Aquatic Plant Management Plan

Balsam Lake

Polk County, Wisconsin

October 2010

Sponsored By
Balsam Lake Protection and Rehabilitation District

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Funded By
Balsam Lake Protection and Rehabilitation District
A Wisconsin Department of Natural Resources Grant

Table of Contents

Tables

Figures

Appendices

Executive Summary

This Aquatic Plant Management Plan for Balsam Lake presents a strategy for managing aquatic plants by protecting native plant populations, managing curly leaf pondweed, and preventing establishment of invasive species through the year 2014. The plan includes data about the plant community, watershed, and water quality of the lakes. It also reviews a history of aquatic plant management on Balsam Lake.

An aquatic plant point intercept survey and curly leaf pondweed bed mapping was completed for Balsam Lake in 2009. The aquatic plant surveys found that Balsam Lake has a healthy, abundant, and diverse plant community. Native plants provide fish and wildlife habitat, stabilize bottom sediments, reduce the impact of waves against the shoreline, and prevent the spread of non-native invasive plants – all critical functions for the lake.

This Aquatic Plant Management Plan, developed with input from an advisory committee including lake property owners, will help the Balsam Lake Protection and Rehabilitation District choose methods to meet plan aquatic plant management goals. The implementation plan describes the actions that will be taken toward achieving these goals.

A special thank you is extended to the aquatic plant advisory committee for assistance with plan development.

Plan Goals

1. Manage established invasive species and eradicate newly introduced invasive species to reduce their impacts to the lake.

2. Prevent the introduction of aquatic invasive species.

3. Maintain navigation for fishing and boating in problem areas, access to lake residences, and comfortable swimming at the village beach.

4. Increase lake residents' and visitors' understanding of aquatic plants and management.

5. Preserve the diverse native aquatic plant community in Balsam Lake.

Introduction

The Aquatic Plant Management Plan for Balsam Lake is sponsored by the Balsam Lake Protection and Rehabilitation District (BLPRD). The planning project is funded by a Wisconsin Department of Natural Resources Aquatic Invasive Species Planning and Education grant and the BLPRD.

This aquatic plant management plan presents a strategy for managing aquatic plants by protecting native plant populations, managing curly leaf pondweed, and preventing the establishment of additional invasive species. The plan includes data about the plant community, watershed, and water quality of the lakes. Based on this data and public input, goals and strategies for the sound management of aquatic plants in the lakes and river are presented. This plan will guide the BLPRD and the Wisconsin Department of Natural Resources in aquatic plant management for Balsam Lake over the next five years (from 2010 through 2014).

Public Input for Plan Development

The BLPRD Aquatic Plant Management (APM) Advisory Committee provided input for the development of this plan. The APM Advisory Committee met three times. At the first meeting on April 6, 2010, the committee reviewed aquatic plant management planning requirements, plant survey results, and discussed aquatic plant management concerns. At a second meeting on May 4, 2010, and a third meeting on May 11, 2010, the committee reviewed aquatic plant management efforts to date, drafted goals, and developed objectives and action steps. The APM Advisory Committee concerns are reflected in the goals and objectives for aquatic plant management in this plan.

The BLPRD board announced the availability of the draft Aquatic Plant Management Plan for review with a public notice in the Polk County Ledger the weeks of June 28 and July 1, 2010. Copies of the plan were made available to the public on the BLPRD web site: BLPRD.com and at the Balsam Lake Public Library. Comments will be accepted through July 17, 2010.

The final draft plan was forwarded to staff of the St. Croix Tribe Environmental Department and the Voigt Intertribal Task Force for review. Final copies will be distributed to these entities as well.

Resident Concerns

The APM Committee expressed a variety of concerns that are reflected in the objectives for plan development and in the goals for aquatic plant management in this plan. Management concerns ranged from being able to respond to resident desire to remove nuisance aquatic plants that impede navigation and swimming, to prevention of invasive species establishment and spread, to maintaining a natural lake environment and fishery.

Property Owner Surveys

A 2007 survey of lake residents was updated in a February 2010 resident survey. As of March 19, 2010, 301 out of 800 surveys were completed and returned, a return rate of 37 percent. Of the 800 surveys distributed, 86 were returned as undeliverable. (The surveys were sent bulk mail, so

they were not forwarded.) Preliminary results were distributed to the APM Committee prior to the April 6th meeting. The results of the survey are discussed below and are found in Appendix A.

Popular lake activities, rated in the chart below by degree of participation from 0 (none) to 4 (a great deal), demonstrate potential conflicts for aquatic plant management. Enjoying the view, appreciating peace and tranquility, and observing wildlife are the highest ranked activities (3.69, 3.48, and 3.13 respectively). These activities are supported by aquatic plants in the lake. However, motor boating and swimming - which may be limited by aquatic plant growth - follow with rankings of 2.82 and 2.33 respectively.

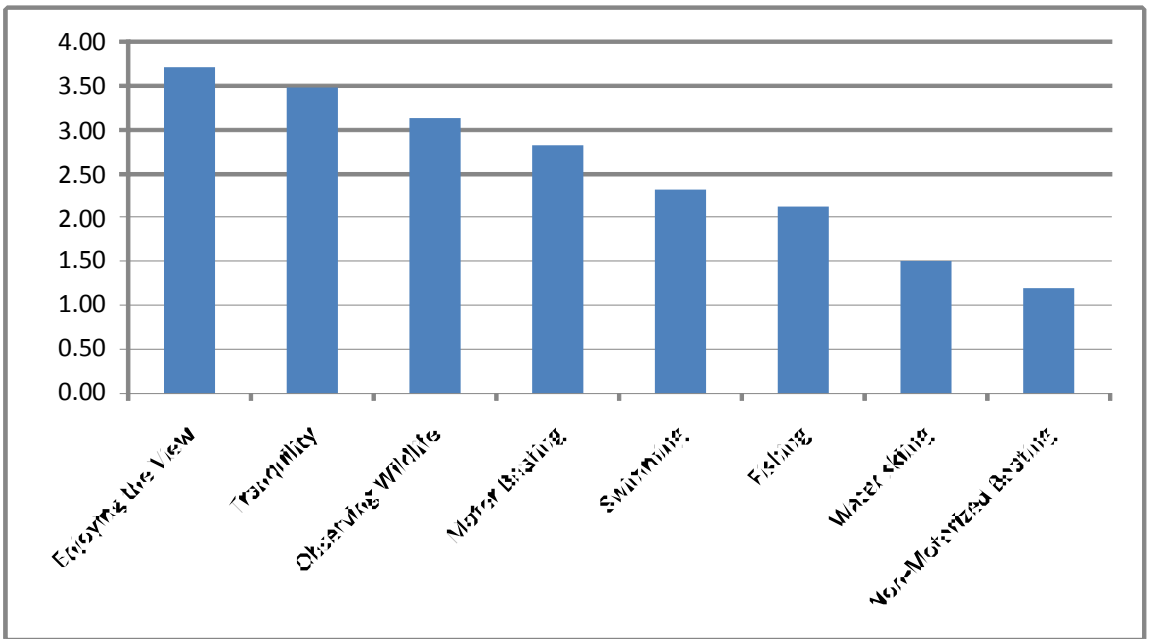

Figure 1. Survey Response: Indicate your degree of participation in the following activities at Balsam Lake.

Additional survey results indicate a range of concerns and priorities from lake residents (Figure 2). In terms of what negatively impacts use and enjoyment of the lake, algae growth and invasive aquatic plant growth and algae growth rank above native plant growth (these are the top three negative impacts on the lake).

Managing invasive aquatic plants in Balsam Lake is generally supported in survey results, with most categories ranking somewhere between “unsure” and “probably yes.” Residents are most supportive of preventing invasive species introduction, educating lake residents, and protecting sensitive habitat areas. There is also strong support for encouraging residents to hand pull or rake to remove invasive aquatic plants. More intensive management of native plants is not as strongly supported.

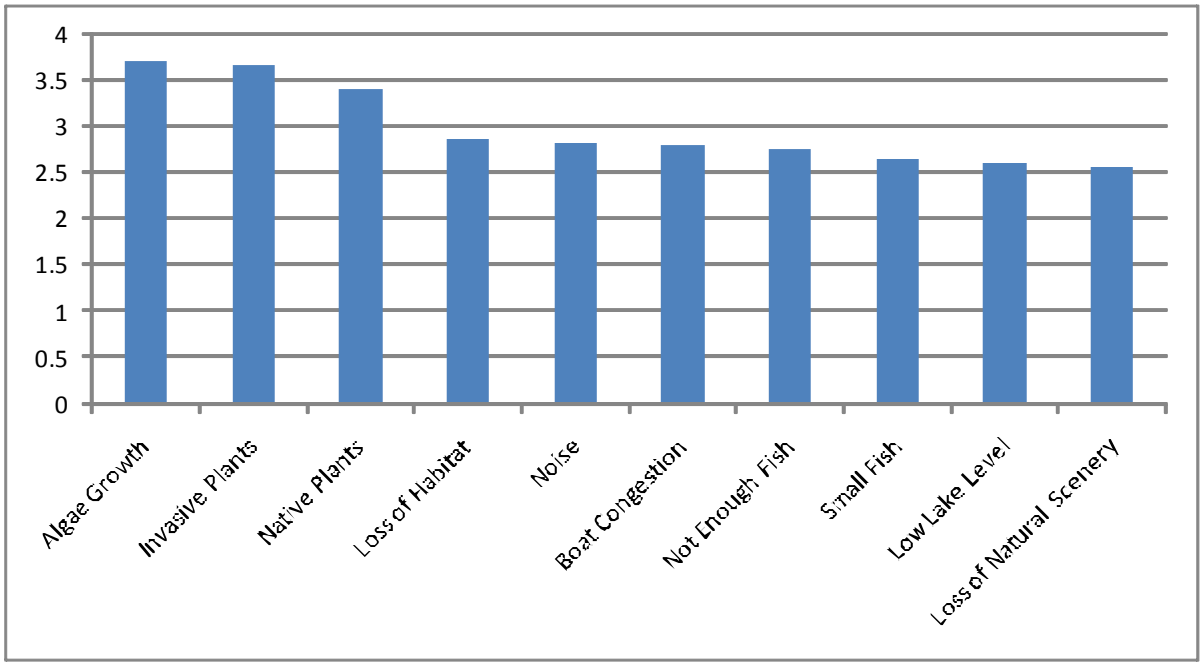

Figure 2. Survey Response: Indicate how much each of the following negatively impacts your use of the lake.

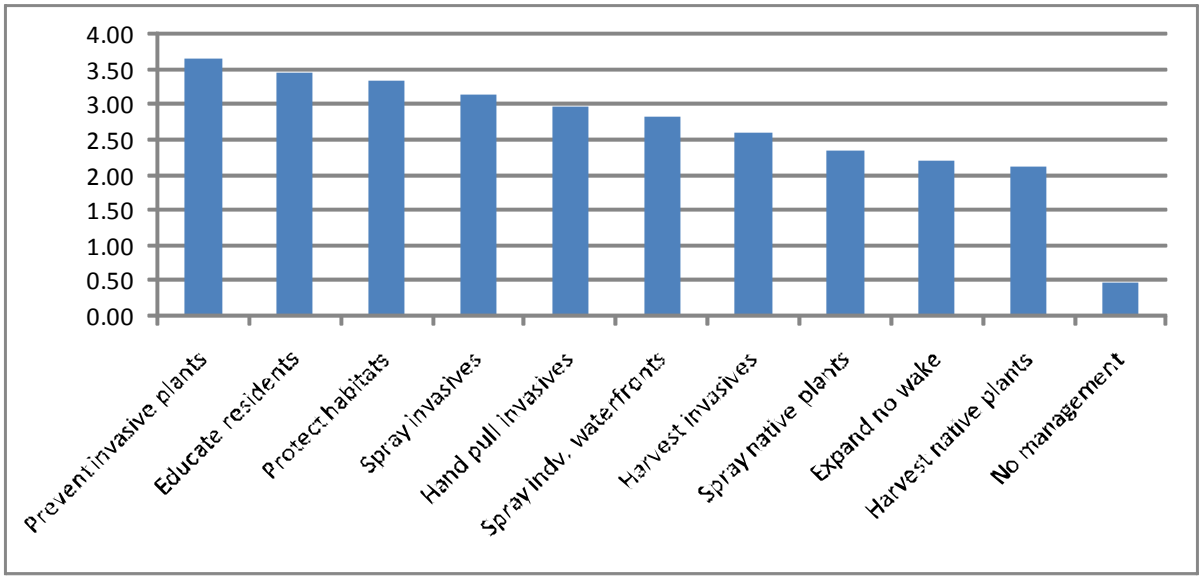

Figure 3. Survey Response: What aquatic plant management actions should the Lake District pursue?

Lake Information

The Lake

Balsam Lake (WBIC 2656200) is located in central Polk County, Wisconsin in the towns of Balsam Lake, Milltown, Georgetown, and Apple River. The lake has a surface area of 2,054 acres and a maximum depth of 37 feet. The average depth is 16.8 feet. Little narrows in the northwestern part of the lake and big narrows in the eastern part separate the lake into three basins. The areas of the Main Basin, Little Balsam, and East Balsam are about 1,270, 86, and 550 acres respectively.[2]

Balsam Lake is a stratified, drainage lake. Two main streams enter Balsam Lake. Rice Creek originates north of and flows through Rice Lake, is joined by Otter Creek, then flows into the northwestern end of Little Balsam Lake. Harder Creek flows from Half Moon Lake into the north side of Balsam Lake's main basin to the Stumps area.

Balsam Lake is mesotrophic to slightly eutrophic with secchi depths averaging 8 feet in the Main Basin, 7 feet in Little Balsam, and 6 feet in East Balsam.[3] The littoral zone reached a depth of 15 feet in the main basin, 14 feet in Little Balsam, and 19 feet in East Balsam in July 2009.[4] The littoral zone is the lake depth to which plants grow. See Table 1 below for further information. The bottom substrate is variable with muck bottoms in most bays and rock and sand bars in the narrows and around the lake's many islands.

Table 1. Lake Information

	Main Basin	Little Balsam	East Balsam	Total
Size (acres)	1270	86	550	2,054
Mean depth (feet)				16.8
Maximum depth (feet)	37			37
Littoral zone depth (feet)	15	14	19	NA
Average summer secchi depth (feet)	8	7	6	NA

A lake map is found on the following page as Figure 4. Boat landings are indicated with an "L" on the lake map.

[2] *Water and Phosphorus Budgets and Trophic State, Balsam Lake, Northwestern Wisconsin.* 1987 – 1989. U. S. Geological Survey. Water Resources Investigations Report 91-4125.

[3] Based on July and August averages from 1987-2009, although citizen lake monitoring reports are not included for every year at each location. dnr.wi.gov/lakes/CLMN/reportsanddata.

[4] Berg, Matthew S., Endangered Resources Services, LLC. *Warm Water Point/Intercept Macrophyte Survey Balsam Lake Polk County, Wisconsin. July 2009.*

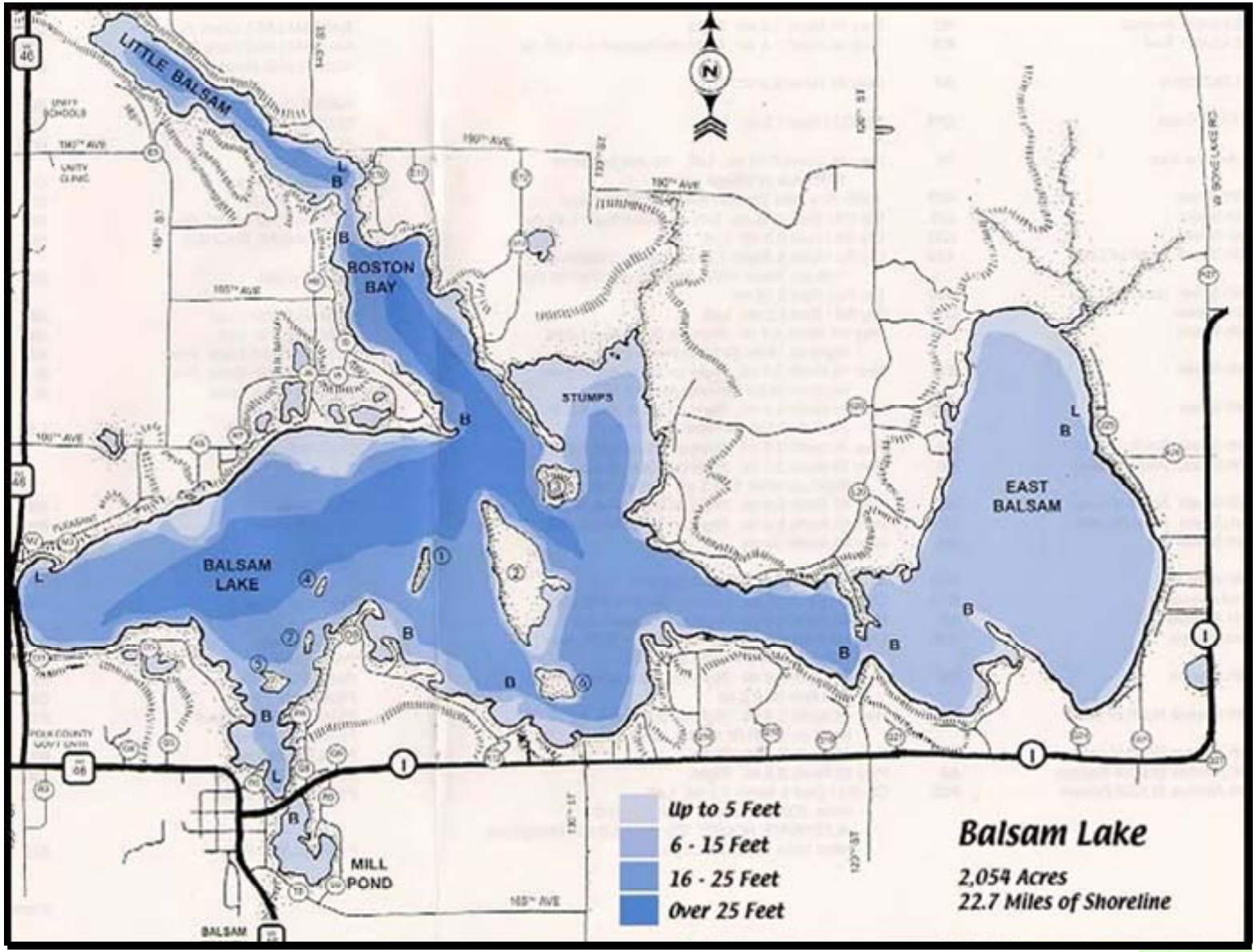

Figure 4. Balsam Lake Map

Water Quality

Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic.

Citizen lake monitoring volunteers have collected data from the lake almost annually since 1987. There are three data collection sites on Balsam Lake one each in the Main Basin, East Balsam, and Little Balsam.

Each of the four sites was sampled on a number of occasions during 2009. Results are available from the WDNR website. Different monitors sampled each location on a different date. July and August average readings are generally reported, but for the main basin and East Balsam, only a single sample was recorded during this time period in late August. Therefore, late August results are reported in Table 2 below. The parameters sampled included water clarity, dissolved oxygen, total phosphorus, and chlorophyll. Trophic State Index classifications were then determined based on the chlorophyll values for the Main Basin and East Balsam and by the Secchi depth for Little Balsam. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticeable algae blooms.

Table 2. Citizen Lake Monitoring Results, 2009[4]

	Main Basin	**East Balsam**	**Little Balsam**
Number of samples, Aug 2009	1	1	2
Secchi Depth (ft)	NA	3	8
Total Phosphorus (µg/l)	27	59	NA
Chlorphyll (µg/l)	12.4	42.8	NA
Trophic State Index (TSI)	54	63	47
TSI Classification (based on Chl.)	Eutrophic	Eutrophic	Mesotrophic

[4] *Reports and Data: Polk County.* WDNR website. December 2009. http://www.dnr.state.wi.us/lakes/CLMN/reportsanddata/

Balsam Lake is classified as mesotrophic to eutrophic. A eutrophic TSI usually suggests decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, evident plant overgrowth, and only warm-water fisheries (pike, perch, bass, etc.).[5]

Figure 5 illustrates the Secchi depth averages for the main basin. Figure 6 graphs the Trophic State Index for the main basin, based upon Secchi depth, chlorophyll, dissolved oxygen, and total phosphorus results. Figures 7 and 8 depict East Balsam's Secchi depth and Trophic State Index, respectively. Figures 9 and 10 show Little Balsam results.

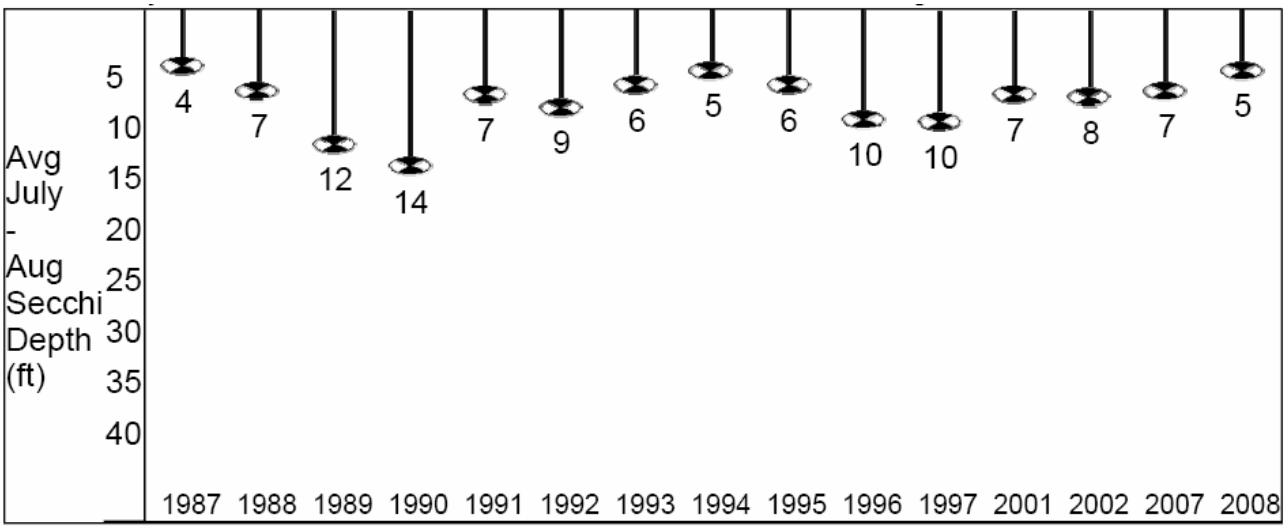

Figure 5. Main Basin Summer Average Secchi Depths 1987-2008.

[5] Reports and Data: Burnett County. WDNR website. June 2009. <http://www.dnr.state.wi.us/lakes/CLMN/reportsanddata/>

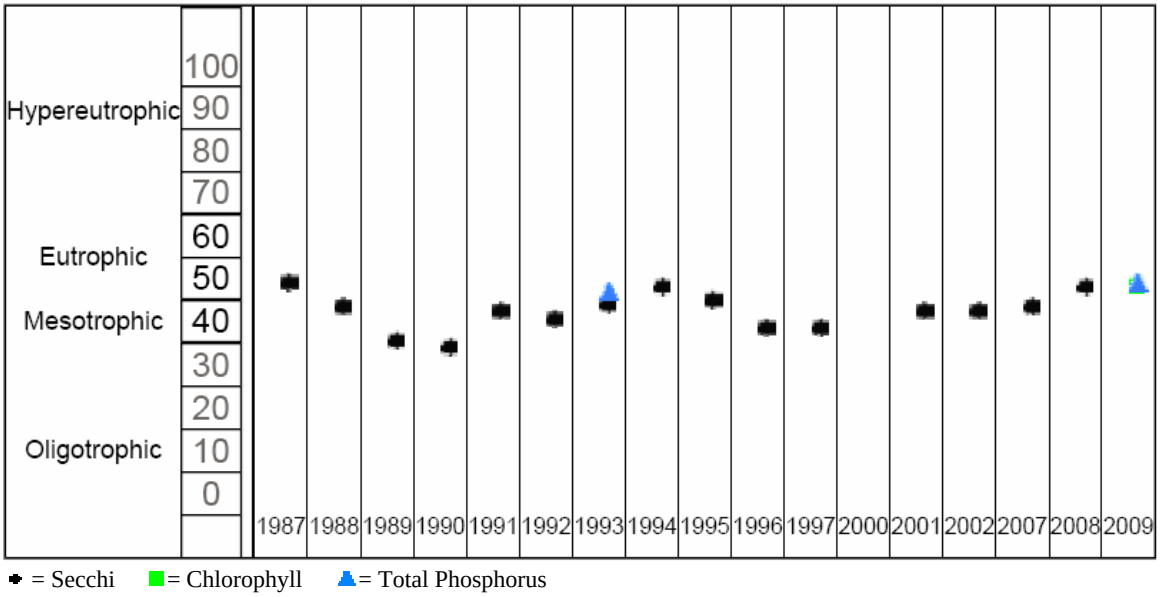

Figure 6. Main Basin Trophic State Index 1987-2009.

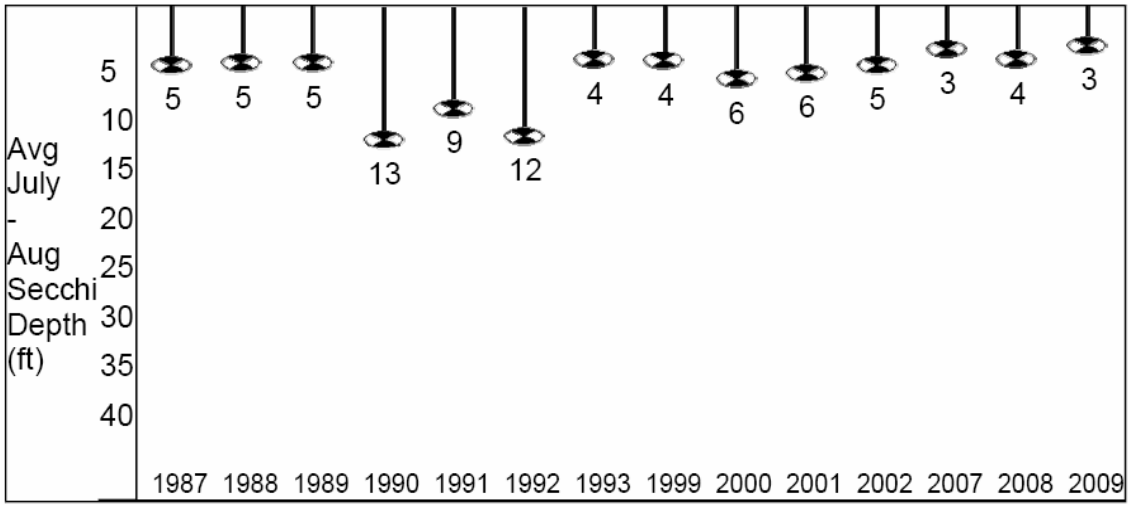

Figure 7. East Balsam Summer Average Secchi Depths 1987-2009.

