Bone Lake Aquatic Plant Management Plan

Bone Lake, Polk County, Wisconsin

Sponsored By Bone Lake Management District

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INSERT WDNR PLAN APPROVAL LETTER

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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 (the Lake District) and the Wisconsin Department of Natural Resources (WDNR) in aquatic plant management for Bone Lake over the next five years (from 2020 through 2024).

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

GOAL 1. MAINTAIN RECREATIONAL USES IMPORTANT TO LAKE RESIDENTS AND USERS WHILE PRESERVING IMPORTANT NATIVE AQUATIC PLANT FUNCTIONS AND THEIR VALUES.

GOAL 2. PREVENT INTRODUCTION OF AQUATIC INVASIVE SPECIES.

GOAL 3. MANAGE CURLY LEAF PONDWEED TO MINIMIZE NAVIGATION PROBLEMS AND PROTECT NATIVE PLANT POPULATIONS.

GOAL 4. PROTECT THE NATURAL FUNCTIONS OF DIVERSE NATIVE PLANT COMMUNITIES.

GOAL 5. EDUCATE LAKE RESIDENTS AND VISITORS ABOUT THE GOALS AND OBJECTIVES OF THE AQUATIC PLANT MANAGEMENT PLAN.

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

The WDNR's aquatic plant management planning guidelines and Northern Region Aquatic Plant Management Strategy (Summer 2007) framed the development of the plan. (See Appendix F for a copy of this strategy.) WDNR 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

https://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/ecology/aquaticplants/default.aspx or

http://dnr.wi.gov/lakes/plants/

PUBLIC INPUT FOR PLAN DEVELOPMENT

Two advisory committee meetings were held for this plan update. The meetings were held February 8 and February 29, 2020 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.

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 plan in the Bone Lake eNews and on Facebook. A notice was also published in the Inter County Leader newspaper. The plan was available for review between March 25 and April 10, 2020 on the Bone Lake web site (bonelakewi.com). Comments are included in Appendix D.

PROPERTY OWNER SURVEY

The Lake District completed a property owner survey in 2018, similar to a survey completed in 2013. The September 2018 survey was mailed to 553 property owners of the Bone Lake Management District, and 262 surveys were returned (47%).

CONCERNS FOR BONE LAKE

Survey respondents were asked to rank their degree of concern with six different issues. A score of four indicated everyone ranked the concern as high, three as medium, two as low, and one as "issue exists but is not a concern." The issue of greatest concern was new invasive species entering the lake, followed by aquatic plant growth, unsafe boat or personal watercraft safety, lack of water clarity in late summer, and noise level on the lake. The level of concern for each issue was similar between the 2018 and 2013 surveys.

Table 1. Degree of Resident Concern for Six Issues

	2018	2013
New invasive species entering the lake	3.4	3.6
Excessive aquatic plant growth	2.8	3.0
Unsafe boat or personal watercraft safety	2.6	2.4
Lack of water clarity in late summer	2.5	2.6
Noise level on the lake	2.2	2.0
Bright shoreline lighting	1.6	1.8

MANAGEMENT ACTIVITIES

Survey respondents were asked if seven different activities should be continued by the Lake District to improve Bone Lake. More than three-quarters of respondents felt that the Lake District should continue to implement: programs to deter new aquatic invasive species (95%), incentives to upgrade non-conforming septic systems (90%), treatment for curly leaf pondweed (88%), programs to encourage rain gardens and waterfront plantings to reduce waterfront runoff (83%), and programs to promote stream bank stabilization to reduce runoff from the watershed (77%). Half of respondents thought the Lake District should increase the number of acres of curly leaf pondweed treated with herbicide (56%, 11% decrease from 2013).

COMMUNICATION

The preferred method for receiving information from the Lake District continues to be the newsletter (78%) followed by email (41%). One-quarter of respondents prefer to receive information from the website (27%, 7% increase from 2013), Bone Lakers Facebook page (26%), and annual meeting (23%, 7% increase from 2013). Fewer respondents (9%) indicated they preferred eNews.

BONE LAKE MANAGEMENT PLAN

The *2015 Bone Lake Management Plan* guides the Lake District in managing water quality, fisheries, wildlife, and natural beauty with the following goals:

1. Improve Bone Lake water clarity.
2. Maintain safe navigation in Bone Lake.
3. Protect and improve the Bone Lake fishery.
4. Maintain and enhance Bone Lake's natural beauty.
5. Protect and enhance wildlife habitat.

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 $175,000 2015 Lake Protection 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. A brief overview of committees and their programs follow:

Evaluation and Studies Committee

The Evaluation and Studies Committee has collected samples and worked with consultants to complete several studies including 1) the inputs to Bone Lake from its tributaries and other non-point sources within the watershed by testing flow and nutrients in culverts and tributaries in 2010 and 2015. The tributary studies are now used to prioritize the work of the watershed committee. 2) the impact of the die-back of curly leaf pondweed on the lake phosphorus budget in 2010; 3) Bone Lake's internal load or amount of phosphorus loading from lake sediments; and 4) groundwater contributions to the phosphorus budget.

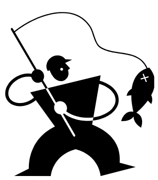
Watershed Committee

The Watershed Committee is using the culvert nutrient and flow monitoring results to target their activities. The Polk County Land and Water Resources Department has assisted with this effort. Example projects include a plunge pool on a pond outlet that flows to the lake, in-stream ponding to decrease sediment flow to the lake, a streambank stabilization project, and correcting improper placement of a private road culvert. An infiltration project for a large restaurant parking lot is planned for 2020.

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 encourages individual site assessments that result in recommendations to reduce runoff and erosion and improve habitat along the water. Projects installations on 45 properties from 2010 to 2019 have included a shoreline buffer, native plantings (37), rain gardens (4), diversions (4), rock infiltration (10), porous pavers (2), and a series of rock checks in a road ditch. The Bone Lake North Landing provides a 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.

Fisheries Committee

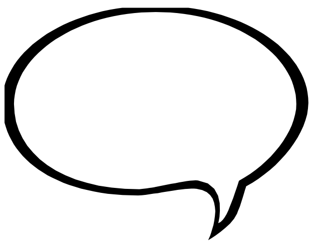


The Fisheries Committee installed three fish stick complexes with approximately 20 trees in each complex in the winter of 2010/11. The committee has also installed 80 half log structures throughout the lake. The Lake District also supported the stocking of 12,500 small mouth bass in 2011, 2012, and 2013. Based on a concern for levels of winter Tribal harvest of muskies, the fisheries committee networked 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 and education to property owners about protecting wildlife and enhancing habitat around Bone Lake. Leaving native plants in place on land and in the water; adding native plants, trees, and shrubs at the shore; and maintaining woody debris in the water away from swimming and boating can assure a safe place for wildlife to nest, live, and grow. Eliminating the use of household poisons is encouraged so our birds and animals will stay healthy; using non-toxic fishing tackle and ammunition is encouraged to reduce lead poisoning in area raptors and waterfowl. The committee suggests it's up to each Bone Lake property owner to create, maintain, and protect the priceless beauty they seek while respecting the desires of others around the lake.

Communications Committee



The Communications Committee develops and distributes important messaging to Bone Lake property owners via:

- Biannual 12-page full color newsletter
- Website, bonelakewi.com
- Bone Lake eNews, opt-in email messaging
- Bonelakers, a Facebook group page
- Wilkins Bar and Resort on Bone Lake poster board

Other communications are developed as needed by the District and its committees.

Internal Load Committee

The Internal Load Committee and sub committees met several times in 2019. The committee's mission was to evaluate the use of alum to treat Bone Lake's internal load and to make a recommendation to use or not to use alum to the board of commissioners and Lake District membership at the 2019 annual meeting. While the committee voted against recommending alum at the 2019 annual meeting, interest in an alum treatment led to ongoing work by the committee and a planned vote for the 2020 annual meeting.

AIS Network/Lake Monitoring Team

This team of volunteers monitors for invasive species and performs lake chemistry and Secchi disk measurements (supported by the WDNR Citizen Lake Monitoring Network). A volunteer also takes water samples to monitor for e coli. A new focus of the monitoring team is to look for zebra mussels in the lake. To do this, volunteers monitor plate samplers (14 currently) installed at their docks and check docks and hoists when removed from the lake in the fall.

Lake volunteers perform many other functions including managing the Clean Boats, Clean Waters Program, maintain landing cameras, and supervising curly leaf pondweed control.

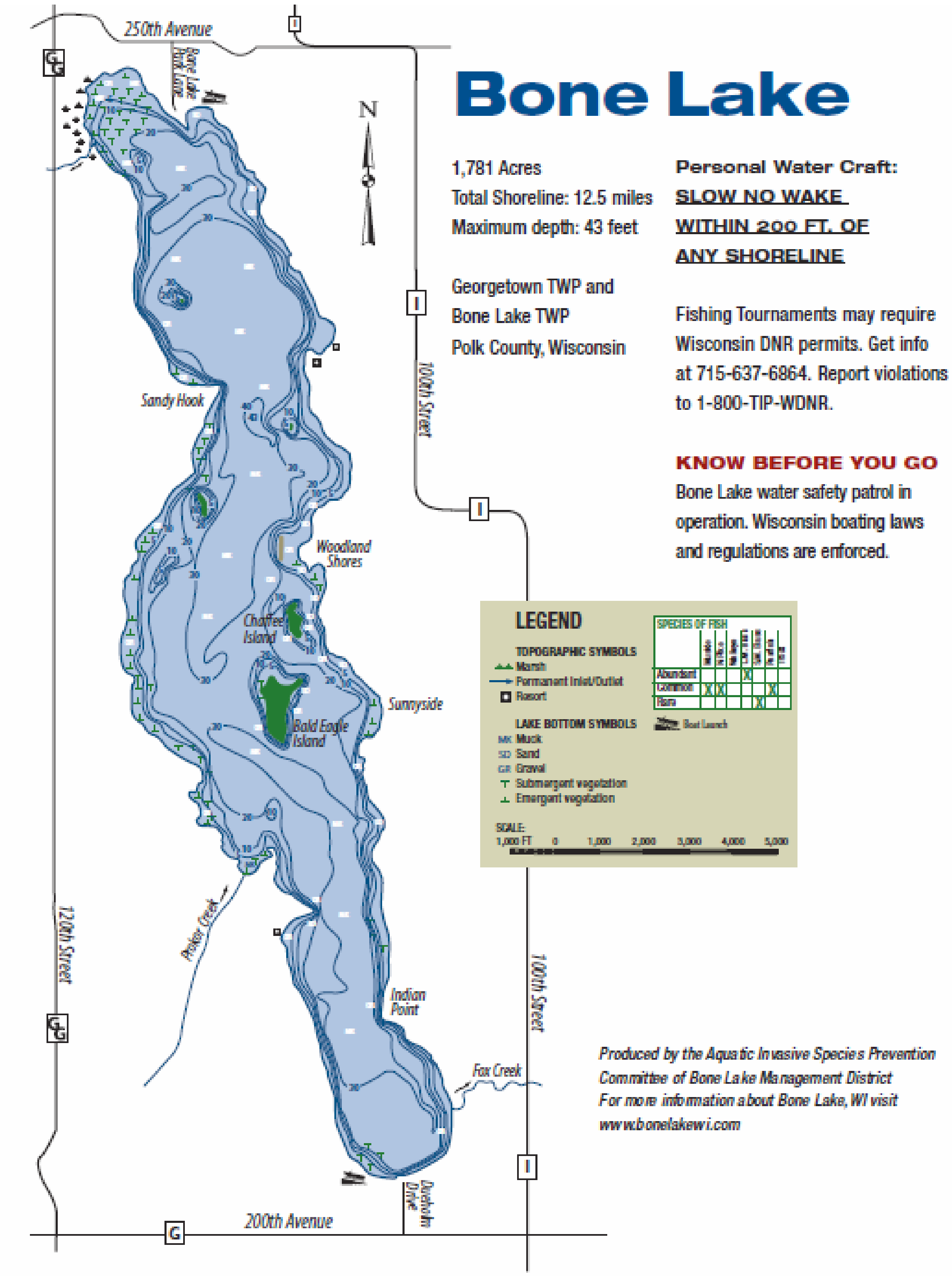


Figure 1. Bone Lake Map

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, the northwest tributary, and other 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 1.

WATER QUALITY

Bone Lake was listed as an impaired water for recreational use by the Wisconsin Department of Natural Resources in 2012. The lake is impaired from excess algae growth and the pollutant listed is phosphorus.[2]

TROPHIC STATE

Trophic state describes the productivity of a lake. Lakes with more nutrients are more productive. The least productive lakes are oligotrophic lakes. The most productive lakes are referred to as eutrophic. Those in the middle are called mesotrophic. 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 generally deteriorates with frequent algae blooms in mid to late summer. The south basin tends to have 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 periodically mixes 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. Summaries of these previous studies are included in Appendix B of the 2015 Bone Lake Management Plan. More recent studies are summarized in this plan.

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[2] https://dnr.wi.gov/water/impairedDetail.aspx?key=16565

LAKE SELF-HELP MONITORING RESULTS[3]

Lake resident volunteers have collected Secchi disc self-help monitoring data since 1989 (although not every year). 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 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 2 below.

Figure 3 illustrates all sample test results using TSI (trophic state) rankings. Figure 4 shows how water clarity changed over the 2019 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.

