Itasca Soil and Water Conservation District

Jessie Lake Watershed Protection and Restoration Plan (TMDL Implementation Plan for Jessie Lake)

January 2010
Revised January 2011

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Table of Contents

Table of Contents (cont.)

TABLES

FIGURES

APPENDICES

Implementation Plan Review Combined
Checklist and Comment

Reviewer______________________________

Date (first review)______________________

Date (final review)_____________________

Requirement	Location in Document	Enhancements needed for approval
a.1. geographical extent of watershed (use HUC's, stream segments, etc.)	pg 1-1, Figure 2.2	
a.2. measurable water quality goals	pg 2-4	
a.3. causes and sources or groups of similar sources	Section 3.0	
b.1. description of nonpoint source management measures	Section 3.0	
b.2. description of point source management	N/A	
c.1. estimate of load reductions for nonpoint source management measures listed in b.1	Section 3.0	
c.2. estimate of load reductions for point source management measures listed in b.2	N/A	
d.1. estimate of costs for nonpoint source measures	Section 3.0	
d.2. estimate of costs for point source measures	N/A	

Requirement	**Location in Document**	**Enhancements needed for approval**
e. information/education component for implementing plan and assistance needed from agencies	pg 3-1	
f.1. schedule for implementing nonpoint source measures	Section 4.0	
f.2. schedule for implementing point source measures	N/A	
g. a description of interim measurable milestones for implementing management measures (point source and nonpoint source) (by measure if needed)	Section 4.0	
h. adaptive management process- that includes set of criteria- to determine progress toward attaining nonpoint source reductions	Section 4.0	
i. monitoring component	Section 4.0	

1.0 Introduction

Section 303(d) of the Federal Clean Water Act (CWA) requires the Minnesota Pollution Control Agency (MPCA) to identify water bodies that do not meet water quality standards and to develop total maximum daily pollutant loads for those water bodies. A total maximum daily load (TMDL) is the amount of a pollutant that a water body can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads are allocated to permitted and non-permitted sources within the watershed that discharge to the water body.

Jessie Lake (DNR# 31-0786) in Itasca County, Minnesota is located in the Big Fork River watershed within the Lake of the Woods basin. The lake was placed on the State of Minnesota's 2004 303(d) list of impaired waters. Jessie Lake is impaired for aquatic recreation (e.g., swimming). Water quality in Jessie Lake does not meet state standards for nutrient concentrations. Late season nuisance algal blooms impede recreation on the lake. Residents have voiced concern over the algal blooms and the habitat in Jessie Lake.

The *Lake Nutrient TMDL for Jessie Lake* (Itasca SWCD, October 2009, hereafter refereed to as the "TMDL Study") quantified the phosphorus load reductions needed to meet State water quality standards in Jessie Lake and the endpoint proposed for the TMDL. The next step in the TMDL process is the development of a Watershed Protection and Restoration Plan (TMDL Implementation Plan) that identifies the activities that will be undertaken to protect water resources in the Jessie Lake Watershed and to restore Jessie Lake by reducing phosphorus loading the lake.

This Watershed Protection and Restoration Plan provides a brief overview of the TMDL findings; describes the principles guiding implementation; discusses priorities, sequencing, timing, lead agencies, partners, and other implementation general strategies; and describes the proposed implementation activities.

2.0 Jessie Lake TMDL Summary

The TMDL Study identified that a summer average in-lake phosphorus concentration of 29 μg/L was the appropriate endpoint for the lake, and that a 22% reduction in phosphorus loads to the lake was required to meet that endpoint. The nutrient TMDL for Jessie Lake was established in accordance with section 303(d) of the Clean Water Act.

Jessie Lake is one of 950 lakes located in Itasca County. The total drainage area of the sub-watersheds draining to the Jessie Lake is approximately 29.7 square miles, excluding the lake surface which is 2.69 square miles. The morphometric characteristics of Jessie Lake are shown in Table 2.1.

Table 2.1 Morphometric characteristics for Jessie Lake

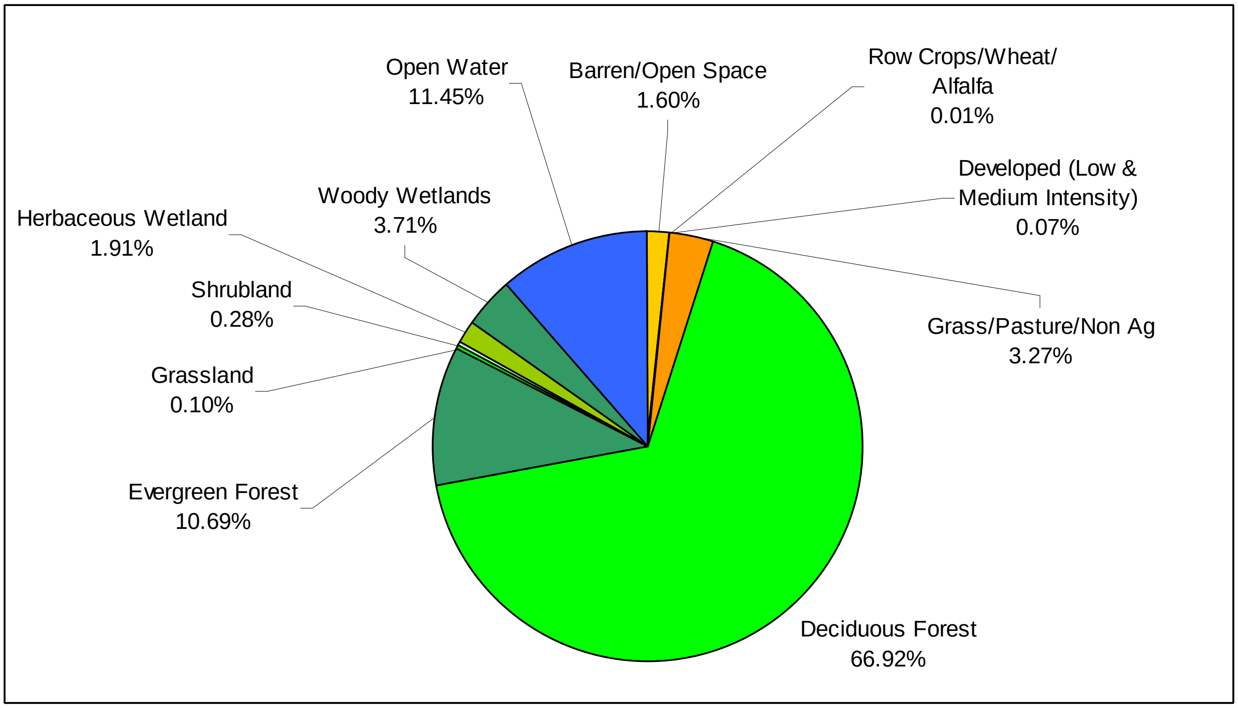
Parameter	Jessie Lake
Surface Area (ac)	1,723
Average Depth (ft)	27.7
Maximum Depth (ft)	42
Volume (ac-ft)	39,535
Average Residence Time (years)	11.2
Littoral Area (ac)	445
Watershed not including lake surface area (ac)	19,012

In 1998, a thick algae bloom and subsequent fish kill sparked stakeholder concern over declining water quality in Jessie Lake. A lake assessment conducted that same year showed markedly higher in-lake total phosphorus (TP) concentrations than those observed in 1990. Stakeholders implemented further study of Jessie Lake including a Cleanwater Partnership project in 2000 (MPCA 2002) and a diatom study (Kingston 2002). The Itasca SWCD has monitored water quality annually in Jessie Lake since 1998. Data collected from these studies showed the lake was impaired for nutrients.

Average summer surface TP concentrations in Jessie Lake ranged from 19 to 48 μg/L between 1998 and 2008, with an average concentration of 35 μg/L for that 10-year period. Based on existing data, the likely background concentrations for Jessie Lake range from 25 to 30 μg/L. The Northern Lakes and Forest Ecoregion standard is 30 μg/L. Jessie Lake lies within the Chippewa Sand Plains, a sub-region of the Northern Lakes and Forest Ecoregion. Data suggests that lakes within the Chippewa Sand Plains may have higher background TP concentrations than other lakes in the Northern Lakes and Forest Ecoregion. This is a point currently under review within the MPCA. Based on existing data, the endpoint for the Jessie Lake nutrient TMDL is 29 μg/L.

