Aquatic Plant Management Plan

Solberg Lake

Solberg Lake Association

December 2012

AQUATIC PLANT MANAGEMENT PLAN
SOLBERG LAKE

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1.0 Executive Summary

The Solberg Lake Association (SLA) was formed in 1981 to address resource management concerns on Solberg Lake. The Association has been active in a number of lake management activities on Solberg Lake including aquatic plant management, invasive species monitoring and control, habitat improvements, boat landing monitoring and community education activities. SLA contracted Flambeau Engineering, LLC to develop an aquatic plant management (APM) Plan for Solberg Lake. The Solberg Lake APM Plan includes a review of available lake information, an aquatic plant survey, water quality evaluation and an evaluation of feasible physical, mechanical, biological and chemical aquatic plant management alternatives if deemed appropriate. The APM Plan also recommends specific management activities for aquatic invasive species (AIS) and native vegetation in the lake system which are discussed below.

Flambeau Engineering completed an aquatic plant survey on Solberg Lake in 2011, which identified 20 aquatic plant species. The most abundant aquatic plants identified during the survey were watershield, wild celery and floating-leaf bur-reed. The Floristic Quality Index (FQI) is an index that uses the aquatic plant community as an indicator of lake health. Solberg Lake exhibited an FQI of 28.3, higher than the state northern ecoregion average (24.3).

Recommended Aquatic Plant Management Plan

One aquatic invasive plant was observed during the aquatic plant survey in 2011; curly-leaf pondweed (*Potamogeton crispus* – CLP). This species had been previously identified within the lake and actively managed. Management of the AIS will help prevent its spread within Solberg Lake and to other lakes. The Recommended Action Plan created for the lake focuses on AIS control and public education.

The following Active Goals form the structure of the Solberg Lake Aquatic Plant Management Plan:

Active Goal: Effectively manage CLP to improve recreation and rehabilitate native plants.
Active Goal: Improve navigation through Squaw Creek, Disappearing Creek and Comfort Cove.
Active Goal: Implement and maintain an aquatic invasive species monitoring program that will survey for invasive species, and if found, monitor their locations and extent of population spread.
Active Goal: Continue and expand the Solberg Lake comprehensive water quality monitoring program through the WDNR Citizen Lake Monitoring Network. The program would include Water Clarity Monitoring and Water Chemistry Monitoring.
Active Goal: Continue and expand the Clean Boats, Clean Waters program on Solberg Lake.
Active Goal: Prevent the spread of existing and introductions of new of AIS by educating lake users.
Active Goal: Promote shoreland protection and restoration to improve water quality and habitat.

2.0 Introduction

Solberg Lake is located in the Town of Worcester in central Price County in T38N, RIE, S16, 20, 21, 28 and 29. Solberg Lake was created in 1940 by damming Squaw Creek; the dam was constructed as a Works Program Administration (WPA) project. The dam has 15-foot of head and the outflow is estimated to average 14.4 cubic feet/s. Solberg Lake is 859 acres and has a long, irregular shape with 11 islands and 12.4 miles of shoreline. The lake is fed by Squaw Creek from the north, Disappearing Creek from the west and three unnamed creeks from the east. The shoreline is 94% upland, 5% sedge marsh and 1% leatherleaf bog. The littoral bottom is composed mainly of sand with small amounts of gravel, rubble, bedrock and muck. Aquatic vegetation is common throughout the littoral area of the lake with heavy stands in the quiet bays and up the inlets of Squaw Creek, Disappearing Creek and in Comfort Cove. Solberg Lake is classified as a drainage lake and it has a relatively large watershed that covers 17,438 acres. The watershed is composed of forest land (53.5%) wetlands (39%), water (5%) and residential development (2.5%). There are four public and two private boat landings, Solberg Lake County Park (County Park) (contains one of the boat landings, campground, picnic area and beach), two private campgrounds and two resorts that offer plenty of access to the water. These ample access and recreational areas draw statewide users to this area of Price County.

Historically, Solberg Lake has been a great draw for fisherman and hunters from around Wisconsin and the Midwest. The lake is used heavily by nesting and migratory ducks. A large population of Canada geese also call the lake home. Muskellunge, walleyes, perch, largemouth bass, black crappies, pumpkinseeds, black bullheads, white suckers and minnows make up the fish population. Numerous publications and magazines list the waters of Solberg Lake as a top destination in the State for fishing opportunities. Many fishing tournaments have been held on its waters while it remains a popular destination for walleye and musky fisherman. Because of its high use and value to the community, State and Midwest, the Solberg Lake Association (SLA) was formed in 1981 to protect and enhance recreational opportunities on the lake for future generations. The SLA holds an annual meeting at Solberg Lake County Park to promote community involvement in the lake and conducts a raffle as a fund raiser. Several brat sales are held to raise funds and awareness regarding invasive species issues also.

Solberg Lake contains a diverse aquatic plant community (24 species in 2002, 20 species in 2011) and has several Critical Habitat Ares designated and mapped by the WDNR. Solberg Lake is also home to rare, aquatic plant species with an identified Natural Heritage Inventory species present within the lake. This allows the lake to be classified as an Area of Special Natural Resource Interest (ASNRI); a Slow No Wake Ordinance on the lake protects two of the designated areas. It is also a Priority Navigable Waterway due to naturally reproducing walleye and musky populations. Though the aquatic ecosystem in Solberg Lake is very diverse, the aquatic invasive species (AIS) curly-leaf pondweed (CLP) was confirmed within the lake in 2002; at this time a single plant was found and removed. Since this single plant was found it has spread to several isolated locations throughout the lake; the Association and landowners have been hand-pulling the CLP plants on an annual basis to try to control the spread. Solberg Lake gets substantial use from the visitors of the County Park. Though good for the community, this diverse and expansive user group presents a unique and extensive threat for the introduction of new AIS or the spread of existing AIS to not only surrounding water bodies, but to any water bodies that both fishermen & vacationers may use.

An APM Plan was written in 2002 for Solberg Lake, the SLA has set in action steps to update the outdated document to protect Solberg Lake and other water bodies from the threat of AIS and to educate the lake users on AIS. SLA sought matching funds (**65% State and 35% Association shares**) from the Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Education, Prevention and Planning Grant program to update the APM Plan, to recommend methods for treatment and control of CLP and to educate the public on AIS.

Solberg Lake offers the following recreational opportunities and extended benefits for visitors and local community:

- Recreational boating
- Waterskiing
- Fishing
- Wildlife viewing
- Pontoon boating
- Non-motorized watercraft use
- Aesthetic beauty
- Important habitat for fish and wildlife
- Waterfowl hunting
- Swimming
- Snowmobiling
- Revenue for local and surrounding communities including real estate taxes and tourism dollars

This document is the APM Plan for Solberg Lake and discusses the following:

- Lake morphology and lake watershed characteristics
- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2011 aquatic plant survey data
- Feasible aquatic plant management alternatives
- Selected suite of aquatic plant management recommendations

Two public meetings were held to discuss the APM Plan. The first was held in Spring 2011 to kickoff the project and explain to the attendees the purpose of the project. A component of the presentation was AIS education. Attendees were introduced to both plant and animal AIS identification and impacts to lake resources. A second meeting was held in December 2011 to present the APM Plan and gather public input. The majority of attendees agreed that the aquatic plants in Disappearing Creek, Squaw Creek and Comfort Cove need some type of management to allow access and recreational use. Many attendees felt widespread management of the native vegetation would be an improvement on the lake due to navigation and recreation issues caused by dense vegetation. All agreed that CLP should be managed with the goal of controlling spread to other areas of the lake. One issue that was brought up is the goose population on the lake and the problems they cause. It seems there is a rather large population of geese that congregate on lawns and cause problems with goose droppings. A question was raised on the impact these geese may have on water quality in the lake. Although it would be difficult to determine what impact this has on water quality, animal waste is a source of phosphorous and e. coli. Steps may be taken to discourage the geese from congregating on lawns. Fencing along the shoreline, not feeding the geese, maintaining/restoring a natural buffer of tall grasses and shrubs may help deter the geese. Encouraging goose hunting may help to reduce the population also.

3.0 Baseline Information

Following is baseline information on the lake and surrounding watershed. This information provides background on the lake.

3.1 Lake History and Morphology

Solberg Lake is located in the Town of Worcester in central Price County, Wisconsin. The lake is part of the Squaw Creek system that drains to the south into the Phillips Chain of Lakes. Figure 1 (included in Figures Section) depicts the lake location. The following summarizes the lake's physical attributes:

Lake Name	Solberg Lake
Lake Type	Drainage
Surface Area (acres)	859
Maximum depth (feet)	16
Mean depth (feet)	8
Volume (ac-ft)	6,920
Littoral Area	15%
Watershed:Lake Ratio	19:1
Residence Time (yrs)	0.5
Shoreline Length (miles)	12.4
Number of Islands	11
Public Landing	Yes

Source: Wisconsin Lakes, WDNR 2005 and WDNR Lake Survey map, 1969

Figure 2 (included in Figures Section) illustrates the lake bathymetry. Solberg Lake is 859 acres and has a long, irregular shape with 11 islands and 12.4 miles of shoreline. The lake is fed by Squaw Creek from the north, Disappearing Creek from the west and three unnamed creeks from the east.

3.2 Watershed Overview

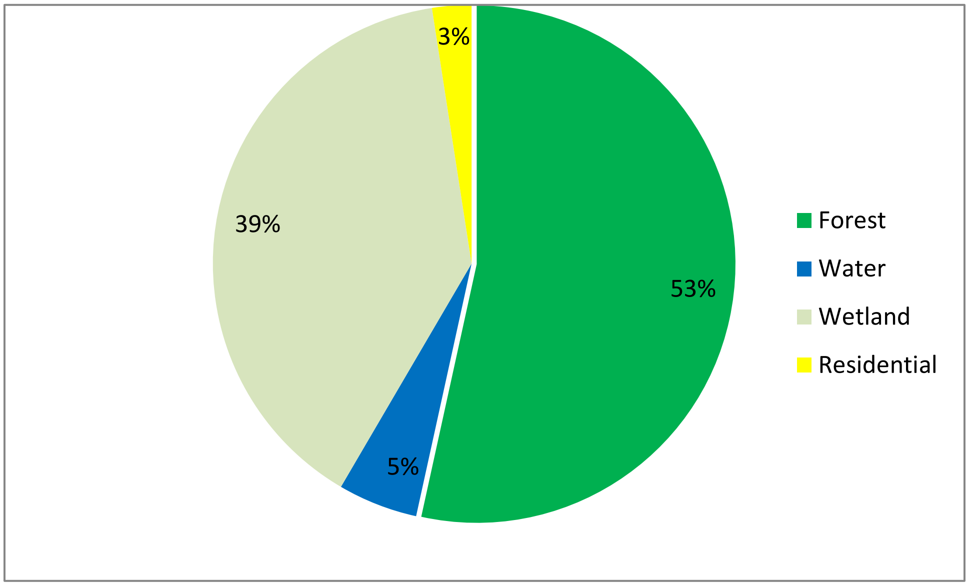
A review of existing data was completed to gather information on the watershed of Solberg Lake. A comprehensive lake plan was completed in 1993 that contained the following data on the watershed. The watershed encompasses approximately 17,438 acres. It is mostly forested with a ring of development around the shoreland. The following table lists the land use and area of each.

Table 1 Watershed Landuse Area in Acres

Land Use	Percentage	Acres
Forest	53.5	9808
Water	5	915
Wetland	39	7180
Urban-Residential	2.5	450

The following figure depicts the land use as a percent of the watershed area.

Figure 3 - Watershed Landuse Percent of Area



3.3 Water Quality

WDNR Lake Water Quality Database indicates that the following water quality information is available

- Water clarity (Secchi depth) - 1990-1992, 2000-2001, 2006
- Total phosphorus – 1973-1975, 1991, 2011
- Chlorophyll a – 1973-1975, 1991, 2011

The parameters listed above are commonly used to assess water quality of lakes. Secchi depth is used to measure water clarity and light penetration. Total phosphorus is a measure of nutrients available for plant growth. Chlorophyll a is green pigment present in all plant life and necessary for photosynthesis. These three parameters are used to evaluate the trophic status of a lake. The trophic state index (TSI) ranges along a scale from 0-100 and is based upon relationships between secchi depth and surface water concentrations of chlorophyll a and total phosphorus. The higher the TSI the lower the water quality of the lake. The TSI of Solberg Lake is currently 58 indicating eutrophic conditions. All of the water quality parameters mentioned above are further discussed in subsequent sections of this report.

3.4 Summary of Lake Fishery

In 2010 a Fishery Management Plan was completed for Solberg Lake by WDNR. The fishery information was reviewed for this report. Solberg Lake supports a good fishery that draws fishermen from near and far to the lake. The lake has good diversity with 14 species identified in the netting and electrofishing surveys conducted on the lake from 1957 to 2003. The following species have been identified on the lake:

- Bluegill
- Walleye
- Black crappie
- Yellow perch
- Muskellunge
- Smallmouth bass
- Largemouth bass
- Northern pike
- Bullheads
- Rock bass

The diversity of Solberg is lower than the downstream Phillips Chain where the number of species range from 16 to 25. Solberg likely has greater diversity than documented due to the single-species target of the past surveys; surveys were conducted to assess walleye population.

Stocking of various species has occurred over the years on the lake. Stocking of muskellunge has taken place on the lake from 1952 to 2000. In early stocking efforts small (2 to 4 inches) and large (9 to 13 inches) fingerling were stocked in two or more annual shipments. After 1977 only large fingerling were planted at a density of 1 or 2 per acre. By 1960 angler success and survey results indicated a good musky population. Surveys conducted in 1980's and 1990 have indicated evidence of natural reproduction. In 2001 musky stocking in the lake was suspended as part of a 10-year evaluation on the effects of stocking and recruitment of naturally reproducing musky.

Not long after musky stocking first began walleye were introduced to the lake. In 1956, 1958 and 1960 8,100 walleye fingerlings were stocked to reduce the perceived overabundance of black crappie. The first attempt to establish walleye was largely unsuccessful. In 1961 80,000 walleye fingerlings were planted which resulted in a self-sustaining population of walleye that no longer required stocking. By 1971 the walleye population appeared to have an effect on the panfish population; panfish abundance had declined. In that same year 7,266 bluegill and pumpkinseed were stocked. Stocking of panfish ceased until 33,400 yellow perch were stocked from 1999 to 2003 and again in 2010.

There may be steps taken to improve the habitat in the lake. Flowages that are created by damming rivers generally have an abundance of coarse woody habitat when they are new and young. As they age the wood ages and decays leaving less habitat. There have been several attempts made to enhance habitat in the lake with varied success. Rock placement near the County Park for walleye spawning habitat was probably not necessary or effective. Dozens of fish cribs made from natural and synthetic material have been placed in the lake and are of questionable value. The one attempt that may have the most value is the tree drops along the shoreline. A number of these have been completed through the years and more are planned for the future. Jeff Scheirer (DNR fishery biologist) should be contacted to determine the best type and location of future habitat enhancement activities.