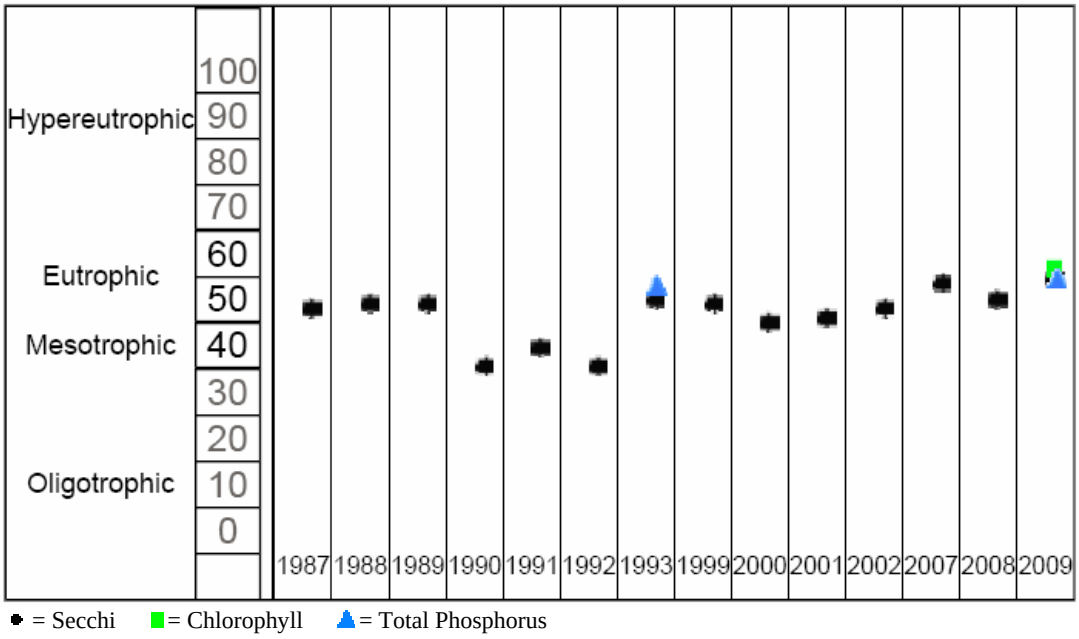

Figure 8. East Balsam Trophic State Index 1987-2009.

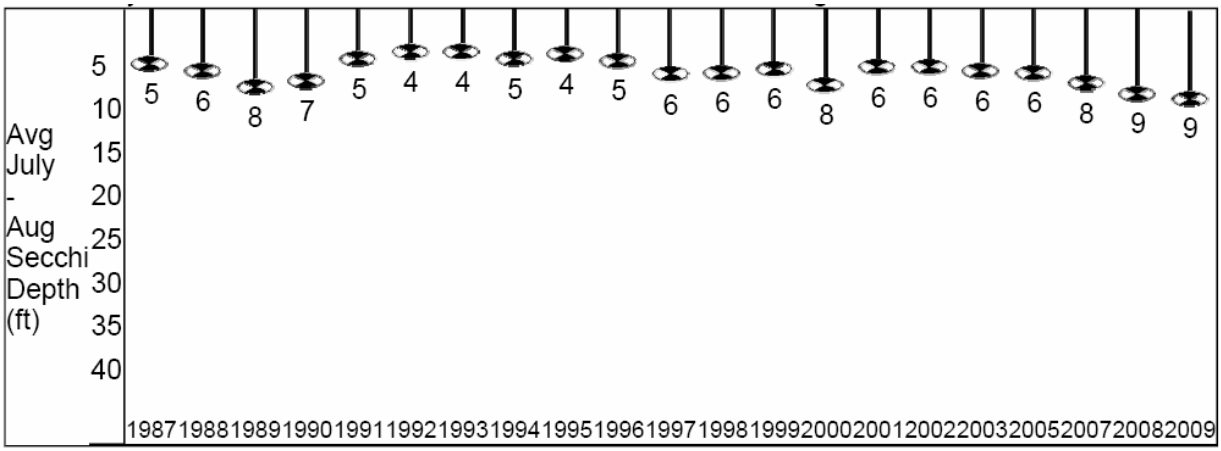

Figure 9. Little Balsam Summer Average Secchi Depths 1987-2009.

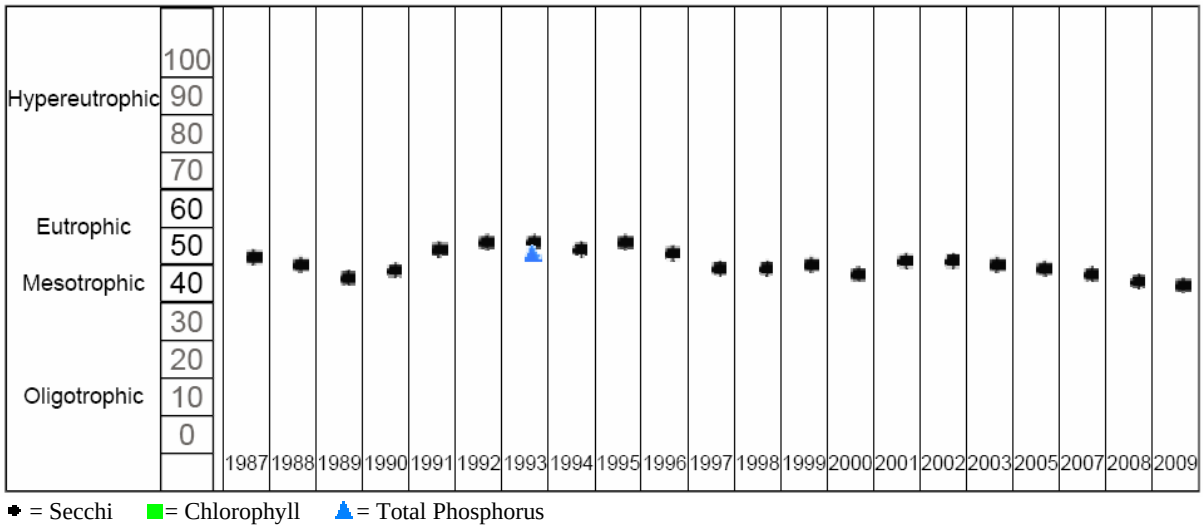

Figure 10. Little Balsam Lake Trophic State Index 1987-2009.

Water Cycle

Water and total-phosphorus budgets assist in understanding nutrient and water dynamics that influence algae and aquatic plant growth. Water and total-phosphorus budgets were most recently assessed for Balsam Lake using data from December 1987 through November 1989.[6] Precipitation, groundwater levels, and stream flow (all components of the water budget) were below normal during the study period and the year preceding the study. Precipitation, the dominant water-budget inflow component, was followed in decreasing order by inflows from Rice Creek, groundwater, Harder Creek, and near-lake drainage. The Long Range Plan describes additional historical water quality studies.

The BLPRD commissioned a water quality study to be completed from 2009 – 2011 based upon recommendations in the Long Range Plan. The study will re-examine watershed and internal sources of phosphorus to the lake and update water quality recommendations. Barr Engineering is completing this study. It is funded in part by DNR Lake Planning Grants.

Watershed Description

The Balsam Lake watershed is a portion of the Balsam Branch watershed in the St. Croix Basin. The Balsam Lake watershed is roughly 17,000 acres of which 10,219 acres drain directly to Balsam Lake with little or no retention in wetlands or low areas. Of the direct drainage area, 30.5 percent is forested, 20 percent is open water, 19 percent is grassland, 13 percent is row crops, 12 percent is wetland, 4.5 percent is forage (hay crop) and 1 percent is barren. Forested lands may, in fact, be in residential development because of tree cover over houses and yards.[7] The Balsam Lake watershed is found in an area of glacial end moraine composed of till and stratified sand and gravel to the north and south of the lake. Glacial drift in areas east and west of the lake is pitted outwash composed of stratified sand and gravel. A thin (0.5 to 2 feet thick) layer of loess overlying the drift is the parent material for most topsoil. Most soils are loams, silt loams, or peat. Much of the watershed area drains to wetlands and small pothole lakes.[8] These areas of closed depressions result in only about 60 percent of the watershed draining directly to the lake.

Phosphorus from Watershed Runoff

Phosphorus is a primary nutrient, essential for healthy plant and algae growth. However, increased phosphorus levels speed up the process of eutrophication - where excess nutrients stimulate plant growth and cause extensive algae blooms. Prolific plant growth may lower dissolved oxygen levels when plants decay and consume oxygen.

A 2002 State of the St. Croix River Basin identified three key priorities for the basin that apply to the Balsam Branch Watershed, all of which are associated with water quality:[9]

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[6] *Water and Phosphorus Budgets and Trophic State, Balsam Lake, Northwestern Wisconsin.* 1987 – 1989. U. S. Geological Survey. Water Resources Investigations Report 91-4125.

[7] Data from Polk County Land and Water Resources Department.

[8] *Water and Phosphorus Budgets and Trophic State, Balsam Lake, Northwestern Wisconsin.* 1987 – 1989. U. S. Geological Survey. Water Resources Investigations Report 91-4125.

[9] *The State of the St. Croix River Basin.* Wisconsin Department of Natural Resources. 2002.

1. Protection and restoration of shoreland habitat
2. Control of nonpoint source runoff contamination of surface waters
3. Restoration of grasslands, prairies, and wetlands to protect soil and water quality and to enhance wildlife habitat

Phosphorus loading in Balsam Lake is the result of non-point sources. Non-point sources include rain falling on the lake and runoff from within the watershed. Phosphorus can be dissolved in the runoff water as well as carried in soil particles that erode from bare soil.

The amount of phosphorus runoff from the watershed is determined by land use in the lake's watershed along with watershed soils and topography. Shoreland areas are particularly important areas of a lake's watershed. Agricultural and residential development tends to increase runoff and the amount of phosphorus that makes its way to the lake as a result. Land maintained in a natural, vegetated state, on the other hand, is beneficial to soil and water quality. With natural vegetation, soil erosion is reduced and fewer pollutants are able to enter and impact the lake via runoff. Tall vegetation slows the flow of water, while forest groundcover and fallen leaves allow runoff water to soak into the soil.

Balsam Branch Priority Watershed Project

The Balsam Branch Priority Watershed Project was a project of the Polk County Land and Water Resources Department (LWRD) supported by state Department of Natural Resources (DNR) and Department of Agriculture, Trade, and Consumer Protection (DATCP) funding. BLPRD commissioners provided input as part of the citizen's advisory committee that assisted with plan development. The BLPRD also assisted with landowner cost sharing in implementation of conservation best management practices. Discussion of the watershed project is included here because of the importance of watershed management for lake water quality.

The Balsam Branch Priority Watershed Project provided an opportunity to identify and address sources of watershed pollution entering Balsam Lake. The Balsam Branch Priority Watershed Project plan examines the sources of nonpoint pollution in the watershed and guides the implementation of pollution control measures. Funding was available for installation of water quality conservation best management practices from 1996 – 2006. The watershed plan established an in-lake summer phosphorus concentration goal of 16 ug/l. A total phosphorus reduction of 26.7 percent was needed to reach the in-lake phosphorus goal.[10]

The Department of Natural Resources conducted a water quality appraisal as background for the priority watershed project. The appraisal identified the primary phosphorus sources to Balsam Lake as agricultural runoff (37 percent) and Rice Lake (via Rice Creek) (18 percent).[11] Recommendations from the appraisal:

[10] Nonpoint Source Control Plan for the Balsam Branch Priority Watershed Project. Wisconsin Department of Natural Resources, et al. April 1995.

[11] *An Appraisal of the Surface Water Resources of the Balsam Branch Priority Watershed.* The Wisconsin Nonpoint Source Priority Watershed Program. Wisconsin Department of Natural Resources. August 1989.

- Target a 60 percent phosphorus loading reduction in the areas draining directly to surface water flowing to Balsam Lake (a whole lake reduction of 42 percent);
- Conduct an intensive urban nutrient reduction program;
- Consider in-lake remediation (alum treatment) for Little Balsam; and
- Reduce nutrients from Rice Creek tributary.

Watershed Project Results

Landowners installed many best management practices for the watershed project. The state/county share of practice installation amounted to $171,663. The total amount provided for the whole project area (the entire Balsam Branch watershed) was $811,234. Conservation best management practices were aimed at reducing runoff from agricultural areas and improving habitat and reducing runoff from waterfront property.

The BLPRD encouraged participation in the project by paying a portion of the landowner share for watershed practices. The BLPRD provided the entire 30 percent landowner share for projects within the district and 22.5 percent (or 75 percent of the landowner share) for projects within the Balsam Lake subwatershed. State and county cost sharing and the landowners paid the remaining costs. Some of the projects in the Balsam Lake subwatershed were completed before the BLPRD made the offer to pay a portion of the landowner share.

Table 3. Balsam Branch Priority Watershed Cost Share Projects with BLPRD Contributions

Project	Year	BLPRD Contribution
Little Balsam Gully #1	2003	$9,585
Little Balsam Gully #2	2003	$3,559
Barnyard Fencing and Watering	2004	$2,230
Otter Creek Bank Stabilization	2003	$2,587
Manure Pit Closure	2002	$2,893
TOTAL BLPRD		**$20,854**

The BLPRD met periodically with Polk County LWRD staff to review priorities for watershed practice installation. Polk County LWRD staff identified priorities for conservation best management practice installation, met with landowners to encourage participation, and provided technical assistance and cost sharing for practice installation.

Because computer tracking methods for sediment and phosphorus (P) delivery to water were not year 2000 compliant, it was not possible to assess progress toward meeting the watershed phosphorus reduction goal from installation of conservation practices.

Changing agricultural practices also influenced sediment and phosphorus delivery to Balsam Lake, although it is uncertain whether this change was positive or negative. There are currently fewer dairy farms (a potential source of nutrients from animal manure) than when the watershed inventory occurred in 1994. In 1994 there were 29 barnyards inventoried for a total contribution of 1,121 pounds of P. Retirement and economic

attrition has claimed 15 of these originally inventoried farms. Based on the modeling at the time of inventory, these changes reduced approximately 630 pounds of annual P loading. Of the 14 active farms, 7 have developed and implemented nutrient management plans.

However, these phosphorus loading reductions from fewer barnyards may be negated because of increases in soil erosion. Fields that grew hay for dairy cattle consumption ten years ago are now used for row crop production. Row crop production generally results in higher soil erosion rates and higher nutrient and sediment delivery to water bodies.

Transect surveys, used by the Polk County Land and Water Resources Department to monitor soil erosion, found that erosion increased in the Balsam Branch watershed from 1999 to 2009. There are more sample sites above T, the tolerable soil loss rate, as more fields are planted to row crops. Recent changes have slowed the increased erosion somewhat. With the high cost of fuel, conservation tillage increased since 2007. There has also been a shift to crops with higher after harvest residue. Both help to increase crop residues and decrease soil erosion from fields. The shift in crops was due to a more favorable commodity price for corn and wheat compared to soybeans. Forage and idle ground, such as that in the Conservation Reserve Program (CRP), have been on a steady decline. The graph below illustrates the percentage of crop fields sampled with various multiples of T, which is generally a loss of 4 to 5 tons of soil per acre per year in Polk County.

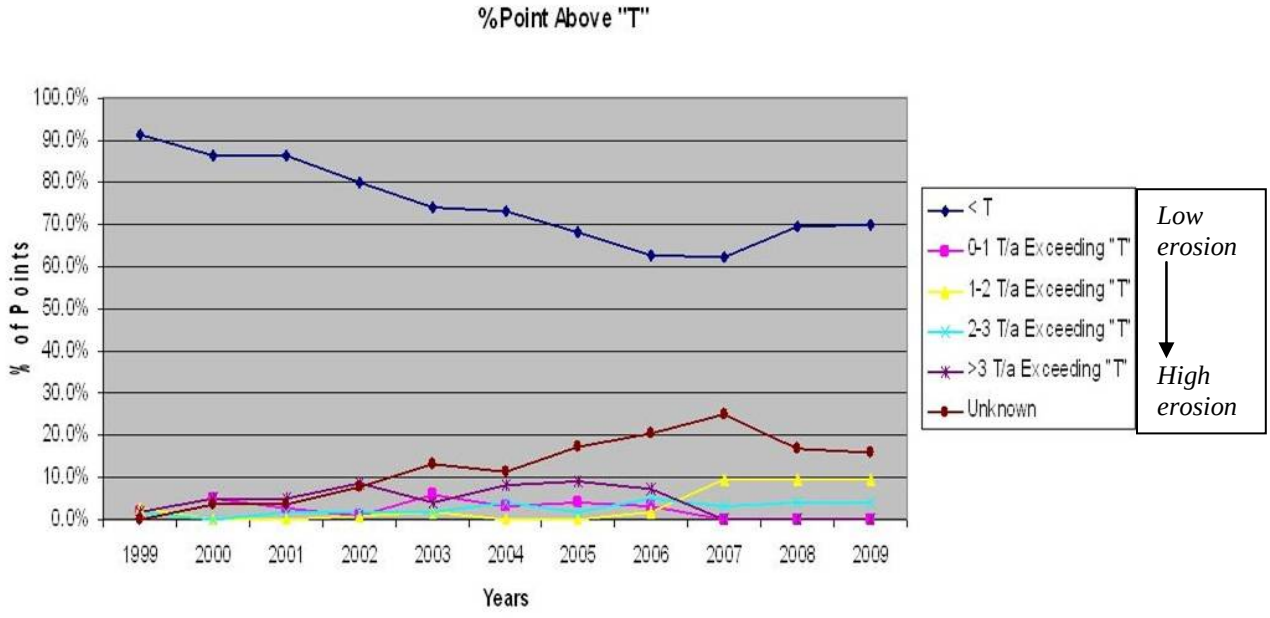

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Figure 11. Soil Loss in the Balsam Lake Watershed.

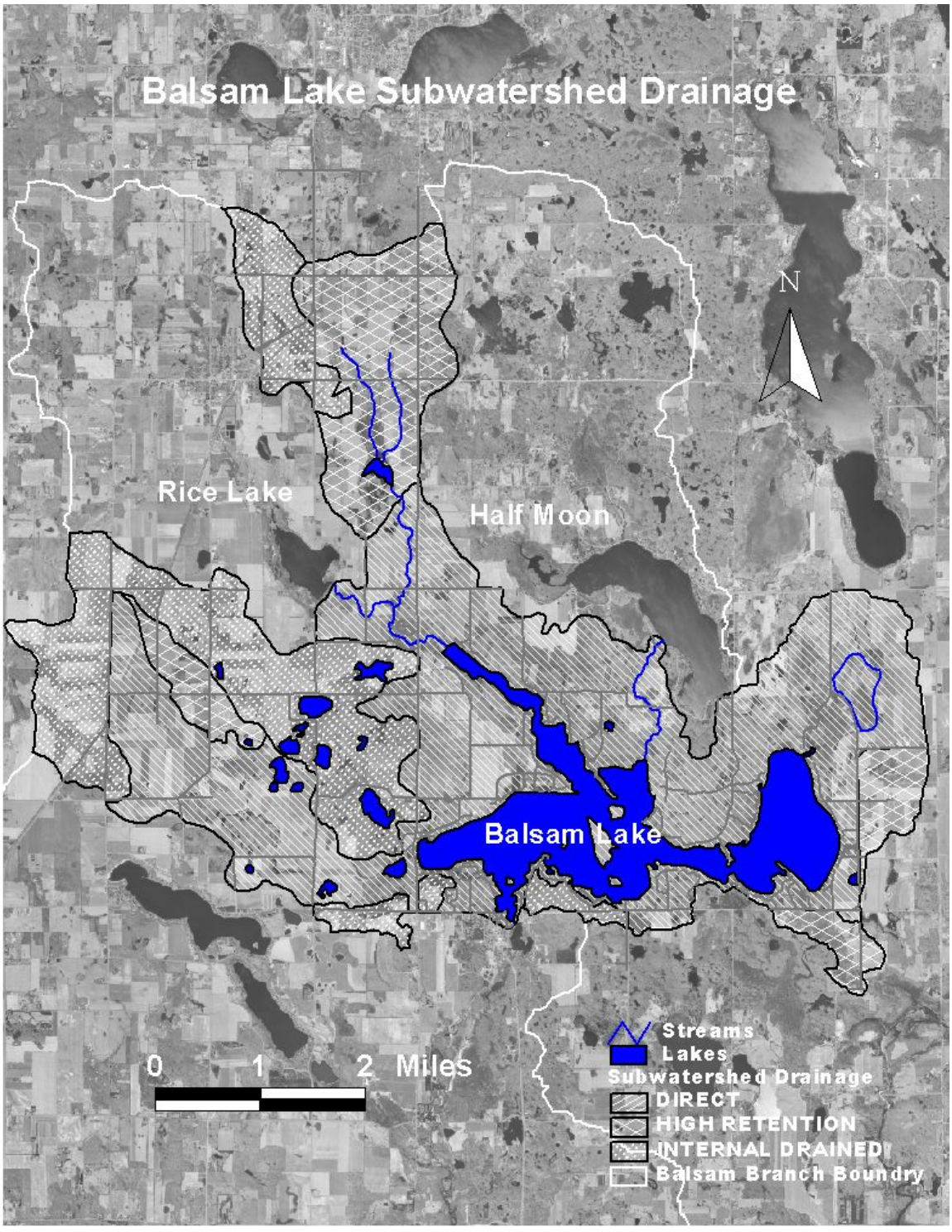

Figure 12. Balsam Lake Watershed and Drainage Areas.

Balsam Lake Protection and Rehabilitation District (BLPRD) Activities

The Balsam Lake Protection and Rehabilitation District has been active in water quality monitoring and implementing water quality improvements for Balsam Lake since its formation in 1976. A timeline of BLPRD activities is included on the following page.

Waterfront Runoff Program

In addition to other activities listed in the timeline , the BLPRD initiated the Waterfront Runoff Program in 2008. The program offers technical assistance, education, and limited cost sharing for installation of waterfront water quality practices. Free site visits are provided to residents interested in correcting erosion problems and reducing runoff from their property. Workshops provide information about rain gardens and native plants and highlight installed demonstration practices. Educational materials developed for this program including a waterfront runoff self-evaluation checklist and waterfront runoff guide for waterfront property owners, are available to other lake organizations to use with similar programs.

About 45 visits and designs were completed in 2008, 2009, and 2010. The program has paid a portion of the installation costs for 6 rain gardens, 3 shoreland buffer zones, 1 tree drop, and 4 rock pits or trenches. The program is planned to continue through December 31, 2010.

Conservancy Properties

Lake district conservancy properties can be established through outright ownership or by establishing conservation easements. Conservancy properties allow preservation of critical habitat and watershed areas. They also provide the ability to install conservation practices. The BLPRD currently owns title to four conservancy properties.

Conservation easements may be used as a tool in the future. Conservation easements are property deed restrictions that limit the uses of the property in perpetuity. They are voluntary agreements between the easement holder and the landowner that generally limit development of commercial or residential buildings and related structures. Conservation easements may place additional restrictions on how the property is used.

A Timeline of BLPRD Efforts

1974 Balsam Lake Homeowners Association formed

1976 Balsam Lake Protection and Rehabilitation District established

1977 Aquatic plant harvesting began – contract with Aquatic Nuisance Control

1983 BLPRD spent $9,000 to assist with clean-up of Glenna Farm[12]

1985 Sanitary sewer feasibility study (SEH, Inc.)

1986 Sanitary sewer study completed. Board decided not to proceed with sewer system

1988 Portable toilets installed at boat landings

Boat and boat lift purchased for water safety patrol

1994 80 acre Glenna Farm purchased and named property Balsam Acres
Animals removed from farm and ended farming operations
(reduced nutrient and sediment loading to Rice Creek and Balsam Lake)

1995 Balsam Acres uplands seeded to prairie

Dockside newsletter began

1998 Sewer feasibility study completed (Cedar Corporation)

1999 Flyover study completed (A.W. Research)
Sanitary district formed within boundaries of the lake district
Sediment basin constructed on Balsam Acres

2000 Water quality testing of some streams initiated
Ground-truthing for flyover study completed
Web site established
Macrophyte management plan (Barr Engineering) adopted
Application of herbicide to lake navigational channels began; ended harvesting
Cost-share plan with Village of Balsam Lake for dam operation began

2002 Sewer feasibility study results presented(Cedar Corporation)
Sanitary sewer system proposal rejected at annual meeting
Four survey monuments to monitor lake levels and better manage dam installed
Five contiguous Deaver Trust parcels on south shore of Balsam Lake acquired
Water quality testing around lake completed
Phosphorus-free fertilizer $2 coupons distributed

2003 Lake level monitoring began
Acquisition of Stumps properties pursued
Grant for acquisition of lot next to Deaver property received
Auto sampler on Harder Creek installed
Portion of the cost to install conservation practices provided:
1) stabilized two gullies on Little Balsam
2) cleaned-up gravel pit on Otter Creek
3) fenced cattle from pond adjacent to East Balsam

2004 Park Drive (Lot 77) property acquired

2005 Peterson property acquired in the Stumps area

2007 Clean Boats, Clean Waters Program began

2008 Waterfront Runoff Program began

[12] The property was eventually purchased by the BLPRD, and conservation practices were installed here.

Aquatic Habitats

Primary Human Use Areas

Balsam Lake is a high-use lake for fishing, and is the location for professional and amateur fishing tournaments (10 – 12 per year). There are four main boat landings for public use: the Highway 46 landing just north of the Village of Balsam Lake, the County I landing in the Village of Balsam Lake, the East Balsam landing off of County I N, and the Town of Milltown landing on Little Balsam. All of these landings are marked with an "L" on the map in Figure 1. There are a total of 46 parking spaces for boats and trailers at these landings. Public boat landings increase the use of the lakes, and therefore increase the risk of introduction of invasive species.

Residential development generally surrounds the lake. Waterfront property owners and the general public utilize Balsam Lake for a wide variety of activities including fishing, boating, swimming, and viewing wildlife.

Functions and Values of Native Aquatic Plants

Naturally occurring native plants are extremely beneficial to the lake. They provide a diversity of habitats, help maintain water quality, sustain fish populations, and support common lakeshore wildlife such as loons and frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algal growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent re-suspension of sediments from the lake bottom. Stands of emergent plants (whose stems protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline. The rush, reed, and rice populations around Balsam Lake are particularly important for reducing erosion along the shoreline, but these populations are also vulnerable to the nutrient loading and the resultant algae growth in the lakes. Wild rice was found on only one sampling site in the Stumps area of the lake during the 2009 survey. It had been identified at the mouth of Rice Creek in previous years.

Fishing

Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for many species of fish. Other fish, such as bluegills, graze directly on the plants themselves. Plant beds in shallow water provide important spawning habitat for many fish species.

Waterfowl
Plants offer food, shelter, and nesting material for waterfowl. Birds eat both the invertebrates that live on plants and the plants themselves.[13]

Protection against Invasive Species
Non-native invasive species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and curly leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established and spread in the lake. This concept of opportunistic invasion can also be observed on land, in areas where bare soil is quickly taken over by weeds.

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. The presence of invasive species can change many of the natural features of a lake and often leads to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native plants may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.[14]

Aquatic Invasive Species Status
Purple loostrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), and curly leaf pondweed (*Potamogeton crispus*) have been observed on Balsam Lake. Purple loosestrife was recorded near the County I landing in 2009. The BLPRD referred this location to the Polk County Land and Water Resources Department who removed the plants and treated the stems with herbicide.[15] Curly leaf pondweed is found in many locations around the lake. There is a high risk that Eurasian water milfoil and other aquatic invasive species may become established in Balsam Lake. As described previously, there are four heavily used boat landings on the lake. The lake is a popular lake for bass fishing – including tournament fishing. Many fishermen travel from the Twin Cities, Minnesota area, and access the lake at the boat landings. With Eurasian water milfoil present in many urban Twin Cities lakes, the danger of transporting plant fragments on boats and motors is very real. According to the Minnesota Sea Grant Office:

> *Eurasian water milfoil can form dense mats of vegetation and crowd out native aquatic plants, clog boat propellers and make water recreation difficult. Eurasian water milfoil has spread to over 150 lakes [in Minnesota], primarily in the Twin Cities area.*

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[13] Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.
[14] *Aquatic Plant Management Strategy. DNR Northern Region.* Summer 2007.
[15] Jeremy Williamson, Polk County LWRD Personal communication. October 2009.