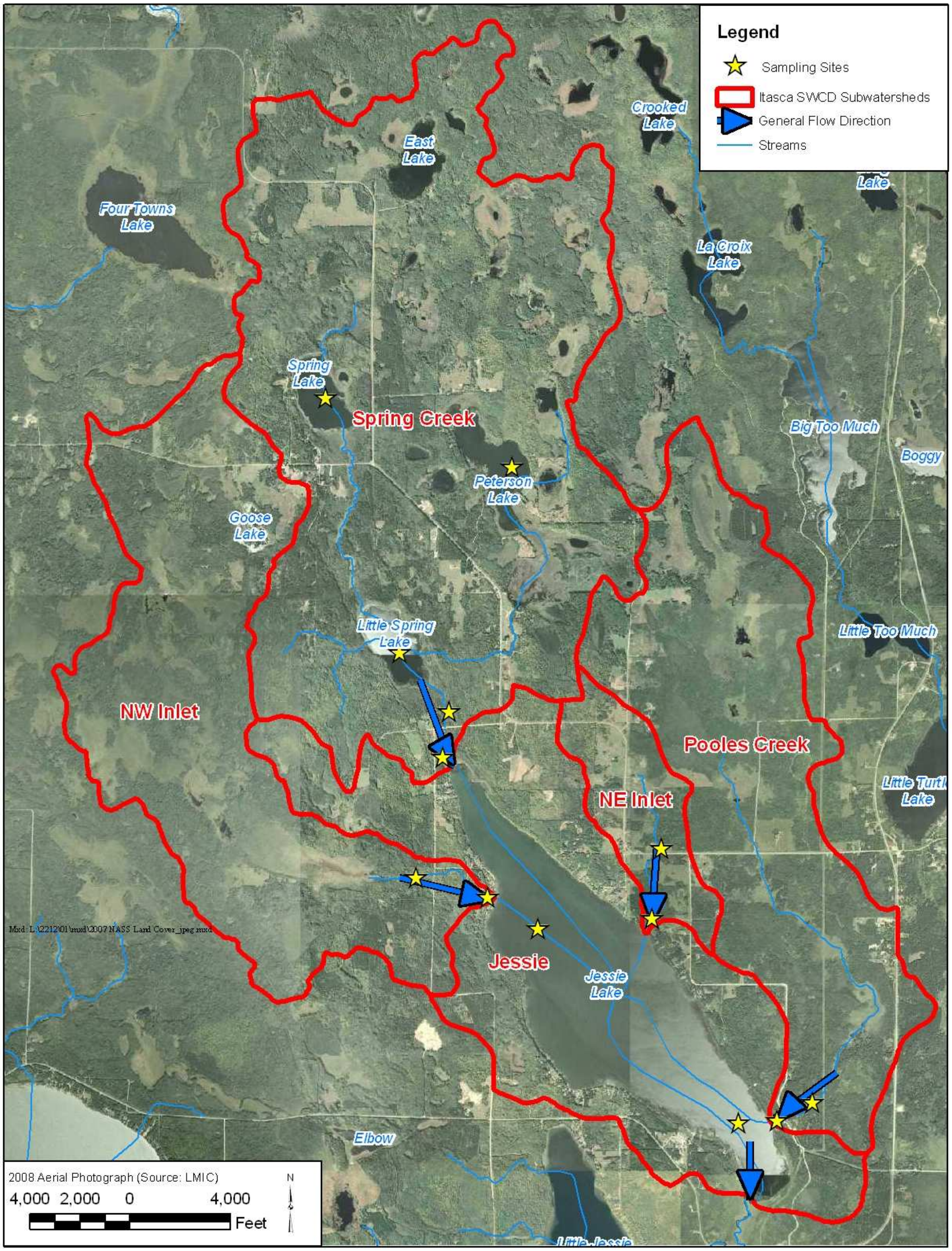
The sources of phosphorus to Jessie Lake include land use based watershed sources, groundwater contributions to the lake, internal cycling of phosphorus and atmospheric deposition. Current anthropogenic phosphorus sources to Jessie Lake are minimal as over 95% of the watershed is undeveloped. Figure 2.1 shows landuse breakdown for the watershed. The annual loads are dominated by internal cycling of TP in the lake which is driven by nutrient rich sediments, periods of summer anoxia and late summer de-stratification events.

Figure 2.1 Jessie Lake Drainage Area Land Use Breakdown



Internal loads are likely the result of a combination of historical anthropogenic impacts such as logging in the watershed, the naturally occurring TP concentrations in the area soils, and the lake morphometry and climate which results in late summer destratification events releasing TP into the epilimnion making it available for algal growth. Recent increases in the length of the growing season may be contributing to the internal loading. Figure 2.2 shows the watershed area and lake inflows.

Figure 2.2 Jessie Lake and Drainage Area and Flow Schematic



The annual phosphorus load reduction for Jessie Lake under average conditions to meet the TMDL endpoint of 29 µg/L is 22% TP (Table 2.2). Internal load management, septic system improvements, and reduction of phosphorus from watershed runoff will be required to meet load reduction goals.

Table 2.2. Average and Goal TP Load and Percent Load Reduction by Source

	Modeled Average	Modeled Goal	% Reduction
In-Lake Concentration (ug/L)	**34**	**29**	**15%**
Watershed	1,579	1,421	10%
Septics	103	0	100%
Atmophseric	310	310	0%
Groundwater	1,064	1,064	0%
Internal	2,398	1,439	40%
Total	5,454	4,234	22%
T:\2212-Jessie\MPCA Q data\[Copy of RAK_Q Eval_jcm_Calib4.xls]Implementation			

The watershed load reductions coupled with an additional 40% reduction in internal loads and elimination of failing septic systems will result in Jessie Lake meeting the endpoint specified in the TMDL under average conditions. Since the bulk of the load reductions are from internal sources, and internal loads vary from year to year depending on climate conditions a load reduction closer to 60% from internal sources is needed to meet goals under most conditions.

The Itasca SWCD will coordinate efforts with other local stakeholders including the Jessie Lake Watershed Association, Department of Natural Resources, US Forest Service, and others to implement the approved TMDL for Jessie Lake. Itasca SWCD is the appropriate local unit of government (LGU) to coordinate with other stakeholders to implement the TMDL given their coordination of the stakeholder process for preparing the TMDL, their jurisdiction over the entire drainage area for Jessie Lake, and their existing resources in terms of their annual monitoring program and qualified staff.

The stakeholder process for the Jessie Lake TMDL was considerable. A technical advisory committee (TAC) was formed from representatives of stakeholder groups including:

- Jessie Lake Watershed Association (JLWA),
- Itasca Soil and Water Conservation District (Itasca SWCD),
- Minnesota Department of Natural Resources fisheries and hydrology departments (MN DNR),
- US Forest Service (USFS) and
- Minnesota Pollution Control Agency (MPCA)

Results of modeling conducted to set the TMDL were presented to the TAC at three presentations and in the form of Technical Memos which are included in the final TMDL report. Details of the modeling, goal selection and potential load reductions are presented in these memos. These memos were used as the foundation of the TMDL report.

3.0 Watershed Restoration and Protection Plan

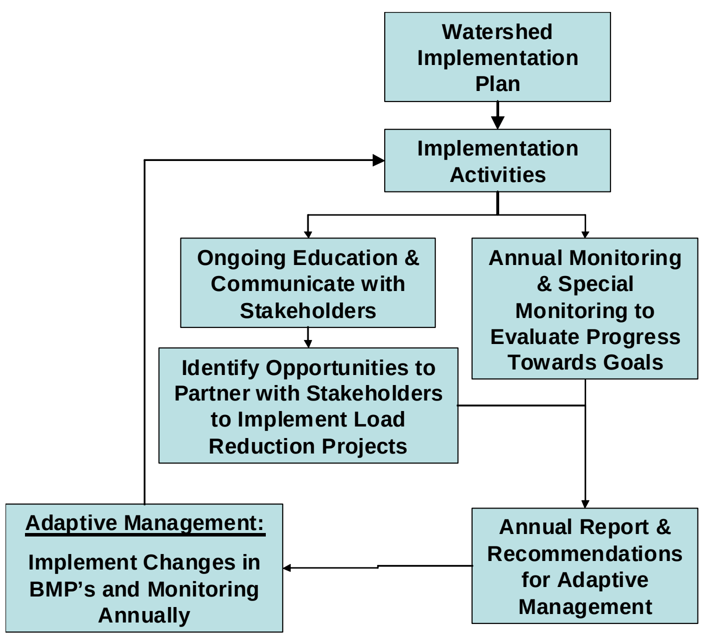
3.1 IMPLEMENTATION FRAMEWORK

Implementing this plan will be a collaborative effort between state and local government, and individuals, with the overall effort led by the Itasca SWCD.

