non-Regulated Load*	361	0.99
Typo Lake Watershed	1,507	4.13
SSTS	0	0
Atmospheric	64	0.18
Total	**3,722**	**10**

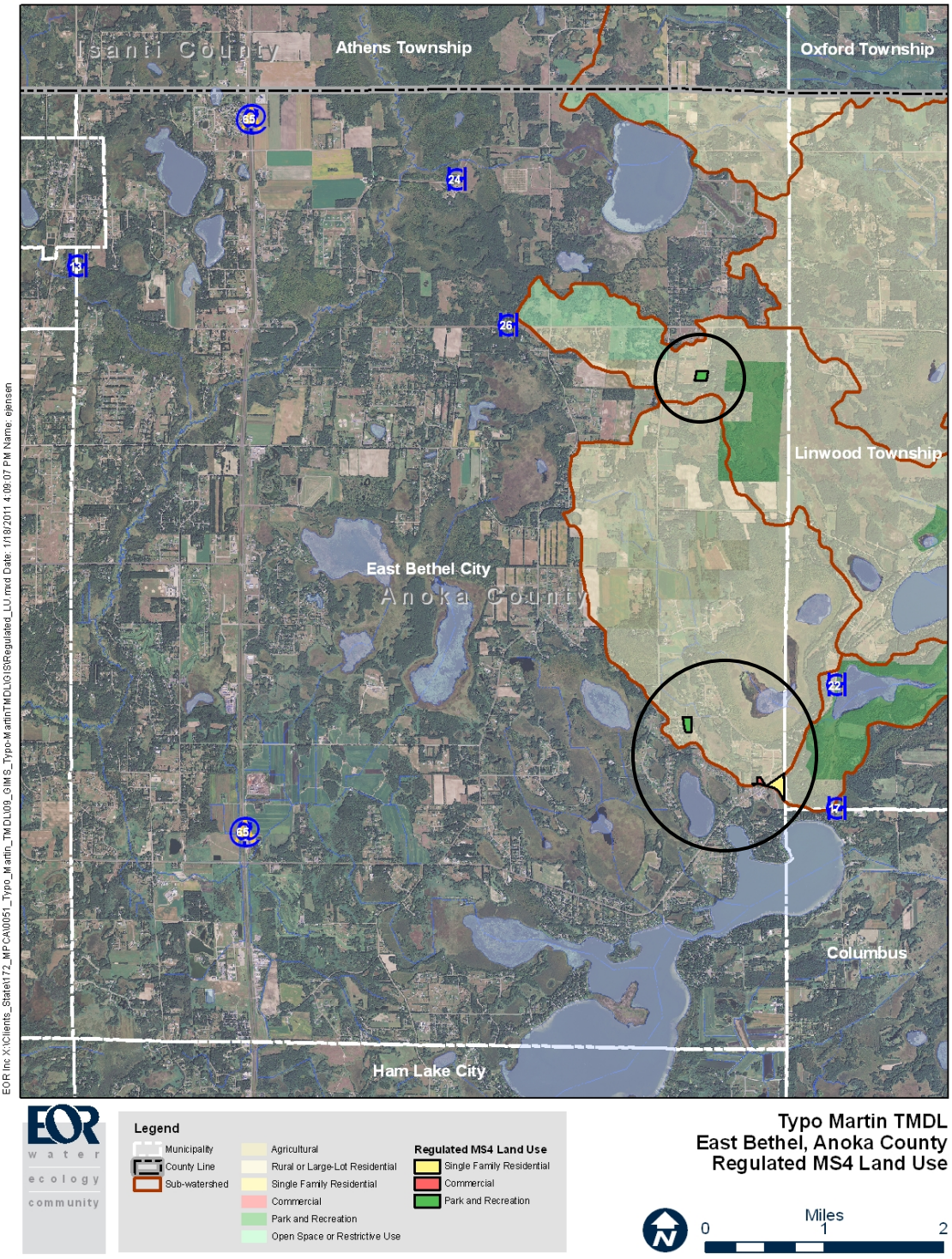


Figure 2. Land uses Regulated by the MS4 Permit in the City of East Bethel that received a WLA for the Martin Lake TMDL

Highlighted and Circled areas (4 individual polygons) represent those areas (21 acres) within the City of East Bethel that are regulated by the MS4 stormwater permit.

Implementation Plan

Implementation Approach

Implementation of this TMDL must begin with realistic expectations. Overall, rehabilitating these waterbodies to the goals described above will be difficult, but making substantial improvements should be a high priority. The impairments are severe. The conditions causing the impairments may be difficult to overcome. Yet, improving the condition of these waterbodies is desirable for their own sake, as well as for the sake of several high-priority downstream waterbodies. Mild improvements may take years. Reaching water quality standards on these lakes will likely take decades. Short term measures of success will be incremental phosphorus reductions that do not necessarily result in recognizable as changes to the appearance of Typo Lake, but are recognizable as significant reductions in loading to Martin Lake and other downstream waterbodies.

Improvement of these waterbodies will be through adaptive management (Walker 2003). The course of action will be flexible and change with new insights gained from each effort. The probability of reaching goals will increase with each iteration. At the same time, each iteration of management must be strongly designed to yield significant reductions; strong negative feedback systems within the lakes must be overcome.

A wide variety of types of work will be involved in implementation of this TMDL. Approaches are designed to ensure new phosphorus discharges within the watershed are insignificant, existing sources are reduced, and the lake is ecologically switched into a state with clearer water and more macrophytes. Some of these approaches are incentive based, for example, septic system improvements, agricultural BMPs, and lakeshore restorations. Others are regulatory-based, such as stormwater and industrial permits. Education is also an important component. But the majority of the strategies are projects to be implemented in the lakes or watershed.

These projects address large and small phosphorus sources alike because of the large reductions necessary. It is difficult to predict the nutrient reduction that would result from each strategy because we do not know each non-point pollutant source's exact contribution to the lake, several strategies are designed to address more than one source, and because many strategies would have synergistic effects if used together. The cost and relative impact on phosphorus loads will be considered when selecting projects.

