Little Saint Germain Lake

Vilas County, Wisconsin

Lake Management Plan

March 2008

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Funded by: Little Saint Germain Lake Protection and Rehabilitation District.
Wisconsin Dept. of Natural Resources
Aquatic Invasive Species ALPT-008-04

Acknowledgements

This management planning effort was truly a team-based project and could not have been completed without the input of the following individuals:

Little Saint Germain Lake Protection and Rehabilitation District

Ted Ritter	Mark Hiller
Lou Mirek	John Manki
Tom Best	Mary Platner
Bob Foley	Todd Wiese

Wisconsin Dept. of Natural Resources

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Great Lakes Indian Fish and Wildlife Commission

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TABLE OF CONTENTS

FIGURES

TABLES

MAPS

APPENDICES

1.0 INTRODUCTION

Little Saint Germain Lake, Vilas County (Map 1), comprises five main basins (Lower East Bay, East Bay, No Fish Bay, West Bay and South Bay) with a surface area of 980 acres. The water level of Little Saint Germain Lake is held approximately 5 feet higher than its natural level by a dam that is maintained by the Wisconsin Valley Improvement Company (WVIC). The WVIC uses the lake as a storage impoundment, where each winter it releases about 1.5 feet of water height for use in hydroelectric power generation. Little Saint Germain Lake empties into the Wisconsin River via Little Saint Germain Creek which flows out of the lake's South Bay.

Like many lakes in northern Wisconsin, invasive species establishment threatens the health and beauty of the ecosystem. Little Saint Germain Lake is known to harbor Eurasian water milfoil and curly-leaf pondweed, and on its shores, purple loosestrife. In 2004, the Town of Saint Germain initiated the creation of an Aquatic Plant Management Plan for 8 of the town's lakes which included Little Saint Germain Lake. At the same time, the Wisconsin Department of Natural Resources (WDNR) was drafting a document which later received the title, Aquatic Plant Management in Wisconsin. This guidance document was intended to assure that our public waterways were being managed in a holistic manner intended to maintain our lakes as healthy ecosystems for current and future generations to enjoy – not just the select few who own property on them.

During the creation of the guidance document, the authors began understanding the need for consistency in data collection to insure that the baseline data collected could be replicated at a later date to determine if changes were occurring within the system. Initially, a plot-on-transect method was to be used to collect aquatic plant data for the eight Town of Saint Germain project lakes. However, a new method using a grid of evenly spaced sample locations covering the entire lake was emerging. This *point-intercept* method was adopted for Little Saint Germain Lake because managers knew that large-scale management actions aimed at aquatic invasive species (AIS) were likely to occur on the system in the future.

In early 2005, the Little Saint Germain Lake Protection and Rehabilitation District (LSGLPRD) successfully applied for a WDNR AIS grant to aid in the control of Eurasian water milfoil and curly-leaf pondweed within the lake. After the grant was awarded, Onterra was contracted to locate and map the AIS and setup the treatments. During the course of this multi-year project, the scope of the project morphed into monitoring the treatments to determine effectiveness.

In 2009, the five year control project on Little Saint Germain Lake will come to an end. The WDNR requested that the LSGLPRD complete an aquatic plant management (APM) plan using the latest version of the guidance document before lake management actions involving chemical treatments or harvesting activities commence in 2009.

The primary objective of the APM plan is to provide a clear and rational strategy for the LSGLPRD to utilize in the management of Little Saint Germain Lake aquatic plant community. The development of a plan also leads to consistency within the waterbody in regard to manipulations of the system. The cumulative impact of many property owners managing the shorelands and littoral area adjacent to their property can disrupt the system and habitat value to the point that the entire lake may be damaged.

This document includes information surpassing just that concerning aquatic plants and their management on Little Saint Germain Lake. Much of the vegetation data discussed within this document was collected during the district's AIS project discussed above, while information pertaining to water quality and the Little Saint Germain watershed were collected and/or developed by other entities, such as district volunteers, the United States Geological Survey (USGS), the WDNR, and Barr Engineering, Inc. (Barr). The document summarizes information from these sources and also directs the reader towards the original source for complete information.

2.0 STAKEHOLDER PARTICIPATION

Stakeholder participation is an important part of any management planning exercise. During this project, stakeholders were not only informed about the project and its results, but also introduced to important concepts in lake ecology. Stakeholders were also informed about how their use of the lake's shorelands and open water areas impact the lake. Stakeholder input regarding the development of this plan was obtained through communications and meetings with the LSGLPRD and via a stakeholder survey. A description of each stakeholder participation event can be found below, while supporting materials can be found in Appendix A.

Project Kick-off Meeting (Part of Town of Saint Germain APM Project)

On May 23, 2004, a project kick-off meeting was held in the Town of Saint Germain Community Center to introduce the project to the general public. The meeting was announced through multiple mediums, including, a special mailing to each property owner on the eight project lakes, newspaper articles, and radio announcements. The approximate 45 attendees were welcomed by Mr. Ted Ritter, Chair, Town of Saint Germain Lakes Committee and were informed about the events that led to the initiation of the project. Mr. Ritter's opening remarks were followed by a presentation given by Tim Hoyman that started with an educational component regarding the importance of aquatic vegetation and the affect non-native invasive plants may have on it and ending with a detailed description of the project including opportunities for stakeholders to be involved. Mr. Hoyman's presentation was followed by a question and answer session.

Stakeholder Survey

During June 2008, a six-page, 24-question survey was mailed to LSGLPRD members. Just less than 50% of the 418 surveys were returned and the results were entered into an Onterra-provided spreadsheet by LSGLPRD members. The data were summarized and analyzed by Onterra for use at the planning meeting and within the management plan. The full survey and results can be found in Appendix B, while discussion of those results is integrated within the appropriate sections of the management plan.

Planning Committee Meeting

On November 5, 2008 Tim Hoyman and Eddie Heath of Onterra met with 4 members of the LSGLPRD Planning Committee and Kevin Gauthier of the WDNR for a little over 3½ hours. All study components including, Eurasian water milfoil treatment results, aquatic plant inventories, and the stakeholder survey were presented and discussed. The control of invasive native and non-native aquatic plants was presented as the primary concerns of the planning committee.

Management Plan Review and Adoption Process

On December 1, 2008, a draft of the Little Saint Germain Lake Management Plan was supplied to the WDNR and the LSGPLRD Board of Commissioners for review. After the district's review, a formal response was provided to Onterra on December 19, 2008 (Appendix A).

During December 2008 and January 2009, Onterra worked closely with Ted Ritter and other LSGLPRD members to create a WDNR AIS Established Population Control Grant to carry out the implementation plan as it pertains to AIS control and monitoring on Little Saint Germain Lake. This project was partially funded during the February 1, 2009 grant cycle and the remaining funds needed to carry out the multi-year project were awarded during the following grant cycle (August 2009). As evidenced by the LSGLPRD project resolution for these AIS grants, the Board of Commissioners formally adopted this portion of the implementation plan.

Additional correspondence between members of the LSGLPRD and Onterra solidified other implementation plan components, including the mechanical harvesting plan, the inclusion of periodic residual herbicide testing, and increased stakeholder involvement.

The WDNR provided written comments to the draft management plan on June 15, 2009. After integration of WDNR and LSGLPRD comments, a second draft was provided to these entities in March 2010 and posted on the district's website (www.littlesaint.org) for review. The WDNR approved final report will be reviewed by the Board of Commissioners and a vote to adopt the management plan will be held during the September 2010 annual district meeting.

Project Wrap-up Meeting
Planned for summer 2010.

3.0 RESULTS & DISCUSSION

3.1 Lake Water Quality

Primer on Water Quality Data Analysis and Interpretation

Reporting of water quality assessment results can often be a difficult and ambiguous task. Foremost is that the assessment inherently calls for a baseline knowledge of lake chemistry and ecology. Many of the parameters assessed are part of a complicated cycle and each element may occur in many different forms within a lake. Furthermore, not all chemical attributes collected may have a direct bearing on the lake's ecology, but may be more useful as indicators of other problems. Finally, water quality values that may be considered poor for one lake may be considered good for another because judging water quality is often subjective. However, focusing on specific aspects or parameters that are important to lake ecology, comparing those values to similar lakes within the same region and historical data from the study lake provides an excellent method to evaluate the quality of a lake's water.

Many types of analysis are available for assessing the condition of a particular lake's water quality. In this document, the water quality analysis focuses upon attributes that are directly related to the ecology of the lake. In other words, the water quality that impacts and controls the fishery, plant production, and even the aesthetics of the lake are related here. Specific forms of water quality analysis are used to indicate not only the health of the lake, but also to provide a general understanding of the lake's ecology and assist in management decisions. Each type of available analysis is elaborated on below.

Water quality information is also included within a USGS report (USGS 2000) and a proposal created by Barr for the treatment of Little Saint Germain Lake using aluminum sulfate (Barr 2009). These documents are contained in Appendices F and G, respectively. As appropriate, the results and discussion are referred to within in this document.

Comparisons with Other Datasets

As mentioned above, chemistry is a large part of water quality analysis. In most cases, listing the values of specific parameters really does not lead to an understanding of a lake's water quality, especially in the minds of non-professionals. A better way of relating the information is to compare it to similar lakes in the area. In this document, a portion of the water quality information collected in Little Saint Germain Lake is compared to other lakes in the region and state. In addition, the assessment can also be clarified by limiting the primary analysis to parameters that are important in the lake's ecology and trophic state (see below). Three water quality parameters are focused upon in the Little Saint Germain Lake water quality analysis:

> **Phosphorus** is the nutrient that controls the growth of plants in the vast majority of Wisconsin lakes. It is important to remember that in lakes, the term "plants" includes both *algae* and *macrophytes*. Monitoring and evaluating concentrations of phosphorus within the lake helps to create a better understanding of the current and potential growth rates of the plants within the lake.
>
> **Chlorophyll-*a*** is the green pigment in plants used during *photosynthesis*. Chlorophyll-*a* concentrations are directly related to the abundance of free-floating algae in the lake. Chlorophyll-*a* values increase during algal blooms.

Secchi disk transparency is a measurement of water clarity. Of all limnological parameters, it is the most used and the easiest for non-professionals to understand. Furthermore, measuring Secchi disk transparency over long periods of time is one of the best methods of monitoring the health of a lake. The measurement is conducted by lowering a weighted, 20-cm diameter disk with alternating black and white quadrates (a Secchi disk) into the water and recording the depth just before it disappears from sight.

The parameters described above are interrelated. Phosphorus controls algal abundance, which is measured by chlorophyll-*a* levels. Water clarity, as measured by Secchi disk transparency, is directly affected by the particulates that are suspended in the water. In the majority of natural Wisconsin lakes, the primary particulate matter is algae; therefore, algal abundance directly affects water clarity. In addition, studies have shown that water clarity is used by most lake users to judge water quality – clear water equals clean water (Canter et al. 1994, Dinius 2007, and Smith et al. 1991).

Lillie and Mason (1983) is an excellent source of data for comparing lakes within specific regions of Wisconsin. They divided the state's lakes into five regions each having lakes of similar nature or apparent characteristics. Vilas County lakes are included within the study's Northeast region (Figure 3.1-1) and are among 243 lakes randomly sampled from the region that were analyzed for water clarity (Secchi disk), chlorophyll-*a*, and total phosphorus. These data along with data corresponding to statewide natural lake means and historic data from Little Saint Germain Lake are displayed in Figures 3.1-2 – 3.1-7. Please note that the data in these graphs represent values collected only during the summer months (June-August) from the deepest locations in Little Saint Germain Lake's four out of five named-bays; Lower East Bay, East Bay, South Bay, and West Bay (No Fish Bay is the fifth bay). Furthermore, the phosphorus and chlorophyll-a data represent only surface samples. Surface samples are used because they represent the depths at which algae grow and depths at which phosphorus levels are not greatly influenced by phosphorus being released from bottom sediments during periods of strong stratification (see discussion under Internal Nutrient Loading below).

Figure 3.1-1. Location of Little Saint Germain Lake within the regions utilized by Lillie and Mason (1983).

Apparent Water Quality Index

Water quality, like beauty, is often in the eye of the beholder. A person from southern Wisconsin that has not seen a northern lake may consider the water quality of their lake to be good if the bottom is visible in 4 feet of water. On the other hand, a person accustomed to seeing the bottom in 18 feet of water may be alarmed at the clarity found in the southern lake.

Lillie and Mason (1983) used the extensive data they compiled to create the *Apparent Water Quality Index* (WQI). They divided the phosphorus, chlorophyll-*a*, and clarity data of the state's lakes into ranked categories and assigned each a "quality" label from "Excellent" to "Very Poor". The categories were created based upon natural divisions in the dataset and upon their experience. As a result, using the WQI as an assessment tool is very much like comparing a particular lake's values to values from many other lakes in the state. However, the use of terms like, "Poor", "Fair", and "Good" bring about a better understanding of the results than just comparing averages or other statistical values between lakes. The WQI values corresponding to the phosphorus, chlorophyll-*a*, and Secchi disk values for Little Saint Germain Lake are displayed on Figures 3.1-2 – 3.1-7.

Trophic State

Total phosphorus, chlorophyll-*a*, and water clarity values are directly related to the *trophic state* of the lake. As nutrients, primarily phosphorus, accumulate within a lake, its productivity increases and the lake progresses through three trophic states: *oligotrophic*, *mesotrophic*, and finally *eutrophic*. Every lake will naturally progress through these states and under natural conditions (i.e. not influenced by the activities of humans) this progress can take tens of thousands of years. Unfortunately, human influence has accelerated this natural aging process in many Wisconsin lakes. Monitoring the trophic state of a lake gives stakeholders a method by which to gauge the productivity of their lake over time. Yet, classifying a lake into one of three trophic states often does not give clear indication of where a lake really exists in its trophic progression because each trophic state represents a range of productivity. Therefore, two lakes classified in the same trophic state can actually have very different levels of production. However, through the use of a *trophic state index* (TSI), an index number can be calculated using phosphorus, chlorophyll-*a*, and clarity values that represent the lake's position within the eutrophication process. This allows for a more clear understanding of the lake's trophic state while facilitating clearer long-term tracking.

Trophic states describe the lake's ability to produce plant matter (production) and include three continuous classifications: *Oligotrophic* lakes are the least productive lakes and are characterized by being deep, having cold water, and few plants. *Eutrophic* lakes are the most productive and normally have shallow depths, warm water, and high plant biomass. *Mesotrophic* lakes fall between these two categories.

Carlson (1977) presented a trophic state index that gained great acceptance among lake managers. Because Carlson developed his TSI equations on the basis of association among water clarity, chlorophyll-*a*, and total phosphorus values of a relatively small set of Minnesota Lakes, researchers from Wisconsin (Lillie et. al. 1993), developed a new set of relationships and equations based upon the data compiled in Lillie & Mason (1983). This resulted in the Wisconsin Trophic State Index (WTSI), which is essentially a TSI calibrated for Wisconsin lakes. The WTSI is used extensively by the WDNR and is reported along with lake data collected by Citizen Lake Monitoring Network volunteers.

Limiting Nutrient

The *limiting nutrient* is the nutrient which is in shortest supply and controls the growth rate of algae and some macrophytes within the lake. This is analogous to baking a cake that requires four eggs, and four cups each of water, flour, and sugar. If the baker would like to make four cakes, he needs 16 of each ingredient. If he is short two eggs, he will only be able to make three cakes even if he has sufficient amounts of the other ingredients. In this scenario, the eggs are the limiting nutrient (ingredient).

In most Wisconsin lakes, phosphorus is the limiting nutrient controlling the production of plant biomass. As a result, phosphorus is often the target for management actions aimed at controlling plants, especially algae. The limiting nutrient is determined by calculating the nitrogen to phosphorus ratio within the lake. Normally, total nitrogen and total phosphorus values from the surface samples taken during the summer months are used to determine the ratio. Results of this ratio indicate if algal growth within a lake is limited by nitrogen or phosphorus. If the ratio is greater than 15:1, the lake is considered phosphorus limited; if it is less than 10:1, it is considered nitrogen limited. Values between these ratios indicate a transitional limitation between nitrogen and phosphorus.

Temperature and Dissolved Oxygen Profiles

Temperature and dissolved oxygen profiles are created simply by taking readings at different water depths within a lake. Although it is a simple procedure, the completion of several profiles over the course of a year or more provides a great deal of information about the lake. Much of this information relates to whether the lake thermally stratifies or not, which is determined primarily through the temperature profiles. Lakes that show strong stratification during the summer and winter months need to be managed differently than lakes that do not. Normally, deep lakes stratify to some extent, while shallow lakes (less than 17 feet deep) do not.

Lake stratification occurs when temperature gradients are developed with depth in a lake. During stratification the lake can be broken into three layers: The *epiliminion* is the top layer of water which is the warmest water in the summer months and the coolest water in the winter months. The *hypolimnion* is the bottom layer and contains the coolest water in the summer months and the warmest water in the winter months. The *metalimnion*, often called the thermocline, is the middle layer containing the steepest temperature gradient.

Dissolved oxygen is essential in the metabolism of nearly every organism that exists within a lake. For instance, fishkills are often the result of insufficient amounts of dissolved oxygen. However, dissolved oxygen's role in lake management extends beyond this basic need by living organisms. In fact, its presence or absence impacts many chemical process that occur within a lake. Internal nutrient loading is an excellent example that is described below.

Internal Nutrient Loading In lakes that support stratification, the hypolimnion can become devoid of oxygen both in the water column and within the sediment. When this occurs, iron changes from a form that normally binds phosphorus within the sediment to a form that releases it to the overlaying water. This can result in very high concentrations of phosphorus in the hypolimnion. Then, during mixing events, these high concentrations of phosphorus are mixed within the lake and utilized by algae and some macrophytes. This cycle is termed "internal phosphorus loading"; a phenomenon that can support nuisance algae blooms decades after external sources are controlled.

Little Saint Germain Lake Water Quality Analysis

Little Saint Germain Lake Long-term Trends

Average growing season total phosphorus data collected from near-surface depths within Lower East Bay, East Bay, South Bay, and West Bay since 1996 are displayed in Figure 3.1-2. Similar data can be found in Appendix F (Figure 7) and Appendix G (Figures 3 and 4). Please note that in the USGS (2000) document (Appendix F), Lower East Bay is referred to as "Upper East Bay" (see Appendix F, Figure 2). Within this report, we follow the naming convention used by Barr (Appendix G, Figure 10) and the LSGLPRD.

In all bays, total phosphorus concentrations have fluctuated over the course of the dataset (Figure 3.1-2) with East and Lower East Bays exhibiting the highest average concentrations (Figure 3.1-3), followed by South Bay. West Bay, which is the deepest and voluminous of the four study bays, has the lowest average concentrations. West Bay is also the only bay that is not influenced by Muskellunge Creek, a major source of phosphorus to Little Saint Germain Lake as discussed by USGS researchers in Appendix F.

On a site-by-site basis, phosphorus concentrations from Lower East and East Bays tend to remain primarily in the "Poor" range of the WQI, especially since 2001. South Bay's concentrations fluctuate within the "Fair" range, and West Bay primarily holds within the "Good" range. The average data in Figure 3.1-3 demonstrate that with the exception of West Bay, all the bays have higher total phosphorus levels than those typically found in Wisconsin and Northeast Region lakes.

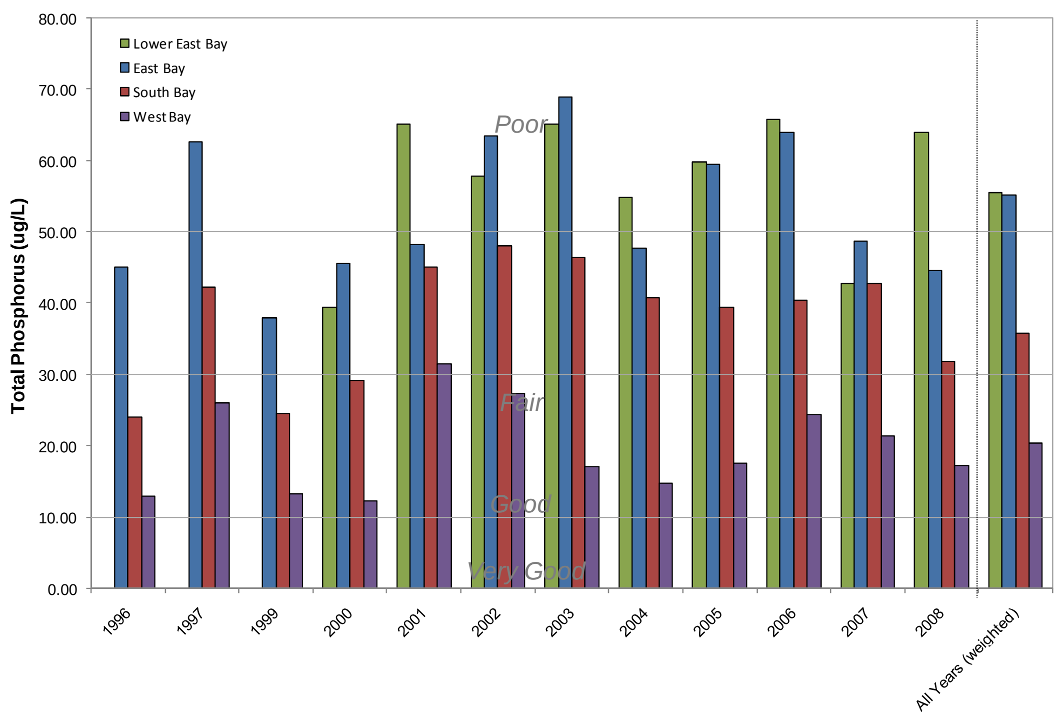

Figure 3.1-2. Little Saint Germain Lake average growing season total phosphorus concentrations. Mean values calculated with growing season surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

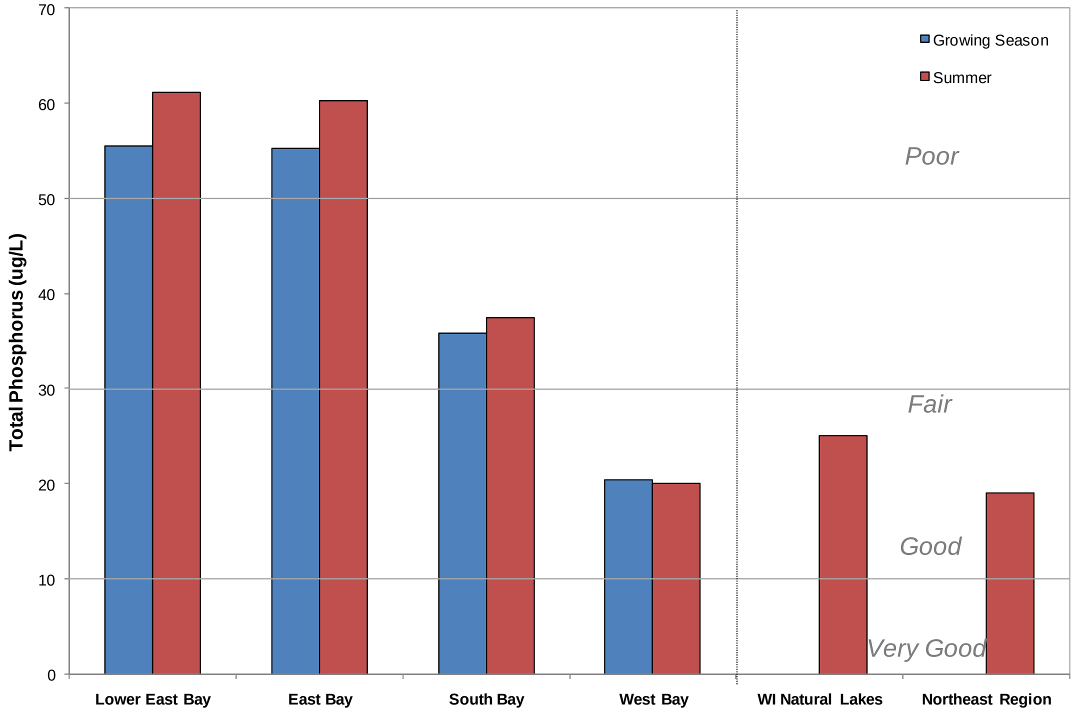

Figure 3.1-3. Little Saint Germain Lake regional, and state average total phosphorus concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

Chlorophyll-*a* values for the four sampled bays of Little Saint Germain Lake follow much the same pattern as found with the total phosphorus data. Growing season mean values (Figure 3.1-4) demonstrates how these values fluctuate over the years. Further, there appears to be an upward trend within South, East, and Lower East Bays when comparing data collected during and prior to 2001 to those collected following 2001. This trend is not apparent in the West Bay data. Concentrations in Lower East Bay, East Bay, and occasionally in South Bay are found to be in the “Very Poor” range, while West Bay’s values fluctuate between “Very Good” and “Fair”. As discussed in both the USGS (2000, Appendix F) report and the Barr (2009, Appendix G) proposal, there is obviously a direct relation between phosphorus levels and chlorophyll-*a* concentrations in each of these bays.

Figure 3.1-5 contains average chlorophyll-*a* values for each bay over the extent of the 1996-2008 dataset. As with the phosphorus data, Lower East Bay and East Bay values are much higher than those found among Wisconsin and Northeast Region lakes. South Bay’s values are slightly higher than those found within the state and region, while West Bay’s values are lower.