Department of Natural Resource scientists have also found Eurasian water milfoil in the nearby Wisconsin counties of Burnett (Ham, Shallow, and Round Lakes), Barron (Beaver Dam, Horseshoe, Sand, Kidney, Shallow, Duck, and Echo Lakes), and St. Croix (Bass Lake, Goose Pond, Little Falls Lake, Lake Mallalieu, and Perch Lake). In Polk County, EWM is found in Long Trade, Horseshoe and Pike Lakes.

Sensitive Areas

The Wisconsin Department of Natural Resources has completed sensitive area surveys to designate areas within aquatic plant communities that provide important habitat for game fish, forage fish, macroinvertebrates, and wildlife, as well as important shoreline stabilization functions. The Department of Natural Resources has transitioned to designations of *critical habitat areas* that include both *sensitive areas* and *public rights features*. The *critical habitat area* designation will provide a holistic approach to ecosystem assessment and protection of those areas within a lake that are most important for preserving the very character and qualities of the lake. Protecting these *critical habitat areas* requires the protection of shoreline and in-lake habitat. The *critical habitat area* designation provides a framework for management decisions that impact the ecosystem of the lake.

Critical habitat areas include *sensitive areas* that offer critical or unique fish and wildlife habitat (including seasonal or life stage requirements) or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). The Wisconsin Department of Natural Resources is given the authority for the identification and protection of sensitive areas of the lakes. *Public rights features* are areas that fulfill the right of the public for navigation, quality and quantity of water, fishing, swimming, or natural scenic beauty.

Sensitive Area Study

The Wisconsin Department of Natural Resources completed an Aquatic Plant Management Sensitive Area Assessment in 1989. The assessment identified 26 areas on the lake with aquatic plant values and described management requirements for each sensitive area. These areas are mapped in the sensitive area assessment in Figure 13. The full report is found at www.dnr.state.wi.us/lakes/criticalhabitat/final.

Twenty-four of the areas contain aquatic plant communities that provide important fish and wildlife habitat. Certain areas (11 out of 26) provide gravel and coarse rock rubble habitat important for walleye spawning. The report describes the sensitive area guidelines on the following page as good recommendations for the entire lake.

The BLPRD purchased two properties along Park Drive to protect one sensitive area and the 18.5-acre Peterson property to protect another significant sensitive area. The acquisition of this parcel carries out a recommendation specifically mentioned in the DNR Balsam Lake Sensitive Area Study**.**

> *This large, mostly undeveloped bay provides great aesthetic and fish and wildlife value to the Balsam Lake ecosystem. It should be zoned conservancy and should be considered for acquisition by the lake district or a conservation organization to ensure it remains in its present state.*

There are sensitive areas surrounding or very near each of the lake's four boat landings. Educational efforts and watercraft inspections take place at the boat landings. The BLPRD-owned Peterson conservancy property is near the boat landing on East Balsam.

Sensitive Area Guidelines to Protect Fish and Wildlife Habitat

1. Limit vegetation removal to navigation channels or to no removal at all.
2. Control purple loosestrife.
3. Prohibit alterations to the near shoreline (covered by Chapter 30 permits).
4. Leave large woody debris (logs and stumps) in the water near the shoreline.
5. Maintain a natural shoreline buffer.
6. Prevent erosion, especially from construction sites.
7. Strictly enforce zoning ordinances.
8. Eliminate nutrient inputs caused by lawn fertilizers, failing septic systems, and other sources.
9. Consider acquisition of property in the Stumps area.

Sensitive Area Guidelines for Walleye Spawning Areas

1. No alterations to gravel and coarse rock substrate unless alterations are to improve walleye spawning.
2. Erosion control is especially critical.
3. Chemical treatment and mechanical removal of aquatic plants need not be quite as restrictive as in aquatic plant sensitive areas.

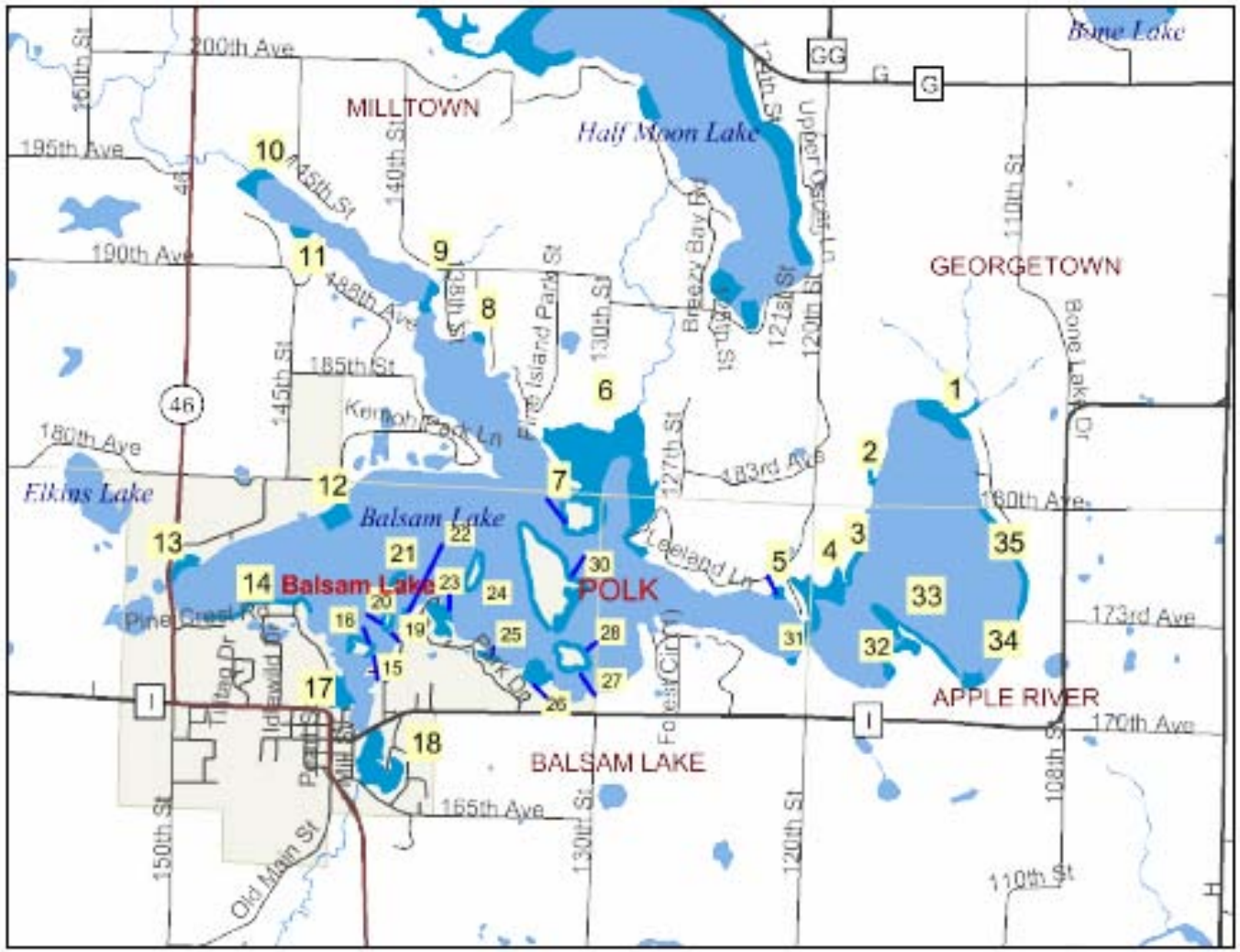


Figure 13. Balsam Lake Sensitive Area/Critical Habitat Area Designations.

Rare and Endangered Species Habitat

The Natural Heritage Inventory (NHI) map of Polk County indicates occurrences of aquatic listed species in the sections where project lakes are located. A species list is available to the public only by town and range. The towns included are as follows: Balsam Lake (T34N R17W), Milltown (T35N R17W), Georgetown (T35N R16W), and Apple River (T34N R16W).

Table 4. Natural Heritage Species in the Balsam Lake Area

Scientific Name	**Common Name**	**Status**	**T34N R17W**	**T35N R17W**	**T34N R16W**	**T35N R16W**
Cypripedium parviflorum var.m	Northern yellow lady's-slipper	SC			X	
Etheostoma microperca	Least darter (fish)	SC/N			X	
Fundulus diaphanus	Banded killifish	SC/N	X	X	X	X
Haliaeetus leucocephalus	Bald eagle	SC/P	X	X	X	X
Pandion haliaetus	Osprey	THR	X		X	
Platanthera dilatata	Leafy White Orchis	SC			X	

Key: **END** = endangered
THR = threatened
SC = special concern

WDNR and federal regulations regarding special concern species range from full protection to no protection. The current categories and their respective level of protection are as follows:
SC/P = fully protected
SC/N = no laws regulating use, possession, or harvesting

There are no aquatic communities listed in the NHI for the towns of Balsam Lake, Milltown, Georgetown, and Apple River.

The proposed actions within the plan are not anticipated to affect wildlife including the natural heritage species shown in Table 4.

Balsam Lake Fishery

The Balsam Lake fishery is comprised of northern pike, walleye, largemouth bass, and pan fish. At the 2009 BLPRD annual meeting, DNR fishery biologist Heath Benike reported largemouth bass were very common, but small. He also reported large and plentiful pan fish. These populations can be attributed to good aquatic plant structure. Recommendations were made for altering fish regulations to increase the allowed size of bass to keep and to increase the number of walleye. Stocking of large walleye fry was also recommended.

Largemouth bass are the dominant game fish in Balsam Lake. Approximately 25,000 largemouth bass larger than 8 inches inhabit Balsam Lake. In 2002, the WDNR liberalized bass regulations on Balsam Lake because bass growth rates declined and the overall condition of bass was poorer when compared to past fish surveys. Anglers are now allowed and encouraged to keep one bass less than 14 inches as part of their daily bag limit of five bass. The regulation is designed to reduce the number of smaller bass in the lake. With less competition for the available forage base in the lake, the larger, remaining bass will be able to grow faster and reach greater sizes.

The walleye population continues to decline on Balsam Lake. In 2005, only 1,650 adult walleye were present. This is just over half the number present in a 2002 estimate of 3,100 adult walleye. The reason for walleye population decline is still unclear. The WDNR has been aggressively stocking walleye in the lake over the past decade with limited success. It appears predation from other fish may be a key limiting factor in walleye recruitment. The DNR stocked larger walleye fingerling (averaging around 7 inches in length) in an effort to increase recruitment of stocked walleye. More restrictive walleye regulations may also be pursued in the future to protect the declining walleye population.[16]

When considering fish in lake and watershed management, the following should be considered[17]:

1. Walleye spawn on clean gravel beds. Sedimentation can render these areas useless as spawning beds. It is important to keep sedimentation to these areas to a minimum. Waterfront runoff reduction projects and shoreline buffers of native vegetation can reduce sedimentation. The beds designated for walleye spawning areas (11 out of 35 total sensitive areas) include: 3, 7, 14, 16, 20, 21, 24, 28, 30, 33, and 35.

2. Black crappie spawn when the water temperature is the same as that recommended for CLP treatment. This treatment would need to be timed accordingly prior to crappie spawning.

3. Since they spawn when water temperatures are in the 40's F, and herbicide treatments occur when the water temperatures are higher, herbicide application should not coincide with or disrupt northern pike spawning.

[16] 2006 Fishing Preview Barron and Polk Counties. Heath Benike, DNR Fisheries Biologist.
[17] From *Draft Aquatic Plant Management Plan Lake Wapogasset and Bear Trap Lake*. Ecological Integrity Services. August 2009.

Table 5. Spawning Temperatures and Substrate Needs

Fish species[18]	**Spawning Temp in ^{o}F**	**Spawning substrates**
Black crappie	Upper 50's to lower 60's	Build nests in 1-6 feet on hard bottom
Bluegill, Largemouth bass and Pumpkin seed	Mid 60's to lower 70's	Build nests in less than 3 feet on hard bottom
Northern pike	Upper 30's to mid 40's soon after ice-out	Broadcast eggs onto vegetation (eggs attach)
Smallmouth bass	Usually between 62 and 64 but recorded as low as 53	Nests in circular, clean gravel
Walleye	Low 40's to 50 degrees	Gravel/rocky shoals with moving or windswept water 1-6 feet deep
Yellow perch	Mid 40's to lower 50's	Broadcast eggs in submergent vegetation or large woody debris

[18] Information from Heath Benike. Wisconsin DNR Fisheries Biologist. 2006

Plant Community

Aquatic Plant Survey Results

An aquatic plant inventory was completed for Balsam Lake in July of 2009, according to the WDNR-specified point intercept method. Prior to the main inventory in late June, a curly leaf pondweed (CLP) survey was conducted to confirm the locations of this aquatic invasive species. Since CLP typically dies in early July, CLP surveys are usually done in early June while the CLP is robust. A general boat survey was conducted prior to the point intercept survey to gain familiarity with the lake and the species present in it.

The results discussed below, are summarized or taken directly from the aquatic plant survey. The survey and data analysis methods for the aquatic macrophyte survey are found in the following report: *Warm Water Point/Intercept Macrophyte Survey, Balsam Lake, Polk County, Wisconsin*, conducted and prepared by Matthew S. Berg of Endangered Resource Services, LLC.

Using a standard formula based on a lake's shoreline shape and length, islands, water clarity, depth, and size, the Wisconsin Department of Natural Resources (WDNR) generated the sampling point grid of 1,095 points. Figure 14 below shows the distribution of these sampling points.

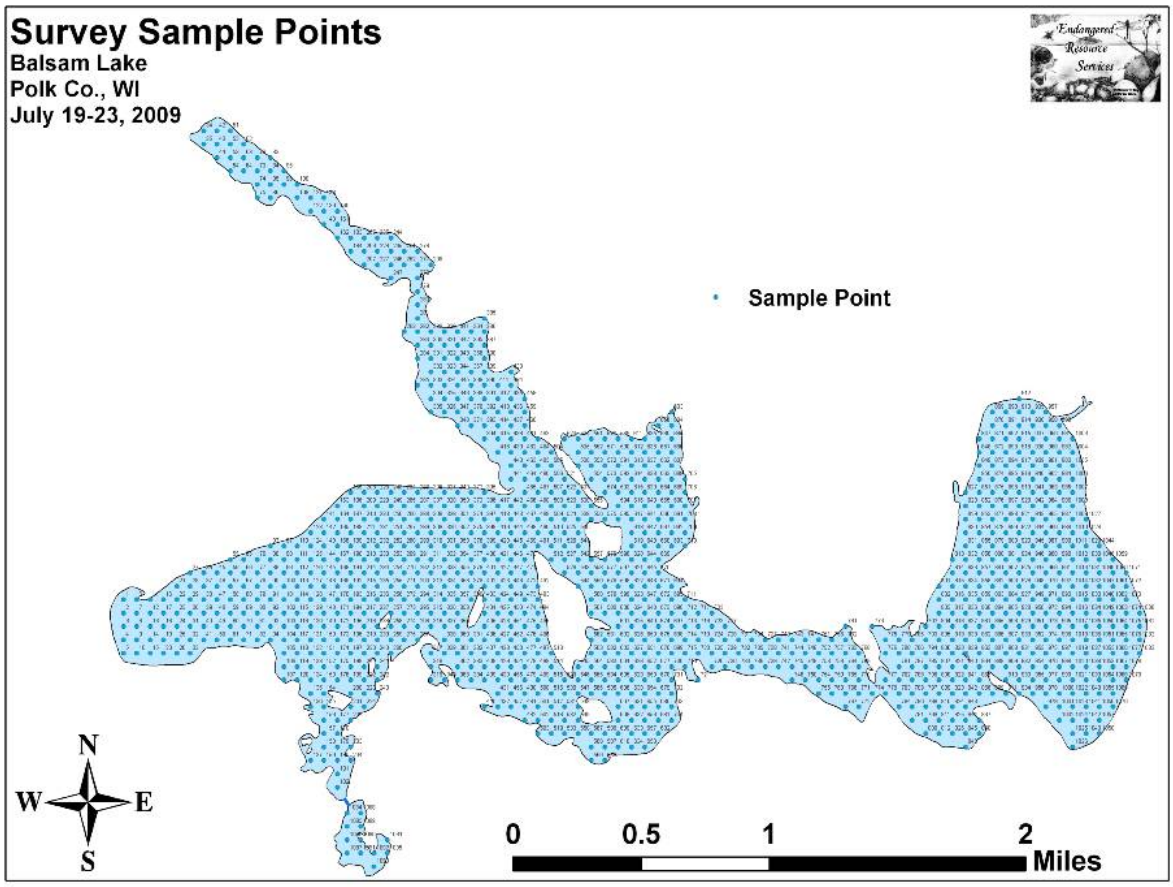


Figure 14. Sampling Point Grid.

In July 2009, plants were found growing on approximately 55% of the lake bottom (608 of 1,095 sampling points) and 90% of the littoral zone (the depth at which plants can grow).

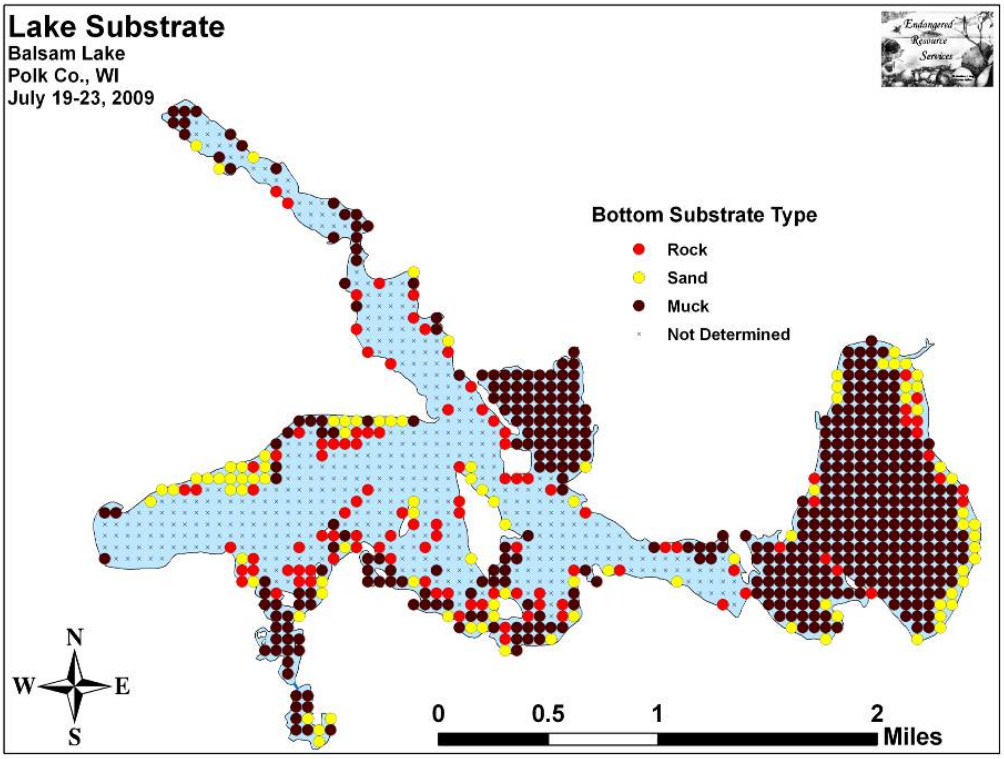


Figure 15. Balsam Lake Bottom Sediment Type.

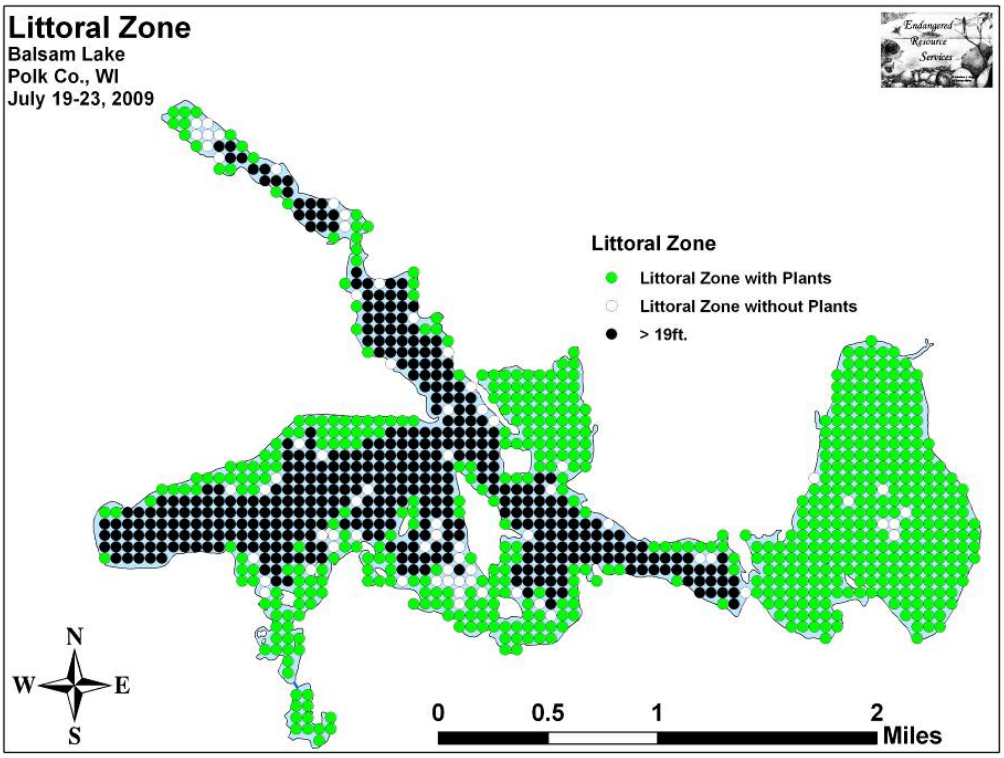


Figure 16. Balsam Lake Littoral Zone.

Plant diversity was very high in Balsam Lake with a Simpson Diversity Index of 0.91. The Simpson Diversity Index is a measure of the likelihood that a different species of plant would be found each time a grab sample is taken. The highest Simpson Diversity Index is 1.0. A total of 49 aquatic macrophyte species were sampled in and adjacent to the lake during the study. The majority of plant species were found growing in relatively deep water with both the mean and median plant depths near 10 feet.

Table 6. Aquatic Macrophyte Survey Summary Statistics

Total number of points sampled	1,095
Total number of sites with vegetation	608
Total number of sites shallower than the maximum depth of plants	676
Frequency of occurrence at sites shallower than maximum depth of plants	89.94
Simpson Diversity Index	0.91
Maximum depth of plants (ft)	19.00
Number of sites sampled using rope rake (R)	116
Number of sites sampled using pole rake (P)	537
Average number of all species per site (shallower than max depth)	3.41
Average number of all species per site (veg. sites only)	3.79
Average number of native species per site (shallower than max depth)	3.24
Average number of native species per site (veg. sites only)	3.61
Species richness	41
Species richness (including visuals)	42
Species richness (including visuals and boat survey)	49
Mean depth of plants (ft)	10.05
Median depth of plants (ft)	10.00

Plants grew as deep as 19 feet. However, coontail (*Ceratophyllum demersum*), forked duckweed (*Lemna trisulca*), and small pondweed (*Potamogeton pusillus*) were the only species that regularly occurred below 12 feet. As the plants present along the gradual drop offs in East Balsam and Stump Bay demonstrate, species richness, diversity and total rake biomass generally decline with increasing depth. Figure 17 is a map of various areas of Balsam Lake discussed below.

The lake's shallow bays supported extensive submergent, floating, and emergent plant beds. Shallow water and thick organic muck appear to promote both high plant density and species richness. Of the shallow bays, Idlewild, Stump, and Raskin were the most diverse. Each bay had unique species not found anywhere else on the lake. Idlewild in particular had several species more commonly associated with acidic lakes that have floating bogs.

The sandy/rocky bottom areas and relatively narrow littoral zone of Little Balsam, Boston Bay, most of the north shore, and island borders supported fewer species in lower densities, although the species were unique to these habitats.