To meet water quality standards, Itasca SCWD will leverage existing regulatory framework, and relationships to generate support for Watershed Protection and TMDL implementation efforts, providing technical support, funding, coordination and facilitation when needed. Efficiency and cost savings are realized by using existing governmental programs and services for TMDL implementation to the maximum extent possible.

This Watershed Protection and Restoration Plan is the first step in the framework of TMDL implementation and is meant to be a living document. The general framework is to implement the initial steps recommended in this plan (Section 4.2 and 4.3), evaluate results through monitoring and data collection (as recommended in Section 5), evaluate progress, report findings and refine recommendations (Figure 3.1).

Figure 3.1 Implementation Framework



3.2 APPROACH

The general approach to watershed protection and restoration (implementation of TMDLs) in Itasca County is summarized by three key elements:

Leverage Existing Programs & Partnerships to the Maximum Practical Extent

Itasca SWCD already implements several programs to monitor and improve water quality, and also partners with state and local governments, lake associations to implement programs and projects for water resource improvements. This ongoing Itasca SWCD approach leverages existing state and local available funding and expertise to maximize water quality benefits. To achieve the significant load reductions required to meet state standards at a reasonable cost, the Itasca SWCD will continue with this approach.

The One-Water Approach

The Itasca SWCD will incorporate watershed protection as well as restoration in its implementation of TMDLs. The Jessie Lake watershed will be viewed as a system, rather than focusing solely on the impaired lake at the downstream end of the system. As the lead agency for implementation, the Itasca SWCD will also be reviewing other water resources within its boundaries and within the larger watershed.

A Sustained Effort

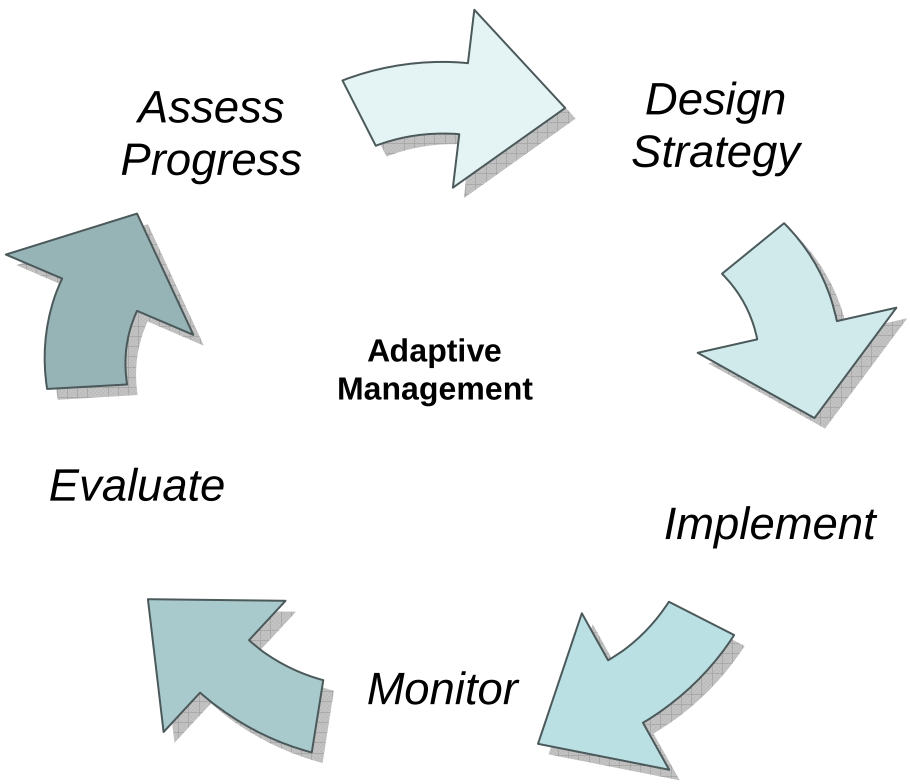
The BMPs prescribed herein require participation and buy-in from all stakeholders. As the impairments were not created overnight, the solution will not be implemented overnight, but over a long period of time. A sustained effort requires a sustained stakeholder process.

3.3 ADAPTIVE MANAGEMENT

The load allocation in the TMDL represents an aggressive goal for in lake nutrient concentrations. While specific BMPs are prescribed, implementation will be conducted using adaptive management principles. Adaptive management is an iterative approach of implementation, evaluation, and course correction (see Figure 3.2). It is appropriate here because it is difficult to predict the lake and stream responses to load reductions. Future conditions and technological advances may alter the specific course of actions detailed in this Plan. Continued lake and stream water quality monitoring and course corrections responding to monitoring results offer the best opportunity for meeting the water quality goals established in this Watershed Protection and Restoration Plan.

Adaptive management will be tracked by leveraging the Itasca SWCD's existing monitoring and annual reporting program. It is recommended that the program be enhanced to track progress towards goals and to quantify progress of specific BMPs. A section should be added to the end of the annual report that will specifically track the BMPs implemented, load reductions and progress towards goals. The implementation strategies will be evaluated and ranked based on the criteria developed in the annual report. A spreadsheet will be maintained to prioritize future BMPs and projects for funding to ensure the maximum benefit for costs incurred. In short, the annual report is the tool through which effectiveness is tracked and new recommendations are made.

Figure 3.2 Adaptive Management



3.4 PARTNERS

3.4.1 Itasca SWCD

The mission of the Itasca SWCD is to provide a local organization through which landowners and operators, local units of government and state and federal agencies can cooperate to improve, develop and conserve soil, water, wildlife and recreational resources.

The SWCD will encourage adoption of proper land use practices as needed, recognizing that these measures are essential for maintenance of permanent and prosperous natural resource-based industries in Itasca County.

Because the primary goal and mission of the Itasca SWCD is in line with the goal of Watershed Protection and Restoration, many of the implementation strategies are extensions of existing Itasca SWCD programs and projects and can be implemented to some extent using existing Itasca SWCD budgets and staff. However, additional funding will be necessary. The recommended implementation plan to meet lake water quality goals and associated cost is described in the following sections.

3.4.2 Jessie Lake Watershed Association

Partnerships with counties and lake associations are one mechanism through which the Itasca SWCD protects and improves water quality. The Itasca SWCD will continue its strong tradition of partnering with state and local government to protect and improve water resources and to bring Jessie Lake into compliance with State standards.

3.4.3 BWSR

The Itasca SWCD recognizes that public funding to set and implement TMDLs is limited, and therefore understands that leveraging matching funds as well as using existing programs will be the most cost efficient and effective way to implement the Jessie Lake TMDL. The Itasca SWCD does project a potential need for about 50% cost-share support from the BWSR or other sources in the implementation phase of the TMDL process.

3.5 REDUCTION STRATEGIES

The focus in implementation will be on reducing the annual phosphorus loads to the lake through structural and non-structural Best Management Practices and projects. The TMDL established for Jessie Lake is presented in Section 2.0 of this report.

No reductions in atmospheric or groundwater loading are targeted because these sources are not readily controllable. The remaining load reductions were applied based on our understanding of the lake and surrounding watershed, as well as output from the model.

The current modeled average load to the lake is 5,454 lbs/yr. The modeled load at the goal concentration of 29 µg/L is 4,234 lbs/ yr. A 22 % reduction in overall P loads is required to meet the annual goal under average conditions. Table 3.1 shows existing and proposed reductions.

Table 3.1 Modeled Average and Goal Phosphorus Loads to Jessie Lake and Percent Reductions Required

	Modeled Average	Modeled Goal	% Reduction
In-Lake Concentration (ug/L)	**34**	**29**	**15%**
Watershed	1,579	1,421	10%
Septics	103	0	100%
Atmospheric	310	310	0%
Groundwater	1,064	1,064	0%
Internal	2,398	1,439	40%
Total	5,454	4,234	22%
T:\2212-Jessie\MPCA Q data\[Copy of RAK_Q Eval_jcm_Calib4.xls]Calibration Summary			

About a 10% load reduction from watershed sources is likely achievable through BMPs. Septic system discharge is not permitted under state law and therefore the 100% reduction is required. This leaves a required internal load reduction of about 40%. It is important to note that under the highest internal loading conditions, the internal phosphorus load is about 3,500 lbs/ year.