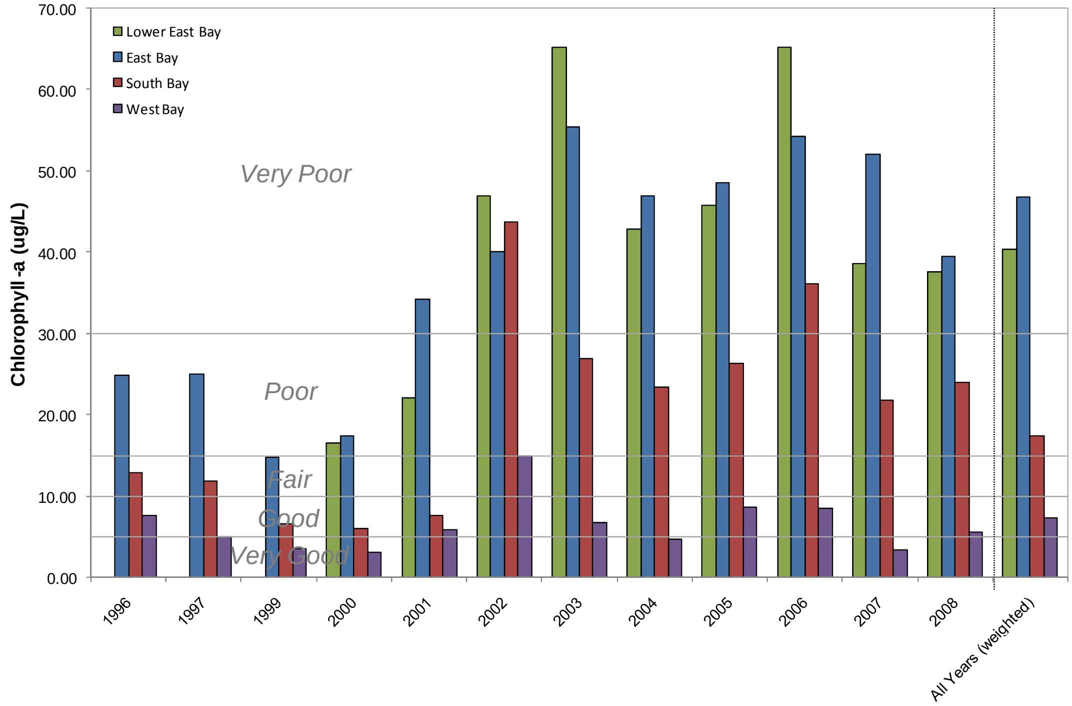

Figure 3.1-4. Little Saint Germain Lake average growing season chlorophyll-*a* concentrations. Mean values calculated with growing season surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

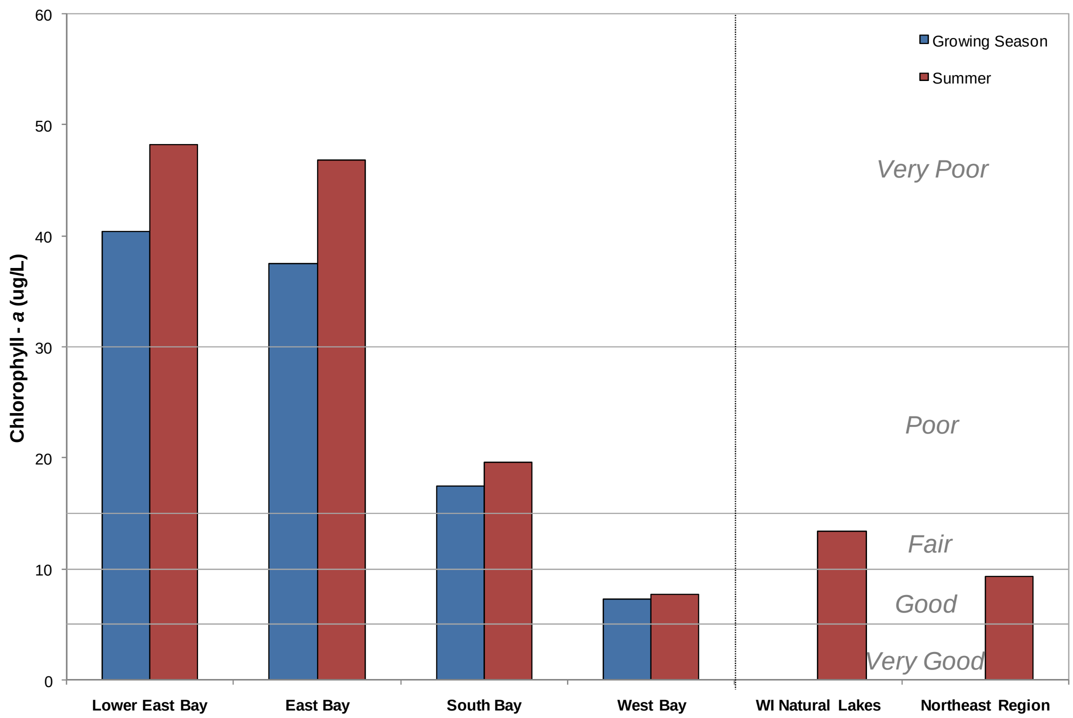

Figure 3.1-5. Little Saint Germain Lake regional, and state average chlorophyll-*a* concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

Secchi disk values, as discussed above, are highly related to chlorophyll-*a* values in Wisconsin lakes, so it is not surprising that water clarity values in Lower East, East, and South Bays tend to be much lower than those found in West Bay (Figure 3.1-6). Water clarity data for West Bay extends back to the early 1970's and the values appear to increase slightly between 1992 and 2004 only to reduce again starting in 2006. Limited information for South Bay also shows lowered values in 2003 and beyond compared to 2000 and 2001. Values for Lower East and East Bay have stayed low since 2003. Again values for West Bay are consistently "Good" to "Very Good" with the other Bays primarily occurring in the "Very Poor" to "Poor" range. As demonstrated in Figure 3.1-7, West Bay's values exceed those of the state and regional averages, while the remaining bays fall short.

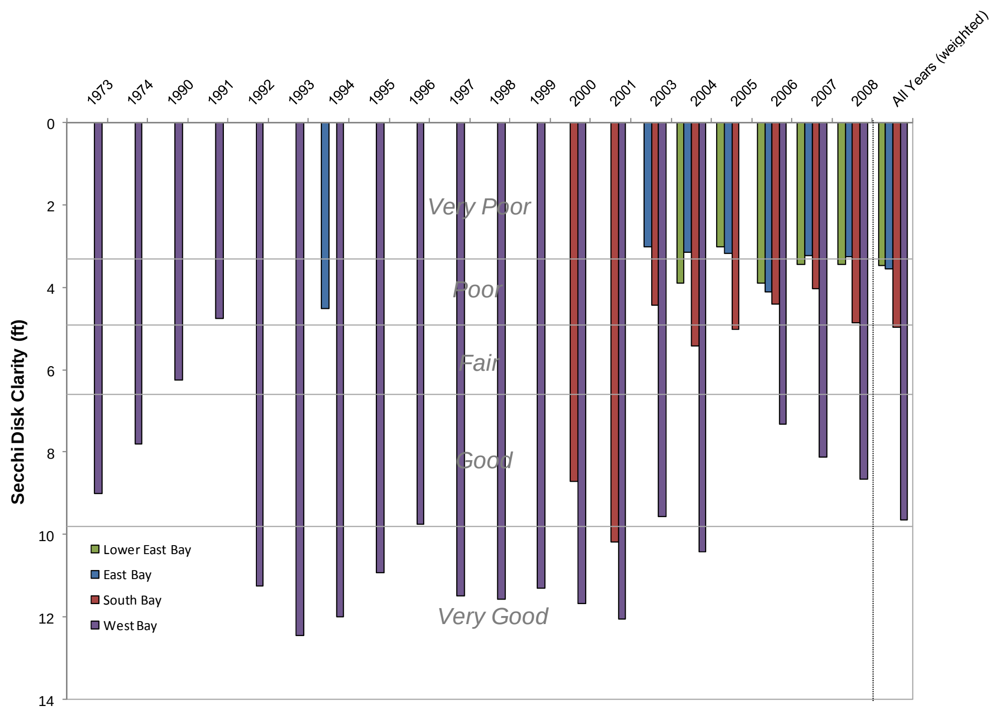

Figure 3.1-6. Little Saint Germain Lake average growing season Secchi disk depths. Mean values calculated with growing season surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

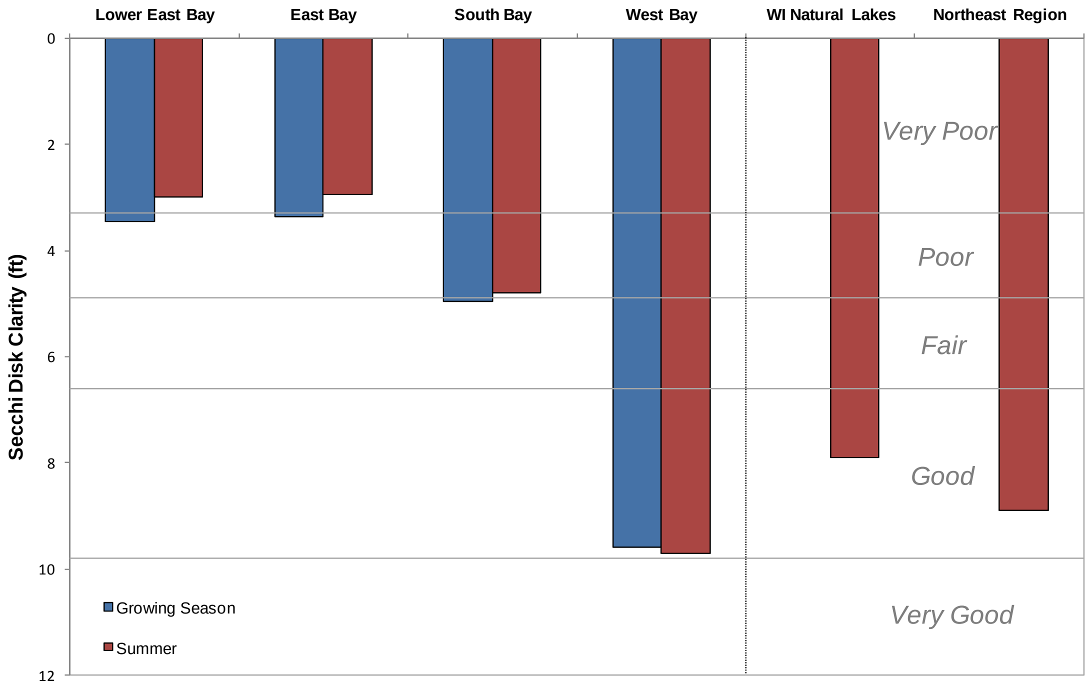

Figure 3.1-7. Little Saint Germain Lake regional, and state average Secchi disk depths. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

Limiting Plant Nutrient of Little Saint Germain Lake

Recent nitrogen data useable for calculating total nitrogen values are not available for Little Saint Germain Lake. As a result, total nitrogen to phosphorus ratios cannot be calculated and limiting plant nutrient determined. Studying this aspect of the lake may lead to interesting results because with the extreme levels of phosphorus found Lower East and East Bays, nitrogen may actually be the limiting nutrient, at least periodically.

Little Saint Germain Lake Trophic State

Figures 3.1-8 – 3.1-11 display WTSI values for the four sampled bays of Little Saint Germain Lake. The WTSI values were calculated with weighted average Secchi disk, chlorophyll-*a*, and total phosphorus values collected during the summer months. The WTSI values for West Bay (Figure 3.1-11), not surprisingly, are the lowest of the four bay with its values bordering on mesotrophic/eutrophic. South Bay's values (Figure 3.1-10) are solidly within the eutrophic range indicating the productive nature of the bay. Values of 60 or greater are generally accepted as hyper-eutrophic – the values for both Lower East Bay (Figure 3.1-8) and East Bay (Figure 3.1-9) border on that range. This fact is discussed within the Barr proposal (2009, Appendix G) and is supported with a great deal of convincing evidence.

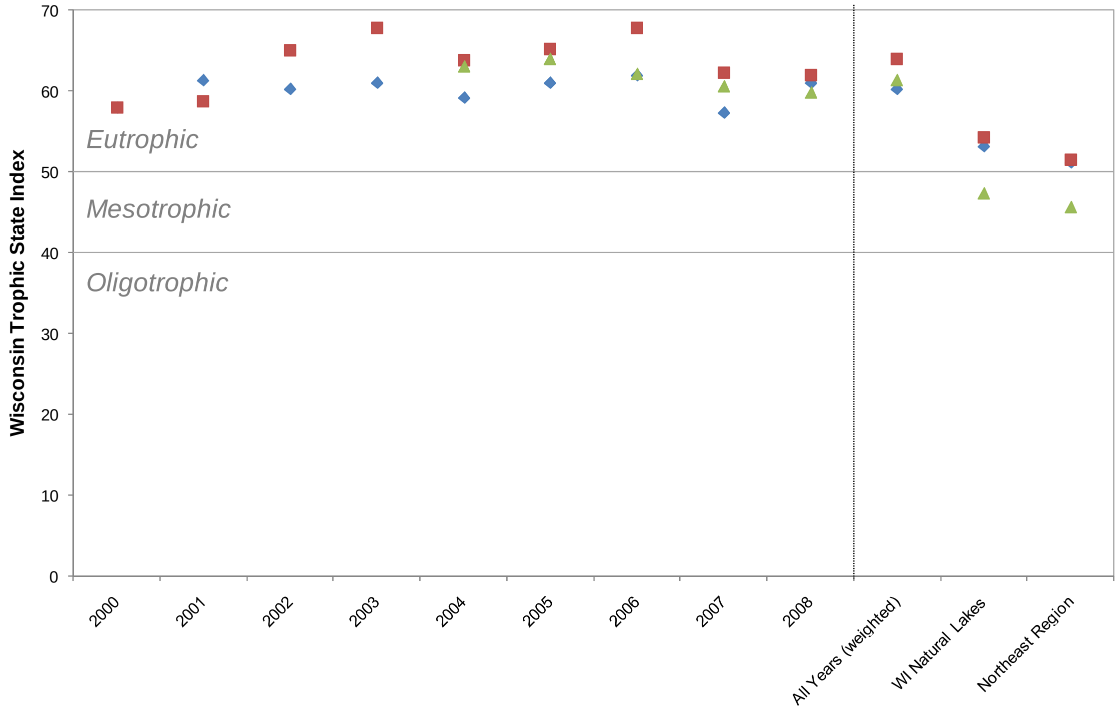

Figure 3.1-8. Lower East Bay, Little Saint Germain Lake, regional, and state Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using Lillie et al. (1993).

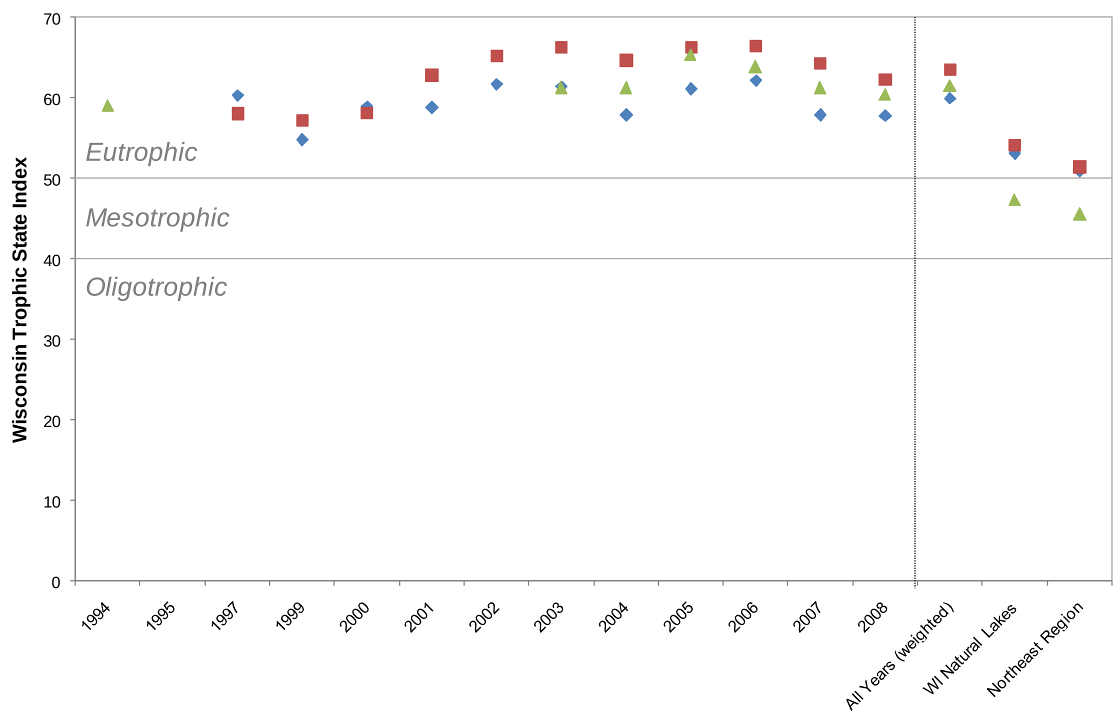

Figure 3.1-9. East Bay, Little Saint Germain Lake, regional, and state Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using Lillie et al. (1993).

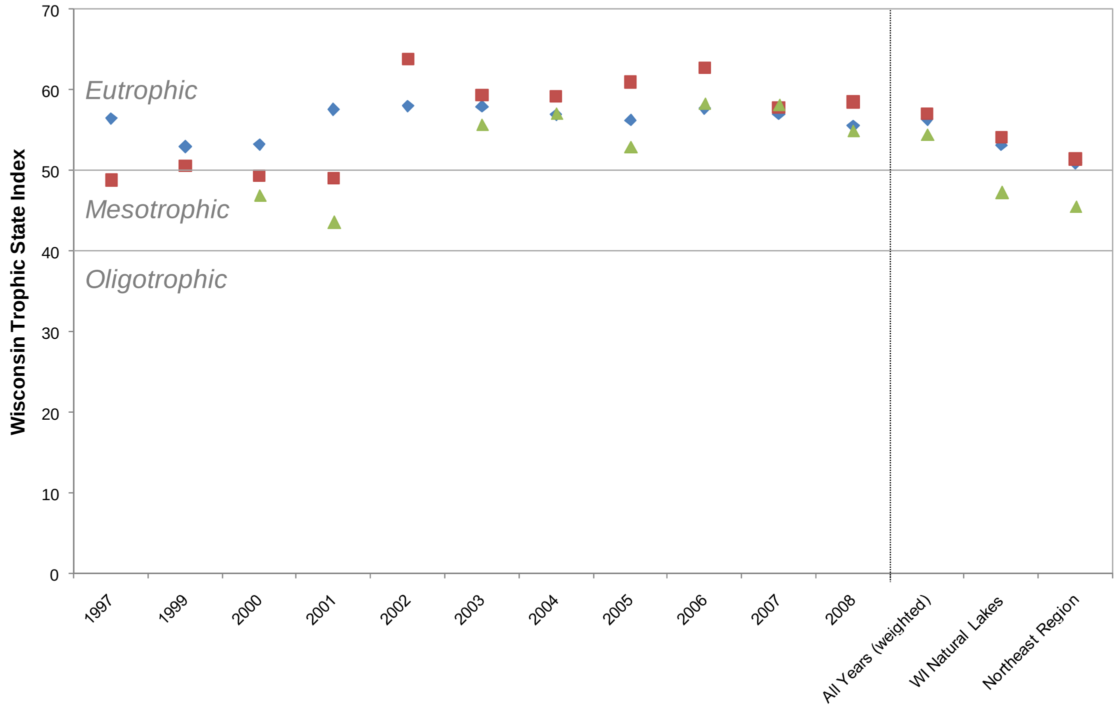

Figure 3.1-10. South Bay, Little Saint Germain Lake, regional, and state Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using Lillie et al. (1993).

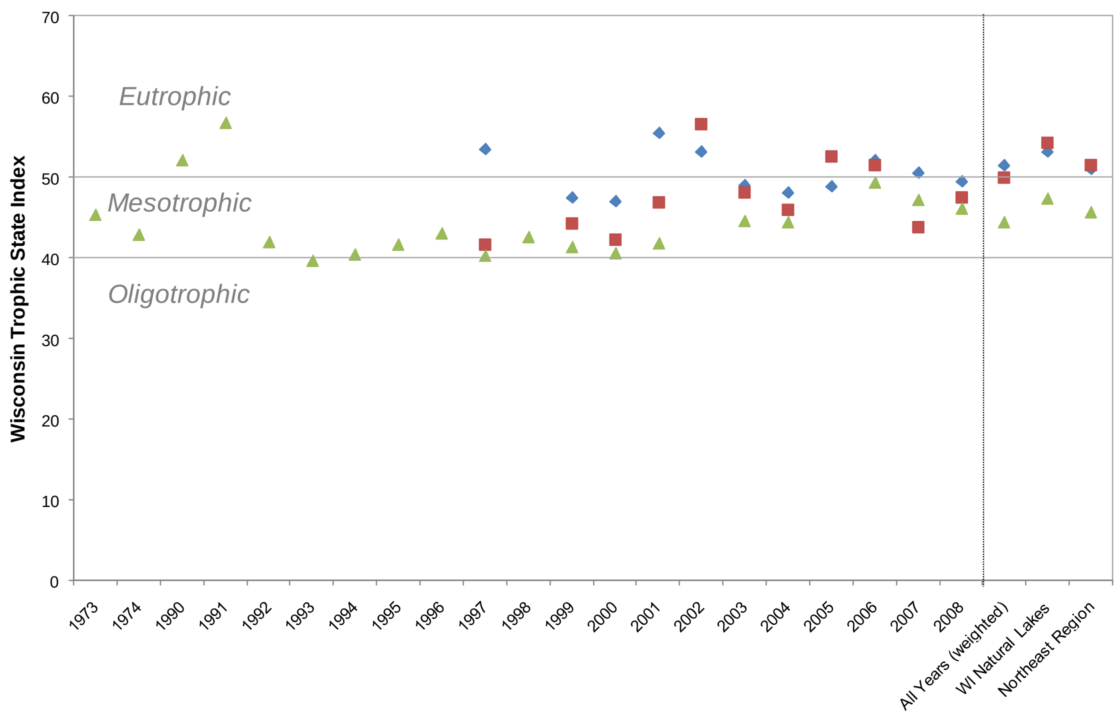

Figure 3.1-11. West Bay Little Saint Germain Lake, regional, and state Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using Lillie et al. (1993).

Dissolved Oxygen and Temperature in Little Saint Germain Lake

Dissolved oxygen and temperature are discussed at length in the Barr (2010) report, especially as they relate to internal loading within all four of the bays that have been discussed thus far. Dissolved oxygen is also discussed within USGS (2000, Appendix F), especially regarding the lack thereof in portions of the lake to the extent that fishkills had occurred frequently and spurred the LSGPRD to install an aeration system feeding to East and Lower East Bay in 2002 and 2003. Operation of the aeration system has prevented further winterkills from occurring.

Internal Nutrient Loading

Within the USGS report (2000, Appendix F), little mention is made of internal nutrient loading within Little Saint Germain Lake. In fact, internal nutrient loading is not considered a part of the lake's nutrient budget (Figure 5, Appendix F).

The Barr proposal (2009, Appendix G) considers internal nutrient loading to be significant within Lower East, East, South, and West Bays; however, due to the strong stratification that occurs within South and West Bays, the impacts of the internal loading in these two bays are minimized as the high concentrations of phosphorus from bottom water layers are only released during fall turnover. Portions of Lower East and East Bays, on the other hand, while not strongly stratified, are believed to intermittently mix throughout the summer (polymictic) and release high concentrations for phosphorus originating from bottom sediments to upper water layers. These high phosphorus concentrations then spur algal blooms which steady worsen over the summer.

3.2 Watershed Assessment

Little Saint Germain Lake's watershed is approximately 6,400 acres and predominately forest (68%), wetland (17%) and open water (8%) (USGS 2000, Appendix F). Figure 1 (Appendix F) displays Little Saint Germain Lake's watershed and land cover types. The primary tributary to Little Saint Germain Lake, Muskellunge Creek, flows from Muskellunge Lake, a shallow, eutrophic lake approximately 3 miles away. Studies conducted during 2009 found average summer total phosphorus values in Muskellunge Lake to be approximately 43 µg/l, which corresponds with a WTSI value of roughly 57 (see water quality section above). Studies completed by the WDNR (1985) found that the high total phosphorus values found in Muskellunge Lake, Muskellunge Creek, and Little Saint Germain's upper bays, originate from watershed soils which are naturally high in phosphorus content. The USGS (2000, Appendix F) found that Muskellunge Creek accounted for 53-61% of the Little Saint Germain Lake's incoming phosphorus load while ground water inflows made up between 35 and 39%.

3.3 Analysis of Aquatic Plant Data

Introduction

Although the occasional lake user considers aquatic macrophytes to be "weeds" and a nuisance to the recreational use of the lake, the plants are actually an essential element in a healthy and functioning lake ecosystem. It is very important that lake stakeholders understand the importance of lake plants and the many functions they serve in maintaining and protecting a lake ecosystem. With increased understanding and awareness, most lake users will recognize the importance of the aquatic plant community and their potential negative effects on it.

Diverse aquatic vegetation provides habitat and food for many kinds of aquatic life, including fish, insects, amphibians, waterfowl, and even terrestrial wildlife. For instance, wild celery (*Vallisneria americana)* and wild rice (*Zizania aquatica* and *Z. palustris*) both serve as excellent food sources for ducks and geese. Emergent stands of vegetation provide necessary spawning habitat for fish such as northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*) In addition, many of the insects that are eaten by young fish rely heavily on aquatic plants and the *periphyton* attached to them as their primary food source. The plants also provide cover for feeder fish and *zooplankton*, stabilizing the predator-prey relationships within the system. Furthermore, rooted aquatic plants prevent shoreline erosion and the resuspension of sediments and nutrients by absorbing wave energy and locking sediments within their root masses. In areas where plants do not exist, waves can resuspend bottom sediments decreasing water clarity and increasing plant nutrient levels that may lead to algae blooms. Lake plants also produce oxygen through photosynthesis and use nutrients that may otherwise be used by *phytoplankton*, which helps to minimize nuisance algal blooms.

Under certain conditions, a few species may become a problem and require control measures. Excessive plant growth can limit recreational use by deterring navigation, swimming, and fishing activities. It can also lead to changes in fish population structure by providing too much cover for feeder fish resulting in reduced numbers of predator fish and a stunted pan-fish population. *Exotic* plant species, such as Eurasian water-milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) can also upset the delicate balance of a lake ecosystem by out competing *native* plants and reducing *species diversity*. These *invasive* plant species can form dense stands that are a nuisance to humans and provide low-value habitat for fish and other wildlife.

When plant abundance negatively affects the lake ecosystem and limits the use of the resource, plant management and control may be necessary. The management goals should always include the control of invasive species and restoration of native communities through environmentally sensitive and economically feasible methods. No aquatic plant management plan should only contain methods to control plants, they should also contain methods on how to protect and possibly enhance the important plant communities within the lake. Unfortunately, the latter is often neglected and the ecosystem suffers as a result.

Aquatic Plant Management and Protection

Important Note:
Even though most of these techniques are not applicable to Little Saint Germain Lake, it is still important for lake users to have a basic understanding of all the techniques so they can better understand why particular methods are or are not applicable in their lake**.** The techniques applicable to Little Saint Germain Lake are discussed in Summary and Conclusions section and the Implementation Plan found near the end of this document.

Many times an aquatic plant management plan is aimed at only controlling nuisance plant growth that has limited the recreational use of the lake, usually navigation, fishing, and swimming. It is important to remember the vital benefits that native aquatic plants provide to lake users and the lake ecosystem, as described above. Therefore, all aquatic plant management plans also need to address the enhancement and protection of the aquatic plant community. Below are general descriptions of the many techniques that can be utilized to control and enhance aquatic plants. Each alternative has benefits and limitations that are explained in its description. Please note that only legal and commonly used methods are included. For instance, the herbivorous grass carp (*Ctenopharyngodon idella*) is illegal in Wisconsin and rotovation, a process by which the lake bottom is tilled, is not a commonly accepted practice. Unfortunately, there are no “silver bullets” that can completely cure all aquatic plant problems, which makes planning a crucial step in any aquatic plant management activity. Many of the plant management and protection techniques commonly used in Wisconsin are described below.

Permits

The signing of the 2001-2003 State Budget by Gov. McCallum enacted many aquatic plant management regulations. The rules for the regulations have been set forth by the WDNR as NR 107 and 109. A major change includes that all forms of aquatic plant management, even those that did not require a permit in the past, require a permit now, including manual and mechanical removal. Manual cutting and raking are exempt from the permit requirement if the area of plant removal is no more than 30 feet wide and any piers, boatlifts, swim rafts, and other recreational and water use devices are located within that 30 feet. This action can be conducted up to 150 feet from shore. Please note that a permit is needed in all instances if wild rice is to be removed. Furthermore, installation of aquatic plants, even natives, requires approval from the WDNR.

Permits are required for chemical and mechanical manipulation of native and non-native plant communities. Large-scale protocols have been established for chemical treatment projects covering >10 acres or areas greater than 10% of the lake littoral zone and more than 150 feet from shore. Different protocols are to be followed for whole-lake scale treatments (≥160 acres or ≥50% of the lake littoral area). Additionally, it is important to note that local permits and U.S. Army Corps of Engineers regulations may also apply. For more information on permit requirements, please contact the WDNR Regional Water Management Specialist or Aquatic Plant Management and Protection Specialist.

Native Species Enhancement

The development of Wisconsin's shorelands has increased dramatically over the last century and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects (Jennings et al. 2003). The maintenance of the newly created area helps to decrease water quality by considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreline. Removal of native plants and dead, fallen timbers from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving bottom and shoreline sediments vulnerable to wave action caused by boating and wind (Jennings et al. 2003, Radomski and Goeman 2001, and Elias & Meyer 2003). Many homeowners significantly decrease the number of trees and shrubs along the water's edge in an effort to increase their view of the lake (. However, this has been shown to locally increase water temperatures, and decrease infiltration rates of potentially harmful nutrients and pollutants. Furthermore, the dumping of sand to create beach areas destroys spawning, cover and feeding areas utilized by aquatic wildlife (Scheuerell and Schindler 2004).

In recent years, many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic its unaltered state. An area of shore restored to its natural condition, both in the water and on shore, is commonly called a *shoreland buffer zone.* The shoreland buffer zone creates or restores the ecological habitat and benefits lost by traditional suburban landscaping. Simply not mowing within the buffer zone does wonders to restore some of the shoreland's natural function.

Enhancement activities also include additions of *submergent*, *emergent*, and *floating-leaf* plants within the lake itself. These additions can provide greater species diversity and may compete against exotic species.