Management recommendations contain a disproportionately large number of strategies that, at least in part, target internal loading factors. Without addressing internal loading we will have difficulty achieving perceptible change in the waterbodies. These factors include abundant rough fish, in-lake sediments high in phosphorus, lack of plants, shallow depths, wind mixing, and others. These factors are part of self-perpetuating and self-reinforcing feedback mechanisms that keep the lake in a strongly impaired condition. External load reductions are also must, but the size of achievable reductions may be limited given that current land use practices in the watershed are, for the most part, not noticeably poor. There are also historical modifications, such as ditching of wetlands that contributes phosphorus, which cannot realistically be un-done.

Water quality improvement for Typo Creek will be accomplished through implementation activities on Typo Lake. This is because Typo Creek is the outlet of Typo Lake and there are no other significant pollutant sources to the creek.

Phosphorus Reduction Strategies

Table 2 on the following page contains a menu of phosphorus reduction strategies. Each strategy is described in detail on the following pages. A 20-year time span is considered for the purpose of estimating costs of repeated tasks or maintenance. The total estimated cost for water quality improvement projects in Table 2 is $1,200,356. This does not include costs for continued implementation of erosion and stormwater regulations already required regardless of this TMDL.

Phosphorus reduction estimates for each potential project are on the following pages. Many of these reduction estimates have a low degree of certainty because little or no analysis and modeling have been done. Two exceptions are rough fish management and stormwater retrofitting, which have been analyzed in greater detail. Yet, even in these cases we must acknowledge the difficulty of estimates for reasons including:

- Alternative stable states in the lake may cause initial projects to have little apparent benefit. However, the cumulative effects of many projects may cause a sudden change when a tipping point is reached.
- Multiple variables are at play. While benefits may be achieved, other changes in the system may negate these effects.
- Projects may have positive, synergistic effects if done together.
- Natural variation, such as climatological effects.
- Large pools of phosphorus-rich sediments have accumulated in the lakes over decades, and may present themselves as “ghost effects” of past harms, even if cleaner water is entering the lakes.

Because of these reasons, the high uncertainty, we do not feel it is accurate to simply add the estimated phosphorus reductions for each project. This would not be and accurate estimate of benefits of doing all of the nutrient reduction strategies. Adaptive management approaches will be important to ensuring progress toward water quality goals.

Table 7. Menu of phosphorus reduction strategies. Each strategy is described in detail in the following pages.

Strategy	Description	Targeted Lake*	Relative Cost	Relative Impact on P Loads	Likely Partners for Implementation
1	Plug County Ditch 20 Lateral Ditches	Typo	Low	Med	MN DNR, Isanti County, Oxford Township, SRWMO, ACD, MPCA
2	Data Creek Water Treatment Facility	Typo	High	Med	ACD, MN DNR, Oxford Township, Isanti County, SRWMO, MPCA
3	Rough Fish Control	Both	High	High	MN DNR, SRWMO, ACD, Martin Lakers Assoc., MPCA, Linwood Township
4	Drawdown Typo Lake	Typo	High	High	SRWMO, MN DNR, ACD, MPCA
5	Lakeshore Septic System Updates	Martin	Low	Low	Linwood Twp, Martin Lakers Assoc., SRWMO, Anoka Co. Env. Services, MPCA
6	Lakeshore Restorations	Both	Low	Low	SRWMO, ACD, residents,
7	Martin Lake Stormwater Retrofits	Martin	Low	Low	SRWMO, ACD, Martin Lakers Assoc.,
8	Stormwater and Erosion Control Permits and Regulations	Both	Low	NA	MPCA, Linwood and Oxford Townships, Isanti County, SRWMO
9	Agricultural Best Management Practices (BMPs)	Both	Med	Low	USDA – NRCS, Isanti Conservation District, ACD
10	Education	Both	Low	Low	SRWMO, ACD, Linwood & Oxford Twps, Martin Lakers Assoc., MPCA
11	Effectiveness Monitoring	Both	Low	NA	SRWMO, MPCA, ACD

ACD = Anoka Conservation District, MN DNR = Minnesota Department of Natural Resources, MPCA = Minnesota Pollution Control Agency, SRWMO = Sunrise River Watershed Management Organization, USDA-NRCS = US Dept. of Agriculture – Natural Resources Conservation Service

* All strategies targeting Typo Lake will also benefit Typo Creek and Martin Lake because they are downstream

Strategy 1. Plug County Ditch 20 Lateral Ditches

County Ditch 20 has been identified as an area where phosphorus is being released from ditched wetland soils. Plugging lateral ditches could reduce the amount of this soil phosphorus that reaches the waterway. Lateral ditches are those smaller channels dug as tributaries to the main channel to more completely drain areas farther from the main ditch. Soil phosphorus must travel by subsurface flow to the ditch or lateral ditch. By eliminating some lateral ditches, the drainage scope of the ditch is reduced and less soil water (and its associated phosphorus) will enter the main ditch. Likely candidate lateral ditches are shown on Map 2. A side benefit of this technique is that methylmercury release from the saturated peatland soils into the target water bodies would be reduced as well (Balogh et al. 2004). Methylmercury is the form of mercury that bioaccumulates, sometimes resulting in fish consumption advisories.

Estimate of load reductions – Reductions possible are small because they address loading only from small (<200 ac) wetland areas. 2-10 lbs/yr phosphorus might be a realistic expectation.

Timeline - Option to be explored in the future.

Outline of Tasks:

Task	Estimated Cost
1. **Meet with landowners** of the targeted lateral ditches to describe the management measures sought, request permission for on-site review, and ultimately obtain permissions or agreements in writing. Assistance from an attorney will be required. Subsequent steps are dependent upon the outcome of this process. If the only project sites are on publicly owned property, costs may be less.	$8,000
2. **Obtain any necessary approvals** from wetland or construction regulatory agencies.	$3,000
3. **Obtain engineering plans** for the ditch plugs.	$5,000
4. **Install ditch plugs** in accordance with plans determined through the proceeding steps.	$12,000
Total	$28,000.00

Strategy 2. Data Creek Water Treatment Facility

A settling basin or other water treatment facility for suspended materials carried by Data Creek would be beneficial because nearly 3/4 of the phosphorus delivered to Typo Lake through Data Creek is attached to particles. The most likely candidate site is along Typo Creek Drive and within the Schubring Wildlife Management Area. An engineering study is needed to determine if and how this project might be accomplished given the flat topography, wetland soils, and large size of the facility needed to treat storm and post-storm flows which have the highest phosphorus and suspended solids. A fish barrier should be included at the outlet in order to prevent rough fish from breeding within the basin.

