Aquatic Plant Management Plan
Bone Lake
Polk County, Wisconsin

June 2013

Sponsored By
Bone Lake Management District

Prepared By
Harmony Environmental
Ecological Integrity Services

Funded By
Bone Lake Management District
A Wisconsin Department of Natural Resources Grant

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Committee Members
Bob Boyd
Alex Chorewycz
Phil Foster
Judy and Roger Gammel
Cindy Gardner
Karen Engelbretson
Tim Killeen
Ron and Mary Lachenmayer
Shelley and Jeff Rose
John Spies
Bill Ward
Wayne Wolsey

Advisors
Aaron Cole, Alex Smith, and Mark Sundeen, Wisconsin Department of Natural Resources

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Introduction

This Aquatic Plant Management Plan for Bone Lake, Polk County, Wisconsin presents a strategy for managing aquatic plants by protecting native plant populations, alleviating nuisance conditions, and preventing establishment of invasive species. The plan includes data about the plant community, watershed, and water quality of Bone Lake. Based on this data and public input, goals and strategies for the sound management of aquatic plants in the lake are presented. This plan will guide the Bone Lake Management District and the Wisconsin Department of Natural Resources in aquatic plant management for Bone Lake over the next five years (from 2013 through 2017).

This aquatic plant management plan is an attempt to balance a variety of resident concerns while protecting the lake ecosystem as described in the mission statement below.

Plan Mission Statement

Bone Lake is a precious resource and one of the premier recreational lakes in this area. The overall goal of the aquatic plant management plan is to maintain Bone Lake aquatic plants so that they support a healthy lake that offers recreation, sport fishing, clean water, and natural beauty to our children, grandchildren and others for decades to come.

Bone Lake Aquatic Plant Management Goals

The goals of the aquatic plant management plan were developed in 2007/8. They are as follows:

Goal 1. *Maintain recreational uses important to lake residents and users including swimming, fishing, and boating while balancing the need to preserve important native aquatic plant functions and their values.*

Goal 2. *Prevent the introduction of Eurasian water milfoil and other invasive aquatic plants.*

Goal 3. *Manage curly leaf pondweed to minimize navigation problems, prevent its spread, and protect native plant populations.*

Goal 4. *Protect the natural functions of diverse native plants including fish and waterfowl habitat, sediment stabilization, protection against invasion by non-native species, and natural aesthetics.*

Goal 5. *Educate lake residents and visitors about the role of aquatic plants in the lake, the management strategies found in the plan, and appropriate plant management actions.*

This aquatic plant management plan is guided by public input, scientific data, and requirements from the Wisconsin Department of Natural Resources (DNR). The plan is required by DNR regulations for certain aquatic plant management activities and to obtain grants that fund aquatic invasive species management. DNR guidelines determine the required plan contents and necessary public input.

The DNR's aquatic plant management planning guidelines and Northern Region Aquatic Plant Management Strategy (Summer 2007) framed the development of the plan. (See Appendix G for a copy of this strategy.) DNR sampling protocol and plant survey methods were also utilized in plan development. The Bone Lake Aquatic Plant Advisory Committee worked within these limits and guidelines to develop the management strategy for aquatic plants in Bone Lake.

More information about managing aquatic plants in Wisconsin is available from www.uwsp.edu/cnr/uwexlakes/ecology/apmguide.asp or
http://dnr.wi.gov/lakes/plants/

Public Input for Plan Development

A single advisory committee meeting was held April 6, 2013 to gather input to update the Bone Lake Aquatic Plant Management (APM) Plan. The group met to learn about APM planning requirements, the status of various aspects of the plan, and to provide input to guide the plan update. The 2008 plan was developed with extensive input from an advisory committee which met four times during 2007 and 2008.

Following advisory committee input, the draft plan update was made available to lake residents and other interested parties. Residents were made aware of the availability of the draft in the Bone Lake newsletter and a notice was published in the Inter County Leader newspaper. The plan was available for review between May 1 and June 15, 2013 on the Bone Lake web site (bonelakewi.com) and at the Luck Public Library during regular business hours. No comments were received.

Property Owner Survey

A lake property owner survey was distributed in October 2007. The survey was not updated for this plan. The results of the survey are discussed below and are found in Appendix A of the 2008 plan.

The 2008 APM Committee expressed a variety of concerns that are reflected in 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.

Popular lake activities demonstrate potential conflicts for aquatic plant management. Enjoying the view was the most frequently mentioned activity (92% of property owners). However, fishing (which requires plant growth for success) and swimming (for which plant growth is generally not desired) follow with 83% of owners enjoying each of these activities.

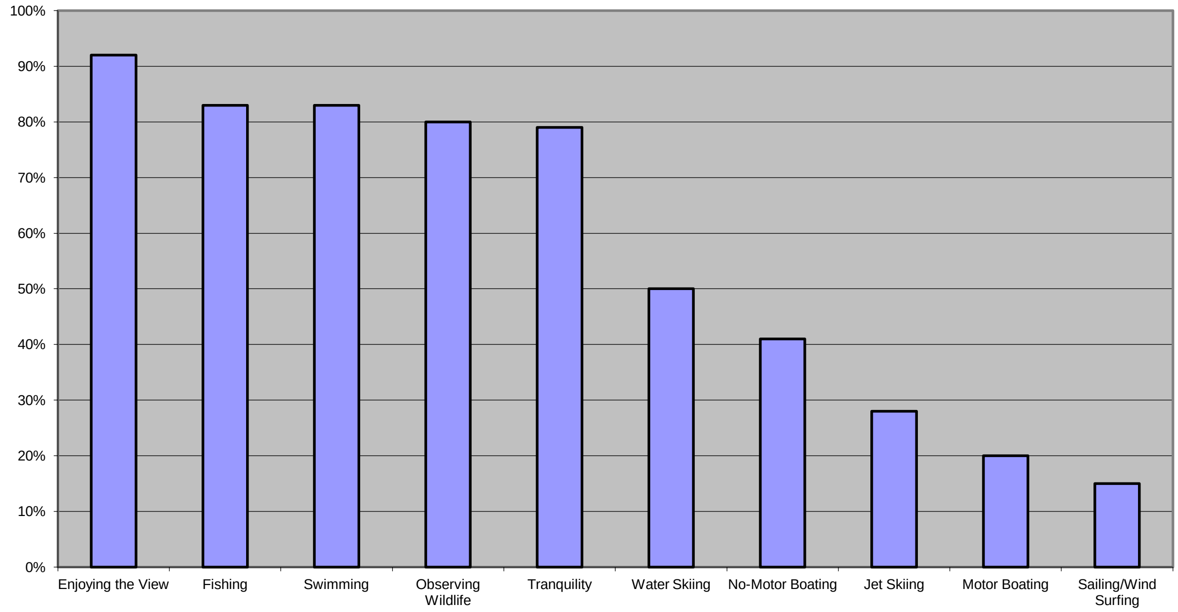


Figure 1. Survey Response: What recreational activities do you enjoy at the lake?

Additional survey results indicate a range of concerns and priorities from lake residents. While excessive plant growth is a concern to property owners, it ranks below paying property taxes, protecting the lake environment, and water clarity at the end of an owner's dock. In terms of what negatively impacts use and enjoyment of the lake, invasive aquatic plant growth and algae growth rank above native plant growth (these are the top three negative impacts on the lake). And, while monitoring and preventing aquatic invasive species introduction rank in the top three management actions for the lake management district to consider, spraying aquatic plants in the lake ranks in the middle of responses.

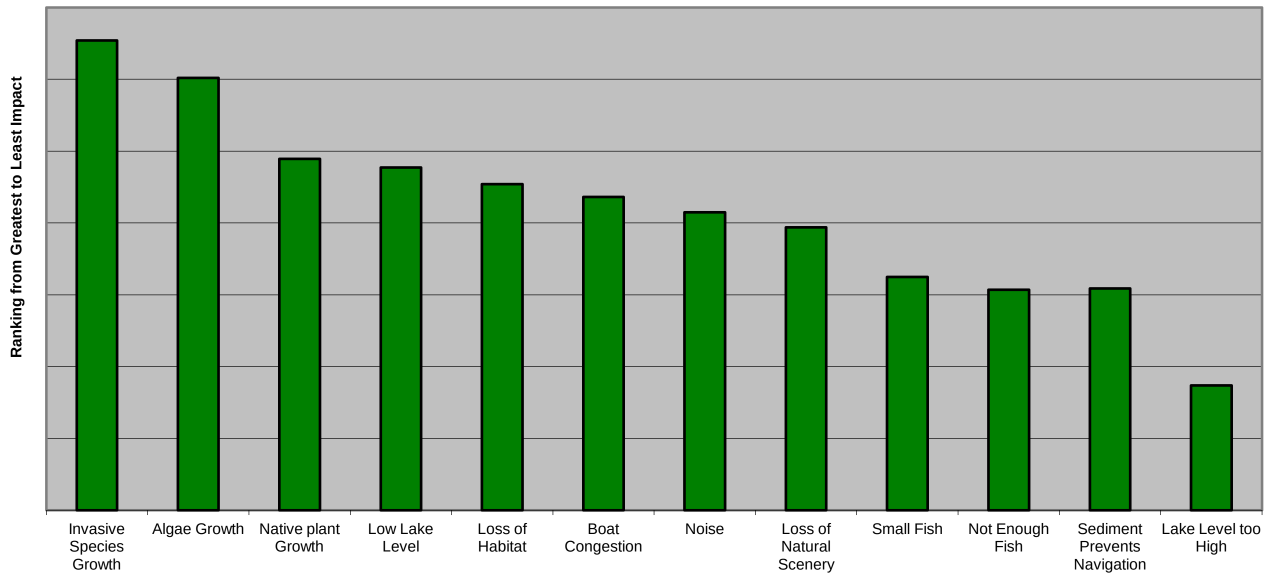


Figure 2. Survey Response: Rank the degree each concern negatively impacts your use or enjoyment of the lake.

Bone Lake Management Plan

The *2009 Bone Lake Management Plan* guides the lake district in managing water quality, fisheries, wildlife and natural beauty with the following goals:

Goal 1. *Improve Bone Lake water clarity by 20% over 10 years*

Goal 2. *Maintain and enhance Bone Lake's natural beauty*

Goal 3. *Protect and enhance wildlife habitat*

Goal 4. *Protect and improve Bone Lake fishery*

Goal 5. *Maintain safe, effective navigation on Bone Lake*

Lake Plan Committees

Committees of lake residents and the Board of Commissioners guide the implementation of the Lake Management Plan. The committees include Waterfront Runoff, Watershed, Evaluation and Studies, Fisheries, and Wildlife and Natural Beauty. A $197,000 grant from the Wisconsin Department of Natural Resources supports plan implementation.

The Lake District uses a committee structure to implement the Comprehensive Lake Management Plan with assistance from Harmony Environmental. A brief overview of committees and their programs follow:

Evaluation and Studies Committee

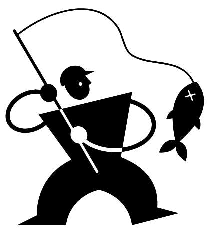
The Evaluation and Studies Committee monitored the inputs to Bone Lake from its tributaries and other non-point sources within the watershed in 2010 by testing flow and nutrients in culverts and tributaries. Consultants guide testing and studies. The tributary study is now used to prioritize the work of the watershed committee. The evaluation and studies committee also assisted with a study of the impact of the die-back of curly leaf pondweed on the lake phosphorus budget in 2010.

Watershed Committee

The Watershed Committee is using the culvert nutrient and flow monitoring results from 2010 to target their activities. The Polk County Land and Water Resources Department is helping with this effort. Example projects include stream walks to assess stream bank erosion, a streambank stabilization project, and correcting improper placement of a private road culvert.

Waterfront Runoff Committee

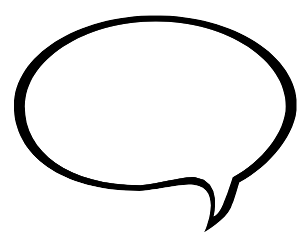
The Waterfront Runoff Committee provides lakeshore property owners with educational materials, technical assistance, financial incentives, and encouragement to reduce runoff from their property. This committee is using innovative marketing techniques in a step-by-step manner to encourage program participation. This marketing program encourages individual site assessments that result in recommendations to reduce runoff and erosion and improve habitat along the water. Twenty-six properties were visited in 2010, 19 properties were visited in 2011, and 11 were visited in 2012. Projects including a shoreline buffer, rain gardens and diversions, and a rock trench were installed on 3 sites in 2011, and 4 additional projects are ready for installation. The north landing is an excellent demonstration site for lake residents and visitors with a diversion across the boat landing to a rain garden, a rock trench at the base of the parking area, and an extensive native planting. The Lake District is taking extra initiative to encourage native plantings for water quality and wildlife benefits by providing a financial incentive for planting a 300 square foot area next to the water. The cost of supplies for these 10X30 plantings is split between the owners with the Lake District paying up to $500. Special designs and plant lists are developed for three types of sites: woodland, prairie, and wet meadow.



Fisheries Committee
The Fisheries Committee installed 3 fish stick complexes with approximately 20 trees in each complex in the winter of 2010/11. The committee has also installed 80 half log structures throughout the lake. Stocking of 5,000 small mouth bass is planned for the fall of 2011, 2012, and 2013. One of the reasons for stocking small mouth bass is to control rusty crayfish that were recently discovered in the lake. Based on a concern for levels of winter Tribal harvest of muskies, the fisheries committee is also actively working with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) and the Wisconsin Department of Natural Resources (WDNR) Fisheries.

Wildlife and Natural Beauty Committee
The Wildlife and Natural Beauty Committee provides information to lake residents to encourage maintaining undeveloped natural areas, enhancing the natural beauty of developed areas around Bone Lake, and encouraging appropriate shoreland lighting. They sponsored a workshop featuring wildlife expert Jim Gilbert, provided free nest boxes, and conducted a spring breeding bird survey in 2011. Polk County plant lists have also been updated to reflect the wildlife each species attracts. In 2012 the committee supported the development of a lake map of birds and frogs and their habitats, a workshop with meteorologist Mike Lynch to observe stars and learn about appropriate lighting, and interpretive information for the north landing plantings.

Communications Committee
The Communications Committee facilitates lake resident education through the distribution of materials and information. The Communications Committee manages the Bone Lake web site and newsletter.



Aquatic Plant Management Committee
An Aquatic Plant Management Committee convened on April 16, 2011 to review the results of the curly leaf pondweed (CLP) study and effectiveness of CLP treatment. They also considered potential changes to the Aquatic Invasive Species (AIS) prevention program. An updated 2012 – 2014 APM Implementation Chart, which was subsequently approved by the Board of Commissioners, is the result of that meeting. Recommended changes to the CLP program included expanding treatment acreage, completing turion monitoring, mapping CLP beds annually, and measuring total phosphorus in the lake more frequently. Recommended changes to the AIS prevention program included staffing changes for the Clean Boats, Clean Waters program, consideration of a surveillance camera, and investigating other monitoring methods. The 2012 plant survey and 2013 plan update were included in the updated implementation chart.

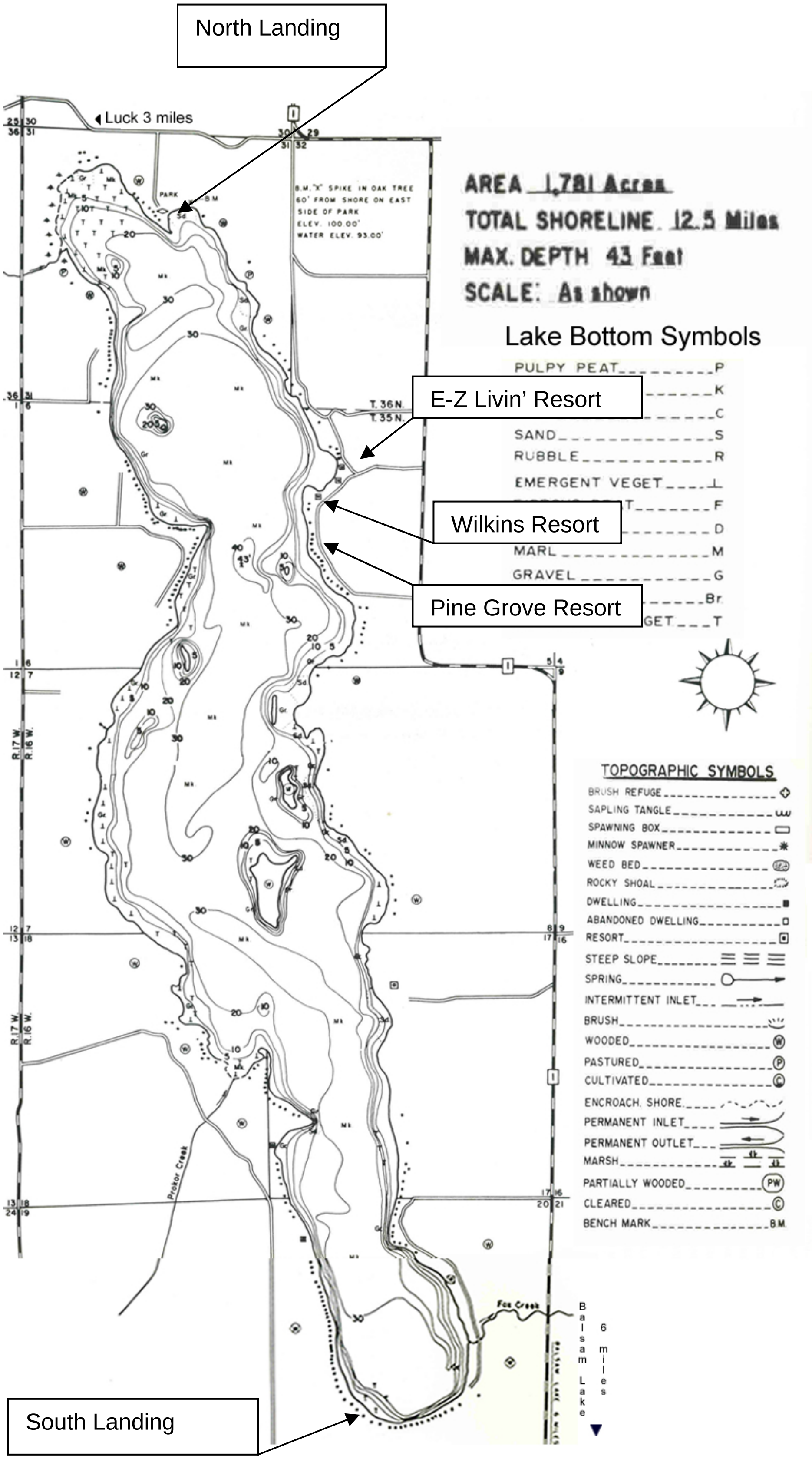


Figure 3. Bone Lake Map

Lake Information

Bone Lake is a 1,781 acre lake located in Polk County, Wisconsin in the Town of Georgetown (T35N, R16W, S5, 6, 7, 8, 17, 18, and 20) and the Town of Bone Lake (T36N, R16W, S 31); WBIC: 2628100. It is a drainage lake with Prokop Creek and three intermittent streams flowing into the lake and Fox Creek flowing from the lake. Fox Creek eventually flows to the Apple River. The maximum depth is 43 feet, and the mean depth is almost 22 feet. A lake map is included as Figure 3.

Water Quality

Trophic State

Trophic state describes the productivity of a lake. The least productive lakes are oligotrophic lakes. The most productive lakes are referred to as eutrophic. Those in the middle are called mesotrophic. The more nutrients available in a lake, the more productive the lake will be. If a watershed with little runoff and phosphorus sources surrounds a lake, the water will tend to have low phosphorus levels. This will result in limited plant and algae growth, causing it to be classified as an oligotrophic lake.

Bone Lake is a mesotrophic to eutrophic lake with clear water in early summer that deteriorates with frequent algae blooms in mid to late summer. The south basin generally has greater water clarity than the north basin. Phosphorus concentrations control the level of water clarity in Bone Lake because increased phosphorus levels increase algae growth. Lake sediments release phosphorus when the lake water temperatures stratify in the summer and oxygen levels decrease at the lake bottom. The lake may periodically mix with high summer winds so that phosphorus-rich bottom waters are brought to the surface and increase algae growth. Phosphorus input to Bone Lake also comes from the watershed, direct rainfall, groundwater, and septic systems.

Previous Lake Studies

The Bone Lake Management District requested and/or funded a variety of studies to increase understanding of the water quality and plant community of Bone Lake. The Wisconsin Department of Natural Resources Office of Inland Lake Renewal completed a lake feasibility study with management alternatives in 1980. Barr Engineering completed a lake management plan that included a water quality study (1997), hydrologic and phosphorus budgets (1997), and additional water quality monitoring and management recommendations (1999). The Polk County Land and Water Resources Department and The Limnological Institute updated water quality monitoring, and Aquatic Engineering prepared a water quality technical report in 2004. Lake resident volunteers have collected Secchi disc self-help monitoring data since 1989 (although not every year). Summaries of previous studies are included in Appendix A.

Lake Self-Help Monitoring Results[2]

Secchi depths are the most commonly collected self-help lake monitoring data reported. Secchi depths measure water clarity. The Secchi depth reported 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

[2] Wisconsin Department of Natural Resources Self Help Monitoring results.

occur with greater water clarity. Results of average July and August Secchi depth readings for the Deep Hole of Bone Lake are shown in Figure 4 below. Figure 5 illustrates all sample test results using TSI (trophic status) rankings. Figure 6 shows how water clarity changed over the 2012 growing season with increasing algae growth and decreasing water clarity as the summer progresses. Results available for a second sampling point south of the large island show similar results for all reports.

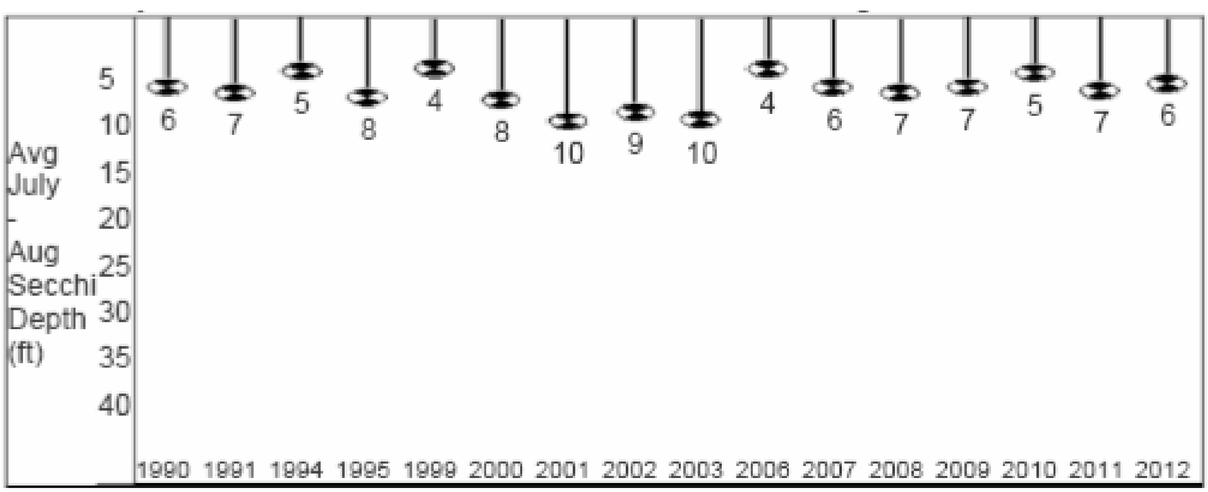


Figure 4. Bone Lake Deep Hole Average July and August Secchi Depths 1990 - 2012

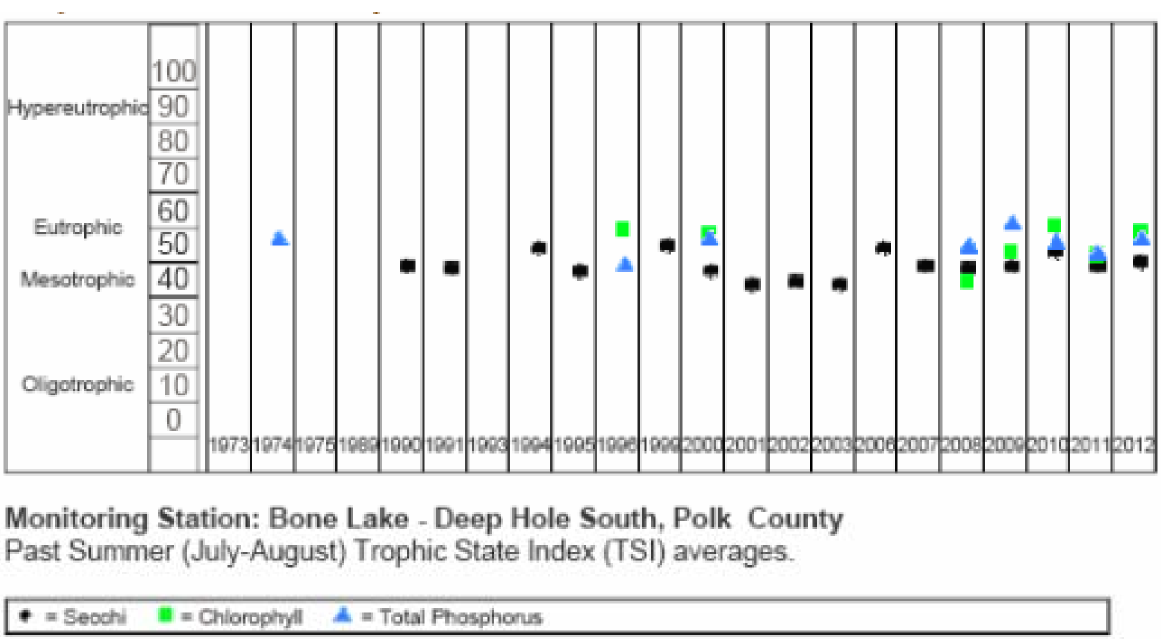


Figure 5. Bone Lake Deep Hole July and August Trophic State Index

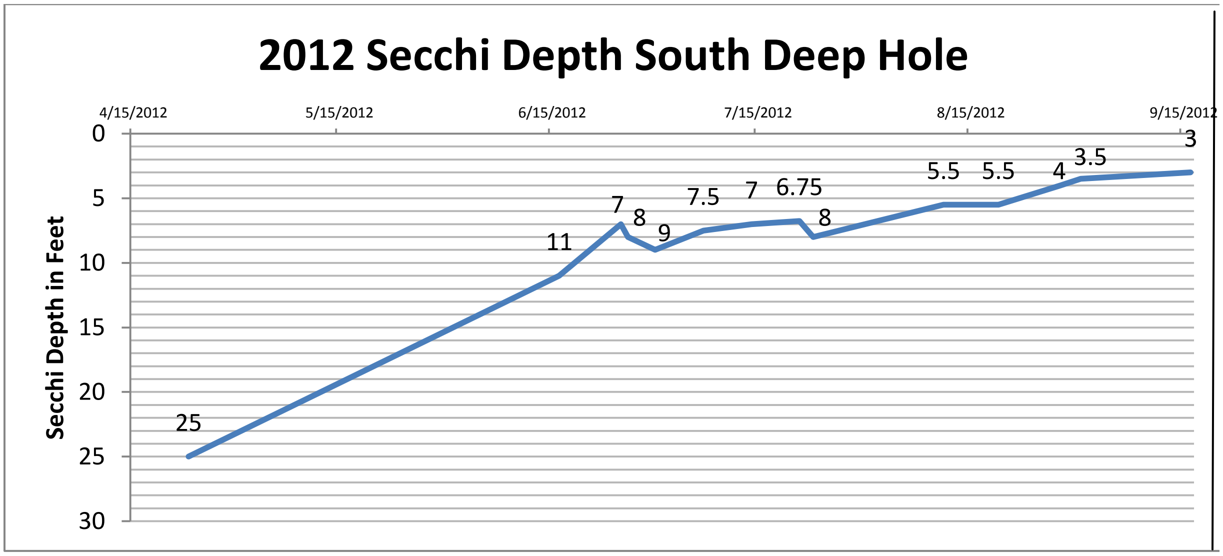


Figure 6. 2012 Secchi Depth South Deep Hole

Watershed

The Bone Lake watershed is part of the Upper Apple River watershed in the St. Croix River Basin. The entire watershed (excluding the lake surface) is 9,173 acres. Of this acreage, 3,088 acres are internally drained, flowing to ponding areas within the larger watershed. Therefore, the area that drains directly to Bone Lake is about 6,085 acres. The watershed area is illustrated in Figure 8.