Cost

The cost of native, aquatic and shoreland plant restorations is highly variable and depend on the size of the restoration area, planting densities, the species planted, and the type of planting (e.g. seeds, bare-roots, plugs, live-stakes) being conducted. Other factors may include extensive grading requirements, removal of shoreland stabilization (e.g., rip-rap, seawall), and protective measures used to guard the newly planted area from wildlife predation, wave-action, and erosion. In general, a restoration project with the characteristics described below would have an estimated materials and supplies cost of approximately $4,200.

- The single site used for the estimate indicated above has the following characteristics:
    - An upland buffer zone measuring 35’ x 100’.
    - An aquatic zone with shallow-water and deep-water areas of 10’ x 100’ each.
    - Site is assumed to need little invasive species removal prior to restoration.
    - Site has a moderate slope.
    - Trees and shrubs would be planted at a density of 435 plants/acre and 1210 plants/acre, respectively.
    - Plant spacing for the aquatic zone would be 3 feet.
    - Each site would need 100’ of biolog to protect the bank toe and each site would need 100’ of wavebreak and goose netting to protect aquatic plantings.
    - Each site would need 100’ of erosion control fabric to protect plants and sediment near the shoreline (the remainder of the site would be mulched).
    - There is no hard-armor (rip-rap or seawall) that would need to be removed.
    - The property owner would maintain the site for weed control and watering.

Advantages	***Disadvantages***
• Improves the aquatic ecosystem through species diversification and habitat enhancement. • Assists native plant populations to compete with exotic species. • Increases natural aesthetics sought by many lake users. • Decreases sediment and nutrient loads entering the lake from developed properties. • Reduces bottom sediment re-suspension and shoreline erosion. • Lower cost when compared to rip-rap and seawalls. • Restoration projects can be completed in phases to spread out costs. • Many educational and volunteer opportunities are available with each project.	• Property owners need to be educated on the benefits of native plant restoration before they are willing to participate. • Stakeholders must be willing to wait 3-4 years for restoration areas to mature and fill-in. • Monitoring and maintenance are required to assure that newly planted areas will thrive. • Harsh environmental conditions (e.g., drought, intense storms) may partially or completely destroy project plantings before they become well established.

Manual Removal

Manual removal methods include hand-pulling, raking, and hand-cutting. Hand-pulling involves the manual removal of whole plants, including roots, from the area of concern and disposing them out of the waterbody. Raking entails the removal of partial and whole plants from the lake by dragging a rake with a rope tied to it through plant beds. Specially designed rakes are available from commercial sources or an asphalt rake can be used. Hand-cutting differs from the other two manual methods because the entire plant is not removed, rather the plants are cut similar to mowing a lawn; however Wisconsin law states that all plant fragments must be removed. One manual cutting technique involves throwing a specialized "V" shaped cutter into the plant bed and retrieving it with a rope. The raking method entails the use of a two-sided straight blade on a telescoping pole that is swiped back and forth at the base of the undesired plants.

In addition to the hand-cutting methods described above, powered cutters are now available for mounting on boats. Some are mounted in a similar fashion to electric trolling motors and offer a 4-foot cutting width, while larger models require complicated mounting procedures, but offer an 8-foot cutting width. Please note that the use of powered cutters may require a mechanical harvesting permit to be issued by the WDNR.

When using the methods outlined above, it is very important to remove all plant fragments from the lake to prevent re-rooting and drifting onshore followed by decomposition. It is also important to preserve fish spawning habitat by timing the treatment activities after spawning. In Wisconsin, a general rule would be to not start these activities until after June 15th.

Cost

Commercially available hand-cutters and rakes range in cost from $85 to $150. Power-cutters range in cost from $1,200 to $11,000.

Advantages	***Disadvantages***
• Very cost effective for clearing areas around docks, piers, and swimming areas. • Relatively environmentally safe if treatment is conducted after June 15th. • Allows for selective removal of undesirable plant species. • Provides immediate relief in localized area. • Plant biomass is removed from waterbody.	• Labor intensive. • Impractical for larger areas or dense plant beds. • Subsequent treatments may be needed as plants recolonize and/or continue to grow. • Uprooting of plants stirs bottom sediments making it difficult to conduct action. • May disturb *benthic* organisms and fish-spawning areas. • Risk of spreading invasive species if fragments are not removed.

Bottom Screens

Bottom screens are very much like landscaping fabric used to block weed growth in flowerbeds. The gas-permeable screen is placed over the plant bed and anchored to the lake bottom by staking or weights. Only gas-permeable screen can be used or large pockets of gas will form under the mat as the result of plant decomposition. This could lead to portions of the screen becoming detached from the lake bottom, creating a navigational hazard. Normally the screens are removed and cleaned at the end of the growing season and then placed back in the lake the following spring. If they are not removed, sediments may build up on them and allow for plant colonization on top of the screen.

Cost

Material costs range between $.20 and $1.25 per square-foot. Installation cost can vary largely, but may roughly cost $750 to have 1,000 square feet of bottom screen installed. Maintenance costs can also vary, but an estimate for a waterfront lot is about $120 each year.

Advantages	*Disadvantages*
• Immediate and sustainable control. • Long-term costs are low. • Excellent for small areas and around obstructions. • Materials are reusable. • Prevents fragmentation and subsequent spread of plants to other areas.	• Installation may be difficult over dense plant beds and in deep water. • Not species specific. • Disrupts benthic fauna. • May be navigational hazard in shallow water. • Initial costs are high. • Labor intensive due to the seasonal removal and reinstallation requirements. • Does not remove plant biomass from lake. • Not practical in large-scale situations.

Water Level Drawdown

The primary manner of plant control through water level drawdown is the exposure of sediments and plant roots/tubers to desiccation and either heating or freezing depending on the timing of the treatment. Winter drawdowns are more common in temperate climates like that of Wisconsin and usually occur in reservoirs because of the ease of water removal through the outlet structure. An important fact to remember when considering the use of this technique is that only certain species are controlled and that some species may even be enhanced. Furthermore, the process will likely need to be repeated every two or three years to keep target species in check.

Cost

The cost of this alternative is highly variable. If an outlet structure exists, the cost of lowering the water level would be minimal; however, if there is not an outlet, the cost of pumping water to the desirable level could be very expensive. If a hydro-electric facility is operating on the system, the costs associated with loss of production during the drawdown also need to be considered, as they are likely cost prohibitive to conducting the management action.

Advantages	Disadvantages
• Inexpensive if outlet structure exists. • May control populations of certain species, like Eurasian water-milfoil for a few years. • Allows some loose sediment to consolidate, increasing water depth. • May enhance growth of desirable emergent species. • Other work, like dock and pier repair may be completed more easily and at a lower cost while water levels are down.	• May be cost prohibitive if pumping is required to lower water levels. • Has the potential to upset the lake ecosystem and have significant affects on fish and other aquatic wildlife. • Adjacent wetlands may be altered due to lower water levels. • Disrupts recreational, hydroelectric, irrigation and water supply uses. • May enhance the spread of certain undesirable species, like common reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*). • Permitting process may require an environmental assessment that may take months to prepare. • Unselective.

Mechanical Harvesting

Aquatic plant harvesting is frequently used in Wisconsin and involves the cutting and removal of plants much like mowing and bagging a lawn. Harvesters are produced in many sizes that can cut to depths ranging from 3 to 6 feet with cutting widths of 4 to 10 feet. Plant harvesting speeds vary with the size of the harvester, density and types of plants, and the distance to the off-loading area. Equipment requirements do not end with the harvester. In addition to the harvester, a shore-conveyor would be required to transfer plant material from the harvester to a dump truck for transport to a landfill or compost site. Furthermore, if off-loading sites are limited and/or the lake is large, a transport barge may be needed to move the harvested plants from the harvester to the shore in order to cut back on the time that the harvester spends traveling to the shore conveyor. Some lake organizations contract to have nuisance plants harvested, while others choose to purchase their own equipment. If the latter route is chosen, it is especially important for the lake group to be very organized and realize that there is a great deal of work and expense involved with the purchase, operation, maintenance, and storage of an aquatic plant harvester. In either case, planning is very important to minimize environmental effects and maximize benefits.

Costs

Equipment costs vary with the size and features of the harvester, but in general, standard harvesters range between $45,000 and $100,000. Larger harvesters or stainless steel models may cost as much as $200,000. Shore conveyors cost approximately $20,000 and trailers range from $7,000 to $20,000. Storage, maintenance, insurance, and operator salaries vary greatly.

Advantages	***Disadvantages***
• Immediate results. • Plant biomass and associated nutrients are removed from the lake. • Select areas can be treated, leaving sensitive areas intact. • Plants are not completely removed and can still provide some habitat benefits. • Opening of cruise lanes can increase predator pressure and reduce stunted fish populations. • Removal of plant biomass can improve the oxygen balance in the littoral zone. • Harvested plant materials produce excellent compost.	• Initial costs and maintenance are high if the lake organization intends to own and operate the equipment. • Multiple treatments are likely required. • Many small fish, amphibians and invertebrates may be harvested along with plants. • There is little or no reduction in plant density with harvesting. • Invasive and exotic species may spread because of plant fragmentation associated with harvester operation. • Bottom sediments may be re-suspended leading to increased turbidity and water column nutrient levels.

Chemical Treatment

There are many herbicides available for controlling aquatic macrophytes and each compound is sold under many brand names. Aquatic herbicides fall into two general classifications:

1. *Contact herbicides* act by causing extensive cellular damage, but usually do not affect the areas that were not in contact with the chemical. This allows them to work much faster, but does not result in a sustained effect because the root crowns, roots, or rhizomes are not killed.
2. *Systemic herbicides* spread throughout the entire plant and often result in complete mortality if applied at the right time of the year.

Both types are commonly used throughout Wisconsin with varying degrees of success. The use of herbicides is potentially hazardous to both the applicator and the environment, so all lake organizations should seek consultation and/or services from professional applicators with training and experience in aquatic herbicide use.

Applying herbicides in the aquatic environment requires special considerations compared with terrestrial applications. WDNR administrative code states that a permit is required if “you are standing in socks and they get wet.” In these situations, the herbicide application needs to be completed by an applicator licensed with the Wisconsin Department of Agriculture, Trade and Consumer Protection. All herbicide applications conducted under the ordinary high water mark require herbicides specifically labeled by the United States Environmental Protection Agency.

Herbicides that target submersed plant species are directly applied to the water, either as a liquid or an encapsulated granular formulation. Factors such as water depth, water flow, treatment area size, and plant density work to reduce herbicide concentration within aquatic systems. Understanding concentration exposure times are important considerations for aquatic herbicides. Successful control of the target plant is achieved when it is exposed to a lethal concentration of the herbicide for a specific duration of time. Some herbicides are applied at a high dose with the anticipation that the exposure time will be short. Granular herbicides are usually applied at a lower dose, but the release of the herbicide from the clay carrier is slower and increases the exposure time.

Below are brief descriptions of the aquatic herbicides currently registered for use in Wisconsin.

<u>Fluridone</u> (Sonar®, Avast!®) Broad spectrum, systemic herbicide that is effective on most submersed and emergent macrophytes. It is also effective on duckweed and at low concentrations has been shown to selectively remove Eurasian water-milfoil. Fluridone slowly kills macrophytes over a 30-90 day period and is only applicable in whole lake treatments or in bays and backwaters were dilution can be controlled. Required length of contact time makes this chemical inapplicable for use in flowages and impoundments. Irrigation restrictions apply.

<u>Diquat</u> (Reward®, Weedtrine-D®) Broad spectrum, contact herbicide that is effective on all aquatic plants and can be sprayed directly on foliage (with surfactant) or injected in the water. It is very fast acting, requiring only 12-36 hours of exposure time. Diquat readily binds with clay particles, so it is not appropriate for use in turbid waters. Consumption restrictions apply.

<u>Endothall</u> (Hydrothol®, Aquathol®) Broad spectrum, contact herbicides used for spot treatments of submersed plants. The mono-salt form of Endothall (Hydrothol®) is more toxic to fish and aquatic invertebrates, so the dipotassium salt (Aquathol®) is most often used. Fish consumption, drinking, and irrigation restrictions apply.

<u>2,4-D</u> (Navigate®, DMA IV®, etc.) Selective, systemic herbicide that only works on broad-leaf plants. The selectivity of 2,4-D towards broad-leaved plants (dicots) allows it to be used for Eurasian water-milfoil without affecting many of our native plants, which are monocots. Drinking and irrigation restrictions may apply.

<u>Triclopyr</u> (Renovate®) Selective, systemic herbicide that is effective on broad leaf plants and, similar to 2,4 D, will not harm native monocots. Triclopyr is available in liquid or granular form, and can be combined with Endothal in small concentrations (<1.0 ppm) to effectively treat Eurasian water-milfoil. Triclopyr has been used in this way in Minnesota and Washington with some success.

<u>Glyphosate</u> (Rodeo®) Broad spectrum, systemic herbicide used in conjunction with a *surfactant* to control emergent and floating-leaved macrophytes. It acts in 7-10 days and is not used for submergent species. This chemical is commonly used for controlling purple loosestrife (*Lythrum salicaria*). Glyphosate is also marketed under the name Roundup®; this formulation is not permitted for use near aquatic environments because of its harmful effects on fish, amphibians, and other aquatic organisms.

Imazapyr (Habitat®) Broad spectrum, system herbicide, slow-acting liquid herbicide used to control emergent species. This relatively new herbicide is largely used for controlling common reed (giant reed, *Phragmites*) where plant stalks are cut and the herbicide is directly applied to the exposed vascular tissue.

Cost

Herbicide application charges vary greatly between $400 and $1000 per acre depending on the chemical used, who applies it, permitting procedures, and the size of the treatment area.

Advantages	*Disadvantages*
• Herbicides are easily applied in restricted areas, like around docks and boatlifts. • If certain chemicals are applied at the correct dosages and at the right time of year, they can selectively control certain invasive species, such as Eurasian water-milfoil. • Some herbicides can be used effectively in spot treatments.	• Fast-acting herbicides may cause fishkills due to rapid plant decomposition if not applied correctly. • Many people adamantly object to the use of herbicides in the aquatic environment; therefore, all stakeholders should be included in the decision to use them. • Many herbicides are nonselective. • Most herbicides have a combination of use restrictions that must be followed after their application. • Many herbicides are slow-acting and may require multiple treatments throughout the growing season. • Overuse may lead to plant resistance to herbicides

Biological Controls

There are many insects, fish and pathogens within the United States that are used as biological controls for aquatic macrophytes. For instance, the herbivorous grass carp has been used for years in many states to control aquatic plants with some success and some failures. However, it is illegal to possess grass carp within Wisconsin because their use can create problems worse than the plants that they were used to control. Other states have also used insects to battle invasive plants, such as waterhyacinth weevils (*Neochetina spp.*) and hydrilla stem weevil (*Bagous spp.*) to control waterhyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata)*, respectively. Fortunately, it is assumed that Wisconsin's climate is a bit harsh for these two invasive plants, so there is no need for either biocontrol insect.

However, Wisconsin, along with many other states, is currently experiencing the expansion of lakes infested with Eurasian water-milfoil and as a result has supported the experimentation and use of the milfoil weevil (*Euhrychiopsis lecontei*) within its lakes. The milfoil weevil is a native weevil that has shown promise in reducing Eurasian water-milfoil stands in Wisconsin, Washington, Vermont, and other states. Research is currently being conducted to discover the best situations for the use of the insect in battling Eurasian water milfoil. Currently the milfoil weevil is not a WDNR grant-eligible method of controlling Eurasian water milfoil.

Cost

Stocking with adult weevils costs about $1.20/weevil and they are usually stocked in lots of 1000 or more.

Advantages	***Disadvantages***
• Milfoil weevils occur naturally in Wisconsin. • Likely environmentally safe and little risk of unintended consequences.	• Stocking and monitoring costs are high. • This is an unproven and experimental treatment. • There is a chance that a large amount of money could be spent with little or no change in Eurasian water-milfoil density.

Wisconsin has approved the use of two species of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*) to battle purple loosestrife. These beetles were imported from Europe and used as a biological control method for purple loosestrife. Many cooperators, such as county conservation departments or local UW-Extension locations, currently support large beetle rearing operations. Beetles are reared on live purple loosestrife plants growing in kiddy pools surrounded by insect netting. Beetles are collected with aspirators and then released onto the target wild population. For more information on beetle rearing, contact your local UW-Extension location.

In some instances, beetles may be collected from known locations (*cella* insectaries) or purchased through private sellers. Although no permits are required to purchase or release beetles within Wisconsin, application/authorization and release forms are required by the WDNR for tracking and monitoring purposes.

Cost

The cost of beetle release is very inexpensive, and in many cases is free.

Advantages	***Disadvantages***
• Extremely inexpensive control method. • Once released, considerably less effort than other control methods is required. • Augmenting populations many lead to long-term control.	• Although considered “safe,” reservations about introducing one non-native species to control another exist. • Long range studies have not been completed on this technique.

Analysis of Aquatic Plant Data

Aquatic plants are an important element in every healthy lake. Changes in lake ecosystems are often first seen in the lake’s plant community. Whether these changes are positive, like variable water levels or negative, like increased shoreland development or the introduction of an exotic species, the plant community will respond. Plant communities respond in a variety of ways; there may be a loss of one or more species, certain life forms, such as emergents or floating-leaf communities may disappear from certain areas of the lake, or there may be a shift in plant dominance between species. With periodic monitoring and proper analysis, these changes are detectable and provide critical information for management decisions.

As described in more detail in the methods section, multiple aquatic plant surveys were completed on Little Saint Germain Lake. Some of these focused on native aquatic plants while others focus on a particular invasive species such as Eurasian water milfoil or curly-leaf pondweed. Native aquatic plant surveys were completed in 2004 and 2008 and invasive species surveys were completed annually since 2004. Combined, these surveys produce a great deal of information about the aquatic vegetation of the lake. These data are analyzed and presented in numerous ways; each is discussed in more detail below.

Primer on Data Analysis & Data Interpretation

Species List

The species list is simply a list of all of the species that were found within the lake, both exotic and native. The list also contains the life-form of each plant found, its scientific name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in life-forms that are present, can be an early indicator of changes in the health of the lake ecosystem.

Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems in the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states.

Frequency of Occurrence

Frequency of occurrence describes how often a certain species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of Little Saint Germain Lake, plant samples were collected from plots laid out on a grid that covered the entire lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. In this section, relative frequency of occurrence is used to describe how often each species occurred relative to the other plants. These values are presented in percentages and if all of the values were added up, they would equal 100%. For example, if water lily had a relative frequency of 0.1 and that value was described as a percentage, it would mean that water lily made up 10% of the plant population.

In the end, this analysis indicates the species that dominate the plant community within the lake. Shifts in dominant plants over time may indicate disturbances in the ecosystem. For instance, low water levels over several years may increase the occurrence of emergent species while decreasing the occurrence of floating-leaf species. Introductions of invasive exotic species may result in major shifts as they crowd out native plants within the system.

Species Diversity

Species diversity is probably the most misused value in ecology because it is often confused with species richness. Species richness is simply the number of species found within a system or community. Although these values are related, they are far from the same because diversity also takes into account how evenly the species occur within the system. A lake with 25 species may not be more diverse than a lake with 10 if the first lake is highly dominated by one or two species and the second lake has a more even distribution.

A lake with high species diversity is more stable than a lake with a low diversity. This is analogous to diverse financial portfolio in that a diverse lake plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. For example, a lake with a diverse plant community is much better suited to compete against exotic infestation than a lake with a lower diversity.

Floristic Quality Assessment

Floristic Quality Assessment (FQA) is used to evaluate the closeness of a lake's aquatic plant community to that of an undisturbed, or pristine, lake. The higher the floristic quality, the closer a lake is to an undisturbed system. FQA is an excellent tool for comparing individual lakes and the same lake over time. In this section, the floristic quality of Little Saint Germain Lake is compared between the 2004 and 2008 datasets and to lakes in the same ecoregion and in the state (Figure 3.3-1).

The floristic quality of a lake is calculated using its species richness and average species conservatism. As mentioned above, species richness is simply the number of species that occur in the lake, for this analysis, only native species are utilized. Average species conservatism utilizes the coefficient of conservatism values for each of those species in its calculation. A species coefficient of conservatism value indicates that species' likelihood of being found in an undisturbed (pristine) system. The values range from one to ten. Species that are normally found in disturbed systems have lower coefficients, while species frequently found in pristine systems have higher values. For example, cattail, an invasive native species, has a value of 1, while common hard and softstem bulrush have values of 5, and Oakes pondweed, a sensitive and rare species, has a value of 10. On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality.

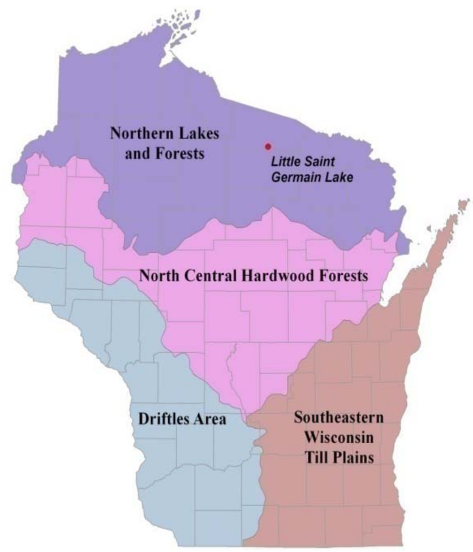

Figure 3.3-1. Location of Little Saint Germain Lake within the ecoregions of Wisconsin. After Nichols 1999.

Community Mapping Survey

A key component of the aquatic plant survey is the creation of an aquatic plant community map. The map represents a snapshot of the important plant communities in the lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with surveys completed in the future. A mapped community can consist of submergent, floating-leaf, or emergent plants, or a combination of these life-forms. Examples of submergent plants include wild celery and pondweeds; while emergents include cattails, bulrushes, and arrowheads, and floating-leaf species include white and yellow pond lilies.

Emergents and floating-leaf communities lend themselves well to mapping because there are distinct boundaries between communities. Submergent species are often mixed throughout large areas of the lake and are seldom completely visible from the surface; therefore, mapping of submergent communities is more difficult and often impossible.

Comprehensive Plant Survey Results

The 2004 comprehensive plant survey was completed utilizing a point-intercept method as outlined by the WDNR. Based upon initial guidance by the WDNR concerning the surveys at Little St. Germain Lake, geographic information system software was utilized to produce point locations at a 150-meter resolution and resulted in 175 points being created for the entire lake. Examination of the layout indicated that only 13 points would be located within the littoral zone of West Bay because of the lake's depth (Z_{max}=53 feet) and sharp drop off. Please note that based upon earlier studies conducted by Onterra, the littoral zone of the lake is believed to extend to a depth of approximately 12-feet. In order to increase the points within West Bay, a 100-meter resolution was used to create point locations for that bay alone. This resulted in an additional 15 points being created within West Bay's littoral zone. In 2004, 364 total sample locations were surveyed.

While the project scope originally intended to replicate the 2004 survey in 2008 to evaluate the five-year AIS control plan, it was determined through discussions with WDNR Science Services that the 2008 survey should be completed using the most current department protocol. Utilizing guidance provided within the WDNR publication, Aquatic Plant Management in Wisconsin, (April, 2008), a point spacing of 75 meters resulting in approximately 699 points surveyed on Little St. Germain Lake. Map 4 displays the sample locations from the two surveys.

Table 1 lists the aquatic plant species found within Little Saint Germain Lake during the two surveys. In addition to the two exotic species found in 2004, Eurasian water milfoil and curly-leaf pondweed, purple loosestrife was also discovered in 2008 (Map 3). Purple loosestrife has the ability to displace valuable emergent wetland species. Fifteen emergent plant species are known to exist in Little Saint Germain Lake (Table 3.3-1).

Coontail and common waterweed (Figure 3.3-2) continue to be the two most abundant plants within Little Saint Germain Lake, together accounting for over 37% and 47% of the relative frequency of plants found within the lake in 2004 and 2008, respectively. Because Little Saint Germain Lake has a very high number of aquatic plant species, one may assume that the lake would also have a very high diversity. The relative uneven distribution of coontail and common waterweed throughout the lake (relative frequency) has an influence on the diversity metric. The diversity index shows little change when comparing the 2008 (Simpson's 1-D = 0.89) data with the 2004 data (Simpson's 1-D = 0.90). Although more species were discovered in 2008, the lake's diversity was slightly less because of an increase in dominance by coontail and flat-stem pondweed. The moderately high diversity that Little Saint Germain contains is important in maintaining the lake's stability during ecological changes such as water level fluctuations, invasive species infestations, and changes in water clarity.

Other common species that occur throughout much of the lake include slender naiad, fern pondweed, and white-stem pondweed (Figure 3.3-2). Of the 52 species found within Little Saint Germain Lake during 2008, 43 were located during the point-intercept survey; Eurasian water milfoil was the 12th most abundant plant during this survey. In 2004, Eurasian water milfoil was not located within the point-intercept survey, but was noted from other surveys.

Vasey's pondweed, a species of special concern in Wisconsin, was found in Little Saint Germain Lake. Although this species is secure globally, it is "imperiled" in Wisconsin because of rarity (WDNR 2008b).

Combining, the high species richness of the aquatic plants within the lake with their relatively high coefficient of conservatisms value, the FQA indicates that floristic quality of Little Saint Germain Lake (Figure 3.3-3) is excellent, especially when compared to median values for the state and ecoregion. As described above, floristic quality utilizes average conservatism value for all of the native species found in the lake and the total number of those species.

Data collected from 2004 and 2008 indicate that the average conservatism values are higher than the state median and similar to the Northern Lakes Ecoregion median. This indicates that many of the species present in the lake are indicative of an undisturbed system. Little Saint Germain Lake contains portions of undeveloped shoreline, including approximately 2,200 feet of shoreline in West Bay and 2,260 feet in Lower East Bay (including this bay's island) which are owned by the State of Wisconsin. However, Little Saint Germain Lake is a popular recreation destination in the area and endures considerable use which has potential to negatively impact plant communities. A stakeholder survey sent to LSGLPRD members indicate that motor boats with greater than a 25 horsepower motor are the most prevalent watercraft on the lake (Appendix B, Question #9).

Median Value This is the value that roughly half of the data are smaller and half the data are larger. A median is used when a few data are so large or so small that they skew the average value to the point that it would not represent the population as a whole.

Combining the number of species with the average conservatism, the Floristic Quality Index indicates that the aquatic plant population of Little Saint Germain Lake is in excellent condition (see equation below for the 2008 survey).

$$\text{FQI} = \text{Average Coefficient of Conservatism (6.9)} * \sqrt{\text{Number of Native Species(52)}}$$
$$\text{FQI} = 49.6$$

The quality is also indicated by the high incidence of emergent and floating-leaf plant communities that occur in many areas of the lake as evidenced by roughly 51 acres of these communities being mapped during 2008 (Table 3.3-2, Maps 2 and 3). This is important, because these communities are often negatively affected by recreational use and shoreland development. Radomski and Goeman (2001) found a 66% reduction in vegetation coverage on developed shorelines when compared to undeveloped shorelines in Minnesota Lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelines. Many studies have documented the adverse affects of motorboat traffic on aquatic plants (e.g. Murphy and Eaton 1983, Vermaat and de Bruyne 1993, Mumma et al. 1996, Asplund and Cook 1997). In all of these studies, lower plant biomasses and/or declines and higher turbidity were associated with motorboat traffic.

Table 3.3-1. Little Saint Germain Species List. List compiled from data collected during 2004 & 2008 surveys.