Estimate of load reductions – Potentially large reductions, but at substantial expense. If a 20% reduction from Data Creek watershed sources were achieved that would be approximately 1,517 lbs/yr. Low certainty on this load reduction estimate, and the feasibility of this project is uncertain at this time.

Timeline – Option to be explored in the future.

Outline of Tasks:

Task	Estimated Cost
1. **Engineering feasibility study.**	$8,000
2. **Design and installation of a water treatment facility**.	$150,000
3. **Maintenance of the facility.**	$10,000
Total	$168,000.00

Strategy 3. Rough Fish Control

Rough fish have consistently been a dominating force in these two lakes and are a serious issue contributing to water quality degradation. They are a cause of, or are strongly related to, several internal loading mechanisms. They also have the potential to strongly counteract many of the other management recommendations. For these reasons, future, intensified efforts to control rough fish should be pursued. It will be useful to develop a long-term rough fish management strategy as part of TMDL implementation. Considerations for a rough fish management plan are discussed below.

Both rough fish barriers and harvests are planned for 2012-14. The project is led by the Anoka Conservation District.

Harvests

Commercial seine harvests can be done in both winter and during open water. Winter harvests are not practical on Typo Lake because the shallow depth prohibits use of submarines to pull nets. These harvests can be aided by radio tagging several carp which help fishermen located the schooled fish.

Barriers

Regardless of rough fish removal technique(s) chosen, fish barriers should be considered at the major inlets and outlets of each lake. Purposes for the barriers include:

(a) Isolating segments of the system for better effectiveness of rough fish removals and to prevent recolonization of harvested areas.

(b) Minimizing access to breeding areas outside of the lakes. Typo Creek, which connects Martin and Typo Lakes, is broad, slow and mucky-bottomed. It is good carp breeding habitat. Smaller tributaries to Martin and Typo Lake also have these characteristics, but to a lesser degree. Rough fish reproduction might be reduced by eliminating access to these areas.

(c) Eliminating seasonal rough fish migrations. Fish can move between lakes seasonally to find the most suitable habitat. For instance, low dissolved oxygen during winter in Typo Lake may cause fish to migrate to Martin Lake for improved survival, especially in winter.

Predatory Fish Stocking

Presently, these lakes are stocked with walleye both for a fishery and to control rough fish. Periodic review of the management prescription for these lakes is recommended to determine whether a different mix or size of predatory species should be stocked. These stockings should be an attempt to permanently shift the fish community structure, as has been the target with previous MN DNR stocking. Such a shift will help ensure long-term benefits from any rough fish harvesting.

Complete Fish Removal from Typo Lake

Complete fish removal from Typo Lake should be considered, but such a project is unlikely to be feasible. The most likely technique would be rotenone treatment. The other techniques listed in this section are preferable. Complete fish removal is a technique of last resort. It would require 1) a fish barrier on the outlet, 2) a fish barrier preventing downstream emigration on Data Creek, 3) identification of all in-lake inflows of groundwater; 4) drawdown to a level so there is no water under floating bogs, and 5) obtain agreement of 75% of lakeshore property owners to do the drawdown (required by law). Untreated water under floating bogs (which are present in Typo Lake) provide a refuge and often result in an incomplete kill. The constant outflow of water from Typo Lake even when inflows are small suggests that there are significant groundwater inflows to the lake; it would be necessary to operate drip stations of liquid chemical at all major spring discharges, else the inflow of untreated ground water would provide a refuge and result in an incomplete kill.

Complete fish removal is not considered appropriate for Martin Lake because rough fish are a lesser portion of the fish community and because it is a recreational lake.

Effectiveness Monitoring

Intensified rough fish control and game fish stocking efforts should include fish surveys at a frequency adequate to monitor the results of management efforts.

Estimate of load reductions

Several factors help generate an approximate benefit of rough fish management. These include:

- Current rough fish biomass as a percentage of all lake biomass.
- The intensity of internal loading – in-lake phosphorus is typically 4-7x greater than tributary water.
- The effects of the 1998 successful carp harvest from Martin Lake, which reduced in-lake phosphorus the following year by approximately 20%.
- While internal loading is smaller in Martin Lake and larger in Typo Lake, any benefits to Typo Lake will also be realized in Martin Lake because it is downstream.

Conservatively, we might estimate phosphorus reductions up to 10% system-wide. 10% of Typo Lake's overall loading is 886 lbs/yr. 10% of Martin Lake's overall loading is 721 lbs/yr.

Timeline

Rough fish barriers are currently being planned for installation being in 2012-2014. Commercial carp harvests, aided by radio tracking, planned for 2013 or 2014.

Outline of Tasks:

Task	Estimated Cost
1. **Harvests**	$10,000

2. **Barriers**	$200,000
3. **Periodic review of fisheries management** and make changes accordingly. This should include consideration of removing all fish from that lake.	$3,000
4. Implementation of fisheries management plan changes.	$100,000
Total	$313,000.00

Strategy 4. Drawdown Typo Lake

Drawdown of shallow lakes can be useful to address several internal loading factors. The process consolidates bottom sediments, stimulates aquatic plant growth, and can provide opportunities for fish community manipulation. Partial drawdowns periodically occur naturally on shallow lakes.

Partial drawdown of Typo Lake would probably have desirable consequences, but several things need to happen for this strategy to be implemented. First, agreement from 75% of lakeshore homeowners must be obtained to make drawdown legally permissible. Secondly, a feasibility study is needed to determine if it is practical or possible. A feasibility study should assess methods for drawdown, effort needed to achieve drawdown and sustain it, desired amount and duration of drawdown, how fast the lake would refill, and any fish manipulations that could be done simultaneously. The open-culvert outlet structure of the lake would almost certainly need to be replaced with a structure that allowed water level manipulation, and preferably serves as a rough fish barrier.