Watershed Land Use[3]

The land use was determined through an analysis of 2006 digital ortho aerial photos. Watershed and subwatersheds developed for the Barr Engineering study in 1996 were adjusted following field checks of the topography and culvert locations in 2008. The resulting watershed map is illustrated in Figure 7 below. Figure 8 illustrates the land use in the Bone Lake watershed. Land uses are important to understanding nutrient loading because they influence the amount of runoff generated and the nutrients carried to the lake.

[3] Dave Peterson, Polk County Land and Water Resources Department, completed this analysis.

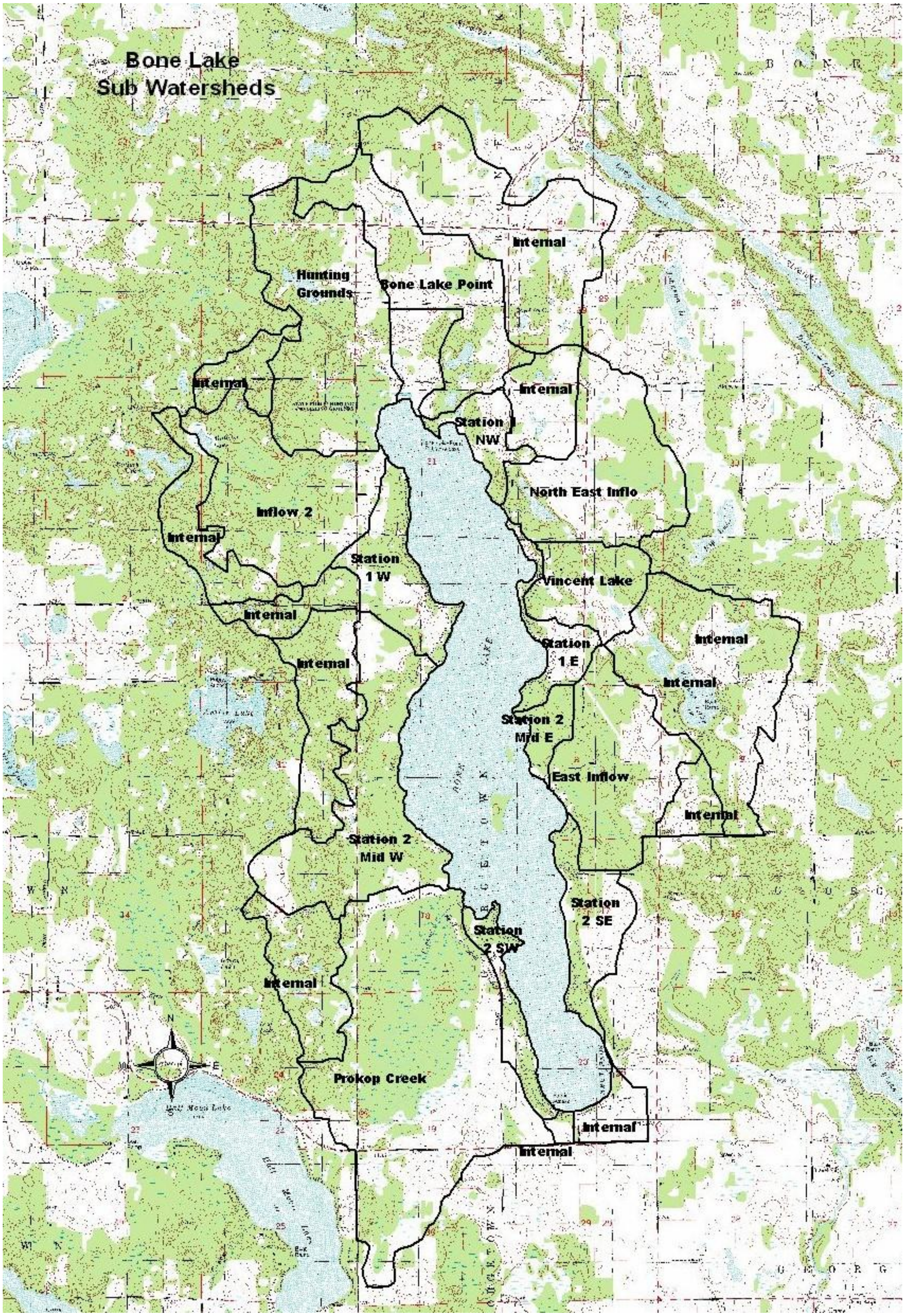


Figure 7. Bone Lake Subwatersheds

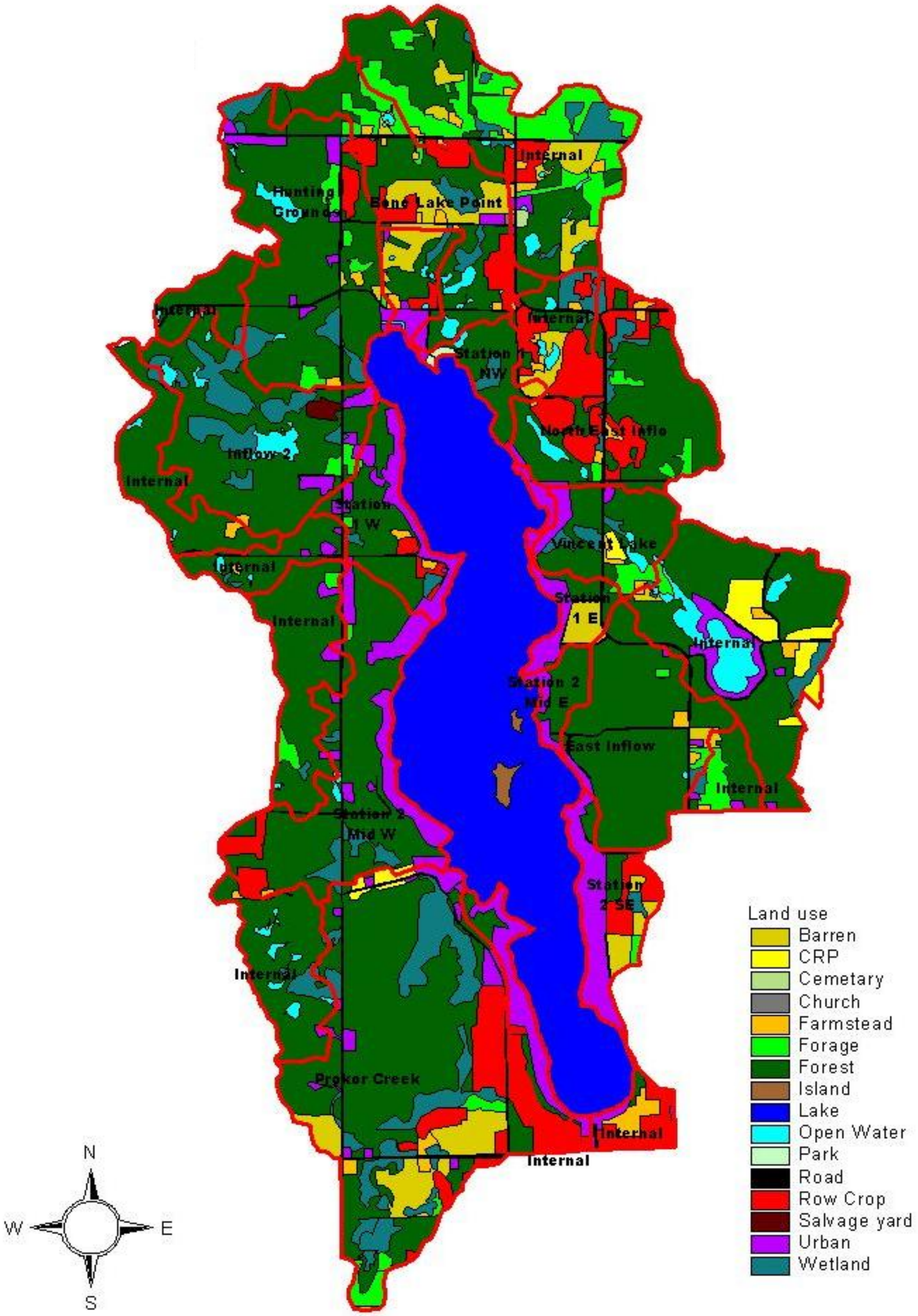


Figure 8. Land Use of Bone Lake Subwatersheds

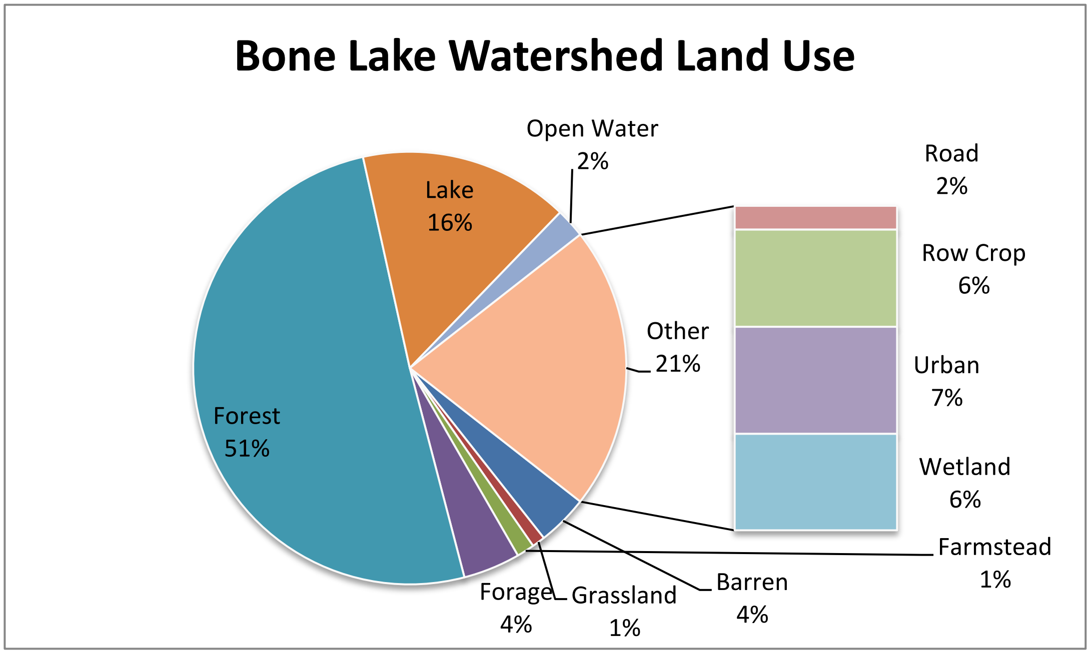


Figure 9. Bone Lake Watershed Land Use

Forest makes up just over half of the land use area. This forest cover helps to maintain good water quality in Bone Lake with low rates of runoff and pollutant loading. While row crops and urban land use make up only 6.33% and 6.97% of the watershed respectively, they have high phosphorus loading rates, and greater proportional impact than other land uses. Therefore, management of these land uses may significantly reduce phosphorus loading.

Phosphorus from Watershed Runoff

Phosphorus is the pollutant that most influences the clarity of Bone Lake because it is the limited ingredient for algae growth in the lake. Phosphorus is found dissolved in runoff water and carried in soil particles that erode from bare soil. Phosphorus runoff from the watershed is determined by how land is used in the lake's watershed, along with watershed soils and topography.

When a watershed is maintained in natural vegetation, there is less runoff of pollutants that impact the lake. Agricultural and residential land tends to contribute greater amounts of phosphorus in runoff. Soil erosion is reduced when there is good vegetative cover. Water flow is slowed by tall vegetation, and forest groundcovers and fallen leaves allow runoff water to soak into the ground. In summary, anything that reduces soil erosion and/or the amount of runoff water flowing from a portion of the watershed reduces pollution to the lake.

Sources of Phosphorus and Algae in Bone Lake

Phosphorus comes from both outside and within the lake including the following major sources:

- Runoff from the watersheds
- Precipitation on the lake
- Septic systems
- Water flow from two tributary streams
- Release from lake bottom sediments
- Die back of curly leaf pondweed (CLP)

The Bone Lake Management District commissioned studies in 2009 and 2010 to better understand the phosphorus budget of the lake and the significance of curly leaf pondweed to that budget. This included an analysis of the release of phosphorus from the lake's bottom sediments, a study of release of phosphorus from CLP, and measuring flow and taking water quality samples from culverts that flow from the watersheds to the lake. The updated pie chart of phosphorus loads for Bone Lake for 2010 is shown below.

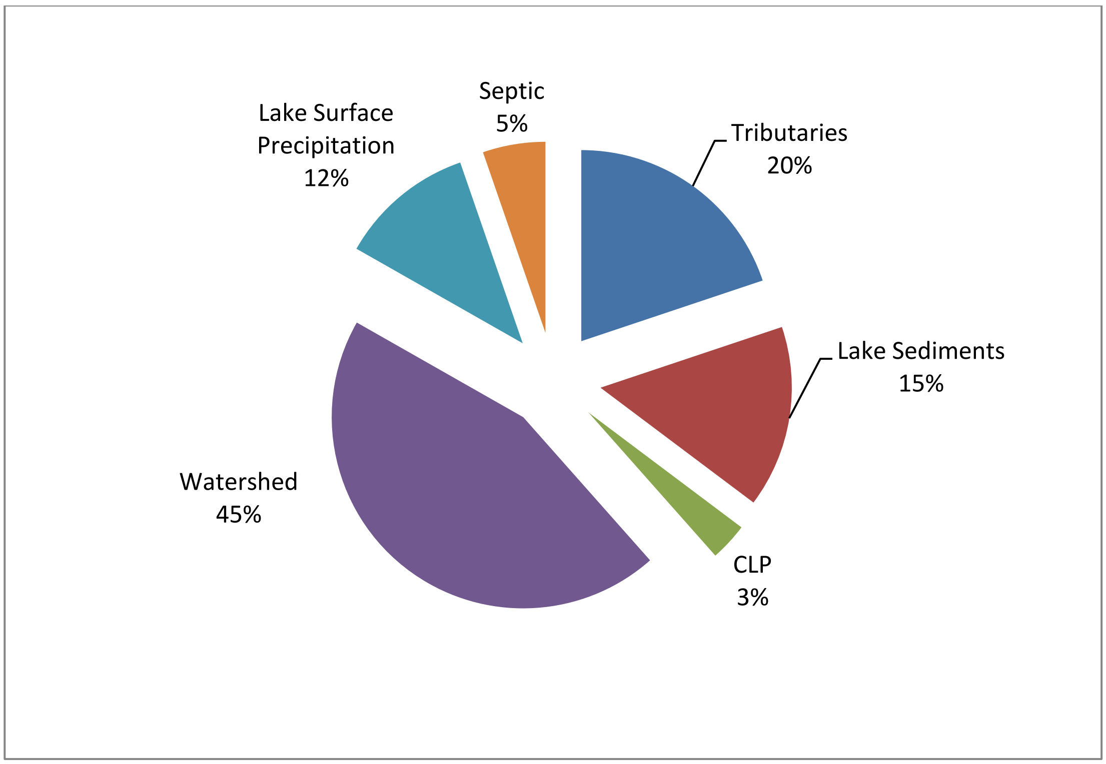


Figure 10. Bone Lake 2010 Phosphorus Loading

Like precipitation and resulting tributary loading, sediment loading of phosphorus can vary from year to year in Bone Lake. The result is that the chart of phosphorus loading also varies from year to year. The Bone Lake Management District is working to minimize manageable loads of phosphorus from waterfront property, the watershed, septic systems, and the northwest tributary. Phosphorus loading from in-lake sediments is not currently targeted for management.

Curly leaf pondweed management provides an opportunity to reduce phosphorus in the lake. While the contribution of phosphorus from CLP is relatively small (about 3-6%) it comes at a time when the lake waters are warm and algae can grow. A management program to minimize the amount of CLP in the lake could potentially delay an algae bloom in Bone Lake. While CLP treatment had limited effectiveness in 2008 and 2009, changes to the treatment program resulted in a successful treatment in 2010, 2011, and 2012. Given existing costs and success with curly leaf pondweed management, it may be an economical way to control phosphorus when compared to management of other sources.

Aquatic Habitats

Primary Human Use Areas

Figure 3 illustrates the location of boat landings and resorts on the lake shoreline. The North Landing is the most heavily used access on the lake. There are three resorts on the lake with a combination of seasonal cabins, mobile homes, and campers. Bone Lake is highly developed with permanent residences and seasonal cabins. A comprehensive inventory of shoreland habitat was completed as part of the comprehensive lake management plan in October 2008.

Shoreland Habitat Assessment

The purpose of the assessment was to assess the shoreline and buffer zone composition, to identify habitat characteristics around the lake, and to assess the potential for runoff from waterfront lots.

The assessment looked at the characteristics of the immediate shoreline at ordinary high water mark and in the shoreland buffer zone. The ordinary high water mark is the level water reaches during periods of high water.[4] The shoreland buffer zone begins at the ordinary high water mark and extends 35 feet inland. Results are illustrated in Figure 11 and Figure 12.

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[4] In 1914, the Wisconsin Supreme Court defined the OHWM as "the point on the bank or shore up to which the presence and action of the water is so continuous as to leave a distinct mark either by erosion, destruction of terrestrial vegetation or other easily recognized characteristic."

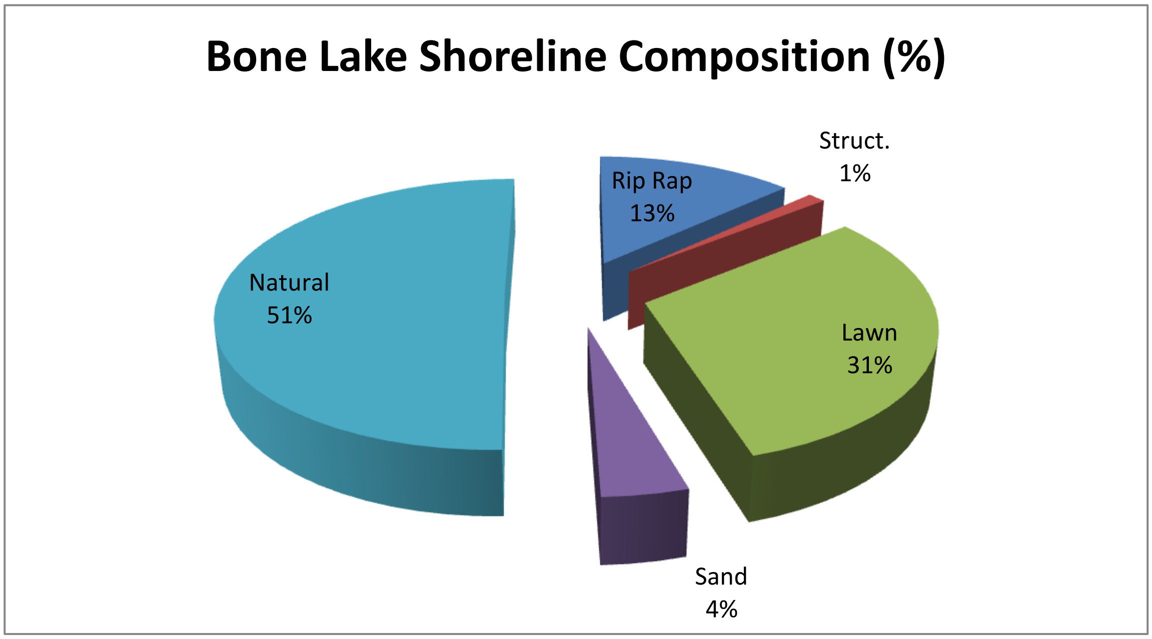

Figure 11. Bone Lake Shoreline Composition

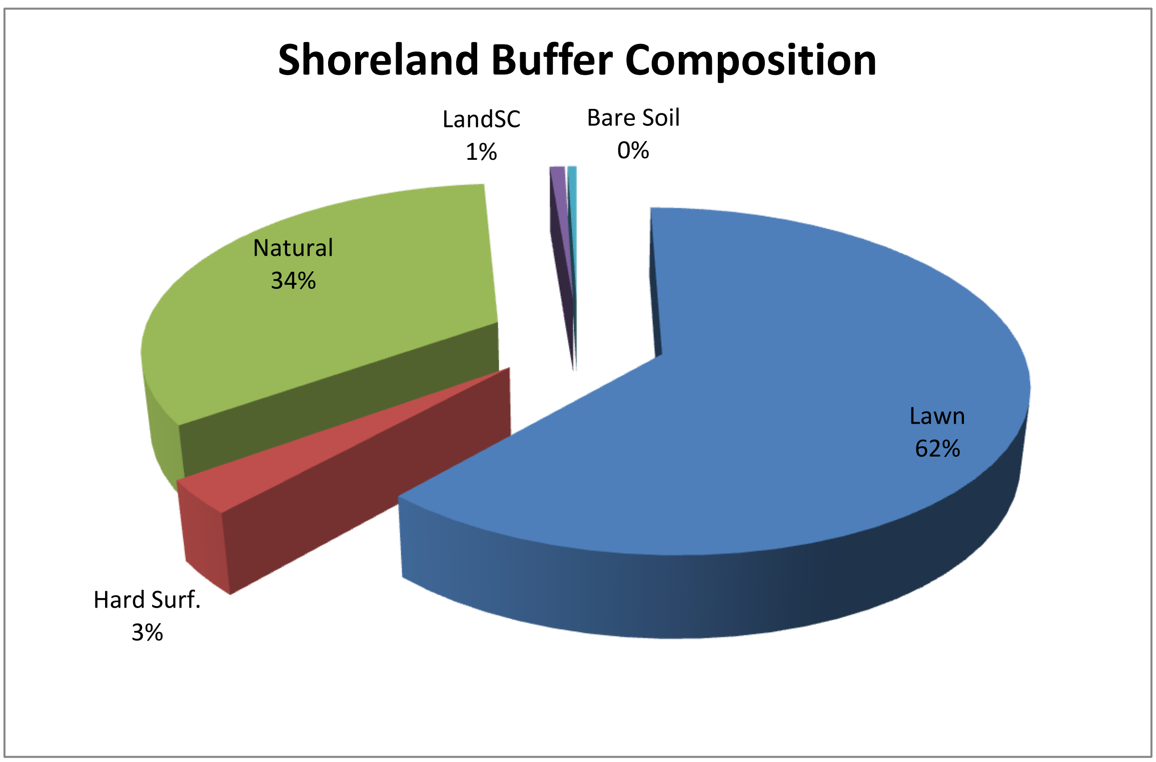

Figure 12. Bone Lake Shoreland Buffer Composition

Over half of the Bone Lake shoreline was found to have natural vegetation at the water's edge. This vegetation, along with vegetation in the water, can prevent erosion and sedimentation into the lake. Rock rip rap, found along 13% of the Bone Lake shoreline also stabilizes the bank, but may be detrimental to lake habitat.