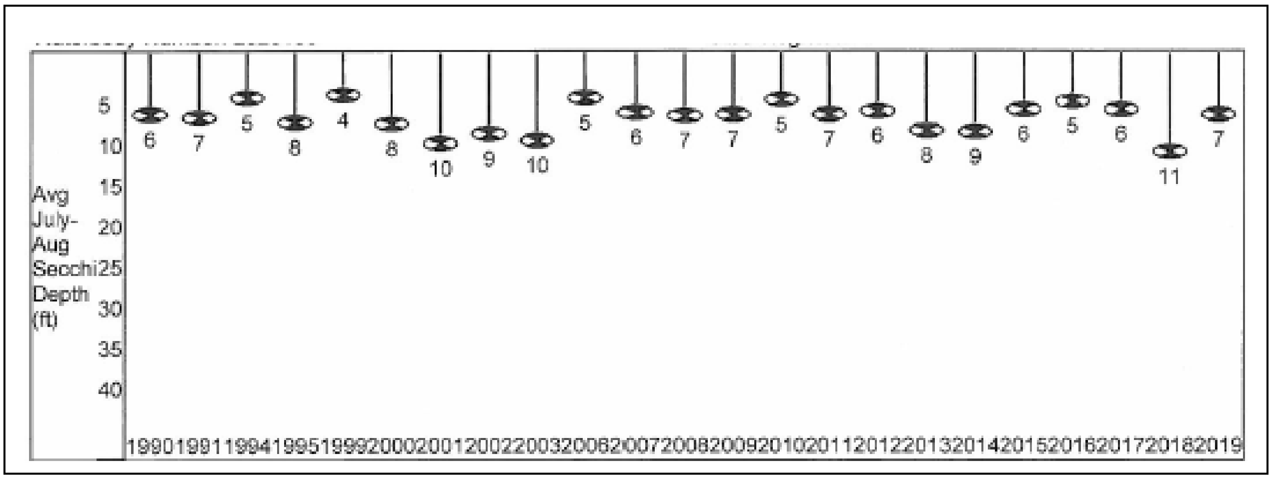

Figure 2. Bone Lake Deep Hole July and August Secchi Depth 1990 - 2019

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

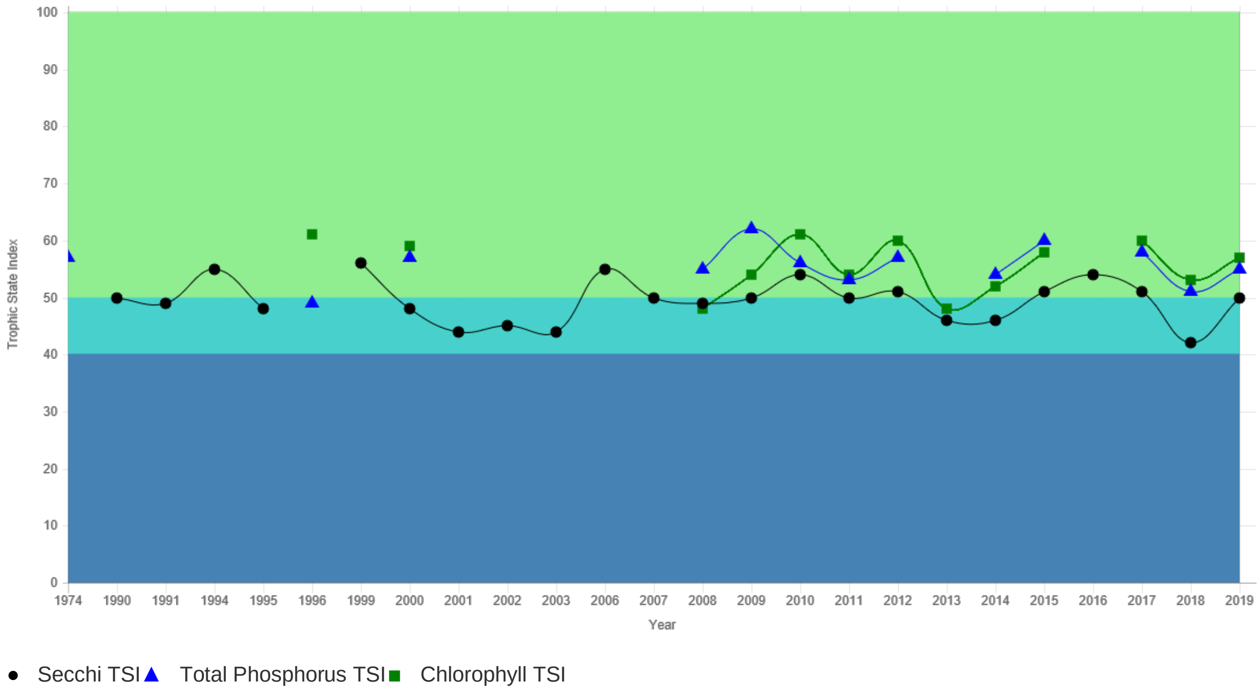

Figure 3. Bone Lake Deep Hole July and August Trophic State Index

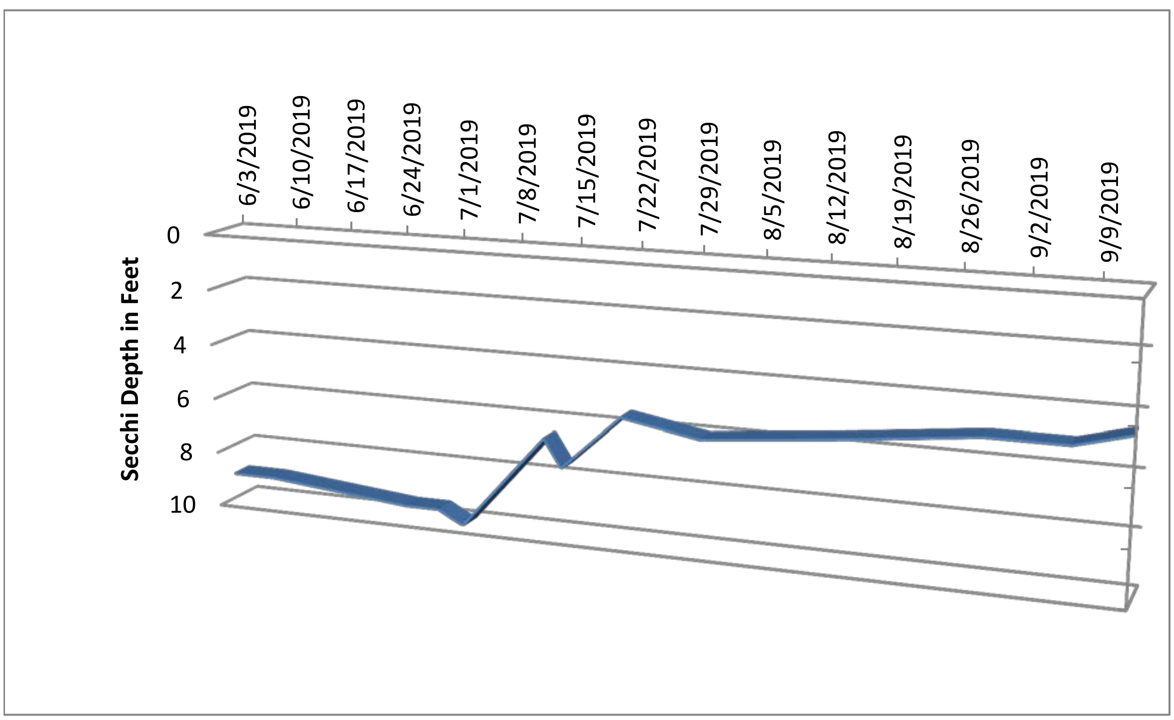

Figure 4. 2019 Secchi Depth Deep Hole

Lake Sediment Historical Water Quality Analysis

The Lake District commissioned a study of Bone Lake sediments in the fall of 2014. The purpose of the study was to assess historical water quality and sediment accumulation from the watershed. Sediments from a 1.95 meter core were dated, and diatoms, sediment accumulation rates, and other factors were examined for this study.

Diatoms are types of algae. By examining the types of algae present, it is possible to “reconstruct” historical phosphorus levels in the lake. The diatom remains show that Bone Lake was a rather nutrient rich lake, even back in the early 1800s before development occurred. However, nutrient levels increased, and algae composition shifted in the 1930s and 1940s with highest nutrient levels and lowest water quality from the 1920s to the 1990s. Water quality improvements were evident beginning in the mid-1990s.

The analysis of inorganic sediment accumulation from the watershed showed an increase after 1900 with sedimentation rates doubling by the late 1940s. In recent years, sedimentation rates from the watershed have decreased, but not back to predevelopment levels. The report recommends continued watershed management efforts to minimize sediment and nutrient loading. (Edlund, Ramstack, Hobbs, and Williamson 2015)

A follow-up analysis of historical algae pigments was completed in 2017. For this study, a single sediment core was recovered from Bone Lake’s southern basin in August 2015 and analyzed for fossil algal pigments to reconstruct a historical record of algae populations. The pigment record from Bone Lake shows that cyanobacteria (blue-green algae) have long-been a substantial part of the lake’s algae community and are a natural and native part of the lake’s algae. (Edlund and Williamson 2017)

However, two major periods of change in the 1940s and 1980s capture reorganization of the lake’s algae that appear to have made bloom-formers and potentially toxic forms a common phenomenon in recent decades. The earlier change coincides with increases in P levels based on diatom-inferred reconstructions (the previous study) and may also reflect increased N deposition from watershed and atmospheric sources. The latter change shows enhanced numbers of cyanobacteria and increased numbers of diatoms that are eutrophic indicators.

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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 5.

WATERSHED LAND USE[4]

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 5 below. Figure 6 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.

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 influence phosphorus loading.

PHOSPHORUS FROM WATERSHED RUNOFF

Phosphorus is the pollutant that has the most impact on 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.

[4] Dave Peterson, Polk County Land and Water Resources Department, completed this analysis in 2008.