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)	2004	2008
Emergent	*Bolboschoenus fluviatilis*	River bulrush	5		I
	Calla palustris	Water arum	9	I	I
	Carex comosa	Bristly sedge	5		I
	Dulichium arundinaceum	Three-way sedge	9	I	X
	Eleocharis erythropoda	Bald spike-rush	3		I
	Eleocharis palustris	Creeping spikerush	6	I	X
	Iris versicolor	Northern blue flag	5		I
	Juncus effusus	Soft rush	4		I
	Juncus pelocarpus	Brown-fruited rush	8	X	X
	Lythrum allatum	Winged loosestrife	6		I
	Lythrum salicaria	Purple loosestrife	Exotic		I
	Pontederia cordata	Pickerelweed	9	I	X
	Sagittaria latifolia	Common arrowhead	3	I	I
	Schoenoplectus acutus	Hardstem bulrush	5	I	X
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I	I
	Typha latifolia	Broad-leaved cattail	1	I	I
FL	*Brasenia schreberi*	Watershield	7		X
	Nuphar variegata	Spatterdock	6	X	X
	Nymphaea odorata	White water lily	6	X	X
FL/E	*Sparganium androcladum*	Shining bur-reed	8		I
	Sparganium angustifolium	Narrow-leaf bur-reed	9		X
	Sparganium emersum	Short-stemmed bur-reed	8		X
	Sparganium eurycarpum	Common bur-reed	5	I	I
	Sparganium fluctuans	Floating-leaf bur-reed	10	X	
FF	*Lemna minor*	Lesser duckweed	5	X	X
	Lemna trisulca	Forked duckweed	6	X	X
	Spirodela polyrrhiza	Greater duckweed	5	X	X
	Wolffia columbiana	Common watermeal	5	X	
Submergent	*Ceratophyllum demersum*	Coontail	3	X	X
	Chara sp.	Muskgrasses	7	X	X
	Elatine minima	Waterwort	9	X	
	Elodea canadensis	Common waterweed	3	X	X
	Heteranthera dubia	Water stargrass	6	X	X
	Isoetes lacustris	Lake quillwort	8	X	
	Lobelia dortmanna	Water lobelia	10	X	X
	Megalodonta beckii	Water marigold	8	X	
	Myriophyllum sibiricum	Northern water milfoil	7	X	X
	Myriophyllum spicatum	Eurasian water milfoil	Exotic	I	X
	Myriophyllum tenellum	Dwarf water milfoil	10	X	
	Najas flexilis	Slender naiad	6	X	X
	Nitella sp.	Stoneworts	7	X	X
	Potamogeton alpinus	Alpine pondweed	9	X	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X	X
	Potamogeton crispus	Curly-leaf pondweed	Exotic	I	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	8		X
	Potamogeton foliosus	Leafy pondweed	6	X	X
	Potamogeton gramineus	Variable pondweed	7	X	X
	Potamogeton illinoensis	Illinois pondweed	6	X	X
	Potamogeton nodosus	Long-leaf pondweed	7	I	
	Potamogeton praelongus	White-stem pondweed	8	X	X
	Potamogeton pusillus	Small pondweed	7	X	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X	X
	Potamogeton robbinsii	Fern pondweed	8	X	X
	Potamogeton spirillus	Spiral-fruited pondweed	8		I
	Potamogeton strictifolius	Stiff pondweed	8		X
	Potamogeton vaseyi	Vasey's pondweed	10		X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X	X
	Ranunculus aquatilis	White water-crowfoot	8	X	X
	Utricularia vulgaris	Common bladderwort	7		X
	Vallisneria americana	Wild celery	6	X	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X	X
	Sagittaria graminea	Grass-leaved arrowhead	9	X	X

FL = Floating Leaf
FL/E = Floating Leaf/Emergent
FF = Free-floating
S/E = Submergent/Emergent
I = Incidental

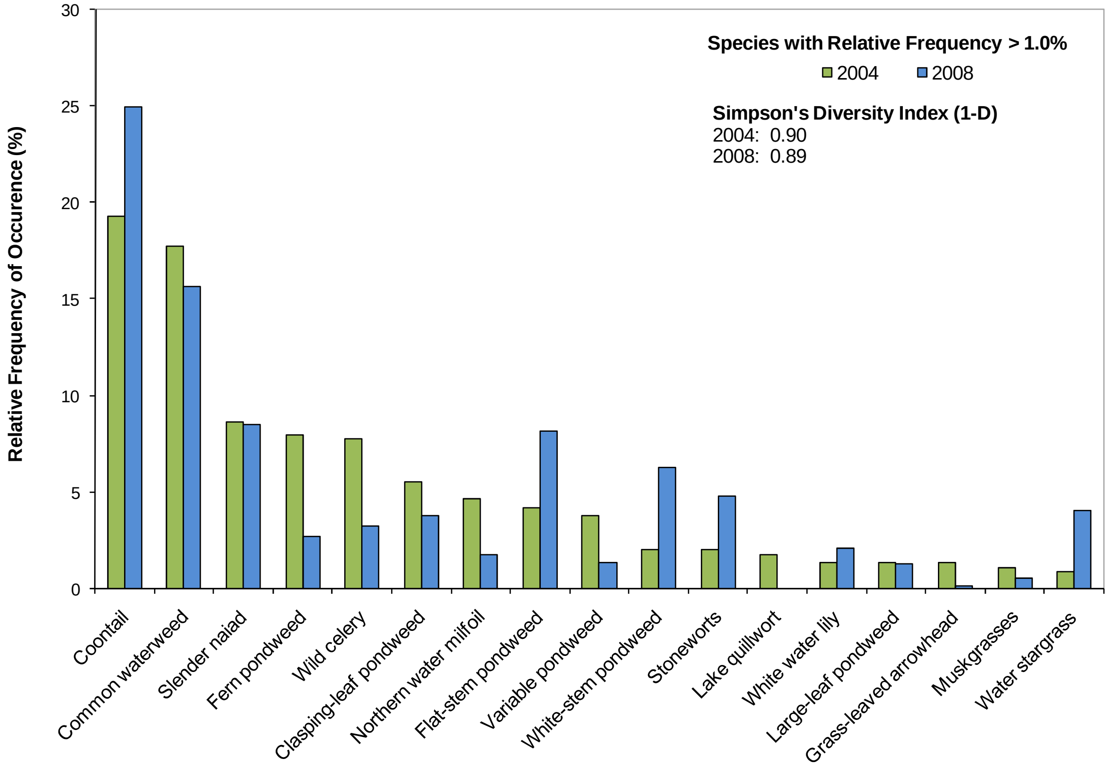

Figure 3.3-2. Little Saint Germain Lake aquatic plant relative frequency of occurrence analysis of 2004 & 2008 survey data.

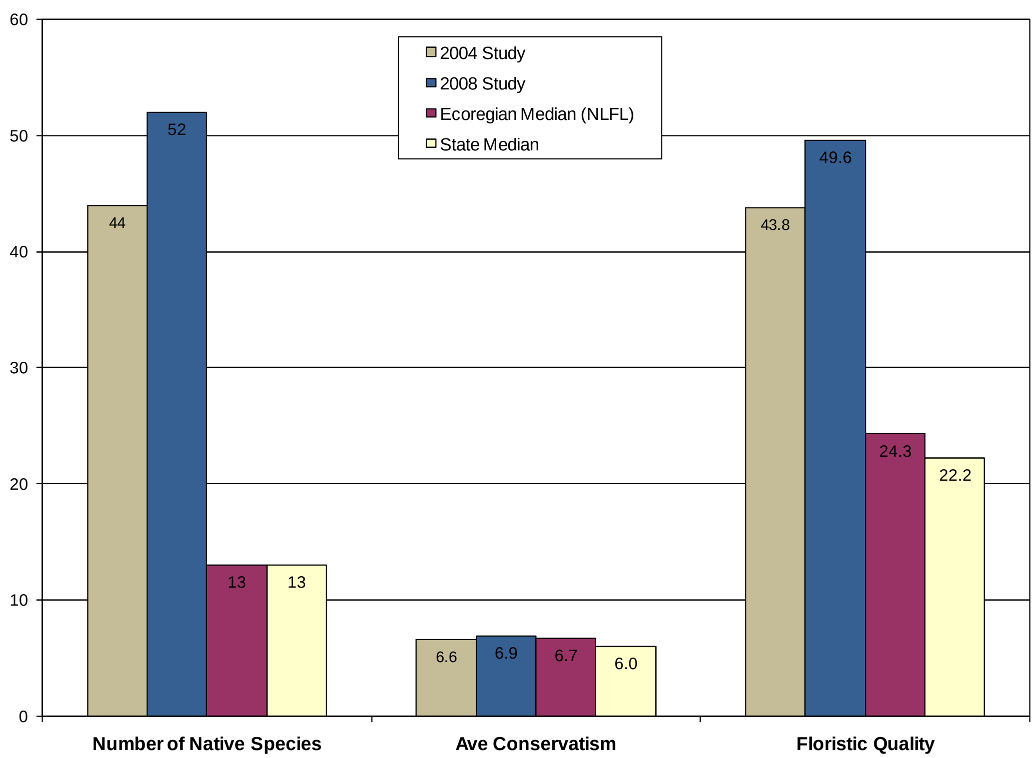

Figure 3.3-3. Little Saint Germain Lake Floristic Quality Assessment of 2004 & 2008 survey data. Analysis following Nichols 1999.

The 2004 community map is provided in Appendix C (Map 1). This map indicates that there are many areas in each basin where diverse floating-leaf and emergent communities can be found. Each of these areas provides valuable fish and wildlife habitat important to the ecosystem both inside and outside of the lake.

Continuing the analogy that the community map represents a 'snapshot' of the important plant communities, another picture was taken in the summer of 2008. The results of this survey are contained in Maps 2 and 3. Also displayed on these maps are the community outlines from the 2004 survey. It is important to note that there is a fine line between what is best represented as a small plant community or a large community. Examination of the 2008 community maps will yield a number of instances where the community was mapped with a point in 2004 and a polygon in 2008 (and vice-versa). This does not necessarily mean that there are changes in the plant community in these areas, simply they are represented differently. Table 3.3-2 shows an overview of the changes that have occurred on the lake in terms of acreage of each type of community mapped during the two surveys.

Table 3.3-2. Little Saint Germain acres of plant community types from the 2004 and 2008 community mapping surveys.

Plant Community	2004 Acres	2008 Acres
Emergent	1.8	1.1
Floating-leaf	5.8	2.2
Mixed Floating-leaf and Emergent	31.9	48.1
Mixed Submergent and Emergent	0.9	0.0
Total	40.4	51.4

A few changes are observed by comparing the two data sets. In front of the Muskellunge Creek inlet, the 2004 plant community is observed extending further lakeward than mapped in 2008. However in 2004, ecologists actually mapped floating mats of submergent species (coontail, common waterweed, and Eurasian water milfoil) as well as the emergent and floating-leaf species. In 2008, the submergent species were not mapped as a part of this community. This change is likely attributed to differences in water levels, where the submergent species were not matting at the surface in this area. As a water storage reservoir for the Wisconsin Valley Improvement Company (WVIC), Little Saint Germain Lake is partially formed by a small dam which attempts to keep the water level relatively constant. However, the WVIC reported 1,000 cubic feet less storage in 2004 than in 2008 (WVIC 2008).

Also, an increased amount of mixed floating-leaf and emergent plant communities were noticed in some areas of the lake, specifically in southwest portions of East Bay (Figure 3.3-4). In 2004, an area of bulrushes (green star on Figure 3.3-4) was represented separately from a nearby mixed floating-leaf emergent community. However, in 2008, the floating leaf species had expanded into this bulrush colony and could not be represented separately. Riparians traditionally navigated around the bulrush community and traveled through a pseudo-navigation lane until they reached their respective docks. However, it has been brought forth that navigating through this area is no longer possible and may need responsible management techniques alleviate these issues. However, emergent and floating-leaf plant communities are known to expand and contract over time; therefore, the management of these areas and other areas of the lake must be considered on an annual basis. Aquatic plant management based upon assumption of need, as opposed to actual need, could harm the Little Saint Germain Lake ecosystem beyond the recreational benefits achieved through these management actions.

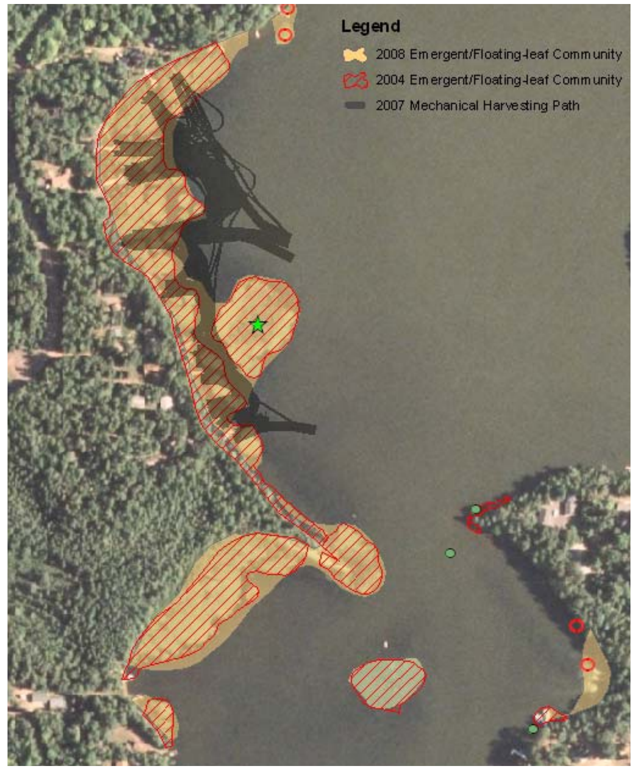

Figure 3.3-4. Area of Concern in southwest East Bay. Close up of Map 2 including 2007 mechanical harvesting area (Schmidt's Aquatic Plant Control). The green star indicates the bulrush community.

Mechanical Harvesting

Current management of nuisance levels of native aquatic plants occurs on portions of Little Saint Germain Lake using a mechanical harvester. The areas of Little Saint Germain Lake requiring mechanical harvesting change annually. Map 9 is an aggregate of all mechanical harvesting locations since 2002. Each year previous to the growing season, the LSLPRD applies for a mechanical harvesting permit from the WDNR. Once the high-use periods in July are past, the LSGLPRD evaluates whether harvesting activities are required on the lake. The harvesting program is aimed solely at improving navigation. When submergent species are the target plant, the threshold (trigger) for harvesting set by the LSGLPRD is when the plants reach the surface and have aggregated masses of coontail and other non-rooted plant species forming a mat.

Harvesting of submergent plant species did not occur on Little Saint Germain Lake in 2008 or 2009, as nuisance conditions were localized and did not significantly hinder recreational activities. An area along the southern part of South Bay was harvested in 2007 as submergent plants were found to be at nuisance levels. Also in 2007, harvesting activities occurred on an area in East Bay, largely focused on creating lanes through floating-leaf vegetation (e.g. water lilies). Personal communication with the mechanical harvesting contractor indicates that shallow water and the target species made this activity very difficult and only marginally effective. The contractor's belief is that this area is not conducive to mechanical harvesting and alternative methods, possibly including a smaller mechanical harvester, should be applied in this area.

Next to AIS, excessive plant growth is the factor that LSGLPRD members feel most negatively impacts their lake (Appendix B, Question #16). While mechanical harvesting can have positive impacts to recreation and aesthetics, they have the ability to spread Eurasian water milfoil and curly-leaf pondweed. Harvesting activities should not occur in areas near or around known colonies of these plants.

Non-native Aquatic Plants

Curly-leaf pondweed was first discovered in Little Saint Germain Lake in the early summer of 2002 and floating Eurasian water milfoil fragments were first discovered near the West Bay public boat landing in May 2003. Management actions aimed at reducing lake-wide levels of curly-leaf pondweed and Eurasian water milfoil have been conducted on Little Saint Germain Lake since 2003 (Figure 3.3-5 and 3.3-7). Previous to the 2005 field season, the LSGLPRD received a WDNR AIS Established Population Control Grant to aid in the control of Eurasian water milfoil and curly-leaf pondweed within the lake. After the grant was awarded, Onterra was contracted to monitor and coordinate the treatments.

Volunteer Training Session

On July 19, 2007, two volunteers attended a training session held by Onterra ecologists. These individuals were already versed on invasive species identification; therefore the purpose of the training session was aimed at gaining familiarity with mapping techniques. Combining a land-based interactive demonstration with a practical example on Little Saint Germain Lake, volunteers were trained on how to collect GPS points in manner that would convey information about an exotic species colony. Volunteers were trained to use a Garmin GPSMap 76cx, which was preloaded by Onterra with the 2007 curly-leaf pondweed and Eurasian water milfoil treatment areas. Volunteers were advised to use the GPS to visit the current year's treatment areas and check on the treatment results as well as map new occurrences of exotic species. These individuals were advised to collect data in June for curly-leaf pondweed and August for Eurasian water milfoil. AIS occurrences mapped by the volunteers served as the focus areas for the professional monitoring efforts later that summer and the following spring.

LSGLPRD members already conduct volunteer surveys as a part of the 'adopt a shoreline program' as outlined in the Town of Saint Germain management plan. A long term goal is to train all these volunteers to collect meaningful GPS data. Teaching such a large group of volunteers, each containing differing levels of technological expertise, this task may take considerable time. Until that time, it is important to utilize their eyes to locate the Eurasian water milfoil and then coordinate with the two trained individuals to map the locations, providing useful information to aid in the management of the lake.

Treatment Monitoring

At the current time, the use of herbicides to control submergent AIS is the most practical form of management and is supported by approximately 85% of LSGLPRD members (Appendix B, Question #20). Determining the success or failure of chemical treatments on Eurasian water milfoil is often a difficult task because the criteria used in determining success or failure is ambiguous. Most people involved with AIS management, whether professionals or laypersons, understand that the eradication of AIS from a lake, or even a specific area of a lake, is nearly, if not totally, impossible. Most understand that achieving control is the best criteria for success.

As a part of this project, herbicide treatments of Eurasian water milfoil and curly-leaf pondweed have been monitored since 2005. A qualitative assessment was determined for each treatment site by comparing detailed notes of pre- and post treatment observations and spatial data were collected with a sub-meter GPS data collector. The original project scope contained a component which consisted of a point-intercept survey of the entire lake in early May. The point-intercept survey was intended to provide a systematic way to look at the entire lake for AIS. However it became apparent that this method was too *coarse scale* to provide the information for which it was intended (Table 3.3-3). Starting in May 2008, the quantitative monitoring scheme was modified according to current WDNR protocols (April 2008) to provide analysis of treatment efficacy.

Table 3.3-3. Frequency of pretreatment survey's sample locations containing aquatic invasive species.

Year	Eurasian water milfoil Frequency	Curly-leaf pondweed Frequency
2005	2%	4%
2006	0%	1%
2007	3%	3%

The quantitative assessment of the treatment was made by collecting data at point-intercept sub-sample locations contained within the treatment areas. In general, treatment areas would be quantitatively monitored before and after treatments. Before a Eurasian water milfoil treatment is completed on a particular area, it would be monitored during the late summer before treatment and during the early spring of the treatment. That same area would again be monitored during the same timeframe following the treatment. Monitoring the effectiveness of the herbicide treatments on curly-leaf pondweed differs slightly from the model used for Eurasian water milfoil. A spring pretreatment survey (year of treatment) will need to be compared to a spring post treatment survey, the year following treatment. Because curly-leaf pondweed normally dies back in early summer, it is impossible to determine if the treatment was successful based upon a post treatment survey completed during early summer. This is because the survey results would not differentiate whether the observations were a result of the treatment or simply related to the mid-summer die back that is a part of the plant's normal life cycle (see below).

Project summary reports were written in December 2005 and March 2008 and are provided in Appendix C and D. These reports detail the management actions conducted on the lake previous to its distribution date. Data from all years will be discussed in the following sections.

Curly-leaf Pondweed

Curly-leaf pondweed is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. Curly–leaf pondweed begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment. The turions lie dormant until fall when they germinate to produce roots and winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced almost immediately following ice-out, giving the plant a significant jump on the growth native vegetation. Curly-leaf pondweed can become so abundant that it hampers recreational activities within the lake. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.

Curly-leaf pondweed treatments have occurred on Little Saint Germain Lake since 2003, the year following its detection. Reliable anecdotal data suggests that in 2003, curly-leaf pondweed could be observed growing in dense colonies with some surface matting occurring. Only very small occurrences of this type of growth have been observed on the lake since that first treatment.

Starting in 2006, a new approach to curly-leaf pondweed management on Little Saint Germain Lake was undertaken utilizing sub-meter GPS technology to map curly-leaf pondweed occurrence within the lake. Although the previous methods of mapping curly-leaf pondweed were not as technologically advanced as the approach taken in recent years, they most likely adequately represented the past treatment locations. A cursory look at this data may indicate that the curly-leaf pondweed treatments on Little Saint Germain Lake are not successful since there has been an increase in the amount of curly-leaf pondweed treated each year between 2006 and 2008 (Figure 3.3-5). Because curly-leaf pondweed primarily spreads from asexual reproductive structures called turions which can last in the sediment for a number of years, a continued commitment to this management strategy will be needed to reduce the turion base.

Map 5 shows that the 'core' of each curly-leaf pondweed colony has been treated between 2006 and 2008 with additions made to colony expansions and new locations. In 2008, many of these areas have been treated 2 or 3 times (annually), possibly approaching the time when the depletion of the turion base can be detected, as manifested by the decrease in the number of plants that sprout each spring from this reproductive structure.

The reduction in acreage requiring treatment in 2009 likely indicates this phenomenon (Map 6). Onterra field crew visited in the lake in early-May, and for the most part, CLP density was observed to significantly less within all of the treatment sites – especially in CLP A. CLP sites G and H were removed as almost no plants were observed within the proposed treatment areas after being transected numerous times using submersed video and rake tows (Map 6). This marked the first occasion since professional involvement began where CLP treatment acreage was reduced.

Quantitative evaluation of the treatments began in May 2008 using a 20-meter point-intercept grid placed over the treatment areas (Map 6). Before the 2008 treatment, 14 of the 185 sub-sample locations contained CLP and 18 contained CLP during the spring following the treatment (2010). Because the CLP infestation in Little Saint Germain is sparse, significant differences are impossible to detect. Actually, except for CLP C-09, none of the results including the treatment-wide results are statistically significant and difference could be a result of random variation (Map 6). More detail related to the quantitative evaluation of the 2008 curly-leaf pondweed treatment area provided in Appendix H.

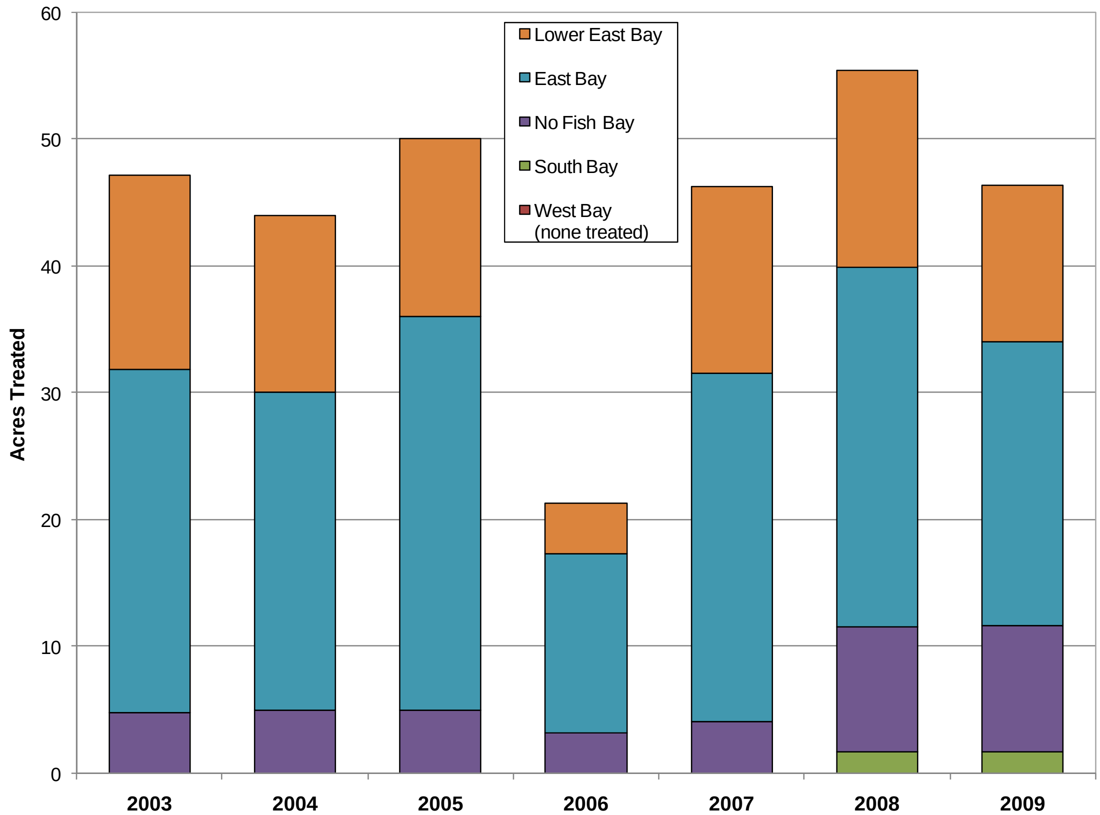

Figure 3.3-5. Acres of curly-leaf pondweed treated in Little Saint Germain Lake since 2003. Data displayed by lake basin (refer to Map 1). Curly-leaf pondweed management involving professional lake managers began in 2006.

Eurasian water milfoil

Eurasian water-milfoil is an invasive species, native to Europe, Asia and North Africa, that has spread to most Wisconsin counties (Figure 3.3-6). Eurasian water-milfoil is unique in that its primary mode of propagation is not by seed. It actually spreads mostly by shoot fragmentation, which has supported its transport between lakes via boats and other equipment. In addition to its propagation method, Eurasian water-milfoil has two other competitive advantages over native aquatic plants; 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian water-milfoil can create dense stands and dominate submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating.

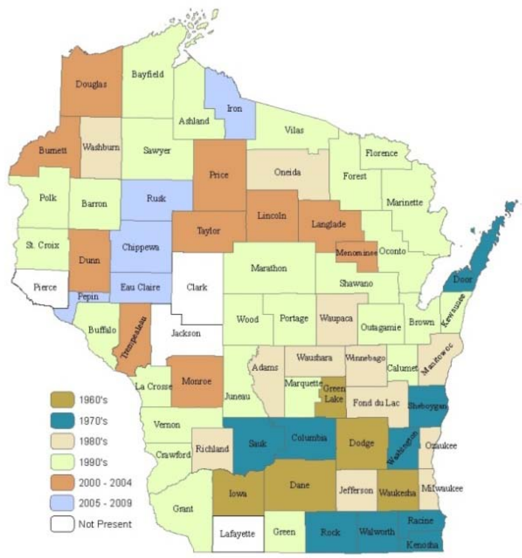

Figure 3.3-6. Spread of Eurasian water milfoil within WI counties. WDNR Data 2009 mapped by Onterra.

As stated above, floating Eurasian water milfoil fragments were discovered near the West Bay public boat landing in May, 2003. Mark Hiller organized volunteers to aid in SCUBA expeditions in May and June of 2003. These surveys indicated that there were numerous infestations of Eurasian water milfoil in West Bay. A small area near the public boat landing (approximately 3 acres) was treated on July 1, 2003 and later on August 4, 2003 a 30-foot wide perimeter strip of West Bay (approximately 9 acres) was also treated. The 30-foot wide strip was treated again on July 2, 2004 and based on the applicator’s advice; this strip was widened to extend to 15 feet of water and treated on August 24, 2004 (approximately 33 acres). In July 2005, 8.5 acres of Eurasian water milfoil were treated in West Bay, No Fish Bay, and near the Muskellunge Creek inlet in East Bay (Figure 3.3-7). All treatments were completed with granular 2,4-D at 100 lbs/acre.

Dr. Michael Moody at the University of Connecticut Department of Ecology and Evolutionary Biology tested suspicious milfoil specimens using DNA analysis from plant samples received in 2004 from Little Saint Germain Lake (Laura Herman, personal comm.). The analysis showed that the specimens were either pure Eurasian water milfoil or northern water milfoil (not the hybrid). Milfoil hybrids are located in approximately 30 lakes in Wisconsin and are managed in the same fashion as if it were Eurasian water milfoil, because this strain often takes on the invasive characteristics of its non-native parent.

Similarly with the management of curly-leaf pondweed, Eurasian water milfoil management was fully turned over to Onterra ecologists in 2006. Starting in 2006, Eurasian water milfoil control was conducted through early-season treatments. By completing the treatments before June 1 or water temperatures reach 60°F, the collateral damage to native dicots would be limited as many of these species have not yet sprouted or are at extremely low biomass. It is also generally believed that greater control of Eurasian water milfoil is achieved at this time of year as it is in an active growth stage. Details of the 2006-2007 treatments are provided in the March 2008 project update, included in Appendix D.