The shoreland buffer composition is far from meeting state standards and recommendations. A minimum recommendation is for the buffer zone to extend 35 feet inland from the ordinary high water mark on at least 70% of developed parcels. Only 34% of the shoreland buffer of Bone Lake consisted of natural vegetation with much of this on undeveloped parcels.

Woody debris, such as fallen trees in the water, is important for fish and wildlife habitat structure. The habitat survey found only thirteen locations where woody debris was present. Although more may have occurred where there were large stretches of natural areas.

The Waterfront Runoff Committee and Wildlife and Natural Beauty Committees actively encourage Bone Lake residents to plant native plants along the shoreline and throughout their properties to enhance water quality and wildlife habitat.

Functions and Values of Native Aquatic Plants

Naturally occurring native plants provide a diversity of habitat, help maintain water quality, sustain the fishing quality for which Bone Lake is known, and support common lakeshore wildlife from loons to frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algae growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent resuspension of sediments from the lake bottom. Stands of emergent plants (with stems that protrude above the water surface) and floating plants help to blunt wave action and prevent erosion at the shoreline.

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 fish. Other fish such as bluegills graze directly on the plants themselves. Plant beds provide important spawning habitat for many fish species.

Waterfowl

Plants offer food, shelter, and nesting material. Birds eat both the invertebrates that live on plants and the plants themselves.[5]

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 these “invaders” benefit where an opening occurs from removal of plants. Without competition from other plants, invasive species may successfully become established in a lake. Removal of native vegetation not only diminishes the natural

[5] Above paragraphs summarized from Through the Looking Glass. Borman etal. 1997.

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. This concept is easily observed on land where bared soil is quickly taken over by weeds that establish themselves as new occupants of the site. While not a providing a 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. Invasive species 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.[6]

Sensitive Areas

The Wisconsin Department of Natural Resources designated sensitive areas for Bone Lake in 1988 and 1989. These sensitive areas are labeled A through K in Figure 13. Sensitive areas contain aquatic plant communities that provide important game fish, forage fish, macroinvertebrate, and wildlife habitat as well as important shoreline stabilization functional values. Native plant populations also help to prevent the introduction of Eurasian water milfoil and other invasive plants. The sensitive area report is included as Appendix B.

Recommendations for each area from the report are included in the table below. Where there is developed property adjacent to the sensitive area, the following recommendations are also included:

- Prevent erosion from developments
- Strictly enforce shoreland and wetland ordinances.

Table 1. Plant Management Restrictions for Sensitive Areas

Area	No chemical treatment	No mechanical harvesting	No hand control around docks	Minimal hand control around docks	Chemical treatment of floating vegetation for navigation only	Mechanical control up to 25 feet wide to developed properties	Chemical treatment of submergents only
A	X	X		X			
B	X	X		X			
C					X	X	
D	X	X	X				
E	X	X	X				
F	X					X	
G	X	X	X				
H						X	Only 25' channel
I				X			X
J	X	X	X				
K*		Except for navigation channels					Only navigation channel

* Care should be taken to allow growth of wild rice in this area.

[6] Taken from Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

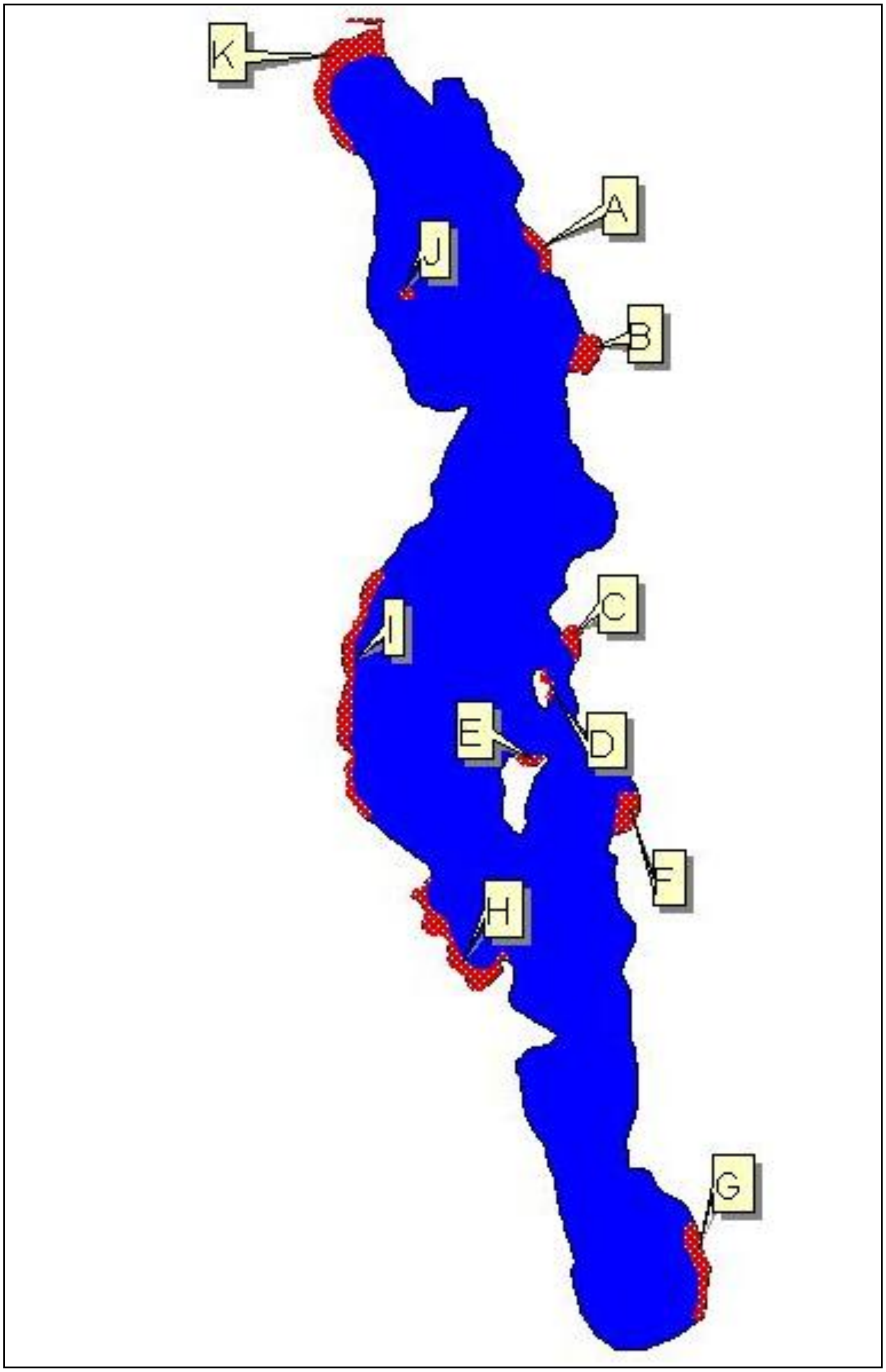

Figure 13. Bone Lake Sensitive Areas

Critical Habitat Areas

The Department of Natural Resources has transitioned from sensitive area designations to designations of *critical habitat areas* that include both *sensitive areas* and *public rights features*. S*ensitive areas* offer critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). Wisconsin Department of Natural Resources is given the authority for the identification and protection of sensitive areas of the lake in this code. *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. Protecting these *critical habitat areas* requires the protection of shoreline and in-lake habitat. The *critical habitat area* designation will provide a framework for management decisions that impact the ecosystem of the lake.

Areas of Property Owner Concern

The survey sent to all lake residents in October of 2007 requested identification of areas of concern related to aquatic plants according to the following key on a map of Bone Lake.

R = My residence is located here on the lake.

H = Aquatic plants need to be preserved for fish and wildlife habitat

NSP = Aquatic plants impede boat navigation in the spring

NSU = Aquatic plants impede boat navigation in the summer

SW = Aquatic plants make it difficult to swim.

A total of 265 out of 487 surveys mailed were returned, a response rate of 54 %. Of the respondents, 75% returned maps and 47% indicated areas of concern related to aquatic plants. Figure 14 compiles map survey responses. Concerns related to swimming were generally identified directly in front of the residence of the responder. In contrast, habitat and navigational concerns were more often identified further from the residence.

The map illustrates several common areas of concern that coincide with the sensitive area designations. However, not all of the concerns identified are related to preserving habitat in the sensitive areas. There is a concentration of navigational concerns identified in sensitive areas C, F, G, H, I, and K. The navigational concerns for Area K seem to be most related to reaching a dug channel on the north end of the lake. The sensitive area plant management restrictions in Table 1 include some allowance for access to developed properties via a 25- foot corridor using mechanical and/or chemical means.

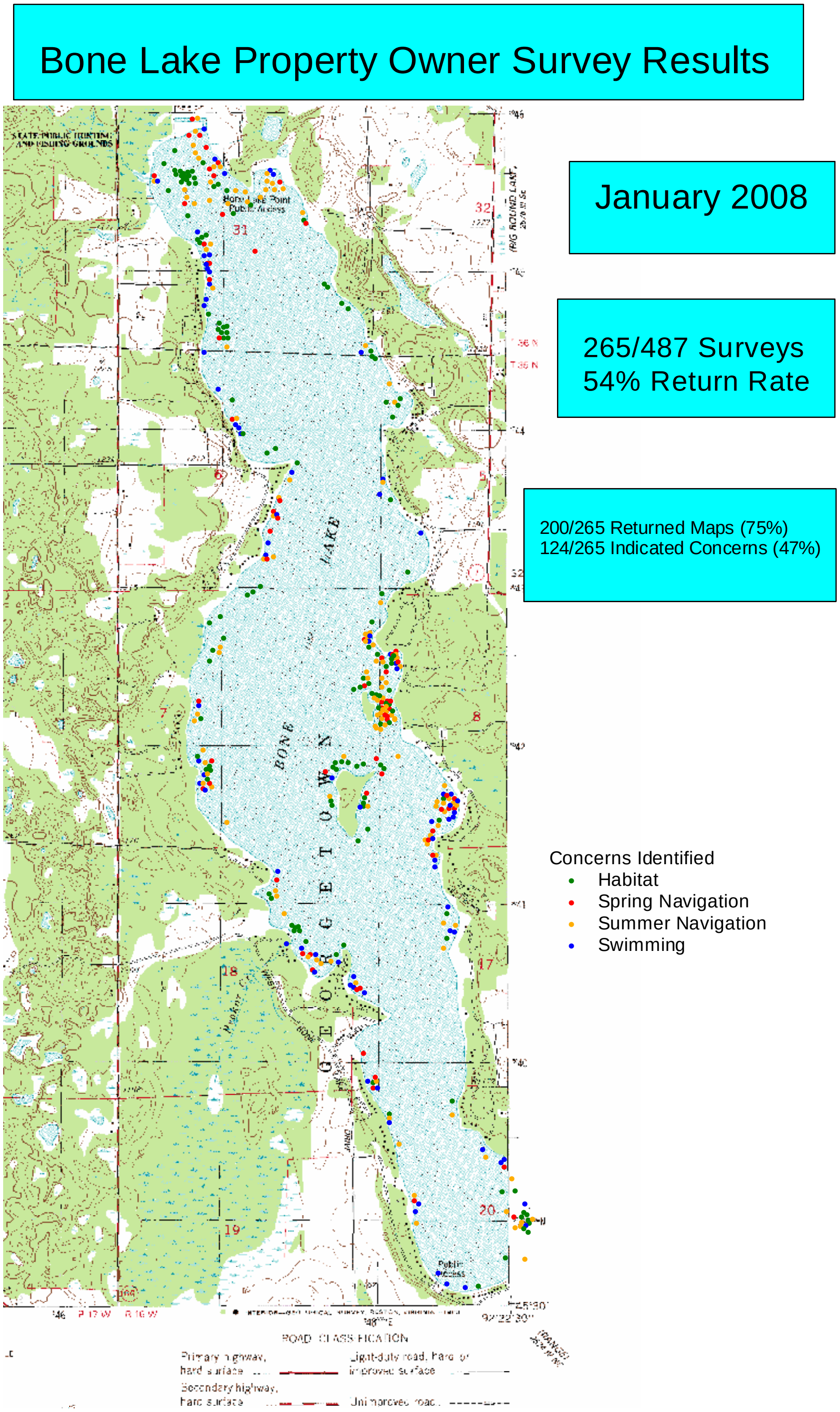

Figure 14. Bone Lake Property Owner Survey Plant Concerns Map

Rare and Endangered Species Habitat

Bone Lake is in the Town of Georgetown (T35N, R16W) and the Town of Bone Lake (T36N, R16W). Rare species are noted in this area. However, records of species present are not available to the public, so there is no indication of what species are present or if they are located within or surrounding Bone Lake. No state or federally listed threatened, endangered, rare or special concern plant species were found in any lake plant surveys.

Scientific Name	**Common Name**	**State Status**[7]	**T35N R16W**	**T36N R16**
BUTEO LINEATUS	RED-SHOULDERED HAWK	THR		YES
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	SC/FL	YES	YES
DENDROICA CERULEA	CERULEAN WARBLER	THR		YES
CYGNUS BUCCINATOR	TRUMPETER SWAM	END		YES
OPHIOGOMPHUS SMITHI	SAND SNAKETAIL	SC/N		YES
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	SC		YES

Species Longer Actively Tracked

Scientific Name	**Common Name**	**State Status**	**T35N R16W**	**T36N R16**
PANDION HALIAETUS	OSPREY	THR		YES
WILSONIA CANADENSIS	CANADA WARBLER	SC/M		YES
DENDROICA CAERULESCENS	BLACK-THROATED BLUE WARBLER	SC/M		YES
COCCYZUS AMERICNUS	YELLOW-BILLED CUCKOO	SC/M		YES
FUNDULUS DIAPHANUS	BANDED KILLIFISH	SC/N	YES	YES
HEMIDACTYLIUM SCUTATUM	FOUR-TOED SALAMANDER	SC/H		YES

The following communities are also listed in the database for T35N R16W:

Northern dry-mesic forest
Northern wet-mesic forest

The following communities are also listed in the database for T36N R16:

Open bog
Northern wet forest
Northern dry-mesic forest
Northern wet-mesic forest
Lake – soft bog
Ephemeral pond
Southern dry-mesic forest
Tamarack (poor) swamp

[7] THR = Threatened, END = endangered, SC/FL = Special Concern (federally protected as endangered or threatened), SC/N = Special Concern (no laws regulating use, possessions, or harvesting), SC/M = fully protected by federal and state laws under the migratory bird act, and SC/H = Special Concern (take regulated by establishment of open / closed seasons). List updated 11/04/11.

Bone Lake Fishery[8]

Fish Community

The fish community in Bone Lake consists of muskellunge, largemouth bass, bluegill, pumpkinseed, black crappie, yellow perch, northern pike, smallmouth bass, walleye, white sucker, bullheads, and golden shiner. All fish present in Bone Lake depend to some degree upon aquatic vegetation for survival and life processes. Stands of aquatic vegetation provide cover from predatory fish as well as forage areas for fish to feed on small organisms. Any changes to the plant community could adversely impact the fish population; therefore, aquatic plant management plans need to take potential implications with the fish community into consideration.

Bone Lake is well known for its muskellunge fishery. The Wisconsin DNR currently stocks 2,500 large fingerling muskellunge every other year, and the lake is now managed as a trophy lake for muskellunge with a 50-inch minimum length limit regulation. The abundance and size structure of muskellunge has decreased in recent years according to WDNR muskellunge surveys. The abundance of adult muskellunge was at an all-time high in 1999 when it was 0.99 fish/acre. However, due to concerns of intra-specific competition and poor condition, stocking was reduced and the lake has been managed as a lower-density fishery since then. As a result, the population density in 2005 was only 0.55 adult fish/acre, and it has continued to decrease. During the most recent survey in 2011 it was only 0.42 adult fish/acre. The current population level is the lowest it has been since 1964, but is still within the target density level (0.4-0.6 adult fish/acre) for Bone Lake. The relative weight (a measure of fish condition) of muskellunge has improved following the reduction in stocking after the 1999 assessment. Muskellunge relative weight has increased from 96 in 1995, to 104 in 2006, to 111 in 2011 (100 is considered normal).

In 2006, a moderate density largemouth bass population of 5.9 fish/acre or 10,508 bass larger than 8 inches was present with a respectable number of larger bass in the 18-20 inch range. Northern pike were also present with many individuals in the 24-30 inch size range, and the fish were in excellent condition. Panfish were generally small when compared to other Polk County lakes, but an expanding yellow perch fishery is present and has provided good results for ice fishing.

Bone Lake Fishery Committee

The Bone Lake Management District has a very active Fishery Committee that completed several projects over the last three years. They installed “fish stick” complexes at three different locations on Bone Lake. Fish sticks are essentially a complex of approximately 16 to 60 whole trees that are acquired from an upland source, cabled together, and secured to the shoreline. The intent of these projects was to replicate wood that was historically present in the near shore littoral zone before lakeshore development and logging activities at the turn of the century “cleaned up” much of the shorelines. The installation of over 100 trees provided valuable cover for fish, wildlife, and a host of other aquatic organisms. Additional fish stick complexes are not planned for installation at this time for the following reasons: 1) Bone Lake has limited shoreline

[8] Information from Aaron Cole, DNR Fisheries Biologist, and Robert Boyd, Bone Lake Management District Fisheries Committee. February 2013.

that is protected from spring ice-out movement (which causes damage and shifting of the fish stick complexes); 2) much of the shoreline is developed into residential lots that do not have space available for complexes; 3) the water is too shallow for proper placement in most potential sites; and 4) wakes from excessive boat traffic cause a shifting of the complexes. However, natural recruitment of woody habitat is very important, and lake residents are encouraged to leave trees that fall naturally into the water. In some locations hinge trees (those that could be cut and dropped into the water to provide cover) will be considered for additional wood habitat.

The Fishery Committee has also installed 80 half log structures throughout the lake. Half logs consist of a hardwood log 6-8' long and 8-12" in diameter that is split lengthwise. The log is anchored to cinder blocks on the underside so that when placed into the lake there is a space between the lake bottom and the half log structure. The half logs are intended to provide cover for spawning fish and add additional structure for the fish community. The Fishery Committee has planned to install additional half log structures in 2013. Funding for the wood habitat projects have come from a WDNR lake protection grant and from district funds.

The Bone Lake Management District has provided funds for a smallmouth bass stocking program in Bone Lake. The Fishery Committee has stocked 12,500 smallmouth bass in the last three years under the guidance of the WDNR. The goal of these stockings was to establish a fishable population of smallmouth bass in Bone Lake. The Fishery Committee will work with the WDNR to evaluate the success of this project, and also monitor natural recruitment of smallmouth bass in the future. The Fishery Committee will continue to meet and plan future projects.

Black Crappie Sarcoma

In recent years, there has been an increase in black crappies that have a condition with large open raised sores on the skin of the fish; this condition has been termed "black crappie sarcoma". Although the exact mechanism of transfer is unknown, it is suspected that it is from fish to fish contact. Black crappie sarcoma does not seem to be lethal, as it appears to be more prevalent in larger and older fish. In general, diseases of fish in Wisconsin do not infect people because the human body temperature is too warm. However, since it is a tumor, the current recommendation is not to eat fish that have lesions or that look abnormal as the tumor goes deep into the muscle and is not just a surface lesion. Anglers that catch infected fish are encouraged to keep and discard them, but anglers should realize infected crappies still count towards their daily bag limit.

Management Recommendations to Minimize Impact to Fishery[9]

- No plant management should occur in designated sensitive areas unless some benefit can be justified ecologically from treating an identified sensitive area.

- No plant management should occur in water less than 3 feet. Most of the fish spawning takes place in this shallow water zone. This area also provides critical nursery habitat for fish once the eggs hatch.

[9] Personal communication. Aaron Cole. WDNR fisheries manager. 03/04/13.

Plant Community

The Bone Lake Management District commissioned an aquatic macrophyte (plant) survey in 2012 in preparation for updating the aquatic plant management plan for Bone Lake. A previous survey was completed in 2007. The Management District funded the survey with the help of a Department of Natural Resources grant. Plant survey methods are found in Appendix C and the full survey report is available as a separate document.

Aquatic Plant Survey Results

Ecological Integrity Service completed the plant inventory according to the DNR-specified point intercept method in June and August of 2012. The results discussed below are from that survey. Survey results are also compared between 2012 and 2007. No major changes were found between the two years except that some plants were growing at greater depths.

Plant Coverage

The DNR designated a grid of 1,000 sample points for Bone Lake. Once the maximum depth where plants were present was established, each point equal to or less than that depth was sampled. The depth where plants are present is referred to as the littoral zone in a lake. Figure 15 shows the sample grid while Figure 16 shows the location of points where plants were present and their density.

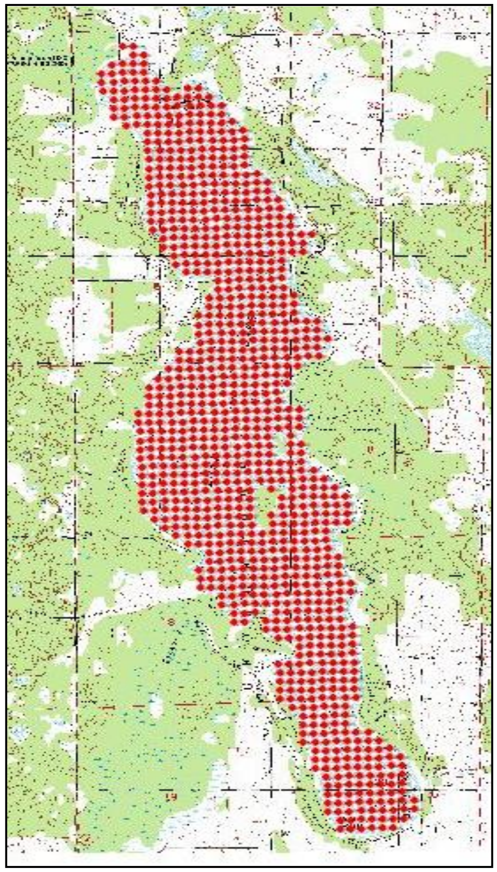

Figure 15. Sample Point Grid

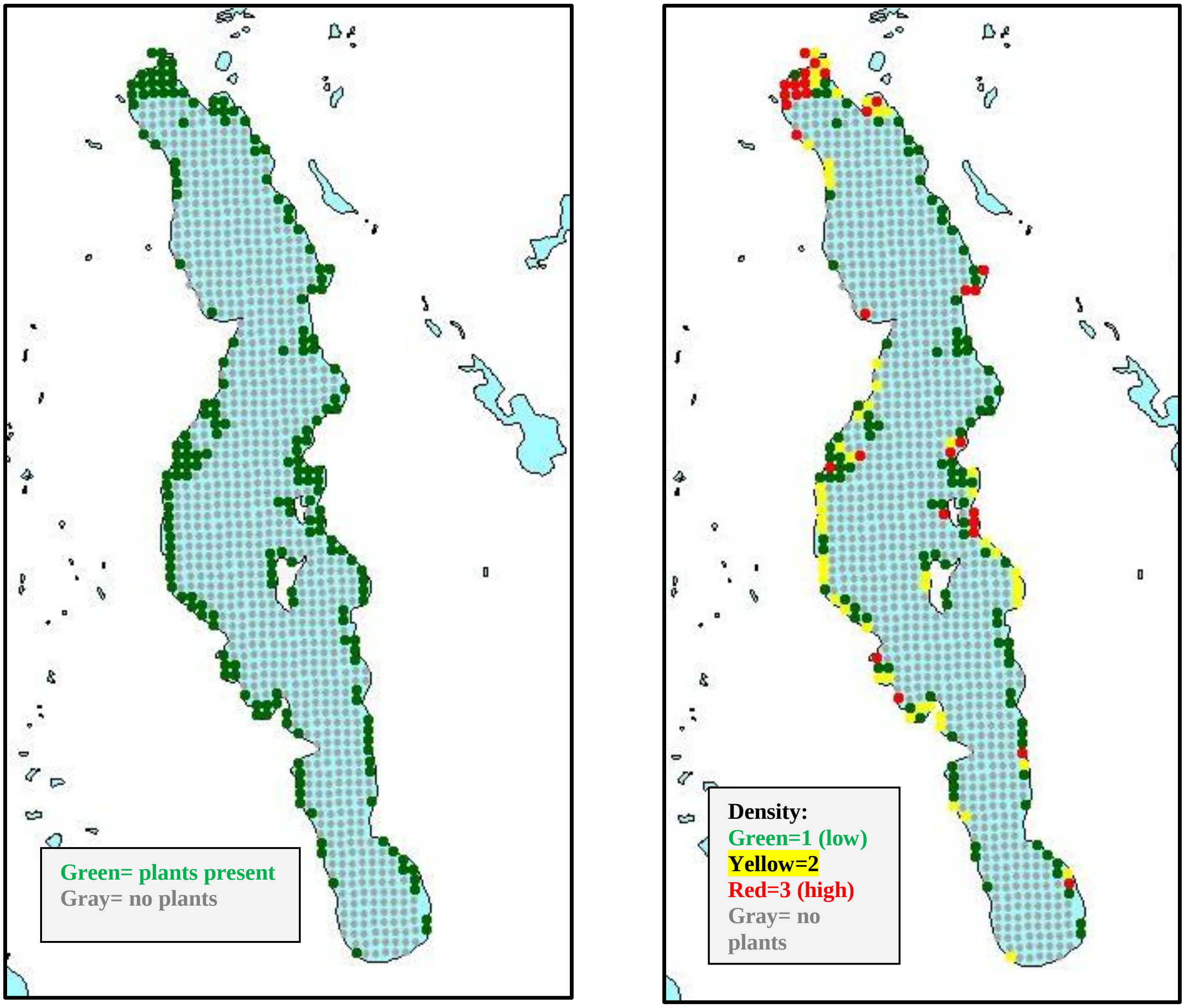

Figure 16. Plant Growth and Density 2012

Bone Lake has fairly limited plant growth. Of the 1,000 sample points in the grid, only 298 of them occur in water less than 20.7 feet which is the maximum depth where plants grew in 2012. This depth defines the littoral zone, or the zone where plants can grow. Due to the bathymetry (or depth contours) of Bone Lake, the littoral zone is narrow and limited in area. Even within the littoral zone, only 64.4% of sample points had plants present. The dominant sediment in most areas of Bone Lake is low nutrient sand and rock, which also limits plant growth. Table 2 compares plant coverage between 2007 and 2012.