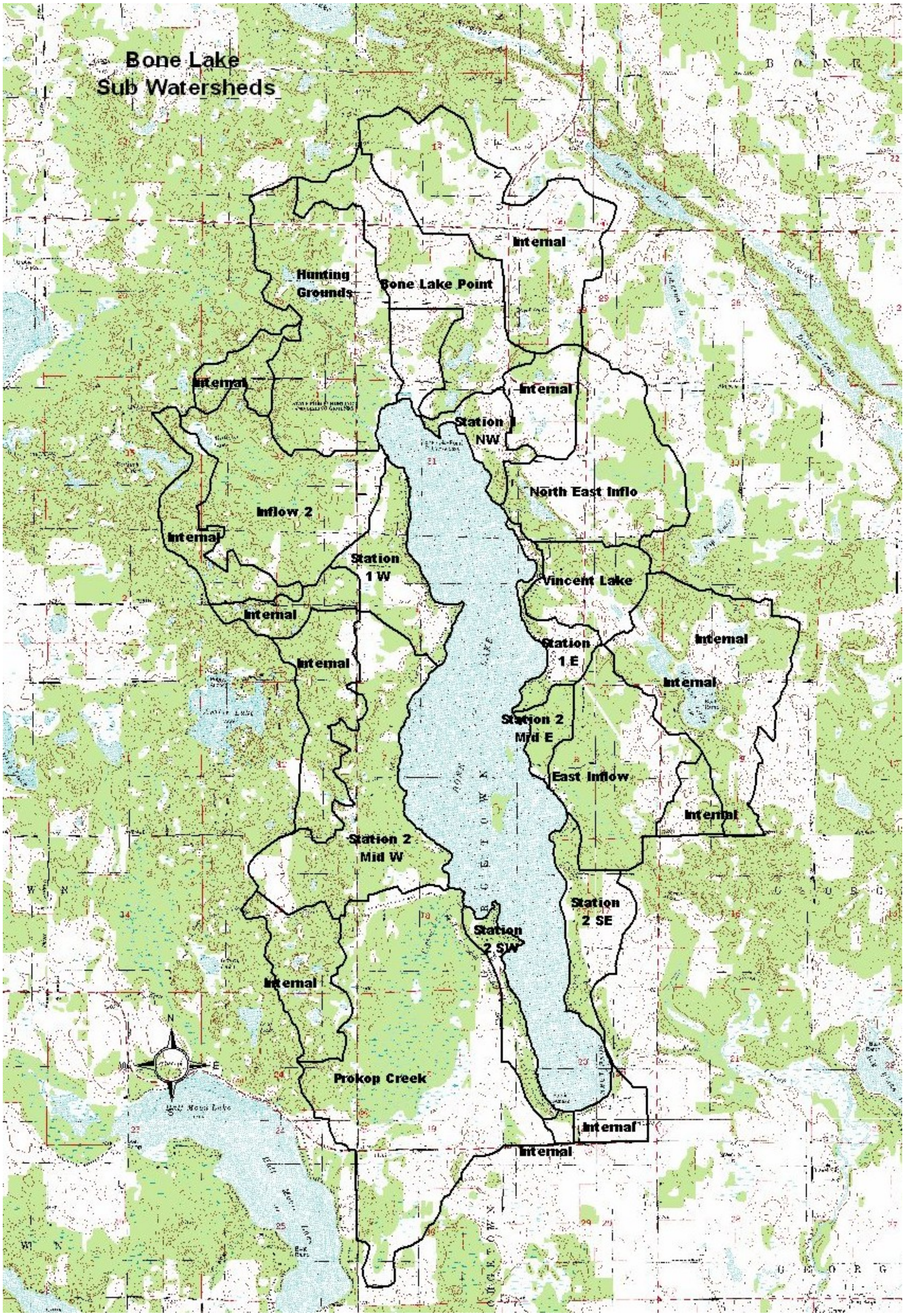

Figure 5. Bone Lake Subwatersheds

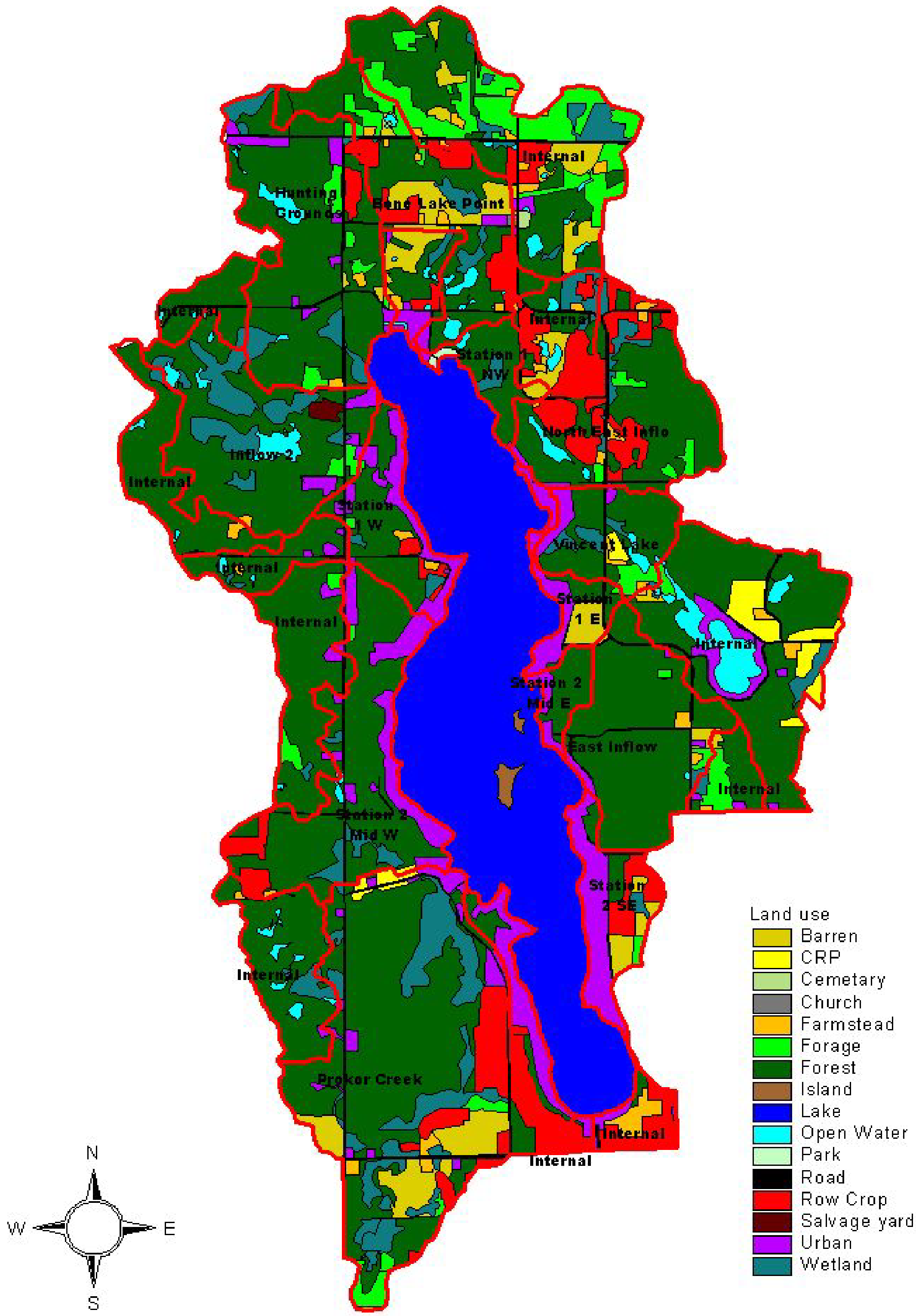

Figure 6. Land Use of Bone Lake Subwatersheds

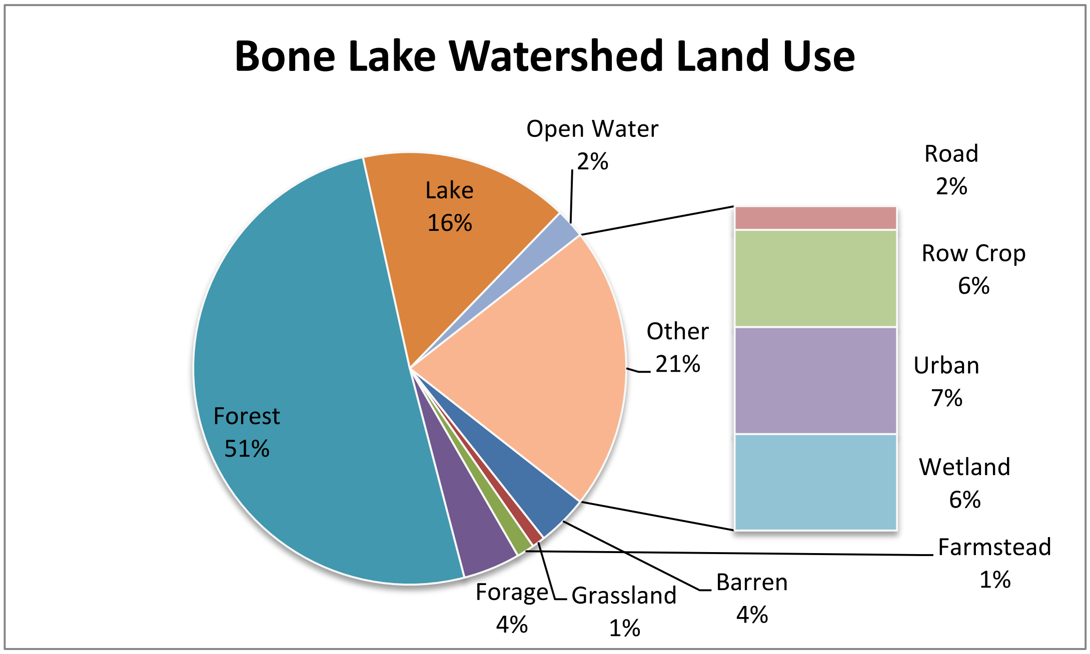

Figure 7. Bone Lake Watershed Land Use

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
- Atmospheric deposition including 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 several studies to better understand the phosphorus budget of the lake. This included an analysis of the release of phosphorus from the lake's bottom sediments – the internal load, measurements of groundwater contributions, a study of release of phosphorus from curly leaf pondweed (CLP), and measuring flow and taking water quality samples from culverts that flow from the watersheds to the lake.

INTERNAL PHOSPHORUS LOAD STUDY

The Bone Lake Management District embarked on more detailed and accurate ways to measure internal loading with two studies initiated from 2015-2017 (Schieffer 2017 and James 2017). These studies were supported by Wisconsin DNR grants.

Volunteers and scientists measured temperature stratification and phosphorus levels in the lake for this study. They took temperature and oxygen profiles (measurements at various depths) at 24 locations in deep areas of the lake from mid-May to the end of September in 2015, 2016, and 2017. These measurements told us how long bottom waters of each basin were anoxic (very low in oxygen) and therefore released phosphorus. They also told us the time period each basin stratifies (and when it mixes). In-lake phosphorus concentration was measured every other week in each of the three basins in Bone Lake (North, Central, and South). Measurements of phosphorus concentration throughout the water column before and after mixing told us how much phosphorus was released from lake sediments. Phosphorus measurements in the water near the lake bottom also provided a means to measure phosphorus release from sediments.

Results show that the lake was anoxic for 58 to 69 days in each year over the 3 year period. The lake was weakly stratified over the study period, suggesting partial mixing of lake layers throughout the summer. In each year there was a full lake mixing event in early to mid-August resulting in substantial phosphorus release and algae blooms.

INTERNAL PHOSPHORUS LOAD ESTIMATE

Two methods were used to calculate the internal load from lake sediments: a study by Ecological Integrity Service measuring lake stratification and phosphorus levels and a UW-Stout study examining phosphorus release from Bone Lake sediments in the laboratory. The estimate for annual internal phosphorus loading over the three-year period was 51% of the total lake phosphorus budget.

REMOVING INTERNAL LOAD – PREDICTED RESULTS

A lake model (Bathtub) was used to test the calculated internal and external phosphorus loads and to estimate the impact of removing the internal load. The estimated in-lake total phosphorus for 2015 to 2017 averaged 54 ppb (ug/L), which predicts a Secchi depth of 1.8 m or 5.9 feet. The actual Secchi depth averaged 1.8 m. If the internal load from sediment release of phosphorus is eliminated, the model predicts a total phosphorus concentration of 34 ppb, a Secchi depth of 2.6 m or 8.5 feet, and a chlorophyll-a concentration of 12 ppb. This is a 37% decrease in total phosphorus, a 44% increase in Secchi depth, and a 45% decrease in chlorophyll-a.[5] Chlorophyll-a is a measure of algae growth.

[5] Bone Lake is listed as an impaired water for total phosphorus (NR 102 4 (b)). It is considered a deep lowland lake. As such, the total phosphorus standard Bone Lake must attain to be removed from the Wisconsin Impaired Waters List is 30 ug/L.

Table 2. Bone Lake Water Quality Actual and Predicted Water Quality with Internal Load Control

*Model Predictions**	2015-17 mean	No sediment release	No internal (remove sediment & CLP)
Total Phosphorus (ppb)	54	34	31
Chlorophyll-*a* (ppb)	22	12	10
Secchi (m)	1.8	2.6	2.7
Secchi (ft)	5.9	8.5	8.9

*These are "growing season means", so total P and chl-*a* will likely be lower in early summer and higher later in summer/fall, and Secchi depth will likely be higher in early summer and lower in later summer.

LABORATORY SEDIMENT PHOSPHORUS RELEASE AND ALUM DOSING CONSIDERATIONS

This study estimated sediment phosphorus release rate from sediment cores incubated in the laboratory (James 2017). The internal load is calculated using the release rate and the duration of anoxia. The lake-wide sediment phosphorus release rate was 6.42 $mg/m^2/day$. This rate (along with duration and area of anoxia) estimates an internal load of 1505 kg in 2017. This is close to the results from the Ecological Integrity Service study and validates each result.

The study also looked at the types of phosphorus contained in Bone Lake sediments and characteristics of the sediment. This information can be used to design an alum treatment for Bone Lake and predict the result of an alum treatment.

Alum (aluminum sulfate) is used to bind phosphorus and prevent its release from lake sediments. Alum application was recommended where anoxia occurs (at least 30 feet and deeper according to the Ecological Integrity Service study). A dose of 90 to 100 g/m^2 split over several years each in early June is recommended. Such a dose is estimated to cost about $1.4 to $1.8 million. Since the cost of alum could increase the future, this cost estimate should be considered conservative. Extensive monitoring of lake sediment and water quality response is recommended to adjust doses made following an initial application of 60% of the recommended total amount. Application of multiple alum doses likely leads to more effective binding of phosphorus and longer control of internal load.

GROUNDWATER STUDY

The groundwater phosphorus load was calculated by using the groundwater flow multiplied by the average concentration of phosphorus in groundwater samples (Schieffer 2019). Groundwater flow was estimated in winter months by measuring tributary inflow and outflow and changes in lake volume from lake level measurements.

Well samples were taken and data analyzed to estimate groundwater phosphorus concentration. The updated phosphorus budget incorporating all previous study results is shown in Figure 8. The figure below also includes updated estimates of CLP loading that followed these internal load studies.

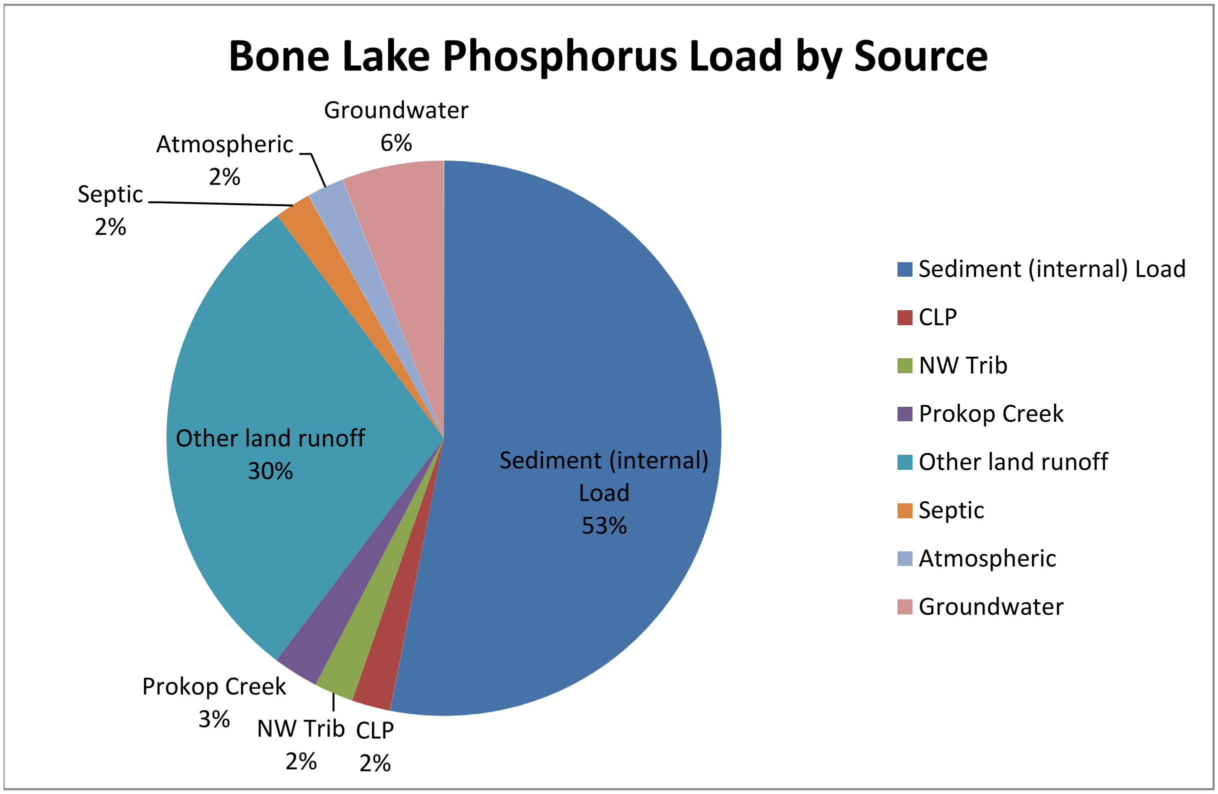

Figure 8. Bone Lake 2019 Phosphorus Budget

CLP SIGNIFICANCE TO BONE LAKE PHOSPHORUS LOAD[6]

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%) 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

[6] 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.

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.

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 did not 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.