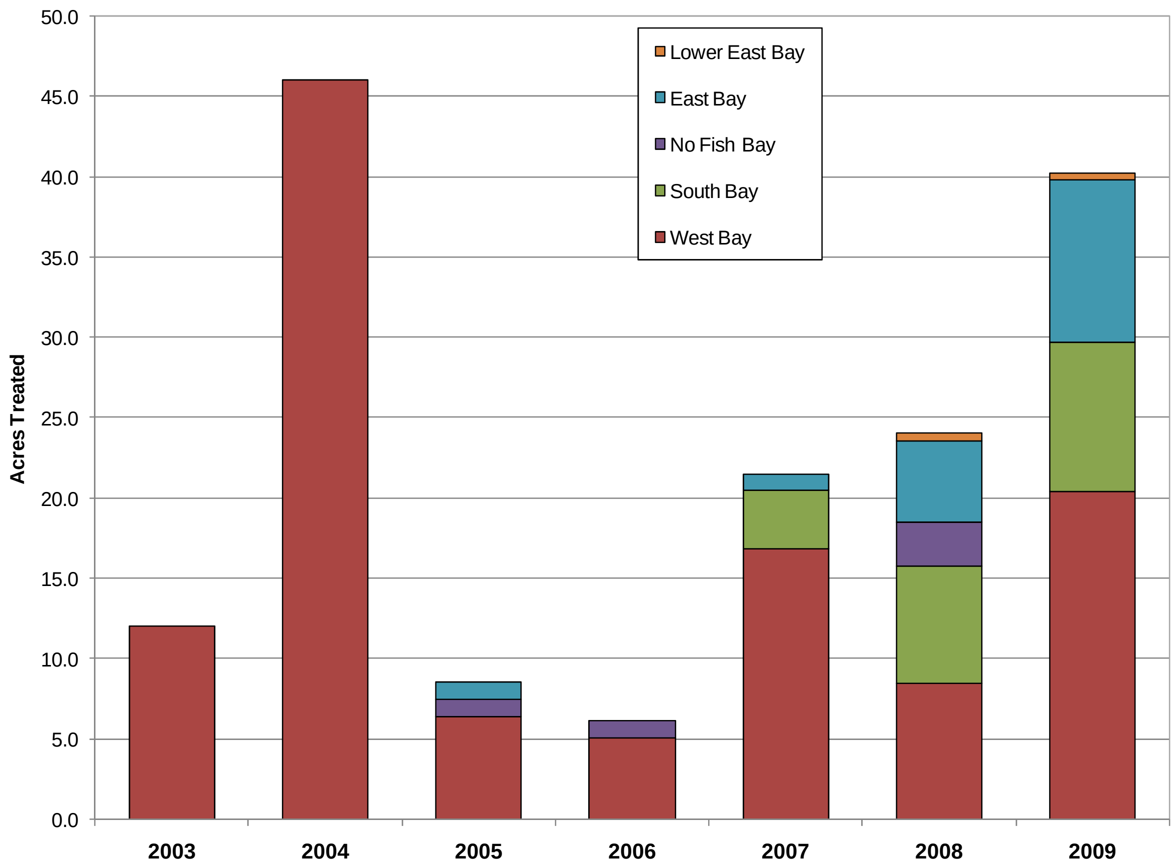

Figure 3.3-7. Acres of Eurasian water milfoil treated in Little Saint Germain Lake since 2003. Data displayed by lake basin (refer to Map 1). Eurasian water milfoil management involving professional lake managers began in 2006.

Figure 3.3-7 shows that the acreage of Eurasian water milfoil treatment has increased since profession involvement began in 2006. Retreating areas is not uncommon in Eurasian water milfoil management as dense areas often require multiple years of the treatment to drastically decrease the site's density. One explanation for this may be the fact that the colony rebounds after treatment through germination of existing stock within the sediment's seed bank and/or through the propagation of new plants through dormant root crowns. As the area is repetitively treated, the source for new plants is depleted and the colony cannot rebound. This is much like using repeated, annual treatments to reduce the turion (reproductive structure) bank which is common in the management of CLP.

Past Eurasian water milfoil treatments on Little Saint Germain, particular on West Bay have not been met with acceptable levels of success. In 2008, herbicide dosages were increased from 100 to 150 lbs of Navigate (granular 2,4-D) per acre in West Bay and select treatment areas in other lake basins. Some successes were observed in 2008 and all 2009 treatment areas were treated at the increased dose. The 2009 Treatment Report for Little Saint Germain Lake is included in Appendix H.

While there were Eurasian water milfoil density reductions within the West Bay treatment areas in 2009, the treatment efficacy was not considered high. It is hypothesized that the lack of success may be related to plant injury (only killing part of the plant) caused by insufficient herbicide dose or exposure time, rather than complete plant mortality. Increases in herbicide dose or the use of different herbicides are likely needed for a successful treatment to occur in West Bay and possibly other basins of Little Saint Germain Lake (Map 7).

Although it is never the intent of the treatments to impact native species, these management actions have the ability to collaterally impact non-target native species. As stated above, the collateral damage to native dicots is limited by conducting the herbicide treatment before June 1, as many of these species have not yet sprouted or are at extremely low biomass at this time of the year. On Little Saint Germain Lake, we have the ability to look at comparative data from the two whole-lake point-intercept surveys that were completed in 2004 and 2008. Comparing these point-intercept surveys, 15 plants showed a statistically significant change in percent frequency (Figure 3.3-8).

Please note that Figure 3.3-8 is displaying the difference between frequency of occurrence between these surveys for each native plant listed and <u>not</u> a percent change in frequency. For example, coontail occurred in 55.1% of the plots during 2004 and 75.2 % during 2008. Therefore, the chart indicates a positive difference (increase) of approximately 20.1 (75.2% – 55.1%) and <u>not</u> a percent change. If percent change was calculated, we would see in this example that coontail increased by 36.5% ((75.2% – 55.1%)) / 55.1% x 100%).

Statistical analysis is used by scientists to determine if an observed difference is sufficient to be attributed to a particular factor or if the difference may have occurred randomly. If the difference is sufficient, it is considered to be *significantly different*, if it is not sufficient, it is considered to be *insignificantly different*. In the end, a significant difference can be attributed to some factor, while an insignificant difference can only be attributed to random variation.

The fact that species frequency and distribution can vary within such a short time is not alarming. Actually, it lends to the importance of diversity. As environmental and climactic factors change, a diverse plant community is more resilient to these changes.

The four dicot species displayed in Figure 3.3-8 are of particular concern as 2,4-D is selective towards dicots species under typical concentration and exposure times. All 15 species are susceptible to the contact herbicide, Endothall, used to manage curly-leaf pondweed.

Within sample locations less than maximum depth of plants (approximately within the littoral zone), coontail increased from 55.1% to 75.2% occurrence. It is unrealistic to quantitatively define the term “nuisance,” as this designation is subjective by nature. However, WDNR Science Services researchers indicate that nuisance levels of Eurasian water milfoil likely occur when frequency of occurrences exceed 35% (Alison Mikulyuk, personal comm.). Admittedly, coontail is a different species, but its occurrence greatly exceeds this relative benchmark.

Map 8 shows the 2008 coontail locations and associated rake fullness ratings. During both point-intercept surveys (2004 and 2008), coontail was found to be the most abundant plant in Little Saint Germain Lake. Coontail is a common plant in much of the state and in many parts of Little Saint Germain, district members believe it exists at nuisance levels. Mechanical harvesting activities have occurred on Little Saint Germain to control this species as well as elodea and some pondweed species found to be canopying at the surface (Map 9). These species are typical in productive lakes that contain highly organic (mucky) substrates (Map 10). Common waterweed and coontail are largely non-rooted plants which have the ability to be moved throughout the system by water currents and have the capacity to aggregate and form dense mats at the surface as they become entangled in rooted plants. Formulating management actions aimed at controlling these species can be difficult, as the nuisance conditions may not occur in the same parts of the lake from year to year.

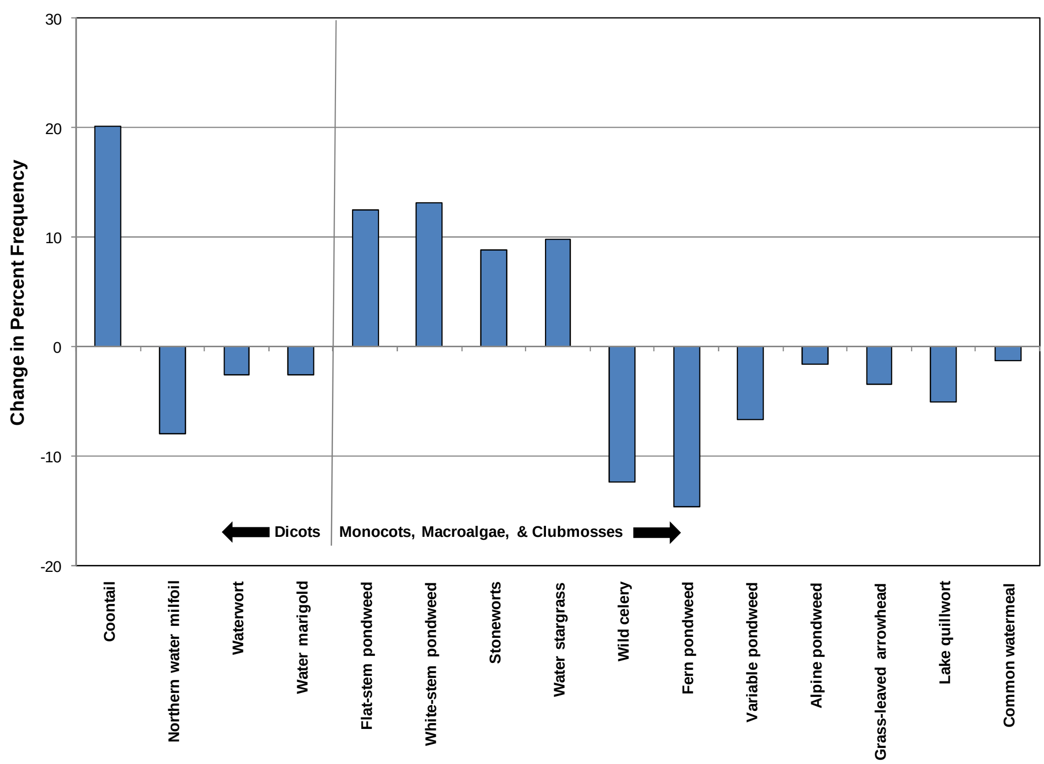

Figure 3.3-8. Little Saint Germain Lake changes in aquatic plant frequency of occurrence analysis of 2004 & 2008 survey data. Please note only plant species shown to significantly change are displayed. Statistical significance is determined by Chi-square distribution analysis (alpha = 0.05).

Of the native plants monitored during invasive control programs, especially that of Eurasian water milfoil, northern water milfoil is arguably the most closely watched due to its importance in Wisconsin lake ecosystems and its phylogenetic relationship to Eurasian water milfoil. It appears that northern water milfoil populations were decreased in West Bay, but increased significantly in South Bay. Northern water milfoil is usually found in soft sediments and its feathery foliage trap filamentous algae and detritus, providing valuable invertebrate habitat. Because northern water milfoil prefers high water clarity, its populations are declining state-wide as lakes are becoming more eutrophic. This plant's intolerance to reduced water clarity is likely the reason it is not found in East Bay or No Fish Bay, which exhibit the lowest water clarity values compared to West Bay and South Bay (Figure 3.2-6).

It is important to reiterate that eradication of AIS from a lake, or even an area within a lake is an unrealistic goal. While the lake is definitely not in a *maintenance mode* as of yet, the current management of Eurasian water milfoil on Little Saint Germain Lake comprises putting out small 'fires' around the lake. This is largely different from the management occurring on many other area lakes where tens of acres of contiguous and dominant Eurasian water milfoil are treated annually. Great strides in the management of AIS on Little Saint Germain Lake have been made including tuning herbicide dosage, the adaption of quantitative treatment monitoring, and the use of volunteers to help coordinate the treatments. Continuation of these activities will be needed to ensure the ecological health of Little Saint Germain for the future.

3.4 Fisheries Overview

Fishery management is an important aspect in the comprehensive management of a lake ecosystem; therefore, a brief summary of available data is included here as reference. Although current fish data were not collected, the following information was compiled based upon data available from the WDNR and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) (WDNR 2010 & GLIFWC 2010).

Table 3.4-1. Gamefish present in Little Saint Germain Lake with corresponding biological information (Becker, 1983).

Common Name	Scientific Name	Max Age (yrs)	Spawning Period	Spawning Habitat Requirements	Food Source
Muskellunge	*Esox masquinongy*	30	Mid April - Mid May	Shallow bays over muck bottom with dead vegetation, 6 - 30 in.	Fish including other muskies, small mammals, shore birds, frogs
Northern Pike	*Esox lucius*	25	Late March - Early April	Shallow, flooded marshes with emergent vegetation	Fish including other pikes, crayfish, small mammals, water fowl, frogs
Walleye	*Sander vitreus*	18	Mid April - Early May	Rocky, wave-washed shallows, inlet streams on gravel bottoms	Fish, fly and other insect larvae, crayfish
Largemouth Bass	*Micropterus salmoides*	13	Late April - Early July	Shallow, quiet bays with emergent vegetation	Fish, amphipods, algae, crayfish and other invertebrates
Smallmouth Bass	*Micropterus dolomieu*	13	Mid May - June	Nests more common on North and West shorelines, over gravel	Small fish including other bass, crayfish, insects (aquatic and terrestrial)
Bluegill	*Lepomis macrochirus*	11	Late May - Early August	Shallow water with sand or gravel bottom	Fish, crayfish, aquatic insects and other invertebrates
Pumpkinseed	*Lepomis gibbosus*	12	Early May - August	Shallow warm bays 0.3-0.8 m, with sand or gravel bottom	Crustaceans, rotifers, mollusks, flatworms, insect larvae (ter. and aq.)
Yellow Perch	*Perca flavescens*	13	April - Early May	Sheltered areas, emergent and submergent veg	Small fish, aquatic invertebrates
Black Crappie	*Pomoxis nigromaculatus*	7	May - June	Near Chara or other vegetation, over sand or fine gravel	Fish, cladocera, insect larvae, other inverts
Rock Bass	*Ambloplites rupestris*	13	Late May - Early June	Bottom of course sand or gravel, 1cm-1m deep	Crustaceans, insect larvae, and other inverts
Black Bullhead	*Ictalurus melas*	5	April - June	Matted vegetation, woody debris, overhanging banks	Amphipods, insect larvae and adults, fish, detritus, algae
Yellow Bullhead	*Ameiurus natalis*	7	May - July	Heavy weeded banks, beneath logs or tree roots	Crustaceans, insect larvae, small fish, some algae

Based on data collected from the stakeholder survey (Appendix B), fishing was the highest ranked important or enjoyable activity on Little Saint Germain Lake (Question #10). Approximately 80% of these same respondents believed that the quality of fishing on the lake was either fair or poor (Question #11); and approximately 88% believe that the quality of fishing has remained the same or gotten worse since they have obtained their property (Question #12).

Table 3.4-1 (above) shows the popular game fish that are present in the system. Management actions that have taken place and will likely continue on Little Saint Germain according to this plan include herbicide applications to control Eurasian water milfoil and curly-leaf pondweed. In the future, these applications will occur in May when the water temperatures are below 60°F. It is important to understand the effect the chemical has on the spawning environment which would be to remove the submergent plants that are actively growing at these low water temperatures. Yellow perch is a species that could potentially be affected by early season herbicide applications, as the treatments could eliminate nursery areas for the emerged fry of these species. Muskellunge is another species that may be impacted by early season treatments as water temperatures and spawning locations often overlap.

Approximately 22,400 square miles of northern Wisconsin was ceded to the United States by the Lake Superior Chippewa tribes in 1837 and 1842 (Figure 3.4-1). The Little Saint Germain Lake falls within the ceded territory based on the Treaty of 1842. This allows for a regulated open water spear fishery by Native Americans on specified systems. GLIFWC and WDNR fisheries biologist believe that approximately 35% of a lake's walleye or muskellunge population can be removed annually without adversely affecting the ability of the population to maintain itself. This 35% exploitation rate is called the total allowable catch. The safe harvest level is set at approximately one third (33%) of the total allowable catch (GLIFWC 2004). The six Wisconsin Chippewa Tribes declare a tribal quota based on a percent of the estimated safe harvest each year by March 15. The tribal declaration will influence the daily bag limits for hook-and-line anglers. The tribes have historically selected a percentage which allows for a 2-3 daily bag limit for hook-and-line anglers (USDI 2007). Since 2000, the Lac Du Flambeau tribe has declared approximately 55% of the safe harvest.

Figure 3.4-1. Location of Little Saint Germain Lake within the Native American Ceded Territory (GLIFWC 2007). This map was digitized by Onterra; therefore it is a representation and not legally binding.

Spearers are able to harvest muskellunge, walleye, northern pike, and bass during the open water season. The spear harvest is monitored through a nightly permit system and a complete monitoring of the harvest (GLIFWC 2004). Creel clerks and tribal wardens are assigned to each lake at the designated boat landing. A catch report is completed for each boating party upon return to the boat landing. In addition to counting every fish harvested, the first 100 walleye (plus all those in the last boat) are measured and sexed. An updated nightly quota is determined each morning by 9 a.m. based on the data collected from the successful spearers. Harvest of a particular species ends once the quota is met or the season ends.

Walleye and muskellunge comprise the vast majority of the open water spear fish harvest. Since 1998, only three northern pike and two bass have been harvested on Little Saint Germain Lake.

Walleye open water spear harvest records are provided in Table 3.4-2. One common misconception noted from the stakeholder survey (Appendix B – Written Comments) is that the spear harvest targets the large spawning females. Table 3.4-2 and Figure 3.4-2 clearly show that the opposite is true with only 13% of the total walleye harvest (58 fish) since 1998 comprising of female fish on Little Saint Germain Lake. Tribal spearers may only take two walleyes over twenty inches per nightly permit; one between 20 and 24 inches and one of any size over 20 inches (GLIWC 2007). This regulation limits the harvest of the larger, spawning female walleye.

Because Little Saint Germain Lake is located within ceded territory, special fisheries regulations may occur, specifically in terms of walleye. County-wide minimum length limit on walleye is 15 inches and a daily bag limit of 3. An adjusted walleye bag limit pamphlet is distributed each year by the WDNR which explains the more restrictive bag or length limits that may pertain to Little Saint Germain Lake. In 2008, the daily bag limit remained at 3 for the lake.

Table 3.4-2. Spear harvest data of walleye for Little Saint Germain Lake (GLIFWC annual reports for Little Saint Germain Lake, Krueger 1998-2007).

Year	Tribal Quota	Tribal Harvest	%Quota	Mean Length* (in)	%Male*	%Female*	%Unknown
1998	108	89	82.4	16.2	70.8	2.2	27.0
1999	92	77	83.7	19.6	44.6	33.8	21.6
2000	57	57	100.0	16.7	66.7	27.3	6.1
2001	57	10	17.5	21.5	50.0	0.0	50.0
2002	59	56	94.9	17.6	94.6	5.4	0.0
2003	62	20	32.3	17.5	25.0	15.0	60.0
2004	62	36	58.1	18.1	83.3	2.8	13.9
2005	61	33	54.1	16.2	75.8	24.2	0.0
2006	61	49	80.3	15.8	55.1	6.1	38.8
2007	63	29	46.0	19.5	10.3	13.8	75.9

*Based on Measured Fish

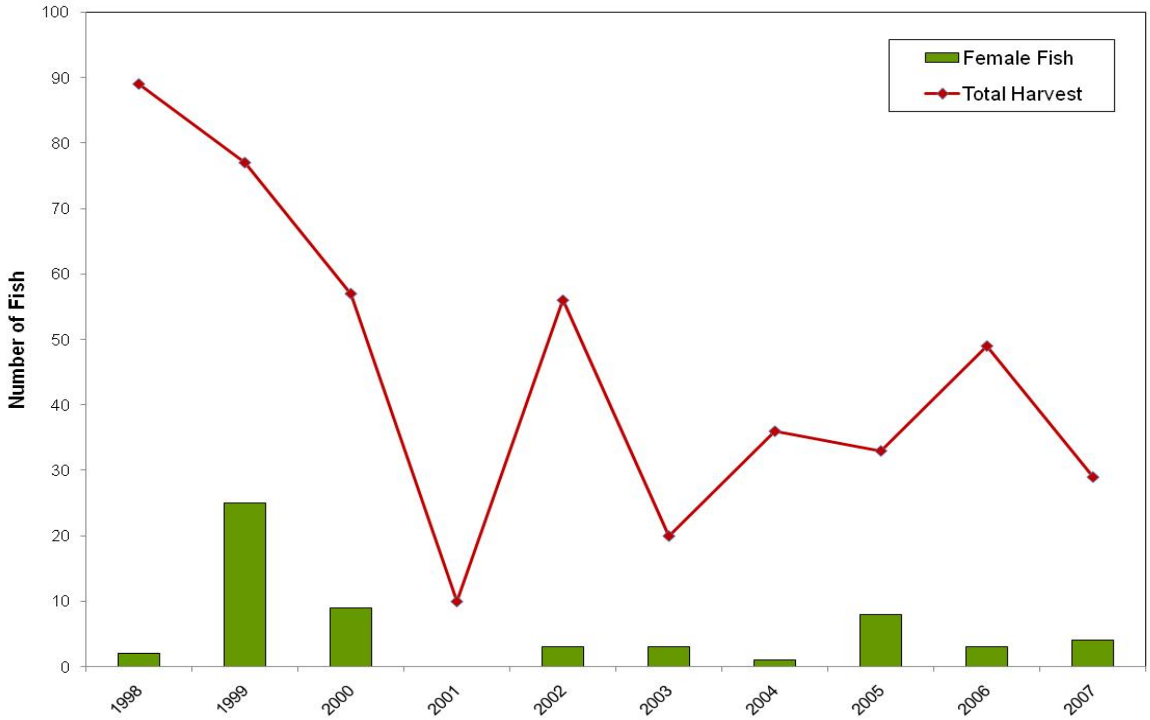

Figure 3.4-2. Walleye spear harvest data. Annual total walleye harvest and female walleye harvest are displayed since 1998 from GLIFWC annual reports for Little Saint Germain Lake (Krueger 1998-2007).

Table 3.4-3 displays the Native American open water muskellunge spear harvest since 1998. Since 1998, approximately 4.9 muskellunge per year have been harvested during the open water spear fishery. Native Americans also exercise their rights to spear harvest muskellunge through the ice on Little Saint Germain Lake. Current regulations for this continuous season include no bag limits and the first fish can be of any size and "thereafter at least half the catch must be at least 32 inches" (GLIFWC 1992). Little Saint Germain Lake has been included in the GLIFWC winter creel survey rotation (once every 5 years) in 1998-1999, 2003-2004, and 2008-2009 (Mark Luehring, personal comm.). During the last survey, Little Saint Germain Lake was surveyed on 12 weekdays and 3 weekend days (approximately 3 weekdays and 1 weekend day each week for 1 month). No spearing effort and consequently no muskellunge harvest was detected during these creel surveys. However, WDNR fisheries biologist, Steve Gilbert, believes that a "fair amount of tribal winter ice spearing for muskellunge (occurs) on this lake in some years" (Appendix I).

Muskellunge have been actively stocked in recent years by the WDNR (Table 3.4-4) in an effort to influence the populations of these species. Under the WDNR's classification of muskellunge waters, Little Saint Germain ranks as a Class A2 angling lake. This classification means that Little Saint Germain can provide consistent angling action, with relatively large numbers of muskellunge, however larger fish make up a smaller percent of the total population. The minimum length limit on muskellunge is 45 inches for anglers and was put in place to help improve size structure of the population. Appendix I is a memorandum written by Mr. Gilbert to retain the current 45 inch size limit on muskellunge in Little Saint Germain Lake and includes supporting muskellunge population and size data.

Table 3.4-3. Open water spear harvest data of muskellunge for Little Saint Germain Lake (GLIFWC annual reports for Little Saint Germain Lake, Krueger 1998-2007).

Year	Tribal Quota	Total Harvest	% Quota	Mean Length* (in)
1998	9	9	100.0	34.3
1999	9	7	77.8	35.4
2000	9	6	66.7	34.7
2001	9	0	0.0	-
2002	9	3	33.3	34.2
2003	9	5	55.6	42.0
2004	9	6	66.7	35.6
2005	10	1	10.0	39.0
2006	10	8	80.0	38.4
2007	9	4	44.4	39.0

Steve Gilbert stated that Little Saint Germain is being managed for a balanced fishery including, panfish, bass, walleye, and muskellunge. Tables 3.4-4 and 3.4-6 show that since 2001, walleye and muskellunge have been stocked approximately every other year. Mr. Gilbert believes there is adequate habitat for natural reproduction of these species to occur within the lake. However, there needs to be an improved adult density before natural reproduction can occur at a sustaining level. Largemouth bass stocking has also occurred on Little Saint Germain Lake, most recently during and just previous to 2000 (Table 3.4-5).

Mr. Gilbert applauds the LSGLPRD's work at improving the winter water quality of the system by purchasing two aeration systems. One aeration system is located in East Bay near the Muskellunge Lake inlet and the other is located in Lower East Bay. The gradual benefit from this management activity should be observed in all fish species, as winter kill will be less severe and fish will not have to migrate to West Bay, where fishing and predation pressures were likely elevated on the aggregated populations.

Table 3.4-4. Muskellunge stocking data available from the WDNR from 1972 to 2006 (WDNR 2010).

Year	Age Class	# Stocked	Avg. Length (inches)
1972	Fingerling	2,200	5
1972	Fingerling	1,827	12.00
1973	Fingerling	1,119	11.00
1973	Fry	35,000	1.60
1974	Fingerling	1,242	9.00
1976	Fingerling	500	11.00
1979	Fingerling	1,876	8.50
1983	Fingerling	1,804	10.00
1984	Fingerling	1,916	11.33
1985	Fingerling	2,945	11.33
1986	Fingerling	2,209	12.00
1987	Fingerling	5,694	11.67
1988	Fingerling	2,249	10.29
1990	Fingerling	1,900	11.00
1996	Fingerling	2,021	10.77
1998	Large Fingerling	1,774	12.15
1998	Fry	80,000	NA
2000	Large Fingerling	1,800	10.80
2002	Large Fingerling	490	10.70
2004	Large Fingerling	490	10.05
2006	Large Fingerling	490	10.20

Table 3.4-5. Largemouth bass stocking data available from the WDNR from 1972 to 2006 (WDNR 2010).

Year	Age Class	# Stocked	Avg. Length (inches)
1972	Fingerling	2,200	5
1972	Fingerling	2,200	5.00
1973	Fingerling	424	3.00
1986	Fingerling	3,750	4.00
1997	Large Fingerling	550	3.40
1998	Large Fingerling	934	5.40
1999	Large Fingerling	674	4.80
2000	Large Fingerling	3,000	2.00

Table 3.4-6. Walleye stocking data available from the WDNR from 1972 to 2006 (WDNR 2010).

Year	Age Class	# Stocked	Avg. Length (inches)
1972	Fingerling	2,200	5
1972	Fry	500,000	NA
1973	Fry	2,000,000	NA
1974	Fingerling	16,320	3.00
1974	Fry	450,000	1.00
1975	Fingerling	31,600	NA
1975	Fry	1,000,000	NA
1976	Fry	500,000	0.30
1977	Fry	750,000	NA
1978	Fry	100,000	2.00
1979	Fry	1,033,000	NA
1981	Fingerling	13,000	2.00
1982	Fingerling	66,000	2.00
1984	Fingerling	50,000	2.00
1985	Fingerling	100,000	2.00
1986	Fingerling	50,000	3.00
1987	Fingerling	150,000	1.00
1989	Fingerling	69,800	0.50
1996	Fry	500,000	NA
1999	Large Fingerling	4,704	7.80
2000	Large Fingerling	4,329	8.00
2001	Large Fingerling	9,850	7.65
2003	Large Fingerling	4,900	7.70
2005	Small Fingerling	49,000	2.00

As previously mentioned, Mr. Gilbert stated that Little Saint Germain is being managed for a balanced fishery. A 2004 study by the Wisconsin Valley Improvement Company and the WDNR focused on determining the diversity of the fishery, and also examining the population characteristics of panfish in the system. The study indicated that panfish (bluegill, pumpkinseed, and black crappie) were abundant, yet growing at a slower rate than panfish in nearby lakes (Appendix J). The researchers attributed the slow growth to over-abundance of the species. Table 3.4-7 summarizes the findings for the three panfish species in the 2004 study.