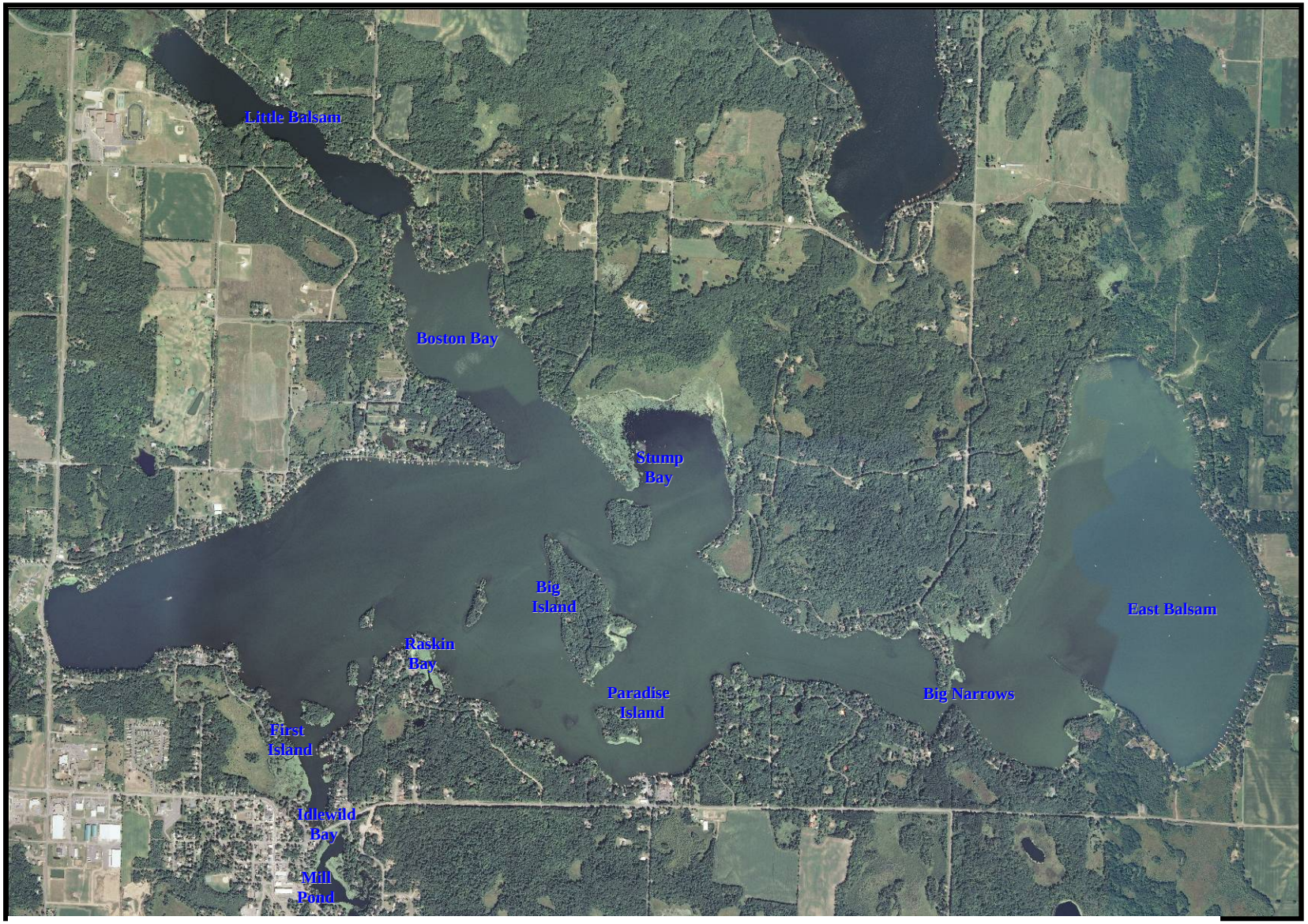


Figure 17. Balsam Lake Areas

Table 7. Balsam Lake Species Frequency and Mean Rake Fullness

Species	Common Name	Total Sites	Relative Frequency	Freq. in Vegetation	Freq. in Littoral	Mean Rake
Ceratophyllum demersum	Coontail	344	14.94	56.58	50.89	1.68
Lemna trisulca	Forked duckweed	331	14.37	54.44	48.96	1.49
Potamogeton pusillus	Small pondweed	288	12.51	47.37	42.60	1.90
Potamogeton zosteriformis	Flat-stem pondweed	212	9.21	34.87	31.36	1.55
Filamentous algae		184	7.99	30.26	27.22	1.59
Vallisneria americana	Wild celery	127	5.51	20.89	18.79	1.74
Myriophyllum sibiricum	Northern water milfoil	123	5.34	20.23	18.20	1.79
Potamogeton crispus	Curly-leaf pondweed	113	4.91	18.59	16.72	1.14
Potamogeton robbinsii	Robbins pondweed	93	4.04	15.30	13.76	1.69
Elodea canadensis	Common waterweed	77	3.34	12.66	11.39	1.44
Potamogeton richardsonii	Clasping-leaf pondweed	65	2.82	10.69	9.62	1.35
Potamogeton praelongus	White-stem pondweed	46	2.00	7.57	6.80	1.33
Nymphaea odorata	White water lily	40	1.74	6.58	5.92	1.75
Ranunculus aquatilis	Stiff water crowfoot	37	1.61	6.09	5.47	1.46
Lemna minor	Small duckweed	30	1.30	4.93	4.44	1.40
Spirodela polyrhiza	Large duckweed	29	1.26	4.77	4.29	1.66
Potamogeton illinoensis	Illinois pondweed	26	1.13	4.28	3.85	1.35
Najas flexilis	Bushy pondweed	18	0.78	2.96	2.66	1.56
Potamogeton amplifolius	Large-leaf pondweed	14	0.61	2.30	2.07	1.86
Wolffia columbiana	Common watermeal	14	0.61	2.30	2.07	1.43
Megalodonta beckii	Water marigold	13	0.56	2.14	1.92	1.00
Nuphar variegata	Spatterdock	13	0.56	2.14	1.92	1.85
Stuckenia pectinata	Sago pondweed	10	0.43	1.64	1.48	1.70
Chara sp.	Muskgrass	9	0.39	1.48	1.33	1.33
Heteranthera dubia	Water star-grass	9	0.39	1.48	1.33	1.11

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton natans	Floating-leaf pondweed	7	0.30	1.15	1.04	1.14
Nitella sp.	Nitella	4	0.17	0.66	0.59	1.50
Sagittaria cristata	Crested arrowhead	4	0.17	0.66	0.59	1.25
Eleocharis acicularis	Needle spikerush	3	0.13	0.49	0.44	2.00
Pontederia cordata	Pickerelweed	3	0.13	0.49	0.44	3.00
Potamogeton friesii	Fries' pondweed	3	0.13	0.49	0.44	1.33
Utricularia gibba	Creeping bladderwort	3	0.13	0.49	0.44	1.00
Brasenia schreberi	Watershield	2	0.09	0.33	0.30	2.00
Utricularia vulgaris	Common bladderwort	2	0.09	0.33	0.30	1.00
Aquatic moss		1	0.04	0.16	0.15	1.00
Myriophyllum verticillatum	Whorled water milfoil	1	0.04	0.16	0.15	1.00
Sagittaria rigida	Sessile-fruited arrowhead	1	0.04	0.16	0.15	1.00
Schoenoplectus acutus	Hardstem bulrush	1	0.04	0.16	0.15	1.00
Sparganium eurycarpum	Common bur-reed	1	0.04	0.16	0.15	1.00
Typha latifolia	Broad-leaved cattail	1	0.04	0.16	0.15	3.00
Zizania palustris	Northern wild rice	1	0.04	0.16	0.15	2.00
Calla palustris	Water arum	**	**	**	**	**
Eleocharis intermedia	Matted spikerush	***	***	***	***	***
Eleocharis palustris	Creeping spikerush	***	***	***	***	***
Lythrum salicaria	Purple loosestrife	***	***	***	***	***
Phalaris arundinacea	Reed canary grass	***	***	***	***	***
Potamogeton epihydrus	Ribbon-leaf pondweed	***	***	***	***	***
Sagittaria latifolia	Common arrowhead	***	***	***	***	***
Schoenoplectus tabernaemontani	Softstem bulrush	***	***	***	***	***

*** Visual Only*

**** Boat Survey Only*

Coontail, forked duckweed, small pondweed, and flat-stem pondweed were the most common macrophyte species (Table 7). They were found at 56.58%, 54.44%, 47.37%, and 34.87% of survey points with vegetation respectively (Figure 18). Together, they comprised almost 51% of the total relative frequency. Coontail, forked duckweed and flat-stem pondweed were common and widely distributed over muck bottom areas. Small pondweed was also found scattered throughout, but it became dominant in East Balsam, where it formed expansive, nearly monotypic beds in 10 to 18 feet of water.

Although many other species were common and widely distributed, no other species had relative frequencies over eight percent. This indicates evenly dispersed species in most areas of the lake, with no single, dominant species.

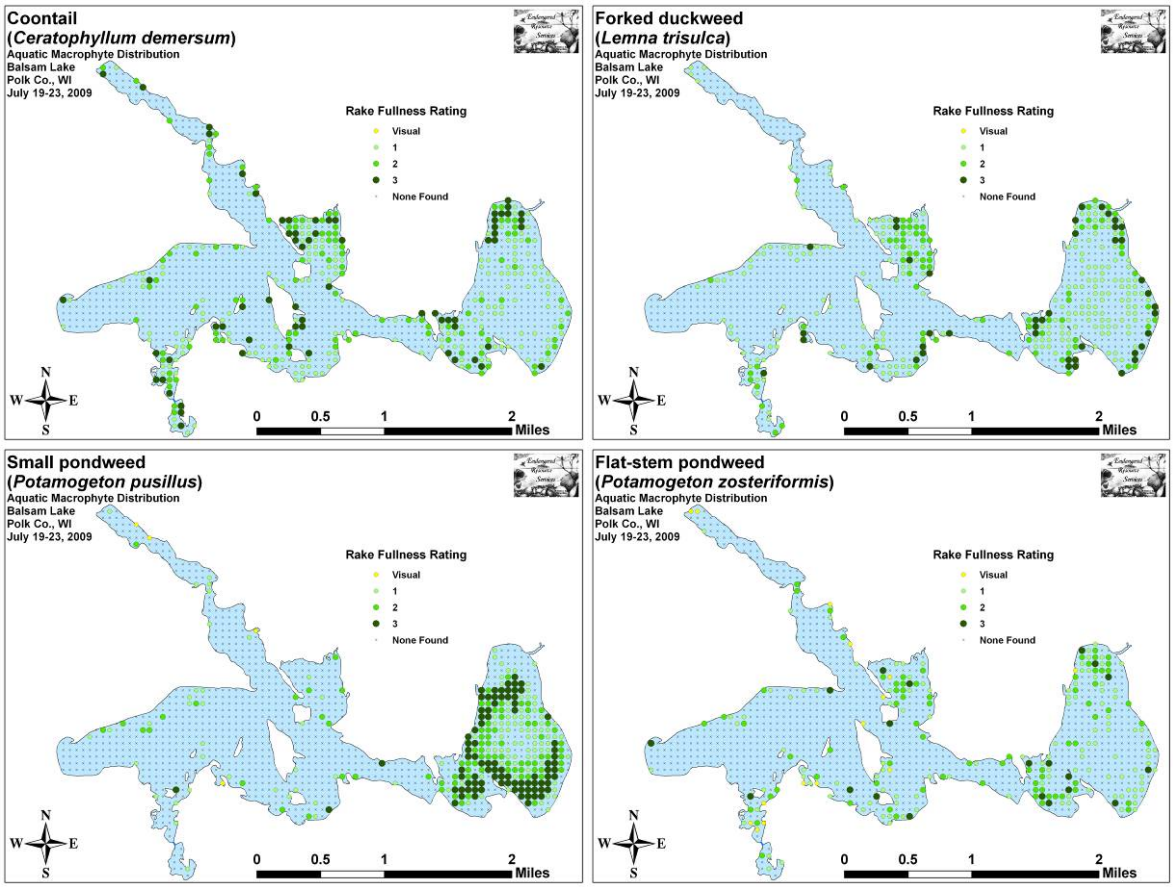


Figure 18. Balsam Lake's Most Common Species.

The Floristic Quality Index (FQI) is an index developed by Dr. Stanley Nichols of the University of Wisconsin-Extension. This index is a measure of the plant community response to development and human influence on the lake. It takes into account the species of aquatic plants present and their tolerance for changing water quality and habitat characteristics. A plant's tolerance is expressed as a coefficient of conservatism (C). Native plants in Wisconsin are assigned a conservatism value between 0 and 10. A plant with a high conservatism value has more specialized habitat requirements and is less tolerant of disturbance and/or water quality changes. Those with lower values are more able to adapt to disturbance or changing conditions, and can therefore be found in a wider range of habitats.

The FQI is calculated using the number of species present and these plants' species conservatism values. A higher FQI generally indicates a healthier aquatic plant community.

The 38 plants identified to species during the point intercept survey produced a mean Coefficient of Conservatism of 6.2 and a Floristic Quality Index of 38.4 (Table 8). Nichols (1999) reported an average mean C for the Northern Central Hardwood Forests Region of 5.6 putting Balsam Lake well above average for this part of the state. The FQI was also nearly double the mean FQI of 20.9 for the Northern Central Hardwood Forests Region (Nichols 1999).

Northern Wild Rice

Wild rice is an aquatic plant with special significance to Native American Tribes. It was found in only one location during the 2009 survey, in the Stumps area of Balsam Lake.

Wild rice was found previously at the mouth of Rice Creek. DNR Aquatic Plant Biologist, Frank Koshere, photographed the plant at the mouth of Rice Creek on July 11, 2007. Dan Harrington, DNR Water Regulations, identified wild rice where Rice Creek enters Little Balsam on October 28, 2008. Both findings are documented with photographs in the BLPRD records.

Table 8. Floristic Quality Index

Species	**Common Name**	**C**
Brasenia schreberi	Watershield	7
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis acicularis	Needle spikerush	5
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	5
Lemna trisulca	Forked duckweed	6
Megalodonta beckii	Water marigold	8
Myriophyllum sibiricum	Northern water milfoil	7
Myriophyllum verticillatum	Whorled water milfoil	8
Najas flexilis	Bushy pondweed	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	9
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton friesii	Fries' pondweed	8
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Robbins (fern) pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	Stiff water crowfoot	7
Sagittaria cristata	Crested arrowhead	9
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	5
Sparganium eurycarpum	Common bur-reed	5
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Utricularia gibba	Creeping bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Wolffia columbiana	Common watermeal	5
Zizania palustris	Northern wild rice	8
N		38
mean C		6.2
FQI		38.4

Invasive Species

Three invasive species were located in the aquatic plant surveys. They include purple loosestrife, curly leaf pondweed, and reed canary grass. More information about these species is included in Appendix B. Inventory results from the point intercept survey and other sources are included below.

Purple Loosestrife

Purple loosestrife was found in a single location near the Village of Balsam Lake boat landing in 2009. The BLPRD referred this location to the Polk County Land and Water Resources Department who removed the plants and treated the stems with herbicide.[19]

Curly Leaf Pondweed

Endangered Resource Services conducted a curly leaf pondweed distribution survey June 2 through 6 and a bed mapping survey June 8 and 9, 2009.[20] The distribution survey involved taking rake samples and recording plant abundance. Results of this survey are illustrated in Figure 19 below.

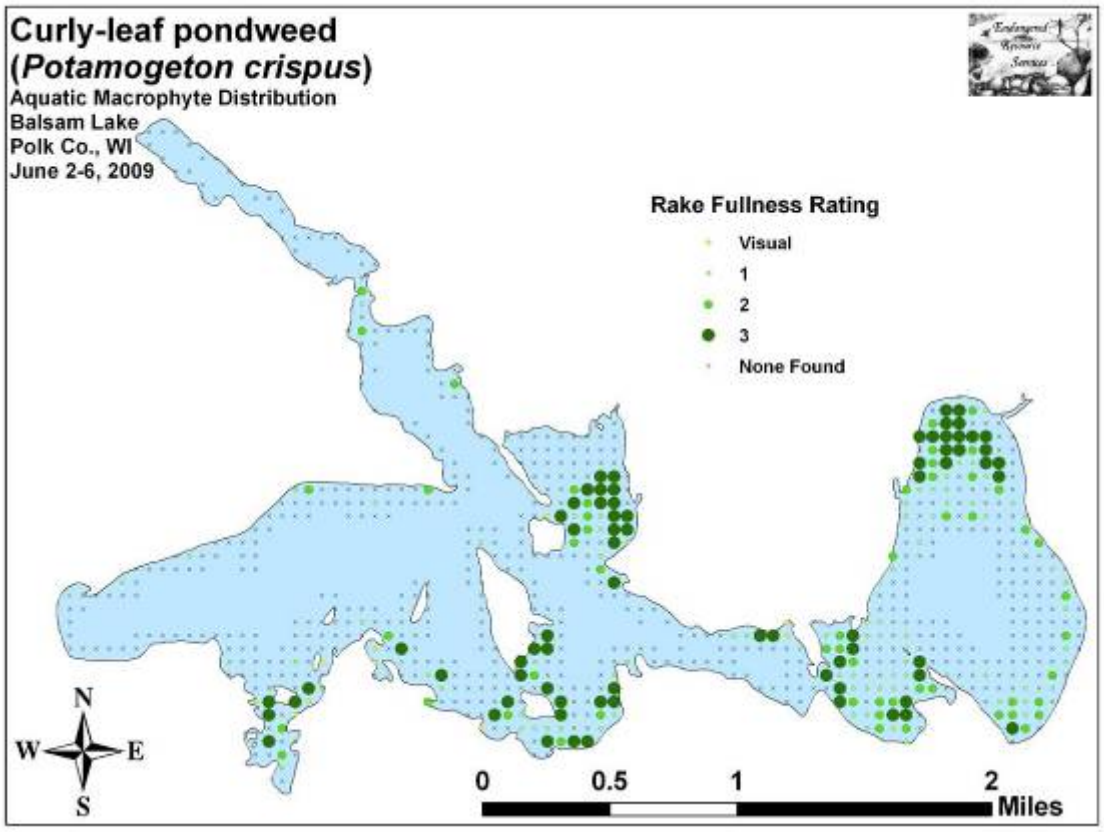


Figure 19. Balsam Lake CLP Density.

[19] Jeremy Williamson. Polk County LWRD, Personal communication. October 2009.
[20] Berg, Matthew S. *Curly-leaf Pondweed P/I, Bed Mapping, and Pre/Post Herbicide Surveys Balsam Lake Polk County, Wisconsin.* Endangered Resource Services, LLC. June 2009.

Curly Leaf Pondweed Density Survey
Curly leaf pondweed was present in 212 out of 757 littoral zone rake sample locations. This extrapolates to CLP presence in approximately 20 percent of the lake. About 12 percent of the lake had dense CLP growth (a rake sample result of 3 on a 0-3 scale). Although widely distributed throughout Balsam and East Balsam, CLP was not found in Little Balsam. CLP grew in all bottom types, but achieved its greatest densities in sheltered bays with muck bottoms in water from 3 to 7.5 feet deep.

CLP Bed Mapping Survey
For the purpose of this study, a CLP bed was defined by the following criteria: 1) CLP plants made up greater than 50% of all aquatic plants in the bed, and 2) the CLP had canopied at the surface or was close enough to the surface that the growth would likely interfere with normal boat traffic.

Endangered Resource Services (ERS) located and mapped a total of 21 beds on Balsam Lake ranging in size from 0.1 acre to 10.1 acres. Combined, these beds covered a total of 41.2 acres - just over 2 percent of the lake's 2,053 acres (Table 9) (Figure 20). With the addition of the 8 acres successfully treated (and therefore not mapped) in 2009, these beds total 49.2 acres. More detailed maps are found in the ERS CLP report. Although many additional areas of the lake had CLP, it was either not invasive to the point of excluding natives (density less than 50%) or the beds were located well below the surface and thus would not interfere with watercraft.

Table 9. CLP Beds on Balsam Lake (2009)

Bed Number	Acreage	2009 Navigation Concern?
1	1.8	Yes – clipped by props
2	1.7	Maybe – resident access
3	0.2	No
4	0.7	No
5	0.3	No
6	0.1	No
7	10.1	Maybe – resident access
8	0.6	No
9	0.1	Yes – resident access
10	0.2	Yes – resident access
11	2.8	No
12	0.7	No
13	5.3	No – mostly natives
14	1.3	Maybe – resident access
15	3.5	Maybe – access to Big Island
16	1.2	Yes – clipped by props
17	0.7	No
18	0.6	Yes
19	4.8	Yes
20	4.2	Yes
21	0.3	
Treated Bed	8.0	Yes- resident access
Total Acres	49.2	

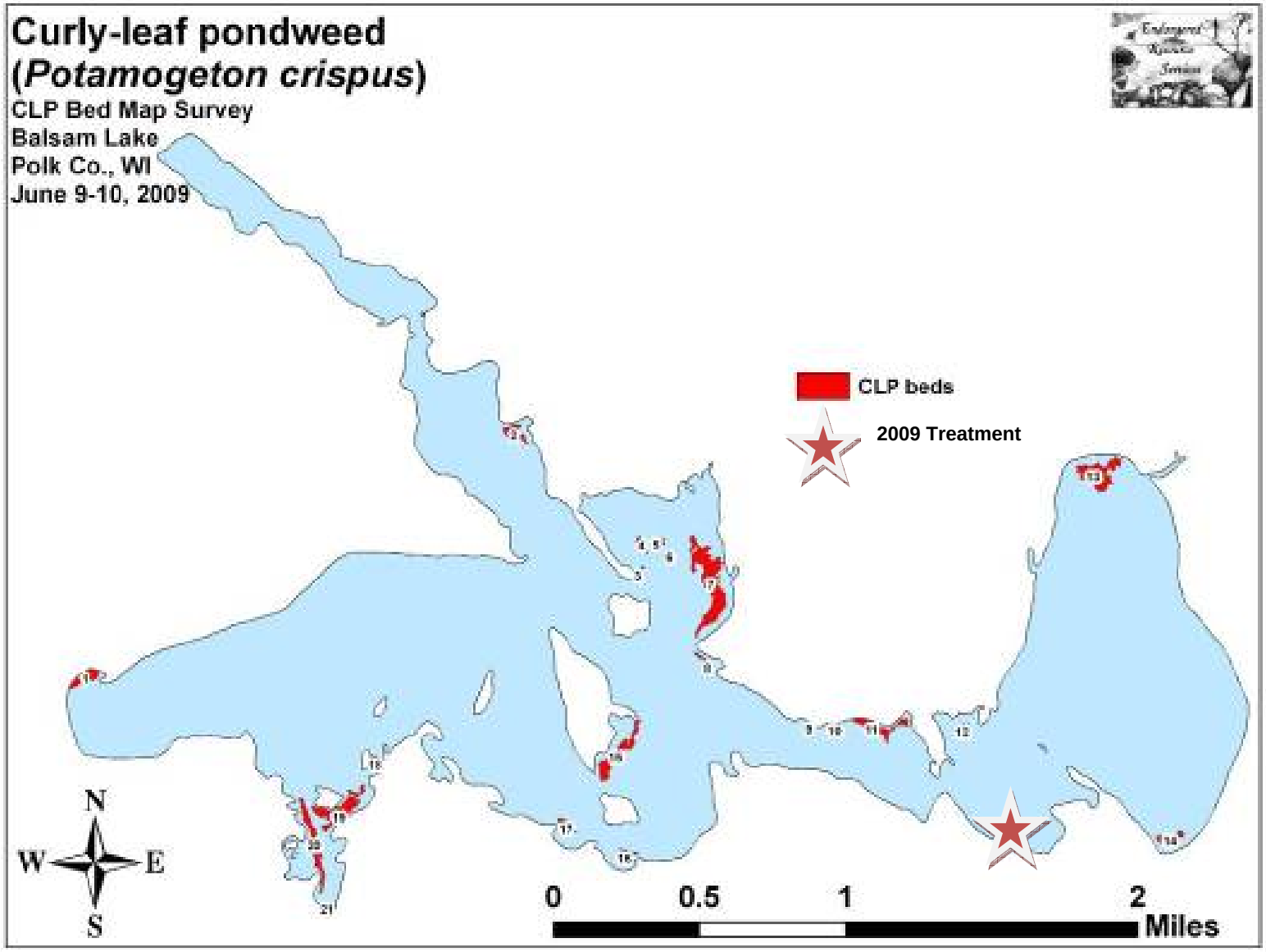


Figure 20. Balsam Lake CLP Bed Map.

CLP Bed Descriptions

Bed 1 – Located just out from the west boat landing, the bed was dense, monotypic, and canopied for approximately 35 meters extending out from the lily pads (*Nuphar variegata* and *Nymphaea odorata*) in front of Ward's Resort. Beyond this, the bed was still dense and monotypic, but was approximately 0.5 meters below the surface. Many plants showed evidence of being clipped by boat props.

Little Narrows between Boston Bay and Little Balsam Lake – CLP was located in the narrows near the "slow no wake" buoys, but it did not form beds and was mixed in with an abundance of high quality native species like large-leaf pondweed (*Potamogeton amplifolius*) and fern pondweed (*Potamogeton robbinsii*).

Bed 2 – Most of the bed in Boston Bay was just below the surface, although some areas were beginning to canopy. Plants were dense and monotypic except on the very edges of the bed. CLP in this area may interfere with cabin residents' access to the main lake, but is not likely to impact other boaters as the bed is relatively small and outside observed main traffic areas.

Beds 3, 4, 5, and 6 – The far west and north side of Stump Bay had few CLP plants with the exception of these four small beds. Although dense, they were easily avoided, were mixed with some natives, and supported visible schools of pan fish and their spawning beds. With native species just beginning to grow, CLP likely provides these and other fish with important early season habitat in this bay, as well as in other parts of the lake.

Bed 7 and Stump Bay – Bed 7 was the biggest bed on the lake at over 7 acres. On the north and east sides of the bed, CLP was extremely dense, non-navigable, and had excluded most if not all native species. On the west and south sides where the bay sloped into deeper water, its dominance shrunk to about 50% of the macrophyte community, and the edge of the bed became difficult to define as densities varied wildly over short distances. The edges of the bed were a favorite spot for people to fish. There is a navigable area on the inside edge of the bed, but it is likely an inconvenience for property owners in the area. Because it is also shallow, large boats may have trouble navigating it. Although the rake sample survey suggested the entire south end of Stump Bay supported CLP, these plants were not canopied (most were well over a meter below the surface) and did not seem likely to do so as they should be starting to die back by the middle of June.

Bed 8 – This thin ribbon of canopied CLP was navigable on all four sides and quickly disappeared at the sharp drop off into the main lake. It doesn't appear to be negatively affecting anyone.

Beds 9, 10, and 11 – These three beds were all dense and monotypic, especially on the inshore side. They had few areas that would allow a boat to navigate and likely were a significant inconvenience to property owners in the area. Bed 11 broke up near the small bay northwest of the Big Narrows. This area was considered for herbicide treatment in 2009, but was not treated because of low plant densities. This bay had some CLP, but it was very patchy and did not interfere with navigation.

Bed 12 – Located just north of the Big Narrows, this bed had limited canopied CLP, supported many native species in significant quantities, and was navigable on both the inner and outer edges.

Bed 13 and the north bay of East Balsam – The edges of the CLP portion of this bed were extremely difficult to define. A large portion of the bay has canopied plants, but most of them were natives, where CLP was only one component. Coontail (*Ceratophyllum demersum*) was common to abundant on the north edge of the bed, and open beds of Illinois pondweed (*Potamogeton illinoensis*) and Clasping-leaf pondweed (*Potamogeton richardsonii*) were mixed in throughout before becoming dominant on the edges of the canopied CLP bed areas. This area supported large schools of pan fish, and was heavily targeted for fishing. CLP was present to the edge of the littoral zone, but it became uncommon to rare at points beyond 3 meters of water, and disappeared altogether at 4 meters.

Bed 14 – This bed was not overly dense except in the very center. The edges had many native plants mixed in. It may or may not be of concern to local residents.

Treated Southwest Bay (8 acres) - CLP was not visibly canopied anywhere in the bay following treatment. Some CLP and native plants along the edge of the treatment zone were still alive, but, for the most part, neither CLP nor native plants were growing in the treatment zone at the time of the survey. One exception was forked duckweed (*Lemna trisulca*) which formed a thick mat over the bottom of the bay.

Bed 15 - Located on the southeast shore of Big Island, this bed was dense, canopied, mostly monotypic, and had well defined borders where the lake dropped off into deep water. Like the CLP bed in Stump Bay, it was loaded with pan fish and was difficult to survey because there were so many boats fishing in the area. The bed may make access to the few cabins on the island more difficult, but it is not likely an issue for most boaters.

Bay north of Paradise Landing/east of Paradise Island – The rake survey showed both wide distribution and dense areas of CLP at this location. However, it wasn't canopied anywhere, was not an impediment to navigation elsewhere in the bay, and was just another plant in the local macrophyte community that was dominated by Illinois and clasping-leaf pondweed.

Bed 16 – This area between the landing and Paradise Island was an impediment for local property owner's lake access. The bed was dense, monotypic and showed evidence of repeated prop clipping. It was only canopied in a few places, likely because it had been hit by motors so many times.

Bed 17 – This bed was small, popular for fishing, and easily avoided with channels all around it.

Beds 18, 19 and 20 - These beds were a significant impediment to boat traffic. Prop trails were visible through the beds, and people launching their boats from the south landing by the Mill Pond have little choice but to plow through them. If treatment or mechanical removal is performed in this area, care should be taken to avoid the native plant beds on the west side of Bed 20 which contain several sensitive species that are not found anywhere else on the lake.

Bed 21 – This small patch near the shore just east of the boat landing might be a problem for shore fishing. The area is too shallow for motor boating and didn't extend very far into the lake.

2009 Treatment Area

Three areas were considered for treatment in 2009, and one 8-acre area was treated in early May. The treated CLP bed was located southeast of the Big Narrows. All three areas were included in a pre and post monitoring survey required by the Department of Natural Resources. Detailed pre and post treatment monitoring results are included in the report *Curly-leaf Pondweed P/I, Bed Mapping, and Pre/Post Herbicide Surveys.*[21]

The pretreatment survey found CLP in 62 rake samples, with a mean fullness of 1.85 which was deemed an appropriate level of growth for treatment. The post treatment survey documented a highly significant decline in both CLP distribution and density with CLP found at 20 sites with a mean rake fullness of 1.15. There were also significant declines in coontail in the treatment area and a slightly significant increase in the presence of forked duckweed. Other species that increased between surveys such as wild celery, stiff water crowfoot, white water lily and spatterdock are likely due to normal increases in spring plant growth patterns.