3.5 Lake Management History

There has been a recent history of lake management on Solberg Lake. In 1993 a comprehensive lake management plan was completed. In 2002 a lake macrophyte survey and management plan was completed. Other lake management activities that have taken place are monitoring and harvesting of curly-leaf pondweed, fish stocking and herbicide treatment of navigation lanes in Disappearing Creek and Squaw Creek areas.

3.6 Goals and Objectives

SLA identified the following goals for aquatic plant management on Solberg Lake.

- Effectively manage CLP infestation
- Improve navigation through Squaw Creek, Disappearing Creek and Comfort Cove
- Determine plant community diversity in lake
- Maintain and improve recreational opportunities
- Preserve native aquatic plants
- Protect, designate and improve fish and wildlife habitat, Sensitive Areas
- Evaluate water quality and address concerns/solutions
- Conduct pre and post evaluation monitoring of APM management activities
- Prevent the spread of existing and introduction of new AIS
- Identify sources of financial assistance for aquatic plant management activities and shoreland restoration
- Educate the Solberg Lake community on proper AIS identification and prevention efforts

4.0 Project Methods

To accomplish the project goals, the SLA needs to make informed decisions regarding APM on the lake. To make informed decisions, SLA proposed to:

- Collect, analyze, and interpret basic aquatic plant community data
- Recommend practical, scientifically-sound aquatic plant management strategies

Offsite and onsite research methods were used during this study. Offsite methods included a thorough review of available background information on the lake, its watershed, and water quality. An aquatic plant community survey was completed onsite to provide the data needed to evaluate aquatic plant management alternatives.

4.1 Existing Data Review

Flambeau Engineering researched a variety of information resources to develop a thorough understanding of the ecology of the lake. Information sources included:

- Local and regional geologic, limnologic, hydrologic, and hydrogeologic research
- Discussions with lake association members
- Available topographic maps and aerial photographs
- Data from WDNR files

The following specific reports were reviewed:

- Solberg Lake, Price County, Wisconsin, Lake Management Report, Blue Water Science, April 1993
- Solberg Lake Macrophyte Survey and Management Plan, Barr, March 2002
- Fishery Management Plan, Solberg Lake, Price County, Wisconsin, WDNR, March 2010

These sources were essential to understanding the historic, present, and potential future conditions of the lake, as well as to ensure that previously completed studies were not unintentionally duplicated. Specific references are listed in Section 8.0 of this report.

4.2 Aquatic Plant Survey and Analysis

The aquatic plant community of the lake was surveyed on July 7 and July 9, 2011 by Flambeau Engineering with assistance from SLA. The survey was completed according to the point intercept sampling method described by Madsen (1999) and as outlined in the WDNR draft guidance entitled "Aquatic Plant Management in Wisconsin" (WDNR, 2005).

WDNR research staff determined the sampling point resolution in accordance with the WDNR guidance and provided a base map with the specified sample point locations. The sample resolution was a 76 meter grid with 598 pre-determined intercept points. The map showing these points is Figure 4 included in the Figures Section. Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid (Appendix A). Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At intercept points plants were collected by a specialized rake on a pole. The rake was lowered to the bottom and twisted to collect the plants. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus and species) and recorded on field data sheets. Visual observations of aquatic plants were also recorded. Water depth and, when detectable, sediment types at each intercept point were also recorded on field data sheets.

A second point intercept survey was completed in 2012 in the Disappearing Creek and Squaw Creek portions of the lake. These areas were not included in the original survey because they are considered separate waterbodies under DNR classification. In the past these areas have been managed in conjunction with the main lake and will continue to be in the future. Chemical treatment of navigation lanes in these areas has been completed in the past and will be considered in the future. For these reasons a detailed point intercept survey was competed in these areas. Appendix I includes the details of this survey.

The point intercept method was used to evaluate the existing emergent, submersed, floating-leaf, and free-floating aquatic plants. If a species was not collected at a specific point, the space on the datasheet was left blank. For the survey, the data for each sample point was entered into the WDNR "Worksheets" (i.e., a data-processing spreadsheet) to calculate the following statistics:

- **Taxonomic richness** - the total number of taxa detected
- **Maximum depth of plant growth**
- **Community frequency of occurrence** - number of intercept points where aquatic plants were detected divided by the number of intercept points shallower than the maximum depth of plant growth
- **Mean intercept point taxonomic richness** - the average number of taxa per intercept point
- **Mean intercept point native taxonomic richness** - the average number of native taxa per intercept point
- **Taxonomic frequency of occurrence within vegetated areas** - the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points where vegetation was present
- **Taxonomic frequency of occurrence at sites within the photic zone** - the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points which are equal to or shallower than the maximum depth of plant growth
- **Relative taxonomic frequency of occurrence** - the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the sum of all species' occurrences
- **Mean density** - the sum of the density values for a particular species divided by the number of sampling sites
- **Simpson Diversity Index (SDI)** - is an indicator of aquatic plant community diversity. SDI is calculated by taking one minus the sum of the relative frequencies squared for each species present. $SDI = 1-(\Sigma(\text{Relative Frequency}^2))$ Based upon the index of community diversity, the closer the SDI is to one, the greater the diversity within the population.
- **Floristic Quality Index (FQI)** - this method uses a predetermined Coefficient of Conservatism (C), that has been assigned to each native plant species in Wisconsin, based on that species' tolerance for disturbance. Non-native plants are not assigned conservatism coefficients. The aggregate conservatism of all the plants inhabiting a site determines its floristic quality. The mean C value for a given lake is the arithmetic mean of the coefficients of all native vascular plant species occurring on the entire site, without regard to dominance or frequency.

- The FQI value is the mean C times the square root of the total number of native species.
  FQI = mean C * sqrt N
  C= coefficient of conservatism
  N= number of native species

  This formula combines the conservatism of the species present with a measure of the species richness of the site.

4.3 Shoreline Characterization

The point intercept method described above may not accurately identify emergent and floating-leaf aquatic plants in near shore areas. Therefore, a boat tour was completed traveling the entire perimeter of the lake's shoreline. During the boat tour, visual observations of the emergent and floating-leaf plant communities were located and recorded. The boat tour also included a shoreline characterization, which provides an evaluation of shoreline development on the lake. The following scale was used to rate the level of shoreline development.

1: Natural undeveloped - Forested or wetland
2: Moderate development - Structures including homes on the lots; may have docks, swimming rafts, boat lifts; some clearing of vegetation with good tree cover.
3: Major development – All items listed in Moderate but more clearing of shoreland with maintained lawns to waters edge, major clearing of trees, shrubs and native grasses.

4.4 Public Involvement, Questionnaire, and Plan Review

A public questionnaire was developed by Flambeau Engineering, the SLA and the WDNR. This questionnaire was designed to gauge lake users' opinions on a number of important topics related to APM Plan implementation. The survey inquired about the users' perception of aquatic plant problems and other lake issues. The survey was also developed to determine what lake users consider an appropriate plant management intensity and cost. The public questionnaire can be found in Appendix B.

4.5 Water Quality Methods

On September 25, 2011 water samples were collected at five different locations on the lake. Samples for chlorophyll a and total phosphorus were collected with a grab sample at each location and sent to a lab for analysis. Temperature and dissolved oxygen profiles were completed at each site also. All procedures were completed in accordance with Citizen Lake Monitoring protocols.

5.0 Discussion of Project Results

Following is a discussion of the results of the project. It includes data that was collected during the project and the significance of the data.

5.1 Aquatic Plant Ecology

Aquatic plants are vital to the health of a water body. Unfortunately, people all too often refer to rooted aquatic plants as "weeds" and ultimately wish to eradicate them. This type of attitude, and the misconceptions it breeds, must be overcome in order to properly manage a lake ecosystem. Rooted aquatic plants (macrophytes) are extremely important for the well-being of a lake community and possess many positive attributes. Despite their importance, aquatic macrophytes sometimes grow to nuisance levels that hamper recreational activities. This is especially prevalent in degraded ecosystems. The introduction of certain aquatic invasive species can often exacerbate nuisance conditions, particularly when they compete successfully with native vegetation and occupy large portions of a lake.

When "managing" aquatic plants, it is important to maintain a well-balanced, stable, and diverse aquatic plant community that contains a high percentage of desirable native species. To be effective, aquatic plant management in most lakes must maintain a plant community that is robust, species rich, and diverse. Appendix C includes a discussion about aquatic plant ecology, habitat types and relationships with water quality.

5.2 Aquatic Invasive Species

Aquatic Invasive Species (AIS) are aquatic plants and animals that have been introduced by human action to a location, area, or region where they did not previously exist. AIS often lack natural control mechanisms they may have had in their native ecosystem and may interfere with the native plant and animal interactions in their new "home". Some AIS have aggressive reproductive potential and contribute to a decline of a lake's ecology and interfere with recreational use of a lake. Common Wisconsin AIS include:

- Eurasian Watermilfoil
- Curly-leaf Pondweed
- Zebra Mussels
- Rusty Crayfish
- Spiny Water Flea
- Purple Loosestrife

Appendix C2 provides additional information on these AIS.

5.3 2011 Aquatic Plant Survey

The survey was carried out July 7 and 9, 2011, and included a total of 598 intercept points. Of the 598 original sample locations, 151 were sampled. The remaining points were either greater than the depth at which vegetation was found growing or could not be accessed due to various reasons including a combination of shallow water, rocks and thick vegetation. The aquatic macrophyte community of the lake included 20 floating-leaf and submersed aquatic vascular plant species during 2011. The survey completed in 2002 indicated 24 species observed and the survey completed in 1991 indicated 11 species observed. The aquatic plant community in

Solberg Lake fluctuates throughout the years as they do in all natural systems. In 2011 the plant beds were found to be less dense and less widespread than the previous years. This may be due to the late growing season in 2011, higher water levels due to increased precipitation and increased stain in the water which decreases light penetration. At the time of the 2011 survey areas were bare of vegetation that usually held dense beds of submersed vegetation. The inlets of Disappearing Creek, Squaw Creek and Comfort Cove had very little vegetation; in the previous year navigation was very limited to impossible in most portions of these areas. Locations where CLP was identified the previous year had little to no plants present at the time of the survey. Observations made later in the growing season indicated that vegetation did come in thicker in most areas of the lake but did not reach near the levels they did the previous years.

The following data represents the conditions of the aquatic plant community at the time of the survey conducted in 2011. The following table lists the taxa identified during the 2011 aquatic plant survey. Figures 5-1 through Figure 5-27 (included in Figures Section) illustrate the locations of each species identified.

Table 2 Taxa Identified in 2011 Aquatic Plant Survey

Plant Species	Frequency of Occurrence	No. Sites	Rake Fullness	No. of Visual Sitings
Brasenia schreberi, Watershield	34.92	22	1	58
Sparganium fluctuans , Floating-leaf bur-reed	30.16	19	1	17
Vallisineria americana; Wild celery	25.40	16	1	32
Myriophyllum heterophyllum, Various-leaved water milfoil	22.22	14	1	
Ceratophyllum demersum, Coontail	15.87	10	1	
Nymphaea odorata, White water lily	11.11	7	1	47
Aquatic moss	9.52	6	1	2
Potamogeton amplifolius, Large-leaf pondweed	9.52	6	1	16
Elodea canadensis, Common waterweed	6.35	4	1	
Myriophyllum verticillatum, Whorled water milfoil	6.35	4	1	
Utricularia vulgaris, Common bladderwort	4.76	3	1	1
Filamentous algae	1.59	1	1	
Najas flexilis, Bushy pondweed	1.59	1	1	
Potamogeton gramineus, Variable pondweed	1.59	1	1	1
Potamogeton praelongis, White-stem pondweed	1.59	1	2	
Potamogeton robbinsii, Robbins pondweed	1.59	1	1	1
Utricularia minor, Small bladderwort	1.59	1	1	
Nuphar variegata, Spatterdock				27
Potamogeton foliosus, Leafy pondweed				1
Potamogeton zosteriformis, Flat-stem pondweed				1

Vegetation was identified to a maximum depth of 8 feet (photic zone). Aquatic vegetation was detected at 34% of photic zone intercept points. A diverse plant community inhabited the lake during 2011. The Simpson Diversity Index value of the community was 0.89, taxonomic richness was 17 species (20 including visuals), and there was an average of 0.63 species identified at points that were within the photic zone. There was an average of 1.86 species present at points with vegetation present. The following table summarizes these overall aquatic plant community statistics.

Table 3 Summary of Aquatic Plant Survey Statistics

Statistic	Total
Total number of points sampled	**191**
Total number of sites with vegetation	**63**
Total number of sites shallower than maximum depth of plants	**184**
Frequency of occurrence at sites shallower than maximum depth of plants	**34.24**
Simpson Diversity Index	**0.89**
Maximum depth of plants (ft)	**8**
Number of sites sampled using rake on Rope (R)	**0**
Number of sites sampled using rake on Pole (P)	**191**
Average number of all species per site (shallower than max depth)	**0.63**
Average number of all species per site (veg. sites only)	**1.86**
Average number of native species per site (shallower than max depth)	**0.63**
Average number of native species per site (veg. sites only)	**1.86**
Species Richness	**17**
Species Richness (including visuals)	**20**

The most abundant aquatic plant identified during the aquatic plant survey was Watershield (*Brasenia shreberi*). It occurred at 11.96% of the photic zone. It was present at 34.9% of the sites with vegetation and had a 18.8% relative frequency of occurrence. Watershield is a floating-leaf plant that has elastic stems and leaf stalk to allow the leaves to ride the waves without uprooting. All submersed portions of the plant are coated with a thick, gelatinous coating. The seeds, leaves, stems and buds are consumed by waterfowl and the floating leaves offer shade and shelter to fish and invertebrates.

The second most abundant plant identified in the lake was floating-leaf bur-reed. It is one of the most widely distributed aquatic plants within Wisconsin. This plant has long ribbon-like leaves that float on the water surface and grows to 5 feet. It can be distinguished from the similar plant, wild celery *(Vallisneria americana*) by the veins in the leaf. Bur-reed has a smooth appearance with long, vertical veins; wild celery has a prominent midstripe and a serrated pattern.

5.3.1 Floating-Leaf Plants

The following three floating-leaf aquatic plant species were identified during the 2011 aquatic plant survey.

- *Nuphar variegata* (spatterdock)
- *Nymphaea odorata* (white water lily)
- *Brasenia schreberi* (watershield)

5.3.2 Submersed Plants

The following seventeen submersed aquatic plant species were identified during the 2011 aquatic plant survey.