Riparian residents will need to be warned that these techniques will likely result in emergent vegetation levels increasing. Increased vegetation abundance may reduce or limit recreation use of their property. Abundant vegetation in a shallow lake like Typo Lake is ecologically healthy and produces better water quality, but abundant vegetation is not always socially accepted. Residents may resist the notion of increasing vegetation abundance. Some species, such as cattails or curly leaf pondweed may reach high abundances that are both socially and ecologically undesirable. Communicating accurate expectations to residents in an overt way will be important.

Estimate of load reductions

Unable to estimate at this time, but would have a large impact on the internal loading issue.

Timeline

The specific date for this strategy is not know yet, since it has not yet been discussed and would likely have a lot of push back from lake residents. More local outreach would need to be done before any effort was made to mover this strategy forward.

Outline of Tasks:

Task	Estimated Cost
1. **Engineering feasibility study** to determine methods for drawdown, effort needed to achieve drawdown and sustain it, desired amount and duration of drawdown, how fast the lake would refill, any fish manipulations that could be done simultaneously, and outlet modifications needed.	$30,000
2. **Replace Typo Lake culvert outlet** with a structure that allows water level manipulations.	$200,000
3. **Obtain permissions for water level manipulations,** as required by law. This effort will need to include presenting the outcome of the engineering study to residents.	$5,000
4. **Execute the drawdown.** It is likely that this would be multi-year effort.	$100,000
Total	$335,000.00

Strategy 5. Lakeshore Septic System Upgrades

Effluent from failing on-site septic systems contributes significantly, though not of great magnitude, to phosphorus loading in Martin Lake. Loading from failing septics is expected to increase in coming years due to the age of existing systems, lack of maintenance, and small lot sizes without space for a replacement septic. A goal of 100% compliant systems is an important goal that should be strongly pursued.

At least two of these voluntary approaches to addressing failing septic systems should be implemented:

- providing low-interest loans or grants for upgrades.
- continued education about system maintenance, including workshops.
- providing financial assistance with system maintenance. The Martin Lakers Association could secure a lake-wide contract with a septic pumping service. This strategy provides discounted pumping services to shoreland homeowners to encourage regular maintenance, and provide a secured localized workload for the pumping contractor.
- Linwood Township authorities should allow non-traditional systems and upgrades, such a pre-treatment retrofits and cluster systems that serve multiple homes. These may be necessary on small lots. Staff at the University of Minnesota Extension Service and Minnesota Pollution Control Agency can assist with determining which technologies are appropriate and adequately tested.

Regulatory approaches should be used as well, including provisions in Minnesota Rules 7080-7082, which were revised substantially in 2008. These rules require that local ordinances include provisions such as:

- All septic systems are pumped every three years unless an inspection finds pumping is not necessary at that time.
- Failing systems are identified through the pumping and/or inspections process that is required every three years, and these systems are corrected.
- In cases where owners are not providing proper maintenance or correcting non-compliant systems, the municipalities perform corrective actions and assess the costs to the owner.
- Non-compliant systems are repaired or replaced swiftly, especially in shoreland areas and in cases where the system is a imminent threat to public health.
- Septic system options available to landowners include non-traditional or performance systems, particularly in difficult situations such as properties without space for a replacement drainfield.
- A municipality-managed system to remind homeowners when their systems need to be pumped. This would involve keeping records of when each system in the shoreland zone was last pumped and sending a reminder on the three-year anniversary of the last pumping. Failure to provide proof of pumping should be followed with punitive measures including a professional inspection of the system at the homeowner's expense.

For further detail on this set of options and other related ideas, utilize the University of Minnesota Extension Service's informational series entitled "Small Community Wastewater Solutions."

Estimate of load reductions

Only 30-40 homes are present on Typo Lake, so benefits from correcting septic systems here is probably a <0.5% of the overall phosphorus load, and probably less than 50 lbs/yr.

On Martin Lake, there are many homes and data indicates there are a number of failing, aging, or inadequately maintained septic systems. The TMDL study found 164 lbs/yr of phosphorus enter Martin Lake from this source. Complete compliance would mean a reduction of 164 lbs/yr (2% reduction).

Timeline

Minnesota Rules 7080-7082, were revised substantially in 2008 with many provisions that will be beneficial to lake water quality. However, rules are implemented on the local level and local units of government do not need to adopt and implement rules that are consistent with new state provisions until at least 2013.

The local watershed management organization has examined starting a program of low interest loans or similar assistance for correcting non-compliant septic systems. As of 2012, this program is delayed for two reasons. First, interest from landowners is uncertain, perhaps

because few homeowners are willing to reveal to government agencies that they have a troubled septic system. Secondly, financial constraints.

Education to homeowners is annual. The University of Minnesota Extension holds annual workshops for residents. The local watershed organization provides educational materials approximately every 2-3 years. Lastly, the communities have reminder systems, wherein homeowners are sent reminders of needed septic system maintenance every 3 years.

Outline of Tasks:

Task	Estimated Cost
1. **Low interest loan or grant program for non-compliant septic system repair or replacement.** Programs exist from the Anoka County Housing and Redevelopment Authority's Community Development Block Grant and the MN Department of Agriculture Ag BMP Loan Program, but a local administrator is needed. The cost estimate listed is for local administration.	$4,000
2. **Septic system maintenance education efforts which should include locally held workshops and mailings.** The University of Minnesota Extension's Septic System Owner's Guide would be an appropriate mailing.	$10,500
3. **Secure a group contract for septic system pumping around Martin Lake.** This effort would be best led by the Martin Lakers Association. Costs would include soliciting septic pumpers, negotiating fees, and coordinating neighbors.	$3,000
4. **Ordinance updates and enforcement, as required by law.** Minnesota State Rules 7080 were updated in 2008 and require the updates mentioned above. A cost estimate is not provided because this is an already-required activity that would be done regardless of this TMDL.	
Total	$17,500.00

Strategy 6. Lakeshore Restorations

Practices on private lakeshore properties such as mowing to the edge, retaining walls, sand beaches, and removal of aquatic plant contribute to impairments. Restoring native vegetation buffers to the lakeshore can have several benefits including filtering of stormwater runoff toward the lake, improving spawning and foraging habitat for game fish, providing refuges for zooplankton (which eat algae), and dissipating wave energy. Projects that include aquatic plant community enhancement with an upland buffer are strongly preferred. Aquatic plants on 20% of the lakeshore should be the short-term goal, with a long-term goal of 40% (currently is 11.1% on Martin and 9.3% on Typo). Shoreline restorations can be designed to fit into backyard landscaping ,be aesthetically pleasing, and leave space for recreational access (dock, swimming area, etc). Martin Lake should be a focal area for this activity because of the high level of shoreline development.