The density of plant growth is moderate in Bone Lake. The densest growth is in the very north end, and in a bay on the east side, mid-lake running north and south. The remaining portions of the lake had total rake densities that were low (1) to medium (2), with many 2's associated with *Chara sp*. This plant (actually, an algae) lies on the bottom, and does generally not affect navigation.

Figure 17 shows, the maximum depth of plants is just below 21 feet, but the majority of plant growth is in 1 to 13 feet of water. This increased sparse growth of plants in deeper waters lowers the overall percentage of growth in the littoral zone when compared to 2007 results.

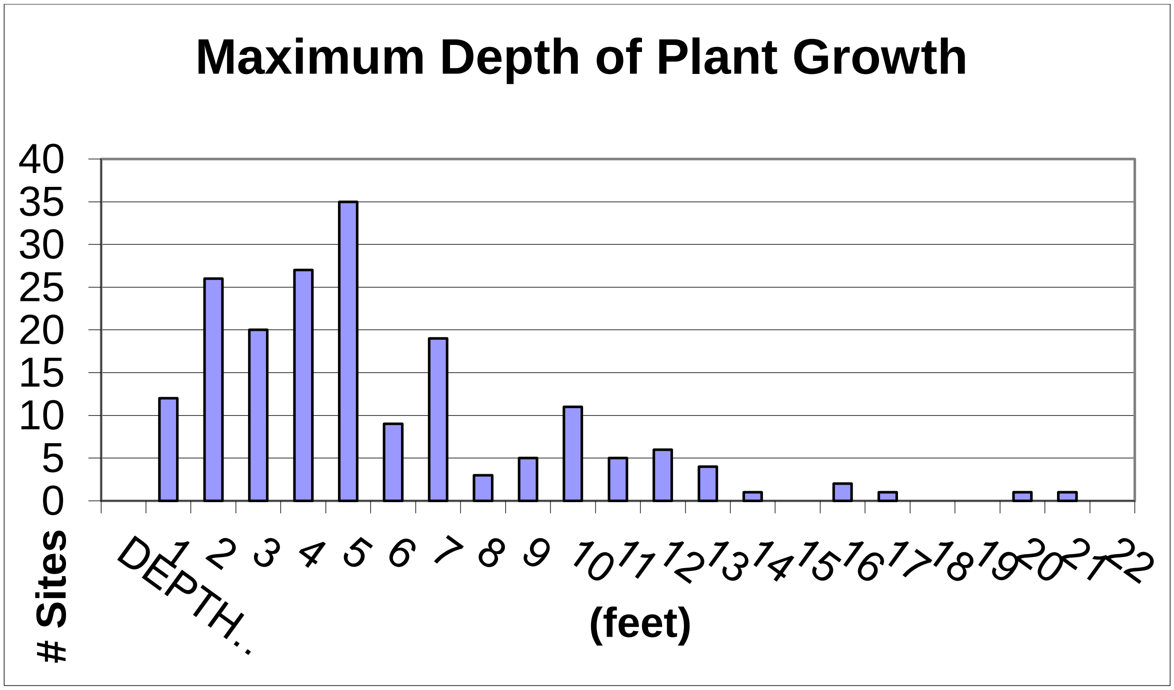

Figure 17. Maximum Depth of Plant Growth at Sample Sites

Table 2. Plant Coverage Statistics

Category	***2007***	***2012***
Percent all sample points with vegetation	22.6%	29.8%
Percentage of points less than maximum depth of plants with vegetation	80.14%	64.4%
Maximum depth of plants	17.9 ft	20.7 ft

Plant Diversity

Bone Lake has a very diverse native plant community. Table 3 lists the 34 native species and 2 non-native species sampled in the plant survey. Of the 34 native species, 32 are vascular plants and 2 are algae (filamentous algae is not included in the species richness - count of plants). Frequency of occurrence means the percentage of all sample points where a given plant occurred. Relative frequency refers to the percentage of times a given plant was sampled compared with of all times plants were sampled in the survey.

The species with the highest relative frequency were *Chara sp*., wild celery *(Vallisneria Americana)* and coontail *(Ceratophyllum demersum)* with relative frequencies of 14.4%, 13.2% and 11.3% respectively. *Chara* is actually an algae, while wild celery and coontail are vascular plants. All three are desirable, native plants found in many Wisconsin lakes. No one plant dominates the aquatic plant community. The distribution of the three most common species is illustrated in Figure 18.

The functions aquatic plants contribute to the lake ecosystem are very important. The most common plant, *Chara sp*. also known as muskgrass, provides great habitat for small invertebrates that are fed on by fish and other organisms. *Chara* also can grow in deep water where other plants may not be very successful. Wild celery, the next most common plant, provides good habitat for fish and food for various waterfowl.

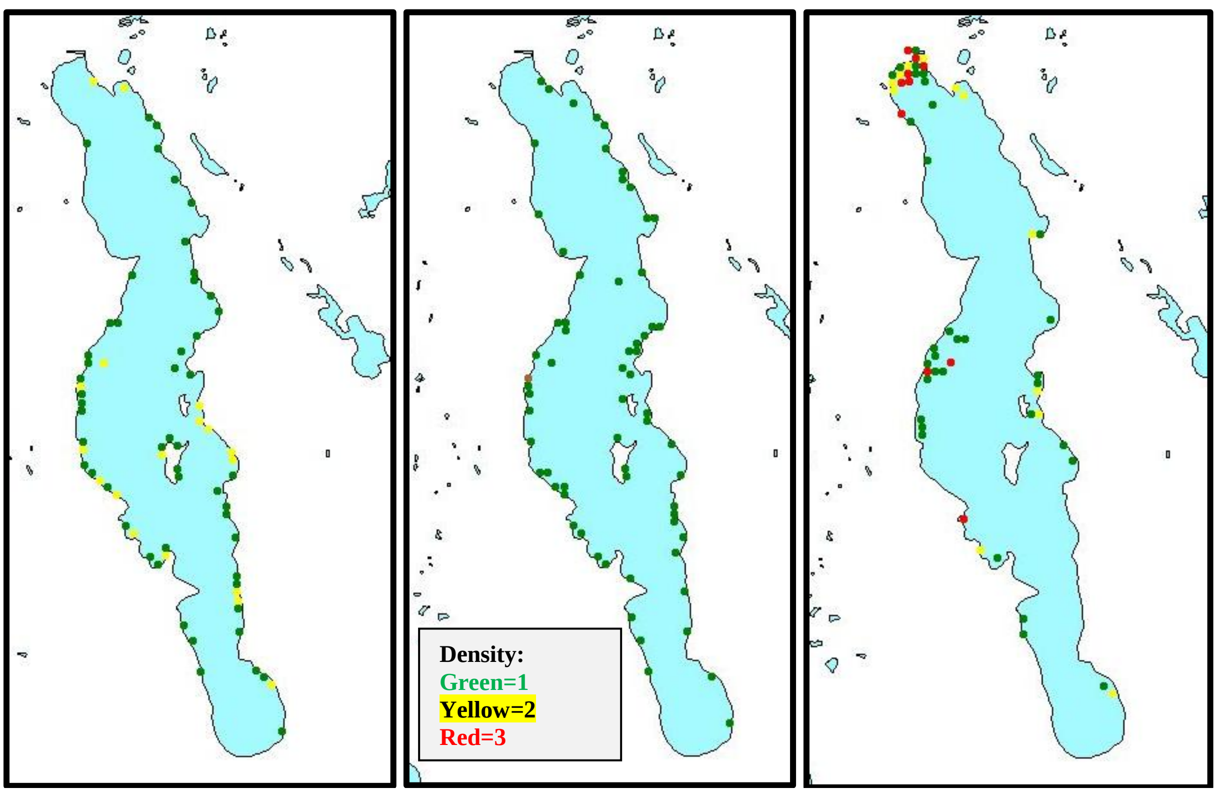

Figure 18. Density of Three Most Common Plant Species: Chara, Wild Celery, and Coontail (from left to right)

Table 3. Aquatic Plants in Bone Lake

Species	Frequency of occurrence	Relative frequency	Number sampled	Mean density
Chara sp., Muskgrasses	36.46	14.40	70	1.26
Vallisneria americana, Wild celery	33.33	13.17	64	1.00
Ceratophyllum demersum, Coontail	28.65	11.32	55	1.58
Najas flexilis, Slender naiad (Bushy pondweed)	21.35	8.44	41	1.07
Potamogeton zosteriformis, Flat-stem pondweed	18.23	7.20	35	1.20
Myriophyllum sibiricum, Northern water-milfoil	16.67	6.58	32	1.09
Potamogeton richardsonii, Clasping-leaf pondweed	9.90	3.91	19	1.00
Potamogeton pusillus, Small pondweed	8.85	3.50	17	1.18
Stuckenia pectinata, Sago pondweed	8.85	3.50	17	1.06
Lemna trisulca, Forked duckweed	8.33	3.29	16	1.06
Potamogeton crispus,Curly-leaf pondweed	7.81	3.09	15	1.00
Lemna minor, Small duckweed	7.81	3.09	15	1.00
Potamogeton illinoensis, Illinois pondweed	6.77	2.67	13	1.00
Wolffia columbiana, Common watermeal	6.77	2.67	13	1.00
Spirodela polyrhiza, Large duckweed	6.25	2.47	12	1.00
Nuphar variegata, Spatterdock	3.65	1.44	7	1.00
Nymphaea odorata, White water lily	3.13	1.23	6	1.00
Potamogeton friesii, Fries' pondweed	2.60	1.03	5	1.20
Schoenoplectus acutus, Hardstem bulrush	2.60	1.03	5	1.00
Potamogeton gramineus, Variable pondweed	2.08	0.82	4	1.00
Potamogeton foliosus, Leafy pondweed	1.56	0.62	3	1.67
Potamogeton praelongus, White-stem pondweed	1.56	0.62	3	1.33
Eleocharis erythropoda, Bald spikerush	1.04	0.41	2	1.00
Heteranthera dubia, Water star-grass	1.04	0.41	2	1.00
Nitella sp., Nitella	1.04	0.41	2	1.00
Potamogeton amplifolius, Large-leaf pondweed	1.04	0.41	2	1.00
Ranunculus aquatilis, White water crowfoot	1.04	0.41	2	1.00
Zizania palustris, Northern wild rice	1.04	0.41	2	1.00
Bidens beckii, Water marigold	0.52	0.21	1	1.00
Elodea canadensis, Common waterweed	0.52	0.21	1	1.00
Equisetum fluviatile, Water horsetail	0.52	0.21	1	1.00
Isoetes lacustris, Lake quillwort	0.52	0.21	1	1.00
Sagittaria cuneata, Arum-leaved arrowhead	0.52	0.21	1	1.00
Sagittaria rigida, Sessile-fruited arrowhead	0.52	0.21	1	1.00
Sparganium eurycarpum, Common bur-reed	0.52	0.21	1	1.00
Phalaris arundinacea, Reed canary grass	0.52	0.21	1	1.00
Filamentous algae	21.35		41	1.15

Bone Lake has a diverse aquatic plant community. Table 4 reports diversity values for 2007 and 2012. The species richness in 2012 (including viewed species) was high at 45 species. Another indicator of diversity is the Simpson's Diversity Index. In 2012 (and 2007) this value was calculated as 0.92. This very high value indicates that any two plants sampled are nearly certain to be different species (1.00 is the highest value for this index).

Relative frequency of the most dominant plants also demonstrates plant diversity in the lake. The most dominant species, *Chara sp.* had a relative frequency of 14.4% which shows there are many other plants that are frequent as well. If diversity is low, there is usually a plant or two that dominate the sampling and have very high relative frequencies (such as 25% or more).

Table 4. Diversity Indicators for Aquatic Plants

Parameter	2007	2012
Species richness not including visuals	31	36
Species richness with visuals	41	45
Mean number of species per vegetated point	3.24	2.59
Simpson's diversity index	0.92	0.92

Floristic Quality Index

The plant community can indicate changes in habitat and water quality from human development using a tool known as the Floristic Quality Index (FQI). This index uses the number of species sampled on the rake and a conservatism value given to certain plants. The greater the conservatism value (ranges from 1-10), the less tolerant the plant is to changes in habitat disturbances. The habitat changes are compared to pre-development characteristics in the lake (prior to human disturbances in lakes).

Dr. Stanley Nichols of UW-Extension surveyed numerous lakes in various eco-regions around Wisconsin. He then calculated the median number of species, median conservatism value, and the median FQI for each eco-region (Nichols, 1999). All parameters in the FQI for Bone Lake are higher than the Eco-region median for North Central Hardwood Forests. The FQI for Bone Lakes demonstrates that the plant community is healthy and is showing little negative response to habitat changes. The high FQI of 35.5 for 2012 is due largely to the high diversity but also the high conservatism value for the plants sampled in Bone Lake. See Table 5 for a 2007 and 2012 FQI comparison.

Table 5. Floristic Quality Index Data

FQI value	**Eco-region median**	**Bone Lake 2007**	**Bone Lake 2012**
Number of Species	14	29	34
Mean Conservatism	5.6	6.28	6.09
FQI	20.9	33.8	35.5

Wild Rice (*Zizania palustris*)

Wild rice is an aquatic plant with special significance to Native American Tribes. Wild rice is both ecologically and culturally important on the landscape. Rice beds provide diverse habitat for wildlife and fish acting as brood rearing and nursery areas. Waterfowl also use rice beds as a food source for both the abundant seeds and the diverse invertebrate community found attached to stalks. An annual grass dependent on flowing water, rice can exhibit a fair amount of variation in abundance from year to year in the same bed. Densities can fluctuate from bumper crops to poor production years. Being a plant of shallow water means that beds will not expand out further than 4 feet deep, preferring water depths from 6 inches to 3 feet. Culturally rice has played a prized role in the lives of the Ojibwe and others who have realized the nutritional value of this important resource.

Tribal Interests

Native American Tribal representatives have special interest and rights related to aquatic plant management in Bone Lake because of the wild rice present. Bone Lake is located within Tribal ceded territories. Staff members from the St. Croix Tribal Environmental Services Department were invited to participate in the planning process. Draft and final copies will be distributed to the Tribe and the Great Lakes Indian Fish and Wildlife Commission.

When Ojibwe tribes living in the western Great Lakes region ceded lands by treaty to the United States, they retained the right to fish, hunt, trap, and gather resources from the lands they ceded. These treaties and the agreements in them have been upheld by modern courts, and remain in effect today. In Wisconsin, roughly the northern third of the state (including all of Polk County but the southwest corner) consists of ceded territory where tribal rights were retained. On these lands, the state has the legal obligation to provide consultation with the tribes whenever a permit, decision, or management action may affect the wild rice resources upon on which their harvest rights depend.

Wild Rice Inventories

A St. Croix Tribal wild rice inventory in 2006 found wild rice totaling about 5.5 acres on the northwest corner of the lake. Rice was estimated to cover about 60 percent of the mapped beds which had a water depth of 12 to 19 inches. The map of rice beds found in medium density is shown in *Figure 19*.

The point intercept survey in both 2007 and 2012 showed limited coverage of wild rice at the sample points. In both years there were only two sample points with rice at or near the point. However, the north end had somewhat more rice where it was growing beyond the sample point grid in both years. Short stems of rice were observed during the sample period in 2012. Most of the tops were missing perhaps as a result of consumption by wildlife. Geese are known to graze on wild rice, and other wildlife may also eat rice plants. The full extent of wild rice beds was not mapped in either 2007 or 2012.

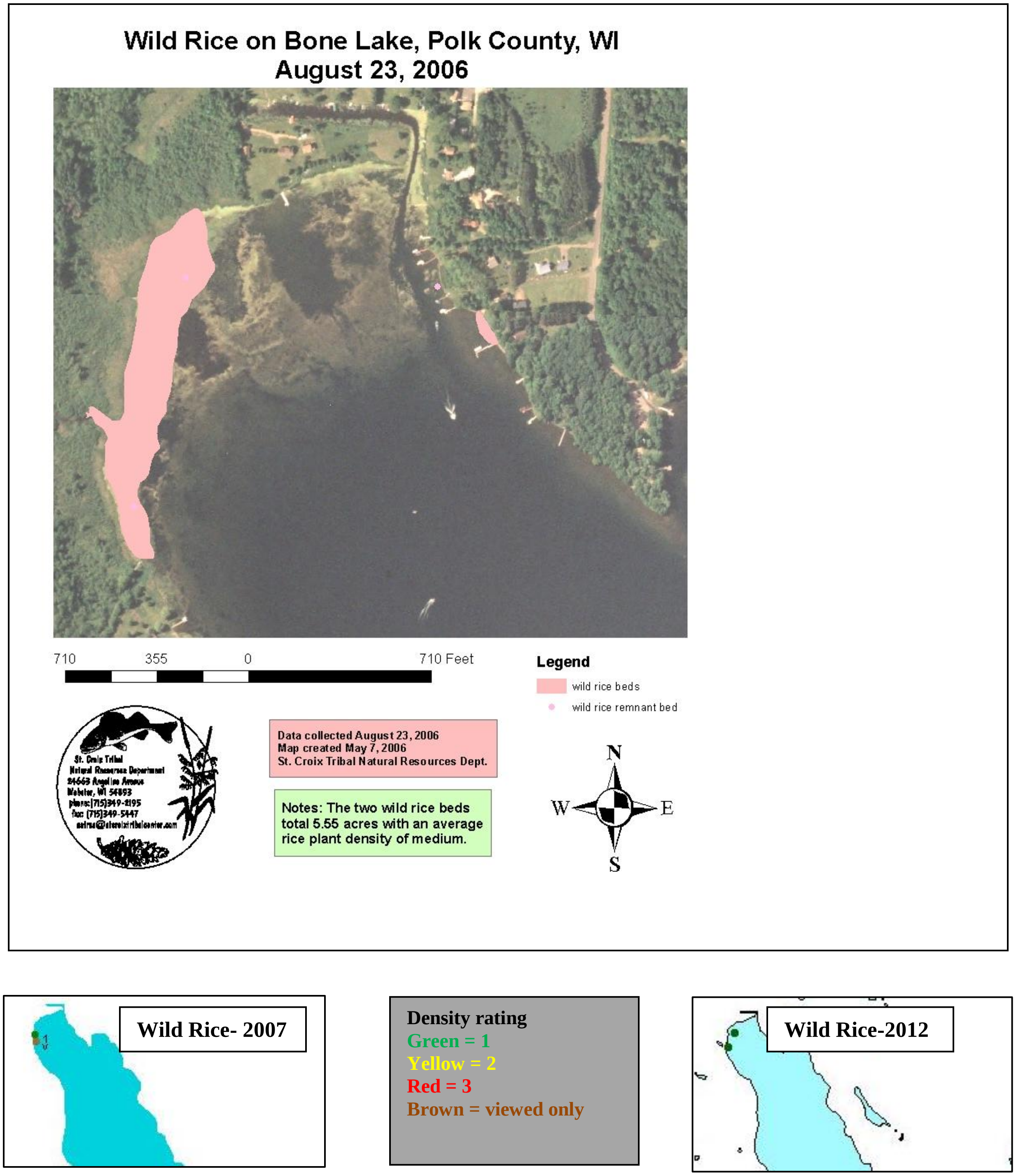

Figure 19. Wild Rice in Bone Lake 2006, 2007 and 2012

Emergent and Floating Plants

Emergent plants such as cattail and bulrush have stems that protrude above the surface of the water and floating plants such as lily pads that float on the surface. Emergent and floating plants provide unique habitat and other benefits compared to the more common submergent (underwater) species. These benefits include stabilizing lake substrates and shoreline areas, reducing wave energy from wind and boats, as well as providing habitat benefits such as shade and/or cover above the lake surface. For example, birds such as loons, herons, and ducks are frequently present among emergent plants. As a result, these areas are a priority for protection. Emergent and floating plants are often susceptible to disturbance from human activity such as boating, and their presence is often reduced. Bone Lake has some very important areas containing emergent and floating species of plants (such as bulrush, white water lily, and spatterdock to mention a few) which are illustrated in Figure 20.

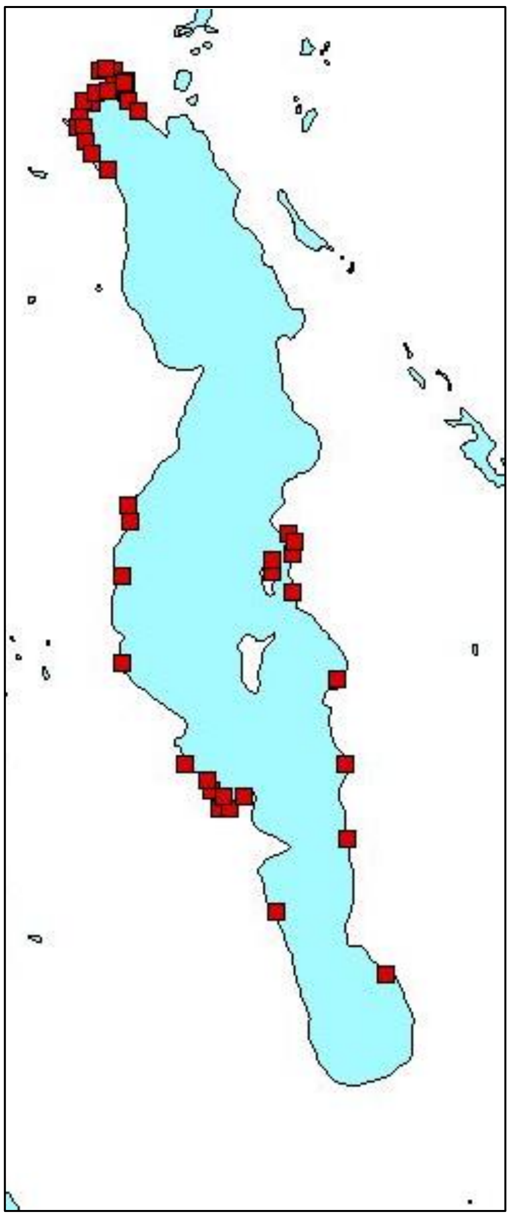

Figure 20. Locations of Floating and Emergent Aquatic Plants 2012

Invasive Species

Curly Leaf Pondweed

Ecological Integrity Service conducted an early season survey to assess the location of the invasive species curly leaf pondweed *(Potamogeton crispus*) in both 2007 and 2012. Because curly leaf pondweed (CLP) is most robust in early summer, the surveys were conducted in June. The entire littoral zone was surveyed for CLP. The CLP beds mapped in Figure 21 below were at or near surface, had a consistent density of 3 (with a scale from least to greatest density of 0 to 3), an estimated aerial coverage of greater than 50%, and were navigable around the perimeter of the bed. Curly leaf pondweed sample locations were also recorded in the later season survey in both 2007 and 2012 and are mapped below. There was less CLP growth in 2012 (68 acres in beds) compared with 2007 (87 acres in beds) in both the early and late season surveys.