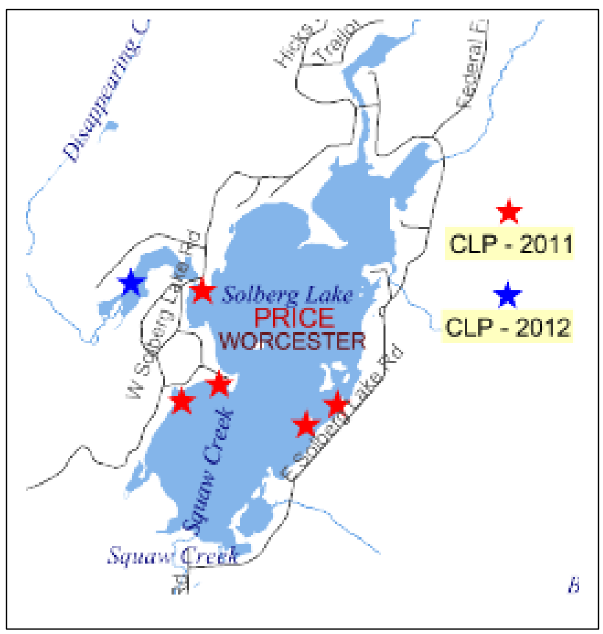
- *Algae sp.* (filamentous algae)
- *Ceratophyllum demersum* (coontail)
- *Elodea canadensis* (elodea or common waterweed)
- *Moss sp.* (watermoss)
- *Myriophyllum heterophyllum* (various-leaved water milfoil)
- *Myriophyllum verticillatum* (whorled water milfoil)
- *Najas flexilis* (bushy pondweed or slender naiad)
- *Potamogeton amplifolius* (large-leaf pondweed)
- *Potamogeton foliosus* (leafy pondweed)
- *Potamogeton gramineus* (variable pondweed)
- *Potamogeton praelongisd* (white-stem pondweed)
- *Potamogeton robbinsii* (robbins pondweed)
- *Potamogeton zosteriformis* (flat-stem pondweed)
- *Sparganium fluctuans* (floating-leaf bur-reed)
- *Utricularia minor* (small bladderwort)
- *Utricularia vulgaris* (common bladderwort)
- *Vallisineria americana* (wild celery)

5.3.3 Curly-leaf Pondweed

During the 2011 survey curly-leaf pondweed (CLP) was not encountered at any of the intersect points; however, it was observed at several locations in the lake. Curly-leaf pondweed (*Potamogeton crispus*) was first discovered in the lake in 2002. Since that discovery it has been actively monitored and managed through hand-pulling. Despite these efforts the plant has spread to several isolated locations in the lake. One additional point of CLP was found and pulled in 2012 by the Association. The following table lists the location of know CLP beds and the adjacent figure shows the locations.

Table 4 CLP Bed Locations (coordinates and map)

CLP Bed	Latitude	Longitude
1	45.750088	-90.381611
2	45.758305	-90.379828
3	45.747768	-90.369409
4	45.749435	-90.366516
5	45.751317	-90.378997



All of the points listed above were monitored in early Summer 2011 and 2012 and hand pulling took place at each location.

CLP is an aquatic invasive species that can grow in thick beds and become a nuisance by hampering navigation, swimming and fishing. It is a submersed plant that grows in 3 to 10 feet of water and tolerates high turbidity and often invades disturbed areas. CLP begins growing very early in the spring and is one of the first plants to appear. It also dies quickly and by June or early July is not visible in the lake. If it grows in thick, large beds it can cause low dissolved oxygen when it dies due to the large influx of decaying plant material at the bottom of the lake and it contributes high nutrient loading. CLP reproduces through the spread of rhizomes (roots) and turions. Turions are a type of winter bud that is the hardened tip of plant; it falls to the sediment and produces a new plant in one to several years. A single turion can yield thousands of additional turions. To effectively control CLP it must be harvested before turions are produced to reduce new growth.

5.3.4 Comparison of 2011 Survey to Historic Surveys

There are two other documented aquatic plant surveys on Solberg Lake. A survey completed in 1991 by Blue Water Science and a survey completed in 2001 by Barr. The surveys conducted in 1991 and 2001 followed the now outdated method of transect surveys. In these surveys transects from the shoreline out into the lake were sampled. The current method followed for 2011 was the point intercept method. This method provides an accurate way to sample the same points in subsequent surveys. Since the survey methods differ from 1991, 2001 and 2011 a statistical comparison of the aquatic plant community cannot be made. General observations can be made however. The following table lists the statistics of the surveys including the depth of water to which plants were found growing, number of species documented and aquatic plant percent coverage of lake surface.

Table 5 Statistics of Surveys

Year	Depth of Plant Growth ft	Number of Species	Coverage %
1991	5	11	18
2001	10.5	24	37
2011	8	17	

Plant growth was found to be sparse in 1991 and color of water was assumed to be the limiting factor for plant growth along with lack of preferred substrate. The 2001 survey showed a great increase in the number of plant species (11 in 1991, 24 in 2001) and a greater depth of growth (5 ft in 1991, 10.5 ft in 2001). The 2011 survey was in the middle of both previous surveys for number of species (17) and depth of growth (8 ft). The coverage of aquatic plants follows the same pattern; as depth of growth increases so does the coverage. This may be due to water color. Aquatic plants grow in the littoral zone of the lake; this is the area where there is adequate light penetration to allow for the growth of plants. In stained water such as Solberg Lake the light cannot penetrate very deeply so growth is limited to approximately 10.5 feet. In clear lakes plant growth is found at 30 feet or more due to increased light penetration. The color of the lake water may vary from year to year based on natural trends.

The staining in the water in Solberg comes from the wetlands that the water flows through before it reaches the lake. In dry years there is lower water flow coming through these wetlands into the lake; this will reduce the stain in the water. In dry years the level of the lake may decrease also. The combination of less staining and lower water levels increases the area of the lake that can grow plants due to increased light penetration. In these years high plant growth is observed. This was likely the case in the several years prior to the 2011 survey.

The 2011 season had a number of factors that may have influenced the plant growth documented during the survey. There was an increase in precipitation from prior years that increased flow of water through wetlands that were dry for several years; this increased staining of the water. There was also higher water level throughout the summer according to lake user observations. The higher water level and increased staining decreased light penetration and in turn decreased the area of plant growth.

The Price County Dam Keeper was contacted to discuss the water levels on the lake. The operating order for the dam allows a variance of +/- 6 inches from the normal operating level. The dam keeper stated the operating order is followed and levels do not vary from the order under normal conditions. The dam keeper did state that during drier years the water levels are on the lower end and may dip below the operating order due to lack of water coming into the lake. Data on the levels over the growing season was not available from the operator for further analysis.

Another factor that impacted the results of the 2011 survey was a late growing season. The growing season started later in the year due to a cold spring. The plant growth observed in the lake during the survey in early July appeared to be at least a month behind a typical growing season. In lakes with curly-leaf pondweed surveys are typically conducted in mid-June since CLP dies off in late June/early July. The survey for Solberg was scheduled for early July to catch the CLP but also allow the native plants to reach maturity so an accurate assessment of density could be achieved.

The following table lists the species observed in each year and the frequency of occurrence for 2001 and 2011.

Table 6 Comparison of Aquatic Plant Surveys Frequency of Occurrence (FOO)

Plant Species	FOQ 2011	FOQ 2001	Observed 1991
Brasenia schreberi , Watershield	34.90	2.9	x
Ceratophyllum demersum , Coontail	15.90	13.3	x
Chara spp., Muskgrass		2.9	
Eleocharis spp. , Spikerush		14.3	
Elodea canadensis ,Common waterweed	6.35	35.2	x
Filamentous algae	1.59		
Lemna minor , Lesser duckweed		1	
Lobelia dortmanna , Water lobelia		39	
Aquatic moss	9.52		
Myriophyllum heterophyllum ,Various-leaved water milfoil	22.22		
Myriophyllum sibiricum, Northern watermilfoil		6.7	
Myriophyllum verticillatum , Whorled water milfoil	6.35	2.9	
Najas flexili s, Bushy pondweed	1.59	1.9	x
Nuphar advena , Yellow pondlily		2.9	
Nuphar variegata , Spatterdock		5.7	x
Nymphaea odorata , White water lily	11.11	10.5	x
Poa spp ., Narrowleaf pondweed		3.8	
Potamogeton amplifolius , Large-leaf pondweed	9.52	22.9	x
Potamogeton crispus , Curly-leaf pondweed		1	
Potamogeton epihydrus, Ribbonleaf pondweed		5.7	
Potamogeton foliosus , Leafy pondweed			
Potamogeton gramineus , Variable pondweed	1.59		
Potamogeton illinoensis , Illinois pondweed		1	
Potamogeton natans, Floating-leaf pondweed		1	x
Potamogeton praelongis, White-stem pondweed	1.59		
Potamogeton robbinsii , Robbins pondweed	1.59		
Potamogeton zosteriformis , Flat-stem pondweed		1.9	
Sagataria sp., Arrowhead			x
Sparganium fluctuans , Floating-leaf bur-reed	30.16		
Sphagnum spp. , Peat			x
Typha sp ., Cattail		1	
Utricularia minor ,Small bladderwort	1.59		
Utricularia vulgaris, Common bladderwort	4.76	7.6	
Vallisneria americana, Wild celery	25.40	28.6	x
Zosterella dubia , Mud plantain		2.9	

5.4 Floristic Quality Index (FQI)

Higher FQI numbers indicate higher floristic quality and biological integrity and a lower level of disturbance impacts. FQI varies around the state of Wisconsin and ranges from 3.0 to 44.6 with the average FQI of 22.2 (WDNR, 2005). The FQI calculated from the 2011 aquatic plant survey data was 28.3 with an average coefficient of conservatism of 6.7. The coefficient of conservatism is a value that is assigned to each species based on the tolerance of that species to disturbance. The following lists the range of Coefficient of Conservatism and the conditions under which the plant is generally found.

- **0-3**: Species found in wide variety of plant communities and very tolerant of disturbance.
- **4-6:** Species found in specific plant community but tolerant of moderate disturbance.
- **7-8:** Species found in narrow range of plant communities in advanced stages of succession but can tolerate minor disturbance.
- **9-10:** Species restricted to narrow range of conditions with low tolerance of disturbance.

The FQI of Solberg Lake is higher than Wisconsin's northern region mean of 24.3 and suggests that Solberg Lake exhibits good water quality when using aquatic plants as an indicator. The average coefficient of conservatism of 6.7 falls between categories and indicates a community that is tolerant of minor to moderate disturbance. The following table summarizes the FQI values. Algae and watermoss were not identified down to species level and were not included in calculation of the FQI.

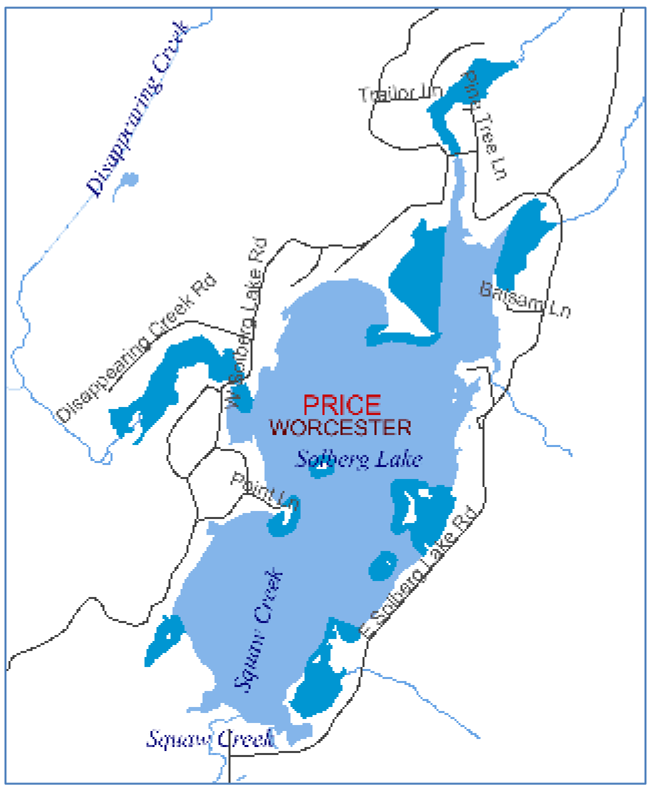
Table 7 Floristic Quality Index and Coefficient of Conservatism

Species	Common Name	C
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Elodea canadensis	Common waterweed	3
Myriophyllum heterophyllum	Various-leaved water-milfoil	7
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton foliosus	Leafy pondweed	6
Potamogeton gramineus	Variable pondweed	7
Potamogeton praelongus	White-stem pondweed	8
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Sparganium fluctuans	Floating-leaf bur-reed	10
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		**18**
Mean C		**6.7**
FQI		**28.3**

5.5 Sensitive Areas

Solberg Lake has twelve Sensitive Areas as designated by WDNR. Sensitive Areas are defined in Ch. NR 107 as areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat to the body of water. Sensitive Areas are under the broader category of Critical Habitat areas. These areas of a waterbody are designated due to the importance they play in the overall health of aquatic plants and animals. Critical Habitat areas (including Sensitive Areas) have special protections and are not exempt from any waterway and wetland permitting. Aquatic plant management in Sensitive Areas is regulated and require permits for most activities. WDNR may deny permits for chemical herbicide treatment for aquatic plant management in Sensitive Areas. Manual removal of plants is not exempt from permit requirements in Sensitive Areas. **If individual landowners wish to remove aquatic vegetation from their riparian area and they are located in a Sensitive Area a permit is required.** The Sensitive Areas are shown in dark blue in the following figure.