Cost share grant programs can be used as incentives to private landowners to implement the practices. It is important to also provide technical assistance with design and installation. The Anoka Conservation District and Sunrise River Watershed Management Organization currently have a cost share and technical assistance program but more installed projects are desired.

Estimate of load reductions

The 2011 Martin Lake stormwater assessment estimated costs and phosphorus reductions for 10, 20, and 30 lakeshore restoration projects (each assumed to be 100 ft of shoreline and 25 ft deep). 30 lakeshore restorations would prevent 0.6 lbs/yr of phosphorus from entering Martin Lake. However, this only examined phosphorus in backyard runoff that would be treated by the restorations. There would be additional benefits to the projects to in-lake phosphorus cycling, as well as favoring biota associated with nutrient reductions (game fish vs rough fish, daphnia and other algae eaters, etc). Therefore, total phosphorus reductions would be >0.6 lbs/yr.

Timeline

This is an ongoing effort. The local watershed organization has a cost share grant program and in 2012 produced a video promoting lakeshore restoration. They plan nearly annual promotions for the next 7 years, including a hands-on workshop and demonstration project in 2012. Technical assistance is available and actively advertised by the Anoka Conservation District.

Outline of Tasks:

Task	Estimated Cost
1. **30 lakeshore restorations.** The total cost is provided, including all elements of project promotion, design, installation, and maintenance. Installation costs are often shared between landowners and government cost share grants.	$180,000
Total	$180,000.00

Strategy 7. Martin Lake Stormwater Retrofits

Currently storm water in the residential areas around Martin Lake is directed by surface flow or curb and gutter systems to the lake. There are many areas where stormwater treatment is missing or inadequate before discharge to the lake. Because the area draining immediately to Martin Lake is small, a reasonable goal would be to treat nearly all stormwater in the neighborhood immediately surrounding the lake. A variety of techniques to retrofit the stormwater system exist, including rain gardens, swales, infiltration basins, sumps, proprietary devices, and others.

In order to accomplish this, a stormwater assessment was completed in 2011 that documents flow patterns and volumes, existing infrastructure, and opportunities for improvement. 11 projects were identified. The top two most cost effective projects were maintenance of existing stormwater ponds; this has been communicated to Linwood Township. Several rain gardens at strategic locations were also identified as beneficial projects, and three of these were installed in 2011. Additional projects were identified and installation should be a priority.

Estimate of load reductions

The 2011 Martin Lake stormwater assessment found 11 potential stormwater retrofits that staff felt could be feasible given present resources. These projects cumulatively would reduce phosphorus export to Martin Lake by 8 lbs/yr. Other projects also exist, but would require larger scale reconstructions (such as whole street reconstructions) and require resources that are generally not available at this time.

Timeline

This program is currently underway. Within the last 2 years three rain gardens have been installed, with another being planned in 2012.

Outline of Tasks:

Task	Estimated Cost
1. **Stormwater assessment -** The assessment process includes mapping stormwater drainages, existing treatment, and identifying locations to add treatment. It also includes securing project locations by working with willing landowners and the municipality.	$15,000
2. **Install stormwater retrofits.** Installation includes materials, labor, and oversight by professionals with knowledge of the practices.	$82,000
Total	$97,000.00

Strategy 8. Stormwater and Erosion Control Permits and Regulations

Within the Typo Lake and Martin Lake project area, there are several permitted activities that will, and have taken place over the last several years. These activities such as construction stormwater and industrial stormwater activities, and the city of East Bethel are permitted by the Minnesota Pollution Control Agency. Each of these activities have requirements in their permit that they must follow to comply with this TMDL and incorporate into their SWPPP.

Other regulators and rules include the Sunrise River Watershed Management Organization (SRWMO), Linwood Township, and Oxford Township also have standards and ordinances designed to be protective of water quality. The SRWMO stormwater standards that require post-development discharge rates to be the same as pre-development and that volume be controlled by infiltrating the first 0.5-inches of precipitation. The SRWMO is has wetland standards that require certain protections, such as buffers. Wetland protections are important because much of the watershed is wetlands and many wetlands have a direct hydrologic connection to streams and ditches. SRWMO standards only apply to Anoka County portions of the watershed, and are administered and enforced through the municipalities. Townships and Isanti County have additional ordinances relating to construction, such as silt fences and other erosion control measures.

An important BMP somewhat unique to this TMDL is minimizing the creation of new ditch systems and improvement of existing systems. Portions of ditches in wetlands should not be improved or maintained to minimize additional phosphorus releases from ditched wetland soils that are currently impacting Typo Lake. Wetland restoration is desirable.

8.1 Construction and Industrial Stormwater

Construction storm water activities are considered in compliance with provisions of the TMDL if they obtain a 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 storm water requirements if they are more restrictive than requirements of the State General Permit.

Industrial storm water activities are considered in compliance with provisions of the TMDL if they obtain an industrial storm water general permit or Sand and Gravel general permit (MNG49) under the NPDES program and properly select, install, and maintain all BMPs required under the permit.

8.2 City of East Bethel (MS4)

In the Martin Lake TMDL the city of East Bethel was assigned a WLA but no reductions. What this means is that any future growth or future planning efforts will need to be made not to increase phosphorus loading to Martin Lake. This will mean using the appropriate measure in planning as new development moves into the watershed. As future planning efforts take place local organizations like the Anoka Conservation District and the Sunrise WMO will work with the city to aid in planning and to assist financially when appropriate.