CURLY LEAF PONDWEED CONTROL PHOSPHORUS REDUCTIONS

Curly leaf pondweed management provides an opportunity to reduce phosphorus in the lake. While the contribution of phosphorus from CLP is relatively small (about 5%) 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. In recent years control efforts are focused on about 30 acres of CLP. Following treatment of 27.34 acres, an additional 41 acres of CLP growth was mapped in 2019. Treatment areas are chosen because they are in areas where reasonable success can be demonstrated because of lake depths. The Lake District is not able to obtain permits to use herbicides to control large CLP beds that exist in proximity to wild rice in the northwest corner of the lake.

Cost of treatment (including monitoring, permitting and coordination) was $1,202 /acre in 2019 with 50% of the cost covered by WDNR grants. WDNR grants covered 50 to 75 percent of CLP control costs since 2009. These grants are competitive and not guaranteed into the future. It is estimated that CLP treatment prevents about 25 kg of phosphorus loading each year.[7] At a total annual cost of $36,000 (without grant funding) it costs about $1,400/kg phosphorus annually to remove phosphorus with CLP herbicide control. The cost over 10 years (a measure to compare other methods to control phosphorus) would be $14,400/kg. Cost estimates of other methods to manage phosphorus on Bone Lake over 10 years are included in Table 3 below. Cost and removal via harvesting CLP on Lake Wapogasset and Bear Trap Lake are also shown in Table 3. CLP control is not currently a cost effective method to manage phosphorus on Bone Lake.

Table 3. Cost to Manage Annual Phosphorus Loading over a Ten Year Period

Curly Leaf Pondweed	$14,400/kg
CLP Harvesting (from WAPO/BEAR)	$13,125/kg
Septic Systems	$8,333/kg
Waterfront/Watershed	$9,490/kg
Alum	$1,875/kg

[7] Steve Schieffer. Email communication. 1/27/2020.

AQUATIC HABITATS

PRIMARY HUMAN USE AREAS

Figure 1 illustrates the location of boat landings and resorts on the Bone 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 Bone Lake Comprehensive Lake Management plan in October 2008. The shoreland habitat assessment was updated in 2018.

SHORELAND HABITAT ASSESSMENT

The purpose of the shoreland habitat 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 the 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.[8] The shoreland buffer zone begins at the ordinary high water mark and extends 35 feet inland. Results are illustrated in Figure 9 through Figure 12.

SHORELINE COMPOSITION

In 2008, over half (51%) 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. Natural vegetation at the shoreline increased to 56% in 2018. Lawn decreased from 31% in 2008 to 18% in 2018. Rock rip rap, which stabilizes the bank but may be detrimental to lake habitat, was found along 13% of the Bone Lake shoreline in 2008 and 20% of the shoreline in 2018.

SHORELAND BUFFER COMPOSITION

The shoreland buffer composition did not meet state standards and recommendations in 2008. 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 in 2008 with much of this on undeveloped parcels. Natural vegetation in the buffer zone increased to 51% in 2018. Woody debris, such as fallen trees in the water, is important for fish and wildlife habitat structure. The 2008 habitat survey found only 13 locations where woody debris was present. Although more may have occurred where there were large stretches of natural areas. Woody habitat was not assessed in the 2018 survey. 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. The Fisheries Committee has installed woody habitat in the lake since 2008.

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[8] 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."

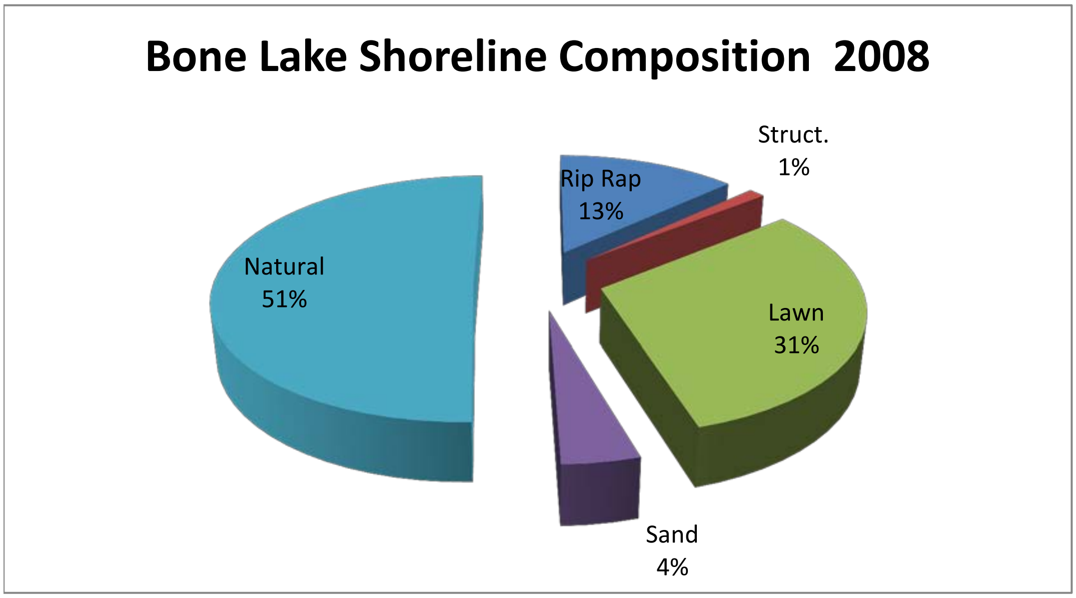

Figure 9. Bone Lake Shoreline Composition 2008

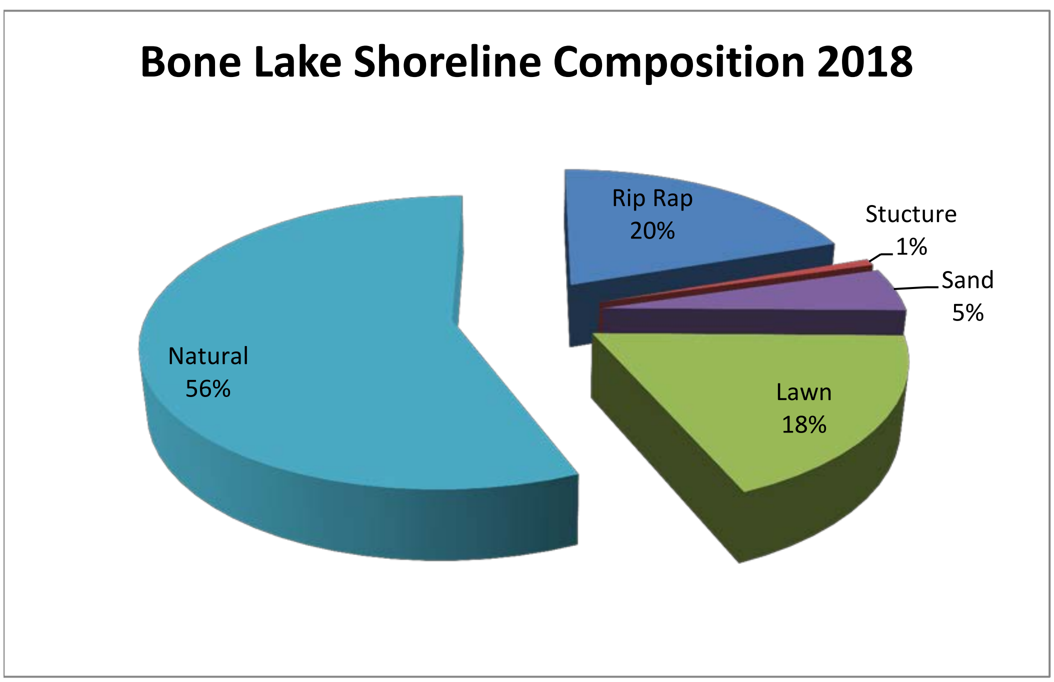

Figure 10. Bone Lake Shoreline Composition 2018

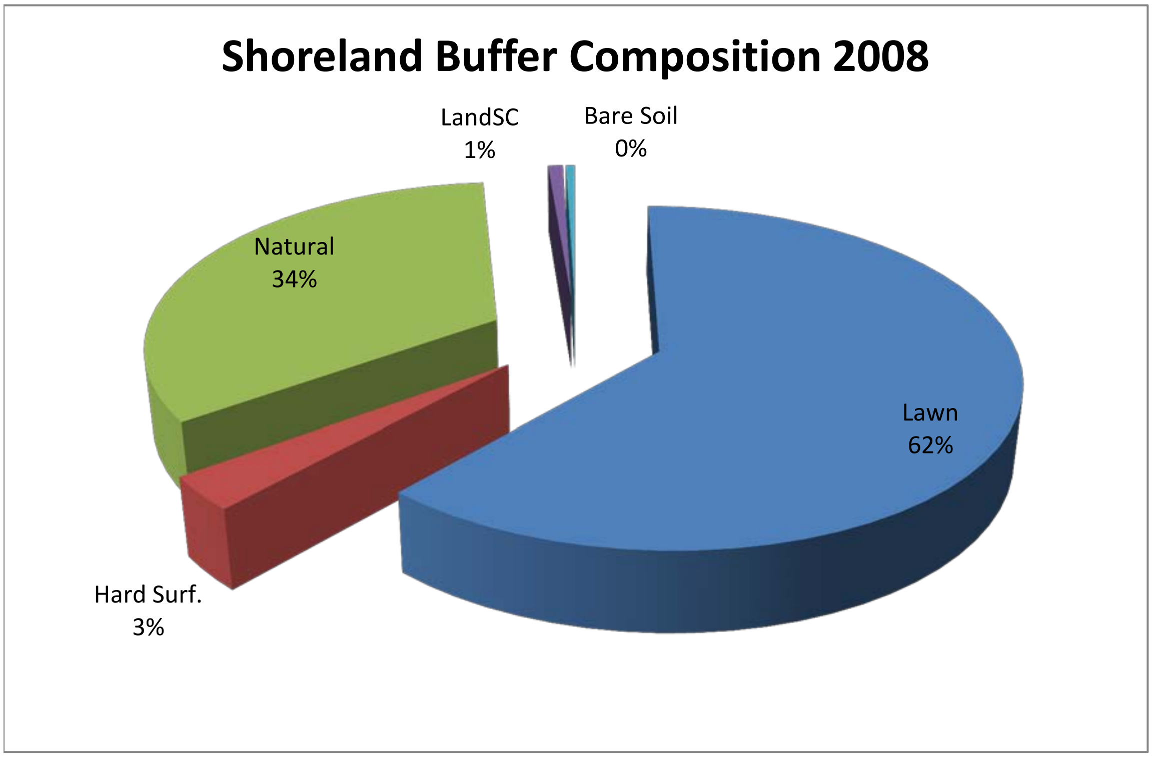

Figure 11. Bone Lake Shoreland Buffer Composition 2008

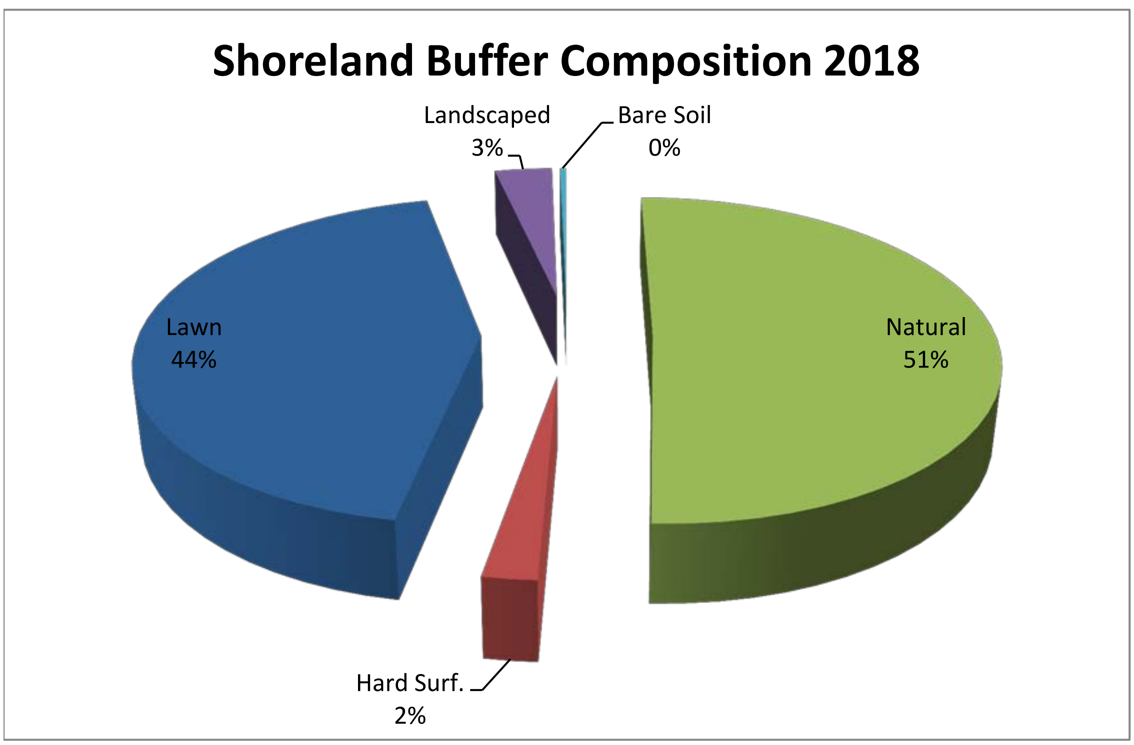

Figure 12. Bone Lake Shoreland Buffer Composition 2018

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.

Bullrush on Bone Lake Photo by Karen Engelbretson

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.[9]

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

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 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 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.[10]

SENSITIVE/CRITICAL HABITAT 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.