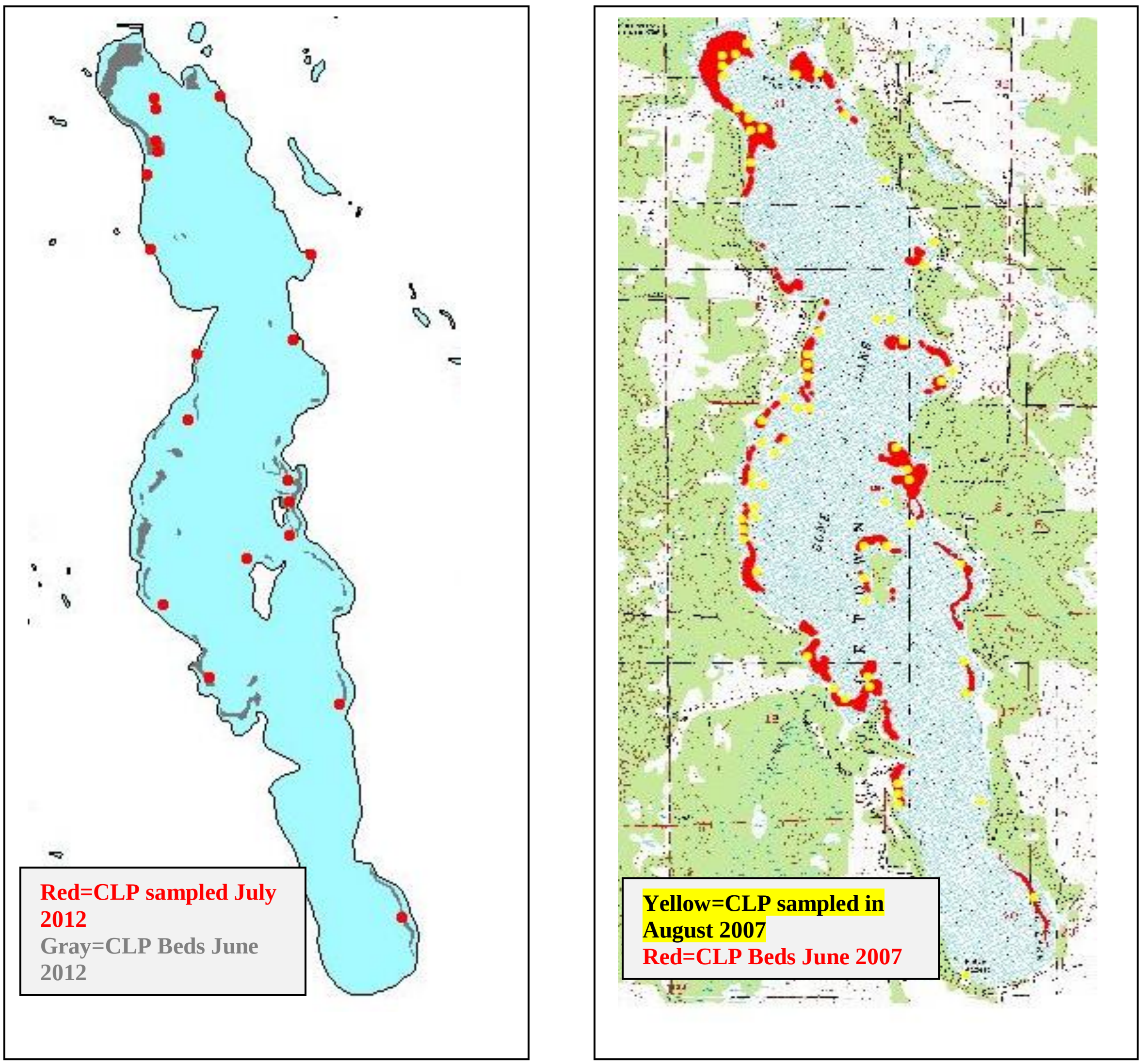

Figure 21. Curly Leaf Pondweed Present in 2012 (left) and 2007 (right)

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.[10]

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.[11]

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[10] Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species. Prepared by Wisconsin DNR. September 2003.
[11] 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*)[12]

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 1 to 3 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 2 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, they germinate in the fall, over-wintering as a small plant. The next summer they 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

[12] 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.

CLP Significance to Bone Lake Phosphorus Load[13]

The Bone Lake Management District commissioned recent studies to better understand the phosphorus budget of the lake and the significance of curly leaf pondweed to that budget. This included an analysis of the release of phosphorus from the lake's bottom sediments, a study of release of phosphorus from CLP, and measuring flow and taking water quality samples from culverts that flow from the watersheds to the lake.

The curly leaf pondweed study provided information regarding the extent and impact of CLP. Forty-six acres of dense beds of curly leaf pondweed were present in Bone Lake in 2010. This acreage was down from 2007 (when previously measured at 87 acres) in part because of the success of CLP treatment efforts. CLP growth can also vary considerably from year to year. The amount of CLP per unit area within beds (294 g/m2) and percent phosphorus within the CLP tissue (0.34 percent) provided an estimate of 187 kg of phosphorus present in CLP in Bone Lake. These results are similar to what is reported in previous studies.

The Bone Lake study took another step: measuring the phosphorus that was released to the water column during the early summer. Two methods were used: 1) phosphorus measurements taken near beds of curly leaf pondweed and in areas of native plant growth and 2) phosphorus measurements taken in enclosed cylinders - one with curly leaf pondweed and the other with native plants. Phosphorus measurements taken near CLP beds in June showed higher rates of phosphorus than near native plants. However, the amounts fluctuated greatly, probably as a result of wave action. The cylinder results were especially enlightening. They demonstrated that only 21% of the phosphorus available in plant tissue was released into the water column. Remaining phosphorus likely returned to the bottom and was unavailable for algae growth. It is this 21% or about 40 kg that is shown in the phosphorus budget pie chart for 2010 (Figure 10).

In-lake measurements at the deep hole of the lake showed a spike in phosphorus July 5th, shortly after CLP died back in 2010. This spike was likely largely due to CLP dieback. The lake was stratified at the time, so the phosphorus didn't come from the bottom sediments. Calculations of loading from the tributaries and culverts showed these amounts were contributing factors, but not the main cause of the spike.

In conclusion, while the contribution of P from CLP is relatively small (about 3%) it comes at a time when the lake waters are warm and algae can grow. A management program to minimize the amount of CLP in the lake, could potentially delay an algae bloom in Bone Lake.

[13] Complete study methods and results are available in the report *Contribution of Potamogeton crispus to the Phosphorus Budget of Bone Lake, Polk County WI*. June 2010.

Curly Leaf Pondweed Control[14]

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[15]

The ecological risks associated with an infestation of Eurasian water milfoil (EWM) appear to surpass those associated with curly leaf pondweed. This plant is not yet present in Bone Lake. However, there is a high risk that Eurasian water milfoil may become established in Bone Lake because of potential transfer from nearby lakes.

The main Bone Lake public boat landing is located at the north side of the lake and a second, less developed landing is on the southern shore (see Figure 5). Bone Lake is a popular fishing lake. Many lake property owners and visiting anglers travel from the Twin Cities, Minnesota metropolitan area and access the lake at the boat landings. With Eurasian water milfoil present in many urban Twin Cities lakes, such as White Bear Lake and Lake Minnetonka, 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.*

Department of Natural Resource scientists have also found Eurasian water milfoil in Polk County (Long Trade, Horseshoe, and Pike Lakes) and in nearby counties of Burnett (Ham, Little Trade, Shallow and Round Lakes), Barron (Beaver Dam, Sand, Kidney, Duck, Horseshoe, Lower Vermillion, and Echo Lakes), and St. Croix County (Bass Lake (T30N, R19W, S23), Goose Pond, Little Falls Lake, Mallallieu Lake, Perch Lake, The New Richmond Flowage, and Lake St. Croix) in Wisconsin. Lake users

[14] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).
[15] Wisconsin DNR Invasive Species Factsheets from http:/dnr.wi.gov/invasives.

carrying plants from one of these lakes into Bone Lake can dramatically increase the chance for colonization of EWM.

The following Eurasian water milfoil information is taken from a Wisconsin DNR fact sheet. Both Northern milfoil and coontail, mentioned below as frequently mistaken for Eurasian water milfoil are present in Bone Lake.

Identification

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.

Characteristics

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 lakebeds, 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.

Reproduction and Dispersal

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.

Ecological Impacts

Eurasian water milfoil’s 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 in infested lakes.

Control Methods

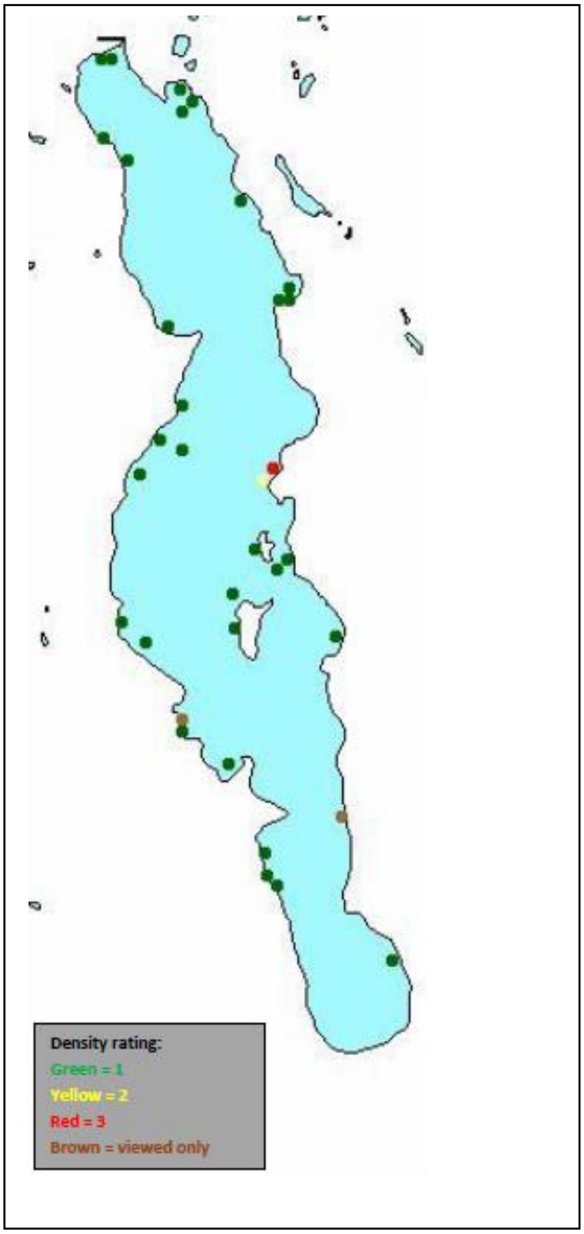
Preventing a Eurasian water milfoil invasion requires various efforts. The first component is public awareness of the necessity to remove weed fragments at boat landings. Inspection programs should provide physical inspections as well as a direct educational message. Native plant beds must be protected from disturbance caused by boaters and indiscriminate plant control that disturbs these beds. A watershed management program should decrease nutrients reaching the lake and reduce the likelihood that Eurasian milfoil colonies will establish and spread.

Monitoring is also important, so that introduced plants can be controlled immediately. The lake association and lakeshore owners should check for new colonies and control them before they spread. The plants can be hand pulled or raked. It is imperative that all fragments be removed from the water and the shore.

If Eurasian water milfoil is introduced, additional control methods should be considered including mechanical control, chemical control, and biological control. As always, prevention is the best approach to invasive species management.

Because Eurasian water milfoil is found in nearby lakes, it is prudent to provide a contingency plan to be best prepared to control EWM, should it be found in the lake. A contingency plan should include a systematic monitoring program and a fund to provide timely treatments.

A good strategy for a systematic monitoring program is to target areas where the native northern water milfoil (*Myriophyllum sibiricum)* is found. This plant is often confused with Eurasian water milfoil, which looks somewhat similar. Unlike Eurasian water milfoil (EWM), northern water milfoil is native and a desirable plant to have in the lake. It has very fine leaves that provide habitat for small planktonic organisms, which make up an important part of the food chain. From a management perspective, the location of northern water milfoil can be important, because EWM and northern water milfoil grow in similar conditions. Northern water milfoil is not very common in Bone Lake with a frequency of occurrence of 6.2%. The northern water milfoil locations shown in Figure 22 below should be carefully monitored for EWM each year.



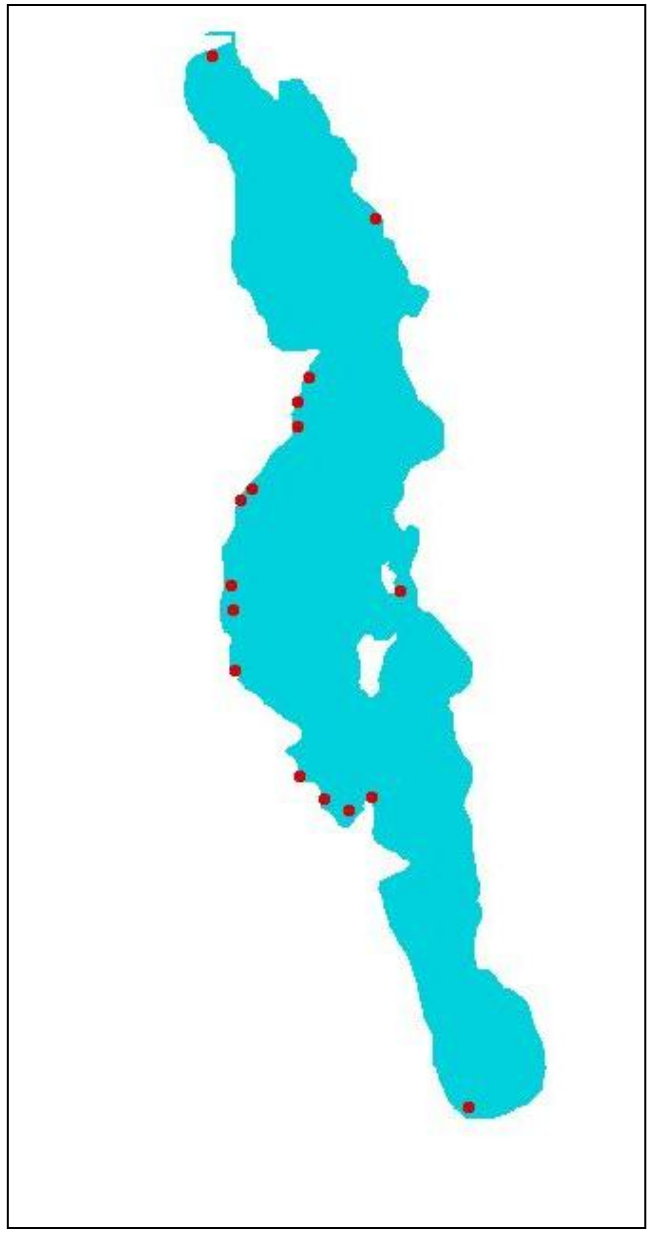


Figure 22. Northern Water Milfoil Locations in 2012 (left) and 2007(right)

Purple Loosestrife (*Lythrum salicaria*)[16]

Purple loosestrife is a non-native plant common in Wisconsin, but not identified on Bone Lake. 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, 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-

[16] Wisconsin DNR Invasive Species Factsheets from http:/dnr.wi.gov/invasives.

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 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. 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 12 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. 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. Generally, the formula designed for use on wet sites should be used. 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: 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. Currently, glyphosate is the most commonly used chemical for killing loosestrife. 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 a permit. He will want to know about your site, may make control suggestions and will issue the permit.

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 DNR, 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 marmoratus*) 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.

Aquatic Plant Management

This section reviews the potential management methods available to reach plan goals, existing management activities, and presents aquatic plant management goals and strategies for Bone Lake.

Discussion of Management Methods

Techniques to control the growth and distribution of aquatic plants are discussed in following text. The application, location, timing and combination of techniques must be considered carefully.

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. This includes granular herbicides available through mail order and internet purchase. A Department of Agriculture, Trade, and Consumer Protection pesticide applicator certification (aquatic nuisance control category) is required to apply liquid chemicals in the water.

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 limited 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 means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.[17]

Manual Removal[18]

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

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[17] More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site www.dnr.wi.gov.
[18] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

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. Department of Natural Resources 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. A harvester can also be used to gather dislodged, free-floating plant fragments such as from coontail or wild celery. 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. Sediment suspension and 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 contracted 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. Contract harvesting is not readily available in Polk County.

The 2007/08 Aquatic Plant Management Committee discussed harvesting as an option for clearing navigation channels. However, native plant growth has not reached a threshold where management has been necessary. Harvesting is not a proven successful method for CLP management. Harvesting is not recommended for native plant management at this time because of the lack of demand and likely small acreage of navigation impairment.

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 pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology should be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can be formed from this type of operation. Fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated to be effective. When applied toward 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 can 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 problem. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment.

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 sediments that are contaminated could possibly release toxins to the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine 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[19]

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 native pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

While this theory has worked in practice for control of some nonnative aquatic plants, results have been varied (Madsen, 2000). Beetles are commonly used to control purple loosestrife populations in Wisconsin with good success. 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. Grass carp introduction is not allowed in Wisconsin.

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, as well as plant-specific control. On the other hand there are several disadvantages to consider, including very long control times of years instead of weeks, lack of available agents for particular target species, and relatively narrow environmental conditions for success.

Biological control is not without risks; new non-native species introduced to control a pest population, may cause problems of its own. Biological control is not currently proposed for management of aquatic plants in Bone Lake.

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

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 Bone Lake because a healthy, diverse native plant population is present.

Physical Control[20]

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 DNR 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. It is best used as a lake remediation technique.

Dredging is not suggested for Bone Lake as part of the aquatic plant management plan. It is being considered in the Lagoon area on the north end of the lake because of navigation impairment from sediment accumulation. The Lagoon is a human-made channel created in the late 1960's.

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.

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

Although drawdown is inexpensive and has 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 often not in a consistent fashion (Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy species, particularly annuals. Drawdown is not a feasible option for Bone Lake.

Benthic Barriers or other bottom-covering approaches are another physical management technique. The basic idea is that the plants are covered over 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 combinations of the above (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984). The problem with synthetic sheeting is that the gasses evolved from decomposition of plants and sediment decomposition collect under and lift the barrier (Gunnison and Barko 1992). Benthic barriers will typically kill plants under them within 1 to 2 months, after which 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 Department of Natural Resources permit would be required for a benthic barrier.

Shading or light attenuation reduces the light plants need to grow. Shading has been achieved by fertilization to produce algal growth, by application of natural or synthetic dyes, shading fabric, or covers, and by 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 of only limited applicability. Physical control is not currently proposed for management of aquatic plants in Bone 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. Wisconsin Department of Natural Resources permits under Chapter NR 107 are required for herbicide application. **Aquatic herbicides must be applied only by licensed applicators.**

General descriptions of herbicide classes are included below.[21]

Contact Herbicides

Contact herbicides act quickly and are generally lethal to all plant cells that 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. 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, 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 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,

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

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 that can in turn affect other organisms. Or, weed control operations can affect water chemistry that in turn affects organisms.

General descriptions of the breakdown of commonly used aquatic herbicides are included below.[22] Chemicals recently used in Bone Lake are listed and described in Table 6 below.

Table 6. Herbicides used to manage aquatic plants in Bone Lake

Brand Name(s)	Chemical	Target Plants
Captain, Nautique, Cutrine Plus	Copper compounds	Free floating and filamentous algae, also coontail, curly leaf pondweed, water celery, pondweeds
Aquathol K, Hydrothal	Endothall	Curly leaf pondweed also other submergent plants: coontail, milfoil, pondweed, water celery
Reward	Diquat	Pondweeds, coontail, Eurasian water milfoil
Aquakleen, Navigate	2,4-D	Eurasian and other milfoils

Copper[23]

Copper is an essential trace element that tends to accumulate in sediments and can be toxic to aquatic life at elevated concentrations (United States Environmental Protection Agency, June 2008).

A study completed by MacDonald et al. (2000) developed consensus based numerical sediment quality guidelines for metals in freshwater ecosystems. This study provides guidelines for metals in freshwater ecosystems that reflect threshold effect concentrations (TECs, below which harmful effects are unlikely to be observed) and probable effect concentrations (PECs, above which harmful effects are likely to be observed). The consensus based TEC for copper is 31.6 mg/kg and the consensus based PEC for copper is 149 mg/kg.

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

23 Copper background information is from the Long Lake Management Plan prepared by the Polk County Land and Water Resources Department March 2013.

The sediments of Bone Lake exceeded the TEC and are near the PEC for copper at sampling sites in the north half (110 mg/kg) and south half (120 mg/kg) of the lake. These samples were taken by DNR staff and tested at the State Laboratory of Hygiene in 2000.

2,4-D

2,4-D photodegrades on leaf surfaces after applied to leaves and is broken down by microbial degradation in water and sediments. Complete decomposition usually takes about 3 weeks in water and 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 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.

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. 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.

Algaecide Treatments for Filamentous Algae

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

Herbicide Use to Manage Invasive Species

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.

Early season herbicide treatment:[24]

Studies have demonstrated that curly leaf can be controlled with Aquathol K (a formulation of endothall) in 50 - 60 degree F water, and that treatments of curly leaf this early in its life cycle can prevent turion formation. Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are yet dormant, this 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.

Because the dosage is at lower rates than 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.[25]

Eurasian Water Milfoil

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil: complexed copper, 2,4-D, diquat, endothall, fluridone, and triclopyr. Early season treatment of Eurasian water milfoil is also recommended by the Department of Natural Resources to limit the impact on native aquatic plant populations. Herbicide use may be necessary to rapidly respond to an infestation if discovered in Bone Lake.

[24] Research in Minnesota on Control of Curly Leaf Pondweed. Minnesota Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.
[25] Personal communication, Frank Koshere. March 2005.

Current and Past Aquatic Plant Management Activities

Preventing Invasive Species

There are four major elements of the Bone Lake Management District program to prevent invasive species: education to lake users, Clean Boats Clean Waters program, lake monitoring for new invasive species, and a control program for any new invasive species.

Education to Lake Users

Education efforts focus on identification and prevention of new invasive species. The AIS Committee has held AIS workshops, created and improved signage at the public landings and private boat launch areas, created a laminated lake map with an AIS message, created an AIS float in the annual boat parade, and established and maintains the Bone Lake District web site. The Lake District web site, which includes AIS education materials, was improved in 2010. AIS prevention and identification information along with committee efforts are frequently highlighted in the semi-annual Bone Lake Management newsletter.

Clean Boats Clean Waters (CBCW) Program

According to the Bone Lake Newsletter, 2012 was a very successful year for the Bone Lake Clean Boats Clean Waters Program. Dick Mackie, a local volunteer, provided training for 15 CBCW youth. One of them coordinated the work scheduling and entered data. In 2012 CBCW students interviewed 732 boaters. College student, Lucas Lee provided staffing and coordination for the landing in 2011. In 2009 and 2010, students from Luck High School staffed the Clean Boats monitoring at the north landing site. They worked a total of 385 hours over the summer months in 2010 and 467.5 hours in 2009.

Clean Boats Clean Waters educators provide boaters with information on the threat posed by Eurasian Milfoil and other invasive species. They offer tips on how to keep boats, trailers and equipment free of aquatic hitchhikers. They also collect information on boater behavior, concerns, and knowledge of existing local and state laws related to anti-AIS measures. Volunteers supported the program in 2006 (24 volunteers), 2007 (30 volunteers), and in 2008 (26 volunteers).

Landing Surveillance Cameras

The video camera at the north end public landing was operational May 4, 2012. The camera is positioned to record watercraft being launched with vegetation attached. Violations of the ordinance that prohibits transporting and launching boats and trailers with vegetation attached will be enforced. The camera also serves as a reminder for boaters to check their equipment before launching and serves in that capacity as an educational tool. As of October 3, 2012, 6,219 videos were reviewed and of those there were 1,305 watercraft launches. There were no citations or warnings issued for vegetation on any watercraft based on video images. A second camera is being considered for installation at the south landing in spring 2013.

Lake Monitoring

The objective of lake monitoring is to look for new invasive species, track the spread of curly leaf pondweed, and perform lake chemistry and Secchi disk measurements. Volunteers work in teams. In 2010, 30 volunteers accumulated 136 hours of monitoring time. In the years 2006 to 2009, from 27 to 50 volunteers worked on monitoring teams logging from 146 to 250 hours.

In 2011 divers surveyed the north end landing for AIS. The intent is to survey both landing areas for AIS each year, however, neither landing was surveyed in 2012. It is critical to complete this survey when algae growth is low and visibility is good.

Rapid Response for New Invasive Species

The activity is intended to control any new invasive species that are found in the lake. The Lake District owns two EWM buoys, which will alert boaters to stay out of an area where EWM is growing. The rapid response protocol is updated in Appendix D.

Rusty crayfish (*Orconectes rusticus*) an aquatic invasive species, was discovered in Bone Lake in the summer of 2012. An email list, the web site, and newsletter were used to alert lake residents. There will be an effort to estimate Bone Lake's rusty crayfish population in the summer of 2013.

Curly Leaf Pondweed Management[26]

The Bone Lake Aquatic Plant Management Plan (2008) initiated an early season herbicide treatment of curly leaf pondweed beginning in 2008. Plan implementation for curly leaf pondweed management (Goal 3) emphasizes alleviating specific spring navigation concerns, addressing CLP growth in front of individual properties, testing the effectiveness of ongoing treatment methods, and protecting native plant populations. The potential approaches considered in the 2008 were described in Appendix E of the 2008 plan.

The treatment strategy followed accepted practices of using a low dose of the herbicide Endothall to control CLP before native plants are growing and before the CLP has formed reproductive structures (turions). While similar treatment methods had been used in 2006 and 2007, no detailed monitoring of effectiveness was available. The plan included testing treatment effectiveness using accepted standard DNR methods for monitoring prior to and after CLP treatment (pre and post monitoring). Pre and post monitoring was conducted by Steve Schieffer of Ecological Integrity Service from 2008 through 2012.

Four beds totaling 14 acres were selected for the CLP treatment trial. These beds were originally chosen as priorities for treatment in 2006 and 2007. CLP treatment occurred in from 2008 through 2012. Because the original treatment strategy met with limited success in 2008 and 2009, changes were made.

Changes to the program focused on maintaining needed herbicide contact time over the CLP beds. A low dose of chemical had been successfully used on other lakes and was recommended for CLP treatment. However, this concentration of chemical must remain in contact with the

[26] Schieffer, Steve. Bone Lake Treatment Analysis 2009, 2010, 2011 and 2012.

plants for at least 12-24 hours in order to be effective. In 2008 the borders of treatment areas as marked with GPS points were modified to be sure the treatment occurred over the plants and not in deep water as previously marked. Treatment bed #1, located across the lake from bed #2 near a steep drop off was eliminated from treatment for 2009. Drop offs can cause water currents which dilute herbicides that are applied. However, little success was measured in either 2008 or 2009. As a result herbicide concentration was increased and restrictions for wind conditions (current and forecast low winds) were added for the 2010 season.

2010 Treatment Results

2010 was the third year of herbicide treatment on 3 of the 4 beds (2, 3, and 4) and the second on bed 5. The map shows the location of each bed treated and the acreage. The 2010 treatment occurred over two days in May using Aquathol K (Endothall) at a target concentration of 1.5 ppm. The herbicide treatment was effective in 2010. All data shows a significant reduction in the density of CLP in each bed. All individual beds except bed 4 showed a statistically significant reduction in frequency. The analysis of all beds together shows a significant reduction in the frequency of CLP. Visual observation supports this reduction as no beds had CLP growth at or near the surface.