Table 3.4-7. 2004 Panfish population characteristics in Little Saint Germain Lake (Appendix J)

Species	Fish Caught	Mean Length (in)	Most Abundant Age Class	Relative Density	Growth Rate
Black Crappie	452	7.3	3 and 4 years	Moderate	Slower than average
Bluegill	6,048	5.6	5 years	Very high	Slower than average
Pumpkinseed	2,122	5.3	3 years	Very high	Slower than average

According to the point-intercept survey conducted by Onterra, 94% of the substrate sampled in the littoral zone on Little Saint Germain was muck, with the remaining 6% being split evenly between rock and sand (Map 10). Substrate and habitat are critical to fish species that do not provide parental care to their eggs, in other words, the eggs are left after spawning and not tended to by the parent fish. Muskellunge is one species that does not provide parental care to its eggs (Becker 1983). Muskellunge broadcast their eggs over woody debris and detritus, which can be found above sand or muck. This organic material suspends the eggs above the substrate, so they do not get buried in sediment and suffocate. Walleye is another species that does not provide parental care to its eggs. Walleye preferentially spawn in areas with gravel or rock in places with moving water or wave action, which oxygenates the eggs and prevents them from getting buried in sediment. Fish that provide parental care are less selective of spawning substrates. Species such as bluegill tend to prefer a harder substrate such as rock, gravel or sandy areas if available, but have been found to spawn in muck as well.

4.0 SUMMARY AND CONCLUSIONS

The biology and chemistry of Little Saint Germain Lake has been studied intensely over the past decade or more. These studies have included analysis of the lake's water quality, assessments of its watershed, and various surveys of its aquatic plant community. And for the first time, the opinions and comments of the lake's stakeholders were also solicited, as a part of this project. These studies have led to numerous management actions taking place on and in the lake; such as the installation of the aeration system, periodic mechanical harvesting, and the chemical control of Eurasian water milfoil and curly-leaf pondweed-leaf pondweed.

The aeration system is believed to have reduced winterkill and allowed for ice-fishing pressure to be more evenly spread throughout the lake. The control program for Eurasian water milfoil has met with limited success when only the acreage of Eurasian water milfoil treated on a lake-wide basis is considered. However, in the larger picture, this work being completed on the lake has led to better monitoring protocols, increased knowledge relating to treatment timing and dosing, increased volunteer capacity for actively participating in the control program, and maybe most importantly, a better understanding of the Little Saint Germain Lake Eurasian water milfoil population and its dynamic nature, which will likely lead to better results as the lake's second AIS control and prevention project begins.

The curly-leaf pondweed control program has shown definite signs of success, both in terms of a decrease in acreage requiring treatment in 2009 and observed decreases in plant density by Onterra ecologists during spring pretreatment surveys. This success should continue through the second phase of the control program.

At times, native plants may hamper recreation, especially navigation of shoreland property owners and transient boaters. Through periodic and minimal mechanical harvesting efforts, the LSGLPRD has alleviated this issue. Responsible use of mechanical harvesting in Little Saint Germain Lake on an as needed basis should continue following the plan described in the Implementation Plan below.

As discussed in the water quality section, much of Little Saint Germain Lake is considered highly eutrophic to possibly hyper-eutrophic. Water quality has not been truly addressed by any of the management actions initiated for the lake. Currently, the LSGLPRD is working with Barr Engineering to design and implement an alum treatment to reduce internal nutrient loading (Appendix G). While the USGS studies (Appendix F) pointed to inflows from Muskellunge Creek and groundwater inputs as being the major contributors to the lake's annual phosphorus budget, recent studies completed by Barr indicate that internal loading, especially within Lower East and East Bays, also play a significant role.

If internal loading of phosphorus is as high as Barr believes, then minimization of that source through an alum treatment is a logical method to reduce the lake's annual phosphorus load. It may be possible to reduce internal nutrient loading in some lakes through soft sediment consolidation as a result of water level drawdown. However, this would not be applicable to Little Saint Germain as its dam does not have sufficient freeboard to reduce water levels to the point needed in the lake to expose the nutrient-rich sediment areas to open air.

As mentioned above, the 2000 USGS studies (Appendix F) indicate that Muskellunge Creek contributes high loads of phosphorus to Little Saint Germain Lake. The well-drained sand and sandy loams of the creek's drainage basin are thought to be naturally high in phosphorus and thus greatly increase the creek's phosphorus content. Treatment of tributary water to lower phosphorus content could be achieved through the installation of an alum treatment facility near Muskellunge Creek before it enters Little Saint Germain Lake. This alternative, along with that of an in-lake alum treatment were studied by Barr (Appendix G). The in-lake treatment was found to be more feasible. The plan for completing the in-lake alum treatment can be found in Appendix K.

Within the next 5-7 years, the LSGLPRD will need to update its management plan much like it has done with this project. That update will need to revisit the aspects of the lakes discussed above, including its vegetation, water quality, and watershed. Hopefully, the reassessment will document positive changes in the lake ecology due to the AIS control efforts and the completion of the alum treatment. With those concerns reduced, the LSGLPRD should turn much of its focus on improving the lake through improving its immediate watershed, specifically through restoration of native habitat on developed properties and protection of existing habitat on undeveloped properties. The first step in this process would be the completion of a shoreland assessment aimed a documenting the lake's shoreline condition. That information would then be used to create the shoreland restoration and protection plan.

5.0 IMPLEMENTATION PLAN

The Implementation Plan presented below was created through the collaborative efforts of the Little Saint Germain Lake Protection & Rehabilitation District Planning Committee and ecologist/planners from Onterra. It represents the path the LSGLPRD will follow in order to meet their lake management goals. The goals detailed within the plan are realistic and based upon the findings of the studies completed in conjunction with this planning project and the needs of Little Saint Germain Lake stakeholders as portrayed by the members of the Planning Committee, the returned stakeholder surveys, and numerous communications between Planning Committee members and the lake stakeholders. The Implementation Plan is a living document in that it will be under constant review and adjustment depending on the condition of the lake, the availability of funds, level of volunteer involvement, and the needs of the stakeholders.

Management Goal 1: Maintain recreational access to Little Saint Germain Lake for shoreland property owners and other lake users

Management Action: Use contracted mechanical harvesting services to remove nuisance levels of native plants from specific areas of Little Saint Germain Lake to maintain navigational access

Timeframe: Begin 2009

Facilitator: Board of Commissioners

Description: Specific areas of Little Saint Germain Lake have historically supported nuisance levels of native aquatic plant growth. As stated within the aquatic plant section, harvesting normally occurs during a one-week period in late-July or August when submergent plant growth coupled with entangle non-rooted species reduce navigability, upsetting access to and from these areas.

During the summer of 2007, the WDNR released, Aquatic Plant Management Strategy Northern Region WDNR, which offers guidance on management of native plants species (Appendix L). The goal of this strategy is to preserve native species diversity to foster natural habitat as well as to prevent openings for invasive species caused by the removal of native plant species, especially through the use of contact herbicides. This document also clearly states that "no permits for control of native aquatic plants will be issued…unless a (management) plan clearly documents impairment of navigation and/or nuisance conditions."

The LSGLPRD supports reasonable and environmentally sound actions to facilitate access to open water areas of Little Saint Germain Lake. These actions would target nuisance levels of native aquatic plants in order to restore navigability. Reasonable and environmentally sound actions are those that meet WDNR regulatory and permitting requirements and do not impact anymore shoreland or lake surface area required to permit the access. These actions do not include areas that can be controlled through manual removal such as swimming areas and areas around piers and boatlifts.

The areas of Little Saint Germain Lake requiring mechanical harvesting change annually and the harvesting plan needs to be flexible to adapt to the changing situation. The LSGLPRD did not utilize mechanical control methods in 2008 or

2009, demonstrating that they can be objective in determining if the control method is to be implemented. Based upon past harvesting needs of the district, Map 9 displays approximately 180 acres of Little Saint Germain Lake that should be considered for harvesting. The LSGLPRD will contract harvesting services to maintain access to these areas adhering to the following guidelines:

1. The district applies for a multiyear conditional harvesting permit (3 year).
2. The threshold (trigger) for mechanical harvesting to occur is when submergent plants in a given area reach the surface and either disrupt navigability themselves or aggregating masses of coontail and other non-rooted plant species in those areas which manifests the nuisance condition. WDNR may require documentation of the nuisance conditions, possibly through a site visit.
3. Based upon depth data collected during the 2008 point-intercept survey, the littoral zone of Little Saint Germain Lake, excluding West Bay, is approximately 610 acres. The district should not harvest more than 1/8 of the littoral zone (75 acres) in any year.
4. Harvesting activities will not occur if Eurasian water milfoil or curly-leaf pondweed is found within the harvest areas during the time of harvesting. If isolated exotic species occur with a prospective harvest area, LSGLPRD volunteers need to remove the plants using hand harvest or with the aid of a rake. If too many exotic plants exist in the area to be effectively removed in this manner, mechanical harvesting should not occur.
5. A map displaying the finalized harvest areas are provided to the WDNR 14 days prior to the expected harvesting dates.

Action Steps: See description above.

Management Action: Use control methods to maintain lake access for residences on southwest shore of East Bay.
Timeframe: Begin 2009
Facilitator: Board of Commissioners
Description: Figure 3.3-4 indicates the spread of floating-leaf species near the bulrush stand in the southwest corner of East Bay (Map 2). This, along with anecdotal information suggests that the adjacent riparian properties once had access to open water within the past 5-10 years, but now it is being restricted by the increase in both density and area of these native plant beds (see discussion in Aquatic Plant Section).

As illustrated within the management action above, the LSGLPRD understands that native species control should only occur when individual manual removal of a shoreland property owner's shoreline is infeasible. This method is explained in detail within the Aquatic Plant Section. The WDNR Guidance document, Aquatic Plant Management Strategy Northern Region WDNR (Appendix L), clearly states that no individual permits will be issued. If documentation of impairment exists, a permit must be obtained by the district.

The ecology of the area must be seriously considered when considering any control options. Loss of native plants in any area of a lake is unfortunate because they are the foundation of the lake ecosystem. Further, in a lake such as Little Saint Germain where invasive plant species are established, the destruction of native plant stands actually opens additional areas for non-native establishment.

Five possibilities exist to maintain access to open water from the impacted riparian properties.

1. Riparian manually remove 30-foot (length of shore) by 150-foot (out from shore) area without a permit, but all manually removed plants must be taken to shore and the area must include any docks, piers, or swimming areas on the property.
2. Contract to have the plants removed manually, possibly by an aquatic plant nursery or landscaping company, without a permit in the area listed above.

Only applicable when the above possibilities do not feasibly yield lake access

3. Obtain a permit and contract to have the plant manually removed in the form of an access lane.
4. Contract to have the plants cut and removed through mechanical harvesting.

Only applicable when the above possibilities do not feasibly yield lake access

5. Contract licensed applicator to use contact herbicides on target plants.

At this time it is unknown if a contractor exists that is able to manually remove the plants in feasible manner that would create navigation lanes to open water from the shoreland properties. As indicated by Schmidt's Aquatic Plant Control, conventional mechanical harvesting equipment may not be applicable to the area due to shallow water. However, both of these techniques would be preferable over chemical treatments; therefore, those options will be exhausted before herbicide applications are used.

If aquatic plants continue to be at nuisance levels and the first four possibilities listed above have been documented to be infeasible, the use of herbicides will only be considered by the WDNR if all adjacent property owners contain natural buffer areas along their shorelands. Excessive plant growth is associated with increased nutrient levels. Best management practices for shoreland properties to reduce their nutrient loads are to have buffer areas of native plant species at least 30 feet wide along their shorelines. These improvements would provide important shoreline habitat improvement to mitigate the losses of the floating-leaf habitat that would be removed by the control action.

Regardless of the technique used, their impact on the native plant community will be minimized by removing only as much native habitat as necessary in order gain access to open water. No more than a 30-foot wide navigation lane will be cleared in any area and the shortest route possible will be used.

Action Steps:

1. Obtain proper permits from WDNR, if necessary.
2. If chemical herbicides are necessary, contact Vilas County Lake Specialist to discuss necessary steps to begin shoreland restorations on applicable properties.

Management Goal 2: Maintain or Enhance Current Water Quality Conditions

Management Action: Monitor water quality through WDNR Citizens Lake Monitoring Network

Timeframe: Ongoing

Facilitator: Board of Commissioners

Description: Currently monitoring of water quality is conducted by a LSGLPRD volunteer through the Citizens Lake Monitoring Network's advanced protocol. It is important to continue this monitoring as early discovery of negative trends may lead to the reason as to why the trend is developing. The volunteer monitoring of the water quality is a large commitment and new volunteers may be needed in the future as the volunteer's level of commitment changes. It is the responsibility of the facilitator to coordinate new volunteers as needed. Note: as a part of this program, the data collected are automatically added to the WDNR database and available through their Surface Water Integrated Monitoring System (SWIMS) by the volunteer.

Action Steps:

Please see description above.

Management Action: Conduct alum treatment within specified areas of East Bay and Lower East Bay to decrease summer algal blooms and increase water clarity.

Timeframe: Begin 2009

Facilitator: Board of Commissioners

Description: LSGLPRD needs to provide a description for this management action.

Action Steps: Action steps need to be determined.

Management Action: Complete Shoreland Condition Assessment as a part of next management plan update

Timeframe: Next Plan Update

Facilitator: Board of Directors

Description: As the discussed above, unnatural shorelands can negatively impact the health of a lake, both by decreasing water quality conditions as well as removing valuable habitat for fish and other aquatic species that reside within the lake. Understanding the shoreland conditions around Little Saint Germain Lake will serve as an educational tool for lake stakeholders as well as identify areas that would be suitable for restoration.

Shoreland restorations would include both in-lake and shoreline habitat enhancements. In-lake enhancements would include the introduction of course woody debris, a fisheries habitat component lacking around the shores of Little Saint Germain Lake. Shoreline enhancements would include leaving 30-foot no-mow zones or by planting native herbaceous, shrub, and tree species as appropriate for Vilas County. Ecologically high-value areas delineated during the survey would also be selected for protection, possibly through conservation easements of land trusts.

Projects that include shoreline condition assessment and restoration activities will be better qualified to receive state funding in the future. These activities could be completed as an amendment to this management plan and would be appropriate for funding through the WDNR small-scale Lake Planning Grant program.

Action Steps: See description above.

Management Goal 3: Control Aquatic Invasive Species within Little Saint Germain Lake

Management Action: Continue Clean Boats Clean Waters watercraft inspections at Little Saint Germain Public Boat Landing.

Timeframe: 2009

Facilitator: Planning Committee

Description: Since 2005, the Town of Saint Germain has completed grant-funded watercraft inspections on town lakes as a part of their AIS education and prevention program. The town has secured additional WDNR Lake Planning Grant funds to continue this work on the other seven main lakes located within the township. The LSGLPRD maintains two voting seats on the Town Lakes Committee and supports these actions.

Currently the LSGLPRD monitors the public boat landing using training provided by the Clean Boats Clean Waters program. Little Saint Germain Lake is a popular destination by recreationists and anglers, making the lake vulnerable to new infestations of exotic species. The intent of the boat inspections would not only be to prevent additional invasives from entering the lake through its public access point, but also to prevent the infestation of other waterways with invasives that originated in Little Saint Germain Lake. The goal would be to cover the landing during the busiest times in order to maximize contact with lake users, spreading the word about the negative impacts of AIS on our lakes and educating people about how they are the primary vector of its spread.

Due to the large number of activities that volunteers are called upon on Little Saint Germain Lake (AIS monitoring, stakeholder education, ect.), paid watercraft inspectors may be sought to monitor the Little Saint German Lake's single improved public boat landing.

Action Steps: See description above as this is an established program.

<u>Management Action:</u> Coordinate annual volunteer monitoring of aquatic invasive species within Little Saint Germain Lake.

Timeframe: Continuation of existing efforts

Facilitator: Board of Commissioners

Description: Volunteers have been monitoring invasive species on Little Saint Germain Lake since 2002 when curly-leaf pondweed was discovered on the lake. As described earlier in this document, the use of volunteer monitors has evolved over the past few years from random monitoring events with little data tracking to scheduled surveys with effective tracking and transfer of textual and spatial data between the volunteers and professional lake managers.

Volunteers from the LSGLPRD would monitor AIS and other aquatic invasive species within Little Saint Germain Lake using the training they had in 2008 by Onterra staff. This training included identification of target species and native look-a-likes, proper use of GPS for recording aquatic plant occurrences, note taking, and transfer of data utilizing the grant-funded GPS unit. Volunteers were also trained on proper hand removal techniques for varying conditions of water depth and clarity.

Suspicious plants would be marked by knowledgeable lake users (riparians and fishing guides) using the district-owned marker buoys. These locations would later be visited by trained volunteers and assessed whether hand removal is applicable. If applicable, the location would be marked and the plant would be removed. If the location is not suitable for hand removal, the location would be properly marked by the volunteer and notes would be collected reflecting the description of the location (single plant, clump, or colony) and the height of the plant within the water column. During the subsequent aquatic invasive species peak biomass mapping survey, professional ecologists would visit all marked locations including the sites where plants were removed. The results of the professional surveys would be used to create the prospective treatment areas for the following year.

Volunteers would continue their efforts to reduce the occurrence of CLP from Muskellunge Creek. Since it was located in 2006; volunteers have been surveying Muskellunge Creek for this plant. When found, the plant was removed with a rake, as this is the best control method with the soft sediments and the flowing water. These locations would be marked with a GPS before removal and later visited by professional ecologists to verify the control method was successful.

Currently, the only issue hampering the volunteer monitoring program is the lack of volunteers. In order to effectively continue the program, the LSGLPRD must fortify the volunteer base. Once the volunteers are enlisted, a second training session can be held to bring all volunteers up to speed.

Action Steps: See description above.

<u>Management Action:</u> Control Eurasian water milfoil and curly-leaf pondweed infestations within Little Saint Germain Lake using herbicide applications.

Timeframe: Initiate 2009

Facilitator: Board of Commissioners with professional help as needed

Description: As described in the Aquatic Plant section Little Saint Germain Lake contains both Eurasian water milfoil and curly-leaf pondweed. At this time, the most feasible method of control is herbicide applications, specifically, early-spring treatments with 2,4-D to control Eurasian water milfoil and Endothal to control curly-leaf pondweed. The responsible use of this technique is well supported by Little Saint Germain Lake stakeholders as indicated by approximately 89% of stakeholder survey respondents indicating that they believe aquatic plant control is needed on the lake and 66% indicating they are supportive of an herbicide control program (Appendix B, Questions #19 & 20, respectively).

Treatments of Eurasian water milfoil and curly-leaf pondweed have been found to successfully yield control of these species in the past. Further, success has been increased in the past two years with refinements in plant monitoring techniques and refinements in dosages.

The objective of this management action is not to eradicate Eurasian water milfoil or curly-leaf pondweed from Little Saint Germain Lake, as that would be highly unlikely utilizing the current available management techniques. The objective is to bring the invasives down to more easily controlled levels. In other words, the goal is to reduce the amount of Eurasian water milfoil and curly-leaf pondweed to levels that would only require spot treatments to keep them under control. To complete this objective efficiently, a cyclic series of steps is used to plan and implement the treatment strategies. The series includes:

1. A lake-wide assessment of curly-leaf pondweed and Eurasian water milfoil completed while the plant is at peak biomass (June and August, respectively).
2. Creation of treatment strategy for the following spring.
3. Verification and refinement of treatment plan immediately before treatments are implemented.
4. Completion of treatments.
5. Assessment of treatment results.

Once Step 5 is completed, the process would begin again that same summer with the completion of a peak biomass survey. The survey results would then be used to create the next spring's treatment strategy.

Obviously, monitoring is a key aspect of the cycle, both to create the treatment strategy and monitor its effectiveness. The monitoring would also facilitate the "tuning" or refinement of the treatment strategy as the control project proceeds. It must be remembered, that this portion of the management plan (control plan) would be intended to span approximately 5 years, before it would need to be updated to account for changes within the ecosystem. The ability to tune the treatment strategies is important because it would allow for the most effective results to be achieved within the plan's life span.

The impacts to native submersed species are believed to occur when the non-native species reaches an aerial coverage of approximately 50% (dominance). Therefore, by minimizing the occurrence of these dense stands, the exotic's impact on the lake's ecology will also be minimized. An aggressive approach to Eurasian water milfoil management would occur during the multi-year control project where all colonies found to contain dominant densities of Eurasian water milfoil will warrant treatment. Adjacent areas of lesser Eurasian water milfoil density would also be treated in order to adequately target the entire area. New infestations in areas not previously known to contain the exotic species will be prioritized for treatment to reduce the potential for establishment in the area.

Two types of monitoring would be completed to determine treatment effectiveness; 1) quantitative monitoring using WDNR protocols, and 2) qualitative monitoring using observations at individual treatment sites and on a treatment wide basis. Results of both of these monitoring strategies would be used to create the subsequent treatment strategies. The quantitative strategies include sampling plants, both exotic and native species, at predetermined locations (points) within treatment areas, while the qualitative monitoring includes the determination of exotic abundances based upon a continuum of density. The density continuum ranges from non-detectable levels of Eurasian water milfoil and curly-leaf pondweed to what is considered a monoculture where the exotic is essentially the only plant that exists in the area. Both monitoring types would be completed before and after the treatments (pretreatment surveys and post treatment surveys). Comparing the monitoring results from the pretreatment and post treatment surveys would determine the effectiveness of the treatment on a site-by-site basis and on a treatment wide basis. Finally, a lake-wide plant survey (point-intercept survey) would be completed after this management action is completed (5 years) to determine the effectiveness of the intense control program.

Success Criteria

Determining the effectiveness of the treatment program is impossible unless specific success criteria (goals) are set before beginning the program. For this control program, the criteria would be evaluated at three levels

1. Treatment area (site specific)
2. Annual treatment (treatment wide)
3. Control program

Treatment Area

Qualitatively, a successful treatment on a particular site would include a reduction of exotic density as demonstrated by a decrease in density rating.

Quantitatively, a successful treatment on a specific-site level would include a significant reduction in Eurasian water milfoil or curly-leaf pondweed frequency following the treatments as exhibited by at least a 50% decrease in exotic frequency from the pre- and post treatment point-intercept sub-sampling. In other words, if the Eurasian water milfoil or curly-leaf pondweed frequency of occurrence before the treatment was 40%, the post treatment frequency would need to be 20% or lower for the treatment to be considered a success for that particular site. Further, there would be a noticeable decrease in rake fullness ratings within the fullness categories of 2 and 3.

Annual Treatment

Qualitatively, success would be achieved annually when 75% of the treatment areas are reduced by a density rating (as described above).

Similar to the site specific evaluation, annual treatment success would be observed when a 50% decrease in exotic frequency from the sub-sampling occurs. Preferably, there would be no rake tows completed during the post treatment surveys exhibiting a fullness of 2 or 3.

Control Program

At the end of the project, it is hoped that no exotic colonies would exist with a density rating greater than *scattered*. Ecological function of a particular area is thought to be reduced when the exotic becomes the dominant plant.

The control program would be quantitatively evaluated by recompleting the whole-lake point-intercept survey at the end of the project and observing a reduction in frequency of both Eurasian water milfoil and curly-leaf pondweed.

Control Program Specifics

This control program is anticipated to span 5 treatment years. Although it is very difficult, if not impossible, to accurately estimate how many acres of Eurasian water milfoil or curly-leaf pondweed will need to be treated for some number of years in the future, it is obviously needed for budgeting purposes. Based upon the Eurasian water milfoil surveys completed in recent years and the results of recent treatments, a conservative estimate of treatment acreages is listed below. It is conservative in anticipation of some areas requiring treatment for multiple years to reduce densities as discussed in the success criteria.

		Estimated Treatment Acreage	
Project Year	**Treatment Year**	**Eurasian water milfoil**	**Curly-leaf Pondweed**
2009	1	22	55
2010	2	20	55
2011	3	20	20
2012	4	15	20
2013	5	15	10

Project Funding Assistance

Funds from the Wisconsin Department of Natural Resources Aquatic Invasive Grant Program will be sought to partially fund this control program and other elements of this management plan. Specifically, funds would be applied for under the Established Infestation Control Project classification.

Action Steps:

1. Retain qualified professional assistance to develop a specific project design utilizing the cyclic series of steps discussed above.
2. Apply for a WDNR Established Infestation Control Grant based on developed project design.
3. Initiate control plan
4. Revisit control plan in 5 years
5. Update management plan to reflect changes in control needs and those of the lake ecosystem.

Management Action: Monitor residual herbicide concentrations in association with aquatic invasive species control actions

Timeframe: Initiate 2010 or as applicable

Facilitator: Board of Commissioners with professional help as needed

Description: Since 2003, approximately 160 acres worth of granular 2,4-D and 310 acres worth of liquid Endothall have been applied on Little Saint Germain Lake. While these treatments have all be completed within United States Environmental Protection Agency approved label rates, members of the LSGLPRD have requested additional monitoring of these herbicides be conducted on Little Saint Germain Lake.

A current study by the WDNR and the United States Army Corps of Engineers (USACOE) is investigating herbicide concentrations in the water column (residuals) at different locations and lengths of time after treatment. At this time, the focus of the study surrounds the use of liquid 2,4-D, but also includes research on granular 2,4-D and Triclopyr.

As applicable to Little Saint Germain Lake, understanding the residual concentrations of granular 2,4-D within the lake, particularly West Bay, would offer much information in "tuning" an effective long-term control plan. Along with addressing questions of public and ecological health, managers would also learn if the herbicide dose was high enough and sustained long enough to impact Eurasian water milfoil, but also if the dose was too high or sustained for too long that unintended collateral damage to native plants may occur.

This monitoring may not be applicable to all treatments or treatment years, but periodic review of residual herbicide levels may allow a better understanding of herbicide selection and dose to be made.

Action Steps:

1. Retain qualified professional assistance to develop a specific project design in accordance with WDNR recognized and approved protocols.
2. Coordinate and train individuals to collect data at specified locations and time periods following the herbicide treatment (e.g. 3 locations in West Bay on days 1, 3, 7, 14, 21, and 28 after treatment).
3. Send samples to USACOE, State Laboratory of Hygiene, or other testing location to process as specified by WDNR.
4. Integrate results into control strategy as applicable.

Management Action: Monitor native and non-native aquatic plants on a lake wide basis in Little Saint Germain Lake.

Timeframe: Initiate 2013

Facilitator: Board of Commissioners with professional help as needed

Description: Much of the discussion within the study results pertaining to treatment effectiveness revolve around monitoring that was completed in and near the known locations of the exotic colonies, of which the majority are treatment areas. Although repeating these surveys at specific times of the year can lead to an understanding of how the native and non-native plant communities are reacting to the treatments, that data can only be used to make those determinations within the treatment areas and cannot be extrapolated to the effects on the entire lake. This is especially true of the non-target (native) plants. To determine the effects of the control program on a lake wide basis, a survey must be completed that inventories the lake's entire plant community.

The crux of this action will be the repeat completion of the whole lake point-intercept surveys completed in 2004 and 2008. The data collected during the 2013 survey will be compared with the past survey data with the intent of determining the success of the control plan on a lake wide basis and the impact of it on the native plant community of Little Saint Germain Lake.

Action Steps:

Please see description above.