Conservative implementation planning would require load reduction from internal sources at 60% to reach the modeled goal in years with the highest anoxic factors.

The specific strategies evaluated are described in the remainder of the section. The final recommended strategies are presented in tabular format as measurable milestones.

3.5.1 Internal Load Reduction

Modeling efforts and nutrient load quantification conducted as part of the Jessie Lake TMDL, as well as past studies of Jessie Lake, indicate that internal loading comprises a large percentage of the Jessie Lake nutrient budget. The modeled average total phosphorus load for Jessie Lake is 5,454 lbs/yr with 2,398 lbs/yr contributed by the internal load. It is believed that an implementation strategy which incorporates internal nutrient load management will be necessary to achieve water quality targets and goals for Jessie Lake. The desired internal load reduction is 40% for a total internal load contribution of 1,439 lbs/yr. There are several internal load management options which could be implemented to achieve the desired internal load reduction for Jessie Lake:

- Hypolimnetic Withdrawal
- Hypolimnetic Aeration
- Alum Dosing
- Watchful Waiting

Each of these options was examined with regard to feasibility, load reduction and cost. Detailed descriptions of each option are presented in the following sections.

3.5.1.1 Hypolimnetic Withdrawal

During hypolimnetic withdrawal anoxic water from the lake bottom is removed and either discharged downstream or treated and returned to the lake. To achieve hypolimentic withdrawal in Jessie Lake, water would be pumped out of the hypolimnion into a pump house constructed on shore. A force main would be laid on the bottom of the lake with a screen at the intake. The intake would be placed at a depth below the normal thermal stratification depth. Once water reaches the pump house, it would be aerated over a cascade of concrete weirs into a basin. Water pumped from the hypolimnion would than be pumped to a constructed pond or wetland for treatment prior to returning to the surface waters of Jessie Lake. Returning the hypolimnion waters to Jessie Lake would minimize an overall decrease in the lake volume and minimizes impacts to downstream waters and minimizes costs.

Several options exist for the removal of phosphorus from the hypolimnetic water. Phosphorus can be reduced through a constructed wetland by adsorption to wetland soils and precipitation with calcium, iron, and aluminum. Soils higher in these elements have a greater potential to reduce phosphorus in the downstream flow. Other non-organic substrates can be added to the constructed wetland to enhance the treatment capabilities similar to a media filter. Industrial by-products, iron filings, granular iron, sand mixtures, even crushed oyster shells have been used to bind phosphorus and can enhance treatment capabilities. Traditional wastewater treatment processes use chemical additions to create a floc with the phosphorus requiring physical removal. Alum injection can provide a much higher level of treatment and certainty that phosphorus will be removed to levels that will benefit the lake. Alum would be injected to form a floc at the pump house, and then the floc would be settled out in a primary settling pond.

Each increase in treatment level will have a corresponding increase in operation and maintenance. For the purposes of this study, costs were estimated for treatment with and without alum injection.

3.5.1.1.1 Preliminary Design and Feasibility Analysis

For the purposes of removing the quantity of phosphorous rich hypolimnion waters desired, the hypolimnetic withdrawal option was examined using the assumption that withdrawal and treatment activities would occur solely during the anoxic period. Water quality data for Jessie Lake shows that the anoxic period typically occurs during the summer months (June – August).

In 2001, the average depth of anoxia (for June, July, and August) was 26.5 feet. For the preliminary design calculations, a depth of 25 feet was assumed (due to available lake volume data). The average total phosphorous concentration within the hypolimnion for June through August 2001 was 133 ug/L. The 2001 June through August average bottom concentration was used for preliminary design because samples were collected every two weeks and coupled with lake profile data, 2001 provides the best data set currently available to characterize potential removal. However, one to three additional years of hypolimnetic phosphorus, iron and stratification data is needed to optimize design and verify feasibility.

Reduction of the internal contribution to the total phosphorous load by 40% would result in an internal load of 1,439 lbs/yr requiring the removal of 959 lbs of phosphorous annually. The volume of water requiring removal to achieve the desired reduction in total phosphorous was calculated assuming that water would be pumped constantly over the summer months (90 days). A total of about 864 million gallons of hypolimnetic waters would need to be withdrawn to decrease the internal loading. This results in a pumping rate of 10 MGD.

Consultation with a local pump supplier reveal that there are two pump options that could meet the pumping conditions assumed for the hypolimnetic withdrawal, a vertical turbine pump or a horizontal split case pump. Two pumps would be needed, the first to pump water from the intake point to the pump/aeration house, and the second to pump from the treatment pond back to Jessie Lake surface waters. Further design would be necessary to determine which pump would be the most efficient for the application. The cost of the horizontal split case pump was used for the cost estimate discussed below.

It is recommended that the force main intake be placed near the deepest portion of the lake at a depth of 35 feet. Pumping from the deepest area removes the hypolimnetic waters with the highest phosphorous content since the dissolved oxygen content will be lower than it would be at a shallower depth within the hypolimnion. Also, due to the bathymetry of the lake, pumping from this area would minimize the amount of piping needed to reach a pump house on the shoreline which would in turn reduce implementation and maintenance costs.

Treatment capabilities with hypolimnetic water in a constructed wetland cannot be easily quantified. Alum injection can provide a much higher level of treatment and certainty that phosphorus will be removed to the desired levels. A treatment pond, or series of ponds, would need to be constructed to treat the withdrawn hypolimnion waters. Preliminary calculations and an assumed treatment settling rate indicate that the size of a constructed treatment area would need to be approximately 2.6 acres to accommodate the required removal rate. General assumptions were made as to the depth of the treatment area required for the purposes of the cost estimate presented in Section 4.0.

3.5.1.1.2 Implementation Considerations

The above potential removal scenario was examined on a preliminary scale with the use of multiple assumptions. The actual placement of the intake, force main, pump house, and constructed treatment pond(s) as well as all pump, pipe, and pond sizing would require an in depth engineering design study beyond the scope of this report. There are several other considerations which would need to be made prior to final design and implementation including electrical service requirements and treatment efficiency.

Also, the water in the hypolimnion of Jessie Lake likely contains hydrogen sulfide (H_2S). This could result in the aeration process releasing hydrogen sulfide gas into the air, creating a very potent “rotten egg” smell. However, due to the rural location of the lake it may be possible to construct the discharge system in an area that would not impact local lake residents or the resorts on the lake. If it is determined that residents may be impacted by the smell of the water from the system, the hydrogen sulfide gas would need to be reduced to a suitable level before leaving the pump house. To reach this level, a series of air filters would be required. Along with the air filters in the pump house building, air monitoring equipment will also be required because even at low concentrations, hydrogen sulfide is potentially dangerous to maintenance personnel working in the building.

As discussed above, design pumping rates are based on hypolimnetic concentrations and depth of anoxia. Additional characterization of these data is necessary to optimize design.

Viability of this option would be dependent on the land area available for construction of a treatment pond or wetland. Land availability was not researched as part of this preliminary examination.

3.5.1.1.3 Permit Requirements

Hypolimnetic withdrawal implementation would require a General Work in Public Waters permit. The typical time frame to acquire a General Work in Public Waters permit is 60 days. However, depending on the complexity of the project and the potential for controversy with the lake shore residents and/or general public the permitting process could take considerably longer. Typical processes for obtaining these permits can last from a period of many months to many years and involve a TAC to approve final design. DNR shoreline set-back requirements may apply to certain aspects of the project construction. The MPCA would also need to review the project in conjunction with the DNR permits.

Additionally, the project would require a Water Appropriations permit from the DNR. The threshold for an appropriations permit is one million gallons per year. Due to the large volume of the hypolimnion of Jessie Lake, this volume would be exceeded.

A third permit that may be required from the DNR is Partial Drawdown Waters Work permit. An analysis of the impact to the lake water levels as a result of the project would need to be conducted. The Partial Drawdown Waters Work permit is not defined by a certain minimum or maximum allowable level to fluctuate without requiring a permit. Instead the language is very general and reviewed on a case by case basis. If it is determined that a Partial Drawdown Waters Work permit is required, then all of the lake shore property owners would be required to approve the project before a permit could be issued. The MPCA would need to review the project in conjunction with the DNR permit.