The timing of early season treatments is selected in part to avoid damage to native aquatic plants. There was no significant change in *native* plant frequency between 2009 and 2010 in the four beds except for filamentous algae (which showed a reduction). This is not a concern as the filamentous algae is an unwanted species at high levels of growth. Filamentous algae is not affected by this herbicide, so this reduction was not due to the treatment.

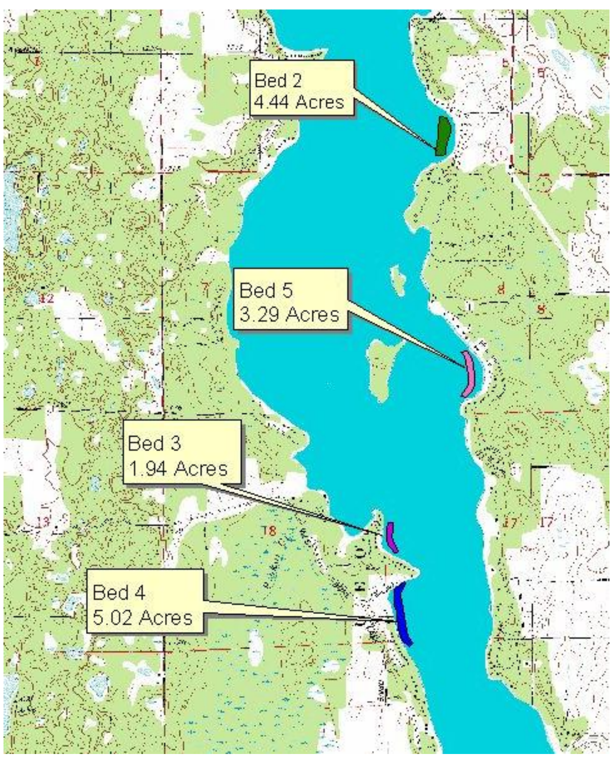


Figure 23. CLP Treatment Areas 2009 – 2012

2011 Treatment Results
The 2011 CLP treatment occurred on May 17 and May 19. Target treatment concentration was 1.5 ppm or 1 gallon per acre foot.

Bed	Treatment Date	Water Temp	Wind Speed/ Direction	Reported Treatment	Acre Feet	Gal/Acre Foot
2	5/17/11	51.3 º F	3-6 mph SSE	31.52 gal	28.0	1.12
3	5/19/11	54.8 º F	3-6 mph ESE	15.97 gal	16.3	.98
4	5/19/11	54.9 º F	2-5 mph ESE	43.72 gal	45.5	.96
5	5/17/11	51.1 º F	2-6 mph SSE	22.98 gal	24.1	.95

Treatment in 2011 was less effective than in 2010 even though specified treatment conditions were followed. Reductions were shown between the pre and post monitoring for each bed. However, there was no significant reduction in CLP frequency between 2010 and 2011 overall or in any of the individual beds.

There was significantly less growth in three native species: forked duckweed, wild celery, and flat-stem pondweed between 2010 and 2011. However, this difference is likely due to a late spring in 2011 rather than a reduction due to the herbicide treatment.

2012 Treatment Results
An early season CLP treatment occurred on May 8 and May 16, 2012 with 12.7 acres of CLP treated. Target treatment concentration was increased to 2.0 ppm.

The treatment surveys show that the overall treatment was statistically significant in reducing CLP frequency. When comparing the 2011 post treatment to the 2012 post treatment, all beds combined had a reduction in frequency and density. However, the total area of CLP beds lake-wide increased from 56 acres (2011) to 68 acres (2012), most likely due to annual variability rather than ineffective treatment.

Table 7. Comparison of 2011 and 2012 CLP Post Treatment Frequency

	2011 post	2012 post	Decrease?	Significant?
Plot 2	0.31	0.35	NO	---
Plot 3	0.60	0.12	YES	---
Plot 4	0.61	0.06	YES	---
Plot 5	0.79	0.39	YES	---
All Beds	0.59	0.22	YES	YES*

No statistically significant impacts to native plants were found within the treatment beds between the 2011 and 2012 post treatment surveys. In fact, northern water milfoil had a significant increase in frequency.

2013 Planned Treatment
Expanded CLP treatment is planned for 2013 as outlined in Table 8 and shown in Figure 24.

Table 8. Planned 2013 CLP Treatment

Bone Lake CLP Beds for 2013 Treatment (tentative)				
Bed	**Area (acres)**	**Mean Depth (ft)**	**Acre Feet**	**Endothall Concentration**
2	2.53	9.1	23.0	2 ppm
3	2.2	7.4	16.3	2 ppm
4	4.4	8.5	37.4	2 ppm
5	3.26	8.2	26.7	2 ppm
6-new	8.81	6(approx)	52.9	2 ppm
7-new	5.25	7(approx)	36.8	2 ppm
8-new	4.01	6(approx)	24.0	2 ppm
Total	**30.46**			

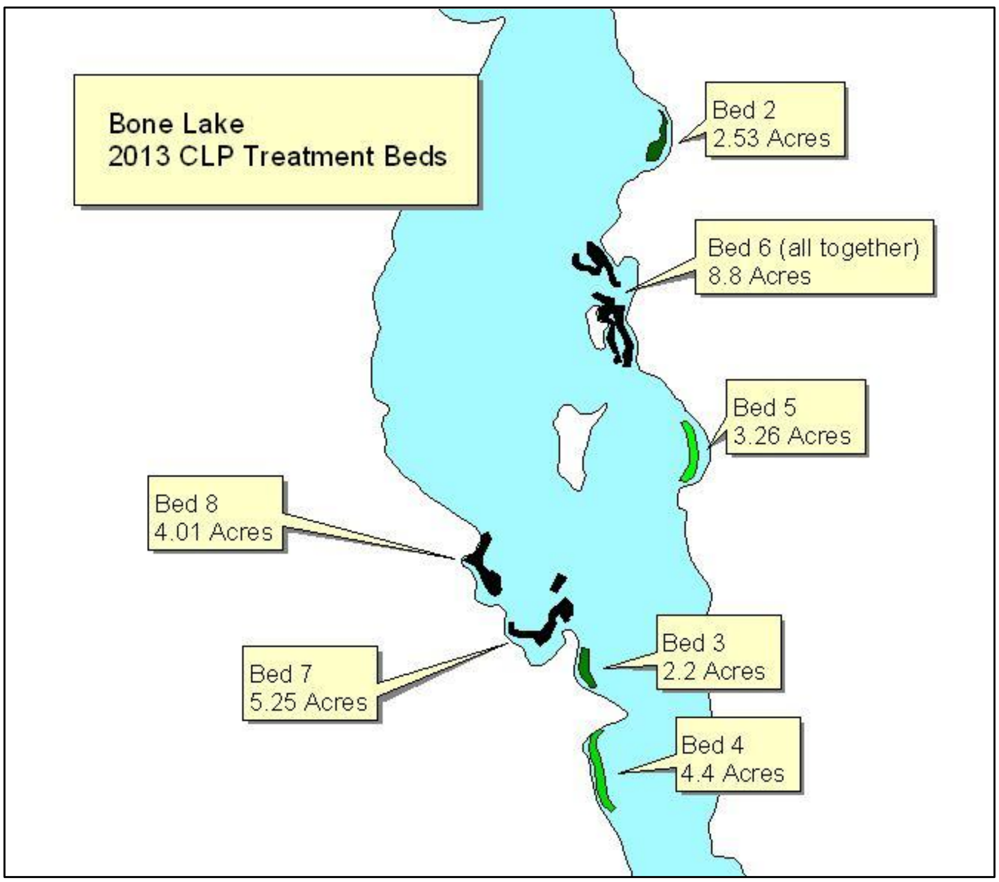


Figure 24. Planned 2013 CLP Treatment Beds

Turion Monitoring

Turions are the reproductive structures from which new CLP plants will germinate in late summer, fall, and early spring. CLP turions can live in lake sediments for many years. A primary objective of the CLP herbicide treatment program is to kill CLP plants before they can form turions, thereby depleting the turion bank in the sediments and preventing future CLP growth.

Turion monitoring measures the density of turions in the sediment. Turion sediment monitoring is conducted late in the summer after CLP plants die back. A sediment sampler is used to collect bottom sediment at several randomly selected sample points within the treatment beds. The sample is then filtered with a filter bucket, and the turions are counted. Because the sample collection area is known, the number of turions per square meter of lake bed can be estimated.

Repeated years of turion density measurements provide a means to predict the following year's CLP growth and to evaluate the long term effectiveness of the herbicide treatment program. The data will aid in decisions regarding continuation or suspension of herbicide treatment. Turion monitoring was recommended for Bone Lake CLP management with the updated implementation plan for 2011. Sediment turions were analyzed within the CLP treatment beds in 2011 and 2012. The sediment turion analysis revealed a density reduction from 2011(296 turions/m^2) to 2012 (75 turions/m^2). Turion density results are shown for each bed in Figure 25.

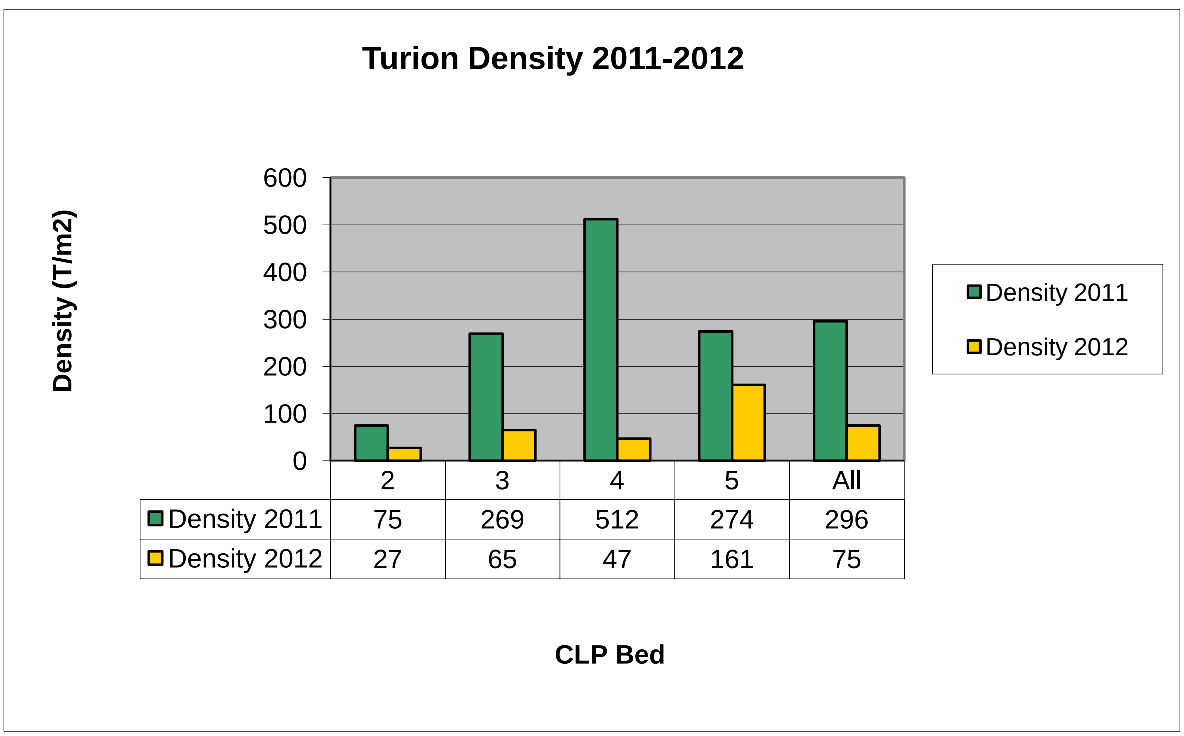


Figure 25. Bone Lake Turion Density 2011 – 2012

Navigation Channel Management

Navigation channels were designated in the 2008 Aquatic Plant Management Plan and refined in the summer of 2009. Severe navigation impairment must be found before any management of native plants is authorized by permit. No severe navigation impairment was identified in 2008 through 2012. If navigation impairment was identified, the 2008 APM plan selected herbicide treatment as the management method. Harvesting is listed as an alternative for maintaining summer navigation channels.

The *Bone Lake Aquatic Plant Survey Technical Report and Management Plan* (Draft 2 December 2005) and *2005 Bone Lake Aquatic Plant Management Plan Implementation Report* designated navigational channels at specific locations in the lake. These proposed navigational channels shown in the report total 7.4 acres. They are 20, 25, or 50 feet wide depending upon location.

Wisconsin Department of Natural Resources Aquatic Plant Management permits and required application reports provided by the herbicide applicator to DNR indicate that the navigation channels were treated in 2006. In 2007, DNR again issued a permit to treat navigational channels in late June or early July. This permit included the condition that treatment would not be allowed if the Secchi depth was less than four feet at the proposed time of application. The rationale was that a navigation corridor would not be visible with low water clarity. Herbicide treatment did not occur to maintain navigational corridors in 2007 because DNR and Bone Lake Management District representatives agreed that plant density did not warrant treatment.

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.

Documenting Impaired Navigation or Nuisance Conditions

Impairment of navigation

- 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

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

The 2007/08 Aquatic Plant Committee reviewed the navigational channels designated in the 2005 report along with the 2007 waterfront property owner survey results and developed a new map of potential navigational channels. These potential channels were shown in the 2008 APM Plan.

These channels were designated for monitoring of nuisance conditions and potential early season CLP treatment. Summer herbicide treatment or harvesting was not to be pursued unless severely impaired navigation occurred in these locations according to the procedure in the plan goals and strategies section. No summer navigation channel control was pursued by the Bone Lake Management District from 2009 – 2012.

Some of the channels were treated for early season CLP control. This included 50 foot wide channels A, K and E in 2009 through 2011. The extension of channel E into the bay was only 25 foot wide and called channel N in 2009 and 2010. Early season CLP treatment of channel A was requested but not permitted by DNR in 2012 because of tribal concerns related to wild rice growth at the north end of the lake.

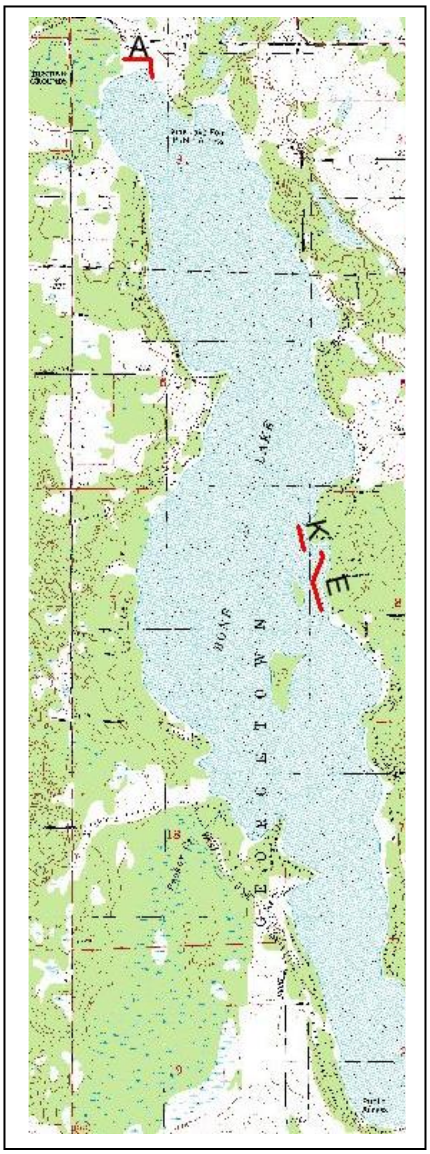


Figure 26. Bone Lake CLP Navigation Channels 2009 – 2011

Private Waterfront Herbicide Application

A significant number of landowners previously hired private contractors to spray aquatic plants to maintain boating and swimming areas in front of their Bone Lake waterfront property in the past. Most of these openings were 50 feet wide and extended out about 150 feet from the shoreline. Some areas were as wide as 150 and 400 feet. Those that sprayed plants generally also sprayed to control algae growth. Some owners had their property sprayed 2 or 3 times during the summer. Department of Natural Resources records of herbicide permits since 2000 for individual owners are summarized in Table 9. There have been no individual waterfront permits issued since 2007.[27]

Table 9. Waterfront Herbicide Treatments on Bone Lake

Year	Property Owners	Maximum Allowed Acres
2007	32[28]	5.28
2006	42	7.51
2005	34	5.89
2004	40	7.28
2003	42	6.76
2002	58	7.66
2001	72	10.63
2000	43	6.06

The DNR Northern Region released an Aquatic Plant Management Strategy in the summer of 2007 to protect the important functions aquatic plants provide 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.[29] Permits for waterfront corridors were issued in 2008 only for formerly permitted sites where impairment of navigation and/or nuisance conditions were demonstrated. 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 is carefully reviewed. The DNR has not allowed removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented.

There was certainly previous high demand for this type of management on Bone Lake. Results from the waterfront property owner survey indicated that 30% of Bone Lake residents had used chemicals to maintain an opening in front of their residence. In addition, of those who returned maps for the survey, 40% indicated navigation impairment in the spring or summer and/or a concern related to swimming in front of their residence because of the presence of aquatic plants.

The DNR recommends (and may require) that residents who wish to maintain an opening for boating and swimming use rakes or other hand methods.

[27] Mark Sundeen, DNR Aquatic Plant Permit Contact, email communication February 5, 2013.
[28] Although 29 sites were permitted, it appears from reports that 32 were sprayed.
[29] Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

Plan Goals and Strategies

Bone Lake Aquatic Plant Management Goals

Goal 1. Maintain recreational uses important to lake residents and users including swimming, fishing, and boating while balancing the need to preserve important native aquatic plant functions and their values.

Goal 2. Prevent the introduction of Eurasian water milfoil and other invasive aquatic plants.

Goal 3. Manage curly leaf pondweed to minimize navigation problems, prevent its spread, lower phosphorus contribution to algae blooms, and protect native plant populations.

Goal 4. Protect the natural functions of diverse native plants including fish and waterfowl habitat, sediment stabilization, protection against invasion by non-native species, and natural aesthetics.

Goal 5. Educate lake residents and visitors about the role of aquatic plants in the lake, the management strategies found in the plan, and appropriate plant management actions.

The goals above were established in the 2008 Bone Lake Aquatic Plant Management Plan. The goals were reviewed by the advisory committee at the April 2013. Objectives and actions were updated following input from the committee. This input is included as Appendix E.

All action items are to be conducted by the Bone Lake Management District in partnership with other agencies unless otherwise indicated. Responsible parties for plan implementation are described on the following page. The implementation plan chart summarizes the timeline, costs, and responsible parties for the action items listed under the plan goals and objectives.

Responsible Parties for APM Implementation and Monitoring

Bone Lake Management District Board (DB) – elected/appointed officials responsible for oversight of the lake management district. Some actions such as hiring a contractor or consultant require a vote of the board.

APM Lead – Commissioner or lake volunteer who makes day-to-day APM decisions and directs contractors in herbicide treatments and related monitoring. The APM Lead will also have volunteers and consultants to assist in these activities. Bob Boyd is the APM Lead.

AIS Network Coordinator – leads and coordinates volunteer AIS education activities including Clean Boats, Clean Waters monitoring and education at the boat landings and lake monitoring. The AIS Network Coordinator is currently Bob Boyd.

AIS Network– carries out AIS activities and makes recommendations for grants and project activities as coordinated by the AIS Network Coordinator.

Clean Boat, Clean Waters Coordinator (CBCW) – leads and coordinates Clean Boats Clean Waters program as outlined in the plan. The CBCW Coordinator is currently Dick Mackie.

Monitoring Coordinator (MC) – leads and coordinates volunteer monitoring as outlined in the plan. The Monitoring Coordinator is currently Bob Boyd.

Monitoring Volunteers (VOL) – work under the supervision and guidance of the Monitoring Coordinator.

Citizen Lake Monitoring Volunteers (**CLM**) – take Secchi disk and lake chemistry measurements and collect water quality samples. Water quality volunteers are under the guidance of the APM lead. John McCall currently takes Secchi disk readings. Bob and Lorraine Boyd take lake chemistry readings, Secchi disk readings, and collect water samples.

Contractor – the herbicide applicator hired by the District Board to complete herbicide treatment as permitted by the Wisconsin Department of Natural Resources.

Consultants – will be hired to complete monitoring and coordination activities under the direction of the APM Lead and the District Board.

DNR – APM staff will review aquatic plant management permit applications and help to develop a system for assessing when treatment is warranted for both navigational channels and individual corridors.

Goal 1*. Maintain recreational uses important to lake residents and users including swimming, fishing, and boating while balancing the need to preserve important native aquatic plant functions and their values.*

Objective: Maintain summer navigational channels when navigation becomes severely impaired.

Objective: Allow individual corridor summer swimming and boat access when severe nuisance conditions occur.

Objective: Protect native plant populations

Action Items

Summer navigation channels
Monitor areas of navigation impairment to identify when herbicide treatment or harvesting is appropriate. To minimize impacts to native plants, treat only when navigation is severely impaired as identified with DNR and outlined on the following page.

Apply for permits for navigation channel herbicide treatment if navigation impairment is identified.

Supervise and direct contracted applicator.

Conduct treatment according to permit conditions.

Provide follow-up monitoring on effectiveness of treatment.

Consider marking navigation channels with buoys to identify their location to boaters. Installation of marker buoys requires a permit from the DNR warden.

Definition
Navigation Channels are the common navigation routes for general use.

Procedure for Summer Navigation Channel Permitting and Monitoring
(responsible parties in parenthesis)

<u>Document impairment of navigation (provide in permit) (Board APM Lead with guidance from MC.</u>

- 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
- Consultant to provide this information in permit application based upon information in Aquatic Plant Management Plan and authorized by the APM Lead.

<u>Verify/refute impairment of navigation (Board APM Lead with assistance from volunteers unless noted)</u>

- Inspect as a response to complaints or observations.
- If navigation impairment is identified, document conditions with photographs and measurements of navigation impairment.
- Measure water clarity using Secchi disk. (WQ) If Secchi depth is less than 4 feet, herbicide treatment will not be allowed because corridors are unlikely to be visible.
- For curly leaf pondweed treatment, verification must occur the year before treatment. Once CLP nuisance is verified and permit is approved, additional verification is not needed for three subsequent years (although permit applications and pre and post monitoring must be completed each year).
- Prepare and send APM permit application to DNR to receive authorization for herbicide treatment.
- DNR informs Board APM Lead if treatment is authorized.
- Board APM Lead informs herbicide applicator when herbicide treatment is authorized by DNR.

Individual corridor access
Herbicide treatment may be permitted for individual corridors in front of waterfront property. Treatment thresholds will be determined by DNR and verified by the landowner and contractor (herbicide applicator). The Bone Lake Management District will be involved only to help clarify conditions when treatment will be allowed and will not be involved in each permit request.

Inform waterfront property owners of process and limits of individual corridor access management options including DNR thresholds for allowing herbicide treatment

Procedure for Individual Corridor Permitting and Monitoring

Document nuisance conditions (landowner/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
- 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 pesticide use that were considered. These might include:
  Hand removal/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?
- Spraying will be limited to 30 foot corridors (wider corridors may be allowed at public launch areas and commercial facilities).
- Contractor (aquatic herbicide applicator) to provide this information in permit application based on information from the landowner.

Verify/refute nuisance conditions/navigation impairment

- Landowners will document conditions with photographs and submit request for treatment to DNR.
- 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 will not be allowed if water temperatures reach or exceed 58 degrees F.
- DNR will contact herbicide applicator and owner with a notice to proceed with treatment.

Goal 2. *Prevent the introduction of Eurasian water milfoil and other invasive aquatic plants.*

Objective: Be ready to rapidly respond to the introduction of aquatic invasive plant species.

Objective: Raise lake user and resident awareness to prevent Eurasian water milfoil introduction.

Objective: Monitor to detect early Eurasian water milfoil and other AIS colonization.

Action Items

Implement *Protocol for Confirmation and Response to Suspected Eurasian Water Milfoil* detailed in Appendix D.

Continue invasive species education program including Clean Boats, Clean Waters boat monitoring at landings.

Install camera at south landing. Monitor videos and pursue enforcement in cases where plants are clearly identified.

Continue volunteer monitoring to detect presence of Eurasian water milfoil and other aquatic invasive species. Periodic sampling will cover strategic locations emphasizing areas near public access points and resorts, where northern water milfoil is present, and in areas of mucky sediment.

Continue educational programming as outlined in the educational goal including maintaining signs at boat landings, special events and workshops, newsletter articles, and web site pages.

Goal 3. *Manage curly leaf pondweed to minimize navigation problems, prevent its spread, and protect native plant populations.*

Objective: Improve Bone Lake water quality

Objective: Protect native plant populations

Objective: Alleviate spring navigation concerns

Objective: Improve early season swimming and boat access

Objective: Reduce turion density in targeted beds to 5-10 turions/m2.

Objective: Continually improve CLP management on Bone Lake

Action Items

CLP Treatment: spring navigation channels and CLP beds
Potential spring navigation channels are mapped in Figure 26 of the APM plan.

Standards for when CLP treatment may be warranted:

- identified as a spring navigation concern
- May/June curly leaf pondweed stem growth reaches surface and is thick enough to impede navigation (stem height > 1 meter)
- navigable bed of CLP that is at least 400 square feet
- bed has a coverage of at least 50%
- density rating averages >2 (on a 0-3 scale)
- consideration of likely treatment success likely (not near drop-off, wide rather than narrow band, etc.)

Apply for APM permits for CLP early season Endothall treatment for spring navigation channels and CLP beds in February based on monitoring from the previous year.

Conduct treatment according to permit conditions.