Figure 6 – Solberg Lake Sensitive Areas



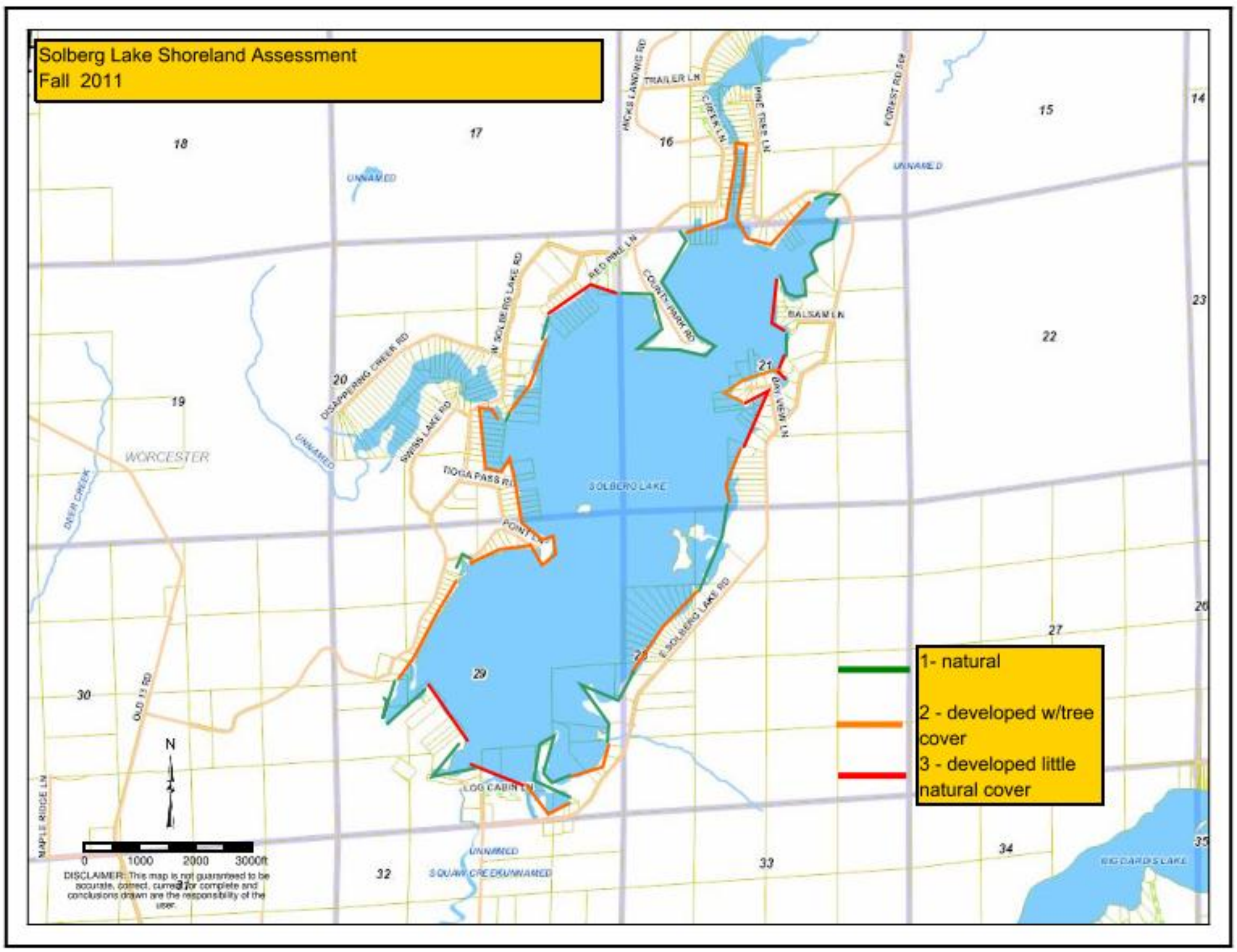
The Sensitive Areas in Solberg Lake are of particular importance in this system due to the sparse vegetation on other areas of the lake. In general the most dense plant growth occurs in the Sensitive Areas. The remainder of the lake contains limited beds of plants that vary in density from year to year. The vegetation in the Sensitive Areas should be protected and preserved as much as possible to provide habitat for fish and wildlife that is sparse in other areas of the lake. The Sensitive Areas are also the locations where the plant growth is so thick that it causes navigational issues. A balance between providing land owners access to the lake and protecting the habitat will have to be carefully managed.

5.6 Shoreline Characterization

Emergent and floating-leaf plants identified along the shoreline outside of formal grid sample points included: *Sagittaria sp.* (arrowhead), *Nuphar variegata* (spatterdock), *Nymphaea odorata* (white water lily), *Typha sp*. (cattail), *Schoenoplectus tabernaemontanii* (softstem bulrush), *Carex sp.* (sedges species) and *Sparganium sp.* (bur-reed). Refer to Appendix D for descriptions of these plants. Plants identified during the shoreline survey but not during the point-intercept method were not included in the community statistics or calculation of the FQI.

The majority of the shoreline was developed with seasonal cabins and permanent homes. Most of the lots contained a mix of natural vegetation with maintained lawns. There is a County owned campground on the east side of the lake and stretches of wetland that are undeveloped. The following figure depicts the shoreline characterization. Appendix J further discusses the shoreland development.

Figure 7 – Shoreland Assessment 2011

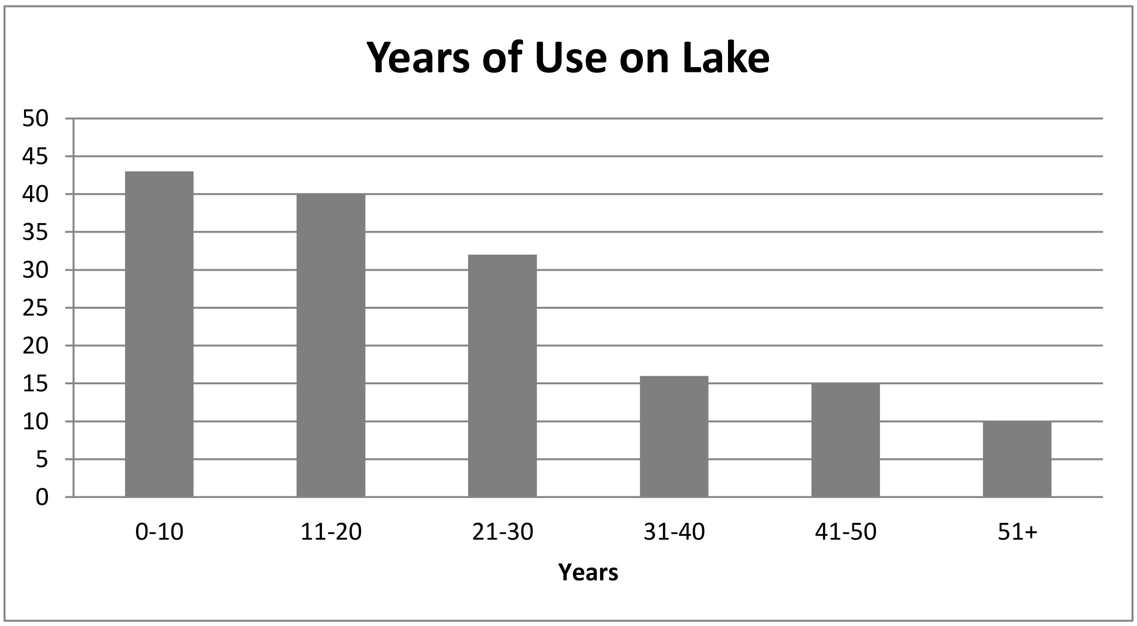


5.7 Public Questionnaire

The results of the survey were very informative and there was a good response rate. A total of 281 surveys were mailed to lake users; 171 were returned for a percent return of 61%. The majority of the surveys were returned by seasonal shoreland residents followed by permanent shoreland residents, nearby year round residents, nearby seasonal residents and other. Results of the survey are discussed below and include graphs; the vertical access on all graphs indicates the number of responses.

The following chart indicates the number of years that the respondents have been using the lake.

Figure 8 - Years of Use on Lake



The majority of respondents have been using the lake 20 years or less.

A variety of activities are enjoyed on the lake as indicated in the following chart.

Figure 9 - Activities

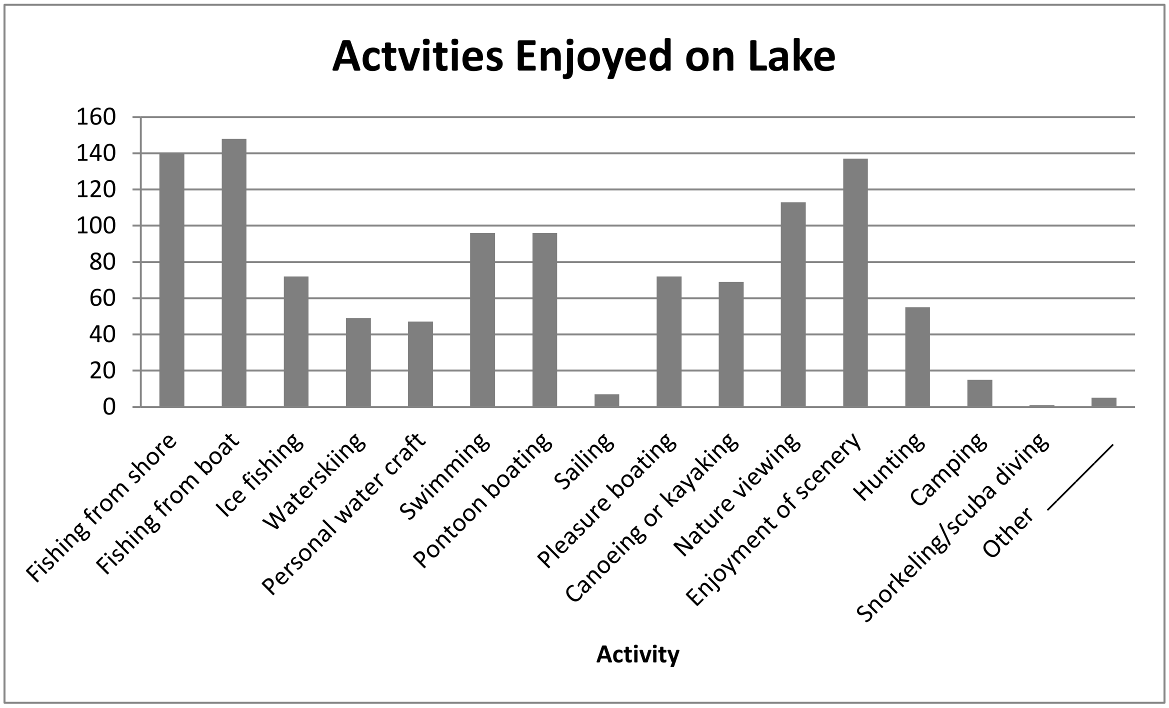
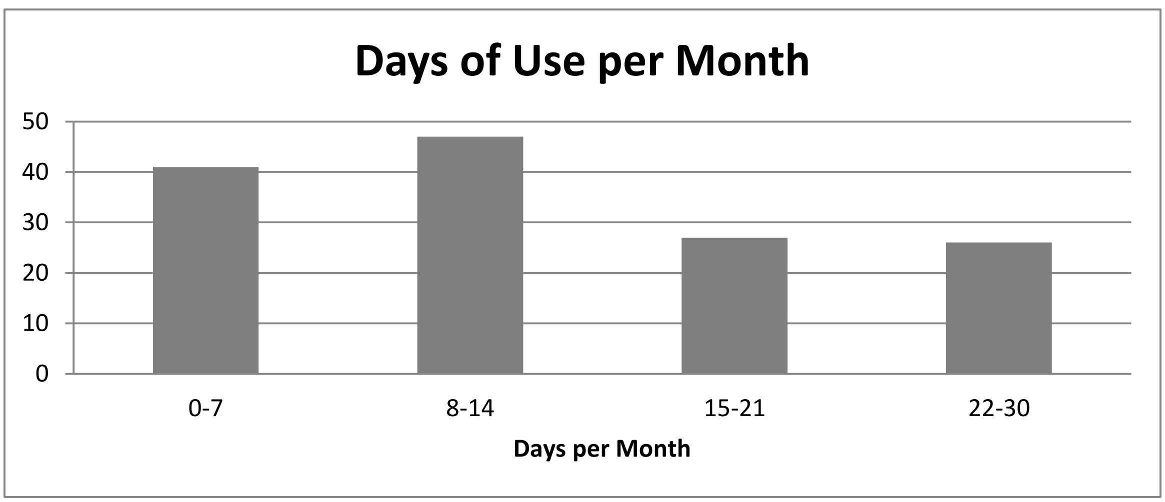
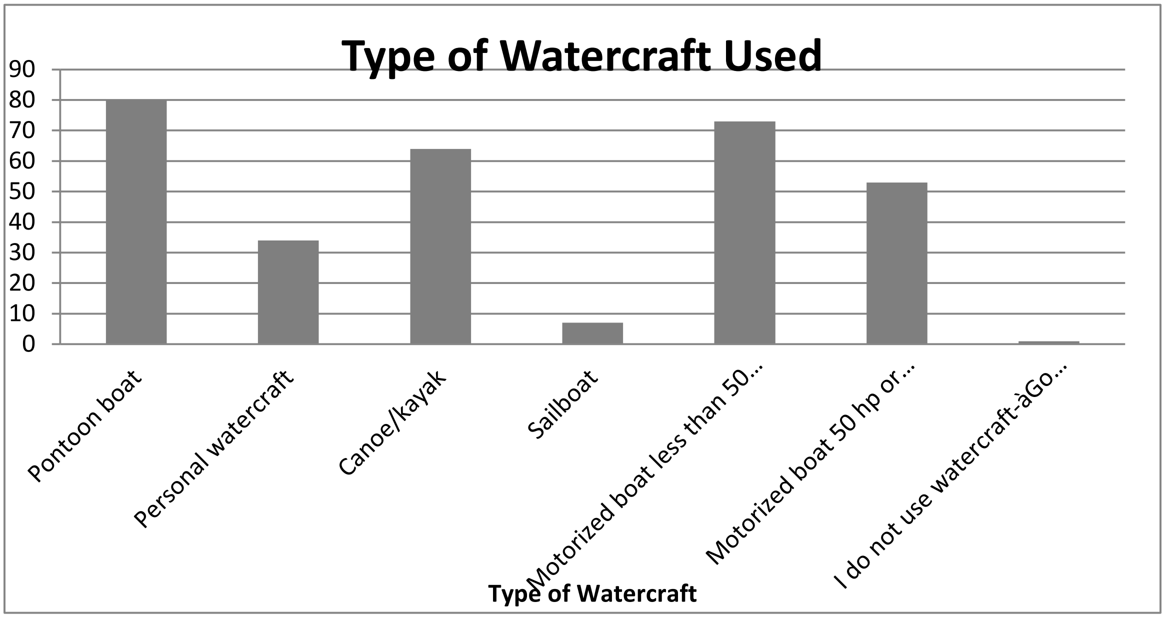


Figure 10 - Days of Use



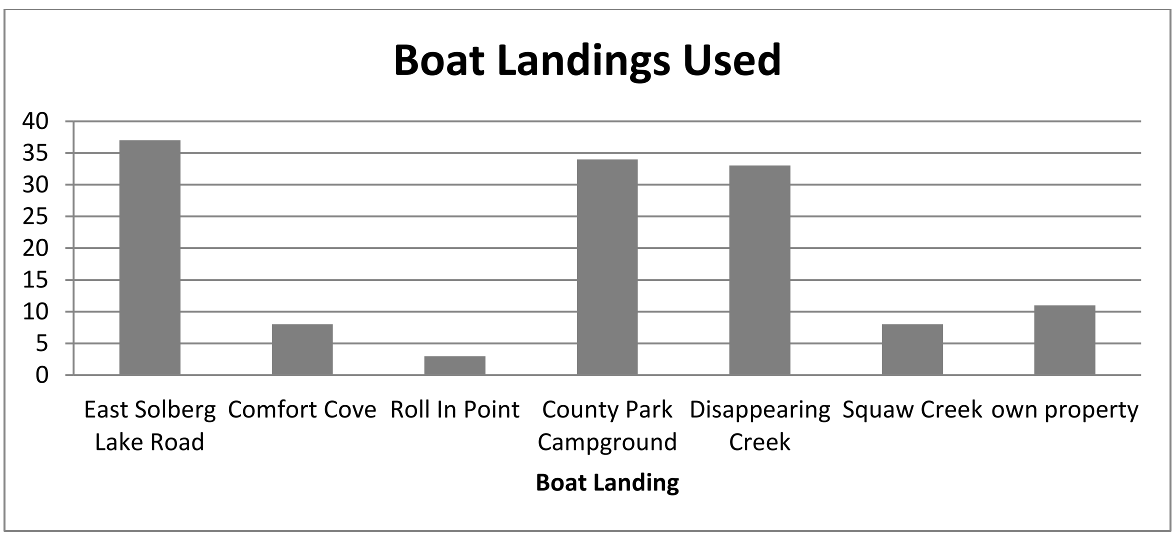
There is a high rate of use on the lake with most respondents using it 8 to 14 days per month.