Specific recommendations for chemical, mechanical, and hand removal were provided for each area in the report. Where there is developed property adjacent to the sensitive area, the following recommendations were included:

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

The WDNR Sensitive Area Report is found on the Bone Lake Management District web site www.bonelakewi.com and on the WDNR web site at https://dnr.wi.gov/lakes/criticalhabitat/Project.aspx?project=10419327

Bone Lake Critical Habitat Area H
Photo by Karen Engelbretson

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

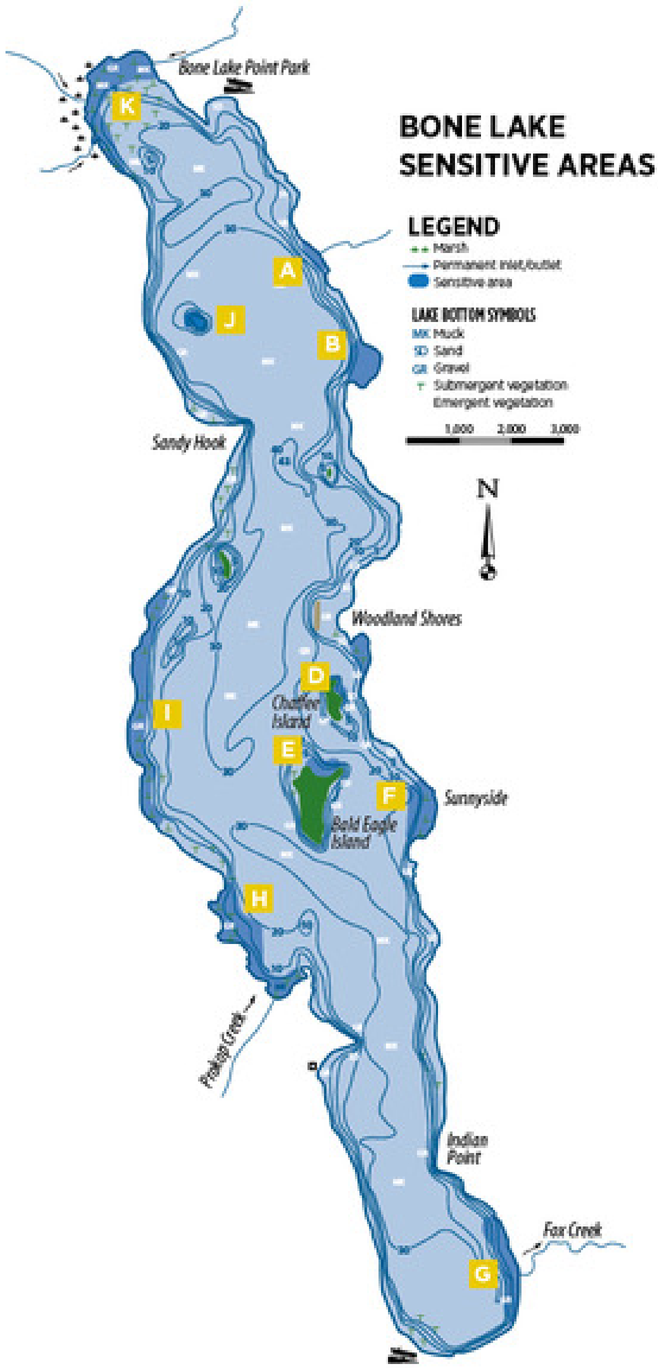

Figure 13. Bone Lake Sensitive/Critical Habitat Areas

Department of Natural Resources *critical habitat areas* 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 provides a framework for management decisions that impact the ecosystem of the lake. From here forward, Bone Lake *sensitive areas* will be referred to as *critical habitat areas* in this plan.

RARE AND ENDANGERED SPECIES HABITAT

Bone Lake is in the Town of Georgetown (T35N, R16W) and the Town of Bone Lake (T36N, R16W). Table 4 is a list of species on the Natural Heritage Working List that have been documented in these areas.[11] Occurrences of certain sensitive species have been omitted since these data are not available to the general public at the township level. No state or federally listed threatened, endangered, rare, or special concern plant species were found in any lake plant surveys.

Table 4. Natural Heritage Inventory Working List for Towns of Georgetown and Bone Lake

Scientific Name	**Common Name**	**State Status[12]**	**T35N R16W**	**T36N R16**
AGABETES ACUDUCTUS	A PREDACEIOUS DIVING BEETLE	SC/N		YES
BUTEO LINEATUS	RED-SHOULDERED HAWK	THR		YES
DENDROICA CERULEA	CERULEAN WARBLER	THR		YES
HELOPHORUS LATIPENIS	A WATER SCAVENGER BEETLE	SC/N		YES
OPHIOGOMPHUS SMITHI	SAND SNAKETAIL	SC/N		YES
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	SC		YES
EMYDOIDEA BLANDINGII	BLANDINGS TURTLE	SC/P		YES
HELOPHORUS LATIPENIS	A WATER SCAVENGER BEETLE	SC/N		YES
HEMIDACTYLIUM SCUTATUM	FOUR-TOED SALAMANDER	SC/H		YES
OPHIOGOMPHUS SMITHI	SIOUX (SAND) SNAKETAIL	SC/N		YES
PLESTIODON SEPTENTRIONALIS	PRAIRIE SKINK	SC/H		YES
SETOPHAGA CERULEA	CERULEAN WARBLER	THR		YES
VERMIVORA CHRYSOPTERA	GOLDEN-WINGED WARBLER	SC/M		YES

[11] https://dnr.wi.gov/topic/NHI/Data.asp?tool=township&mode=detail List updated 4/19/19.

[12] THR = Threatened, SC/N = Special Concern (no laws regulating use, possessions, or harvesting), SC/P = fully protected, SC/M – fully protected by federal and state laws under the migratory bird act.

The following communities are listed in the database for T35N R16W:
Northern dry-mesic forest
Northern wet-mesic forest

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

Black spruce swamp	Poor fen
Open bog	Lake – soft bog
Northern wet forest	Ephemeral pond
Northern dry-mesic forest	Southern dry-mesic forest
Northern wet-mesic forest	Northern tamarack swamp

BONE LAKE FISHERY[13]

The fish community in Bone Lake consists of muskellunge, largemouth bass, bluegill, pumpkinseed, black crappie, green sunfish and 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.

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 0.55 adult fish/acre. The population continued to decrease through 2011 when it was 0.42 adult fish/acre. This 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 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).

Bone Lake has a moderate density largemouth bass population with respectable size structure. Northern pike are present at a lower density with many individuals in the 24-30 inch size range. Bone Lake has abundant pan fish populations.

BONE LAKE FISHERY COMMITTEE

The Bone Lake Management District has an active Fishery Committee that has been engaged in several projects over the last several years. They have 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

[13] Information from Aaron Cole, WDNR Fisheries Biologist, and Robert Boyd, Bone Lake Management District Fisheries Committee. Updated April 2018.

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 has 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 because: 1) Bone Lake has limited shoreline 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 important, and lake residents are encouraged to leave trees that fall naturally into the water. In some locations hinge trees, that could be cut and dropped into the water to provide cover, will be considered for additional wood habitat.

The Fishery Committee installed, and now maintain, 80 half log structures throughout the lake. Half logs consist of a hardwood log 6-8 feet long and 8-12 inches 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. Funding for the wood habitat projects was from a WDNR Lake Protection Grant and Lake District funds. The Bone Lake Fishery Committee has also organized a late winter lake trash clean-up which is completed before ice-out.

SMALLMOUTH BASS STOCKING

The Bone Lake Management District provided funds for a smallmouth bass stocking program in Bone Lake. The Fishery Committee stocked 12,500 smallmouth bass from 2011 - 2013 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.

The WDNR fisheries crew did not see a marked increase in the smallmouth bass population in the 2017 survey compared to previous surveys, but they will evaluate any changes in the smallmouth bass population (including natural recruitment) during future fisheries surveys. In addition, to better estimate the success of the smallmouth bass stockings, the Bone Lake Fishery Committee will be interviewing bass tournament anglers to collect data on the number and size of smallmouth bass that were caught.

BLACK CRAPPIE SARCOMA

In recent years, there was an increase in fish with black crappie sarcoma: a condition where fish have large open raised sores on their skin. Although the exact mechanism of transfer is unknown, it is suspected that it is caused by 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 that goes deep into the muscle, the recommendation is not to eat fish that have lesions or look abnormal. Anglers who catch infected fish are encouraged to keep but discard them. However, anglers should realize infected crappies count towards their daily bag limit.

In an attempt to learn more about black crappie sarcoma, the Bone Lake Fishery Committee networked with and assisted a WDNR black crappie sarcoma study during the winter of 2014-2015. Samples from infected fish were sent to several laboratories across the country. At the U.S. Fish and Wildlife Services Lab in La Crosse, Wisconsin, specimens were tested for suspected viruses and bacteria. Results came back negative for three suspected viruses and bacteria, and an unknown virus was isolated. A Florida laboratory where the viral sample was sent did not find viral DNA using Next Generation Sequencing, so they put the project on hold indefinitely. (Boyd 2018)

The Bone Lake Management District along with other lake organizations supported the *Black Crappie Sarcoma Project*, undergraduate student research at UW Stout in 2018 and 2019. This project worked to extract fish tissue protein from diseased and healthy fish tissue. Researcher, Kayla Boyd also sought support from other scientists to compare extracted proteins and took steps to culture fish tissue. (Boyd 2018) In 2019 abnormal cells with large nuclei and misshapen bodies (an indication of potential cancerous cells) were found in infected fish. Remaining funds donated to this project by lake organizations were subsequently donated to the WDNR to continue this research. (Boyd 2019)

To better understand the prevalence of black crappie sarcoma in Bone Lake and track trends over years, the Bone Lake Fishery Committee will collect and record crappie anglers overall catch as well as the number (and percentage) that appear to show symptoms of black crappie sarcoma. This information will be shared with the WDNR.

TRIBAL FISHING[14]

Lake residents have raised concerns regarding the impact of tribal fishing on Bone Lake fish populations. A review of tribal fishing rights and tribal fishing on Bone Lake is included to better understand this issue.

Tribal fishing rights are accorded as a matter of federal treaty. Prior to the arrival of Europeans in North America, Indian tribes were independent, sovereign nations. Although the Chippewa tribes ceded their land in the northern one-third of Wisconsin to the United States government in the Treaties of 1837 and 1842, they reserved their off-reservation rights to hunt, fish, and gather within the Ceded Territory. The maintenance of these rights is comparable to a conservation easement or the retention of mineral rights by someone selling real estate.

In 1983, in what is commonly referred to as the Voigt case, the United States Court of Appeals for the Seventh Circuit affirmed that the off-reservation hunting, fishing, and gathering rights are part of the sovereign rights that the Chippewa Tribes of Wisconsin have always had and that they have never been voluntarily given up nor terminated by the federal government. The courts defined the scope of these rights between 1985 and 1991. As a result, the Chippewa Tribes of Wisconsin are allowed to legally harvest walleyes and muskellunge using a variety of high efficiency methods, including spearing and gillnetting, on lakes within the Ceded Territory.

TRIBAL HARVEST

The six Chippewa Tribes of Wisconsin are legally able to harvest walleyes using a variety of high efficiency methods, but spring spearing is the most frequently used method. In spring each tribe declares how many walleyes and muskellunge they intend to harvest from each lake. Harvest begins shortly after ice-out, with nightly fishing permits issued to individual tribal spearers. Each permit allows a specific number of fish to be harvested, including one walleye between 20 and 24 inches and one additional walleye of any size. All fish that are taken are documented each night with a tribal clerk or warden present at each boat landing used in a given lake. Once the declared harvest is reached in a given lake, no more permits are issued for that lake and spearfishing ceases.

[14] http://www.dnr.state.wi.us/fish/ceded

MANAGEMENT RECOMMENDATIONS TO MINIMIZE IMPACT TO FISHERY[15]

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

[15] Personal communication. Aaron Cole. WDNR Fisheries Biologist. 03/04/13.

PLANT COMMUNITY

The Bone Lake Management District commissioned an aquatic macrophyte (plant) survey in 2017 in preparation for updating the aquatic plant management plan for Bone Lake. Previous surveys were completed in 2007 and 2012. The Management District funded the survey with the help of a Department of Natural Resources grant. The survey and data analysis methods for the aquatic macrophyte survey are found in the following report: *Aquatic Macrophyte Survey, Bone Lake Polk County, Wisconsin,* July 2017, conducted and prepared by Steve Schieffer, Ecological Integrity Service, Inc. The results discussed below are summarized or taken directly from the aquatic plant survey.

AQUATIC PLANT SURVEY RESULTS

Ecological Integrity Service completed the plant inventory according to the WDNR-specified point intercept method in June and July of 2017. The 2017 survey results are also compared with those from 2007 and 2012.

PLANT COVERAGE

The WDNR 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 14 shows the sample grid, while Figure 15 shows the location of points where plants were present and their rake density.

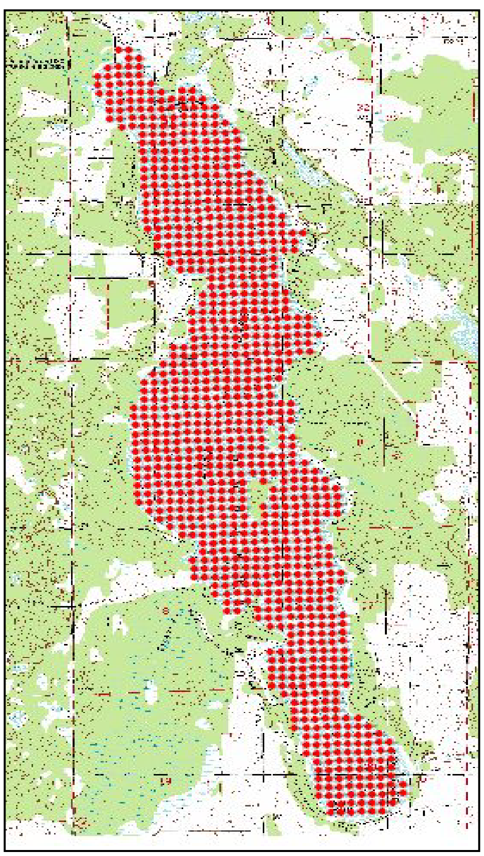

Figure 14. Sample Point Grid

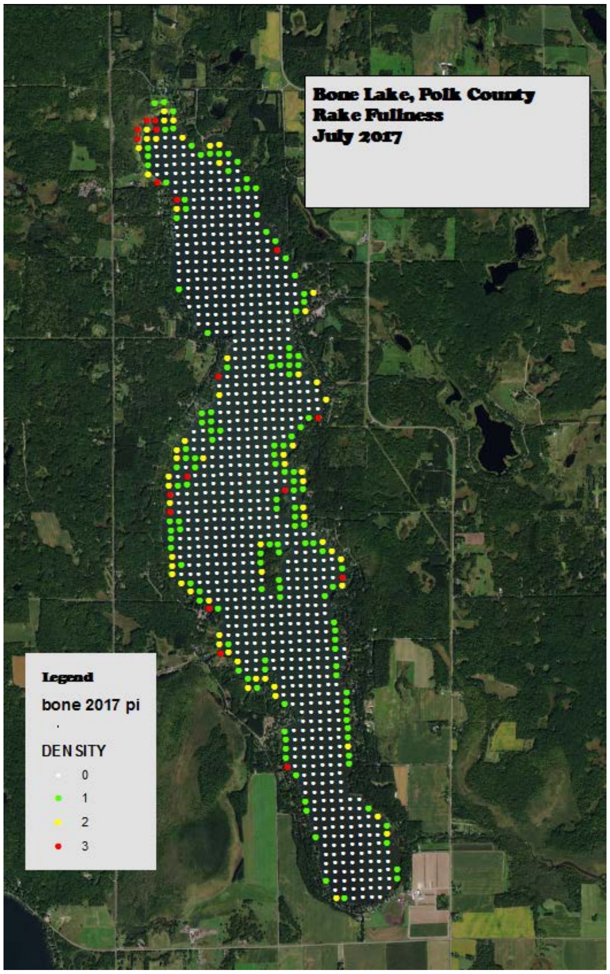

Figure 15. Bone Lake Aquatic Plant Rake Density July 2017

The 2017 Bone Lake point intercept survey revealed a healthy, diverse aquatic plant community. There were 35 native species and one invasive species (*Potamogeton crispus* - curly leaf pondweed) sampled during the rake survey. The Simpson's Diversity Index was relatively high at 0.91.