As part of the East Bethel's MS4 permit, they will be required to incorporate the results of any approved TMDLs within their jurisdiction into their Stormwater Pollution Prevention Program, or SWPPP, within 18 months of TMDL approval.

Estimate of load reductions

As long as the construction and industrial Stormwater permittees continue to meet the requirements of their permit and Appendix A, it is assumed that the WLA for this will be achieved.

As for future growth in the city of East Bethel; local planning efforts between the city, county, and the WMO will be made to ensure that increased loading from permitted areas do not contribute to the impairment

Timeline

The timeline for this task will be the next 20 years. At this time it is hard to determine what the project growth for these areas will be. The future economy and will either slow or speed up this process.

Outline of Tasks:

Task	Estimated Cost
1. **Administer and enforce regulations related to construction and industrial stormwater management, stormwater standards for new developments, and erosion and sediment control.** A cost estimate is not provided because this is an already-required activity that would be done regardless of this TMDL.	$0.00

Strategy 9. Agricultural Best Management Practices (BMPs)

Nutrient loading from agricultural lands should be reduced through the use of agricultural BMPs such as nutrient management, no-till farming techniques, contour farming, and taking sensitive lands out of production. This is particularly applicable to the Isanti County portions of the watershed, where most agriculture exists. The US Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) administers several programs to encourage these activities.

Incentive programs for agricultural BMP's include the Minnesota Conservation Reserve Enhancement Program (CREP), Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), and others. Each of these programs provides payments to landowners who leave sensitive lands out of production, create vegetated stream buffers, or install other practices. Funding is based upon a scoring system. The local soil and water conservation district determines practices and locations that are local priorities and should receive higher local points. The Typo and Martin Lake watersheds should be considered high priority areas by the Anoka and Isanti Conservation Districts. Any practice that minimizes sediment and nutrient delivery to nearby waterways is a priority. The NRCS provides active promotion of these programs to agricultural producers.

Properties that should be a priority for installation of agricultural BMPs, need to be identified. Generally, many of the waterways in this area have buffers and agricultural BMPs already in place. The local soil and water conservation district should identify properties that would be appropriate for additional practices.

Similar strategies can be used to protect lands during the development process. Many agricultural lands in the watershed are being converted to residential. The townships should be responsible for promoting these practices on sensitive areas during the development process. Aside from the programs mentioned above, municipalities can require that development use techniques, often referred to as "conservation development techniques," to minimize impacts to sensitive areas.

Estimate of load reductions

If we conservatively figure 10% of watershed phosphorus sources might be addressed with these practices in the Typo Lake watershed, it would be a 759 lb/yr reduction. This is only a estimate, and future work and studies could better quantify this reduction.

Timeline

This strategy has been a priority for local state, county, and federal agencies in the area. It is expected that this work will continue for the next 20+ years.

Outline of Tasks:

Task	Estimated Cost
1. **Identify priority areas for BMP promotion and installation**.	$5,000
2. **Promote incentive** programs to landowners in priority areas.	$5,000
3. **Agricultural BMP installation.** The cost shown is an estimate of payments to landowners through the USDA-NRCS EQIP program. For the purposes of estimating costs, it is assumed that 5% of Typo Lake's watershed (576 acres) would benefit from these practices and do not have them installed. For this cost estimation the 2009 payment for critical areas planting of $156/acre was used as a typical cost**.**	$89,856
Total	$99,856.00

Strategy 10. Education

Education of residents and public officials will help ensure good housekeeping practices that minimize or reduce phosphorus loading within the watershed. Topics could include septic systems, lawn care, aquatic plants, waste management, etc. Efforts can include mailings, newsletter or newspaper articles, messages on community billboards, workshops, and others. Social marketing techniques should be utilized.

Estimate of load reductions

A good estimate of load reductions for this approach is unavailable. Public education can change behaviors with phosphorus reduction benefits. But it can also improve adoption of all of the other strategies for phosphorus reduction. Therefore, this is an essential element.

Timeline

This is a ongoing effort, and has been a major effort for all local organizations. Efforts include annual education efforts by the Sunrise River Watershed Management Organization, Linwood Township, and the Martin Lakers Association which will continue a for the next 20+ years.

Outline of Tasks:

Task	Estimated Cost
1. **Septic system maintenance education program.** Efforts to educate residents in shoreland areas about septic system maintenance should include: (a) mailing the U of M Extension's Septic System Owner's Manual to lakeshore homes and (b) locally-held workshops, perhaps with U of M Extension as a partner. Educational efforts approximately every three to five years would be appropriate.	$15,000
2. **Aquatic plant education program.** Aquatic plants are essential to shallow, ecologically-healthy shallow lakes. Protecting existing plants is important. As water quality improvements are realized, the clearer water will result in more aquatic plants. This is highly desirable for the lake. It is important to communicate the importance of these plants to lakeshore homeowners.	$6,000
3. **Lakeshore landscaping education program.** This educational program goes hand-in-hand with many other implementation goals, such as lakeshore restorations, but adds other information about lakeshore stewardship, such as fertilizer use and lawn waste disposal.	$6,000
Total	$27,000.00

Strategy 11. Effectiveness Monitoring

This is not a nutrient reduction strategy, but it is important to include monitoring in all future plans for these lakes. Implementation of this TMDL will follow an adaptive management strategy in which management strategies will be continuously re-evaluated and refined based on lessons learned from previous efforts. Periodic monitoring is necessary for adaptive management. Effectiveness monitoring will include the sites, frequency, and parameters outlined below.

Martin and Typo Lakes

Site: Deepest spot in lake, same as past monitoring.

Frequency: Every third year to maintain a baseline dataset plus additional years immediately following major implementation activities. Monitor 10 occasions every other week from May through September.

Parameters: Total phosphorus, chlorophyll-a, Secchi transparency, pH, turbidity, dissolved oxygen.