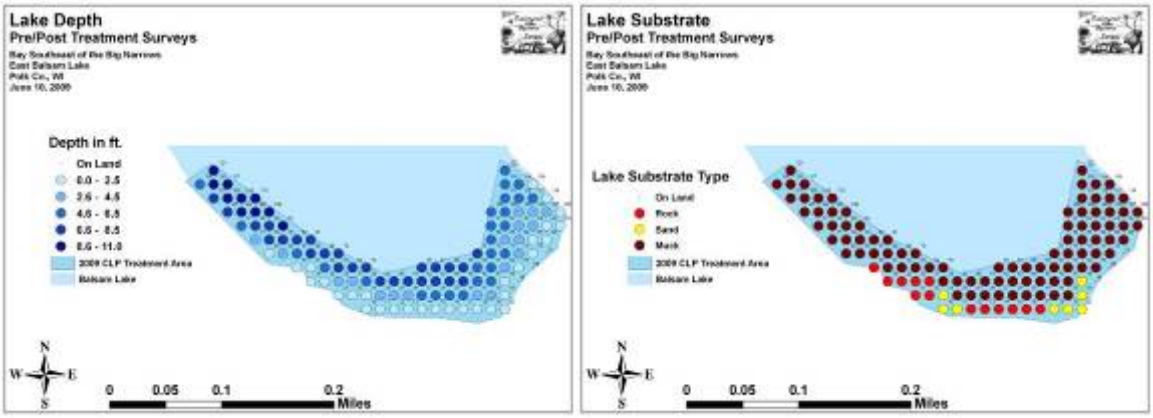


Figure 21. Bay Southeast of the Big Narrows Depth and Bottom Substrate.

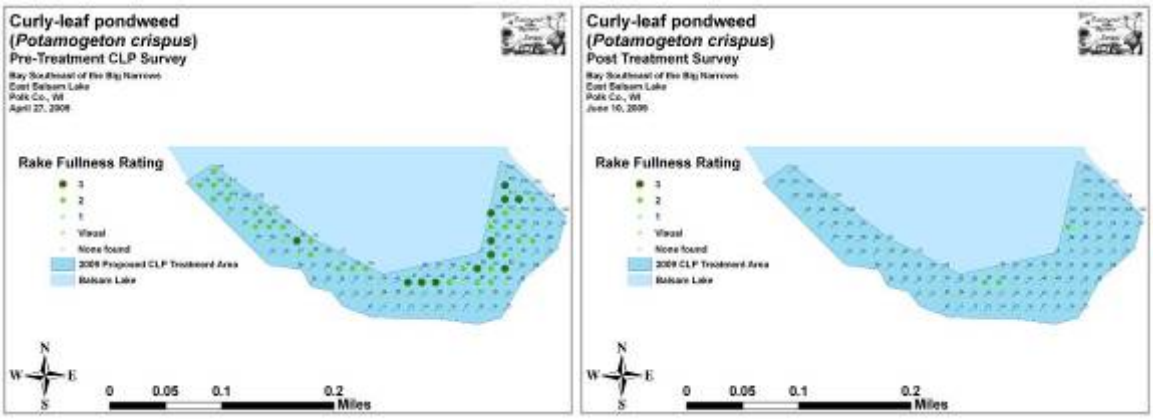


Figure 22. Bay Southeast of the Big Narrows Pre/Post CLP Distribution.

[21] Endangered Resource Services, LLC. 2009.

Aquatic Plant Management

This section reviews the potential management methods available and reports recent management activities on the lakes.

Discussion of Management Methods

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management. A permit is required for any aquatic chemical application in Wisconsin. Additional requirements exist when a lake is considered an ASNRI (Area of Special Natural Resource Interest) due, in the case of Balsam Lake, to the designation of sensitive areas.

The requirements for manual and mechanical plant removal are described in *NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations.* A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline up to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal refers to the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.[22]

The *Department of Natural Resources Northern Region Aquatic Plant Management Strategy* (May 2007) requires documentation of impaired navigation or nuisance conditions before native plants may be managed with herbicides. Severe impairment or nuisance will generally mean that vegetation grows thickly and forms mats on the water surface.

Techniques to control the growth and distribution of aquatic plants are discussed in the following text. The application, location, timing, and combination of techniques must be considered carefully. A summary table of Management Options for Aquatic Plants from the WDNR is found in Appendix E.

Manual Removal[23]

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants with rhizomatous (underground stem) growth, pulling

[22] More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site: www.dnr.state.wi.us.

[23] Information from APIS (Aquatic Plant Information System). U.S. Army Corps of Engineers. 2005. and the *Wisconsin Aquatic Plant Management Guidelines.*

roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to thirty feet wide.

SCUBA divers may engage in manual removal for invasive species like Eurasian water milfoil. Care must be taken to ensure that all plant fragments are removed from the lake. Manual removal with divers is recommended for shallow areas where sporadic EWM growth occurs.

Mechanical Control

Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver-operated suction harvesting, and rotovating (tilling) are the most common forms of mechanical control available. WDNR permits under Chapter NR 109 are required for mechanical plant removal.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from one to six feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

The size, and consequently the harvesting capabilities, of these machines vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide, and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1,000 cubic feet (by volume) or 1 to 8 tons (by weight).

In some cases, the plants are transported to shore by the harvester itself for disposal, while in other cases, a barge is used to store and transport the plants in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm to be used as compost (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate, and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area.

This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures don't make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time as well as cost.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, turions may have formed and may be spread, and there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines.

Harvesting may be an option worth considering for managing curly leaf pondweed on Balsam Lake. The current (2010) aquatic management contract includes harvesting as a management option, but this management method has not been recently used on Balsam Lake. Harvesting in the late 1990's resulted in many complaints about drifting, floating plant fragments.

Diver dredging operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against the pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can result from diver dredging, but fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated more than once to be effective. When applied to a pioneering infestation, control can be complete. However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates play an important part in the effectiveness of a diver dredging operation. Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little difficulty. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment. Diver dredging will be considered as a rapid response control measure for Eurasian water milfoil if discovered in the lake.

Rotovation involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of 20 feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling contaminated sediments could possibly release toxins into the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine the potential impacts from this type of treatment. Tillers do not operate effectively in areas with many underwater obstructions such as trees and stumps. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

Biological Control[24]

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases. With the introduction of pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

The effectiveness of biocontrol efforts varies widely (Madsen, 2000). Beetles are commonly and successfully used to control purple loosestrife populations in Wisconsin. Weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is not allowed in Wisconsin.

Weevils[25] have potential for use as a biological control agent against Eurasian water milfoil. There are several documented "natural" declines of EWM infestations with weevil use. In these cases, EWM was not eliminated but its abundance was reduced enough so that it did not achieve

[24] Information from APIS (Aquatic Plant Information System). U.S. Army Corps of Engineers. 2005.
[25] *Control of Eurasian Water Milfoil & Large-scale Aquatic Herbicide Use*. Wisconsin Department of Natural Resources. July 2006.

dominance. These declines are attributed to an ample population of native milfoil weevils (*Euhrychiopsis lecontei*). Weevils feed on native milfoils but will shift preference over to EWM when it is present. Lakes where weevils can become an effective control have an abundance of native northern water milfoil and fairly extensive natural shoreline where the weevils can over winter. Any control strategy for EWM that would also harm native milfoil may hinder the ability of this natural bio-control agent. Lakes with large bluegill populations are not good candidates for weevils because bluegills feed on the weevils. The presence and efficacy of stocking weevils in EWM lakes is being evaluated in Wisconsin lakes. So far, stocking does not appear to be effective.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, and plant-specific control. On the other hand there are several disadvantages to consider, including very long control times (years instead of weeks), a lack of available agents for particular target species, and relatively specific environmental conditions necessary for success. Biological control is not without risks; new non-native species introduced to control a pest population may cause problems of its own.

Re-vegetation with Native Plants

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994). Re-vegetation following plant removal is probably not necessary on Balsam Lake because a healthy, diverse native plant population is present.

Physical Control[26]

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit would be required.

Dredging removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson 1982). Lakes that are very shallow due to sedimentation tend to have excess plant growth. Dredging can form an area of the lake too deep for plants to grow, thus creating an area for open water use (Nichols 1984). By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community (Nichols 1984). Results of dredging can be very long term. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone.

[26] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

It is best used as a lake remediation technique. Dredging is not suggested for Balsam Lake as part of the aquatic plant management plan.

Drawdown, or significantly decreasing lake water levels can be used to control nuisance plant populations. With drawdown, the water body has water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns need to be at least one month long to ensure thorough drying and effective removal of target plants (Cooke 1980a). In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Although drawdown may be effective for control of hydrilla for one to two years (Ludlow 1995), it is most commonly applied to Eurasian water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980). Drawdown requires a mechanism to lower water levels.

Although drawdown can be inexpensive and have long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to drawdown and individual species responses can be inconsistent (Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy species, particularly annuals.

Drawdown may at first glance appear to be an option for management of curly leaf pondweed in Balsam Lake due to the dam. However, there are several reasons that drawdown for aquatic plant control is not a viable option for the lake. Curly leaf pondweed is found in much of the littoral zone area. A drawdown intended to decrease curly leaf pondweed growth would have an unknown impact on native aquatic plants and other aquatic organisms. Drawdown would dramatically change the use and appearance of the lake and it would take an undetermined amount of time to refill the lake following drawdown.

Benthic barriers or other bottom-covering approaches are another physical management technique. The basic idea is to cover the plants with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt or clay; fly ash; and various combinations of the above materials (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with synthetic sheeting is that the gases evolved from plant and sediment decomposition collect underneath and lift the barrier (Gunnison and Barko 1992).
The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984).

Benthic barriers will typically kill the plants under them within 1 to 2 months, after which time they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing

fish and invertebrate habitat. A WDNR permit would be required for a benthic barrier, and these barriers are not recommended.

Shading or light attenuation reduces the amount of light plants have available for growth. Shading has been achieved by fertilization to produce algal growth, application of natural or synthetic dyes, shading fabric, or covers, and establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are only of limited applicability. Physical control is not currently proposed for management of aquatic plants in Balsam Lake.

Herbicide and Algaecide Treatments

Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (Madsen, 2000).

An important caveat is that these products are considered safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. WDNR permits under Chapter NR 107 are required for herbicide application.

General descriptions of herbicide classes are included below.[27]

Contact herbicides

Contact herbicides act quickly and are generally lethal to all plant cells they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants directly. They are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides, but they quickly resprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat,** and **copper** are contact aquatic herbicides.

Systemic herbicides

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides and those that are absorbed by leaves are referred to as foliar active herbicides. **2,4-D, dichlobenil, fluridone,**

[27] This discussion is taken from: *Managing Lakes and Reservoirs*. North American Lake Management Society.

and glyphosate are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides.

Broad spectrum herbicides
Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most species of vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, endothall, and fluridone** are used as broad spectrum aquatic herbicides, but can also be used selectively under certain circumstances.

Selective herbicides
Selective herbicides are those that are used to control certain plants but not others. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, timing, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

Environmental considerations
Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community, and in turn affect other organisms or weed control operations. These operations can also impact water chemistry which may result in further implications for aquatic organisms.

Table 10. Herbicides Recently Used to Manage Aquatic Plants in Balsam Lake (2006-2009)

Brand Name(s)	Chemical	Target Plants
Cutrine Plus, $CuSO_4$, Captain, Navigate	Copper compounds	Filamentous algae, coontail, wild celery, elodea, and pondweeds
Reward	Diquat	Coontail, duckweed, elodea, water milfoil, and pondweeds
Aquathol, Aquathol K, Aquathol Super K, Hydrothol 191	Endothall	Coontail, water milfoil, pondweeds, and wild celery as well as other submersed weeds and algae
Rodeo	Glyphosate	Cattails, grasses, bulrushes, purple loosestrife, and water lilies
Navigate, Aqua-Kleen, DMA 4 IVM	2, 4-D	Water milfoils, water lilies, and bladderwort

General descriptions of the breakdown of commonly used aquatic herbicides are included below.[28]

Copper

Copper is a naturally occurring element that is essential at low concentrations for plant growth. It does not break down in the environment, but it forms insoluble compounds with other elements and is bound to charged particles in the water. It rapidly disappears from water after application as an herbicide. Because it is not broken down, it can accumulate in bottom sediments after repeated or high rates of application. Accumulation rarely reaches levels that are toxic to organisms or significantly above background concentrations in the sediment.

2,4-D

2,4-D photodegrades on leaf surfaces after being applied to leaves, and is broken down by microbial degradation in water and in sediments. Complete decomposition usually takes about 3 weeks in water but can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

Diquat

When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection levels 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and bound tightly to particles in the water and bottom sediments. When bound to certain types of clay particles, diquat is not biologically available. When diquat is bound to organic matter, it can be slowly degraded by microorganisms. When diquat is applied foliarly, it is degraded to some extent on the leaf surfaces by photodegradation. Because it is bound in the plant tissue, a proportion is probably degraded by microorganisms as the plant tissue decays.

28 These descriptions are taken from Hoyer/Canfield: *Aquatic Plant Management*. North American Lake Management Society. 1997.

Endothall
Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water and 1 week in bottom sediments.

Fluridone
Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs, and microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter, when the sun's rays are less direct and days are shorter, result in longer half-lives. Fluridone usually disappears from pondwater after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

Glyphosate
Glyphosate is not applied directly to water for weed control, but when it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

Copper Compounds
Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

Herbicide Used to Manage Invasive Species

Eurasian Water Milfoil
The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil: 2,4-D, diquat, endothall, fluridone, and triclopyr.[29] All of these herbicides with the exception of diquat are available in both granular and liquid formulations. It is possible to target invasive species by using the appropriate herbicide and timing. Diquat is used infrequently in Wisconsin because it is nonspecific.[30] The herbicide 2,4-D is most commonly used to treat EWM in Wisconsin. This herbicide kills dicots including native aquatic species such as northern water milfoil, coontail, water lilies, spatterdock, and watershield. Early season (April to May) treatment of Eurasian water milfoil is recommended to limit the impact on native aquatic plant populations because EWM tends to grow before native aquatic plants.

Granular herbicide formulations are more expensive than liquid formulations (per active ingredient). However, granular formulations are generally thought to release the active ingredient

[29] Additional information provided by John Skogerboe, Army Corps of Engineers, personal communication. February 14, 2008.
[30] Frank Koshere. Wisconsin DNR. email communication. 3/03/10.

over a longer period of time. Granular formulations, therefore, may be more suited to situations where herbicide exposure time will likely be limited, as is the case of treatment areas in small bands or blocks. In large, shallow lakes with widespread EWM, a whole lake treatment with a low rate of liquid herbicide may be most cost effective because exposure time is greater. Factors that affect exposure time are size and configuration of treatment area, water flow, and wind. Application rates for liquid and granular formulations are not interchangeable. A rate of 1 to 1.5 mg/L 2,4-D applied as a liquid is a moderate rate that will require a contact time of 36 to 48 hours. Application rates recommended for Navigate (granular 2,4-D) are 100 pounds per acre for depths of 0 to 5 feet, 150 pounds per acre for 5 to 10 feet, and 200 pounds per acre for depths greater than 10 feet. Allowed and recommended application rates are found on herbicide labels.

Curly Leaf Pondweed

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Studies have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 to 60 degree F water, and that treatments of CLP this early in its life cycle can prevent turion formation.[31] Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are still dormant, early season treatment selectively targets curly leaf pondweed. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center are conducting trials of this method. These methods are accepted as standard operating procedures being approved in Wisconsin for aquatic invasive species control projects.[32]

Because the dosage is at lower rates than the dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.[33] Steep drop-off, high winds, and other factors that increase herbicide dilution and contact time can decrease treatment effectiveness. Early season treatment similar to that described above can be used to treat corridors for navigation purposes. Because of potential for drift, a higher concentration of endothall is generally used.

[31] *Research in Minnesota on Control of Curly Leaf Pondweed.* Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.
[32] Plan comments, Frank Koshere, September 16, 2010.
[33] Personal communication, Frank Koshere. March 2005.

Previous Aquatic Plant Management Plans

The Balsam Lake Aquatic Plant Management Plan was most recently updated in December 2005. This plan has not been approved by the Department of Natural Resources, in part because a point intercept plant survey was not completed as background for the plan.

Barr Engineering completed a transect macrophyte survey that evaluated plant coverage, density, and species composition in the summer of 1999[34] and repeated the survey in June 2005.[35] The 2005 study reports a healthy, diverse, high quality native plant community in Balsam Lake that has changed little since 1999. Aquatic plants are reported to cover about 41 percent of the lake area. Plant diversity in Balsam Lake is relatively high when compared with 50 Wisconsin lakes. A total of 21 species were found in 2005, and 25 species were found in 1999. [As described previously, the 2009 survey located 49 species.] Coontail (*Ceratophyllum demersum*) was the most frequently occurring species. Curly-leaf pondweed (*Potamogeton crispus*), a non-native invasive plant, occurred at 56 percent of the sample points in 1999 and only 41 percent of the sample points in 2005. This is noted as a positive change for the lake. [In 2009, curly leaf pondweed was found in 20 percent of the lake, which translates to about 36 percent of the littoral zone where plants were present and transects where measured.]

The 2000 plan proposed using herbicide treatments to treat public swimming areas, boat landings, and boat passageways or navigational channels. These 25-foot wide navigational channels are identified in maps in the plan. Prior to 2000 the District used a mechanical harvester to remove plants from the lake. The cost of chemical application was shown to be less than previous mechanical harvester costs. An evaluation in 2004 concluded that herbicide applications were an effective way to maintain navigational channels in the lake. These designated channels have been inspected regularly for potential treatment in recent years.

The 2000 plan also called for treating areas identified as priorities for curly leaf pondweed management. Limited curly leaf pondweed management through the use of early season herbicide treatment was completed on 11.5 acres along the south shore of East Balsam and 1.5 acres in the North Bay near the narrows to East Balsam in 2004. A total of 11 acres were treated in 2005 in the same areas. This treatment strategy was not recommended in the 2005 plan. Instead, a “long term treatment program” - the use of lime slurry to reduce plant density (including curly leaf pondweed density) to attain favorable long-term changes in problematic areas was recommended.

[34] *Balsam Lake Macrophyte Surveys and Management Plan.* Prepared for Balsam Lake Protection and Rehabilitation District. Barr Engineering. February 2000.
[35] *Balsam Lake Aquatic Plant Survey and Management Plan.* Prepared for Balsam Lake Protection and Rehabilitation District. Barr Engineering. December 2005.

Current and Past Aquatic Plant Management

Early Balsam Lake management efforts included the use of chemicals to control aquatic plants and algae. From 1960 through 1985, the most commonly used chemicals were copper sulfate and Endothall compounds. Copper sulfate use is a concern since copper is a heavy metal that can build up in lake sediments. Between 1960 and 1985, over 7.7 tons of copper sulfate were applied to Balsam Lake (not including chemical applications made directly by homeowners).[36]

Native aquatic plants were managed by the BLPRD primarily by harvesting through 1999. When the contract harvester passed away, new management methods were considered. There were many complaints about floating, drifting plant fragments when harvesting was used. Since that time through 2006, herbicides have been used to manage nuisance native aquatic plants.

According to WDNR staff, herbicide use on Balsam Lake was common at least since the 1950s. In the early 1980s through 2007 many property owners hired herbicide contractors to use herbicides to create openings in front of their parcels, generally treating twice each year. Copper compounds were also commonly used to treat planktonic (floating) algae. In the late 1990s DNR permitted only filamentous algae treatments, and copper treatments for algae control were discontinued. At that same time, individual treatment widths were reduced to 50 feet.[37] However, according to treatment records, copper compounds have still been used (in the form of Cutrine Plus and as part of an applicator designated "efficacy mix") at the boat landings and for individual homeowner corridors.

The DNR Northern Region released an Aquatic Plant Management Strategy (Appendix C) in the summer of 2007 to protect the important functions of aquatic plants in lakes. As part of this strategy, the DNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan. [38] Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners must be carefully reviewed before permits are issued. The DNR will not allow removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented.

Individual Corridors

As stated above, some homeowners contracted with herbicide applicators to remove aquatic plants in front of their properties until 2008. A summary of recent treatment is included in Table 11. Emergent, floating, and submerged water plants and algae were targeted. The stated purpose of these treatments was as follows: to maintain shoreline access for boating, swimming, and fishing, and to reduce nuisance algae accumulation.

[36] Analysis of Balsam Lake (Polk County, Wisconsin) with Recommendations for Improved Lake Management. September 1986. Lim Tech Consultants. Report No. LT-R46902.
[37] Email communication. Mark Sundeen. 2/14/2010.
[38] Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

Table 11. Recent Waterfront Herbicide Treatments on Balsam Lake

Year	Individual Properties (#)	Acres Treated w/ Herbicide
2005	73	13.46
2006	66	11.61
2007	64	11.30

Navigation Channels
Recent DNR records document herbicide treatment of designated "navigation channels" in Balsam Lake. These navigation channels were mapped as part of previous aquatic plant management planning efforts. There was no record of navigation channel treatment in 2007 or 2008. An area of 11.5 acres of navigation channels was treated in 2006.

The 2009 herbicide treatments for navigation are reported in permit records as follows:
Raskin Bay: 1.78 acres for lilies, 0.31 acres for submerged vegetation
Mill Pond: 0.21 acres for lilies, 0.5 acres for submerged vegetation.
Chemicals used included Aquathol K, Cutrine Plus, Reward, and Navigate (see Table 10 for chemical descriptions).

Curly Leaf Pondweed[39]
The CLP pondweed bed (8 acres) along the south shore of East Balsam was treated again May 14, 2009 with an early season Endothall treatment. No treatment had occurred since 2005 when about 11.5 acres were treated in this area. Endangered Resource Services completed pre and post monitoring according to DNR methods on April 27 and June 10.

Boat Landings
In past years, the lake district applied chemicals at the public landings in an attempt to prevent the introduction of Eurasian water milfoil to the lake. This technique for EWM prevention is not described in the 2005 plan.

Recent DNR records document herbicide treatment of 100 foot wide swaths at the Balsam Lake boat landings. There were a total of 0.55 acres treated at all 5 landings in 2005. In 2006 and 2007, reports indicated that 4 landings (not including Sunnyside) were treated with the herbicide Reward (see Table 10 for chemical descriptions).

Eurasian Water Milfoil Monitoring
The herbicide contractor currently checks the boat landings monthly during summer months for the presence of Eurasian water milfoil and other invasive plants.[40] Volunteer or intern boat landing monitors check boats, clean boats if necessary, and provide information to lake users at the public boat landing. Volunteers and interns also regularly provide surveillance monitoring at boat landings to check for Eurasian water milfoil using citizen monitoring protocols and report to

[39] Endangered Resource Services. June 2009.
[40] BLPRD Annual Meeting. 2002.

the project coordinator if a suspicious plant is found. If identification is confirmed, the project coordinator will report any positive EWM identification to the Department of Natural Resources.

Clean Boats Clean Waters
The CBCW program inspects boats for invasive species, educates boaters on invasive species and the local and state Aquatic Invasive Species (AIS) rules, and gathers data.

A successful Clean Boats, Clean Waters began on Balsam Lake in 2007. The Clean Boats, Clean Waters program covers four boat landings on Balsam Lake. These areas are staffed Monday, Wednesday, Friday, Saturday, and Sunday from Memorial Day through Labor Day. The program is a cooperative effort between BLPRD and Unity High School. High school students are compensated approximately 50% of the hours, and the remaining hours are considered volunteer. Jeanne Alling, high school agriculture teacher, assists the program by conducting training during school and scheduling students in the summer. Highlights from the program are included in the Table 12.

Table 12. Clean Boats Clean Waters Program Summary

	2007	**2008**	**2009**
Number of Unity Student Involved	17	26	43
Total Inspection Hours	505	961	2,337
Paid Hours	198	468	1,150
Volunteer Hours	307	493	1,187
Number of Inspections	628	995	1,841

A CBCW boat inspection training/orientation program was held on April 25th, 2009. Over 60 students attended the training. Representatives from Half Moon Lake, Bone Lake, and Deer Lake also attended to learn from Balsam Lake's program. Amy Kelsey from the Polk County Land and Water Resources Department assisted with the training, and Carl Holmgren, BLPRD Project Coordinator also had a lead role. Amy (Polk County LWRD) also assisted with the training in 2007 and 2008.

In 2010 the BLPRD coordinator hopes to get families and other lake groups involved in the Clean Boat and Clean Waters programs. There will also be more frequent aquatic plant inspections at the landings in 2010. Additional volunteer inspectors will be needed to complete these activities.

Polk County Land and Water Resources Department (LWRD)
The BLPRD will coordinate training and educational activities with the Polk County Land and Water Resources Department and the Polk County Lakes and Rivers Association. Volunteers will be trained through Clean Boats, Clean Waters workshops in cooperation with the Polk County LWRD. County staff is also willing to provide plant identification assistance.

Polk County recently passed a Do Not Transport Ordinance and will be placing signs at public landings to remind lake users about its requirements. It is illegal to transport aquatic vegetation on boats and equipment in Polk County.

Plan Goals and Strategies

This section of the plan lists goals and objectives for aquatic plant management for Balsam Lake. It also presents a strategy of actions that will be used to reach aquatic plant management plan goals.

Goals are broad statements of direction.

Objectives are measurable steps toward the goal.

Actions are actions to take to accomplish objectives.

The **Implementation Plan** outlines timeline, resources needed, partners, and funding sources for each action item.

Plan Goals

1. Manage established invasive species and eradicate newly introduced invasive species to reduce their impacts to the lake.

2. Prevent the introduction of aquatic invasive species.

3. Maintain navigation for fishing and boating in problem areas, access to lake residences, and comfortable swimming at the village beach.

4. Increase lake residents' and visitors' understanding of aquatic plants and management.

5. Preserve the diverse native aquatic plant community in Balsam Lake.

Responsible Parties for APM Implementation and Monitoring

Balsam Lake Protection and Rehabilitation District Board (BLPRD) – elected/appointed officials responsible for oversight of lake management district. Some actions such as hiring a contractor or consultant require a vote of the board.
APM Lead – makes day-to-day APM decisions and directs contractors in herbicide treatments and related monitoring. The commissioner will have volunteers and consultants to assist in these activities. The Board APM Lead is currently Milt Stanze.
AIS Lead – leads and coordinates volunteer AIS education activities including Clean Boats, Clean Waters monitoring and education at the boat landings and lake monitoring. The AIS Lead is currently Carl Holmgren.
Herbicide Contractor – the herbicide applicator hired by the District Board to complete herbicide treatment as permitted by the Wisconsin Department of Natural Resources.
Harvesting Contractor – the contractor hired to complete harvesting when needed.
APM Monitor– a consultant hired to complete monitoring under the direction of the APM Lead and the District Board.
DNR – APM staff will review aquatic plant management permit applications and enforce permit conditions.
Polk County LWRD – Staff from the Polk County Land and Water Resources Department will help with education and plant identification.

Goal 1. Manage established invasive species and eradicate newly introduced invasive species to reduce their impacts to the lake.

Objectives

A. Reduce the density of curly leaf pondweed (CLP) to allow navigation through existing beds.

B. Maintain navigation to homes, businesses, and public boat landings.

C. Prevent CLP spread – reduce, then limit growth of CLP in identified beds to 20 acres.

D. Identify and remove purple loosestrife (PL) plants from any newly colonized area.

E. Eliminate any new AIS introduction.

Actions

1. Control CLP growing in dense beds using low-dose, early season Endothall treatment or other accepted method. (OBJ A, B, C)

   Identification of CLP Beds
   Beds consist of at least 50% CLP (or other invasive plant).
   Beds top out at the surface (at least 1 meter stem height).
   Average density rating equal to or greater than 2.
   A total of 49.2 acres of CLP beds were mapped in 2009.