3.5.1.2 Hypolimnetic Aeration

Lake hypolimnetic aeration controls internal loads by aerating hypolimnetic waters (cold, dense water trapped at the bottom of a deep lake) to maintain oxic (oxygenated) conditions in the hypolimnion and sediment surface. It is the anoxic (no dissolved oxygen) condition of the hypolimnetic sediments which contribute to the internal phosphorus load. Internal load studies conducted on Jessie Lake sediments during the TMDL revealed that there was little to no phosphorus release from lake sediments under oxygenated conditions. Conversely, these same experiments revealed that phosphorus release from sediments under anoxic conditions was significant. It therefore may be possible to reduce internal phosphorus release from sediments using hypolimnetic aeration. Hypolimnetic aeration only aerates water of the hypolimnion without causing it to mix with the epilimnion. This prevents the lake from stratifying and limits the amount of water to be aerated.

3.5.1.2.1 Preliminary Design and Feasibility Analysis

To achieve a 40% reduction in internal load, a corresponding 40% of the area over the deepest portion of the lake (the portion most likely to become anoxic) would be fitted with aerators.

Air-lift hypolimnetic aerators work by introducing diffused air at the bottom of the aerator in the hypolimnion. The buoyancy of the air-water mixture lifts the water through the central pipe to the top of the aerator. The air bubbles leave the water and are vented to the water surface, while the oxygenated water returns to the hypolimnion by sinking through the external tube.

Preliminary research indicates that a single air-lift aerator would likely not have the capacity to oxygenate the volume of water within the hypolimnion of Jessie Lake. Therefore, multiple air-lift aerators would need to be installed. Assuming an influence zone of 35 acres, 12 air lift aerators would be needed over the approximate 400 acre surface area of the hypolimnion (about

40% of the typical anoxic area). A compressor building would be located on the shoreline with air supply hoses running to each installed aerator. For this quantity of aerators, more than one compressor building may be required.

3.5.1.2.2 Implementation Considerations

Further in depth engineering design would be necessary to determine the specific requirements for successful hypolimnetic aeration. One of the items that would need to be refined is the number and location of the aeration units. Also the location of the compressor building and electrical service needs would have to be determined.

An additional item that would have to be researched would be the possibility of year round aeration. If aeration is used through the winter, it has the disadvantage of destroying ice cover and causing open water, posing a hazard for winter lake use. Therefore, strict safety measures have to be observed if the system was operated during winter.

Another item that would have to be considered is the possible need to add ferric chloride to the system. The addition of ferric chloride (an iron salt) solution may be necessary if iron becomes the limiting constituent in the deactivation of soluble phosphorus release. Therefore both aeration and ferric chloride lines could possibly be installed in the lake during the initial construction.

3.5.1.2.3 Permit Requirements

A hypolimnetic aeration project would likely require review and comment from several local and state agencies. Two permits are required from the Minnesota DNR for a hypolimnetic aeration project. The first is from the Division of Fisheries. The second is the General Work in Public Waters Permit. The typical time frame to acquire a General Work in Public Waters permit is 60 days. However, depending on the complexity of the project and the potential for controversy with the lake shore residents and/or general public the permitting process could take considerably longer. Typical processes for obtaining these permits can last from a period of many months to many years and involve a TAC to approve final design. DNR shoreline set-back requirements may apply to certain aspects of the project construction. The MPCA would also need to review the project in conjunction with the DNR permits.

3.5.1.3 Alum Dosing

One of the more effective tools to control internal loading is sediment phosphorus inactivation, where phosphorus is permanently bound in the sediment using chemical addition. One of the most common chemicals used for phosphorus inactivation is aluminum sulfate or alum. The aluminum-phosphorus bond is very stable under typical environmental conditions and provides a long term sink for phosphorus in the lake.

The process of applying alum to a lake typically includes injection of liquid alum just below the surface of the lake. The alum quickly forms a floc and settles to the bottom of the lake, forming a sediment seal while stripping phosphorus from the water column on the way down to the sediments. The undisturbed floc provides a sediment barrier that binds any phosphorus released from the sediment, essentially eliminating internal phosphorus loading from that portion of the lake.

Studies have shown that alum dosing will typically reduce sediment phosphorous release by 80 – 90 percent for several years.

3.5.1.3.1 Preliminary Design

Effective application of alum to reduce internal loading requires detailed dosing calculations and bench testing to effectively control phosphorus release from the sediment and to prevent aluminum toxicity that occurs if the lake pH drops below 6.0. Two different alum dose calculation methods were utilized to perform preliminary calculations. The maximum alum dose was determined based on in-lake alkalinity and the optimal dose for varying durations of effectiveness was calculated as well. For the purpose of these calculations it was assumed that sediment treatment would occur at depths greater than 5 feet to avoid disturbance by wind, waves, or other activity.

Due to the in-lake alkalinity, calculations show that approximately 3 million gallons of liquid alum could be added to Jessie Lake without creating pH levels below 6.0. Further calculations were performed to determine the amount of alum necessary to reduce the internal load contribution by treating 40% of the total phosphorous, 60% and 100% treatment dose requirements were calculated as well.

The results of these preliminary calculations are summarized in Table 3.2 and detailed in Appendix A. For the purposes of these preliminary calculations, it was assumed that alum applications would need to occur every 15 years to remain effective.

Table 3.2: Summary of alum dose for 15 year treatments.

	40%	60%	100%
Gallons of liquid alum	275,931	414,040	689,972
Areal loading rate [kg/m^2]	0.11	0.17	0.29
Areal loading rate [gal/m^2]	0.05	0.07	0.11

3.5.1.3.2 Implementation Considerations

It is important to note that the dosing calculations discussed above are for costing purposes only. More detailed methods including bench testing should be used to develop specifications if alum dosing is the internal load reduction option selected.

In-lake alkalinity and pH would need to be examined on a detailed level. If an inappropriate alum dose is used and the pH of Jessie Lake drops below 6.0, aquatic toxicity may occur which would be harmful to the aquatic life. Application of a buffer solution, such as liquid sodium aluminate, may be required to keep pH levels above the toxicity threshold.

The long-term effectiveness of an alum treatment is determined by several factors including the depth of treatment, presence of rough fish, long term storage and release of phosphorus in sediments, external loading rates, and application techniques.

3.5.1.3.3 Permit Requirements

No formal permits are required to conduct in-lake alum treatment. However, several agencies request that they be informed of the proposed project so they can provide comment or direction. These agencies include the MPCA and the DNR. When requesting comments for the DNR, both the DNR Waters division and the Fisheries and Ecological Services division would like to provide comments.

3.5.1.4 Cost and Economic Considerations

Cost estimates were prepared for construction and operation for each of the internal load reduction options discussed above. As each of the designs has different operation, maintenance and energy costs, it was necessary to perform an economic analysis to enable a comparison on a common cost basis. Detailed cost estimates are included in Appendix B.

The investment cost includes all costs for implementation and construction of the project. The annual operating costs cover energy and estimated operation and maintenance. Overhaul costs are assumed to take place after 10 or 15 years of operation and represent the replacement of mechanical and electrical equipment and cleaning of wetlands or sediment basins.

The project present value includes the investment cost plus the calculated present value of annual costs and the overhaul costs over 30 years. The interest rate used in this analysis was 3.5%. The project present values allow an equal basis of cost comparison for the different treatment alternatives for an economic life of the project of 30 years.

As there is more information readily available for the alum dosing option, the cost estimates provided is perhaps more accurate than for the other two options. However, the estimate is meant solely for comparison purposes as detailed design would be required to provide more exact costing. Cost estimates are presented for 40, 60, and 100 percent phosphorous treatment over a effective duration of 15 years for this option.

With hypolimnetic aeration, there are again a large number of unknowns and the cost provided is an estimate meant for comparison purposes. To arrive at the cost presented, it was estimated that on average each aerator would require approximately 4000 lineal feet of air supply hose and that 3 compressors buildings would be required to supply the 12 aerators. Derivation of actual quantities would require detailed engineering design.

Due to the large number of unknowns and the scope of the preliminary examination of hypolimnetic withdrawal, the cost estimate provided is meant to present a cost estimate to compare to the other internal load reduction options. Detailed engineering design and study would be necessary to provide a more accurate depiction of cost.

3.5.1.5 Summary

The results of the economic analysis for the internal load reduction options are presented in Table 3.3 below.