Figure 11 - Type of Watercraft



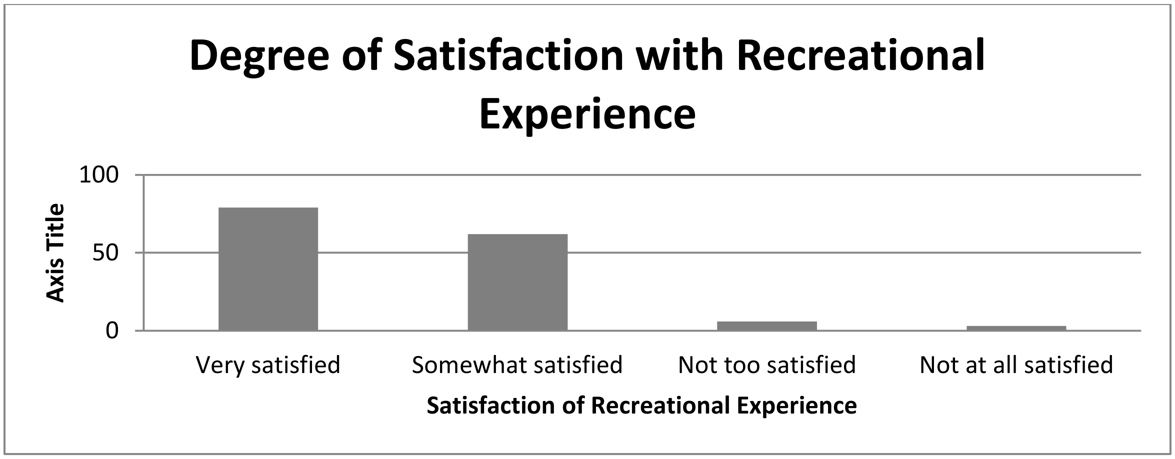
It appears the majority of respondents use the lake for pleasure boating in pontoons and canoes or fishing from smaller boats.

Figure 12 - Boat Landing



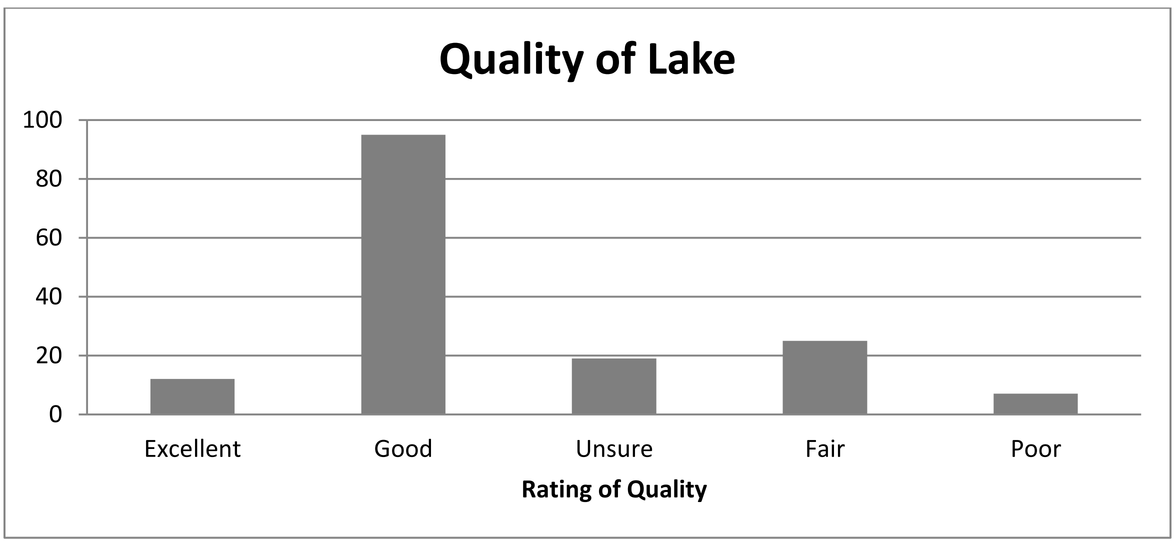
The landings that get the most use from respondents are the public landings; these are the landings that should be targeted for CBCW monitoring and educational signs.

Figure 13 - Satisfaction



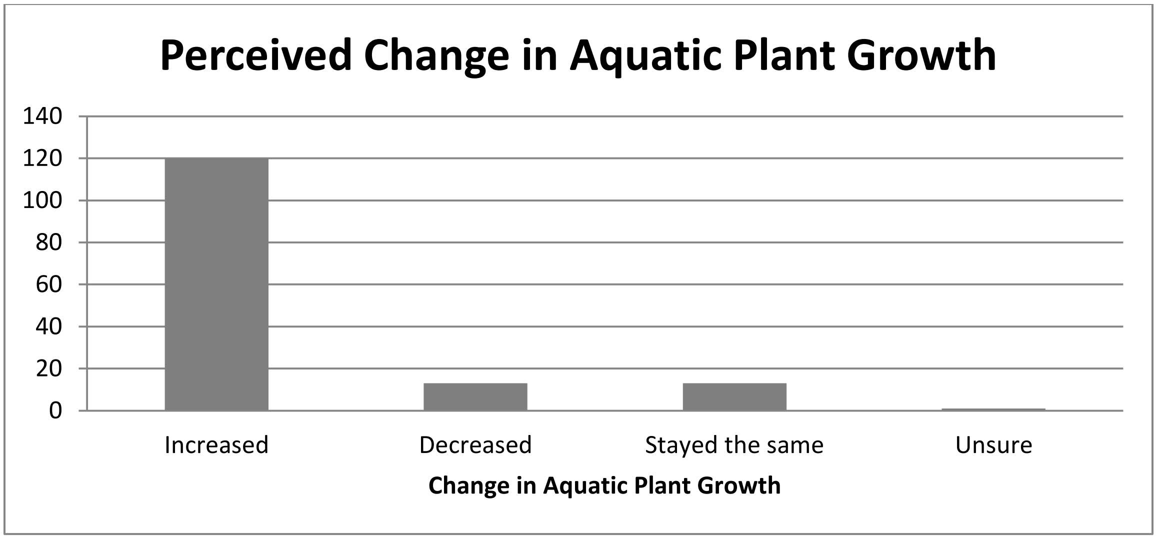
Very few respondents are dissatisfied with their experience on the lake.

Figure 14 - Quality of Lake



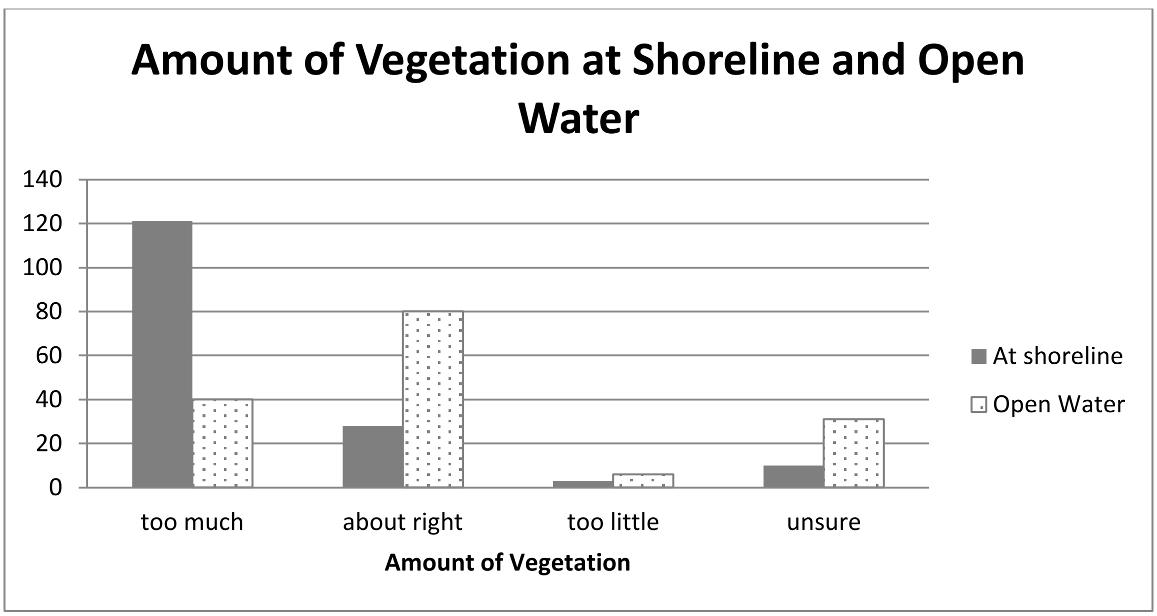
The lake is considered to be good quality to the vast majority of respondents.

Figure 15 - Change in Plant Growth



A great majority feel that the aquatic plant growth on the lake has increased since they have been using the lake.

Figure 16 Shoreline Vegetation



The perception on the amount of vegetation varies based on near shore and open water. Most of the respondents feel that there is too much vegetation near the shoreline but the amount in open water is about right.

The survey also gauged the opinions and knowledge of AIS. 97% of respondents have heard of AIS and 76% have heard of CLP but only 35% were aware that CLP was present in Solberg Lake. Of the respondents that were aware of CLP in Solberg 57% thought it was a moderate to large problem in the lake. For management alternatives the split was relatively close with 53% supporting management of problem areas only and 46% supporting aggressive lake wide management. The methods of management that were supported included hand-pulling, mechanical harvest, aquatic herbicides and biological controls. There was also support for doing nothing and drawdown of the flowage. Respondents indicated they would like more information on the following: AIS present in Price County, methods of AIS prevention, methods of AIS control and long term results of AIS control.

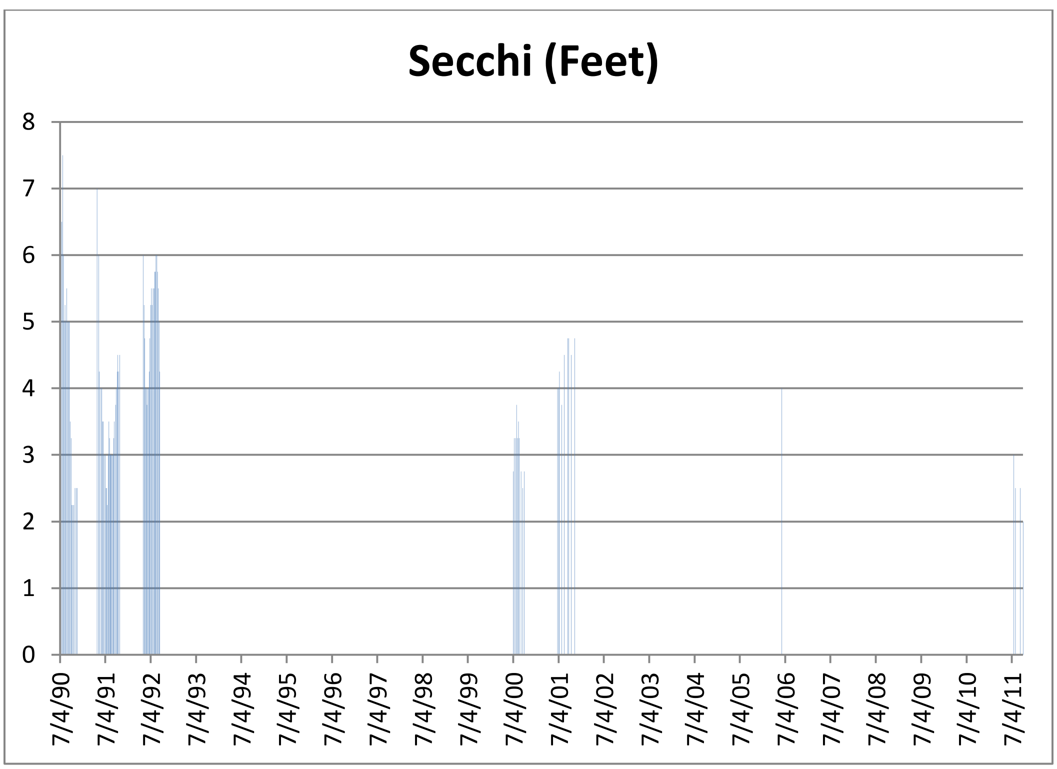
5.8 Water Quality

The water quality of the lake indicates eutrophic conditions with high nutrient levels, low water clarity and high productivity of aquatic plants and fish. It appears to have remained steady over the years based on the limited data that has been collected on total phosphorus and chlorophyll a. The water clarity appears to be trending down indicating more algae blooms. The following sections discuss the water quality results in detail.

5.8.1 Water Clarity

The historical water clarity average based on Secchi Disk readings is 4.18 feet and ranges from 2.25 to 7.5 feet indicating very poor to poor water clarity. The Wisconsin average Secchi Disk reading in 2005 was 10 feet (Larry Bresina, The Secchi Disk and Our Eyes - Working Together to Measure Clarity of Our Lakes; internet document). The low water clarity may be in part due to the dark color and high stain of the water as well as algae. The following graph illustrates the historical water clarity measurements on Solberg Lake.

Figure 17- Secchi Depth (Date v feet)

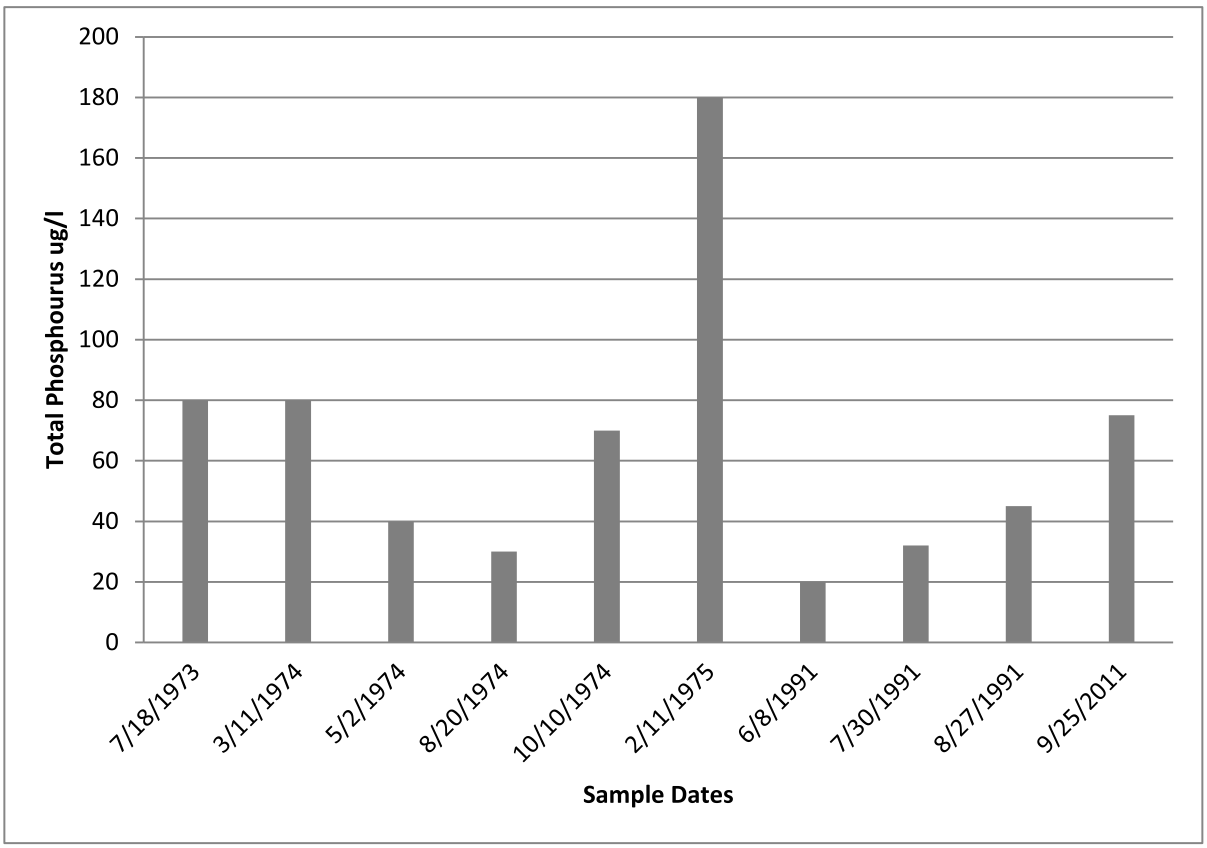


The data on water clarity is sporadic and the collection of more data would give a clearer picture of what is actually happening in the lake. It appears that the water clarity is decreasing. Increased sampling through CLM is recommended to track water clarity.