   Criteria for prioritizing CLP bed treatment:
   Navigation into homes, businesses, or a public boat landing is limited.
   Bed is in a location where treatment is likely to be successful: avoid areas of steep drop off, currents, and/or high exposure to wind.
   The plant survey identified 13 acres of CLP beds as navigation concerns and an additional 17 acres of CLP beds as potential navigation concerns. Up to 20 acres of early season Endothall treatment is recommended for 2011.

   a. Select tentative beds for treatment in July of previous year (APM Lead or committee)
   b. Select APM contractors (Herbicide Contractor, APM Monitor) in December (Board)
   c. Apply for APM permits in January or February (APM Lead with assistance from Herbicide Contractor)
   d. Verify treatment areas with pre monitoring in April or May

2. Conduct DNR specified and required third-party pre and post herbicide monitoring for CLP herbicide treatment. (OBJ A, B, C)

3. Map all beds of curly leaf pondweed (CLP) on the lakes each year. (Coordinate with CLP post treatment monitoring if possible.) Map according to the criteria identified above, or as modified with plan amendment. Information recorded for each bed will include: evidence of navigation impairment, number of adjacent homes, potential navigation routes around CLP bed, early season fishing use. (OBJ A, B, C)

4. Provide info to Balsam Lake residents so they can identify purple loosestrife (PL) and know who to contact if they have a suspected plant. (AIS Lead or Polk County LWRD) (OBJ D)

5. Monitor the lakes for new PL growth each year and mark locations with GPS points. (Herbicide Contractor, APM and/or AIS Leads) (OBJ D)

6. Cut and spray individual PL plants where identification is confirmed. (Polk County LWRD) (OBJ D)

7. Note area where PL is sprayed and monitor in subsequent years. (Polk County LWRD, AIS Lead) (OBJ D)

8. Review the need for updates to the rapid response plan for Eurasian water milfoil and additional aquatic invasive species. The current EWM Rapid Response Plan is included as Appendix E. (OBJ E)

Goal 2. Prevent the introduction of aquatic invasive species (AIS).

Objectives

A. 100% of boaters inspect, clean, and drain boats, trailers, and equipment.

B. New aquatic invasive species are identified as soon as possible after being introduced to the lake. (Include Eurasian water milfoil and purple loosestrife at a minimum.)

C. 100% enforcement of Polk County's Do Not Transport Ordinance.

Actions

1. Continue a successful Clean Boats, Clean Waters monitoring and education program at each boat landing using paid staff and volunteers. (OBJ A)

2. Train volunteer monitors to identify and monitor for aquatic invasive species. (OBJ A and B)

3. Monitor boat landings and other areas with high potential for introduction of AIS. (NEW in 2010 with volunteers, ongoing with Herbicide Contractor) (OBJ B)

4. Work with the Polk County Sheriff's Department to encourage enforcement of the Do Not Transport Ordinance. (OBJ C)

Goal 3. Maintain navigation for fishing and boating in problem areas, access to lake residences, and comfortable swimming at the village beach.

Objectives

A. Maintain navigation for fishing and boating.

B. Allow waterfront property owners the option of maintaining individual access corridors by manual, chemical, or mechanical means.

C. Address aquatic plant nuisances to swimming at the village of Balsam Lake public beach.

D. Conduct all herbicide treatments legally and according to permit conditions. Permits are required for all aquatic application of herbicides in Wisconsin.

Actions

1. Identify ongoing navigation areas of concern caused by native plant growth. *Note currently identified common navigation areas of concern are identified in Figure 23 and the process is outlined in more detail on the following page.* (OBJ A)

2. Monitor these areas of concern on a regular basis and respond to newly identified areas. (OBJ A)

3. Seek permit and address confirmed navigation impairment using appropriate method. *Herbicide application will generally be used to manage impaired navigation areas. The herbicide will target species present in problem area. Floating aquatic species such as water lilies may be addressed in subsequent years with preventative treatment measures (i.e. early June application).* (OBJ A and D)

4. Harvesting may be used to collect nuisance, uprooted, drifting plants such as wild celery. *Note that is the only use where harvesting is the preferred method. Requiring harvesting as a control method in a request for proposals (RFP) likely may limit the herbicide applicators who qualify to respond to the bid.* (OBJ A)

5. Allow individual landowners to apply for permits and treat individual access corridors. These treatments may focus on invasive or native plants. Landowners would bear the cost of these treatments. Hand removal methods will be recommended as a first choice for navigation impairment created by native plants. Hand removal does generally not require a permit when limited to a 30-foot opening. Native plants provide an important shield against invasion by Eurasian water milfoil and other invasive aquatic plant species. (OBJ B and D)

6. The aquatic plant control method for the public beach will be selected by the Village of Balsam Lake. The plan allows for herbicide use, harvesting, hand control, or a combination of these methods. The Village would apply for necessary permits and pay for any treatment. (OBJ C and D)

Addressing Impaired Navigation Conditions – Common Navigation Areas or Nuisance Conditions

1. Common Navigation Areas of Concern

- Current navigation areas of concern are identified in Figure 23.
- New areas may be identified in the following manner:
  - Residents notify APM Lead Commissioner or designee of potential concern.
  - Area is inspected by APM Lead. If navigation impairment is confirmed, document impairment as described in Step 3 below.

2. Monitoring Common Navigation Areas and Identifying Nuisance Conditions

- Navigation areas of potential concern will be monitored 5 times each summer by the Herbicide Contractor or APM Monitor.
- If a navigation concern or nuisance condition is identified, the APM Lead or designee will review and document the concern.
- Concerns identified by resident complaints will be reviewed by APM Lead or designee. These complaints may result in identification of new areas of concern, confirmation of navigation impairment in existing areas, or identification of nuisance conditions.
- If navigation impairment or nuisance condition is confirmed, identify appropriate treatment method (in cooperation with Herbicide Contractor) and proceed with permitting.

3. Documenting Navigation Impairment

- Locate navigation routes with GPS coordinates.
- Provide dimensions (length, width, and depth).
- Indicate when plants cause problems and how long problems persist.
- List adaptations or alternatives considered to lessen problem.
- List the species of plants causing the nuisance.

4. Documenting Nuisance Conditions

- Indicate when plants cause problems and how long problems persist.
- Include photos of nuisance conditions.
- Provide examples of specific activities that are limited because of presence of nuisance aquatic plants .
- An example nuisance condition is drift of uprooted wild celery.

5. Addressing Common Navigation in DNR Sensitive/Critical Habitat Areas

- The appropriate control method will consider sensitive area functions.
- The most likely modification is to limit any navigation routes in sensitive areas to no more than 30 feet in width.

6. Selecting Appropriate Control Method

- Herbicides will generally be used to control the growth of nuisance native aquatic plants. The herbicide proposed for use will be based on the plant species, stage of growth, and other environmental factors.
- Another method such as harvesting may be used if it is found to meet one or more of the following criteria:
  - is more economical
  - is more effective
  - results in fewer negative effects on fish and wildlife
  - results in fewer nuisances to lake residents

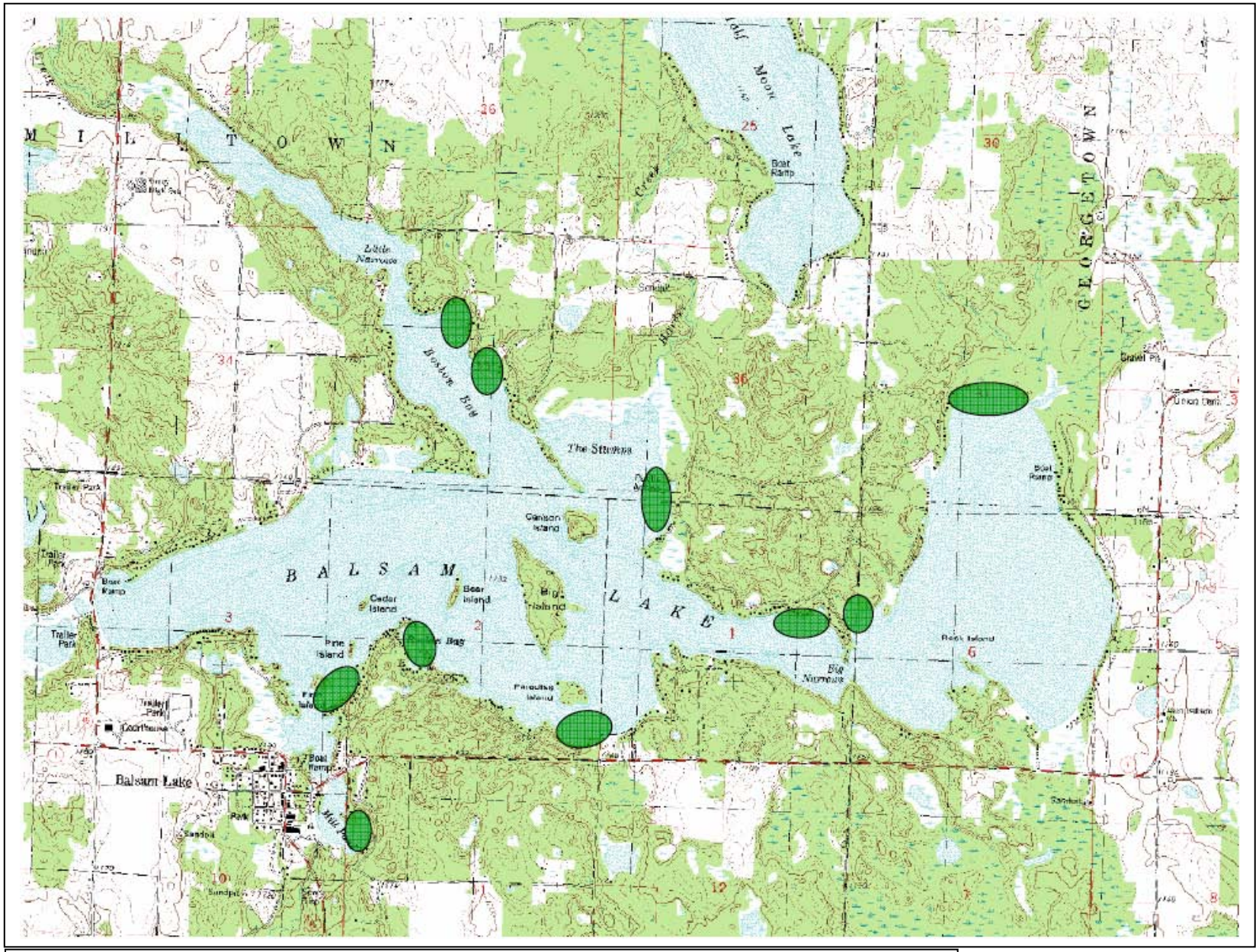


Figure 23. Common Navigation Areas of Concern

Individual Corridor Access

The only time a permit is not required to control aquatic plants is when a waterfront property owner manually removes (i.e., hand-pulls or hand rakes), or gives permission to someone to manually remove, plants (except wild rice) from his/her shoreline in an area that is 30 feet or less in width along the shore and is not within a Designated Sensitive Area. The non-native invasive plants (Eurasian watermilfoil, curlyleaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Wild rice removal always requires a permit.

> Individual Access Corridors are the openings from a waterfront property owner's shoreline out into the lake. These corridors may be a maximum of thirty feet wide and must remain in the same location from year to year. Herbicide treatment or harvesting may be permitted for individual corridors in front of waterfront property to control invasive or native plants.

Invasive Plant Control

Currently the only invasive aquatic plant prevalent in Balsam Lake is curly leaf pondweed. Curly leaf pondweed grows early in the summer, then dies back by early July. Nuisance conditions must be verified for herbicide treatment. The 2009 curly leaf pondweed bed map will verify nuisance conditions for 2011 treatment. The map is included as Figure 24. Once treatments are initiated, they may continue for three years if needed.

Areas on curly leaf pondweed bed map

- Early season endothall treatment may be permitted for 3 years
- Nuisance conditions must be verified beyond this treatment period

Areas outside of curly leaf pondweed bed map

- Nuisance conditions created by curly leaf pondweed must be verified the year before treatment
- Early season endothall treatment may be permitted for a 3 year period following this verification

The BLPRD will inform waterfront property owners of the process and limits of individual corridor access management options.

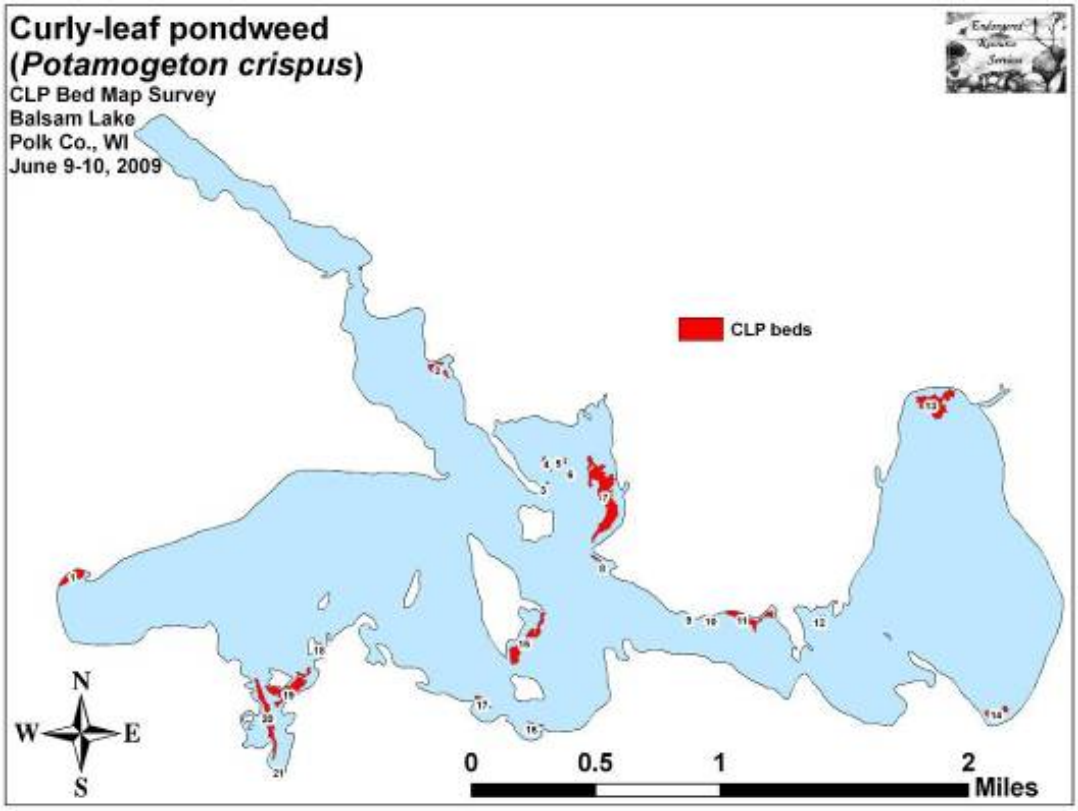


Figure 24. Balsam Lake Curly Leaf Pondweed Beds 2009.

Procedure for Individual Corridor Permitting and Monitoring

Document nuisance conditions (landowner/ herbicide contractor provide in permit application in February/March)

- Indicate when plants cause problems and how long problems persist.
- Include dated photos of nuisance conditions from previous season (or location relative to curly leaf pondweed bed map).
- List depth at end of dock.
- Provide examples of specific activities that are limited because of presence of nuisance aquatic plants.
- Describe practical alternatives to herbicide use or harvesting that were considered. These might include:
  - Hand removal/hand raking of aquatic plants
  - Extending dock to greater depth
  - Altering the route to and from the dock
  - Use of another type of watercraft or motor, i.e., is the type of watercraft used common to other sites with similar conditions on this lake?
- Herbicide use for curly leaf pondweed may occur along the entire length of a waterfront property owner's shoreline. Herbicide use in areas with wild rice will not be permitted.
- Aquatic Herbicide/Harvesting Contractor to provide this information in permit application based on information from the landowner.

Verify/refute nuisance conditions and/or navigation impairment

- Landowners will document conditions with photographs and submit request for review by the APM Lead or designee.
- Landowner requests BLPRD APM Lead review of their property prior to submitting a permit application to DNR.
- The APM Lead visits site, reviews documentation and provides a written opinion of navigation impairment i.e., is herbicide treatment or harvesting warranted?
- Landowner/applicator applies for permit to WDNR including photographic documentation, identification of plants causing navigation problems, and BLPRD evaluation.
- For curly leaf pondweed treatment, verification must occur the year before treatment in May or June. Once CLP nuisance is verified and a permit is approved, additional verification is not needed for three subsequent years (although permit applications must be completed each year). Treatment for CLP must occur with water temperatures from 50 - 58 degrees F.
- WDNR will contact herbicide contractor and owner with a notice to proceed with treatment or denial of permit application.

Goal 4. Educate Balsam Lake residents regarding aquatic plant management.

Audience:

A. Lake residents

B. Business owners

C. Lake users

Messages

1. Provide executive summary of APM plan, notice of public meeting, and how to get full APM plan.
2. List of APM dos and don'ts
3. Contact list for APM: include web resources
4. Emphasize importance of native aquatic plants.
5. Aquatic plants are not weeds – describe their benefits such as fish habitat.
6. Limit impacts on native aquatic plants by traveling with no wake in shallow areas, using hand removal methods near docks and swimming areas, etc.
7. The DNR is not against aquatic plant management to allow navigation. It must be balanced with an understanding and concern for native plant benefits.
8. Procedure for individual corridor herbicide applications and conditions where herbicide treatment may be allowed. Nuisance conditions must be documented.
9. Location and procedures for curly leaf pondweed herbicide treatment
10. The aquatic plant management efforts included in the plan
11. Identification of CLP and methods for removal (include illustrations)
12. Identification of PL and methods for removal (include illustrations)
13. Identification of EWM and contact if suspected (include illustrations)
14. Locations of nearby lakes with EWM
15. New potential invasive species and why they are a threat
16. Native plant identification
17. Inspect, clean, and drain boats and equipment
18. Polk County has an ordinance that makes it illegal to transport aquatic plants on public roads.

Methods

Newsletter articles (Dockside and Lake Association newsletter)

Web site – frequently asked questions, high quality plant ID pictures

Re-publish articles to newsletter or local papers

Placemats at local restaurants

Elementary school education (parents learn from kids)

Info at bait shops, restaurants, bars, other businesses

Aquarium display of native plants

Plant ID expert – bring plants in

Plant ID competition

Internet tools like Twitter and Facebook

Training classes/workshops with quizzes

County fair booth

DNR “wild cards”

Playing cards with aquatic plants on back

Handouts for plant identification – include high quality photos

Goal 5. Preserve the diverse native aquatic plant community in Balsam Lake.

Objectives

A. Implement strict adherence with treatment standards (early CLP treatment prior to native plant growth) and monitoring methods prior to and following herbicide treatment.

B. Limit removal of native plants to areas with severe navigation problems or nuisance conditions.

C. Allow only limited plant control in designated sensitive areas – most often by creating narrower navigation channels through native plants.

D. Increase Balsam Lake residents' understanding of the role and importance of aquatic plants and their impacts on them.

Discussion

The plant community in Balsam Lake is very diverse. It is important to understand that these plants play a critical role in the lake ecosystem. Aquatic plants in the lake provide habitat for fish. They also provide protection from shoreline erosion. Removing native plants could lead to adverse effects on the lake. Healthy native plant populations prevent colonization by invasive plants such as Eurasian water milfoil. Erosion and runoff from waterfront property may alter sediment characteristics encouraging spread of invasive plants. Boating disturbance near the shoreline can remove aquatic plants and the valuable functions they provide.

Actions

1. Follow DNR requirements and BLPRD and APM plan guidelines to allow native plant removal only in areas with severe navigation impairment or nuisance conditions for common and individual navigation corridors. (OBJ A and B)

2. Limit navigation channels in sensitive areas to not more than 30 feet in width, or take other measures to protect these areas when removing native plants. (OBJ C)

3. Conduct a point intercept survey of the lakes every five years. (OBJ A and D)

4. Update the aquatic plant management plan beginning in 2014. (OBJ A, B and C)

   Educational activities are detailed in the discussion for Goal 4.

Implementation Plan for BLPRD[42]

Goal 1. Manage established invasive species and eradicate newly introduced invasive species to reduce their impacts to the lake.				
Actions[43]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
1. CLP Control Herbicide Treatment				
a. select beds for treatment	July (prev. year)	$0	10	APM Lead Board
b. select APM contractors	Dec (prev. year)	$0	10	APM Lead Board
c. apply for APM permits	Jan/Feb	$520	5	APM Lead
d. complete herbicide treatment	Late May	$12,000	5	APM Lead Herbicide Contractor
2. Conduct pre and post treatment monitoring	April/May Mid June	$1,500	5	APM Monitor
3. Map all beds of CLP	Mid June	$800	5	APM Monitor
4. Provide purple loosestrife ID and contact info to residents	July	$100	5	AIS Lead Polk County LWRD
5. Monitor lakes for new purple loosestrife growth	July		40	Herbicide Contractor Volunteer Monitors

[42] Costs are annual costs estimated for initial implementation. These costs will be reviewed each year during the lake district budgeting process.
[43] See previous pages for action item detail.

Goal 1. Manage established invasive species and eradicate newly introduced invasive species to reduce their impacts to the lake.				
Actions[43]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
				AIS or APM Lead
6. Cut and spray identified plants and document location. 7. Monitor these areas in subsequent years for new growth.	Summer	$0	10	Polk County LWRD AIS Lead
8. Implement the Rapid Response Plan for Eurasian Water Milfoil. a. develop contingency fund for rapid response b. consider updates to EWM Rapid Response plan c. consider rapid response for newly prioritized AIS		$10,000	40	APM Lead AIS Lead
SUBTOTAL GOAL 1		$24,920		

Goal 2. Prevent the introduction of aquatic invasive species.				
Actions[44]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
1. Continue Clean Boats, Clean Waters program	Summer	$15,450	700	AIS Lead Unity High School
2. Train volunteers	Spring	$50	25	AIS Lead Unity High School Polk County LWRD
3. Monitor boat landings for AIS and document results	Summer	$1,200	0	AIS Lead Herbicide Contractor or APM Monitor Unity High School
4. Encourage enforcement of Do Not Transport ordinance	Summer	$0	10	AIS Lead APM Lead
SUBTOTAL GOAL 2		$16,700		

[44] See previous pages for action item detail.
BCLRA = Burnett County Lakes and River Association
BCLWCD = Burnett County Land and Water Conservation Department
WDNR = Wisconsin Department of Natural Resources

Goal 3. Maintain navigation for fishing and boating in problem areas and comfortable swimming at the village beach.				
Actions[45]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
1. Identify ongoing navigation areas of concern	Summer	$0	20	APM Lead Lake residents
2. Monitor navigation areas	5 times per summer	$4,000		APM Lead Herbicide contractor
3a. Seek permit if navigation problems identified	Summer	$150		APM Lead
3b. Control nuisance plant growth with permitted method	Summer	$3,500		APM Lead
4a. Maintain harvesting contingency by issuing request for proposal	December	$0	5	APM Lead Board
4b. Permit and implement harvesting as needed	Summer	$1,500/acre	5	APM Lead Harvesting Contractor
5. Evaluate navigation impairment for individual corridors	Summer	$0	40	APM Lead
SUBTOTAL GOAL 3		$7,650	70	

[45] See previous pages for action item detail.

Goal 4. Educate Balsam Lake residents regarding aquatic plant management.				
Actions[46]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Newsletter articles	3 times per year	$500		APM Lead AIS Lead
Web – AIS photos, contacts for plant ID	As needed	$200		AIS Lead
Annual meeting – plant ID, contacts	July	$100		AIS Lead APM Lead
Consider new education activities	Ongoing	$1,000		AIS Lead APM Lead
Subtotal GOAL 4		$1,800		

[46] See previous pages for action item detail.

Goal 5. Preserve the diverse native aquatic plant community in Balsam Lake.				
Actions[47]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Aquatic plant point intercept survey	2013	$9,000		APM Lead Board
Update the Aquatic Plant Management Plan	2014	$8,000		APM Lead Board
Subtotal GOAL 5		$17,000		

[47] See previous pages for action item detail.

Monitoring and Assessment

Aquatic Plant Surveys

Aquatic plant (macrophyte) surveys are the primary means for tracking achievement toward plan goals.

Action. Conduct whole lake aquatic plant surveys approximately once every five years to track plant species composition and distribution. The next survey is scheduled for 2014.

The whole lake surveys will be conducted in accordance with the guidelines established by the Wisconsin DNR. Any new species sampled will be saved, pressed, and mounted for voucher specimens.

Aquatic Invasive Species Grants

Department of Natural Resources Aquatic Invasive Species (AIS) grants are available to assist in funding some of the action items in the implementation plan. Maintaining navigation channels to alleviate nuisance conditions are an exception. Grants provide up to 75 percent funding. Applications are accepted twice each year with postmark deadlines of February 1 and August 1. With completion and approval of the aquatic plant management plan, funds will be available not only for education and planning, but also for control of aquatic invasive species.

The BLPRD currently has an AIS grant for the development of this management plan and the implementation of the Clean Boats, Clean Waters program. The grant provides $50,000 in grant funds for 2010 and 2011.

Appendix A. Balsam Lake Property Owner Survey Results

Please complete and return in the enclosed self-addressed stamped envelope to:
BLPRD
PO Box 202
Balsam Lake, WI 54810

301 of 800 surveys returned: 38%

1. Which of the following best describes when you use your Balsam Lake home/property? (Please consider the property you use most if you own more than one.)
   (Check one)
   61 of 301 20% Full-time residency
   64 of 301 21% Seasonal – continued occupancy for months at a time
   171 of 301 57% During weekends, vacations, and/or holidays
   2 of 310 0.6% Rental to others
   1 of 301 0.3% Land Only
   3 of 301 1% No Response

2. How long have you owned property on Balsam Lake? **(Check one)**
   13 of 301 4.3% 0 to 2 years
   26 of 301 8.6% 2+ to 5 years
   45 of 301 15% 5+ to 10 years
   75 of 301 24.9% 10+ to 20 years
   137 of 301 45.4% More than 20 years
   5 of 301 1.6% No Response

3. Please indicate your degree of participation in the following activities at Balsam Lake?
   (Circle appropriate response for each item)

	None	A little	Some	Quite a bit	A great deal	Average
Appreciating peace and tranquility	0	1	2	3	4	3.48
Enjoying the view	0	1	2	3	4	3.69
Fishing	0	1	2	3	4	2.13
Jet skiing	0	1	2	3	4	0.07
Motor boating	0	1	2	3	4	2.82
Non-motorized boating	0	1	2	3	4	1.19
Observing wildlife	0	1	2	3	4	3.13
Wind surfing	0	1	2	3	4	0.14
Scuba diving or snorkeling	0	1	2	3	4	0.12
Swimming	0	1	2	3	4	2.33
Water skiing	0	1	2	3	4	1.49
Other (list)	0	1	2	3	4	
Snow shoe	1 response at 4			Sailing	5 ave 3	
Running	1 response at 4			Tubing	5 ave 3.2	

Entertain. & Family time	2 at 4	Sun bathing	1 at 3
Snowmobile on lake	3 ave. 2.67	Ice Walking	1 at 1
Walks in Winter	1 at 3	Water Therapy Handi.	1 at 3
Socializing	1 at 4	Wake Boarding	2 ave 3.5
Enjoy Restaurants	1 at 3	Star gazing	1 at 4
Kayaking	1 at 3	Walking	1 at 3
Biking	1 at 3	Paddle boats	1 at 1
Out of Cities	1 at 4	Ice Fishing	1 at 4
Gardening	1 at 4	No Response	1

4. Please indicate how much each of the following **negatively** impacts your use of the lake. If you believe the concern is not present on the lake, circle "0".
(Circle appropriate level of negative impact for each item)

	Level of Negative Impact							Average Score
	Not present	No impact	A little	Some	Quite a bit	A great deal	Unsure	
Algae growth	0	1	2	3	4	5	6	3.71
Small fish size	0	1	2	3	4	5	6	2.65
Not enough fish	0	1	2	3	4	5	6	2.76
Lake level too high	0	1	2	3	4	5	6	1.21
Lake level too low	0	1	2	3	4	5	6	2.61
Native aquatic plant* growth	0	1	2	3	4	5	6	3.4
Invasive aquatic plant** growth	0	1	2	3	4	5	6	3.68
Loss of wildlife habitat	0	1	2	3	4	5	6	2.87
Boat congestion	0	1	2	3	4	5	6	2.81
Noise	0	1	2	3	4	5	6	2.82
Loss of natural scenery	0	1	2	3	4	5	6	2.57
Other (list)	0	1	2	3	4	5	6	

Culvert Size	1 at 5	Rock wall Mcmansions	1 at 5
Too many bass tourn.	1 at 4	Renting out Docks	1 at 5
Fewer Loons	1 at 4	Increase Boat Houses	1 at 1
Muck	1 at 5	Neighbors Renting	1 at 1
Water Clarity	2 at 4	Silt	1 at 5
Loose Dogs	1 at 5	Operation of PWC	1 at 5
ATVs	1 at 5	Float Planes	1 at 1
Garbage in Lake	2 at 4	Too weedy to canoe	1 at 4
DNR is a poison	1 at 1	Too weedy to boat	1 at 4
Light Pollution	2 at 4.5	Large houses right on lake	1 at 1
Street Light Glare	1 at 5	Noise from large boats	1 at 5
Moss on Lake Bottom	1 at 5	Jet Skiing too close to shore	1 at 5

Jet skiing noise	1 at 5
Jet skiing speed	1 at 5
No response	4

*__Native aquatic plants –__ plants which grow submerged in water, floating on the water, or in shallow water. Native aquatic plants are naturally present in the lake. They provide food and cover for fish and wildlife and stabilize lake sediments and shorelines.