Data Creek

Site: Typo Creek Drive crossing, just before creek enters Typo Lake.

Frequency: At least two consecutive years following significant implementation activities to reduce phosphorus in this subwatershed. Each monitored year should include monitoring on at least 8 occasions; 4 during storms and 4 during baseflow.

Parameters: Total phosphorus, total suspended solids, turbidity, pH, and dissolved oxygen. Other parameters, such as soluble reactive phosphorus, should be considered on a case-by-case basis.

Continuous stage (water level) measurements should be taken during monitored years and the existing rating curve for this site should be updated periodically to ensure it is still accurate.

W Branch Sunrise River (Typo Cr) between the two lakes

Sites: South crossing of Typo Creek Drive, just before creek enters Martin Lake

Frequency: At least two consecutive years following significant implementation activities to reduce phosphorus in upstream subwatersheds. Each monitored year should include monitoring on at least 8 occasions; 4 during storms and 4 during baseflow.

Parameters: Total phosphorus, total suspended solids, turbidity, transparency tube, pH, and dissolved oxygen. Other parameters, such as soluble reactive phosphorus, should be considered on a case-by-case basis.

Continuous stage (water level) measurements should be taken during monitored years and the existing rating curve for this site should be updated periodically to ensure it is still accurate.

Additional Sites Other sites may be added as needed. Most notably, some ditch tributaries to Data Creek have recently been added to the 303(d) list of impaired waters. If implementation activities occur which may benefit these ditches, they should be monitored to determine their degree of improvement.

Timeline – Every Third year for the next 25 years, or as long as funding is available.

Outline of Tasks:

Task	Estimated Cost
1. **Lake water quality monitoring** every third year. At a minimum monitoring should include twice-per-month measurements of Secchi depth, total phosphorus, and	$14,000

chlorophyll-a during May-September.	
2. **Stream water quality monitoring** coinciding with implementation of phosphorus reduction strategies in the subwatershed.	$10,000
3. **Stream water level monitoring** with a continuous data logger and coinciding with stream water quality monitoring.	$5,000
4. **Updating the existing rating curves** for Data Creek and Typo Creek so that flow volumes can be calculated from stream water level records.	$8,000
Total	$37,000.00

Strategies Considered But Determined Not Viable

Rejected Strategy 1. – Water Control Structures on Data Creek, Ditch 20

Early in this TMDL study Data Creek, and especially its Ditch 20 tributary, were identified as an important phosphorus source. Peat soils have been identified as the source of a large portion of this phosphorus. Alternating drying and rewetting was identified as a driver of phosphorus release from the peat soils. Adding water control structures to the system was considered as a way to allow managers to minimize drying and rewetting cycles.

New information gathered in 2006 and 2007 have led to the abandonment of this management strategy. Study in those years found that drying and rewetting is not the process driving phosphorus releases or at least is one of several factors depending upon climate conditions. Additionally, we found only about six feet of elevation change in the one-mile distance between Data Creek's crossing of Typo Creek Drive and Ditch 20 at the Mattson property where monitoring occurred. This would make water control structures difficult to engineer without affecting a large area and many property owners. Finally, this management strategy was abandoned because it carries a risk that is not outweighed by possible gains. The risk is that continuously saturated conditions created by water control structures could also release phosphorus from peat soils. During anaerobic conditions of continuous inundation ferric iron that binds phosphorus within the soil is reduced to ferrous iron which cannot bind phosphorus well.

Rejected Strategy 2. - Clean Ditch 20

Ditch 20 cleaning is not recommended. While ditch cleaning (re-excavation to the original profile) might minimize the duration of wet periods in the peatlands when phosphorus can be carried by subsurface flows to the ditches, it has a negative side. Cleaning would likely enlarge the peatland area drained by the ditch. It could also increase flow volumes such that the water would have more erosive force during storms and would be able to keep larger materials suspended in the water. Maintenance of Ditch 20 should be intentionally neglected.

Rejected Strategy 3. - Stream Aeration

In a well-aerated environment, phosphorus in the water can combine with ambient iron to form an insoluble precipitate. In order to be effective, the aeration system must be in contact with the water for an extended period. Although County Ditch 20, Data Creek, and Typo Creek have moderately slow flow, the streams are not well-suited to this technique. The streams flow through a broad wetland; only the water in the stream channel would be treated, and not that in the wetland floodplain. Also because of the adjacent wetlands, maintenance of an aeration system would be difficult.

Rejected Strategy 4. - Typo Creek Water Treatment Station

A water treatment station in Typo Creek, just before it enters the north end of Martin Lake, would be difficult for two reasons. First, the creek is broad with boarding wetlands. Treatment stations require well-defined stream banks and a relatively narrow stream segment. Secondly, a settling basin is also needed, but would be difficult to create with so little topographic relief and broad adjoining wetlands.

Rejected Strategy 5. - Lake Alum Treatments

Alum (aluminum sulfate) is a chemical addition that forms a nontoxic precipitate with phosphorus. It essentially removes the phosphorus from the lake system so it cannot fuel algal growth. It can also form a barrier between lake sediments and the water to curtail phosphorus releases from the sediments.

Alum would cause only a short-term reduction in phosphorus in these lakes. Typo and Martin Lake have short water residence times of less than 60 days. Therefore, new incoming water with high phosphorus content would replace the treated water frequently. Additionally, alum would have limited success forming a barrier between lake sediments and the water due to shallow depth and moderate to intense mixing, especially in Typo Lake.

Rejected Strategy 6. - Dredge Typo Lake

The shallow nature of Typo Lake and its nutrient-rich sediments are factors contributing to high nutrients and algae. Dredging, as suggested by a resident, may reduce the impact of these factors, but would fundamentally change the nature of the lake. Shallow lakes, while less suitable for some water-based recreation, have strong wildlife values. Shallow lakes are capable of having a clear-water, healthy condition (example - Fish Lake which is three miles west of Typo Lake). We favor management strategies that attempt to create a healthy shallow lake rather than change the type of lake. Approaches that reduce nutrient inputs and restore aquatic vegetation are favored.