5.8.2 Total Phosphorus and Chlorophyll *a*

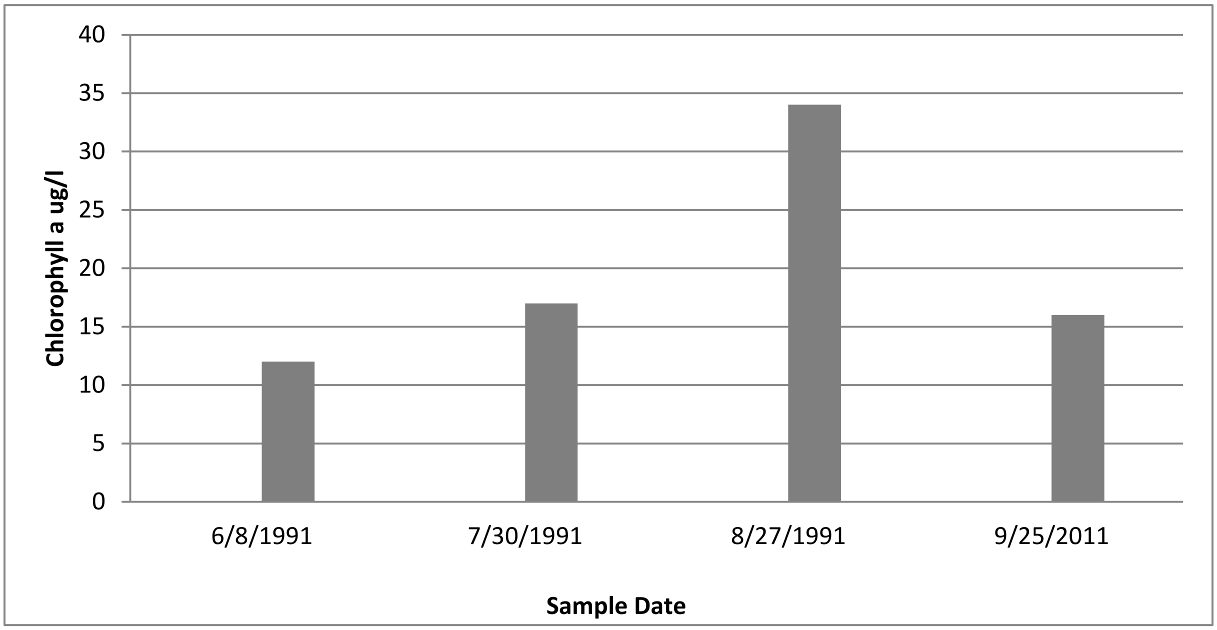
Following is a discussion of the total phosphorous and chlorophyll a concentrations in the lake over the years of data. Historically, the total phosphorus has varied from 180 ug/L (micrograms per liter) to 20 ug/L. The sample from 1975 at 180 ug/L appears to be an outlier and was removed when the average phosphorus concentration was calculated. The average phosphorus concentration is 52 ug/L. The Chlorophyll *a* data has an average of 21 ug/L. Data ranged from 12 ug/L to 34 ug/L. The following graphs illustrate the historical phosphorus and chlorophyll *a* measurements on the lake.

Figure 18 – Total Phosphorous



The measurement on 2/11/1975 appears to be an outlier and was not used in the average calculations for the lake's phosphorus content.

Figure 19 – Chlorophyll a

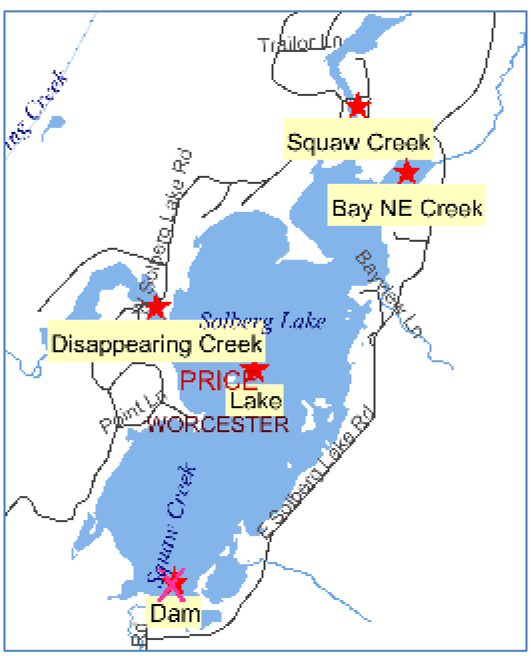


See the following section for more information on total phosphorous and chlorophyll a.

5.8.3 Water Quality 2011

In September 2011 water samples were collected for laboratory analysis and data was collected in the field at five locations of the lake. The samples and data were collected at the locations shown in the following figure.

Figure 20 – 2011 Water Quality Sample Locations



Water Chemistry

The samples collected for laboratory analysis were analyzed for phosphorus, chlorophyll *a* , conductivity, total Kjeldahl nitrogen and pH; the results are included in the following table:

Table 8 - 2011 Water Quality Results

Site	Chlorophyll a ug/l	Conductivity umho	Total Kjeldahl Nitrogen mg/l	pH su	Total Phosphorus mg/l
Lake	6	42	0.50	6.81	0.054
Disappearing Creek	18	42	0.92	6.75	0.079
Squaw Creek	6.2	50	0.70	6.68	0.037
Creek NE Bay	2.4	45	0.70	6.65	0.056
Near Dam	16	44	1.00	6.69	0.075

Total Phosphorus (TP) - measure of nutrients available for plant growth and high concentrations can promote excessive plant growth. In more than 80% of Wisconsin lakes phosphorous is the key nutrient affecting the amount of algae and plant growth. Phosphorous comes from a variety of sources, many of which are human related and include animal and human waste, soil erosion, detergents, septic systems and runoff from agricultural land and lawns. On lakes with high development in the near shore area fertilization of lawns and failing septic systems can contribute high amounts of phosphorous to the water. The historic TP average for the lake is 52 ug/l with a TSI of 58. For the mixed lowland drainage lake this value indicates good condition.

Chlorophyll a - green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae suspended in the water column of a lake. Chlorophyll a is used as a common indicator of water quality (Shaw et al, 2004). Higher chlorophyll a values indicate lower water quality. The average value in the lake is 21 ug/l indicating high levels of algae and a eutrophic classification.

Conductivity – measure of a waters ability to conduct an electrical current and is related to the amount of dissolved substances in the water. Conductivity is about twice the hardness in uncontaminated waters in Wisconsin; if much greater than twice it may indicate presence of contaminants such as sodium, chloride, nitrate or sulfate. The conductivity ranges from 42-50 umho; a low level indicating low levels of contaminants.

pH – an index of waters acid level and an important component of the carbonate system; it is the negative logarithm of the hydrogen ion concentration. Lower pH water has more hydrogen ions and are more acidic than higher pH waters. Lake water in Wisconsin ranges from 4.5 in acid bog lakes to 8.4 in hardwater lakes. A range of pH of 6.65 to 6.81 falls in the normal range of lake water.

Total Kjeldahl Nitrogen (TKN) – several forms of nitrogen exist in lake water. Nitrogen is a nutrient found in all organic matter and is released during decomposition. Nitrogen cycles in a lake through organic matter (plants), sediment, water and air. A lake is nitrogen limited if the ratio of total nitrogen to total phosphorous is less than 10:1. Nitrate + nitrite plus total Kjeldahl nitrogen equals total nitrogen. Nitrate + nitrite was not tested for, TKN ranged from 0.5 – 1.0

mg/l. TN of 0.5 to 1.0 mg/l indicates mesotrophic to eutrophic conditions. Algae growth in these lakes is limited by the amount of phosphorous in the system. Sources of nitrogen include fertilizer, animal and human waste and in some cases groundwater.

Dissolved Oxygen and Temperature

A dissolved oxygen (DO) and temperature profile was recorded in September 2011 at several locations in the lake. Readings were taken at one foot intervals. Results can be found in the following table.

Table 9 Dissolved Oxygen and Temperature Profile

	Sample Site									
	Lake		**Disappearing Creek**		**Squaw Creek**		**Creek**		**Dam**	
Depth ft	DO mg/l	Temp F	DO mg/l	Temp F	DO mg/l	Temp F	DO mg/l	Temp F	DO mg/l	Temp F
1	6.26	56.4	6.77	58.4	5.15	55.5	5.29	55.7	6.43	57.8
2	6.22	56.4	6.67	58.2	5.17	55.4	5.29	55.7	6.39	57.8
3	6.2	56.4	6.59	58.1	5.15	55.4	5.27	55.6	6.38	57.8
4	6.2	56.4	6.56	58.1	5.12	55.4	5.23	55.6	6.37	57.8
5	6.2	56.4	6.4	58	5.11	55.4	5.22	55.6	6.36	57.8
6	6.24	56.4	5.86	57	5.1	55.3	5.07	55.5	6.36	57.8
7	6.26	56.4			5.01	55.3			6.36	57.8
8	6.29	56.3			5.04	55.3			5.88	56.9
9	6.32	56.3			5.04	55.3			5.9	57.1
10	6.29	56.3							5.88	57
11	6.27	56.3								

The data indicates the water of the lake was well mixed at the time of sampling. The uniform DO and temperature readings throughout the water column indicate mixing of the water.

5.8.4 Trophic State Index

Trophic State Index (TSI) values are assigned to a lake based on total phosphorus, chlorophyll *a*, and water clarity values. The TSI is a measure of a lake's biological productivity. The TSI used for Wisconsin lakes is described below.

Figure 21 - TSI Description

Category	TSI	Lake Characteristics	Total P *(ug/l)*	Chlorophyll a *(ug/l)*	Water Clarity *(feet)*
Oligotrophic	1-40	Clear water; oxygen rich at all depths, except if close to mesotrophic border; then may have low or no oxygen; cold-water fish likely in deeper lakes.	< 12	<2.6	>13
Mesotrophic	41-50	Moderately clear; increasing probability of low to no oxygen in bottom waters.	12 to 24	2.6 to 7.3	13 to 6.5
Eutrophic	51-70	Decreased water clarity; probably no oxygen in bottom waters during summer; warm-water fisheries only; blue-green algae likely in summer in upper range; plants also excessive.	> 24	>7	<6.5
Solberg Lake	**58**	**Eutrophic**	**52**	**20**	**4.2**

Adopted from Carlson 1977, Lillie and Mason, 1983, and Shaw 1994 et. al.

The historical water clarity, total phosphorus, and chlorophyll a data indicate that Solberg Lake is a eutrophic lake.

Lakes in Wisconsin are categorized according to area, depth and position in the watershed by the WiscALM document. Solberg is categorized as a mixed lowland drainage lake indicating it is mixed on a regular basis located in the lower portion of the watershed, and a lake that has an inlet and outlet. The WiscALM document assessed the general condition of Wisconsin lakes based on TSI and separated the condition into four categories: excellent, good, fair and poor. Solberg Lake falls into the good category based on TSI.

The TSI averaged over the years that parameters were tested for is 58 indicating eutrophic (productive) water quality. Following is a list of area waterbodies and a range of the average TSI taken from graphs on WDNR lake data website:

Waterbody	TSI
• Eau Pleine flowage, Marathon County:	50-70
• Lake Dubay, Marathon County:	55-65
• Jersey City Flowage, Lincoln County:	50-60
• Mohawksin, Lincoln County:	55-60
• Rice River Flowage, Lincoln County:	45-60
• Spirit River Flowage, Lincoln County:	48-62
• Lac Sault Dore, Price County:	50-65
• Musser Lake, Price County:	35-55
• Round Lake, Price County:	48-60
• Pike Lake, Price County:	34-62

Based on the above data Solberg has a TSI that is similar to area flowages, all are in the same range and are considered mesotrophic (41-50) to eutrophic (51-70).

A closer comparison was completed on the Phillips Chain of Lakes in Price County. This flowage system is downstream of Solberg Lake; Squaw Creek enters Duroy Lake at the head of the Phillips Chain. The following table lists the TSI for secchi, TP and chlorophyll a for the lakes in the Chain.

Table 10 TSI Comparison to Phillips Chain of Lakes

	TSI			
Lake	**Secchi**	**TP**	**Chl a**	**Average**
Duroy	58	58	51	56
Elk	59	59	54	57
Long	43	58	48	50
Wilson	61	58	57	59
Solberg	**57**	**59**	**57**	**58**

The TSI of Solberg is very comparable to the Phillips Chain and indicates the systems have similar water quality.

6.0 Management Alternatives and Recommendations

Based on the goals of the stakeholders as mentioned in section 3.6, several management alternatives are available for this APM plan. Some general alternatives are discussed below. More information on management alternatives is included in Appendix E. Currently, the Northern Region of the WDNR is working under an aquatic plant management strategy that is officially titled Aquatic Plant Management Strategy, Northern Region WDNR, Summer, 2007 (working draft), or commonly referred to as the NOR Region APM Strategy (Appendix H). This strategy lays out an approach for acceptable aquatic plant management in Northern Region lakes. The strategy protects native aquatic plant communities in northern Wisconsin and does not allow permits to control native plants unless documented circumstances of nuisance levels exist. The following management alternatives are based on the approaches described in the NOR Region APM Strategy, and incorporate recommendations of Flambeau Engineering.