__ Invasive aquatic plants__ - Invasive plants are "out of place." They are usually introduced by human action to a location where they did not previously occur naturally and then dominate their new location. Eurasian water milfoil and curly-leaf pondweed are examples of aquatic invasive species.

QUESTIONS RELATED TO AQUATIC PLANT MANAGEMENT FOLLOW

Note that aquatic plants are rooted in the lake bottom or floating on the lake surface. Particles of algae floating in the lake are not considered aquatic plants.

5. How would you describe the overall amount of aquatic plants in the lake? **(Check one)**
   48 of 301 16 % Not sure
   5 of 301 1.6% Too few
   66 of 301 21.9% Right amount
   177 of 301 58.8% Too many
   5 of 301 1.6% No Response

6. Which best describes the amount of rooted aquatic plants near the shore (in the water)? **(Check one)**
   33 of 301 10.9% Not sure
   9 of 301 3 % Too few
   70 of 301 23.3% Right amount
   181 of 301 60.1% Too many
   7 of 301 2.3% No Response

7. At what time period during the year do you consider the aquatic plant growth in Balsam Lake to be excessive? **(Check all that apply)**
   25 of 301 8.3 % May - June
   224 of 301 74.4% July - August
   3 of 301 1 % August - September
   53 of 301 17.6% September - October
   23 of 301 7.6% I don't know
   43 of 301 14.3% Aquatic plant growth is always excessive
   9 of 301 3 % Aquatic plant growth is never excessive
   3 of 301 1 % No Response

8. During the past few years how much, if at all, have aquatic plants limited participation for you or your family in the following activities? **(Circle the appropriate response for each item)**

	Do not participate	Not at all	A little	Somewhat	Quite a bit	A great deal	Average:
Swimming	0	1	2	3	4	5	2.85
Fishing	0	1	2	3	4	5	1.99
Motorized boating	0	1	2	3	4	5	2.35
Non-motorized boating	0	1	2	3	4	5	1.17
Enjoying the view	0	1	2	3	4	5	1.73
Water skiing or tubing	0	1	2	3	4	5	1.79
Jet skiing	0	1	2	3	4	5	0.98

1 No Response

9. Curly leaf pondweed is an aquatic invasive plant that is found in many lakes in Wisconsin. Do you believe that you can identify this plant? **(Check one)**

68 of 301	22.6%	Definitely no
64 of 301	21.3%	Probably no
67 of 301	22.3%	Not sure
64 of 301	21.3%	Probably yes
35 of 301	11.6%	Definitely yes
3 of 301	1 %	No Response

10. How much of a problem, if at all, do you consider curly leaf pondweed growth in Balsam Lake? **(Check one)**

40 of 301	13.3%	Large problem
57 of 301	18.9%	Moderate problem
176 of 301	58.5%	Unsure
16 of 301	5.3%	Small problem
6 of 301	2 %	No problem
6 of 301	2 %	No Response

11. Curly leaf pondweed has been found in Balsam Lake. The potential impacts of this invasive plant include overtaking native plants, impeding navigation in early summer, and increasing phosphorus levels in the water when the plant dies in June or July. The Lake District has previously used the herbicide Endothall to control the growth of curly leaf pondweed early in the season to avoid impacts to native plants. Should the Lake District continue control efforts for curly leaf pondweed? **(Check one)**

4 of 301	1.3 %	Definitely no
3 of 301	1 %	Probably no
34 of 301	11.3 %	Not sure
88 of 301	29.2 %	Probably yes
167 of 301	55.5 %	Definitely yes
5 of 301	1.6 %	No Response

12. In 2009, the Lake District spent about $5,000 to treat an 8 acre area of curly leaf pondweed with herbicide and to monitor the results. Should curly leaf pondweed management efforts be expanded to additional acreage? **(Check one)**

8 of 301	2.6 %	Definitely no
4 of 301	1.3 %	Probably no
68 of 301	22.6 %	Not sure
102 of 301	33.9 %	Probably yes
114 of 301	37.9 %	Definitely yes
5 of 301	1.7 %	No Response

13. Below is a list of management activities that could be used to manage aquatic plants on Balsam Lake. Please tell us if you think each activity should be pursued by the Lake District.

(Circle a response for each item.)

	Definitely no	Probably no	Unsure	Probably yes	Definitely yes	Average
Spray native aquatic plants	0	1	2	3	4	2.34
Harvest native aquatic plants	0	1	2	3	4	2.13
Spray invasive aquatic plants	0	1	2	3	4	3.14
Harvest invasive aquatic plants	0	1	2	3	4	2.61
Educate residents about lake issues	0	1	2	3	4	3.46
Prevent invasive species introduction	0	1	2	3	4	3.66
Protect sensitive habitat areas	0	1	2	3	4	3.33
Expand "slow no-wake" area	0	1	2	3	4	2.21
Encourage individuals to hand pull/rake invasive plants	0	1	2	3	4	2.98
Allow individuals to hire contractors to spray up to 30 ft. around docks	0	1	2	3	4	2.84
No management	0	1	2	3	4	0.46
Other (list)	0	1	2	3	4	

if sprays effect fish	1 response	Allow indiv. Spray entire shore line	1 at 4
DNR won't let us do anything	1 at 4	Use any herbicide/chem.	1 response
Silt	1 at 4	Concerned about toxic subs. used	1 at 4
Harvest!!	1 at 4	No response	4

14. Which of the following methods(s) have been used to control aquatic plants in the lake in front of your lakeshore property within the past 5 years? Please consider the property you use most if you own more than one. **(Check all that apply)**

196 of 301 65.1 % Removal by hand-pulling or raking myself
9 of 301 3 % Hired someone to hand pull or rake
54 of 301 17.9 % Hired an herbicide applicator to apply chemical
26 of 301 8.6% Applied chemical myself
30 of 301 10 % Physical removal aided by a boat, ATV, lawn-mower, or similar machine
29 of 301 9.6 % I don't know
32 of 301 10.6 % None
13 of 301 4.3 % No Response

Other (list)
2 of 301 .7 % Some machine harvesting by BLPRD
2 of 301 .7 % BLPRD spraying
1 of 301 0.3 % Increase native aquatic plant growth
1 of 301 0.3 % Don't remove plant
2 of 301 .7 % Use outboard motor to move dead/cut off weeds
1 of 301 0.3 % Don't own lake shore, only access to it
1 of 301 0.3 % Waiting for harvest machine
1 of 301 0.3 % Have let the lily pads expand
1 of 301 0.3 % Permission from DNR to maintain navig. channel

QUESTIONS RELATED TO THE WATERFRONT RUNOFF PROGRAM FOLLOW

15. Below is a list of landscaping practices designed to protect and improve lake water quality. Please tell us which practices, if any, you use at your Balsam Lake property or whether or not you are familiar with the practice. **(Check one for each line)**

	Already use	Familiar but not used	Not familiar
Rain gardens	12.6%	55.5%	18.9%
Rain barrels	7 %	70.4%	10.3%
Shoreline buffer zones	59.1%	24.9%	9.3%
Native plants anywhere on lake property	55.5%	19.3%	15.3%
Infiltration pits or trenches	7 %	41.2%	38.5%
Water diversions	20.9%	37.5%	28.6%
Not fertilizing or using zero phosphorus fertilizer	80.4%	12 %	4.3%
Other, please list			

Natural rocks SBZ AU 0.7% RG Plan to 0.7% RB plan to 0.3% SBZ Plan to 0.3%
NP Plan to 0.3% Run off Away from lake AU 0.3% Less Grass/More shrub AU 0.3%
No Grass Cutting AU 0.3% Don't burn leaves AU 0.3% Installed "shore sox" 0.3%
No response 0.7%

16. In the following list, please indicate which water quality landscaping practice, if any, you would consider putting in place on your Balsam Lake property. Please see the definitions below. If you already use the practice, please check the box. **(Check all that are of interest)**

124 of 301 41.2% Rain gardens
102 of 301 33.9% Rain barrels
172 of 301 57.1% Shoreline buffer zones
158 of 301 52.5% Native plants anywhere on lake property
63 of 301 20.9% Infiltration pits or trenches
98 of 301 32.6% Water diversions
203 of 301 67.4% Not fertilizing or using zero phosphorus fertilizer
33 of 301 10.9% No Response
Other, please list_____
1 of 301 0.3% Postage stamp size lot
1 of 301 0.3% Don't have mow able shoreline
1 of 301 0.3% Roof water into an abandoned septic system (functional)
1 of 301 0.3% Have 2nd WD that could use a "pit"
1 of 301 0.3% Let people handle own property, w/o gov't control

Rain gardens – Rain gardens are depressions in the landscape planted with flowers and grasses. A rain garden is positioned to capture runoff from rain events and absorb the water over several hours to a few days.
Rain barrels – Rain barrels capture water from a rain gutter downspout for watering gardens and potted plants.
Shoreline buffer zone – Areas of planted or naturally-growing native vegetation beginning at the water's edge and extending upland. Shoreline buffer zone minimum depths generally extend 35 feet back from the high water mark.
Infiltration pit or trench – A depression lined with filter fabric and filled with rock. Runoff is directed to the pit or trench for temporary storage until it soaks into the ground.
Water diversion – A practice that directs water flow to a place where it can soak into the ground rather than flow to the lake. Arranging gutters and downspouts to direct water so that it doesn't flow to the lake is an example. Berms (low ridges), drain tile, and channels are other means to divert water.

17. Are you aware of the free visits the Lake District offered in 2008 and 2009 to lake residents to address waterfront property runoff? **(Check one)**

141 of 301	46.8%	Yes
153 of 301	50.8%	No
7 of 301	0.3%	No Response

18. Have you taken advantage of these services? **(Check one)**

23 of 301	7.6%	Yes (If you choose this answer, go to Question 20)
72 of 301	23.9%	No, but I plan to (If you choose this answer, go to Question 20)
185 of 301	61.5%	No (If you choose this answer, go to Question 19)
20 of 301	6.6%	No Response

19. If you don't plan to request a free visit, please describe the reason. **(Check one)**

92 of 301	30.6%	It is not needed on my property.
12 of 301	3.9%	I don't have time.
12 of 301	3.9%	I am concerned about inviting someone representing the Lake District onto my property.
24 of 301	7.9%	I don't have the money to install a landscaping practice to address waterfront runoff.
44 of 301	14.6%	I don't know enough about the visit.
14 of 301	4.6%	No Response

Other_____

1 of 301	0.3%	Charities my property
1 of 301	0.3%	Not sure of benefits/practice landscaping tech.
2 of 301	0.6%	Small lot
1 of 301	0.3%	Not there on weekdays
2 of 301	0.6%	Handle property w/o gov't body
1 of 301	0.3%	Limited use on home
1 of 301	0.3%	Property 4 sale
1 of 301	0.3%	I have a plan!!
1 of 301	0.3%	Don't drive
1 of 301	0.3%	Condo assn.
1 of 301	0.3%	Don't live right on lake

20. The Balsam Lake District sends out information regarding its management activities and living on the lake. How do you prefer to receive information from the Balsam Lake District?
(Check all that apply)

4 of 301	1.3%	I do not wish to receive information from the Lake District
257 of 301	85.3%	Dockside Newsletter
82 of 301	27.2%	Annual meeting
131 of 301	43.5%	Special mailings
76 of 301	25.3%	Web site
86 of 301	28.6%	E-mail notices
14 of 301	4.7%	No Response

Other, please specify _____

1 of 301	0.3%	Same been doing

In the space below, please include any other comments you may have regarding the lake, or the activities of the Lake District.

Survey 1) In the big scheme of things weed growth is the natural process & by product of an aging lake. I don't believe we should use too much radical intervention to control this issue. I am not a fan of poisons/Herbicides so limiting the use of such treatments would be important to ME. We don't, and won't, know the affects of these on human for years to come. But we all know it won't be good. I am glad that we have an active group of volunteers working on behalf the "the Lake" and its temporary visitors. Thanks for putting your time and efforts into such an important thing to all of us who share the blessing. Help the users become better stewards of this resource.
***Su*rvey 14)** Question 4: and prohibit swimming
Question 13: Enforce the present ones (Expand "slow no wake" area)
Survey 17) Question 7: Really only August
Question 13: Use machine to pull invasive plants-not cut them which makes it worse
Question 14: Harvesting makes a mess of floating weeds that float into our property & Make another mess. Harvesting is like "pruning a shrub", it makes if fuller, (what's left behind), and makes it spread.
Survey 19) Comment: We attended the workshops and had our property evaluated and hope to put into effect what was recommended starting this summer. It was terrific, we got a great plan. It was sad more people didn't attend. The time Breanne spent with us was invaluable and the plans very complete.
Survey 22) Comment: Restricting the number of watercraft (and fisherman) who are not lake residents which trailer in to use the lake. Restricting (somehow) the number of watercraft that each lake resident can own on their property.
Survey 23) Question 8: In our Bay
Comment: Should consider dredging problem bays for home owners!
Survey 25) Comment: What's up with the Levy increase!!
It is Excessive!!! Why is the BLPRD banking up so much money? The primary mission is weed control, for which the DNR is not allowing.
Survey 26) Question 14) New Home Buyer
Survey 28) Haven't been there in about 5 years. Just don't get there….
Survey 31) Question 4: People renting out docks on their property to unrelated parties for money….
Survey 32) Comment: I appreciate the committee taking the time and interest in continuing to protect the lake!! Thank you for helping to educate the Balsam Lake Property owners!
Those who participate in the above protection suggestions should receive a break on their property a "green" tax break on their property taxes. ☺ Thank you for you for your time! Tiffany
Survey 33) Question 6: Too Many in some areas.
Survey 34 Question 4: NOISE-Bass Boats
Survey 36) Question 14: Take better care to get rid of the weed's in our Lake!!
Survey 39 Comment: Love the lake, the area, and atmosphere of Balsam Lake. Please do something about the weeds!!
Survey 40) Comment: Thanks for attention to this issue.
Survey 42) Question 4: Added these to the list but not circle a number: Continual construction by neighbor, and Noise of Balsam Lake Factories.
Survey 43) Question 19: I live in California.

Survey 45) Comment: 1) Low walleye populations is a concern.
2) Concerned about fish population & use of chemicals for weeds that would affect fish population & health risk in consumption of fish.
3) Concerned about all the lawns that look so well & probably treated with pesticides & weed killers & phosphorous that drain in to the lake.
Survey 46) Question 11: How does it affect, fish & wildlife?
Question 12: sort of pricey!
Question 14: 10 of us pitch in to rake or pull by hand
Comment: Things are getting a bit out of control up at Balsam Lake. With the increase of building on the lake the new occupants destroy so much natural shoreline & Beauty. Too much focus on being "on top" of the water, boathouses, manicured lawns. Too much leniency on zoning laws!! Loons inhabit a clean, peaceful lake. Let's hope they never leave our lake due to loss of clean water, habitat & peace. We are so lucky to have them!!
Survey 51) Question 12: Can we afford $153,125 to do this? What was the success rate? (245 acres)
Question 13: Prevent inv. "cost effective!!" Encourage hand pull/rake, "cost effective!!"
Question 20: Special Mailings-High importance items!!
Survey 56) Question 12: What was the result? Cannot answer without results.
Comment: Please consider investigating Goose control. They are becoming pests.
Survey 59) Question 16: Don't know I would use any; I'm there on weekends & like to use the shores and be in the water. Comment: The reason this is late, we just got back from Florida yesterday (Feb. 26) I've been on the lake for over 30 years and I love Balsam Lake. It's a beautiful lake, the only problems is weeds and lake clarity. Thank you Larry (couldn't read the last name)
Survey 61) Comment: We need more attention to fish. The bass are way too small & walleyes hardly exist. Spearing is killing the lake. We need a continual stocking program for walleyes.
Survey 62) Comment: I indicate that noise is an issue. This is primarily due to loud bands playing outdoors at bars in town. Even though we are over a mile away, this noise carries across the lake and ruins our peace and quiet very frequently.
Survey 64) Question 11: What the negatives to its use? How does Endothall effect lake species? Animals? Humans?
Question 12: What is the out come-of the test area?
Survey 67) Comment: I receive information from several plant removal companies. Do you advocate one? Which one?
Survey 69) Comment: Allowing float planes to land in the middle of the lake with blind spots at the ends of the islands is an accident waiting to happen.

Survey 71) Question 4: East Balsam being very shallow promotes algae. Need major effort to prevent algae on north end of East Balsam.
Question 14: Some application of herbicide on East Balsam but not sure how much.
Comment: We are not alone in supporting algae & aquatic plant control on East Balsam. Need some promising plans. Thanks Paul. pheysse@gmail.com
Survey 75) Comment: I am a lake property owner on Balsam Lake in Stump Bay. In July, August, and September that entire bay is taken over by tall weeds. From our dock it is all most impossible to use a motor boat. No swimming either.
Survey 77) 2nd generation family

Question 14: Do not interfere with any growth (put up with it) I do rake tons of weed waste from the shoreline that drift in from being cut off by boat traffic.

Survey 78) Question 4: Where are the walleye????

Survey 84) Question 14: On North side, others cut weeds on other parts of lake & they all end up on our shoreline by the boat load. If someone else cuts the weeds they should take it with them, not burden others with the mess & smell. Thanks ☺

Question 19: found info. Online and Jon Hol, also info from Balsam Lake City Hall, and we leave as much of our yard natural as possible & add lots of new trees and plants each year.

Comment: Thank you for all the work you do to keep the lake safe. It upsets me when I see people cutting down everything and then wondering why the shoreline is caving in.

Survey 87) Comment: Help us manage weeds in town bay. We could hardly use pontoons toward end of _____ do to weeds!!!

Survey 89) Comment: I believe excessive lake weeds could be managed by making them economically valuable, such as allowing them to be harvested & bagged & sold such as peat moss. Though the smell would drive buyers off, or they could be harvested & used in biomass methane generators by the local electric , utility. This would create a value for "seaweed" & change the nature of the problem to an asset. Minnesota should be asked to participate. Mini stills, such as micro breweries could be located close to problem areas & add some jobs and a change of attitude about "lake weeds" or a commercial fishing industry could be developed by introducing a fish such as "grass carp" which thrive on eating weeds. This would also create some jobs and develop a valuable industry over the upper Midwest. A lake can be more than just a reservoir to hold water for recreational purposes-fishing, boating, and swimming. It is also a rich farm land going to waste and lying fallow. Farming the lake could be restricted to week days-leaving the weekends open for recreation. If a government agency studies this problem it will waste money and die on the vine, but if private entrepreneurs are encouraged to come up with a method to control lake weeds it just might happen to the benefit us all. I think a china man would come up with a way to create a bigger benefit from all our lakes but it would probably drive the fish sauce industry into bankruptcy!! Good LUCK.

Survey 91) Question 5: Mill pond (too many)

Survey 92) Comment: I think the use of no phosphors fertilizer, enforcing septic tank inspections, and continuing to work with local farmers involving runoff is the best way to control the phosphorus levels. Harvesting Lake weeds is a good way to remove material; nature has already consolidated it into plant form.

Survey 96) Comment: Too many bass tournaments-it wrecks our weekend fishing!! I don't mind some, but not 2-3x per month!!

Survey 98) Comment: Thank you for doing what I consider to be good work!! We need to get rid of the weeds in East Balsam!! Thanks Ralph McGowley 612-337-2780

Survey 103) Question 11: Though we don't know much about Endothall, we always worry about any chemicals used in our water or around animals. Would prefer non-chemical option.

Survey 107) Comment: We are all concerned about air, lake, water quality. Maybe we have to look at ourselves. Within 4 cabins of mine; one guy had no indoor plumping or properly operating drain field, the other guy shovels out his out house waste and dumps it next to the pond; the third guy burns plastic bags, jugs, & B.S. all weekend. Maybe we should ban burn barrels, outhouses, without containment, and actual look at ourselves and use the money we have for a sanitary inspector and bring people into compliance. Then we can look at other stuff.

P.S. Sanitary should be done by holding tanks, mound systems, and septic systems, NOT costly sewer systems!!
Survey 111) Question 16: I would like to see my neighbors stop burning leaves by the lake shore.
Comment: I have, as you may have guessed, a problem with the DNR. They as, most government offices, start out as a good thing but somewhere along the way they become an elite group that rules over the people that use and own Wisconsin lake property. We need common sense back in our government and the DNR.
Survey 112) Comment: 1. Sanitary sewer systems for all lake properties. 2. Lighting ordinance to reduce glare and unnecessary light pollution in lake district.
Survey 114) Question 11: If not harmful to the water/fish quality.
Comment: How do you stop shoreline erosion, and how to get rid of large beaver house attached to our shorelines?
Survey 118) Question 6: Depends on what part of the lake you are on!!
Comment: Landings-Launching boat sites need to be more restrictive. Bass boaters practices at landings are not good. The way they put their boats on trailers destroys the landings!!! Do Something!!!! Curt
Survey 122) Comment: I am considering selling my property on the lake due to the worsening quality of the water and high taxes. The Secchi Disk readings are horrible on East Balsam and lakes in Hayward, ie. LCO, Round, Whitefish are much better even Half Moon which is next to Balsam is much better. I believe this has been a lack of Board leadership and that sewer systems should have been put in 10 years ago. You will never get this approved now because the 4 seasons places have spent money updating their systems and won't approve and there are older systems that if forced to upgrade will never approve. The Lake Management was anti sewer and lost its chance and the Lake quality has worsened ever since.
Survey 129) Call me at 612-220-6299 (cell) to set up a meeting, or 952-758-6776 (home) after 5:00pm Greg Larson
Survey 130) Question 4: We have protected land already.
Survey 132) Question 18: Made 2 contacts and they never followed thru with visit.
Survey 141) Question 2: 51 years
Question 12: What were the results?
Survey 143) Question 4: Need better access to the Millpond-I do not live on the Millpond but can't get there. Culvert **TOO SMALL**!!
Survey 146) Comment: THANK YOU!!!
Survey 150) Comment: Too high of property taxes!!
Survey 153) Question 11: As long as it doesn't screw up fishing.
Comment: Slow down jet ski's-wild riding; put a 20 mile . Limit on boats-we don't need another Lake Minnetonka; Improve fishing; watch pontoon parting-noise & covering large areas while hooked up; eliminate wave boats-wakes dangerous for small boats.
Survey 158) Question 4: Raskin Bay-Native aquatic plant growth, Boat congestion-July 4
Question 6: Too many rooted plants near the shore of Raskin Bay
Comment: Thank you to the board for all their work!!
Survey 161) Comment: Keep the motorized boats from going too far into stubs bay-let's keep that area natural.
Survey 168) Question 8: Swimming-can't because of Silt.
Question 13: Silt is where the plants root-Let's do something about that!!
Survey 171) Comment: The weeds on my property are out of control!!
Survey 172) Question 5: Reversal during year, Balsam Lake in summer.
Question 6: Average, see below, present late in summer.

Question 8: Late in year (1st four on list) It is getting worse each on my shore where only a few years ago we were weed free all summer.
Question 11: If it works and does not have negative impact.
Question 13: Weeds floor to shore and spread. (1st 4 on list) Do not know if it works (encourage ind. To hand pull/rake invasive plants)
Comment: Thank you for your efforts to improve the quality of the lake. We know Balsam is an _____ reserve to all of us in Polk county. I wish the speed and noise could be limited. I agree boats w/o proper noise control. That erodes shorelines, such as pulling multiple skiers or tubers creating massive waves. Jet ski's!!!!
Survey 173) Comment: We installed a buffer zone a few years ago when money was available to help. We really enjoy it.
Survey 181) Question 7: need for good fishing
Question 11: Only if the product works
Question 12: Did it work???
Question 13: Copper sulfate was put in the lake with DNR approval and look at the effect it has had on the Lake???
Question 14: applied chemical myself-against the law
Any chemical put in the lake by the BLPRD does move about
Comment: Be very careful using ANY chemical in Balsam Lake. Any mistakes you and the DNR make will affect the lake forever. Do not hire any company that uses young people to apply any chemical because they have "no idea" what they are doing. Personal experience, I asked them what they are applying and their answer was- They didn't know they just mixed so much of this & that & spray in the lake. You already put copper sulfate in the lake and that killed most all the bullheads, most frogs & turtles. The few walleye spanning beds were also upset. This is a "FACT" anyone who has lived on the lake a long time knows this.
Survey 183) Comment: I believe the greatest impact on the lake consists of two issues: 1.) Run off from agricultural and land owners, 2.) Not maintaining a buffer between their lake shore and the lake.
Survey 184) Comment: Dock and boat were totally unusable due to weeds. Been on the lake since 1983-never anywhere near this bad before. *In July and August
Survey 185) Question 2: 26 years
Question 4: Boat Congestion-only on weekends, Noise-only on weekends
Comment: Thanks for doing a good job.
Survey 189) Comment: We have already installed a shoreline buffer zone with native plants 2 years ago.
Survey 193) Comment: We have frontage on Raskin Bay as well as Main Lake. In the 5+ years we have been on lake, Raskin Bay has become very congested with lilypads & other plant along shoreline that appear to be negatively impacting, choking the aquatic life out of the bay. A large portion of the bay has become almost non-negotiable. Is there a solution to this?? Tom Kelly 612-508-0879 tkelly56@comcast.net
Survey 194) Comment: It appears that more and more of the lake has visible weeds. North end of the Little Balsam is getting worse. The channel to Little Balsam is getting worse. North side of the Main lake seems to be getting worse. Also North part of the Lake, west of Narrows to East Balsam is bad. And of course most of East Balsam is bad. Algae levels ___ get bad to the point where the water looks gross. However, much of last summer wasn't bad, probably because it was cooler.
Survey 196) Comment: What is the status of efforts to prevent sewage run-off into the lake? Will the sewer line be extended beyond the village of Balsam Lake? Will drain fields and similar sewage management systems be inspected on a regularly recurring schedule? Could owner-paid measures to protect the lake be considered when property

taxes are amended? I appreciate your concern and effort on behalf of the quality of our lake. Thanks!!! Hans & his wife Koenig. hkoenig@blakeschool.org

Survey 200) Question 12: Provided the $5,000 was effective

Comment: 1. Control Adverse runoff

2. Prevent invasive species

3. Address aquatic plant growth before the lake is lost.

4. Continually discourage lawn fertilization

5. Promote more shoreline buffer zones.

Survey 201) Comment: mnelson@apimix.net

Survey 202) Comment: We are very unhappy about the huge increase in taxes.