Pre and post monitoring procedures to be completed by a consultant hired by the District Board and supervised by the APM Lead according to standard DNR methods.

Monitor sediment turions in treated beds. Beds currently targeted for treatment are shown in Figure 24.

Adapt treatment methods according to best available information.

- Current treatment standards specify application **rates of liquid Endothall of 1.5 to 2.0 ppm for beds and 2 ppm for navigation channels.**

forecast wind speed (including gusts) for the 24 hours following application will not be greater than 15 mph.

Individual corridor access
Respond to requests from owners for verification of curly leaf pondweed along individual access corridors.

Identification of nuisance conditions for curly leaf pondweed will need to occur the spring prior to treatment to allow for early season treatment with Endothall.

Treatment will require strict adherence to early season treatment temperature requirements for curly leaf pondweed treatment in order to protect native plant populations.

Residents are responsible for the cost of individual corridor treatments. Treatment timing will be coordinated by the APM Lead who authorizes treatment based on specified wind and temperature conditions.

Be sure residents are aware of manual options for aquatic plant removal. A riparian landowner may manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.[30]

Map curly leaf pondweed beds extent and density
Map curly leaf pondweed beds annually. The CLP beds are defined as having a density >2, an estimated aerial coverage >50%, and are navigable around the perimeter of the bed with a pontoon boat. Areas with CLP present may also be recorded. Method for mapping beds may change with guidance from the DNR.

[30] More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site www.dnr.wi.gov.

Goal 4. *Protect the natural functions of diverse native plants including fish and waterfowl habitat, sediment stabilization, protection against invasion by non-native species, and natural aesthetics.*

Objective: Implement strict adherence with treatment standards and monitoring methods prior to herbicide treatment

Objective: Increase resident's and lake user's understanding of the role and importance of aquatic plants in Bone Lake and their impacts on them.

Discussion

The plant community in Bone Lake is very diverse and extensive. It is important to understand that these plants play a very important role in the lake ecosystem. Aquatic plants in the lake provide habitat for a diverse fish population. They also provide protection from shoreline erosion. Removing native plants could lead to adverse effects in Bone Lake. Healthy native plant populations prevent colonization by invasive plants. 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.

Action Items

Monitoring methods are detailed in the discussion for Goals 1 and 3 and on the following page.

Educational activities are detailed in the discussion for Goal 5.

Goal 5. *Educate lake residents and visitors about the role of aquatic plants in the lake, the management strategies found in the plan, and appropriate plant management actions.*

Audience *(the target group for aquatic plant management messages):*

A. All lake residents
B. Lake users
C. Residents who treated waterfront with herbicides in the past

Messages *(what information to relay):*

1. Summary of APM plan, notice of public meeting, and how to get full APM plan
2. List of APM do's and don'ts
3. Contact list for APM; include web resources
4. Native aquatic plant values
5. Limit impacts to native aquatic plants by traveling with no wake in shallow areas, using hand removal methods near docks and swimming areas, etc.
6. Explain procedure for individual corridor herbicide applications and describe conditions where herbicide treatment may be allowed.
7. Explain procedure for navigational channel herbicide applications
8. Explain location and procedures for curly leaf pondweed herbicide treatment
9. Identification of CLP and methods for removal (include illustrations)
10. Identification of EWM and contact if suspected (include illustrations)
11. Locations of nearby lakes with EWM
12. Describe new potential invasive species and why they are a threat
13. Native plant identification
14. Remove plant fragments from boats and trailers
15. Polk County and the state of Wisconsin have regulations that makes it illegal to transport aquatic plants on public roads.

Methods *(how to relay aquatic plant management information):*

Summary of APM plan

AIS education workshops for all lake users

Improvements to signage at boat landings

Updates to AIS handouts

Newsletter articles

Mailings to lake residents

Web site updates

Clean boats, clean waters monitoring/education

Annual meeting/special meetings

Door-to-door distribution of information

Plastic peel-off stickers for boats

Refrigerator magnets

The chart below is a summary that describes the selected audiences and messages for each aquatic plant management educational method. Additional details will be developed with plan implementation.

Method	**Audience**	**Message**
APM plan summary	A B C	1, 3, 4
AIS workshops	A B	2, 3, 4, 5, 9, 10, 11, 12, 13, 15
Signage	A B	2, 4, 9, 10, 11, 14, 15
Billboard	A B	14, 15
AIS handouts	A B C	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15
Newsletter articles	A	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15
Mailings	A C	1, 3, 4, 6
Web site updates	A B	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15
Clean Boats, Clean Waters	A B	2, 3, 4, 10, 11, 12, 14, 15
Annual and special meetings	A	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15
Door-to-door distribution	A	1, 2, 3, 4, 10
Plastic peel-off stickers	A	3, 4, 10
Refrigerator magnets	A	3, 4, 10

Monitoring and Assessment

Aquatic Plant Surveys

Point intercept sampling by consultant– repeat every five years with next survey in 2017. (supervised by Board APM Lead)

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.

Volunteer monitoring at specific GPS points (supervised by MC)

In-lake Monitoring

Lake chemistry and Secchi disk measurements (completed by volunteer monitors)

Bone Lake APM Implementation Plan (2012 – 2015)

Action Items[31]	**Timeline**	**10/1/12 – 9/30/13**		**10/1/13 – 9/30/14**		**10/1/14 – 9/30/15**		
		Cost	**VOL Hours**	**Cost**	**VOL Hours**	**Cost**	**VOL Hours**	
Navigation Channels[32]								
Monitor navigation channels for potential summer treatment and treatment effectiveness	As needed		5		5		5	APM Lead or designee
Seek permit and apply herbicide to navigation channels (if needed and approved)	As needed – July or August							APM Lead or designee Contractor
Supervise contractor herbicide application	As needed – July or August							APM Lead or designee
Individual Access Corridors								
Inform landowners of process for permits and record conditions								APM Lead or designee
EWM and Other AIS Prevention								
Implement EWM Protocol Develop and implement additional invasive species protocol	Ongoing – See Appendix D		30		30		30	AIS Network District Board

[31] See Bone Lake Aquatic Plant Management Plan for action item detail.
[32] Navigation channels have not been treated during plan implementation. Bids and permits will not be sought unless there is severe navigation impairment.

Action Items[31]	Timeline	10/1/12 – 9/30/13		10/1/13 – 9/30/14		10/1/14 – 9/30/15		
		Cost	VOL Hours	Cost	VOL Hours	Cost	VOL Hours	
Volunteer Monitoring for EWM	Ongoing – See monitoring section							Monitor. Coord. Volunteers
Clean Boats, Clean Waters and other education activities	Ongoing – see education section							AIS Chair and Subcommittee
Surveillance camera – North Landing		$2,700	30	$2,700	30	$2,700	30	AIS Network
Surveillance camera – South Landing		$14,000	40	$2,500	20	$2,500	20	AIS Network
CLP Management								
Treat CLP navigation channels		$0		TBD			TBD	Contractor
Continue treatment of CLP	Late May	$22,622 (31.2 acres)		$23,000			$23,000	Contractor
Complete pre and post monitoring	June	$1,500		$1,500				Consultant
Complete turion monitoring	June	$600		$600				Consultant
Apply for herbicide treatment permits and solicit contractor bids	Each February	$300 $795		$300 $795		$300 $795		Consultant Permit Fees
Supervise contractor herbicide application	Annually		20		20		20	APM Lead Monitor. Coord

Action Items[31]	Timeline	10/1/12 – 9/30/13		10/1/13 – 9/30/14		10/1/14 – 9/30/15		
		Cost	**VOL Hours**	**Cost**	**VOL Hours**	**Cost**	**VOL Hours**	
Map CLP beds throughout the lake	Annually	$1,000		$1,000			$1,000	Consultant
Education								
Signage improvements		$600	5	$1,000	5	$0	0	AIS Chair and Subcommittee
Workshops	Annually	$1,000	50	$1,000	50	$500	25	AIS Chair and Subcommittee
AIS handouts, newsletter articles, mailings, web site updates	Ongoing	$3,500	50	$4,000	50	$2,000	25	AIS Chair and Subcommittee
Clean Boats, Clean Waters Staff Support	Ongoing	$3,000 $700	100	$3,000 $700	100	$3,000 $700	100	CBCW Coordinator
Annual meetings	Annually	$500	8	$500	8	$500	8	District Board
Monitoring								
Whole lake point intercept survey (2017)								
Volunteer monitoring at specific GPS points	Ongoing		250		250		250	Monitor. Coord. and Volunteers
Diver monitoring at landings		$500		$500		$500		Monitor Coord. And Polk County LWRD
Coordinate								
Coordinate grant activities	Ongoing	$2,000		$2,000		$2,000		Consultant

Aquatic Invasive Species Grants

Department of Natural Resources Aquatic Invasive Species Grants are available to assist in funding the action items in the implementation plan. Grants provide up to 75 percent funding. Application periods are accepted twice each year with postmark deadlines February 1 and August 1. Plan action items fall under the Education, Prevention, and Planning Projects and AIS Control projects. Bone Lake has two current AIS grants.

AIS Education and Planning Grant (AEPP-319-12)

This is a 75 percent grant totaling $46,164.75. The grant period is 10/01/2011 through 12/31/2014. The grant covers the Clean Boats, Clean Waters Program, updates of the aquatic plant survey and management plan, education activities, and monitoring camera installation for the north landing only. The grant is matched mostly by volunteer hours.

AIS Control Grant (ACEI-104-12)

This is a 50% grant totaling $28,560. The grant period is 10/01/2011 through 12/31/2013. The grant covers expenses related to the curly leaf management program including pre and post monitoring, turion monitoring, mapping CLP beds, and herbicide treatment costs. The grant is matched mostly by funds from the Bone Lake Management District.

Appendix A. Summaries of Previous Studies

The Bone Lake Management District requested and/or funded a variety of studies to increase understanding of the water quality and plant community of Bone Lake. The Wisconsin Department of Natural Resources Office of Inland Lake Renewal completed a lake feasibility study with management alternatives in 1980. Barr Engineering completed a lake management plan that included a water quality study (1997), hydrologic and phosphorus budgets (1997), and additional water quality monitoring and management recommendations (1999). The Polk County Land and Water Resources Department and The Limnological Institute updated water quality monitoring and Aquatic Engineering prepared a water quality technical report in 2004.

Highlights of the 1980 DNR Study

The study examined nutrient and phosphorus budgets, fisheries, and watershed characteristics. It also recommended management practices. Because nutrient levels were higher than those predicted by estimated watershed and septic loading, in-lake nutrient sources such as aquatic plants and lake sediments were examined as potential sources of additional phosphorus. Management recommendations included harvest of aquatic plants, aeration, and alum treatment of lake sediments. Prevention of the negative impacts of urbanization including increased impervious surfaces, fertilizing, and construction site erosion were discussed.

1980 Study Recommendations

- Consider in-lake treatment
  - Aeration
  - Aquatic plant harvesting
  - Alum treatment
- Prevent negative impacts of watershed development
  - Construction site erosion control
  - Minimize impervious surfaces
  - Avoid phosphorus fertilizer

Highlights of the Barr Engineering Plans (1997 – 1999)

Phosphorus and water budgets developed from 1995-6 data in 1997 were revised with new watershed information in 1999. The final management plan made recommendations for lake and watershed management based upon the new modeling results.

Conclusions from the 1999 report include the following:

- Bone Lake water quality is excellent in early summer and deteriorates as summer proceeds.
- Excess phosphorus concentration in upper layers of the lake result in lake water quality problems with higher than expected algae concentrations given the amount of phosphorus present.
- About two-thirds of the total phosphorus load comes from surface runoff.
- Internal loading from the lake sediments contributes about 14 percent of the phosphorus load.

Barr Engineering Lake Management Plan Recommendations

Recommended goals

- An average annual in-lake total phosphorus goal of 18 micrograms per liter is recommended (compared to summer levels of 29 in the north basin and 27 in the south basin in 1996 and 24.1 in the north basin and 21.4 in the south basin in 2004.)
- Prevent degradation of existing water quality

Recommended management actions

- Treat the lake with alum to reduce 90 percent of the lake sediment internal loading.
- Implement structural best management practices such as sediment retention ponds with any new development in the watershed. To ensure that these practices are put in place; a county stormwater ordinance, shoreland ordinance, and septic system ordinance are recommended. The minimum buffer width recommended for the shoreland ordinance is 100 feet.
- Educate residents to refrain from using phosphorus fertilizer

A long-term water quality monitoring program is also recommended

Highlights of the 2004 Aquatic Engineering Water Quality Report

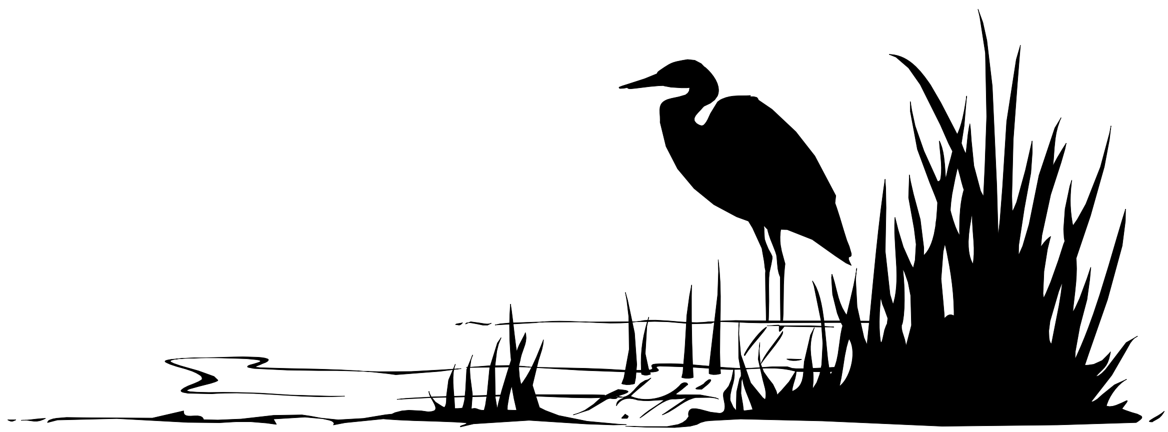
Water clarity improved from the results reported in the 1997 and 1999 reports. These changes could be due simply to variations in temperature and precipitation rather than a true water quality trend.

Recommendations from the Aquatic Engineering Report

- Create and enforce land use and zoning regulations
- Continue long term monitoring
- Manage curly leaf pondweed populations to control summer phosphorus loading from plant die off
- Restore shoreline vegetation to reduce runoff from waterfront lots

Appendix B. Sensitive Area Report

BONE LAKE
SENSITIVE AREA SURVEY REPORT
AND MANAGEMENT GUIDELINES



This document is to be used
with its companion document
"Guidelines for protecting, maintaining,
and understanding lake sensitive areas"

Bone Lake (Polk Co.)
Integrated Sensitive Area Survey Report

Date of Survey: 18 July 1988 Number of Sensitive Areas: 11
26 July 1989

Site Evaluators: Frank Koshere, Water Resources Biologist
Rick Cornelius, Fisheries Biologist
Randy McDonough, Wildlife Technician
Mark Sundeen, Aquatic Plant Specialist
Larry Damman, Fisheries Biologist
Kurt Roblek, Water Resources Biologist - Author

Lake Sensitive Area Survey results identified eleven areas that merit special protection of the aquatic habitat. These areas of aquatic vegetation on Bone Lake offer critical or unique fish and wildlife habitat. This habitat provides the necessary seasonal or life stage requirements of the associated fisheries while offering water quality or erosion control benefits to the body of water.

Wild rice (*Zizania sp.*) was documented in sensitive area "K" occurring on the northern shoreline of the lake. Wild rice holds very important niche in the lake ecosystem from both a human and wildlife standpoint. Care should be taken to allow for the proliferation of this rice stand.

During this survey there were no documented occurrences of Purple Loosestrife. However, the threat of Purple Loosestrife is always a concern and should be dealt with immediately. Methods for control are to remove the entire plant before it produces seeds or by cutting the flower head and spraying with an approved herbicide. You should contact the Department before any of these methods are implemented.

The reader should consider that any buffer that does not extend back from the waters edge at least 35' is not providing adequate protection for water quality and should be expanded to at least 35'. Local zoning ordinances and lakes classification systems have tried to provide better guidelines pertaining to buffer widths and set backs based on lake type. Landowners are encouraged to go beyond the minimum requirements laid out by zoning and consider extending buffer widths to beyond 35' and integrating other innovative ways to capture and reduce the runoff flowing off from their property while improving critical shoreline habitat. Berms and low head retention areas can greatly increase the effective capture rate from developed portions in addition to that portion captured within the buffer.

Site conditions may dictate that a buffer has to be much wider than 35' to be effective at capturing the sediments and nutrients running off the developed portions of the shoreline. If the shoreline is steeply sloped (>7%slope) greater widths should definitely be used.

No mowing should take place within the buffer area (with the exception of a narrow access trail and small picnic area), and trees and shrubs should not be cut down even when they become old and die; because they provide important woody debris habitat within the buffer zone as well as aquatic habitat when they fall into the lake.

The following is a brief summary of the Bone Lake sensitive area sites and the management guidelines. Also, the "Guidelines for Protecting, Maintaining, and Understanding Sensitive Areas" provides management guidelines and considerations for different lake sensitive areas (Attached).

I. Aquatic Plant Sensitive Areas

The following sensitive areas contain aquatic plant communities, which provide important fish and wildlife habitat as well as important shoreline stabilization functional values. Sensitive areas provide important enough habitat for the Bone Lake ecosystem that conservation easements, deed restrictions, or zoning should be used to protect them. Management guidelines for aquatic plant sensitive areas are (unless otherwise specifically stated):

1. Limit aquatic vegetation removal to navigational channels no greater than 25 feet wide where necessary, the narrower the better. These channels should be kept as short in length as possible and it is recommended that people do not completely eliminate aquatic vegetation within the navigation channel; but instead only remove what is necessary to prevent fouling of

propellers to provide access to open water areas. Chemical treatments should be discouraged and if a navigational channel must be cleared, pulling by hand is preferable over mechanical harvesters where practical.

2. Prohibit littoral zone alterations covered by Wisconsin Statutes Chapter 30, unless there is clear evidence that such alterations would benefit the lake's ecosystem. Rock riprap permits should not be approved for areas that already have a healthy native plant community stabilizing the shoreline and property owners should not view riprap as an acceptable alternative in these situations.
3. Leave large woody debris, logs, trees, and stumps, in the littoral zone to provide habitat for fish, wildlife, and other aquatic organisms.
4. Leave an adequate shoreline buffer of un-mowed natural vegetative cover and keep access corridors as narrow as possible (preferable less than 30 feet or 30% of any developed lot which ever is less).
5. Prevent erosion, especially at construction sites. Support the development of effective county erosion control ordinances. The proper use of Best Management Practices (BMP's) will greatly reduce the potential of foreign materials entering the waterway (i.e. silt, nutrients).
6. Strictly enforce zoning ordinances and support development of new zoning regulations where needed.
7. Eliminate nutrient inputs to the lake caused by lawn fertilizers, failing septic systems, and other sources.
8. Control exotic species such as purple loosestrife.

Resource Value of Site A

Sensitive area A is located on the eastern shore at the northern end of Bone Lake. The area includes approximately 1,000 feet of shoreline and extends up to 150 feet from the shore.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent and submergent plant community structure of Sensitive area A includes: **Emergent**; arrowhead (Sagittaria sp.). **Submergents;** muskgrass (Chara sp.), wild celery (*Vallisneria americana*), coontail (Ceratophyllum demersum), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), clasping leaf pondweed (Potamogeton perfoliatus), flat stem pondweed (P. zosteriformis), large leaf pondweed (P. amplifolius), curly leaf pondweed (P. crispus) and white stem pondweed (P. praelongus).

Chemical treatments and mechanical harvesting should not be allowed in this area. Hand-pulling should be limited to dock areas.

Resource Value of Site B

Sensitive area B is located on the eastern shore at the northern half of Bone Lake, along the shore owned by E-Z Living Campgrounds. The area includes approximately 1,000 feet of shoreline and extends up to 150 feet from the shore.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area B includes: **Emergent**; arrowhead (Sagittaria sp.), spikerush (Eleocharis sp.) and bulrush (Scirpus sp.). **Floating**; white water lily (Nymphaea odorata). **Submergents;** muskgrass (Chara sp.), wild celery (*Vallisneria americana*), coontail (Ceratophyllum demersum), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), clasping leaf pondweed (Potamogeton perfoliatus), flat stem pondweed (P. zosteriformis) and large leaf pondweed (P. amplifolius).

Chemical treatments and mechanical harvesting should not be allowed in this area. Hand-pulling should be limited to dock areas.

Resource Value of Site C

Sensitive area C is located at the midpoint of Bone Lake along the eastern shore. The area includes approximately 600 feet of shoreline.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area C includes: **Emergents**; cattails (Typha sp.), bur-reed (Sparganium sp.), bulrush (Scirpus sp.) and arrowhead (Sagittaria sp.). **Floating leafed**; yellow pond lily (*Nuphar advena*) and white water lily (*Nymphaea odorata*). **Submergents;** coontail (Ceratophyllum demersum), mud plantain (Heteranthera sp.), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), clasping leaf pondweed (Potamogeton perfoliatus), flat stem pondweed (P. zosteriformis), large leaf pondweed (P. amplifolius) and curly leaf pondweed (P. crispus).

Chemical treatments should only be allowed for floating vegetation for navigational purposes. Mechanical harvesting should be limited to a 25' navigation channel at developed shorelines.

Resource Value of Site D

Sensitive area D is located along the small of two islands at the midpoint of Bone Lake. The specified area is a small bay at the northeast corner of the State owned island. The site is approximately 400 feet of shoreline and extends outward 100 feet.

This area provides important habitat for centrarchid (bass and panfish) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The floating and submergent plant community structure of Sensitive area D includes: **Floating leafed**; white water lily (*Nymphaea odorata*). **Submergents;** coontail (Ceratophyllum demersum), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), saga pondweed (Potamogeton pectinatus), flat stem pondweed (P. zosteriformis) and large leaf pondweed (P. amplifolius).

Chemical treatments and mechanical harvesting should not be allowed.

Resource Value of Site E

Sensitive area E consists of a small bay located along the north shore of the larger of the two islands at the midpoint of Bone Lake. This island is privately owned. This area consists of approximately 650 feet of shoreline and extends 200 feet from the shore.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The submergent plant community structure of Sensitive area E includes: **Submergents;** musk grass (Chara sp.), wild celery (Vallisneria americana), bushy pondweed/slender water nymph (Najas flexilis), flat stem pondweed (Potamogeton zosteriformis), white stem pondweed (P. praelongus), curly leaf pondweed (P. crispus), large leaf pondweed (P. amplifolius), clasping leaf pondweed (P. richardsonii) and variable pondweed (P. diversifolius).

Chemical treatments and mechanical harvesting should not be allowed.

Resource Value of Site F

Sensitive area F is located in a large shallow bay along the eastern shore at the midpoint of Bone Lake. The area includes approximately 1100 feet of shoreline and extends up to 100 feet from the shore. The entire shoreline is developed with manicured lawns extending to the water's edge.

This area provides important habitat for centrarchid (bass and panfish) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Waterfowl, songbirds, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area F includes: **Emergents;** spikerush (Eleocharis sp.), arrowhead (Sagittaria sp.), bulrush (Scirpus sp.) and cattails (Typha sp.). **Floating leafed**; yellow pond lily (*Nuphar advena*) and white water lily (*Nymphaea odorata*). **Submergents;** bushy pondweed/slender water nymph (Najas flexis), clasping leaf pondweed (Potamogeton perfoliatus) and white water buttercup (Ranunculus longirostris).

Chemical treatment and mechanical harvesting should not be allowed. Minimal hand-pulling can be allowed near docks.

Resource Value of Site G

Sensitive area G is located at the southeast corner of Bone Lake. Fox Creek flows out of Bone Lake in this area. The area includes approximately 2,000 feet of shoreline and extends up to 150 feet from the shore. The northern portion of this site has been developed with manicured lawns extending to the water's edge.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. Heavy use by muskellunge has been observed during spawning seasons in this area.

This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent and submergent plant community structure of Sensitive area G includes: **Emergents;** bulrush (Scirpus sp.). **Submergents;** muskgrass (Chara sp.), wild celery (Vallisneria americana), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), white water buttercup (Ranunculus longirostris), clasping leaf pondweed (Potamogeton perfoliatus), sago pondweed (P. pectinatus), white stem pondweed (P. praelongus), flat stem pondweed (P. zosteriformis), large leaf pondweed (P. amplifolius)

Chemical treatments and mechanical harvesting should not be allowed in this area.

Resource Value of Site H

Sensitive area H is located along the southwestern shoreline of Bone Lake. The area includes approximately 2,500 feet of shoreline and extends up to 200 feet from the shore. Portion of this shoreline have been developed with buffers less than 35' in width.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area H includes: **Emergents;** bulrush (Scirpus sp.), bur-reed (Sparganium sp.), arrowhead (Sagittaria sp.), spike rush (Eleocharis sp.), pickerelweed (Pontederia cordata) and cattails (Typha sp.). **Floating**; white water lily (Nymphaea odorata) and yellow pond lily (Nuphar advena). **Submergents;** muskgrass (Chara sp.), wild celery (Vallisneria americana), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), white water buttercup (Ranunculus longirostris), coontail (Ceratophyllum demersum), clasping leaf pondweed (Potamogeton perfoliatus), white stem pondweed (P. praelongus), flat stem pondweed (P. zosteriformis), large leaf pondweed (P. amplifolius).

Chemical treatment shall be limited to navigation channels, excluding spike rush and bulrush stands. Mechanical harvesting shall be limited to navigation channels, also excluding spike rush and bulrush stands.