6.1 Aquatic Plant Maintenance Alternatives

The maintenance alternative may be used at a lake in which a healthy aquatic plant community exists and invasive and non-native plant species are generally not present. The maintenance alternative is a protection-oriented management alternative because no significant plant problems exist or no active manipulation is required. This alternative can include an educational plan to inform lake shore owners of the value of a natural shoreline and encourage the protection of the lake water quality and the native aquatic plant community. The maintenance alternative is recommended for Solberg Lake in general with limited manupilation techniques in Disappearing Creek, Squaw Creek, Comfort Cove and CLP beds.

6.1.1 Aquatic Invasive Species Monitoring

One AIS (curly-leaf pondweed) was identified during the 2011 survey in Solberg Lake. In order to monitor existing spread of current AIS and for new AIS in the future a strong Citizen Lake Monitoring program that surveys for AIS is highly recommended. In some lake systems, native aquatic plants "hold their own" and AIS never grow to nuisance levels; in others however, vigilant and active management is required. This can be based on several things including water quality. Data provided on the WDNR Citizen Lake Monitoring website indicates monitoring of water clarity was last completed in 2006. Solberg Lake residents should also consider becoming active Citizen Lake Monitors for water quality (Secchi depth, total phosphorus and chlorophyll *a*).

If a new AIS is found the procedures for Early Detection and Rapid Response should be followed immediately upon detection. This DNR document is included in Appendix C2. This document outlines the steps to follow if new AIS are discovered that will help to control pioneer populations before they become established.

The University of Wisconsin-Extension Lake's Program provides training and coordinates the Citizen Lake Monitoring Program. More information about the program is available by contacting Laura Herman, Citizen Lake Monitoring Network Education Specialist, (715) 346-3989, email: lherman@uwsp.edu, website: http://www.uwsp.edu/cnr/uwexlakes/clmn/.

Completing pre and post aquatic plant monitoring in any areas that are actively managed to evaluate management effectiveness is recommended. The protocol for these surveys was created by WDNR and must be followed if the management activities are grant funded. The protocol should be followed even if grant funds are not involved to assess management effectiveness. In general lake-wide aquatic plant surveys are recommended every 5 years (essentially repeating the 2011 point intercept aquatic plant survey) to monitor changes in the overall aquatic plant community and the effects of the APM activities. Aquatic plant communities may change with varying water levels, water clarity, nutrient levels and aquatic plant management actions.

6.1.2 Clean Boats Clean Waters Campaign

Measures for the prevention of the introduction of new AIS to the lake and containment of existing AIS should be a priority. To prevent the spread of CLP out of and other AIS into Solberg Lake, a monitoring program such as Clean Boats Clean Waters (CBCW) is an excellent choice. This program is carried out by trained volunteers who inspect the incoming boats at public launches. Signage also accompanies the use of CBCW to inform lake users of proper identification of AIS and boat inspection procedures. Education of the public, along with private property and resort owners, about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations. Contact with lake users at this time is a great way to distribute other educational materials.

Lake residents are currently participating in Clean Boats Clean Waters program. Continuation of this program is recommended and should be promoted by the current CBCW coordinator on the lake. There are four public landings on Solberg Lake and two private at the resorts. The highest use occurs at the public landings in the following order: East Solberg Lake Road, County Park, Disappearing Creek and Squaw Creek. The busiest landings should be monitored during weekends and holidays to interact with the most lake users. Additional association members should be trained so there are plenty of people to staff the landings. More information and a training schedule can be found at http://dnr.wi.gov/lakes/cbcw/. WDNR offers a grant to help lake associations pay CBCW staff to conduct inspections. Up to $4,000 per landing is available through this grant program. More information can be found at the following website http://dnr.wi.gov/aid/documents/ais/cbcw_fact_sheet.pdf.

6.1.3 Aquatic Plant Protection and Shoreline Management

Protection of the native aquatic plant community is needed to slow the spread of EWM, CLP and other AIS from lake to lake and within a lake once established. Therefore, riparian landowners should refrain from removing native vegetation unless they need access via a 30 ft. corridor. Additionally, EWM and CLP can thrive in nutrient (phosphorus and nitrogen) enriched waters or where nutrient rich sediments occur. Two simple actions can prevent excessive nutrients and sediments from reaching the lake.

The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. Properties with seawalls, manicured lawn to water's edge and active erosion would be good candidates for shoreland restorations. The many benefits of natural shorelands cannot be stressed enough. Establishing natural shoreline vegetation can sometimes be as easy as not mowing to the water's edge. Native plants can also be purchased from nurseries for restoration efforts. Shoreline restoration has the added benefits of providing wildlife habitat, preventing erosion and it may deter geese from entering the lawn area. A vegetated buffer area can also prevent surface water runoff from roads, parking areas and lawns from carrying nutrients to the lake.

The second easy nutrient prevention effort is to use lawn fertilizers only when a soil test shows a lack of nutrients. A relatively new Wisconsin law prohibits the application of turf fertilizer containing phosphorus except in certain circumstances. Phosphorous containing fertilizer may be used when planting a new lawn or when a soil test indicates the soil is low in phosphorous. Fertilizer may not be applied to impervious surfaces or frozen ground under the new law. More information can be found in Wisconsin Statute 94.643. The fertilizers that were commonly used for lawns and gardens have three major plant macronutrients: nitrogen (N), phosphorus (P), and potassium (K). These are summarized on the fertilizer package by three numbers. The middle number represents the amount of phosphorus. Since most Wisconsin lakes are "phosphorus limited", meaning additions of phosphorus can cause increased aquatic plant or algae growth, preventing phosphorus from reaching the lake is a good practice. Local retailers and lawn care companies can provide soil test kits to determine a lawn's nutrient needs. Of course, properties with an intact natural buffer require very little maintenance and no fertilizers.

Another possible source of nutrients to a lake is the septic systems surrounding the lake. Septic systems should be properly installed and maintained in order to prevent improperly treated wastewater, which carries substantial nutrients, from reaching the lake. Property owners who are not sure if their septic system is adding nutrients to the lake should contact a professional inspector and have their system assessed.

The Price County Land Conservation Department (LCD) may be able to offer assistance to restore native vegetation to shoreland property. LCD has been involved in several shoreland restoration projects in the last few years on Solberg that have ranged from plantings to bank stabilization projects. Shoreland restoration can also be funded through a Lake Protection Grant.

6.1.4 Public Education and Involvement

The SLA should continue to keep abreast of current AIS issues throughout the County. The County Land Conservation Department, the WDNR Lakes Coordinator, and the UW Extension are good sources of information. Many important materials can be ordered at the following website:

http://www.uwsp.edu/cnr/uwexlakes/publications/

Appendix G includes resources for further information about public education opportunities.

6.2 Aquatic Plant Manipulation Alternatives

This management alternative may be used when aquatic plants present some sort of problem that must be dealt with or manipulated by human action. This technique is recommended for the CLP beds and for limited management of nuisance native vegetation in Disappearing Creek, Squaw Creek and Comfort Cove. CLP is present in the lake and the spread of this AIS could create navigational and recreational nuisances on the lake. Management of this AIS is highly recommended to maintain the recreational quality of the lake. The following alternatives may be used to manage AIS such as CLP. These techniques may also be used to manage the native vegetation in isolated problem areas.

6.2.1 Manual Removal

Manual removal consists of physically removing plants using bodily force and hand tools. Manual removal efforts include hand raking, cutting and hand pulling unwanted plants. This method is most effective when plants are pulled or cut as near the sediment as possible and all plant material is removed from the lake. Manual removal of aquatic plants can be quite labor intensive and time consuming. This technique is well suited for small areas in shallow water where property owners can weed the aquatic garden. Hiring laborers to remove aquatic vegetation is an option, but also increases cost. Scuba divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal by property owners include lower cost compared to chemical control methods, quick containment of pioneering (new) populations of invasive aquatic plants, and the ability for a property owners to slowly and consistently work on active management. The drawback of this alternative is that pulling aquatic plants include the challenge of working in the water, especially deep water, the threat of letting fragments escape and colonize a new area, and the fact that control of any significantly sized population is quite labor intensive. Again, hiring laborers to remove aquatic vegetation is an option, but also increases cost.

Curly-leaf Pondweed

No permit is required to remove non-native invasive aquatic vegetation, as long as the removal is conducted completely by hand with no mechanical assistance of any kind. All aquatic plant material must be removed from the water to minimize dispersion and re-germination of unwanted aquatic plants. Portions of the roots may remain in the sediments, so removal may need to be repeated periodically throughout the growing season.

CLP should be targeted for removal in the spring or early summer (May/June) before turion production begins. Monitor the mapped stands and when the vegetation can be seen from the surface, coordinate removal efforts. An Adopt-a-CLP-Bed may be a good program to start where lake users/landowners are assigned to a specific CLP bed. When the coordinator determines the CLP is ready for removal the groups will be notified and removal should begin. If new beds of CLP are found in the lake removal should be completed immediately and the location recorded with GPS.
CLP plants should be removed as close to the sediment as possible. When using a rake or weed cutter be sure the head is near the lake bottom. If hand-pulling, use even pressure to try and pull up the entire plant and in shallow water pull as close to the lake bottom as possible.

Native Vegetation

Native plants may be found at nuisance levels that inhibit navigation and recreational use in certain areas in the lake. Manual removal of these plants is allowed at individual properties (except wild rice in the northern region) under Wisconsin law to a maximum width of 30 feet (recreation zone). The intent is to provide pier, boatlift or swimming raft access in the recreation zone. A permit is not required for hand pulling or raking if the site is **not located in a Sensitive Area** and maximum width cleared does not exceed the 30-foot recreation zone (manual removal of any native aquatic vegetation beyond the 30-foot area would require a permit from the WDNR that satisfies the requirements of Chapter NR 109, Wisconsin Administrative Code, see Appendix F). **If the site of manual removal is located in a Sensitive Area a permit is required**. **Disappearing Creek and Squaw Creek are Sensitive Areas** and permits would be required for manual removal of native vegetation. Manual removal is **cautioned** because it could open a niche for non-native invasive aquatic plants to occupy. If a proposed management area is **near a stand of CLP**, removal of native vegetation is **not recommended**. CLP is known for invading disturbed areas where native plants have been removed. Removal of native plants also destroys habitat for fish and wildlife.

Limited manual removal of native vegetation is recommended for individual property owners where nuisance conditions occur. The area of removal should be kept to a minimum and a width of less than 30 feet is recommended. A navigation lane just wide enough for watercraft used is recommended. If lanes for fishing from the dock are required an area a few feet wide could be cleared to provide casting opportunities.

The figures below show the locations of the Sensitive Areas and documented CLP beds.

Figure 22 - Sensitive Area Locations

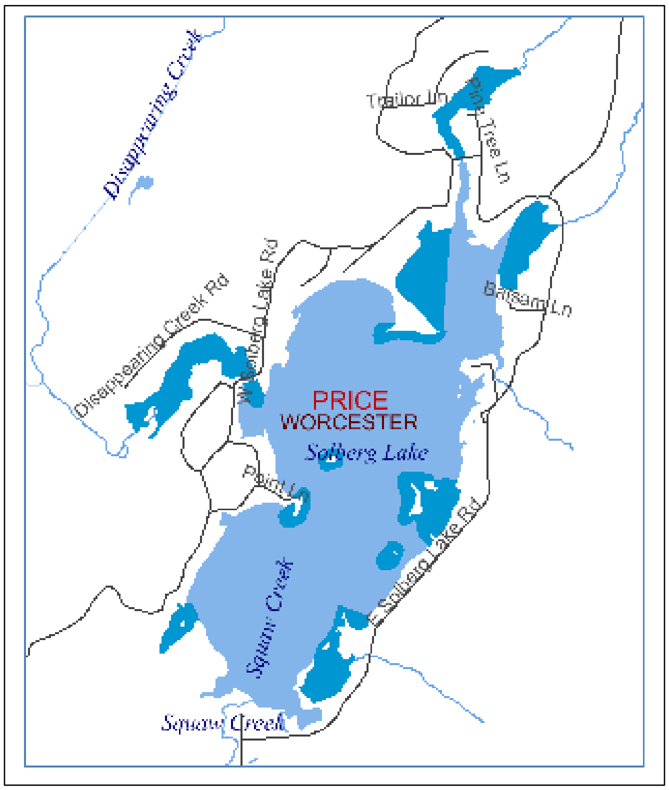
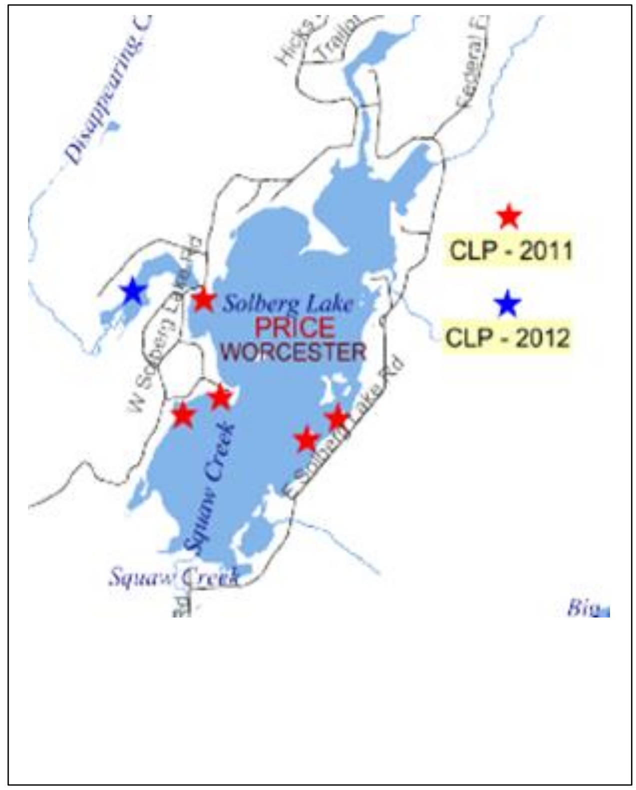


Figure 23 - CLP Bed Locations



6.2.2 Aquatic Invasive Plant Species Chemical Herbicide Treatment

A chemical herbicide treatment may be an appropriate way to treat large areas of AIS to conduct restoration of native plants. Chemical treatments on small, isolated beds of AIS are generally not very effective. In order for herbicides to be effective concentration and contact time need to be maintained; this is difficult to achieve when treating small stands in moving water (such as a flowage). Herbicides are generally not recommended for use in Sensitive Areas; these are areas designated by WDNR that have vegetation offering critical or unique fish and wildlife habitat to the lake. Herbicide application permits may be denied by WDNR if they are for a Sensitive Area. The applicant must demonstrate that the herbicide treatment will not alter the ecological character or reduce ecological value of the area. Five of the six CLP beds are located in or near Sensitive Areas. Since the CLP beds are small, isolated and located in/near Sensitive Areas; **chemical treatment is not recommended at this time**. If the beds expand and/or new ones appear chemical treatment may be a viable option in the future. The aspects of chemical treatment are discussed below.

When using chemicals to control AIS it is a good idea to re-evaluate the lake and the extent of the AIS conditions before, during and after chemical treatment. The WDNR may require another whole-lake plant survey and will certainly require a proposed treatment area survey. Along with the above mentioned survey, pre and post treatment monitoring should be included for all aquatic plant treatments and is typically a WDNR requirement in the Northern Region. WDNR recommends conducting a whole-lake point-intercept survey on a five year basis (for Solberg Lake the next would be 2016). Such a survey may reveal a new AIS and at the very least would provide good trend data to see how the aquatic plant community is evolving.