Survey 203) Comment: More water patrol enforcement. A "no wake" of entire lake before 10 am. No more fishing tournaments!!!!! Too Noisy!!!!!

Survey 205) Question 14: Last year was our first summer

Survey 206) Comment: Lake weeds have become bad enough the last 2 years that they foul the motors almost every time we use the boat late in the season. This has not been and issue in the past at our place. We have been there since the 1950's. We have family photos showing how clean the lake was back then. djsteinke@earthlink.net

Survey 210) Question 12: Yes if needed!!

Question 13: Please, No pulling or raking of invasive plants as I don't think most people pick them up, consequently we get the "leftover's" on our shore line. The odor is terrible and the mess looks terrible.

Survey 215) Question 12: What were the results of the monitoring???

Survey 216) Comment: South end of East Balsam because of low water levels-experience a lot of weed growth.

Survey 218) Comment: I don't drive, so sometimes someone in the family will drive me to the meetings.

Survey 219) Comments: Bass tournaments have to be minimized. I have, and my son has participated in tournaments over the years and have stopped. Our lake cannot support so many tournaments, plus club tournaments during the week. I have talked to many tournaments fisherman who agree.

Survey 220) Question 12: Sounds like a lot to treat 8 acres.

Survey 221) Comment: Weeds need to be controlled. There are plenty of sprays that do not impact fish. I know DNR does not care, but why do we have a lake home when we can't access lake. No lake, no people, hurts economy even more.

Survey223) Question 13: No wake means no wake-not just slow down. I see boats go through the narrows near East Balsam with their front end up in the air. When they are "planed out" the wake the make is huge. They would be better off going through at full speed.

Comment: All in all-I thought the lake was more "clear" this year 2009.

Survey 226) Comment: My greatest concern is the low lake level-mostly in the mid & late summer. I know that annual precipitation has a lot to do with it, but I hope we're keeping as much water in the lake as possible. I don't know what the requirements are for the dam, but don't let too much water out!! Thanks for asking my opinion.

Survey 228) Comment: Last June the lake was clearer than it's been in 20 years.

Survey 230) Comment: Stop letting the Indians spear. Stock with bigger fish, find frogs are just food for the bass.

Survey 233) Comment: Please keep rental property down on lake property. I consider this activity add problems to the lake residents because of the many parties, garbage pollution, security & theft- all around not caring what they do, renters.

Survey 240) Question 5 & 6: Especially East Balsam

Question 14: Applied chemical myself-If legal I would
Question 16: Very little runoff from our road, we are on a back lot with easement to the lake
Comment: Your efforts are very much appreciated-East Balsam is shallow & weeds & algae are an ongoing problem.
Survey 241) Question 12: not enough info on the results.
Question 13: Encourage ind. To hand pull-The method only helps for a week or 2
Survey 242) Comment: I love the plants there, it's good for fishing.
Survey 243) Question 4: Not enough fish-WALLEYES
Survey 244) Question 12: Poor Question!!!! Was the treatment effective?????
Survey 255) Comment: Thank you!!
Survey 257) Comment: Rollie Smith: mcherrier.pcade@yahool.com
Survey 258) Comment: I have a concern about the number of ice fishing houses on Balsam Lake. In the winter and the fact that they are often on the lake for days if not weeks at a time. I am concerned about the manner in which some fisherman treat or mistreat the lake when they are on the ice.
Survey 259) Comment: We would like to try 1 of 2 trench recommendations on our property, but was a bit concerned about cost. We are investigating again this year.
Survey 264) Comment: Important to remove hazardous fallen trees from water to avoid boat damage! Also floating logs… Thanks!
Survey 266) Comment: Weeds so bad in lake home, had to tow boats with rope from shore!! There so called spraying was a joke!!! No affect, and just sprayed around center of bay in the fall after the weeds have died!!!!! Joke watching these guys try to spray!!!!! Don't think they had any idea what they were doing!!! These sprays appeared to have little affect!!!! Raskins Bay
Survey 269) Question 8: Unsure just purchased property in late October.
Survey 270) Residence need to be able to have more control with their weeds by their docks and swimming area.
Survey 273) Comment: Own no lakeshore property!!!!
Survey 247) Comment: I'm selling my property because of the high rural estate taxes.
Survey 275) Comment: I'm not sure how to deal with it, but there does seem an increasing amount of garbage around the shores. I don't know if there is more in the Spring of the year or if it is just more noticeable before Summer vegetation begins to grow.
Survey 276) Question 13: Encourage indiv. To hand pull-"As long as they remove them from the water."
Question 20: Is there a website??
Comment: We enjoy the lake very much. Our property is in Little Balsam. The end of the bay is getting weedier every year. However, on the end going into Boston Bay seems to be clearing out. I find that very interesting. Why are we not harvesting anymore???
Survey 277) Comment: We need to protect our lakes, they are a precious gift!!!!
Survey 281) Question 14: Hired and herbicide applicator to apply chemical—"Thought we couldn't, are herbicides in the lake????"
Survey 285) Comment: Let's research further the feasibility and desirability of opening Mill Pond to boat traffic from the rest of the lake. "JUST DO IT!!!!"
Survey 288) Question 12: What were the results???
Question 16: Buffer zones with desired shoreline plants that would be environmentally friendly, even if not "native".

Survey 291) Comment: Limit time jet skiing is allowed on lake---- 10:00am to 4:00pm
Survey 292) Question 14: Grandchildren cannot even fish off my dock anymore….
Comment: 1. Why don't go back to cutting the weeds as in the past----
2. Ski Boats and boats, coming to close to shore have eroded the shore line out from behind the riprap. We have had installed, washing out the soil into the lake. In front of the rip rap is approx. 30ft of lily pads and the riprap and lily pads don't slow down the wakes which come over everything into the yard…. Why not start enforcing a no wake area out further away from the shoreline
Survey 293) Comment: Make sure property owners do not pollute. I have noticed the real increase in green algae growth in the past 4 years. Some people blame the year or lack of snow. I feel it is affecting the fish population. Walleyes have been planted the last few years, but it doesn't seem like they are multiplying. Where is our pollution occurring?????? Sewers, fertilizing, agriculture???? Identify and publish the source and stop it.
Survey 295) Comment: Keep Educating!!!
Survey 300) Comment: Low water issues!!! Too much water released into Balsam Branch. WE are losing lakeshore due to low water levels. NO!! Too paying more for suggested water culvert into the Millpond $2500.00 for a structure that will last another 50 years to help a private business.

Appendix B. Invasive Species Information

Curly Leaf Pondweed

Curly leaf pondweed is specifically designated as an invasive aquatic plant (along with Eurasian water milfoil and purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a "non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c)."

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

> It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly-leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly-leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly-leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly-leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly-leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly-leaf may not cause a problem.[47]

The state of Minnesota DNR web site explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish, and some waterfowl species feed on the seeds and winter buds.[48]

[47] *Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species.* Prepared by Wisconsin DNR. September 2003.

[48] Information from Minnesota DNR (www.dnr.state.mn.us/aquatic_plants).

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

Curly Leaf Pondweed (*Potamogeton crispus*)[49]

Identification

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters one to three meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as two meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa, and Australia and is now spread throughout most of the United States and southern Canada.

Characteristics

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

Reproduction and Dispersal

Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 – 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer, and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, turions germinate in the fall, over-wintering as a small plant. The next summer plants mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

Ecological Impacts

Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish

[49] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).

populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

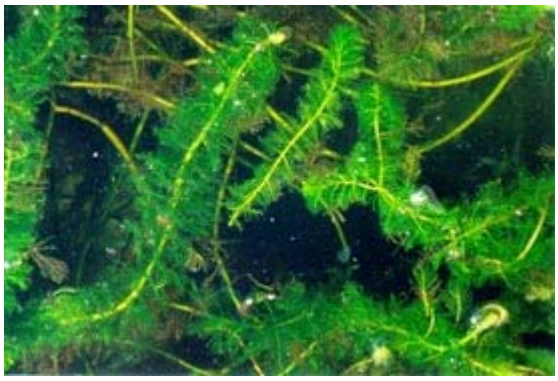
Control

Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed bank over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants may aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

Eurasian Water Milfoil *(Myriophyllum spicatum)*

Introduction



Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

Distribution and Habitat

Eurasian milfoil first arrived in Wisconsin in the 1960's. During the 1980's, it began to move from several counties in southern Wisconsin to lakes and waterways in the northern half of the state. As of 1993, Eurasian milfoil was common in 39 Wisconsin counties (54%) and at least 75 of its lakes, including shallow bays in Lakes Michigan and Superior and Mississippi River pools.

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in

eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Life History and Effects of Invasion

Unlike many other plants, Eurasian water milfoil does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes. [50]

[50] Taken in its entirety from WDNR, 2008 (http://www.dnr.state.wi.us/invasives/fact/milfoil.htm)

Reed Canary Grass (*Phalaris arundinacea*)

Description

Reed canary grass is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The lead ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.

Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass also resembles non-native orchard grass (*Dactylis glomerata*), but can be distinguished by its wider blades, narrower, more pointed inflorescence, and the lack of hairs on glumes and lemmas (the spikelet scales). Additionally, bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary in areas where orchard grass is rare, especially in the spring. The highly transparent ligule on reed canary grass is helpful in distinguishing it from the others. Ensure positive identification before attempting control. The ligule is a transparent membrane found at the intersection of the leaf stem and leaf.

Distribution and Habitat

Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas.

Life History and Effects of Invasion

Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring, then spreads laterally. Growth peaks in mid-June and declines in mid-July. A second growth spurt occurs in

the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems and leaves. The seeds ripen in late June and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites.[51]

Purple Loosestrife (*Lythrum salicaria*)[52]

Description

Purple loosestrife is a non-native plant common in Wisconsin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes (underground stems) that form a dense mat.

Characteristics

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators,

[51] Taken from WDNR, 2008. (http://www.dnr.state.wi.us/invasives/fact/reed canary.htm).
[52] Wisconsin DNR invasive species factsheets.(http:/dnr.wi.gov/invasives).

like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Reproduction and Dispersal

Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland.

Ecological Impacts

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Mechanical Control

Purple loosestrife (PL) can be controlled by cutting, pulling, digging and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective, but can also create disturbed bare spots, which are good sites for PL seeds to germinate, or leave behind root fragments that grow into new plants. Use

these methods primarily with small plants in loose soils, since they do not usually leave behind large gaps nor root tips, while large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full twelve months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

Chemical Control

This is usually the best way to eliminate PL quickly, especially with mature plants. The chemicals used have a short soil life. Timing is important. Treat in late July or August, but before flowering to prevent seed set. Always back away from sprayed areas as you go, to prevent getting herbicide on your clothes. The best method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem, but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

Glyphosate herbicides: Currently, glyphosate is the most commonly used chemical for killing loosestrife. Roundup and Glyfos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife and there is no cost. Contact your regional Aquatic Plant Management Coordinator for permit information.

Biological Control

Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The WDNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf eating beetles

(*Galerucella calmariensis* and *G. pusilla*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratu*s) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

Appendix C. Aquatic Plant Management Strategy WDNR

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote "whole lake" management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the "up-north" appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these "invaders" benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a" whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). “

State Statute 23.24(3)(b) states:
“The department may require that an application for an aquatic plant management permit contain a plan for the department’s approval as to how the aquatic plants will be introduced, removed, or controlled.“

Wisconsin Administrative Code NR 109.04(3)(a) states:
“The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities.”

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions". Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions". No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.

3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
   a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR's Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDR review and approval.
   b. Individuals holding past permits for control of *invasive* aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if "impairment of navigation" and/or "nuisance conditions" is adequately documented, unless there is an approved lake management plan for the lake in question.

4. Control of invasive species or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).

5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

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* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.

- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of *impairment of navigation* by native plants must include:

a. Specific locations of navigation routes (preferably with GPS coordinates)
b. Specific dimensions in length, width, and depth
c. Specific times when plants cause the problem and how long the problem persists
d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

Documentation of the *nuisance* must include:

a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DEFINITIONS

Manual removal:	Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.
Native aquatic plants:	Aquatic plants that are indigenous to the waters of this state.
Invasive aquatic plants:	Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Sensitive area:	Defined under s. NR 107.05(3)(i) (sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water).
Rapid Response protocol:	This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.

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Appendix E

Rapid Response for Early Detection of Eurasian Water Milfoil

1. Conduct volunteer (Clean Boats, Clean Waters crew) and professional monitoring (Herbicide Contractor) at designated public boat landings and other likely areas of AIS introduction. If a suspected plant is found, proceed to Step 2.

2. Balsam Lake residents and visitors will be directed to contact the Aquatic Invasive Species (AIS) Lead (Carl Holmgren) or the Polk County AIS Coordinator (Jeremy Williamson) if they see a plant in the lakes they suspect might be Eurasian water milfoil (EWM). Signs at the public boat landings, web pages, handouts at annual meeting, and newsletter articles will provide plant photos and descriptions, contact information, and instructions.

3. If plant is likely EWM, the AIS lead will confirm identification with Polk County LWCD and the WDNR (Frank Koshere) and inform the rest of the Balsam Lake Protection and Rehabilitation District Board (BLPRD). Two entire intact rooted adult specimens of the suspect plants will be collected and bagged and delivered to the WDNR, (810 West Maple Street, Spooner, WI 54801). WDNR may confirm identification with the herbarium at the University of Wisconsin – Stevens Point or the University of Wisconsin – Madison.

4. Mark the location of suspected EWM (AIS Lead). Use GPS points, if available, or mark the location with a small float.

5. If the suspect plants are determined to be EWM, the location of EWM will be marked with a more permanent marker. Special EWM buoys are available. (AIS Lead).

6. If identification is positive, inform the board, Polk County LWRD, herbicide contractor, the person who reported the EWM, and lake management consultant (APM and AIS Leads).

7. If identification is positive, post a notice at the public landing and include a notice in the next newsletter (DNR has these signs available). Notices will inform residents and visitors of the approximate location of EWM and provide appropriate means to avoid spread (APM Lead, BLPRD board).

8. Hire a consultant to determine the extent of the EWM introduction. A diver may be used. If small amounts of EWM are found during this assessment, the consultant will be directed to identify locations with GPS points and hand pull plants found. All plant fragments will be removed from the lake when hand pulling.

9. The APM Lead and BLPRD board will select a control plan in cooperation with the WDNR (BLPRD). Additional guidance regarding EWM treatment is found in DNR's *Response for Early Detection of Eurasian Water Milfoil Field Protocol*.

Control methods may include hand pulling, use of divers to manually or mechanically remove the EWM from the lake bottom, application of herbicides, and/or other effective and approved control methods.

The goal of the rapid response control plan will be eradication of the EWM.

10. Implement the selected control plan including applying for the necessary permits. Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.

11. BLPRD funds may be used to pay for any reasonable expense incurred during the implementation of the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.

12. The APM Lead or the AIS Lead will work with the WDNR to confirm, as soon as possible, a start date for an Early Detection and Rapid Response AIS Control Grant. Thereafter, the BLPRD shall formally apply for the grant.

13. The BLPRD may choose to develop a contingency fund for rapid response to EWM or other invasive species.

14. Frequently inspect the area of the EWM to determine the effectiveness of the treatment and whether additional treatment is necessary (BLPRD, APM Monitor).

15. Procedures and responsibilities of this rapid response plan will be reviewed on an annual basis. Changes may be made with approval of the BLPRD board of commissioners.

EXHIBIT A[1]

BALSAM LAKE PROTECTION AND REHABILITATION DISTRICT

AIS (Clean Boats, Clean Waters) Lead	Carl Holmgren: 715-485-9421
APM Lead	Milt Stanze: 715-557-0902
Chairman	Howard Seim: 612-756-4940

POLK COUNTY LAND AND WATER RESOURCES DEPARTMENT

AIS Coordinator	Jeremy Williamson: 715-485-8639
Director	Tim Ritten: 715-485-8631

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants	Pamela Toshner: 715-635-4073
Permits	Mark Sundeen: 715-635-4074
EWM Identification and Notice	Frank Koshere: 715-392-0807

HERBICIDE APPLICATOR

Bid each December

APM MONITOR

Endangered Resource Services	Matt Berg: 715-483-2847

DIVERS

Ecological Integrity Services	Steve Schieffer: 715-554-1168
Blue Water Science	Steve McComas: 651-690-9602

[1] This list will be reviewed and updated each year.

Appendix F. Management Options for Aquatic Plants

Management Options for Aquatic Plants

Option	Permit Needed?	How it Works	PROS	CONS
b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore	Immediate results	Not selective in species removed
		Harvest invasives only if invasive is already present throughout the lake	EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting	Fragments of vegetation can re-root
			Usually minimal impact to the lake	Can remove some small fish and reptiles from lake
			Harvested lanes through dense weed beds can increase growth and survival of some fish	Initial cost of harvester expensive
			Can remove some nutrients from lake	
Biological Control	Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year	Effectiveness will vary as control agent's population fluctates
			Lowers density of problem plant to allow growth of natives	Provides moderate control - complete control unlikely
				Control response may be slow
				Must have enough control agent to be effective
a. Weevils on EWM*	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem	Need to stock large numbers, even if some already present
			Selective control of target species	Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines
			Longer-term control with limited management	Bluegill populations decrease densities through predation

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Pathogens	Y	Fungal/bacterial/viral pathogen introduced to target species to induce mortalitiy	May be species specific	Largely experimental; effectiveness and longevity unknown
				May provide long-term control	Possible side effects not understood
				Few dangers to humans or animals	
c.	Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long-term, maintenance-free control	Initial transplanting slow and labor-intensive
				Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermilfoil growth	Spikerushes native to WI, and have not effectively limited EWM growth
					Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d.	Restoration of native plants	N; strongly recommend plan and consultation with DNR	Diverse native plant community established to repel invasive species	Native plants provide food and habitat for aquatic fauna	Initial transplanting slow and labor-intensive
				Diverse native community more repellant to invasive species	Nuisance invasive plants may outcompete plantings
				Supplements removal techniques	Largely experimental; few well-documented cases

Management Options for Aquatic Plants

Option	Permit Needed?	How it Works	PROS	CONS
Physical Control	Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Drawdown	Y, May require Environmental Assessment	Lake water lowered; plants killed when sediment dries, compacts or freezes	Can be effective, especially when done in winter, provided drying and freezing occur. Sediment compaction is possible over winter	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling
		Must have a water level control device or siphon	Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction	Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced
		Season or duration of drawdown can change effects	Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality	May impact attached wetlands and shallow wells near shore
			Success for EWM, variable success for CLP*	Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning
			Restores natural water fluctuation important for all aquatic ecosystems	Winter drawdawn must start in early fall or will kill hibernating reptiles and amphibians
				Controversial

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Dredging	Y	Plants are removed along with sediment	Increases water depth	Expensive
			Most effective when soft sediments overlay harder substrate	Removes nutrient rich sediments	Increases turbidity and releases nutrients
			For extremely impacted systems	Removes soft bottom sediments that may have high oxygen demand	Exposed sediments may be recolonized by invasive species
			Extensive planning required		Sediment testing is expensive and may be necessary
					Removes benthic organisms
					Dredged materials must be disposed of
					Severe impact on lake ecosystem
c.	Dyes	Y	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity	Appropriate for very small water bodies
				Usually non-toxic, degrades naturally over a few weeks.	Should not be used in pond or lake with outflow
					Impairs aesthetics
					Affects to microscopic organisms unknown

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
d.	Mechanical circulation (Solarbees)	Y	Water is circulated and oxygenated	Reduces blue-green algae	Method is experimental; no published studies have been done
			Oxygenation of water decreases ammonium-nitrogen, which is a preferred nutrient source of EWM, theoretically limiting EWM growth (has not been demonstrated scientifically)	May reduce levels of ammonium-nitrogen in the water and at the sediment interface, which could reduce EWM growth	Although EWM prefers ammonium-nitrogen to nitrate, it will uptake nitrate efficiently, so EWM growth may not be affected
				Oxygenated water may reduce phosphorus release from sediments if mixing is complete	Units are aesthetically unpleasing
				Reduces chance of fish kills by aerating water	Units could be a navigational hazard
e.	Non-point source nutrient control	N	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use)	Attempts to correct source of problem, not treat symptoms	Results can take years to be evident due to internal recycling of already-present lake nutrients
				Could improve water clarity and reduce occurrences of algal blooms	Expensive
				Native plants may be able to compete invasive species better in low-nutrient conditions	Requires landowner cooperation and regulation
					Improved water clarity may increase plant growth

Management Options for Aquatic Plants

Option	Permit Needed?	How it Works	PROS	CONS
Chemical Control	Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae	Some flexibility for different situations	Possible toxicity to aquatic animals or humans, especially applicators
		Results usually within 10 days of treatment, but repeat treatments usually needed	Some can be selective if applied correctly	May kill desirable plant species, e.g. native water-milfoil or native pondweeds
			Can be used for restoration activities	Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration
				May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape
				Controversial
a. 2,4-D (Weedar, Navigate)	Y	Systemic[1] herbicide selective to broadleaf[2] plants that inhibits cell division in new tissue	Moderately to highly effective, especially on EWM	May cause oxygen depletion after plants die and decompose
		Applied as liquid or granules during early growth phase	Monocots, such as pondweeds (e.g. CLP) and many other native species not affected.	Cannot be used in combination with copper herbicides (used for algae)
			Can be used in synergy with endotholl for early season CLP and EWM treatments	Toxic to fish
			Widely used aquatic herbicide	

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Endothall (Aquathol)	Y	Broad-spectrum[3], contact[4] herbicide that inhibits protein synthesis	Especially effective on CLP and also effective on EWM	Kills many native pondweeds
			Applied as liquid or granules	May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring	Not as effective in dense plant beds
				Can be selective depending on concentration and seasonal timing	Not to be used in water supplies
				Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds	Toxic to aquatic fauna (to varying degrees)
				Limited off-site drift	3-day post-treatment restriction on fish consumption
c.	Diquat (Reward)	Y	Broad-spectrum, contact herbicide that disrupts cellular functioning	Mostly used for water-milfoil and duckweed	May impact non-target plants, especially native pondweeds, coontail, elodea, naiads
			Applied as liquid, can be combined with copper treatment	Rapid action	Toxic to aquatic invertebrates
				Limited direct toxicity on fish and other animals	Needs to be reapplied several years in a row
					Ineffective in muddy or cold water (<50°F)

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
d.	Fluridone (Sonar or Avast)	Y; special permit and Environmental Assessment may be required	Broad-spectrum, systemic herbicide that inhibits photosynthesis; some reduction in non-target effects can be achieved by lowering dosage	Effective on EWM for 1 to 4 years with aggressive follow-up treatments	Affects many non-target plants, particularly native milfoils, coontails, elodea, and naiads, even at low concentrations. These plants are important to combat invasive species
			Must be applied during early growth stage	Applied at very low concentration	Requires long contact time: 60-90 days
			Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107	Slow decomposition of plants may limit decreases in dissolved oxygen	Demonstrated herbicide resistance in hydrilla subjected to repeat treatments, EWM has the potential to develop resistance
				Low toxicity to aquatic animals	Unknown effect of repeat whole-lake treatments on lake ecology
e.	Glyphosate (Rodeo)	Y	Broad-spectrum, systemic herbicide that disrupts enzyme formation and function	Effective on floating and emergent plants such as purple loosestrife	Effective control for 1-5 years
			Usually used for purple loosestrife stems or cattails	Selective if carefully applied to individual plants	Ineffective in muddy water
			Applied as liquid spray or painted on loosetrife stems	Non-toxic to most aquatic animals at recommended dosages	Cannot be used near potable water intakes
					RoundUp is often illegally substituted for Rodeo
					Associated surfactants of RoundUp believed to be toxic to reptiles and amphibians
					No control of submerged plants

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
f.	Triclopyr (Renovate)	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher doses (e.g. coontail)
			Applied as liquid spray or liquid	More effective on dicots, such as purple loosestrife; may be more effective than glyphosate	May be toxic to sensitive invertebrates at higher concentrations
				Results in 3-5 weeks	Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)
				Low toxicity to aquatic animals	Sensitive to UV light; sunlight can break herbicide down prematurely
				No recreational use restrictions following treatment	Relatively new management option for aquatic plants (since 2003)
g.	Copper compounds (Cutrine Plus)	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
			Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment	Short-term results
				Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Precipitates rapidly in alkaline waters
					Small-scale control only, because algae are easily windblown
					Toxic to invertebrates, trout and other fish, depending on the hardness of the water
					Long-term effects of repeat treatments to benthic organisms unknown
					Clear water may increase plant growth

Management Options for Aquatic Plants

	Option	Permit Needed?	How it Works	PROS	CONS
h.	Lime slurry	Y	Applications of lime temporarily raise water pH, which limits the availablity of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP Prevents release of sediment phosphorus, which reduces algal growth Increases growth of native plants beneficial as fish habitat	Relatively new technique, so effective dosage levels and exposure requirements are not yet known Short-term increase in turbidity due to suspended lime particles High pH detrimental to aquatic invertebrates May restrict growth of some native plants
i.	Alum (aluminum sulfate)	Y	Removes phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus Dosage must consider pH, hardness and water volume	Most often used against algal problems Improves water clarity	Must not eat fish for 30 days from treatment area Minimal effect on aquatic plants, or increased light penetration may increase aquatic plants Toxic to aquatic animals, including fish at some concentrations

***EWM - Eurasian water-milfoil** **Updated March 2006**

***CLP - Curly-leaf pondweed**

[1]Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.

[2]Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.

[3]Broad-spectrum herbicide - Affects both monocots and dicots.

[4]Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.

References to registered products are for your convenience and not intended as an endorsement or criticism of that product versus other similar products.

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

	Option	How it Works	PROS	CONS
Biological Control				
a.	Carp	Plants eaten by stocked carp	Effective at removing aquatic plants	Illegal to transport or stock carp in Wisconsin
			Involves species already present in Madison lakes	Carp cause resuspension of sediments, increased water temperature, lower dissolved oxygen levels, and reduction of light penetration
				Widespread plant removal deteriorates habitat for other fish and aquatic organisms
				Complete alteration of fish assemblage possible
				Dislodging of plants such as EWM or CLP turions can lead to accelerated spreading of plants
b.	Crayfish	Plants eaten by stocked crayfish	Reduces macrophyte biomass	Illegal to transport or stock crayfish in Wisconsin
				Control not selective and may decimate plant community
				Not successful in productive, soft-bottom lakes with many fish predators
				Complete alteration of fish assemblage possible
Mechanical Control				
a.	Cutting (no removal)	Plants are "mowed" with underwater cutter	Creates open water areas rapidly	Root system remains for regrowth
			Works in water up to 25 ft	Fragments of vegetation can re-root and spread infestation throughout the lake
				Nutrient release can cause increased algae and bacteria and be a nuisance to riparian property owners
				Not selective in species removed
				Small-scale control only
b.	Rototilling	Sediment is tilled to uproot plant roots and stems	Decreases stem density, can affect entire plant	Creates turbidity
		Works in deep water (17 ft)	Small-scale control	Not selective in species removed
			May provide long-term control	Fragments of vegetation can re-root
				Complete elimination of fish habitat
				Releases nutrients
				Increased likelihood of invasive species recolonization
c.	Hydroraking	Mechanical rake removes plants from lake	Creates open water areas rapidly	Fragments of vegetation can re-root
		Works in deep water (14 ft)		May impact lake fauna
				Creates turbidity
				Plants regrow quickly
				Requires plant disposal
Physical Control				
a.	Fabrics/ Bottom Barriers	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas	Eliminates all plants, including native plants important for a healthy lake ecosystem
			Useful for small areas	May inhibit spawning by some fish
				Need maintenance or will become covered in sediment and ineffective
				Gas accumulation under blankets can cause them to dislodge from the bottom
				Affects benthic invertebrates