Table 3.3 Estimated costs associated with internal load reduction

Treatment Alternative	Initial Capital Cost	Annual O & M	Overhaul/ Reapplication Costs	Annualized Cost
Alum Treatment (40%)	**$508,000**	**$0**	**$508,000/15 years**	**$44,100**
Alum Treatment (60%)	**$754,000**	**$0**	**$754,000/15 years**	**$65,500**
Alum Treatment (100%)	**$1,250,000**	**$0**	**$1250,000/15 years**	**$109,000**
Hypolimnetic Aeration	**$2,290,000**	**$174,000**	**$897,000/10 years**	**$357,000**
Hypolimnetic Withdrawal	**$1,580,000**	**$79,300**	**$16,000/10 years**	**$166,000**
Hypolimnetic Withdrawal with Alum Injection	**$1,620,000**	**$86,800**	**$16,000/10 years**	**$176,000**

A further comparison of internal load reduction project alternatives is presented in Table 3.4: Phosphorus Cost per Pound Removal. This table shows that the option with the least cost is alum dosing at $28/lb. Any of the three alum dosing treatment options presented would be more cost effective than either hypolimnetic aeration or hypolimnetic withdrawal. The most expensive option is hypolymnetic aeration at $228/lb.

Table 3.4: Phosphorus Cost per Pound Removal

Treatment Alternative	30 Year Present Value Cost	Phosphorus Load (kg / yr)	Phosphorus Reduction per year	Phosphorus Removed per Year (kg)	Phosphorus Removed over 30 Years (kg)	Phosphorus Removed over 30 Years (lb)	Cost per kg Removed	Cost per lb Removed
Alum Treatment (40%)	$811,000	1,088	40%	435	13053	28776	$62	$28
Alum Treatment (60%)	$1,204,000	1,088	60%	653	19579	43164	$61	$28
Alum Treatment (100%)	$1,996,000	1,088	100%	1,088	32632	71940	$61	$28
Hypolimnetic Aeration	$6,567,000	1,088	40%	435	13053	28776	$503	$228
Hypolimnetic Withdrawal	$3,059,340	1,088	40%	435	13053	28776	$234	$106
Hypolimnetic Withdrawal & Alum Injection	$3,239,340	1,088	40%	435	13053	28776	$248	$113

* Note the costs here are 30 year present value, costs for comparison later in the report are based on capital costs over 15 years.

3.5.2 External Load Reduction

The current nutrient balance for Jessie Lake show that 1,579 lb/yr of the total 5,454 lb/yr phosphorus load is contributed by watershed sources, and 103 lbs/ year from septic sources (Table 3.5). This represents an average of several years of data collected over the period of model calibration. The reality is that in some years external load is higher, and in some years it is lower and both fluctuate with groundwater contributions. The partitioned external phosphorus load contribution to total phosphorous for Jessie Lake can be attributed as follows:

Table 3.5 External Loads and Required Reductions

Source Category	Current Contribution	Required Load Reduction
Watershed (1,579 lb/yr)	1,579 lb/ yr	10%
Failing Septics (103 lb/yr)	103 lb/ yr	100%
Atmospheric (310 lb/yr)	310 lb/yr	No reduction
Groundwater (1,064 lb/yr)	1,064 lb/ yr	No reduction

The watershed phosphorus loads are derivative of the land uses within the tributary watersheds. These are primarily forest with some lakeshore residential ringing Jessie Lake and the lakes in the northern portion of the watershed. Current anthropogenic impacts to the watershed are minimal, and as such watershed load reduction opportunities also limited.

Load reductions in atmospheric or groundwater sources have not been considered as they are not readily controllable.

Achieving the phosphorus load reductions necessary to meet the TMDL and achieve water quality goals will require a 10% reduction in watershed sources and a 100% for septic systems.

Options for watershed based load reductions are limited given the limited extent of current anthropogenic impacts. The recommended 10% watershed load reduction is likely achievable through Best Management Practices (BMPs) which may be employed to gain small load reductions and to prevent further increase in watershed nutrient load to the lake. In addition to load reduction strategies, care must be taken with respect to future development not to increase watershed phosphorus loading. Establishing a regulatory framework to address potential increases is critical to maintaining existing water quality in Jessie Lake and achieving water quality goals.

Strategies for phosphorus load reduction to meet in lake water quality goals are discussed below along with the framework for prevention of increased phosphorus loads to the lake through landuse changes.

3.5.2.1 Septic System Load Reduction

State law prohibits discharge from septic systems so a 100% reduction of the nutrient load contribution is required. Homeowner surveys of the lake shore residents ringing Jessie Lake indicate a high potential failure rate of as much as 50%. About 4.2 lbs of phosphorus per failing septic system per year (from a full time equivalent residence) can be removed from Jessie Lake through septic system upgrades. This represents a total load reduction of 103 lbs per year, which compared to the watershed load reduction required of about 158 lbs per year, can be accomplished fairly easily and with relative certainty.

Currently landowners are required to replace septic systems upon property sale or with remodeling. To increase the rate at which septic systems are replaced, County SWCDs can fully fund low interest loans to homeowners to replace systems through the Clean Water Revolving Funds. SSTS installation for a single-family home is $10,000 to $15,000. Low-interest loans can be as little as 1% to 3 % with a 10-year repayment period. There is generally little or no cost to the county.

Inspections and matching grants provide an additional incentive. The MPCA has grants available to conduct inspections for each system and cost share grants and low interest loans can be offered to assist in installation of new systems where they are needed. The cost of inspections of all systems on the lake will cost approximately $38,000. Targeting replacement of 40 failing systems by offering $5,000 in matching funds will cost $200,000 for a total cost of $238,000, the actual number of systems replaced will depend on the results of the survey. Replacing 40 systems over a 10 year period (assume 4 systems are replaced per year, divide the total annual load from failing systems as modeled, 103 lbs, over then number of systems, and use that to calculate the cumulative removal for all the systems replaced over a 10-year period) the expected cost per pound removed for the 10 year period is $514/ lb.

3.5.2.2 Development & Re-development Ordinance

This refers to Itasca County implementing an ordinance requiring permits for development and re-development in the watershed tributary to Jessie Lake. Conditions of permits issued would require no-net increase in phosphorus export as the result of new development, and load reductions over existing conditions in the case of re-development. Such ordinances can be written to require implementation of best management practices to the maximum practical extent and guided by performance design standards. The State of Minnesota is currently working on standards for minimal impact design, recognizing the need for higher clean water performance goals.

The potential load reduction from implementing such an ordinance is dependent on the amount of development and re-development that occurs in the watershed and the level of controls required. Itasca County growth has been projected to be flat to 1 % annually based on the Itasca County Comprehensive Land Use Plan (June 2000) and the Economic Development Intelligence System 2009 Report.

Development in the watershed tributary to Jessie Lake will likely be lake-shore and riparian, as such, ordinances can be tailored towards riparian land uses. Such an ordinance is in line with the Itasca County Comprehensive Development Plan in terms of the goals set with respect to natural resources and lakeshore development. The target load reduction for such an ordinance is 1% (~16 lbs/year).

The steps entailed in administering such a program include developing rules on a county level and running the permit program. Costs include staff time to manage development applications and review and approve or deny those applications and guide developers to performance design standards in low-impact development practices. Funding is required on an annual basis and costs are dictated by development. Additional county board time is typically required to grant formal approval.

Assuming additional staff time is needed to administer the program, work with the board to develop the rules, the initial start up cost is estimated to be $20,000 to develop rules and design standards. Several existing rules and standards of design are available, it is just a matter of Itasca SWCD selecting those appropriate to the Jessie Lake watershed.

Annual costs will vary depending on permit requests, but can likely be offset by permit fees to a large extent. Assuming 1 property will redevelop per year, the cost per pound of phosphorus removal for a 10 year cumulative removal is $278/ lb.

3.5.2.3 Lakeshore and Riparian Buffers

Lakeshore, wetland and stream riparian corridor buffers can improve water quality by reducing nutrient runoff and soil erosion along the riparian zones. Ice, wind, waves and fluctuating water levels damage shoreland areas and cause erosion. Uniformly graded areas of deep rooted, dense vegetation reduce erosion as well as the nutrient loads to lakes and streams from runoff by slowing runoff velocities and trapping sediment and other pollutants and providing some infiltration. They are used to treat sheet flow off agricultural lands as well as flow entering lakes and streams and prevent shoreland erosion. A typical lake or stream buffer zone ranges from 15 to 100 feet with corresponding removal efficiencies for phosphorus for appropriately designed and maintained buffers of 50 to 70% (Met Council 2000).