An additional reason to reject dredging is that greater depths, combined with poor water clarity, would reduce the areas where aquatic plants could grow. Aquatic plants are essential to water quality improvement in shallow lakes. They are both a symptom of clearer water and a cause of it (i.e. they are part of a positive feedback). After a dredging project, even greater water clarity improvements would be needed for aquatic plants to become established and for the positive feedback mechanisms to become established.

A final reason to reject the dredging of Typo Lake is the cost: benefit ratio of the project. Depth would need to be increased several-fold to significantly reduce wind mixing of bottom sediments. The cost would be high. For example, if a new average depth of 8 feet were desired, depth would need to be increased by 5 feet on 80% of the lake. This would require removal of approximately 1,872,112 cubic yards of material. To transport this material for off-site disposal would require about 156,009 dump truck trips (assuming truck capacity is 12 cubic yards). If each disposal trip costs $75, the cost of this transport would be $11,700,700.

This does not include dredging itself. The total project cost would likely exceed $20 million dollars.

Rejected Strategy 7. - Prohibit Motorized Boat Traffic on Typo Lake

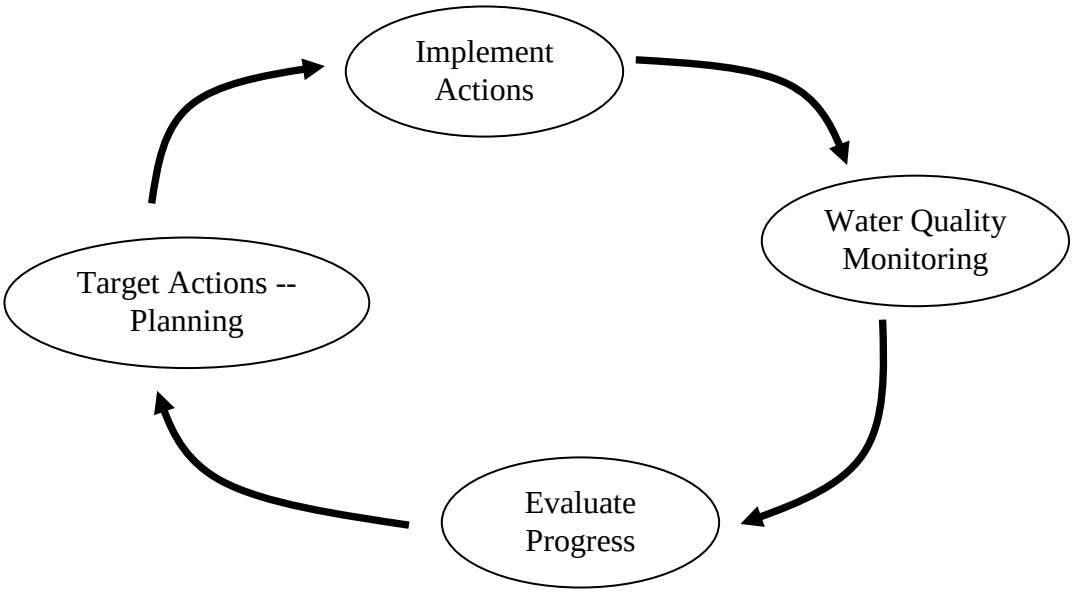
Mixing throughout the water column in Typo Lake causes lake-bottom sediments to become suspended, along with their associated nutrients. This mixing results primarily from wind and the action of rough fish, but boat motors provide additional mixing. Because Typo Lake is shallow, it receives little motorized boat traffic and boat motors are responsible for little of the sediment suspension. Therefore, restricting motorized boat traffic on Typo Lake would yield little additional water quality benefit.

However, restriction of motorized watercraft horsepower or prohibiting motorized traffic on certain portions of the lake may be beneficial for the encouragement of aquatic plants. If aquatic plantings are installed, or desirable aquatic plants begin to become established in one part of the lake, buoys excluding motor boats from these areas may be beneficial. If this occurs, signage should be placed at the public boat access explaining the buoys so boaters are not drawn to investigate their purpose.

Adaptive Management Process

The implementation actions outlined in this management plan will decrease the total phosphorus loading to the each of the lakes. However, at this stage specific sites and project types for future nutrient reduction features have been identified for some, but not all, of the load reductions to fully meet the TMDL. In addition, the actual performance of practices may vary after installation from what was estimated. Since the cumulative effect on water quality therefore is also unknown, a continual process must happen that evaluates lake water quality and then tailors the implementation actions to the findings.

As practices are being implemented in the watershed, lake water quality will be monitored to evaluate the impact that the implementation actions have on eutrophication indicators in Martin Lake and Typo Lake. If water quality is improving, this suggests that the current approach is working and the same course will be followed. If water quality is not improving, this suggests that the approach being taken is not sufficient, or is targeted to the wrong sources. In this case, the approach will be evaluated and adjusted so that tangible water quality improvements can be realized. This process is referred to as adaptive management.



Funding for Implementation

Funding for implementation of this TMDL will need to come from a variety of sources and all partners will need to contribute in meaningful ways to ensure success. The largest funding sources are state grants through the Minnesota Pollution Control Agency and Board of Water and Soil Resources. Broadly, these funds originate from the Clean Water Legacy initiative, the constitutional amendment that dedicated sales tax dollars to clean water beginning in 2009, or section 319 grants. Several factors would make these implementation projects good candidates for these competitive funds, including the completion of the TMDL, the identification of these waterbodies as high priorities in local water plans, and the fact that improvements to these waterbodies would benefit other high priority downstream waterbodies that are also impaired.

Local dollars to match state or federal grants are available, though in limited supply. In early drafts of the Sunrise River Watershed Management Organization they are planning to commit approximately $131,000 during the 2010 to 2019 period to projects specifically mentioned in this implementation plan. Additionally, the Martin Lakers Association maintains a water quality improvement fund, often with amounts less than $10,000. The Anoka Conservation District has a >10 year history of providing substantial in-kind contributions to work on these waterbodies. The USDA-NRCS has existing, funded programs that provide incentives for conservation practices on agricultural lands.

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V. Maps

Map 1. Typo and Martin Lakes TMDL Project Locati