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6.0 METHODS

Aquatic Vegetation

Comprehensive Macrophyte Surveys

Point-intercept Survey

Comprehensive surveys of aquatic macrophytes were conducted on Little Saint Germain Lake to characterize the existing communities within the lake and include inventories of emergent, submergent, and floating-leaved aquatic plants within them. The point-intercept method as described in "Appendix C" of the Wisconsin Department of Natural Resource document, Aquatic Plant Management in Wisconsin, (April, 2008) was used to complete this study in the summer of 2008. A point spacing of 75 meters was used resulting in approximately 699 points.

Community Mapping Survey

During the species inventory work, the aquatic vegetation community types within Little Saint Germain Lake (emergent and floating-leaved vegetation) were mapped using a Trimble GeoXT Global Positioning System (GPS) with sub-meter accuracy. Furthermore, all species found during the point-intercept surveys and the community mapping surveys were recorded to provide a complete species list for the lake.

7.0 LITERATURE CITED

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

Becker, G.C. 1983. Fishes of Wisconsin. The University of Wisconsin Press. London, England.

Canter, L.W., D.I. Nelson, and J.W. Everett. 1994. Public Perception of Water Quality Risks – Influencing Factors and Enhancement Opportunities. Journal of Environmental Systems. 22(2).

Dinius, S.H. 2207. Public Perceptions in Water Quality Evaluation. Journal of the American Water Resource Association. 17(1): 116-121.

Carlson, R.E. 1977 A trophic state index for lakes. Limnology and Oceanography 22: 361-369.

Elias, J.E. and M.W. Meyer. 2003. Comparisons of Undeveloped and Developed Shorelands, Northern Wisconsin, and Recommendations of Restoration. Wetlands 23(4):800-816. 2003.

Great Lakes Indian Fish and Wildlife Service. 1992. Ice fishing regulations Summary: 1837 & 1842 Ceded Territories in WI.

Great Lakes Indian Fish and Wildlife Service. 2004. Seasons of the Ojibwe.

Great Lakes Indian Fish and Wildlife Service. 2010. Interactive Mapping Website. Available at http://www.glifwc-maps.org. Last accessed March 2010.

Jennings, M. J., E. E. Emmons, G. R. Hatzenbeler, C. Edwards and M. A. Bozek. 2003. Is littoral habitat affected by residential development and landuse in watersheds of Wisconsin lakes? Lake and Reservoir Management. 19(3):272-279.

Lillie, R.A., and J.W. Mason. 1983. Limnological characteristics of Wisconsin lakes. Technical Bulletin No. 138. Wisconsin Department of Natural Resources.

Lillie, R.A., S. Graham, and P. Rasmussen. 1993. Trophic state index equations and regional predictive equations for Wisconsin lakes. Research Management Findings 35. Wisconsin Department of Natural Resources.

Mumma, M.T., C.E. Cichra, and J.T. Sowards. 1996 Effects of recreation the submersed aquatic plant community of Rainbow River, Florida. Journal of Aquatic Plant Management 34: 53-56.

Murphy, K.J. and J.W. Eaton. 1983 Effects of pleasure-boat traffic on macrophyte growth in canals. Journal of Applied Ecology 20: 713-729.

Nichols, S.A. 1999. Floristic quality assessment of Wisconsin lake plant communities with example applications. Journal of Lake and Reservoir Management 15(2): 133-141

Radomski, P. and T.J. Goeman. 2001. Consequences of human lakeshore development on emergent and floating-leaf vegetation abundance. North American Journal of Fisheries Management 21: 46-61.

Scheuerell M.D. and D.E. Schindler. 2004. Changes in the Spatial Distribution of Fishes in Lakes Along a Residential Development Gradient. Ecosystems 7: 98–106.

Smith D.G., A.M. Cragg, and G.F. Croker.1991. Water Clarity Criteria for Bathing Waters Based on User Perception. Journal of Environmental Management.33(3): 285-299.

Vermatt, J.E., and R.J. de Bruyne. 1993. Factors limiting the distribution of submerged waterplants in the lowland river Vecht (The Netherlands). Freshwater Biology 30: 147-157.

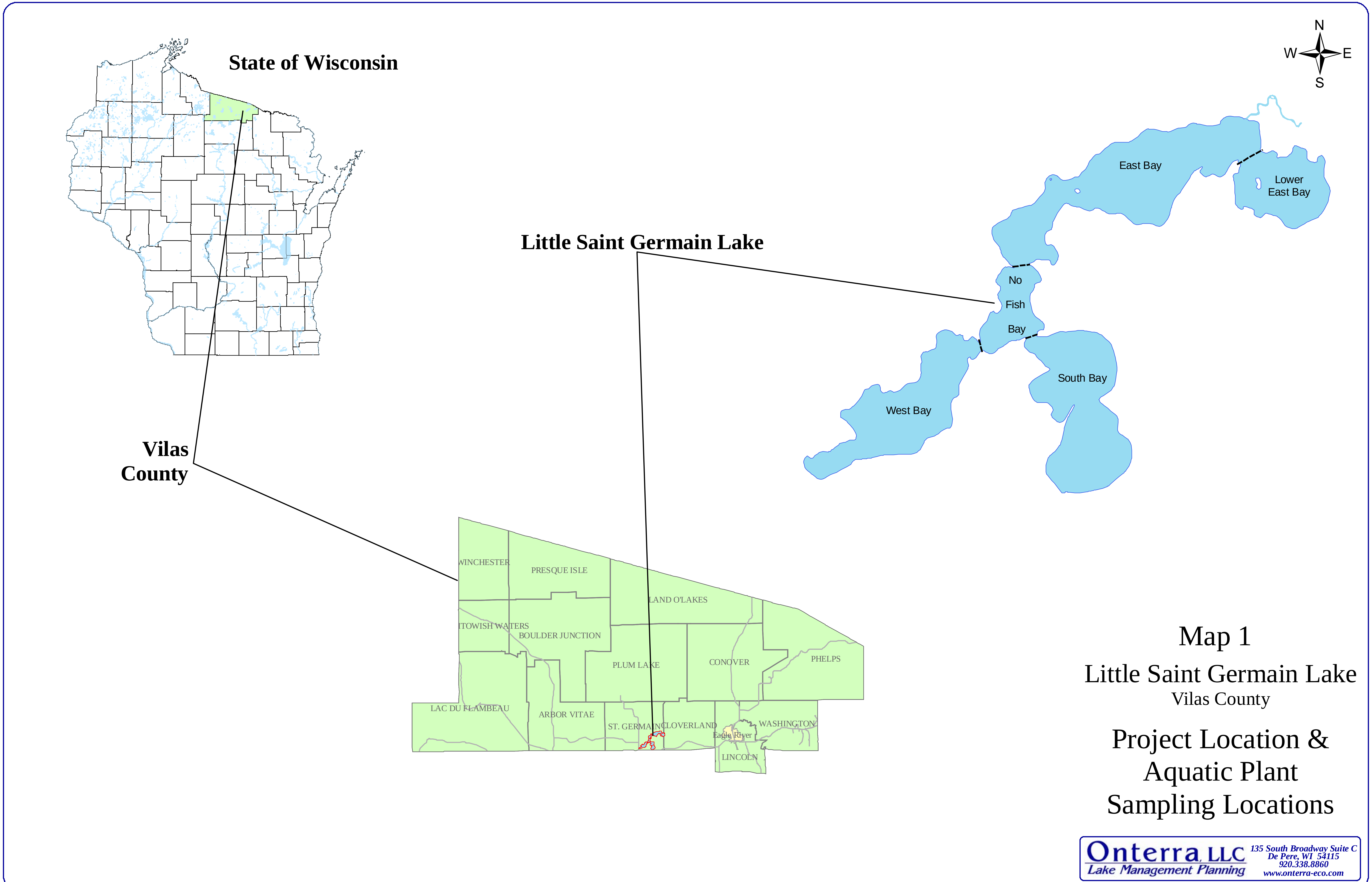
United States Department of the Interior – Bureau of Indian Affairs. 2007. Fishery Status Update in the Wisconsin Treaty Ceded Waters. Fourth Edition.

Wisconsin Department of Natural Resources. 2008a. Aquatic Plant Management in Wisconsin. Available at: http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp. Latest version from April 2008.

Wisconsin Department of Natural Resources. 2008b. Wisconsin Natural Heritage Working List. Available at: http://dnr.wi.gov/org/land/er/wlist/WorkingList_07_09.pdf. Last accessed February 2008.

Wisconsin Department of Natural Resources – Bureau of Fisheries Management. 2010. Fish Stocking Summaries. Available at: http://infotrek.er.usgs.gov/wdnr_public. Last accessed February 2010.

Wisconsin Valley Improvement Company. 2008. Wisconsin Reservoir System Summary: Reservoir Data. Available at: http://www.wvic.com/. Last accessed August 2008.


State of Wisconsin
Vilas County
Little Saint Germain Lake
N
W
E
S
East Bay
Lower East Bay
No Fish Bay
West Bay
South Bay
WINCHESTER
PRESQUE ISLE
LAND O'LAKES
MANITOWISH WATERS
BOULDER JUNCTION
PLUM LAKE
CONOVER
PHELPS
LAC DU FLAMBEAU
ARBOR VITAE
ST. GERMAIN
CLOVERLAND
Eagle River
WASHINGTON
LINCOLN
Map 1
Little Saint Germain Lake
Vilas County
Project Location & Aquatic Plant Sampling Locations
Onterra, LLC
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135 South Broadway Suite C
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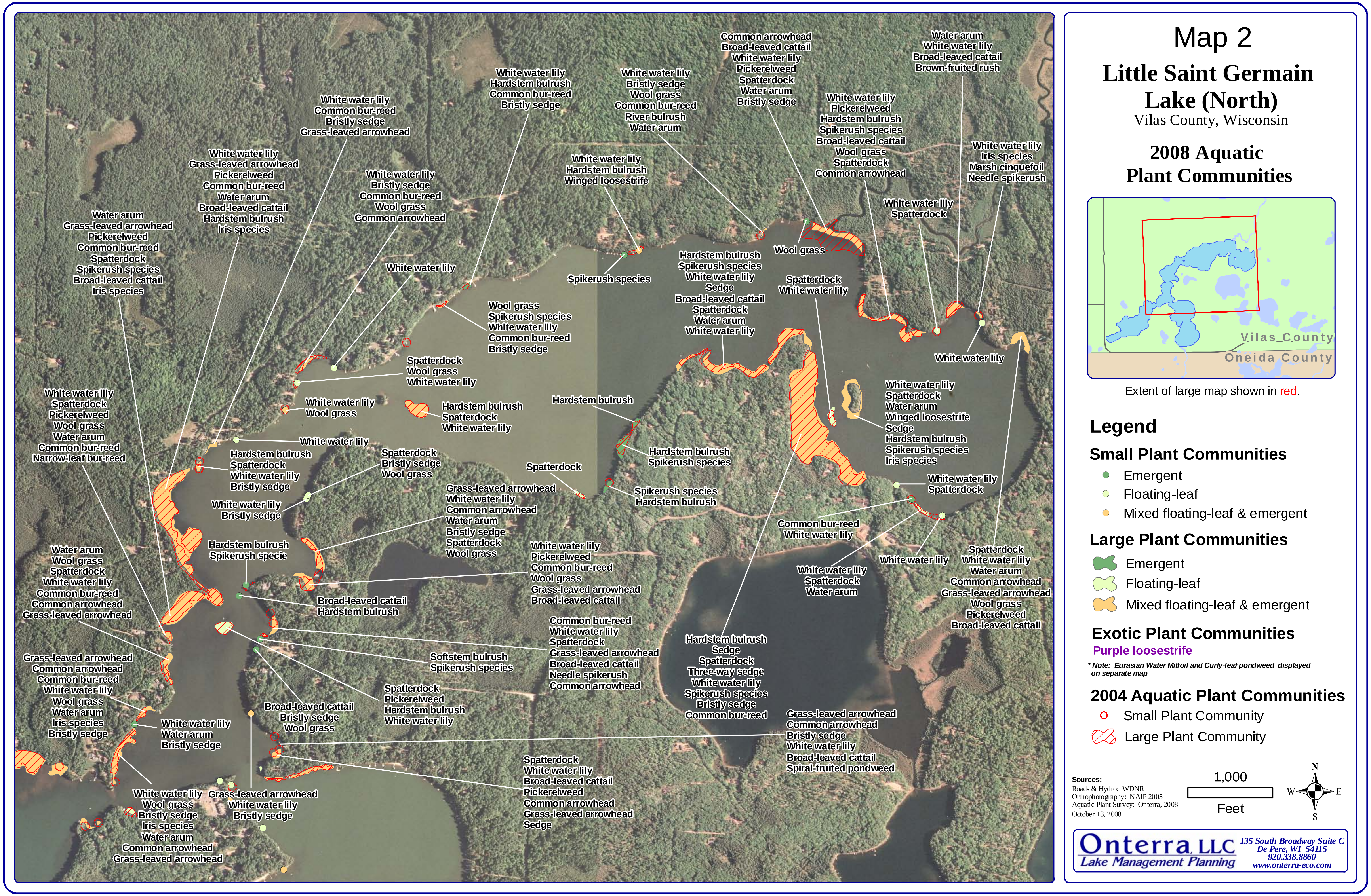
Map 2
Little Saint Germain Lake (North)
Vilas County, Wisconsin
2008 Aquatic Plant Communities
Vilas County
Oneida County
Extent of large map shown in red.
Legend
Small Plant Communities
Emergent
Floating-leaf
Mixed floating-leaf & emergent
Large Plant Communities
Emergent
Floating-leaf
Mixed floating-leaf & emergent
Exotic Plant Communities
Purple loosestrife
* Note: Eurasian Water Milfoil and Curly-leaf pondweed displayed on separate map
2004 Aquatic Plant Communities
Small Plant Community
Large Plant Community
Sources:
Roads & Hydro: WDNR
Orthophotography: NAIP 2005
Aquatic Plant Survey: Onterra, 2008
October 13, 2008
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Feet
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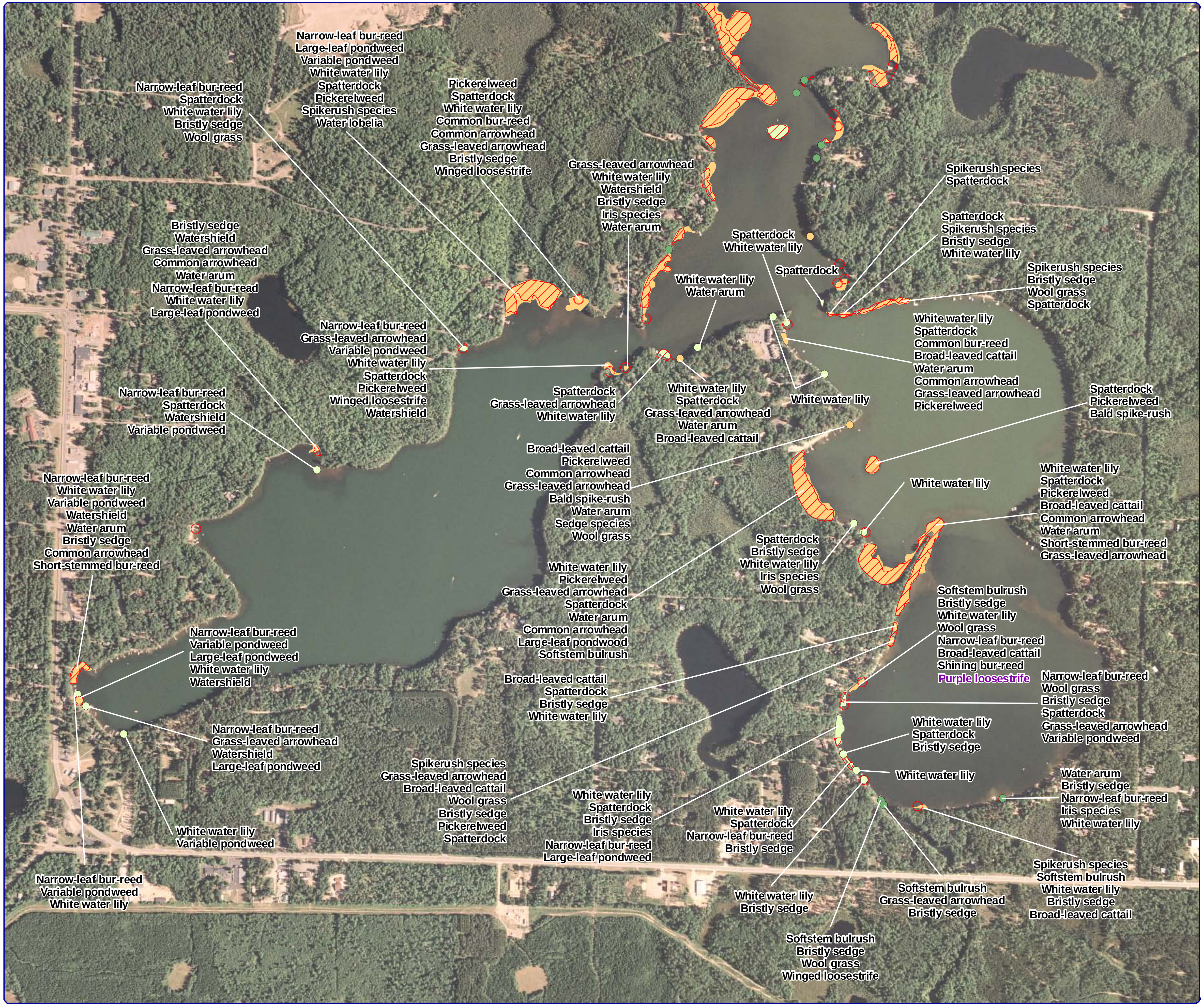
S
Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com
Common arrowhead
Broad-leaved cattail
White water lily
Pickerelweed
Spatterdock
Water arum
Bristly sedge
Water arum
White water lily
Broad-leaved cattail
Brown-fruited rush
White water lily
Hardstem bulrush
Common bur-reed
Bristly sedge
White water lily
Bristly sedge
Wool grass
Common bur-reed
River bulrush
Water arum
White water lily
Common bur-reed
Bristly sedge
Grass-leaved arrowhead
White water lily
Pickerelweed
Hardstem bulrush
Spikerush species
Broad-leaved cattail
Wool grass
Spatterdock
Common arrowhead
White water lily
Iris species
Marsh cinquefoil
Needle spikerush
White water lily
Grass-leaved arrowhead
Pickerelweed
Common bur-reed
Water arum
Broad-leaved cattail
Hardstem bulrush
Iris species
White water lily
Bristly sedge
Common bur-reed
Wool grass
Common arrowhead
White water lily
Hardstem bulrush
Winged loosestrife
White water lily
Spatterdock
Water arum
Grass-leaved arrowhead
Pickerelweed
Common bur-reed
Spatterdock
Spikerush species
Broad-leaved cattail
Iris species
Wool grass
Hardstem bulrush
Spikerush species
White water lily
Sedge
Broad-leaved cattail
Spatterdock
Water arum
White water lily
White water lily
Spikerush species
Spatterdock
White water lily
Wool grass
Spikerush species
White water lily
Common bur-reed
Bristly sedge
White water lily
Spatterdock
Wool grass
White water lily
White water lily
Wool grass
Hardstem bulrush
Spatterdock
White water lily
Hardstem bulrush
White water lily
Spatterdock
Water arum
Winged loosestrife
Sedge
Hardstem bulrush
Spikerush species
Iris species
White water lily
Spatterdock
Pickerelweed
Wool grass
Water arum
Common bur-reed
Narrow-leaf bur-reed
White water lily
Hardstem bulrush
Spatterdock
White water lily
Bristly sedge
Spatterdock
Bristly sedge
Wool grass
Spatterdock
Hardstem bulrush
Spikerush species
Grass-leaved arrowhead
White water lily
Common arrowhead
Water arum
Bristly sedge
Spatterdock
Wool grass
Spikerush species
Hardstem bulrush
White water lily
Spatterdock
White water lily
Bristly sedge
Common bur-reed
White water lily
Hardstem bulrush
Spikerush specie
White water lily
Pickerelweed
Common bur-reed
Wool grass
Grass-leaved arrowhead
Broad-leaved cattail
White water lily
Spatterdock
Water arum
White water lily
Spatterdock
White water lily
Water arum
Common arrowhead
Grass-leaved arrowhead
Wool grass
Pickerelweed
Broad-leaved cattail
Water arum
Wool grass
Spatterdock
White water lily
Common bur-reed
Common arrowhead
Grass-leaved arrowhead
Broad-leaved cattail
Hardstem bulrush
Common bur-reed
White water lily
Spatterdock
Grass-leaved arrowhead
Broad-leaved cattail
Needle spikerush
Common arrowhead
Hardstem bulrush
Sedge
Spatterdock
Three-way sedge
White water lily
Spikerush species
Bristly sedge
Common bur-reed
Softstem bulrush
Spikerush species
Grass-leaved arrowhead
Common arrowhead
Common bur-reed
White water lily
Wool grass
Water arum
Iris species
Bristly sedge
Spatterdock
Pickerelweed
Hardstem bulrush
White water lily
Broad-leaved cattail
Bristly sedge
Wool grass
White water lily
Water arum
Bristly sedge
Grass-leaved arrowhead
Common arrowhead
Bristly sedge
White water lily
Broad-leaved cattail
Spiral-fruited pondweed
Spatterdock
White water lily
Broad-leaved cattail
Pickerelweed
Common arrowhead
Grass-leaved arrowhead
Sedge
White water lily
Wool grass
Bristly sedge
Iris species
Water arum
Common arrowhead
Grass-leaved arrowhead
Grass-leaved arrowhead
White water lily
Bristly sedge

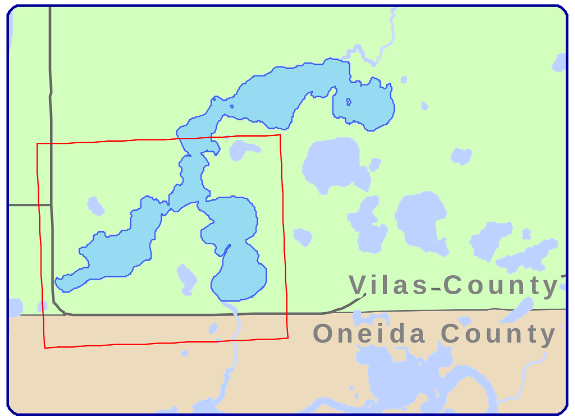


Map 3

Little Saint Germain Lake (South)

Vilas County, Wisconsin

2008 Aquatic Plant Communities



Extent of large map shown in red.

Legend

Small Plant Communities

- Emergent
- Floating-leaf
- Mixed floating-leaf & emergent

Large Plant Communities

- Emergent
- Floating-leaf
- Mixed floating-leaf & emergent

Exotic Plant Communities

Purple loosestrife

** Note: Eurasian Water Milfoil and Curly-leaf pondweed displayed on separate map*

2004 Aquatic Plant Communities

- Small Plant Community
- Large Plant Community

Sources:
Roads & Hydro: WDNR
Orthophotography: NAIP 2005
Aquatic Plant Survey: Onterra, 2008
October 13, 2008

950
Feet

N S W E

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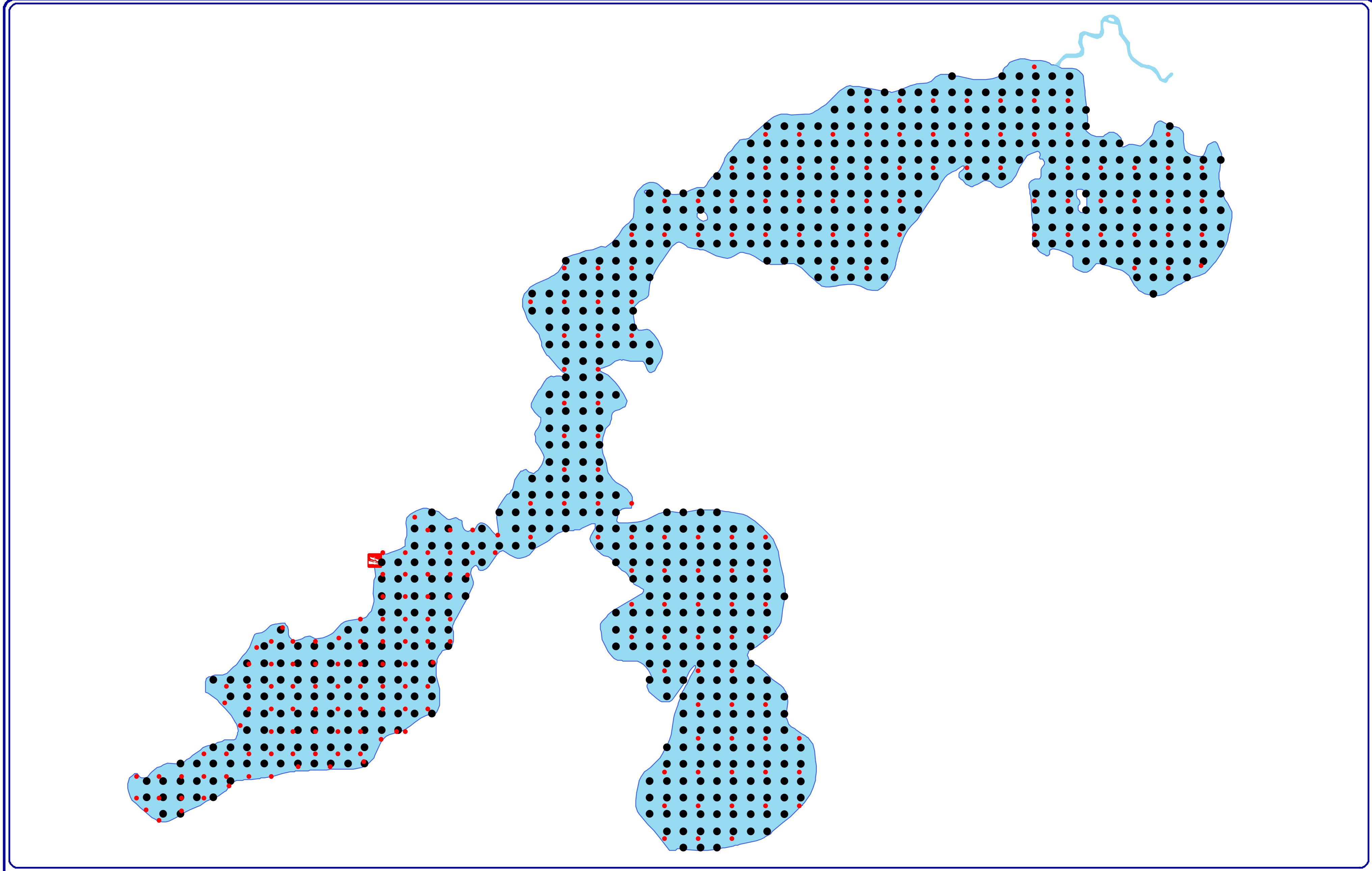

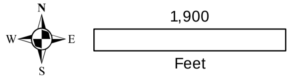

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135 South Broadway Suite C
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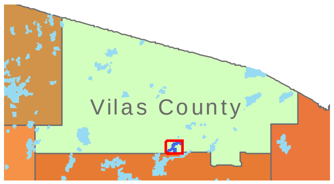
920.338.8860
www.onterra-eco.com

Sources:
Roads & Hydro: WDNR
Treatment Areas: Onterra, Sept. 2008
Aquatic Plants: Onterra, Sept. 2008
Map date: June 4, 2008



Extent of large map shown in red.