The coverage of plants in Bone Lake is limited to a narrow zone that borders the lake. Of the 1000 sample locations, only 209 had vegetation (20.9 % of the lake). Although water clarity is an issue during some growing seasons in Bone Lake, light penetration is adequate to sustain plant life in relatively deep water. Plants were found growing as deep as 18.6 feet. This depth defines the littoral zone, or the zone where plants can grow. Within that defined littoral zone, 77.35% of the sample points had plants present. The mean depth of plant growth was 4.98 feet.

Table 5. Plant Survey Summary 2017

Total number of sample points in full survey	1000
Total number of sites with vegetation	209
Total number of sites shallower than maximum depth of plants	287
Frequency of occurrence at sites shallower than maximum depth of plants	72.82
Simpson Diversity Index	0.91
Maximum depth of plants	18.60 ft.
Mean depth of plants	4.98 ft.
Average number of all species per site (veg. sites only)	2.53
Average number of native species per site (veg. sites only)	2.43
Species Richness	35
Species Richness (including visuals)	38
Mean rake fullness	1.04

Where plants are present, the density of plants is low with a mean rake fullness of 1.04 (on a scale of 1 to 3). Figure 16 shows the species richness at each point. The diversity is higher in most bays, with the highest in those on the north end the west side of the lake. It is common for bays to have the higher diversity because there is a more stable habitat for plant growth and often higher nutrient sediment. Much of Bone Lake sediment is dominated by sand and rock, which can limit plant growth.

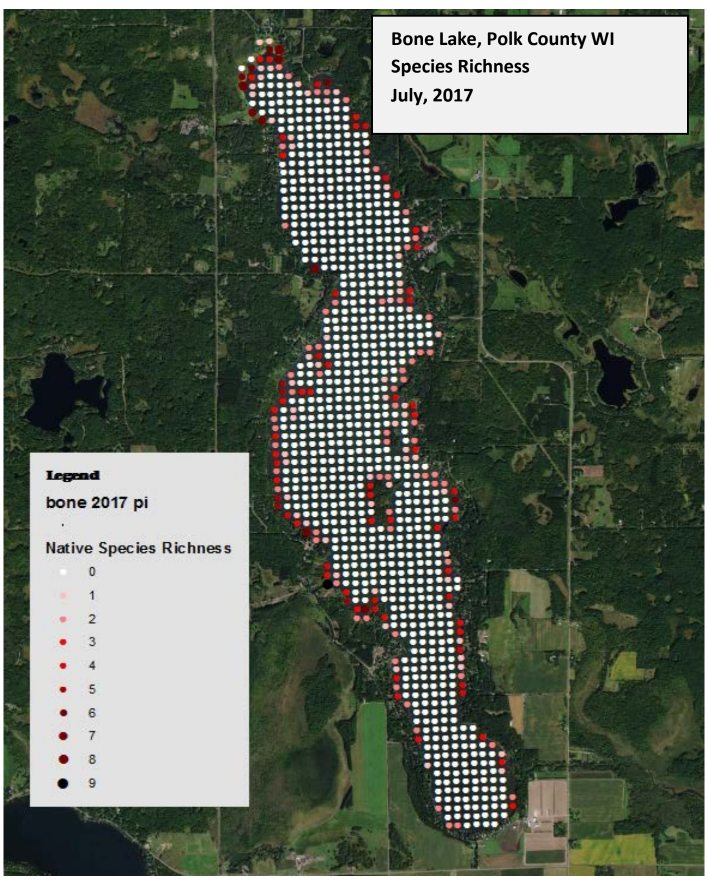

Figure 16. Species Richness 2017

PLANT DIVERSITY

Bone Lake has a very diverse native plant community. Table 6 lists the 34 native species and one non-native species sampled in the plant survey. 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 all times plants were sampled in the survey.

The most common native plant sampled was *Chara sp*., known as muskgrass. This “plant” (actually a green algae species that looks like a plant) is common and desirable in Wisconsin lakes. The second and third most common native plants sampled were *Vallisneria americana*, wild celery and *Najas flexilis*, slender naiad, which are often found in Wisconsin lakes. They provide key food for various organisms and habitat for invertebrates and fish. Figure 17 shows the distribution of the three most common native plant species.

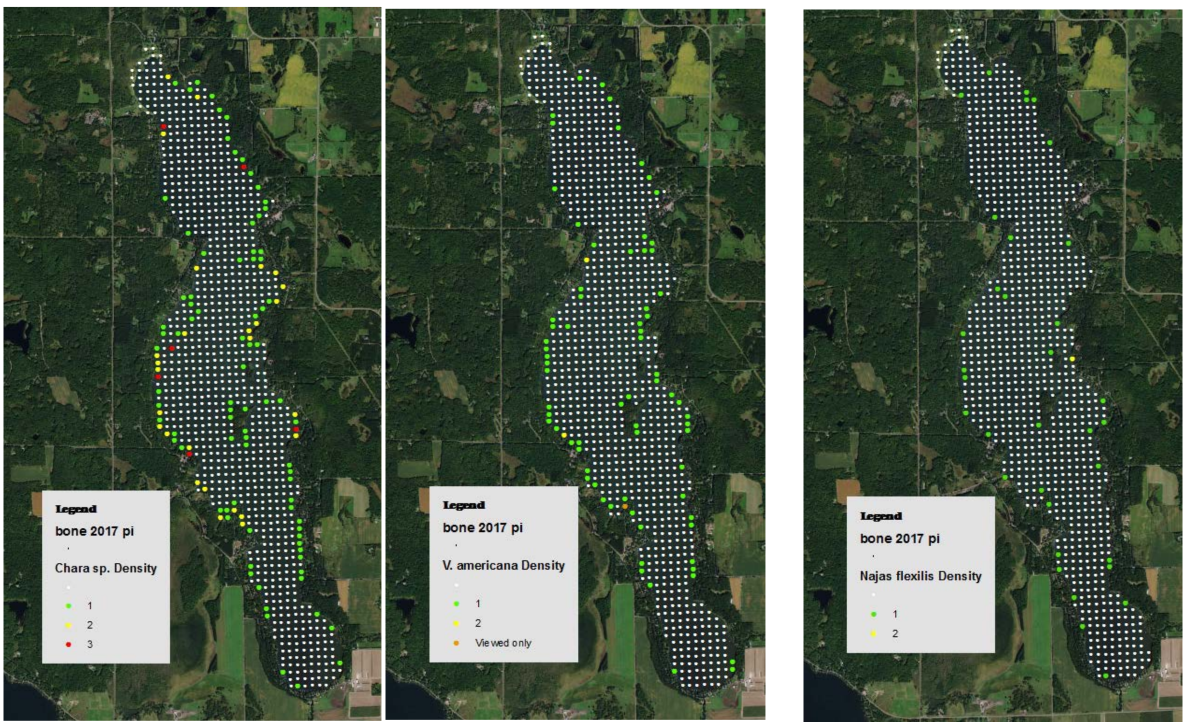

Figure 17. Density of Three Most Common Native Plant Species: Chara, Wild Celery, and Slender Naiad (from left to right)

Table 6. Aquatic Plants in Bone Lake July 13-17, 2017

Species	Frequency of Occurrence (vegetated areas)	Frequency of Occurrence (littoral)	Relative Frequency	Number sampled	Mean Density
Chara sp., Muskgrasses	52.70	40.77	22.1	117	1.33
Vallisneria americana, Wild celery	33.33	25.78	14.0	74	1.03
Potamogeton crispus, Curly-leaf pondweed (invasive) - July, 2017	18.66	13.59	7.4	39	1.05
Potamogeton crispus, Curly-leaf pondweed (invasive) - June, 2017	36.04	27.87	14.0	80	1.74
Najas flexilis, Slender naiad	15.77	12.20	6.6	35	1.03
Ceratophyllum demersum, Coontail	15.32	11.85	6.4	34	1.06
Lemna trisulca, Forked duckweed	15.32	11.85	6.4	34	1.03
Potamogeton pusillus, Small pondweed	8.56	6.62	3.6	19	1.11
Potamogeton zosteriformis, Flat-stem pondweed	8.56	6.62	3.6	19	1.00
Stuckenia pectinata, Sago pondweed	8.11	6.27	3.4	18	1.00
Myriophyllum sibiricum, Northern watermilfoil	7.66	5.92	3.2	17	1.00
Heteranthera dubia, Water star-grass	4.95	3.83	2.1	11	1.00
Nitella sp., Nitella	4.50	3.48	1.9	10	1.00
Potamogeton richardsonii, Clasping-leaf pondweed	4.50	3.48	1.9	10	1.00
Lemna minor, Small duckweed	4.05	3.14	1.7	9	1.00
Potamogeton friesii, Fries' pondweed	4.05	3.14	1.7	9	1.00
Potamogeton gramineus, Variable pondweed	4.05	3.14	1.7	9	1.00
Spirodela polyrhiza, Large duckweed	4.05	3.14	1.7	9	1.00
Wolffia columbiana, Common watermeal	3.60	2.79	1.5	8	1.00
Potamogeton illinoensis, Illinois pondweed	3.15	2.44	1.3	7	1.00
Nymphaea odorata, White water lily	2.70	2.09	1.1	6	1.17
Ranunculus aquatilis, White water crowfoot	2.70	2.09	1.1	6	1.00
Nuphar variegata, Spatterdock	2.25	1.74	0.9	5	1.00
Potamogeton praelongus, White-stem pondweed	2.25	1.74	0.9	5	1.00
Elodea canadensis, Common waterweed	1.80	1.39	0.8	4	1.00
Schoenoplectus acutus, Hardstem bulrush	1.35	1.05	0.6	3	1.00
Bidens beckii, Water marigold	0.90	0.70	0.4	2	1.00
Eleocharis palustris, Creeping spikerush	0.90	0.70	0.4	2	1.00
Eleocharis acicularis, Needle spikerush	0.45	0.35	0.2	1	1.00
Isoetes echinospora, Spiny spored-quillwort	0.45	0.35	0.2	1	1.00
Potamogeton foliosus, Leafy pondweed	0.45	0.35	0.2	1	1.00
Potamogeton strictifolius, Stiff pondweed	0.45	0.35	0.2	1	1.00
Sagittaria rigida, Sessile-fruited arrowhead	0.45	0.35	0.2	1	1.00
Schoenoplectus pungens, Three-square bulrush	0.45	0.35	0.2	1	1.00
Sparganium eurycarpum, Common bur-reed	0.45	0.35	0.2	1	1.00
Zizania palustris, Northern wild rice	0.45	0.35	0.2	1	1.00

Additional Viewed Species

Carex comosa, Bottle brush sedge

Phalaris arundinacea, Reed canary grass (invasive)

Potamogeton amplifolius, Large-leaf pondweed

A boat survey was conducted to capture plant growth (including sensitive and/or invasive species) in under surveyed areas or unique habitats that the sampling grid does not reflect. The resulting plant list is not used in the survey statistics reported in Table 6. Those with * indicate non-native, restricted invasive species.

Table 7. Plant Species Viewed Only in Boat Survey

Asclepias incarnate - swamp milkweed
Calla palustris - wild calla
Carex sp.-sedges
Dulichium arundinaceum - three-way sedge
Pontederia cordata - pickerelweed
Rumex orbiculatus - aquatic dock
**Typha augustifolia* - narrow leaf cattail
Typha latifolia - broad leaf cattail
Sagittaria latifolia - common arrowhead
Schoenoplectus tabernaemontani - softstem bulrush
Iris versicolor - blue flag iris
Schoenoplectus fluviatilis - river bulrush
**Myosotis scorpoiodes* - aquatic forget-me-not

FLORISTIC QUALITY INDEX

The floristic quality index (FQI) may help evaluate changes to plant habitat from human activities. A reduction in FQI could result from a smaller number of species or fewer of the more sensitive (less tolerant) species. Bone Lake FQI data is higher in all categories than the median of lakes in the North Central Hardwood Forests ecoregion. Table 8 summarizes the 2017 FQI data.

Table 8. Bone Lake Floristic Quality Index 2017

Parameter	Bone Lake 2017	Ecoregion Median (Nichols, 1999).
Number of species in FQI	34	14
Mean conservatism	6.08	5.6
FQI	35.5	20.9

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 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 Chippewa (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. Draft and final copies will be distributed to the Tribe and the Great Lakes Indian Fish and Wildlife Commission.