Itasca SWCD currently offers technical support for homeowners to install native shoreland plants in lakeshore areas. This program should be expanded to maximize installation of such buffers along the shoreland of Jessie Lake as well as along streams and wetlands tributary to the area. Buffers can also be effective to reduce impacts of logging, and agriculture.

A program should be formalized to provide design and adopt performance standards for buffer strips and native lakeshore buffers and offer an appropriate level of matching funds to incentivize installation. This funding should be over and above what is already available through BWSR, and the Itasca SWCD. Local stakeholder input can be useful to gauge the necessary level of grant funding.

Jessie Lake consists of approximately 9.2 miles of shoreline (48,576 lineal feet). 65% (31,574 lineal feet) of the shoreline is privately owned. To achieve water quality goals, a target for installation of native buffers along 30% (9,472 lineal feet) of the privately owned shoreline for Jessie Lake yields a removal of 60 lbs/ year. This is based on a 30-foot buffer with a design standard of 60% phosphorus removal. This is about 38 % of the needed watershed load reduction. This is about 6.5 acres of lakeshore buffer in all, targeting 40 of the 96 properties would achieve the goal with a considerable margin of safety, providing more than the estimated 60 lbs/ year.

Individual lake shore buffers typically range from $30 to $50 per lineal foot for a 30-foot wide buffer. To implement lakeshore buffers along the estimated length of shoreline lacking natural vegetation, the installation cost would be approximately $285,000 to $475,000 total. Targeting 4 lakeshore properties per year over a 10 year period and considering the cumulative phosphorus removal over that period, the total cost per pound of phosphorus removed (based on an average removal per site) will likely be on the order of $1,300 per pound not including annual maintenance. With landowners providing a 50 to 75% match, the costs will be $330 to $660/ lb of P removed.

Factoring in existing available grants and technical assistance from the SWCD or NRCS office for design and consultation, the cost per pound will be less than reported above.

The most effective use of buffers will be to target the watersheds that drain directly to Little Spring Lake and Jessie Lake. To be conservative in our estimation, only lakeshore property was used to calculate a potential load reduction, but as stated above, agricultural and logged forest land should also be targeted for installation of buffers.

3.5.2.4 Little Spring Lake Improvements

Nutrient load reductions to the Little Spring Lake, upstream of Jessie Lake may provide a small level of nutrient load reduction due to the reduction of loading to Spring Creek. Reducing in-lake phosphorus concentrations in Little Spring Lake to 30 µg/L may reduce loads to Jessie Lake by 137 lbs annually. Because Little Spring Lake is a shallow lake with a small tributary watershed, it is critical to assess, through additional study of Little Spring Lake, if such an in-lake concentration is achievable. In any case, achieving such a load reduction for Little Spring Lake would likely require a combination of internal and external load reductions. To best guide these efforts additional study is necessary. Upstream lake improvements are likely to be costly given the necessity of additionally study.

3.5.2.5 Forestry BMPs

There are several forestry BMPs which could potentially be implemented to improve water quality in Jessie Lake:

- Pre-Harvest Planning
- Streamside Management

- Forest Wetlands Protection
- Road Construction and Maintenance
- Timber Harvesting
- Revegetation
- Fire Management
- Forest Chemical Management

However, there is an ongoing debate over the future of boreal forest management (such as those found in Itasca County) in the face of climate change. Strategies to preserve the boreal forests include:

> <u>Resistance</u>: holding onto the current boreal tree species
> <u>Resilience</u>: silvicultural practices include planting various native tree species and partial timber harvesting to leave older trees in place.
> <u>Facilitation</u>: moving tree species to entire new ranges where they don't grow today.

Ecologists don't agree on which method(s) will preserve the boreal forest of Minnesota's north woods. In light of the current ecological debate, the future of boreal forest management is unclear. Therefore, it would be difficult recommend on a course for forestry BMPs to improve the water quality of Jessie Lake in the context of this report. However, it is recommended that as part of implementation of the Jessie Lake TMDL, the Itasca SWCD seek to continue the partnership with the US Forest Service and other private landownders to ensure that water quality protection remains a topic of consideration among land owners.

3.5.2.6 Riparian Stream Restorations

Past evaluations of Jessie Lake have identified stream erosion primarily in the NW Inlet and Poole's Creek. Large scale erosion events can deliver sediment and nutrient loads the stream.

Riparian stream restoration uses native vegetation, and other bioengineering methods to reduce nutrient runoff and soil erosion. Restoration of the entire NW Inlet and Poole's Creek is not economically feasible, and may not be necessary. To stabilize these channels with limited funding, it will be necessary to prioritize areas for restoration.

It is advisable to perform baseline evaluation and periodic monitoring to assess stream stability to prioritize areas for restoration and avoid downstream impacts. The Wisconsin Method is a basic low-cost but highly-effective method for evaluating rescission rates, which can be tied into the TMDL and load reduction scenarios. Anthropogenic vs. natural stream rescission should be determined as well. Riparian stream restorations are typically tied more to turbidity TMDLs and biotic impairments. To better quantify the impact of stream bank failures and anthropogenic erosion, biologically available soil P content and rescission rates should be evaluated to quantify the actual annual load to Jessie Lake. It is also important, then, to add a parameter such as TSS and/or turbidity to the stream monitoring. A small portion of the stream load from occasional stream bank failures that occur between the monitoring station and the lake (several hundred feet) may not be represented in the overall load from these lakes. An added benefit of conducting riparian or channel restorations is the creation of additional fisheries habitat that can be used by fish populations from the main lake.

Conventional wisdom suggests that about 40% of sediment loadings in highly unstable stream channels is derived from bed load or in-stream sources. If we assume conservatively that, based on reported erosion in NW Inlet and Poole's Creek, 30% of the phosphorous load in these streams is also from in-stream sources, we can make some calculations about the costs and benefits of stream restoration.

To avoid overestimating the potential mitigation from stream bank restoration, conservative values were used to calculate the potential load removed and benefit. For example, if you assume 30% of stream phosphorus loading is attributed to in-stream sources for NW Inlet and Poole's Creek, that translates into 188 lbs/ year from in-stream sources in NW Inlet and Poole's Creek. An initial target of 20% of the channel length is recommended for restoration. Assuming that, because of initial assessments of high priority areas you can mitigate for at least 20% of that in-stream phosphorus sources, you will achieve a 38 lb phosphorus reduction annually. Staging construction over 10 years, and incorporating the costs for assessment and design, and assuming channel restoration is $150/ lineal foot, the cost per pound of phosphorus removed over 10 years is $423/ lb.

Riparian stream restorations can range from $50 to $200 per lineal foot. Grants are typically available for such work but often require staff time for grant preparation and sometimes matching funds. As stated above initial channel assessments, prioritization of restoration sites, and design will be necessary.

3.5.2.7 Summary of External Load Reduction Scenarios:

Table 3.6 summarizes the estimated TP load reductions for the practices discussed above.

Table 3.6: External Load Reduction BMP Phosphorus Removal

Proposed BMP	Lbs removed (lb/yr)	Target Watershed Load Removal (lbs)	Comments
Septic System Inspection and Replacement	103	103	
No net P increase ordinance	16	158	Depends on development/ re-development rates
Lakeshore buffers	60		
Upstream Lake Improvements	137		Requires further study
Forestry BMPs	--		Currently under debate
Riparian Stream Restorations	38		
Totals	354	261	93 pound or 8% MOS

Although it is indicated that implementation of the above practices would decrease the watershed load contribution by 8% more than required under the TMDL, actual phosphorus load reductions would be highly variably and so providing for such a Margin of Safety in terms of implementation is critical. Further, not all the strategies may be fully successful as they hinge on available funding and landowner participation.

3.6 SCENARIO COST AND ECONOMIC CONSIDERATIONS

The recommended scenario is to employ a combination of in lake and watershed load reductions to meet the TMDL load reduction goal of 1,220 lbs/ year. Recommended BMPs include:

- Alum treatment over 40 percent of littoral zone. This provides a 40% internal load reduction.
- Septic system inspections and upgrades for all failing systems. Fund inspection and provide $5,000 grant, piggy back on low-interest loans already available.
- Development and redevelopment ordinance to reduce P runoff
- Cost share & technical assistance to add over 9,000 lineal feet of buffers on both Jessie Lake shoreland and upland agricultural and forested areas
- Little Spring Lake Feasibility study and improvements
- Assess NW Inlet and Poole’s Creek to prioritize erosion areas, and seek to restore or 4,200 lineal feet of channel

Table 3.7 provides a summary of the total cost and cost per pound of phosphorus removed associated with each load reduction strategy.