Legend

- 2008 Point-intercept Sample Location *(75-m spacing)*
- 2004 Point-intercept Sample Location *(150-m spacing in all basins, except 100-m spacing in West Bay)*

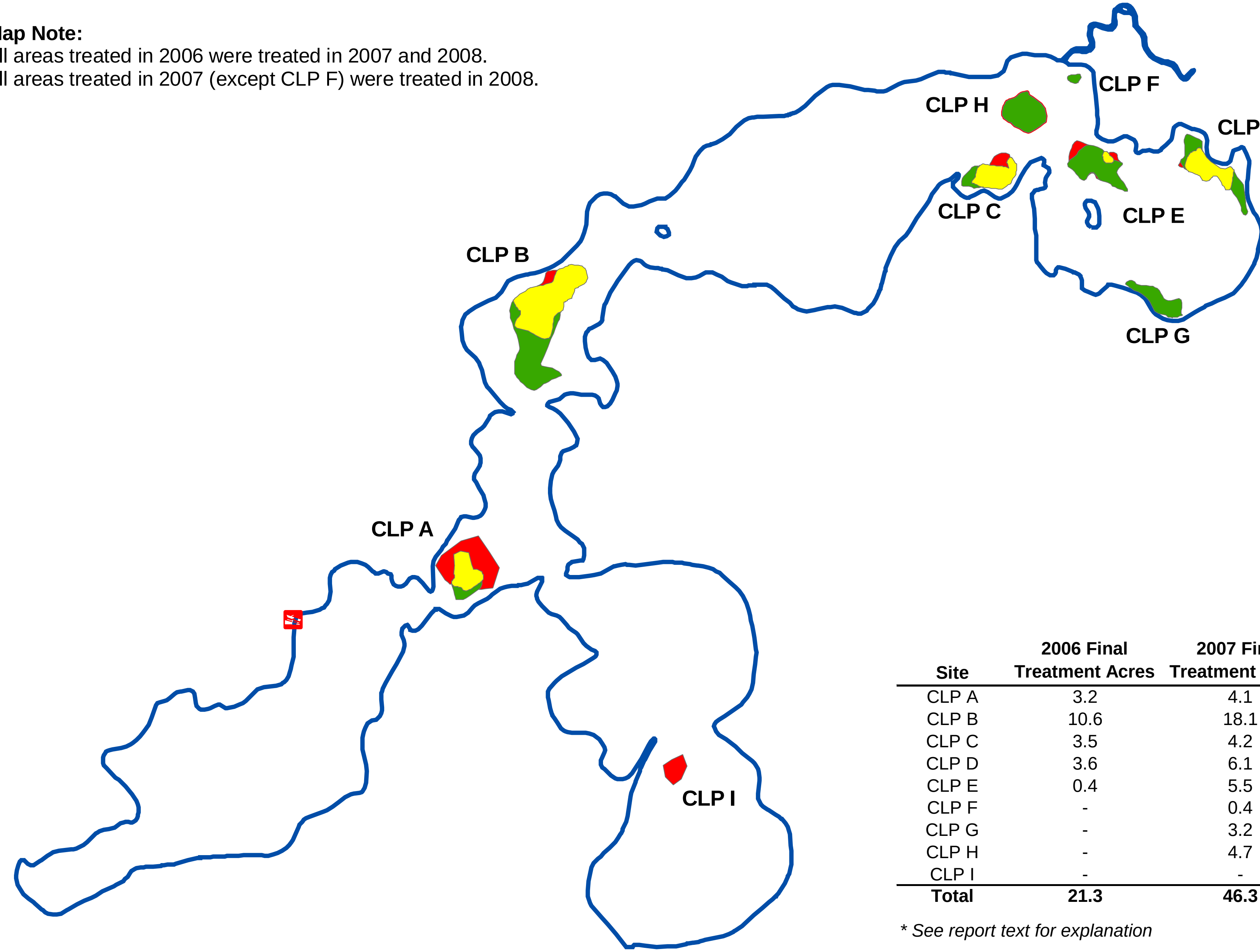
Map 4

Little Saint Germain Lake

Vilas County, Wisconsin

2004 & 2008 Point-intercept Sample Locations

Map Note:
All areas treated in 2006 were treated in 2007 and 2008.
All areas treated in 2007 (except CLP F) were treated in 2008.



Site	2006 Final Treatment Acres	2007 Final Treatment Acres	2008 Final Treatment Acres
CLP A	3.2	4.1	9.9
CLP B	10.6	18.1	18.6
CLP C	3.5	4.2	5.1
CLP D	3.6	6.1	6.1
CLP E	0.4	5.5	6.3
CLP F	-	0.4	Not Treated*
CLP G	-	3.2	3.2
CLP H	-	4.7	4.7
CLP I	-	-	1.8
Total	**21.3**	**46.3**	**55.7**

** See report text for explanation*

N W E S
2,000
Feet

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De Pere, WI 54115
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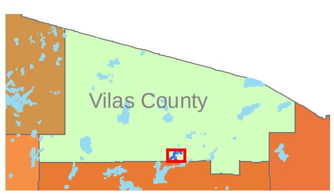
www.onterra-eco.com

Sources:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2006,2008
Bathymetry: WDNR
Map date: October 28, 2008



Extent of large map shown in red.

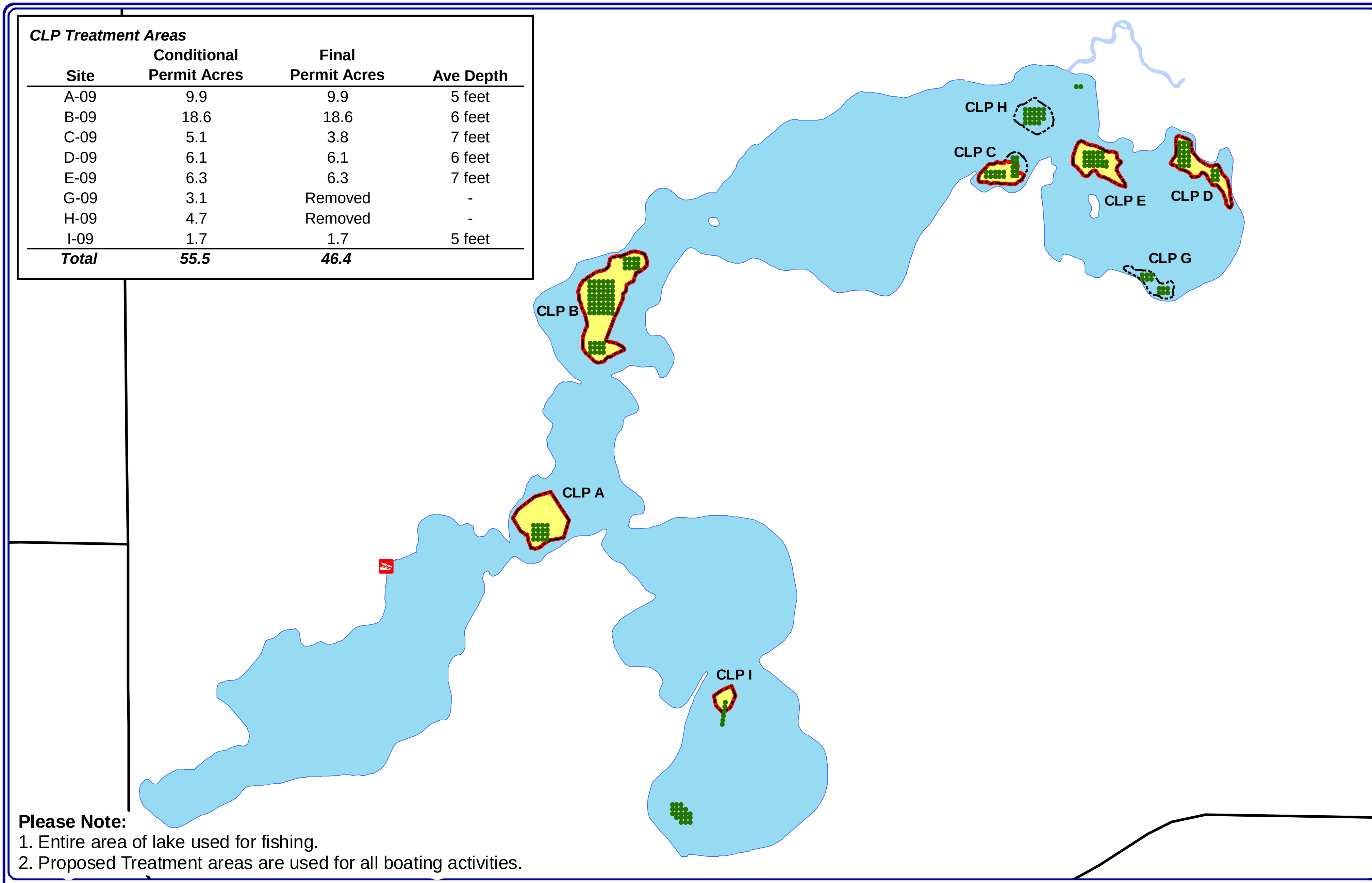
Legend

- 2006 Treatment
- Additional Areas included in 2007 Treatment
- Additional Areas included in 2008 Treatment

Map 5
Little Saint Germain Lake
Vilas County, Wisconsin
2006-2008 CLP Treatment Areas

CLP Treatment Areas

Site	Conditional Permit Acres	Final Permit Acres	Ave Depth
A-09	9.9	9.9	5 feet
B-09	18.6	18.6	6 feet
C-09	5.1	3.8	7 feet
D-09	6.1	6.1	6 feet
E-09	6.3	6.3	7 feet
G-09	3.1	Removed	-
H-09	4.7	Removed	-
I-09	1.7	1.7	5 feet
Total	***55.5***	***46.4***	



Please Note:
1. Entire area of lake used for fishing.
2. Proposed Treatment areas are used for all boating activities.

N
W E
S
1,900
Feet

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135 South Broadway Suite C
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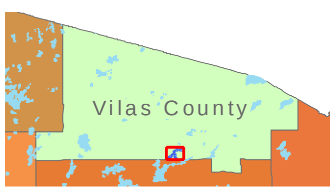
www.onterra-eco.com

Sources:
Roads & Hydro: WDNR
Aquatic Plant Surveys: Onterra 2008-09
Map date: February 4, 2010



Extent of large map shown in red.

Legend

- 2008 Final CLP Treatment Area (Used as 2009 Conditional Pemit Acres)
- 2009 Final CLP Treatment Area
- Point-intercept Sub-sample Location

Map 6
Little Saint Germain Lake
Vilas County, Wisconsin

2009 Final CLP Treatment Areas

2010 Proposed Treatment Areas

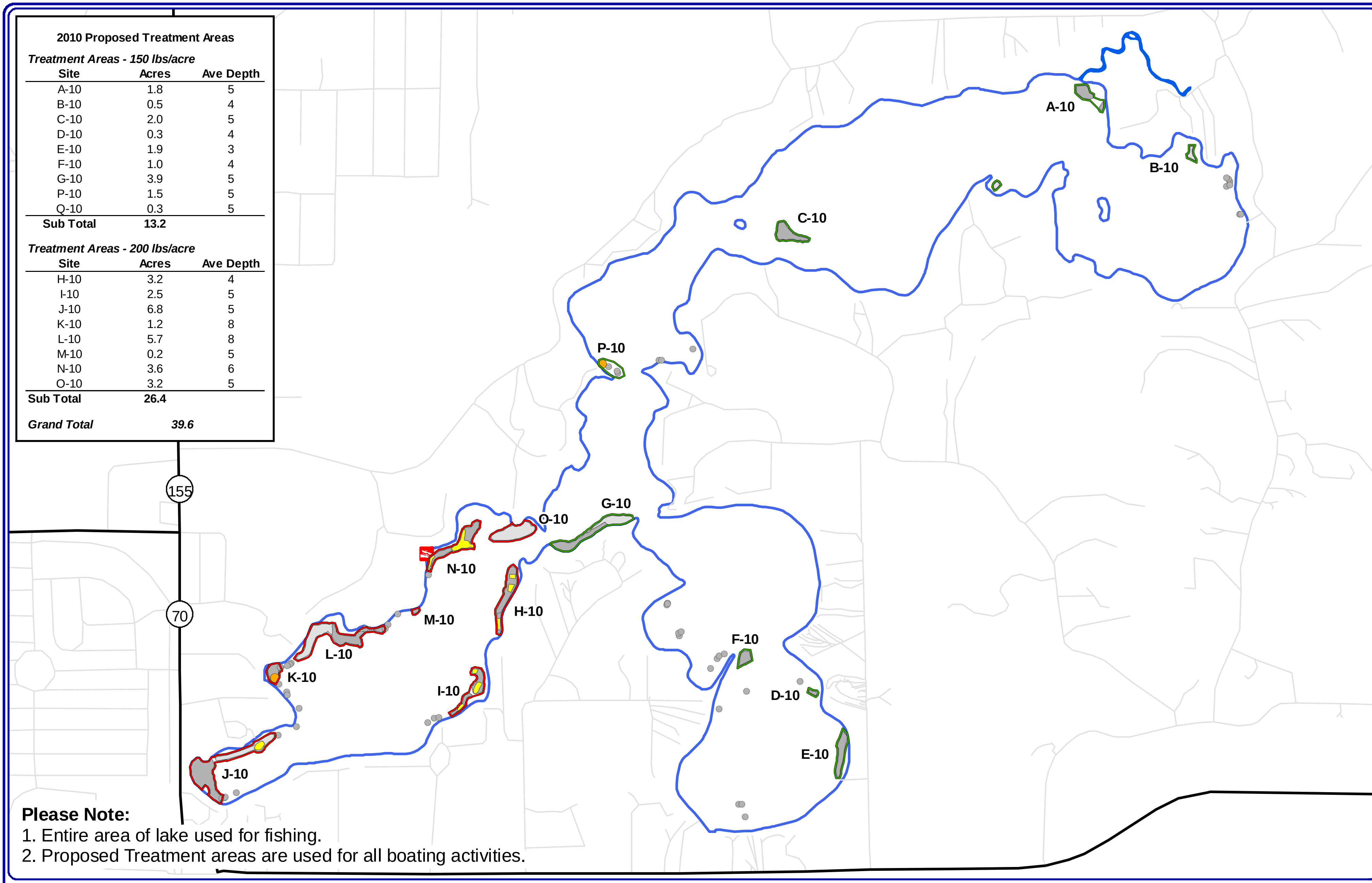
Treatment Areas - 150 lbs/acre

Site	Acres	Ave Depth
A-10	1.8	5
B-10	0.5	4
C-10	2.0	5
D-10	0.3	4
E-10	1.9	3
F-10	1.0	4
G-10	3.9	5
P-10	1.5	5
Q-10	0.3	5
Sub Total	**13.2**	

Treatment Areas - 200 lbs/acre

Site	Acres	Ave Depth
H-10	3.2	4
I-10	2.5	5
J-10	6.8	5
K-10	1.2	8
L-10	5.7	8
M-10	0.2	5
N-10	3.6	6
O-10	3.2	5
Sub Total	**26.4**	

Grand Total ***39.6***



Please Note:

1. Entire area of lake used for fishing.
2. Proposed Treatment areas are used for all boating activities.

N W E S

1,900

Feet

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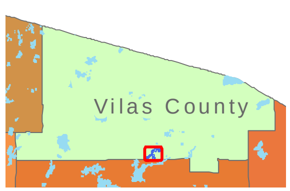
www.onterra-eco.com

Sources:
Roads & Hydro: WDNR
Aquatic Plants Surveys: Onterra 2009
Map date: December 8, 2009



Extent of large map shown in red.

EWM Survey Results (Sept 2009)

- Few or Single Plants
- Small Plant Colony
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant *(none found)*
- Surface Matting *(none found)*

2010 Proposed EWM Treatment Areas

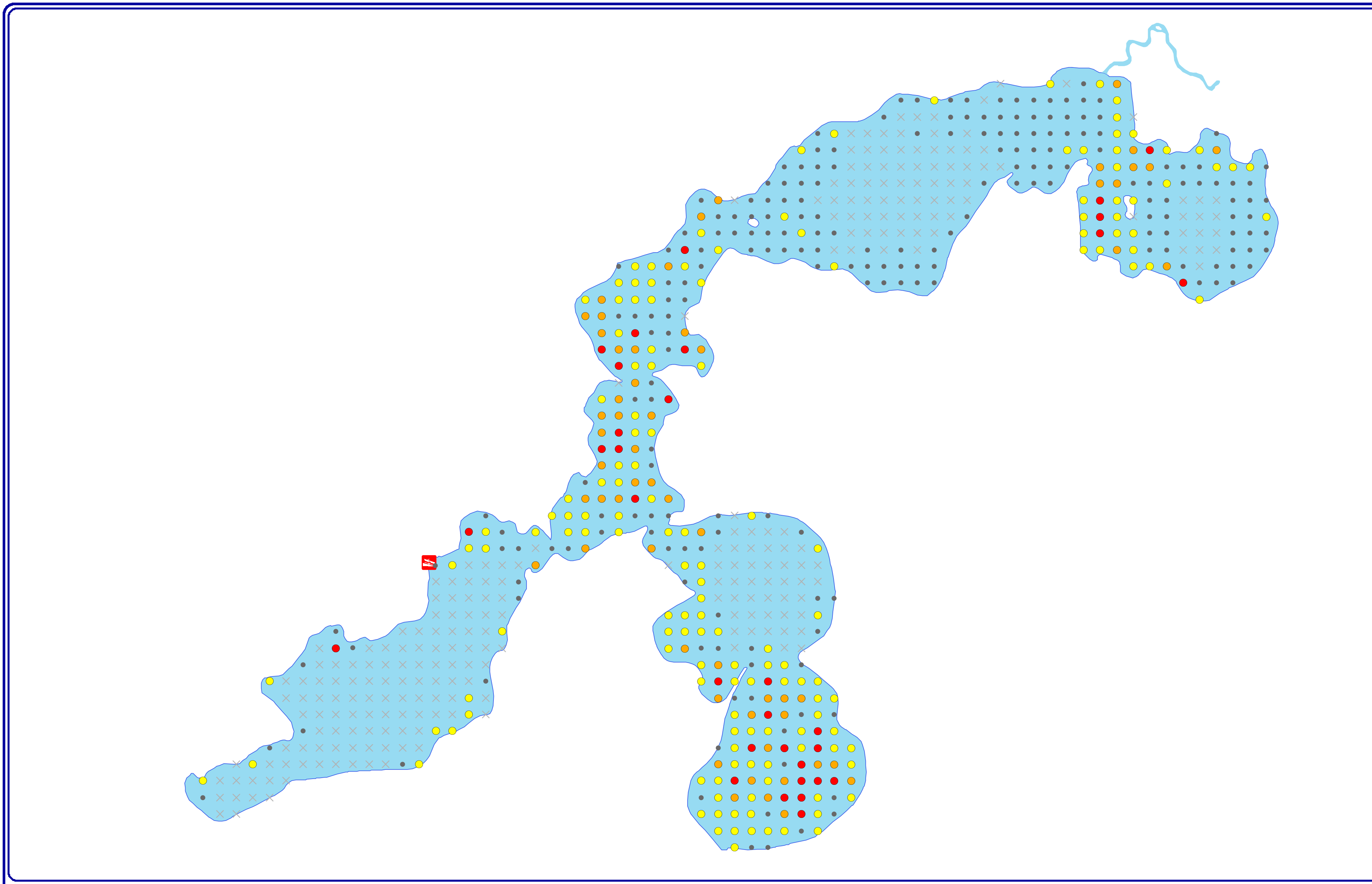
- 150 lbs/acre
- 200 lbs/acre
- Public Boat Landing

Map 7

Little Saint Germain Lake

Vilas County, Wisconsin

2009 EWM Densities and 2010 Proposed Treatment Areas



N
W E
S

1,900

Feet

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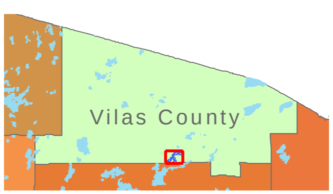
Sources:
Roads & Hydro: WDNR
Treatment Areas: Onterra, Sept. 2008
Aquatic Plants: Onterra, Sept. 2008
Map date: February 18, 2010



Extent of large map shown in red.

Legend

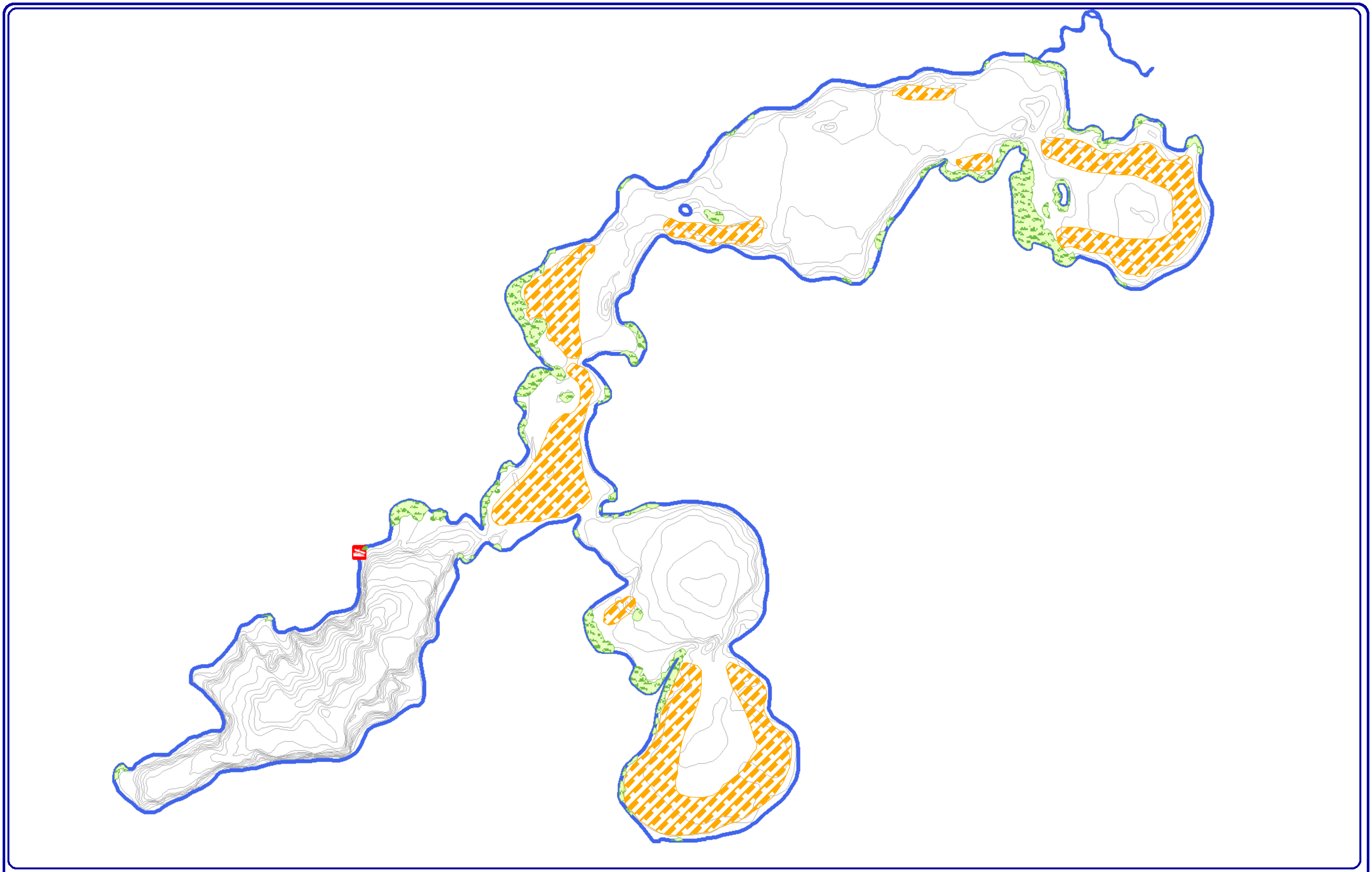
- Rake Fullness = 1
- Rake Fullness = 2
- Rake Fullness = 3
- None Found
- Too Deep for Plant Groth

Map 8

Little Saint Germain Lake

Vilas County, Wisconsin

2008 P-I Survey: Coontail Locations



N
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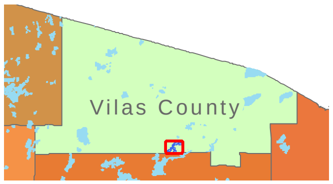
Feet



Extent of large map shown in red.

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Sources:
Roads & Hydro: WDNR
Treatment Areas: Onterra, Sept. 2008
Aquatic Plants: Onterra, Sept. 2008
Map date: February 18, 2010

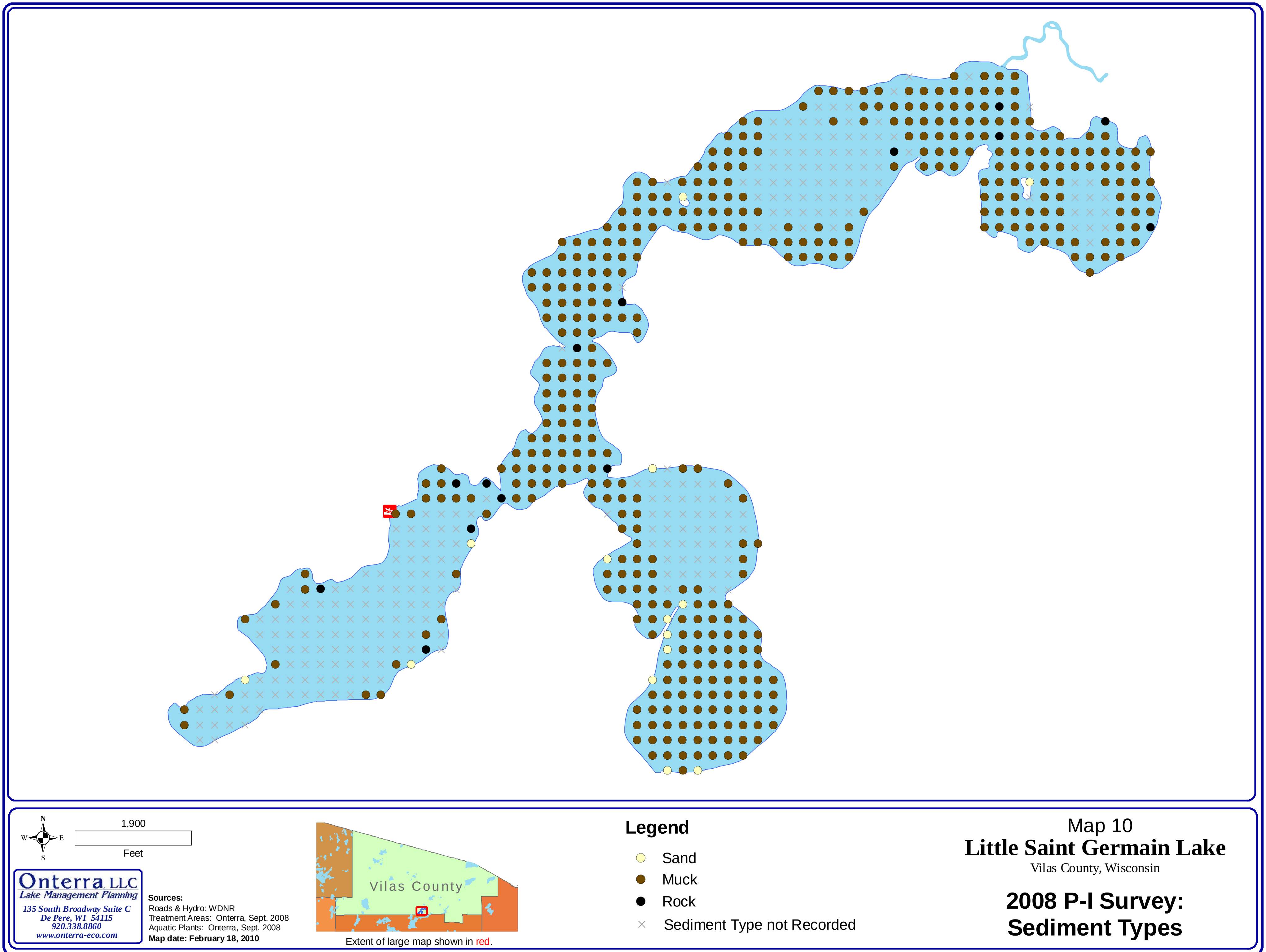
Legend

Potential Harvest Areas

Emergent and/or Floating-leaf Plant Communities

Map 9
Little Saint Germain Lake
Vilas County, Wisconsin

Potential Mechanical Harvest Locations



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Sources:
Roads & Hydro: WDNR
Treatment Areas: Onterra, Sept. 2008
Aquatic Plants: Onterra, Sept. 2008
Map date: February 18, 2010

Map 10
Little Saint Germain Lake
Vilas County, Wisconsin

2008 P-I Survey: Sediment Types