When Chippewa (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 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% 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 18.

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 2007, 2012, or 2017. The point intercept survey found wild rice in low densities at just one or two sample points on the northwest side of the lake in each of these years.

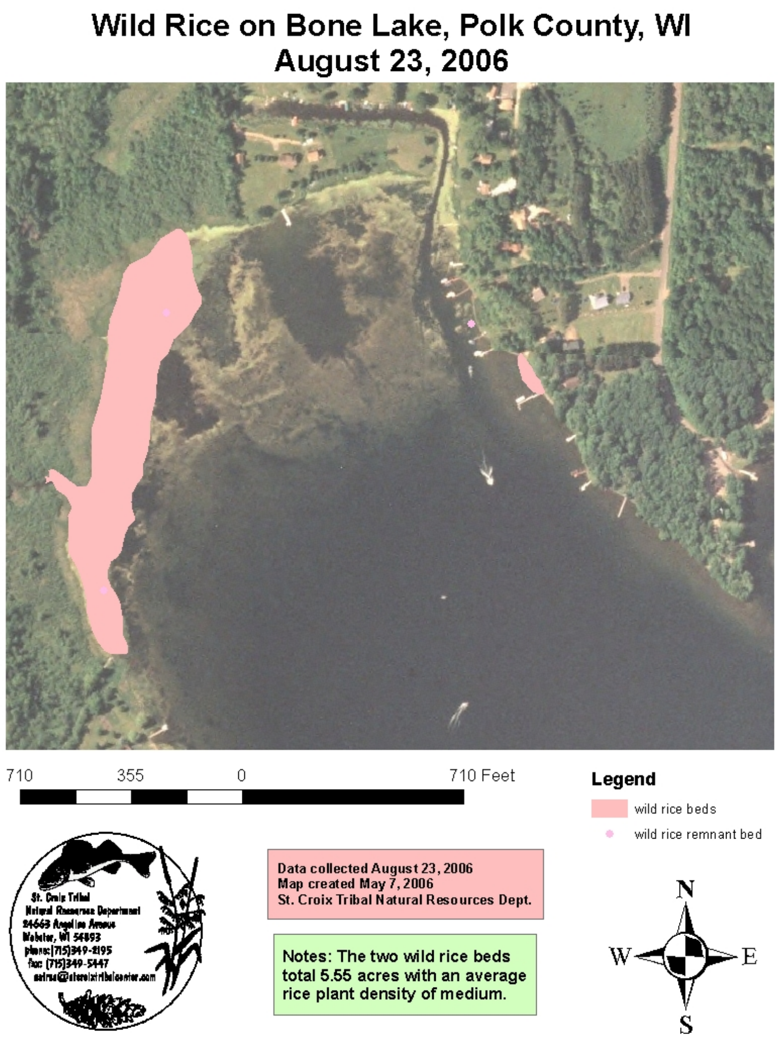

Figure 18. Wild Rice in Bone Lake 2006

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 19.

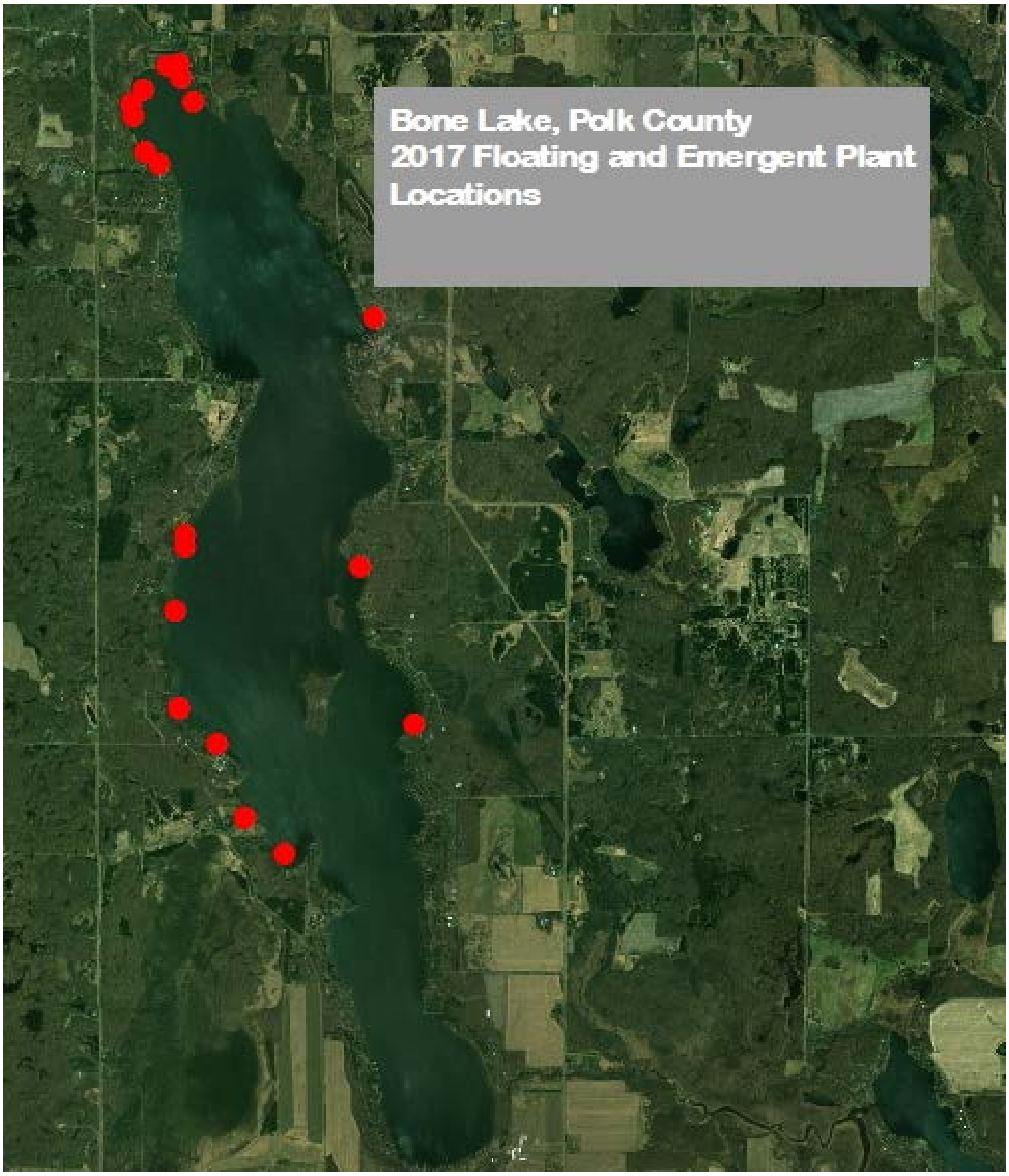

Figure 19. Locations of Floating and Emergent Aquatic Plants 2017

White Water Lily
Photo by Karen Engelbretson

COMPARISON OF PLANT SURVEY RESULTS

Table 9 summarizes results from recent Bone Lake plant surveys for comparison. The plant community has changed little over 10 years. It appears that human activity and management of CLP has had little impact on the plants.

Table 9. Bone Lake Point Intercept Results 2007, 2012, and 2017

Parameter	2007	2012	2017
Species richness	31	36	35
Simpson's diversity index	0.92	0.92	0.91
Maximum depth of plants	17.9 feet	20.7 feet	18.6 feet
FQI	33.8	35.5	35.2
Dominant plant species	*Vallisneria americana*	*Chara sp.*	*Chara sp.*
Relative frequency of dominant species	12.9%	14.4%	22.1%
Percent of all sample points with plants	22.6%	19.2%	20.9%

A more in-depth comparison evaluated the frequency of occurrence (FOO) changes for individual species. Details are reported in the point intercept survey results. Table 10 summarizes significant increases and decreases in native species. The most dramatic decreases over 10 years (2007-2017) were in *Potamogeton amplifolius, Potamogeton illinoensis. Potamogeton zosteriformis*, and *Najas flexilis*. All of these native species are quite common lake plants in Wisconsin lakes and are desirable plants for fish and invertebrate habitat. The cause of the reduction in these plants is unknown. Herbicide use for CLP management might cause declines in native plants. However, declines in these native species with most dramatic decline noted above were not noted within treatment areas in year to year native plant frequency comparisons (Schieffer 2012 – 2019). As evidenced by increases in some native plant frequencies, changes could be the result of natural variation within the plant community. Sample variation can also occur because of limits of precision on GPS points. Other factors, including sedimentation or invasive species such as rusty crayfish or common carp, can also influence plant growth.

Table 10. Significant Changes in Native Plant Species 2007 – 2017 (chi-square P value < 0.05)

	2012-2017	2007-2017
Significant Decreases	*Ceratophyllum demersum* *Potamogeton zosteriformis* *Myriophyllum sibiricum* *Potamogeton richardsonii*	*Najas flexilis* *Potamogeton zosteriformis* *Potamogeton richardsonii* *Potamogeton illinoensis* *Potamogeton amplifolius*
Significant Increases	*Chara sp.* *Lemna trisulca* *Heteranthera dubia* *Nitella sp.*	*Chara sp.* *Nitella sp.* *Spirodela polyrhiza*

AQUATIC INVASIVE SPECIES

Invasive species identified in Bone Lake include curly leaf pondweed, aquatic forget-me-not (*Myosotis scorpioides*), banded mystery snail, Chinese mystery snail, giant knotweed (*Polygonum sachalinense*), narrow-leaf cattail (*Typha angustifolia*), and purple loosestrife. Rusty crayfish (*Orconectes rusticus*) an aquatic invasive species, was discovered in Bone Lake in the summer of 2012. However, subsequent attempts to locate rusty crayfish through trapping were unsuccessful. Adult and larval zebra mussels were confirmed in Polk County in Deer Lake in 2019. Because musky tournament anglers move between Deer Lake and Bone Lake, the concern for infestation is heightened.

More information about invasive species identification and control is found in Appendix A.

CURLY LEAF PONDWEED

Ecological Integrity Service conducted an early season survey to assess the location of the aquatic invasive species curly leaf pondweed *(Potamogeton crispus*) in 2007, 2012, and 2017. Because curly leaf pondweed (CLP) is most robust in early summer, the surveys were conducted in June (following CLP control in designated treatment areas). The entire littoral zone was surveyed for CLP. The CLP beds mapped in Figure 20 below were at or near surface, had a consistent density of 2 (with a scale from least to greatest density of 0 to 2), an estimated aerial coverage of greater than 50%, and were navigable around the perimeter of the bed. CLP acreage in beds declined from 87 acres in 2007, to 68 acres in 2012, to 51 acres in 2017. Some of these declines are due to annual herbicide control as the point intercept survey is completed following herbicide treatment. For example, there were 31 acres of CLP treated in May of 2017. If combined with beds surveyed following treatment, there was little change in total CLP growth since 2007.

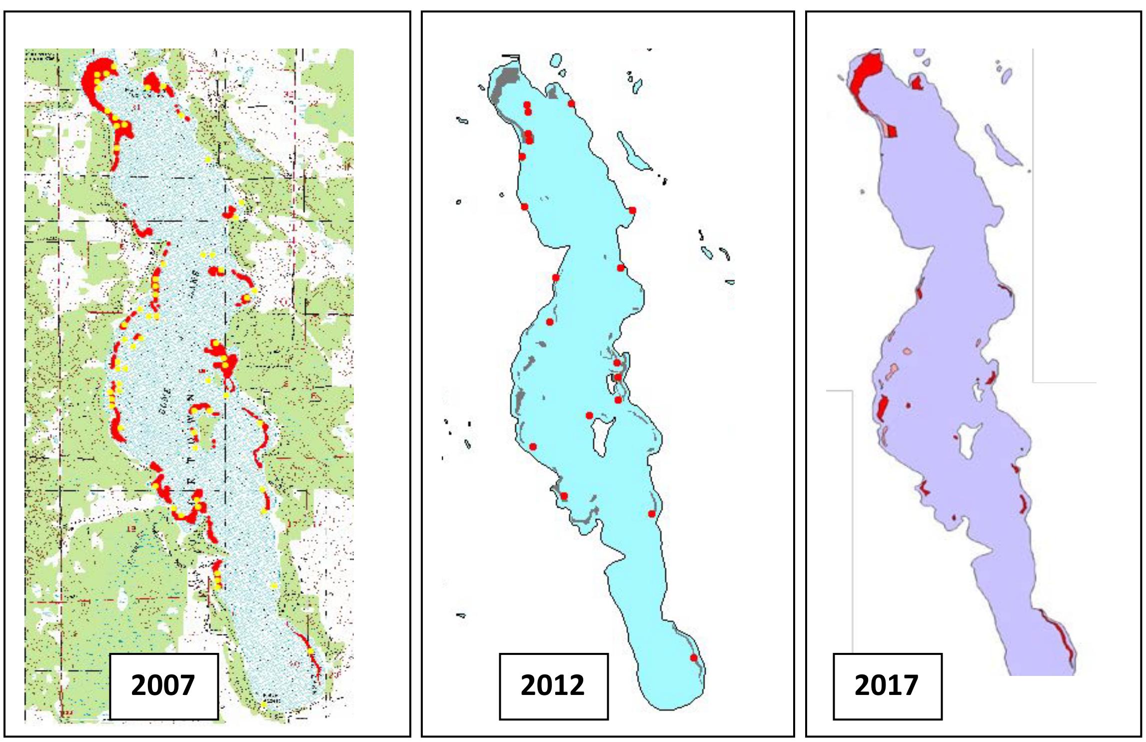

Figure 20. Curly Leaf Pondweed Beds

CURRENT AND PAST AQUATIC PLANT MANAGEMENT ACTIVITIES

PREVENTING AQUATIC INVASIVE SPECIES

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

EDUCATION TO LAKE USERS

Education efforts focus on identification and prevention of new invasive species. The AIS Network 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, displayed an AIS float in the annual boat parade, and established and now maintains AIS education materials on the Bone Lake District web site. AIS prevention and identification information along with AIS Network efforts are highlighted in the semi-annual Bone Lake Management newsletter.