Table 3.7: Load Reduction Strategy Cost Estimates

Source	Implementation Strategy	Target P Removal (lbs/yr)	Unit Cost	Qty	Cost	Cost/lb removed over 10 years
Internal Load	Alum Treatment	959	--	--	$508,000	$35 (15 year cycle)
Septics	Inspect and Replace Septic Systems	103	Proposed $5,000 match ea plus $38,000 for inspections	40	$238,000	$514
Watershed	No net P increase ordinance	16	--	--	$20,000 startup, application fees fund review	$278
	Lakeshore Buffers	60	$30 to 50 /L.F. for 30' wide buffer	9,472	$287,000 to $457,000	$330 to $660
	Upstream Lake Improvements	137	--	--	$460,000	$336
	Forestry BMPs		--	--	--	--
	Riparian Stream Restorations	38	Restoration: $150/lf Field Assessment &Matthiesen Rapid Design: $87,200	4,200	$717,000	$423
Totals:		1,313 (1,220 is goal)			$1.7 to 1.9 m	

As stated above, conservative design of the watershed implementation provides an 8% Margin of Safety, in other words the recommended plan reduces phosphorus by 93 pounds more than required in the 1,220 load reduction. To increase the Margin of Safety more, the most cost effective approach is to increase the treatment area for the alum treatment. It is possible to achieve the TMDL goal by alum treatment alone should the stakeholders choose that route, the associated capital cost is $1.25 M compared with costs of watershed implementation that range from $1.7 to $1.9 M.

4.0 Implementation Priorities, Schedule & Measurable Milestones

Implementation of this load reduction plan is presented in this section. The timeline is incumbent on several factors including the availability of funding, the method of control selected for internal load reduction and associated permit lead time, willingness of stakeholders to implement (specifically for internal load reduction strategies), and the pace of development and re-development in the watershed. Implementation will begin within one calendar year of final approval of the TMDL and Watershed Protection and Restoration Plan (Implementation Plan). The schedules presented here are based estimated approval times, and the recommended course of implementation which is to focus first on watershed based approaches, while continuing to determine the feasibility of internal load reduction..

4.1 IMPLEMENTATION PRIORITIES

In implementing Watershed Protection and Restoration Plans (TMDL Implementation Plans) it is critical to identify priorities for funding and staff time. These limited resources require identification and selection of BMPs that will have the most “bang for the buck”. The priorities for this the Jessie Lake Watershed Protection and Restoration are three fold and address the process, the high-priority locations for implementation, and finally name specific BMPs (how, where and what).

For the Jessie Lake Watershed Protection and Restoration Plan, the first priority is to adhere to the framework for adaptive management presented herein. This is because management goals, technology and available resources will continue to shift, and as such the plans and recommendations must be evaluated in the context of the current situation, preferably annually in light of new data collected. Placing the first priority on following the framework of adaptive management recognizes that the specific goals and priorities of this plan may shift as new information is collected and that is by design.

The second priority is the location of BMPs implemented: Implementation of BMPs will be more effective in riparian areas where phosphorus is mobilized and transported to adjacent waters and eventually into Jessie Lake. Specifically, riparian buffers, septic system rehabs and riparian development/ and redevelopment ordinances.

The third priority and most subject to future change is in reference to the specific management strategies prioritized: BMPs that manage external loads through development/ re-development ordinances and requirements will likely result in the highest load reductions per cost. This is because costs can be incorporated into redevelopment rather than raised as capital expenditures. This is not to say this will add to the cost of redevelopment, often lower impact developments can be less costly than those with higher impacts. Focusing on these types of BMPs will reduce the impacts of development in the watershed and reduce loads to the lakes. It also provides an opportunity to work with land owners.

4.2 INTERNAL LOAD REDUCTION STRATEGIES AND SCHEDULE

The process to manage internal load begins with selection of the internal load reduction strategy. An approach favorable to stakeholders is essential, to that end, the existing TAC will be re-convened to evaluate this report and select the appropriate measure(s) to control internal load. The TAC, led by Itasca SWCD will then finalize design based on selected approach, secure the necessary permits, and implement the selected approach.

The schedule for implementation will depend on the date the TMDL and Implementation plans are approved, the method chosen to mitigate for internal loading, available funding and landowner support. Table 4.1 presents a tentative schedule based on the finds of this report, actual start dates will vary based on the above elements:

Table 4.1 Internal Load Management Schedule, Milestones

Milestone	Responsible Party	Expected Duration	Anticipated Start Date	Anticipated Completion Date
1. Convene TAC	Itasca SWCD	3 Months	Sept 2010	November 2010
2. Select Internal Load Management Strategy	TAC- 3 Meetings	3 Months	November 2010	February 2011
3. Finalize Design/ Permitting/ Funding requests	Itasca SWCD	18 Months	February 2011	August 2012
4. Implement Strategy	Itasca SWCD	--	August 2012	--
5. Monitor effectiveness	Itasca SCWD	10 years (all approaches)	2013	

Task 3 of the above will include additional data collection as detailed in the monitoring section, and a final design, plans, specs and bidding. In terms of Milestones to gauge effectiveness, each task can be evaluated simply based on weather or not it was achieved. The timing of the tasks can be updated as part of the Itasca SWCDs annual monitoring reports.

Once the selected internal load management strategy is implemented, Task 5, Monitor

Effectiveness, will depend on the approach selected. In lake measurement will gauge the effectiveness annually. Results will be reported annually.

This report shows the most cost effective internal load management strategy is alum treatment. If this alternative is chosen, monitoring done in the first year should reveal the initial effectiveness of the treatment. On-going monitoring will track the need for future applications.

4.3 EXTERNAL LOAD REDUCTION STRATEGIES, SCHEDULE & MILESTONES

External load reduction BMPs will be implemented over the next 10 years as funding is available, and as land owners participate in the programs. Establishing the programs should be completed within the next 1 to 2 years.

The external load reduction strategies are listed below as measurable milestones which should be reported on annually. The table may be updated to reflect the progress towards strategies, which may be that they are expanded because they are demonstrated to be highly effective, or abandoned because they are not implementable/ effective.

Strategy/ Milestone	Date Achieved/ Quantity Achieved
Adopting development and redevelopment ordinance (Target 2011)	
Acres of land subject to phosphorus reductions due to development and redevelopment ordinance (Target 1/ year, depends on development)	
Completion of stream assessment and design (Target 2012)	
Miles of stream bank restored (Target 420 lf/ year, probably 2 projects)	
Secure funding for lakeshore matching grants (Target 2011)	
Report annually number of lakeshore buffers and acreage in buffers (Target 4 parcels/ year)	
Secure funding for septic system inspections (Target 2011)	
Perform septic system inspections (Target 2012)	
Secure matching grants for septic system replacements (Apply in 2010)	
Number of septic systems replaced per year (target is 4/ year)	
Feasibility study for Little Spring Lake (Target begin January 2012)	
Improvements and load reductions to Little Spring Lake (Target begin January 2013)	
Annual communication with forestry managers to discuss water quality impacts of landuse (Convene TAC)	

5.0 Monitoring

The Itasca SWCD measures lake water quality annually. This monitoring will continue and along with some recommended additions will be sufficient to track significant water quality trends, assess progress towards goals and make adjustments towards adaptive management. The recommended monitoring plan and adaptive management framework is listed below:

- Monitor lake water quality annually on a monthly basis.

- Assess monitoring data annually and report findings in Annual Monitoring Report. The report should list TMDL implementation activities evaluate progress towards goals and make recommendations towards course corrections in terms of monitoring and implementation annually. This is the framework for adaptive management.

- In addition to baseline lake water quality data, add special monitoring to track progress of implementation strategies. Assess special monitoring needs annually based on implementation projects underway, report findings the Annual Monitoring Report. For example, if watershed loading is targeted, watershed loads should be measured.

- Install a continuous pressure transducer at the Jessie Brook to measure flows and track annual runoff.

- Monitor groundwater elevations to gauge direct inflow to lake. Explore measurement of phosphorus concentrations of groundwater in area wells.
- Field verify watershed boundaries.
- Add gauging and sampling for watershed tributaries.
- Increase frequency of lake DO and temperature profiles to better characterize annual anoxic factor.
- Characterize the conditions of lakes within the Chippewa Sand Plains to assess the validity of the standard and endpoint.
- Consider implementation of Little Spring Lake Monitoring for Feasibility Study