Resource Value of Site I

Sensitive area I is located midway along the western shoreline of Bone Lake. The area includes approximately 5,200 feet of shoreline and extends up to 150 feet from the shore.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent and submergent plant community structure of Sensitive area I includes: **Emergents;** bulrush (Scirpus sp.), bur-reed (Sparganium sp.), and spike rush (Eleocharis sp.). **Submergents;** muskgrass (Chara sp.), wild celery (Vallisneria americana), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), white water buttercup (Ranunculus longirostris), coontail (Ceratophyllum demersum), clasping leaf pondweed (Potamogeton perfoliatus), white stem pondweed (P. praelongus), flat stem pondweed (P. zosteriformis), large leaf pondweed (P. amplifolius).

Chemical treatment should be limited to submergent vegetation only. Emergent aquatics shall not be treated. Mechanical harvesting is allowed.

Resource Value of Site J

Sensitive area J consists of a small 150 x 150 foot bulrush island located near the north end and approximately 1000 feet from the western shore.

This area provides important habitat for centrarchid (bass) and esocid (muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Great Blue Herons use this site for feeding

The emergent plant community structure of Sensitive area J includes: **Emergents;** bulrush (Scirpus sp.).

Chemical treatment and mechanical harvesting should not be allowed in this area.

Resource Value of Site K

Sensitive area K is located at the northern end of Bone Lake. The area includes approximately 3000 feet of shoreline and extends out to the 5 foot depth. This area receives drainage from a large farm land.

This area provides important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

The emergent, floating and submergent plant community structure of Sensitive area K includes: **Emergents;** bulrush (Scirpus sp.), cattails, (Typha sp.), pickerel weed (Pontederia cordata), arrowhead (Sagittaria sp.), wild rice (Zizania sp.) and spike rush (Eleocharis sp.). **Floating**; white water lily (Nymphaea odorata) and yellow pond lily (Nuphar advena). **Submergents;** muskgrass (Chara sp.), wild celery (Vallisneria americana), northern milfoil (Myriophyllum sibiricum), bushy pondweed/slender water nymph (Najas flexis), white water buttercup (Ranunculus longirostris), coontail

(Ceratophyllum demersum), clasping leaf pondweed (Potamogeton perfoliatus), white stem pondweed (P. praelongus), flat stem pondweed (P. zosteriformis), large leaf pondweed (P. amplifolius).

Chemical treatment of submergent vegetation shall be limited to navigation channels only. Chemical treatment of emergent shall not be allowed. Mechanical harvesting shall be limited to navigation channels only.

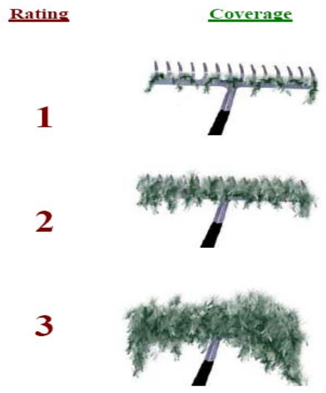
Appendix C. Aquatic Plant Survey Methods

Aquatic Plant Survey Methods

Field Methods

Harmony Environmental employed a point intercept method for the macrophyte sampling. The Wisconsin Department of Natural Resources (Wisconsin DNR) generated the sampling point grid. Only points shallower than 25 feet were initially sampled until the maximum depth of plants could be established. If no plants were sampled at a specific depth, one sample point beyond that depth was sampled for plants. In areas such as bays that appear to be under-sampled, a boat survey was conducted. This involved going to the area and surveying that area for plants, and recording the species viewed and/or sampled. The type of habitat is also recorded. These data are not used in the statistical analysis nor is the density recorded. Only results from predetermined sample points were used in the statistical analysis. In addition, any plant within six feet of the boat was recorded. A handheld Global Positioning System (GPS) located the sampling points in the field. The Wisconsin DNR guidelines for point location accuracy were followed with an 80-foot resolution and the location arrow touching the point.

At each sample location, a double-sided fourteen-tine rake was used to rake a 1 meter tow off the bow of the boat. All plants contained on the rake and those that fell off of the rake were identified and rated as to rake fullness. The rake fullness value was used based on the criteria contained in the diagram and table below. Those plants that were within six feet were recorded as "viewed," but no rake fullness rating was given.



Rake fullness rating	Criteria for rake fullness rating
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space
v	Plant not sampled but observed within 6 feet of boat

The depth and predominant bottom type was also recorded for each sample point. All plants needing verification were bagged and cooled for later examination. Each species was mounted and pressed for a voucher collection. A voucher specimen and may be missing from the collection on rare occasions where a single plant is needed for verification.

Data Analysis Methods

Data collected was entered into a spreadsheet for analysis. The following statistics were generated from the spreadsheet:

- Frequency of occurrence in sample points with vegetation (littoral zone)
- Relative frequency
- Total sample points
- Sample points with vegetation
- Simpson's diversity index
- Maximum plant depth
- Species richness
- Floristic Quality Index

An explanation of each of these data is provided below.

Frequency of occurrence for each species

Frequency is expressed as a percentage by dividing the number of sites the plant is sampled by the number of total sites. There are two frequency values calculated. The first is the percentage of all sample points that a plant was sampled at depths less then maximum depth plants were found (littoral zone), regardless if vegetation was present. The second is the percentage of sample points that the plant was sampled out of only points containing vegetation. The first value shows how often the plant would be encountered in the defined littoral zone, while the second value shows if only points that contain plants were considered. In either case, the greater this value, the more frequent the plant occurs in the lake. If one wants to compare plants within the littoral zone, we look at the frequency of all points below maximum depth with plants. This frequency value allows the analysis of how common plants are where they could grow. If one wants to focus only on where plants are actually present, then one would look at frequency at points in which plants were found. Frequency of occurrence is usually reported using sample points where vegetation was present.

Frequency of occurrence example:

Plant A sampled at 35 of 150 littoral points = 35/150 = 0.23 = 23%
    Plant A's frequency of occurrence = 23% considering littoral zone depths

Plant A sampled at 12 of 40 vegetated points = 12/40 = 0.3 = 30%
    Plant A's frequency of occurrence = 30% in vegetated areas

These two frequencies can tell us how frequently the plant was sampled in the littoral zone or how frequently the plant was sampled at points where plants actually grow. Generally the second will have a higher frequency since there are fewer points where plants grow than points in the entire littoral zone.

Relative frequency

This value shows, as a percentage, the frequency of a particular plant relative to other plants. This is not dependent on the number of points sampled. The relative frequency of all plants will add to 100%. This means that if plant A had a relative frequency of 30%, it occurred 30% of the time compared to all plants sampled or makes up 30% of all plants sampled. This value allows us to see which of the plants are the dominant species in the lake. The higher the relative frequency, the more common the plant is compared to the other plants.

Total point grid

This is the total number of points created for sampling on the lake. This may not be the same as the actual points sampled. When doing a survey, we don't sample at depths outside of the littoral zone (the area where plants can grow). Once the maximum depth of plants is established, many of the points deeper than this are eliminated to save time and effort.

Relative frequency example:

Suppose we were sampling 10 points in a very small lake and got the following results:

	Frequency sampled
Plant A present at 3 sites	3 of 10 sites
Plant B present at 5 sites	5 of 10 sites
Plant C present at 2 sites	2 of 10 sites
Plant D present at 6 sites	6 of 10 sites

So one can see that Plant D is the most frequent plant sampled at all points with 60% (6/10) of the sites having plant D. However, the relative frequency allows us to see what the frequency is compared the other plants, without taking into account the number of sites. It is calculated by dividing the number of times a plant is sampled by the total of all plants sampled. If we add all frequencies (3+5+2+6), we get a sum of 16. We can calculate the relative frequency by dividing by the individual frequency.

Plant A = 3/16 = 0.1875 or 18.75%
Plant B = 5/16 = 0.3125 or 31.25%
Plant C = 2/16 = 0.125 or 12.5%
Plant D = 6/16 = 0.375 or 37.5%

Now we can compare the plants to one another. Plant D is still the most frequent, but the relative frequency tells us that of all plants sampled at those 10 sites, 37.5% of them are Plant D. This is much lower than the frequency of occurrence (60%) because although we sampled Plant D at 6 of 10 sites, we were sampling many other plants too, thereby giving a lower frequency when compared to those other plants. This then gives a true measure of the dominant plants present.

Sample sites with vegetation

The number of sites where plants were actually sampled. This gives a good idea of the plant coverage of the lake. If 10% of all grid sample points had vegetation, it implies about a 10% coverage of plants in the whole lake, assuming an adequate number of sample points have been established. We also look at the number of sample sites with vegetation in the littoral zone. If 10% of the littoral zone had sample points with vegetation, then the plant coverage in the littoral zone would be estimated at 10%.

Simpson's diversity index

Simpson's diversity index is calculated to measure how diverse the plant community is. This value can run from 0 to 1.0. The greater the value, the more diverse the plant community is in a particular lake. In theory, the value is the chance that two species sampled are different. An index of "1" means that the two will always be different (very diverse) and a "0" would indicate that they will never be different (only one species found). The more diverse the plant community, the better the lake ecosystem.

> Simpson's diversity example:
>
> If one sampled a lake and found just one plant, the Simpson's diversity would be "0." This is because if we randomly sampled two plants, there would be a 0% chance of them being different, since there is only one plant.
>
> If every plant sampled were different, then the Simpson's diversity would be "1." This is because if two plants were randomly sampled, there would be a 100% chance they would be different since every plant is different.
>
> These are extreme and theoretical scenarios, but they demonstrate how this index works. The greater the Simpson's index is for a lake, the greater the diversity since it represents a greater chance of two randomly sampled plants being different.

Maximum depth of plants

This depth indicates the deepest that plants were sampled. Generally more clear lakes have a greater depth of plants while lower water clarity limits light penetration and reduces the depth at which plants are found.

Species richness

The number of different individual species found in the lake. Results include a number for the species richness of plants sampled, and another number that takes into account plants viewed but not actually sampled during the survey.

Floristic Quality Index

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 in response to development (and human influence) on the lake. It takes into account the species of aquatic plants found and their tolerance for changing water quality and habitat quality. The index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant to disturbance while a lower value indicates tolerance. Those plants with higher values are more apt to respond adversely to water quality and habitat changes, largely due to human influence. The FQI is calculated using the number of species and the average conservatism value of all species used in the index. The formula is:

$$FQI = \text{Mean } C \cdot \sqrt{N}$$

Where C is the conservatism value and N is the number of species.

Therefore, a higher FQI, indicates a healthier aquatic plant community. This value can then be compared to the mean for other lakes in the assigned eco-region. There are four eco-regions used throughout Wisconsin. These are Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area, and Southeastern Wisconsin Till Plain.

Summary of Northern Lakes and Forest Median Values for Floristic Quality Index:

Mean species richness = 13

Mean conservatism = 6.7

Mean Floristic Quality = 24.3*

*Floristic Quality has a significant correlation with area of lake (+), alkalinity(-), conductivity(-), pH(-) and Secchi depth (+). In a positive correlation, as that value rises so will FQI, while with a negative correlation, as a value rises, the FQI will decrease.

Table 3. List of species used for FQI and conservatism values

Species	Common Name	C
Dulichium arundinaceum	**Three-way sedge**	9
Pontederia cordata	**Pickerelweed**	9
Isoetes sp.	**Quillwort**	8
Potamogeton epihydrus	**Ribbon-leaf pondweed**	8
Potamogeton praelongis	**White-stem pondweed**	8
Potamogeton robbinsii	**Robbins pondweed**	8
Potamogeton spirillus	**Spiral-fruited pondweed**	8
Sagittaria rigida	**Stiff arrowhead**	8
Brasenia schreberi	**Watershield**	7
Chara sp.	**Muskgrasses**	7
Equisetum fluviatile	**Water horsetail**	7
Myriophyllum sibericum	**Northern water-milfoil**	7
Nitella sp.	**Nitella**	7
Potamogeton amplifolius	**Large-leaf pondweed**	7
Potamogeton gramineus	**Variable pondweed**	7
Potamogeton pusillus	**Small pondweed**	7
Ranunculus aquatilis	**Stiff water crowfoot**	7
Najas flexilis	**Bushy pondweed**	6
Nuphar variegata	**Spatterdock**	6
Nymphaea odorata	**White water lily**	6
Potamogeton foliosus	**Leafy pondweed**	6
Potamogeton illinoensis	**Illinois pondweed**	6
Potamogeton zosteriformis	**Flat-stem pondweed**	6
Vallisneria americana	**Wild celery**	6
Zosterella dubia	**Water star-grass**	6
Carex comosa	**Bottle brush sedge**	5
Polygonum amphibium	**Water smartweed**	5
Potamogeton richardsonii	**Clasping-leaf pondweed**	5
Schoenoplectus acutus	**Hardstem bulrush**	5
Schoenoplectus tabernaemontani	**Softstem bulrush**	4
Ceratophyllum demersum	**Coontail**	3
Elodea canadensis	**Common waterweed**	3
Sagittaria latifolia	**Common arrowhead**	3

References

Borman, Susan, Robert Korth and Jo Tempte. *Through the Looking Glass*. University of Wisconsin-Extension. Stevens Point, Wisconsin. 1997. 248 p.

Crow, Garrett E. and C. Barre Hellquist. *Aquatic and Wetland Plants of Northeastern North America*. The University of Wisconsin Press. Madison, Wisconsin. Volumes 1 and 2. 2000. 880p.

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Nichols, Stanley A. *Distribution and Habitat Descriptions of Wisconsin Lake Plants*. Wisconsin Geological and Natural History Survey. Bulletin 96. Madison Wisconsin. 1999. 266 p.

Nichols, Stanley A. *Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications*. Journal of Lake and Reservoir Management 15 (2): 133-141. 1999.

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Appendix D

Rapid Response for Early Detection of Eurasian Water Milfoil[1]

1. The Bone Lake Management District Board (BLMD) has ultimate responsibility for implementing this protocol. The Aquatic Invasive Species Network of the BLMD has responsibility for day-to-day implementation.

2. Bone Lake residents and other users of Bone Lake will be informed of who to contact if they see a plant in the lake they suspect might be Eurasian water milfoil (EWM). Signs at public and resort landings will direct anyone who identifies suspected EWM to contact the Monitoring Coordinator. The following are the steps that will be taken if EWM is suspected in Bone Lake.

3. If the suspected plant appears to be EWM, the Monitoring Coordinator will inform the Chair of the BLMD, the Polk County Land & Water Resources Department (PC LWRD), the APM Consultants, and the Wisconsin Department of Natural Resources (WDNR) of suspected EWM in Bone Lake.

4. Mark the location of suspected EWM and confirm whether it is EWM.

    Within 48 hours of a credible report of EWM in Bone Lake, the location of the suspected EWM will be marked with a uniquely identified small float, and a GPS waypoint will be entered for the float.

    Within 72 hours of a credible report of EWM in Bone Lake, the PC LWRD or the WDNR will examine the plant(s) suspected of being EWM to confirm identification. If there is any question about whether the plant(s) are EWM, appropriate resources at and WDNR or UW Herbarium will be consulted.

    Two entire intact rooted adult specimens of the suspect plants will be collected and bagged and delivered to the WDNR. One of these specimens will be mounted and forwarded to the herbarium at the University of Wisconsin – Stevens Point or the University of Wisconsin – Madison.

    If the suspect plants are determined to be EWM, the location of EWM will be marked with a large EWM buoy.

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[1] The attached Exhibit A is a contact list for various persons involved in implementing this protocol. This list will be kept current.

5. Communicate results of the examination of the suspect plants.

Positive identification will be shared with the BLMD, PC LWRD, WDNR, APM consultants, and herbicide application.

The person(s) reporting the suspected EWM will be contacted and informed whether the presence of EWM in Bone Lake has or has not been confirmed.

If the presence of EWM in Bone Lake is confirmed, a letter will be sent within 48 hours of confirmation to all Bone Lake residents informing them of the presence of EWM in Bone Lake. In addition, notice of the EWM will be immediately posted on the BLMD web site, notices will be posted at all public and resort landings, and notice will be published in the next BLMD newsletter. The letter and the notices will inform all lake users of the approximate location of the EWM and direct them to stay away from the area marked by the EWM buoy.

The AIS Network Coordinator will coordinate these activities.

6. Determine the extent of the EWM.

As soon as possible, the extent of the EWM will be determined. For this purpose, the BLMD will engage a diver who will, to the extent feasible, remove the EWM at the same time the diver is confirming the extent of the EWM.

The Lake Monitoring Coordinator or, if not available, the AIS Network Coordinator will coordinate these activities and draw on the resources of the BLMD, PC LWRD, and WDNR

7. Select a control plan for the EWM.

The BLMD, in consultation with the APM Consultant, WDNR, and PC LWCD, will determine the most effective way to control the EWM.

The goal of the control plan will be eradication of the EWM to the maximum extent possible.

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 efficacious and approved control methods.

The selection of the control method will be guided by what is the best way to assure immediate maximum control of the EWM and will not be guided by a desire to incrementally manage the EWM.

If the control plan involves the use of herbicides or other chemicals, application of the herbicides or other chemicals shall not take place until permits have been granted by the WDNR.

8. Implement the selected control plan.

   Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.

   BLMD AIS contingency reserve funds may be used to pay for any reasonable expense incurred in implementing the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.

   The BLMD Treasurer 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 BLMD shall formally apply for such a grant.

   BLMD shall have the authority to accept donations or borrow money for the purpose of paying for control of EWM.

9. Follow up.

   Frequently inspect the area of the EWM to determine the efficacy of the control measures and whether additional control is necessary.

   Visually survey the entirety of Bone Lake to determine whether EWM has spread to any other parts of the lake. This survey may be carried out by Monitoring volunteers.

   The BLMD, acting through the AIS Network, will commission or conduct a study to determine the cause of the EWM, evaluate the response of the BLMD to the EWM, and recommend modifications to this protocol that will improve the BLMD's ability to detect, confirm, and control EWM in Bone Lake.

EXHIBIT A

BONE LAKE MANAGEMENT DISTRICT

Chair	Bob Murphy, 715–857-5194, 612-822-5187
AIS Network Coordinator	Bob Boyd, 715-857-5495
Monitoring Coordinator	Bob Boyd

POLK COUNTY LAND and WATER RESOURCES

Jeremy Williamson, 715-485-8639

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants	Alex Smith, 715-635-4124
Permits and EWM Notice	Mark Sundeen, 715-635-4074

CHEMICAL APPLICATIOR RETAINED BY BONE LAKE MANAGEMENT DISTRICT

Lake Restoration 763-428-1543

LAKE MANAGEMENT CONSULTANT

Harmony Environmental	Cheryl Clemens, 715-268-9992
Ecological Integrity Service	Steve Schieffer, 715-554-1168

DIVERS

Ecological Integrity Service	Steve Schieffer, 715-554-1168
Polk County Land and Water Resources	Jeremy Williamson, 715-485-8639
Blue Water Science	Steve McComas, 651-690-9602

Appendix E. Committee Input for Aquatic Plant Management 2013

Bone Lake Aquatic Plant Management Plan Update
Advisory Committee Meeting Notes

April 6th, 2013, 9 a.m. to noon
Polk County Justice Center Community Room
Balsam Lake, WI

Meeting Objective
Gather citizen input to guide the update of the Bone Lake Aquatic Plant Management Plan

Participants (THANK YOU!!)
Judy and Roger Gammel
Cindy Gardner
Ron and Mary Lachenmayer
Karen Engelbretson
Bill Ward
John Spies
Wayne Wolsey
Phil Foster
Alex Chorewycz
Tim Killeen
Shelley and Jeff Rose
Bob Boyd

Advisors
Alex Smith
Mark Sundeen
Steve Schieffer
Cheryl Clemens

Meeting Notes
Participants listened to presentations related to aquatic plant management on Bone Lake and asked questions.

A vote was taken on installing a surveillance camera on the south landing. *Participants voted unanimously to install the camera with lake district funding only.* The camera is already budgeted. If DNR grant funds were used, 200 hours of Clean Boats, Clean Waters staffing would be required at the south landing. While CBCW staff spend some time at the landing, 200 hours was seen as excessive. In addition, the grant would only pay about 25% of the cost of camera installation and no ongoing maintenance costs. Other ideas discussed included waiting and measuring use at the south landing, perhaps through a pressure counter, and installing a game camera. It is not possible to close the access to the public.

How is entry of AIS prevented at resorts? Primarily through signage.

Concerns were expressed regarding including Sensitive Area C and D in the curly leaf pondweed (CLP) beds selected for treatment because of potential impact on native plants. Early season CLP herbicide treatments are timed to minimize impacts to native plant populations. Few changes in native plant populations have been identified following Bone Lake CLP treatments, and these changes are likely within normal plant growth fluctuations. Mark Sundeen, DNR Aquatic Plant Permit Manager, said that early season CLP treatment timed to limit impact to natives is viewed differently than full-scale, wide spectrum control of native plants in sensitive areas and therefore may be allowed. Change following meeting: *The proposed bed 6 now cuts off the bay (Sensitive Area C) from the treatment area. This allows proceeding with the CLP treatment with an extra measure of caution.*

Wild rice grows in the northwest part of the lake, and the Great Lakes Indian Fish and Wildlife Commission staff raised concerns about CLP herbicide treatment in the north part of the lake. Because of this, proposed navigation channel A will not be permitted. The Tribes generally rely upon wild rice mapping that they complete themselves. No benefit was seen in having the lake district map wild rice.

CLP bed size may be increased to enhance herbicide effectiveness. Post treatment in-water chemical concentrations will be measured this year.

Individual owners have not treated access to docks since 2007 with the exception of one early season CLP treatment.

Alex Smith, DNR Lakes Coordinator, reported that few changes in Aquatic Invasive Species (AIS) grants are anticipated, and Bone Lake should remain competitive for grants. The AIS control grants are more difficult to obtain than the AIS education and planning grants.

<u>Plan Update Schedule</u>

Committee comments on draft	by April 23, 2013
Plan availability announced	May 2013 (newsletter and newspaper)
Public comments due	June 15, 2013
Commissioners review	July 13, 2013
DNR review	August 1 – September 30

Bone APM Plan Comments (through 04/24/13)

From: Anthony Havranek [mailto:anthonyh@stcroixtribalcenter.com]
Sent: Thursday, April 11, 2013 12:52 PM
To: Cheryl Clemens
Cc: Sundeen, Mark R - DNR; Lisa@glifwc.org; Katie Stariha
Subject: RE: Bone Lake Aquatic Plant Advisory Meeting April 6th

(responses provided in blue following Anthony's questions)

Cheryl,

Thanks for providing the attached information.

I was able to review the document and have just a few comments/questions:

1.) One of the stated goals is to have a 20% improvement in water quality in 10 years. I think that is from the 2009 plan. After four years does it seem like that is still a reasonable goal?
That is a goal in the Lake Management Plan not the APM.

2.) Are the herbicide concentrations you have listed application rates or measured values? There is some interest by St. Croix to ascertain actual concentrations of applied herbicides in the application areas and rice beds that exist on those waters.
Herbicide concentrations are application rates. The lake district will be measuring actual concentrations this year.

3.) You mention that the fishery committee is actively working with tribes on the concern of winter musky harvest. Is any of this work being done with St. Croix or is it with another tribe? This should be specified.
The fishery committee has worked with GLIFWC fisheries biologists. St. Croix Tribal members are among those who fish Bone Lake.

In most situations, St. Croix does not currently support the use of chemicals as a means of aquatic and/or terrestrial vegetation control.

Thanks for allowing us to provide feedback and be a part of the planning process.

Anthony Havranek
Land & Water Resources Manager
St. Croix Tribal Environmental Department
24663 Angeline Avenue
Webster, WI 54893
anthonyh@stcroixtribalcenter.com
P: (715)349-2195 ext. 5183
F: (715)349-8302

Page 3. Goal 1. Summer navigation channels. Harvesting...
Are we still including harvesting in the implementation options? I thought APM meeting group deemed it not manageable due to cost, operation staffing, etc.
Removed to section that discusses management options instead.

Page 10-11. Goal 5. Methods. Method. Audience. Message matrix. Where are the explanations of Audience and Message? Additional information added.

Doesn't seem we're doing much of this. What's required? There are no specific requirements.

Thanks for the op to review,

Karen Engelbretson

Cheryl

Thanks for this and also for a well run and informative meeting on April 6.

The plan looks good. I did notice one discrepancy - on page 68 the water temperature limit is 58 degrees and on page 70 it is 60 degrees.
Will change to 58. Since one of the reasons to control CLP is to limit P release from CLP, we want treatment sooner rather than later.

John A. Spies

1. I notice the APM plan is dated 2012 to 2015. Since we are in 2013 and won't approve the plan until mid year, suggest we add at least another year to 2016 or even better to 2017 to make it a longer term APM plan. Seems like we should only update the APM plan and Lake Mgmt Plan every 5 years versus every 3 years. The plan is for 2013 through 2017 as stated in the overall plan introduction. It is only the implementation plan that is limited to the first 3 years. This is because budget details are hard to plan that far in advance. A three year implementation plans allows for adaptation along the way.

2. For CLP treatment, would endorse spraying 31 acres for the years
2013 to 2015. We then would review to determine if to further change acreage
OK will add

3. On harvestor, we have some words that it may be used. Based on some reviews and discussions, it seems like we have decided that a harvestor would not be conducive to be used on Bone Lake. So would suggest more words like that so doesn't leave the door too open for a harvestor.
I don't think the door has to be completely shut but to send a message now that a harvestor is not being considered and give the reasons why.
Removed to section that discusses management options instead.

Phil Foster

Appendix F. References

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Appendix G. DNR Northern Region Aquatic Plant Management Strategy

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.