The science regarding what chemicals are most effective and how they can be used is constantly being updated. Recent studies have shown good to excellent control of CLP using formulations of diquat (Reward) and endothall (Aquathol K). These treatments are effective but only give control in the year applied. Some studies have shown endothall applied early in spring can control CLP and stop turion production. This experimental study has shown control using Aquathol K in 60 degree (F) water early in CLP lifecycle can prevent turion formation.

Chemical treatment is usually a long term commitment and requires a specific plan with a goal set for "tolerable" levels of the relevant AIS. One such landmark might be 10% or less of the littoral area being occupied by aquatic invasive plants. At this time the CLP beds are far less than 10% of the littoral area.

Advantages of herbicides include broader control than hand pulling, and represents a true restoration effort, which harvesters do not (this is why harvesters are not discussed in this document). Disadvantages include negative public perception of chemicals in natural lakes, the potential to affect non-target plant species (if not applied at an appropriate application rate and/or time of year) and water use restrictions after application may be necessary.

6.2.3 Native Vegetation Management - Chemical Herbicide Treatment

Native vegetation is generally not managed in Wisconsin waters. In the case of Solberg Lake native vegetation has become so thick in isolated areas that it has reached nuisance levels by severely limiting navigation and recreation. Limited management in isolated areas is considered to allow navigation. In 2009 navigation lanes were treated in Disappearing Creek and Squaw Creek. The treatment was very effective and little growth was observed during the 2011 and 2012 aquatic plant surveys in the treated areas. Continued limited treatment of these areas is recommended to provide a navigation lane that allows access for landowners in these areas; without these lanes access to the lake from Squaw and Disappearing Creek is extremely difficult. Both Disappearing and Squaw Creek areas are designated as Sensitive Areas. These areas provide critical habitat for fish and wildlife that is limited in the main body of the lake. Removal of native vegetation also creates the perfect environment for CLP invasion and establishment in these Sensitive Areas. Limited management on an as needed basis is recommended to balance navigation needs and habitat protection.

Manage navigation lanes in Squaw Creek, Disappearing Creek and Comfort Cove

Under this option small areas of native plants would be managed. A navigation lane up to 30 feet wide would be maintained to provide access up Disappearing Creek, Squaw Creek and into Comfort Cove. The vegetation that poses a problem in these areas are both submersed and floating-leaf plants such as watershield, white water lily, common waterweed, coontail, watermilfoil and common bladderwort. Limited chemical treatment may be required to maintain a common navigation lane for access to these areas. Annual evaluation of plant density is recommended to determine when chemical treatment is warranted. The navigation lane should be surveyed for plant density for both submersed and floating-leaf. Plant density should be determined by rake samples at predetermined points for submersed vegetation and visual observation for floating-leaf vegetation. See Appendix I for recommended sample points. Observations should be made at peak plant density late in the growing season in July or August to determine if chemical treatment will be needed the following year to maintain navigation. The following criteria may be followed to assess the need for chemical treatment. If chemical treatment will be pursued a pre-treatment survey will be conducted according to WDNR protocol which is included in Appendix H.

The following criteria may be used to **assess plant density in late summer (August) the year *prior* to herbicide application**:

> **Submersed vegetation** – sample vegetation with a rake at predetermined points. If at least **75%** of the sample points have a **rake density of 3** chemical treatment may be considered the following year.
>
> **Floating-leaf vegetation** – make visual observations of surface coverage at predetermined sample points. If at least **75%** of the **water surface is matted** with vegetation chemical treatment may be considered the following year.

If the treatment criteria have been reached, WDNR Aquatic Plant Management (APM) staff should be contacted and a site visit scheduled for a field assessment. APM staff will evaluate the conditions to determine if herbicide treatment would be approved for the following season. During this site visit the area of treatment should be established.

It is best to treat the vegetation as soon as it is fully developed and exposed; typically early June. To treat the native vegetation, which is a combination of submersed and floating-leaf, a combination of Habitat brand herbicide for floating-leaf with a surfactant (sticking agent) and diquat for submersed species may be an effective choice. As mentioned in the previous section the science on herbicide effectiveness is constantly changing. The consultant applicator that will be applying the herbicide should consult with APM staff to determine the type and concentration of herbicide application.

6.2.4 Water Level Drawdown

Drawdown of water level can be a very effective tool in managing certain AIS and native vegetation. During a drawdown the water levels are lowered to expose the bed of the lake where the AIS is present; the winter temperatures freeze and dry the plants and roots killing them. This technique has drastically reduced Eurasian watermilfoil (EWM) in some lakes for several years before it made a comeback. Drawdowns impact native plants but not to the extent that it does EWM. While drawdown may be very effective on EWM it has not been proven to effectively control CLP on a long term basis. CLP plants are susceptible to the freezing and drying during a winter drawdown but the turions may or may not survive depending on winter severity and desiccation. Turions may be present in the sediment for 5 years before they germinate and grow new plants. Many native plants respond well to fluctuating water levels and there is typically an increase in diversity and density of native aquatic plants following a drawdown. Native plants usually rebound within the first summer after refilling the reservoir. Certain emergent plants benefit from a drawdown and need lowered water levels to germinate and reproduce. Bulrushes are one of the plants that usually come back in abundance after a drawdown.

Drawdowns also help to turn back the clock on the aging process a flowage undergoes. The drawdown knocks back the vegetation that grows in abundance as a flowage ages. It also aids in sediment compaction, especially in the mucky areas of the lake. These areas can experience compaction of up to 12 inches after a drawdown.

Drawdowns do have negative impacts also; mainly to the recreational use of the lake. This can be minimized as the drawdowns are typically over-winter events. When the lake is drawdown there is limited access to the water and use is very limited on the lake. There is a popular belief that drawdowns negatively impact fish populations but that has not been scientifically proven. There are area lakes that have periodic drawdowns and have not noticed a negative impact to the fishery. The fish become more concentrated in the water that is available so there is likely more predation that occurs that thins out the smaller fish. There is also the belief that the fish will be "fished out" when they are concentrated; but with the increase in natural prey they are not so likely to take the anglers bait.

A winter drawdown is an option to consider to reduce the amount of floating-leaf and submersed native vegetation; especially in Disappearing and Squaw Creeks. The drawdown could reduce the nuisance vegetation and may increase other emergent species such as bulrush, bur-reed, sedges and spikerush. The sediment compaction in these areas would be a benefit also, providing greater water depths to keep the density of nuisance vegetation down for a longer period of time. As with any management technique the results and the length of control vary greatly based on site specific conditions. According to the Price County Dam Keeper Solberg Lake dam is capable of a 5 foot drawdown. A drawdown of this extent would likely expose most of the lakebed in the Disappearing and Squaw Creek reaches but further investigation to assess lakebed elevations and dam capabilities would need to be made if this option is considered.

7.0 Conclusion and Recommended Action Plan

One aquatic invasive plant was found during the aquatic plant survey in 2011; curly-leaf pondweed, *Potamogeton crispus* (CLP). This species has been previously identified within the lake and has been actively monitored and managed. The CLP has spread to isolated areas in the lake that reappear each year even after hand-pulling the stands in early summer. Native vegetation has risen to nuisance levels in several areas of the lake and has been actively managed. Due to these issues, the following Recommended Action Plan focuses on CLP control, native nuisance management and public education.

7.1 Recommended Active Goals

The recommended action plan includes actions for Solberg Lake based on the Maintenance Alternatives listed above in Section 6. The SLA president has approved the following active goals. It will be up to residents of Solberg Lake and the SLA to determine the actions, find the funding, and gather the individuals needed to implement the active goals.

Active Goal: Effectively manage CLP to improve recreation and rehabilitate native plants.
Action: Continue monitoring existing CLP stands by documenting location, size and density. Monitor the entire lake for new CLP stands according to Citizen Lake Monitoring Protocol. Continue hand-pulling stands in early summer before turion production occurs. Consider implementing Adopt-a-CLP-Bed Program.
Timing: Begin monitoring beds in early summer (May); when beds are visible coordinate pulling effort.

Active Goal: Improve navigation through Squaw Creek, Disappearing Creek and Comfort Cove.
Action: Use a combination of manual removal and herbicide treatment to manage native vegetation and improve navigation. Herbicide treatments are recommended to create a common navigation lane in these problem areas. Annual assessment will indicate if herbicide treatment will be needed the following year. Pre and post surveying to track effectiveness and impacts is highly recommended. Manual removal is recommended for small areas and for individual land owners to gain access to the navigation lane. If manual removal is proposed in a Sensitive Area obtain permits.
Timing: Complete pre-treatment survey in August of the year prior to treatment. Schedule site visit with DNR APM staff prior to application permit submittal. Apply herbicide in early summer. Manual removal can begin anytime and continue throughout summer.

Active Goal: To implement and maintain an aquatic invasive species monitoring program that will survey for invasive species, and if found, monitor their locations and extent of population spread.
Action: Participate in Citizen Lake Monitoring training for aquatic invasives and monitor the lake on an annual basis according to CLM protocol.
Timing: Complete training in 2012 and begin monitoring immediately.

Active Goal:	To continue and expand the Solberg Lake comprehensive water quality monitoring program through the WDNR Citizen Lake Monitoring Network. The program would include Water Clarity Monitoring and Water Chemistry Monitoring.
Action:	Participate in CLM training for water quality monitoring. Collect samples monthly throughout the growing season for chlorophyll a and total phosphorus along with Secchi measurements.
Timing:	Complete training in 2012. Begin monitoring immediately.

Active Goal:	To continue and expand the WDNR Clean Boats, Clean Waters program on Solberg Lake.
Action:	Train additional members in CBCW protocol and monitor landings at peak use periods such as holidays and weekends. Concentrate efforts on most used landings (County Park, East Solberg Lake Road, and Disappearing Creek).
Timing:	Train additional members in 2012. Create schedule and begin monitoring landings by Memorial Day.

Active Goal:	Prevent the spread of existing, and introduction of new AIS by educating lake users.
Action:	Install/maintain signs at boat landing warning of CLP infestation and prevention techniques. Include information on all AIS to prevent spread into lake.

Active Goal:	Protect, designate and improve fish and wildlife habitat and Sensitive Areas.
Action:	Place maps at landings indicating Sensitive Areas and remind lake users to reduce impacts to these areas. Increase awareness of No-Wake Zones.

Active Goal:	Promote shoreland restoration.
Action:	Complete detailed assessment of shorelines rated 3 in Shoreland Assessment map. Contact property owners that could benefit from shoreland restoration to encourage them to take action. Contact Price County Land Conservation for assistance with restoration plans. Apply for Lake Protection Grant for funding for restorations.

7.2 Pursue Grant Funding to Implement Actions

There are a number of grants available through WDNR to implement actions outlined in this plan and to complete further research and projects on Solberg Lake. Following is a brief description of the grants available through WDNR.

Small Scale Lake Management Planning

Funding Amount: $3,000
Local Match: 33%
Purpose: Funding to collect and analyze information needed to protect and restore lakes and watersheds
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Lake monitoring such as water quality and aquatic plants
- Lake education such as activities that will collect/disseminate information about lakes to educate public on lake use, lake ecosystem and lake management techniques
- Organization development such as assist management units in formation of

goals/objectives for management of lake
- Studies/assessments to implement management goals and expanding monitoring

Large Scale Lake Management Planning

Funding Amount: $25,000
Local Match: 33%
Purpose: Funding to collect and analyze information needed to protect and restore lakes and watersheds
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Gathering and analysis of physical, chemical and biological information
- Describing present and potential land uses in watershed and on shoreline
- Reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, sanitation or pollution control or surface use
- Assessment of fish, aquatic life, wildlife and their habitats
- Gathering and analyzing information from lake property owners/users
- Developing, evaluating, publishing, distributing alternative courses of action and recommendations in a lake management plan

Lake Protection Grant

Funding Amount: $200,000
Local Match: 25%
Purpose: Funding for large, complex, technical projects for lake protection
Application Deadline: May 1
Eligible Projects:

- Purchase of land or conservation easements
- Restoration of wetlands and shorelands to protect water quality
- Development of local regulations to protect lakes and education activities necessary to implement them
- Lake management plan implementation project recommend in **WDNR approved plan**
    - Watershed management projects
    - Lake restoration
    - Diagnostic feasibility studies

Aquatic Invasive Species Education, Planning and Prevention Grant

Funding Amount: $150,000
Local Match: 25%
Purpose: Educate lake users on AIS
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Educational programs including workshops, training or coordinating volunteer monitors.
- Develop prevention and control plans for AIS
- Monitor, map and assess waterbodies for AIS or studies that will aid in prevention AIS
- Watercraft inspection and education projects (CBCW). Inspectors must be trained and staff boat launch facilities a minimum of 200 hours between May 1 and October 30. Limited to $4,000 per boat launch facility.

Aquatic Invasive Species Established Population Control Project

Funding Amount: $200,000
Local Match: 25%
Purpose: Provide for eradication/substantial reduction and long term control of AIS with goal of restoring native species.
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Department approved control activities recommended in control plan
- Experimental or demonstration project in WDNR approved plan
- Purple loosestrife bio-control project

Aquatic Invasive Species Early Detection and Response

Funding Amount: $20,000
Local Match: 25%
Application Deadline: As approved
Eligible Projects: Identification and removal by approved methods of small, pioneer population of AIS. Localized beds must be present less than 5 years and less than 5 acres in size or less than 5% of lake area. Control of recolonization following completion of an established population control project is eligible.

Aquatic Invasive Species Research and Demonstration

Funding Amount: $500,000
Local Match: 25%
Purpose: Funding for cooperative research or demonstration activity between sponsor and WDNR
Application Deadline: Feb 1 and Aug 1

Aquatic Invasive Species Maintenance and Containment

Funding Amount: Full cost of aquatic plant management permit
Local Match: 25%
Purpose: Funding for department approved management at desired level of AIS where eradication is not possible. Monitoring and reporting are required.
Application Deadline: Continuous

7.3 Closing

This APM Plan was prepared in cooperation with the Solberg Lake Association. It includes the major components outlined in the WDNR Aquatic Plant Management guidance. The "Recommended Action Plan" section of this report can be used as a stand alone document to facilitate CLP management activities for the lake. This section outlines important monitoring and management activities. The greater APM Plan document and appendices provides a central source of information for the lake's aquatic plant community information, the overall lake ecology, and sources of additional information. If there are any questions about how to use this APM Plan or its contents, please contact Flambeau Engineering.

This APM Plan should be updated periodically to reflect current aquatic plant problems, and the most recent acceptable APM methods. Repeating the aquatic plant survey and updating the APM Plan is recommended every five years. Information regarding aquatic plant management and protection is available from the WDNR website: http://dnr.wi.gov/org/water/fhp/lakes/aquaplan.htm or from Flambeau Engineering upon request.

8.0 References

While not all references are specifically cited, the following resources were used in preparation of this report.

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