CLEAN BOATS CLEAN WATERS (CBCW) PROGRAM

Clean Boats Clean Waters educators provide boaters with information on the threat posed by aquatic 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. Beginning in 2017, Bone Lake Clean Boats Clean Waters personnel received additional training in zebra mussel identification and supplied zebra mussel handouts to boaters.

In 2019 there were 707 boats inspected at the North Landing with 320 hours spent (2.2 boats/hour) and 256 boats inspected at the South Landing with 307 hours spent (0.83 boats/hour). A minimum of 200 hours of inspection is required to maintain a $4,000 per landing WDNR grant for CBCW inspections.

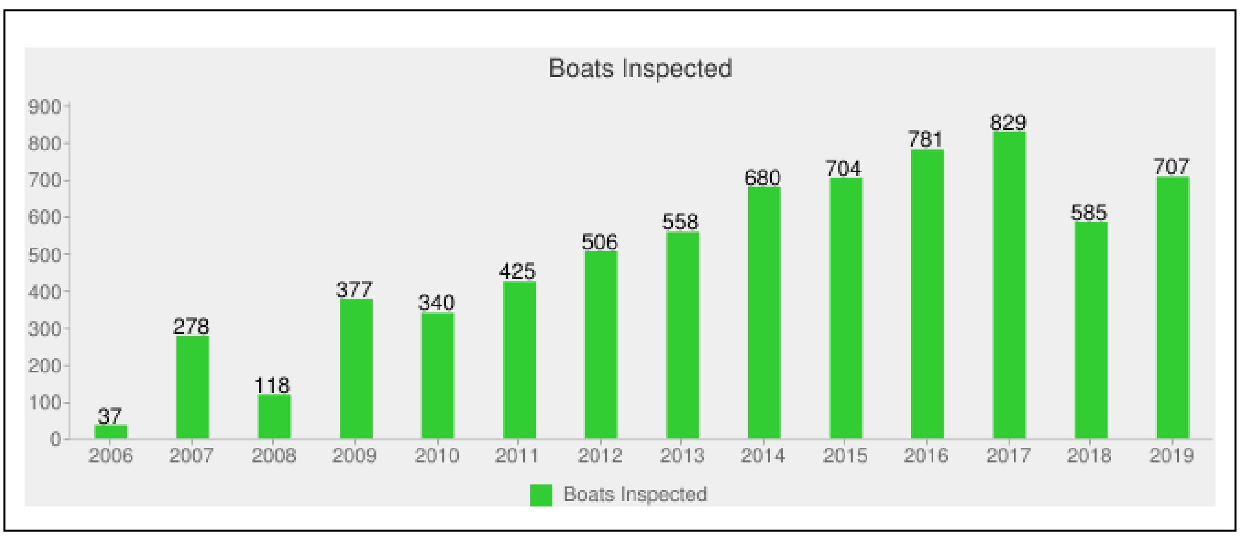

Figure 21. Boats Inspected at the Bone Lake North Landing

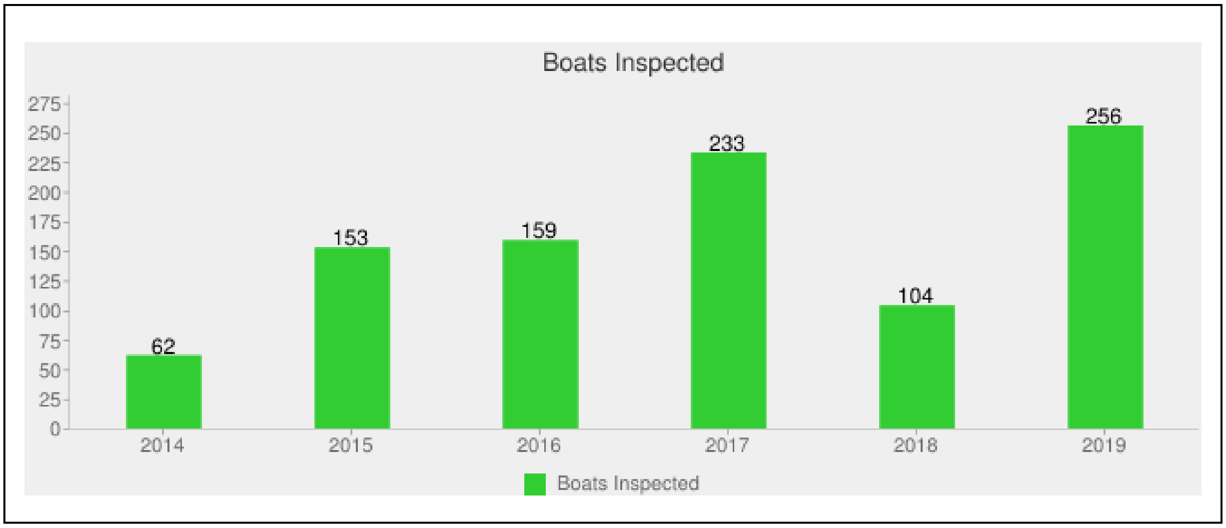

Figure 22. Boats Inspected at the Bone Lake South Landing

LANDING SURVEILLANCE CAMERAS

The video cameras are installed at the public landings on each end of Bone Lake. The cameras are positioned to record watercraft being launched to assess if they have vegetation attached. Suspected violations of the ordinance that prohibits transporting and launching boats and trailers with vegetation attached are reviewed and enforced by the Polk County Sheriff's Department. The camera also serves as a reminder for boaters to check their equipment before launching and serves in that capacity as an educational tool.

In 2019, the cameras were in place at the North and South Landings from late April through late October/early November. There were 2121 launches recorded at the North Landing with four suspected violations reported to the Polk County Sherriff's Department. There were 366 launches recorded at the South Landing with no suspected violations reported. (Environmental Sentry Protection 2019). According to these results, CBCW crews inspect 33 percent of the boats launched at the North Landing and 70% of the boats launched at the South Landing.

AQUATIC INVASIVE SPECIES MONITORING

The objective of lake monitoring is to look for new invasive species. In past years, there were several teams of volunteers who would monitor for aquatic invasive plant species in a coordinated effort. Now a few volunteers occasionally look for invasive aquatic plants. Another option available for AIS plant monitoring is annual volunteer or consultant meandering surveys of the entire littoral zone of the lake.

Because of the threat posed by zebra mussel introduction from Deer Lake and other lakes, zebra mussels are the current focus for AIS monitoring in Bone Lake. An annual musky tournament is held on the two lakes with boats moving between the lakes each day. Clean Boats, Clean Waters records show that many boats entering Bone Lake come from waters infested with zebra mussels such as Mille Lacs and Leech Lakes in Minnesota, Deer Lake in Wisconsin, and the St. Croix River.

Because zebra mussels attach to hard surfaces, cinder blocks or plate samplers placed in shallow water and checked regularly provide a good monitoring method. Net tows aim to collect zebra mussel veligers (the larval stage). Early July is the best time to collect veliger tows. On Bone Lake, zebra mussel monitoring is completed by volunteers checking plate samplers, net tows with sample analysis for veligers, encouraging lake residents to check docks and equipment when taken out of the lake in the fall, wading shore surveys, and checking for zebra mussels during volunteer and consultant plant surveys.

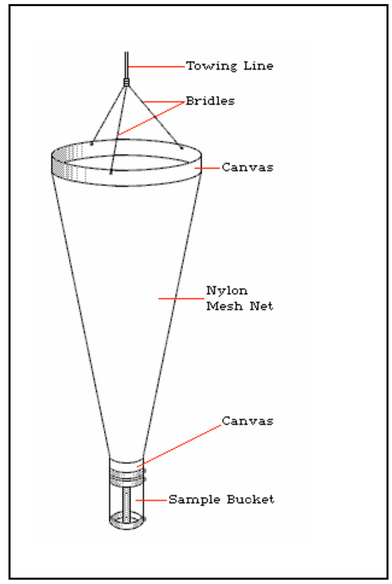

Figure 23. Monitoring Equipment: Cinder Blocks, Sampling Plates, and Nets for Veliger Tows

RAPID RESPONSE FOR NEW INVASIVE SPECIES

The activity is intended to identify any new invasive species introduced into the lake early and rapidly initiate control measures. The aquatic invasive species rapid response protocol is found in Appendix B.

ADDITIONAL AIS PREVENTION OPTION: BOAT WASHING STATIONS

Boat washing stations use hot water and high pressure to remove potential aquatic invasive species from boats, trailers, and equipment. The hot water kills the AIS, and the high pressure removes them. There are no soaps, bleaches, or chemicals used or recommended at this time. Chemicals are not as reliable as temperature at killing AIS. At 140°F, a hot water rinse for 10 seconds to each spot will kill all adult mussels. At 120°F, a contact time of two minutes is needed to destroy zebra mussels. (MNDNR 2017) Use of boat washing stations is voluntary in Wisconsin unless there are local ordinances to require decontamination. Burnett and Washburn Counties have ordinances in place which require decontamination if offered at a public or private water access.

Several lake organizations in Burnett and Washburn County have installed boat washing stations which use a mild bleach solution to decontaminate boats. A contact time of ten minutes is required when using this solution. The bleach solution must be replaced regularly – daily replacement is preferred. Signage is installed to provide instructions for an encourage use. (NW WI ZM Team 2018)

PURPLE LOOSESTRIFE AND GIANT KNOTWEED CONTROL

Purple loosestrife was found at the Bone Lake North Landing in 2015. Volunteers clipped and bagged the plants and treated with Glyphosate that same year. Volunteers returned and resprayed additional plants in a subsequent year. Volunteers will continue to monitor this area and remove purple loosestrife when it is found.

Giant knotweed has also been found in upland residential areas surrounding Bone Lake. Knotweed chemical treatment is planned as part of a current WDNR AIS control grant.

Figure 24. Purple Loosestrife at the North Landing 2015

CURLY LEAF PONDWEED MANAGEMENT

The Bone Lake Aquatic Plant Management Plan (2008) initiated early season herbicide treatment of curly leaf pondweed beginning in 2008. Plan implementation for curly leaf pondweed management (Goal 3) emphasizes alleviating spring navigation concerns, testing the effectiveness of ongoing treatment methods, and protecting native plant populations.

ANNUAL TREATMENT EFFECTIVENESS

The treatment strategy followed accepted practices of using a low dose of the herbicide Endothall to control CLP before native plants were 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 assessing treatment effectiveness using accepted standard WDNR 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 2019 (Schieffer 2009-2019). Four beds totaling 14 acres were selected in 2006 and 2007 as priorities for the initial CLP treatment trial which occurred 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 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 in 2009. Drop offs can cause water currents which disperse and dilute herbicides that are applied. However, little success was measured in either 2008 or 2009 on any of the treatment beds. As a result, herbicide concentration was increased and restrictions for wind conditions (current and forecast low winds) were added beginning in 2010.

- Treatment by volume (1.5 ppm) and with wind restrictions (<10 mph during application, <15 forecast within 24 hours) began in 2010
- Treatment concentration increased in 2012 (to 2.0 ppm) and again in 2015 (to 2.5 ppm for deeper beds) and 2019 (to 3.0 ppm for deeper beds).

Post treatment results for each year are shown in Table 11. Treatment effectiveness as measured by comparing pre and post treatment results has generally improved with these changes.

Figure 25. CLP Treatment Areas 2009 – 2012

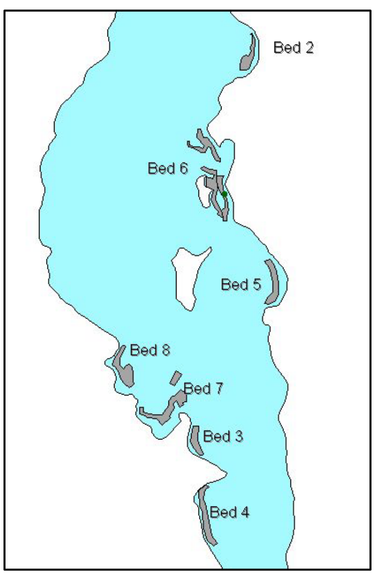

Figure 26. 2013-2019 CLP Treatment Beds

Table 11. Post Treatment Frequency of Occurrence Following CLP Treatment (Schieffer 2008 – 2019) FOO above 20% highlighted.

Bed	2019* (deep = 3.0 ppm) 2-5 mph	2017 (deep = 2.5 ppm) 1-8 mph	2016 (deep = 2.5 ppm) 0-5 mph	2015 (deep = 2.5 ppm) 1-5 mph	2014 (2.0 ppm) 1-4 mph	2013 (2.0 ppm) 0-4 mph	2012 (2.0 ppm) 0-4 mph	2011 (1.5 ppm) 2-6 mph	2010 (1.5 ppm)	2009 (5-7 gal/ acre)	2008 (5-7 gal/ acre)
2	5.9%	10.0%	6.2%	16.7%	8.0%	22.0%	35	31	38	77	73
3	14.3%	27.3%	22.7%	13.6%	4.5%	11.8%	12	60	55	95	78
4	20.0%	22.7%	11.4%	2.2%	2.2%	2.9%	6	61	42	55	100
5	17.8%	26.5%	18.2%	5.9%	8.8%	0.0%	39	79	58		
6	26.8%	15.0%	1.8%	18.8%	4.8%	7.8%					
7	11.1%	34.1%	20.9%	15.6%	23.3%	8.5%					
8	5.7%	81.8%	12.1%	8.8%	31.2%	18.2%					
All beds	**17.5%**	**30.4%**	**11.5%**	**11.8%**	**11.3%**	**9.3%**	**22%**	**59%**			

*There was no CLP treatment in 2018

Table 12. Bone 2019 CLP Treatment Bed Statistics

Bed	**Acres**	**Mean depth**	**Acre feet**	**Target Concentration (ppm)**	**Wind (mph)**	**Water Temp (degrees F)**
2A	0.29	7	2.03	2.0 ppm	5/NE	53
2B	1.53	9.9	15.15	2.5 ppm	5/NE	53
3	1.85	7.4	13.69	2.0 ppm	5/NW	56
4	3.18	8.6	27.35	2.0 ppm	5/NW	56
5	2.95	8.2	24.19	2.0 ppm	5/NE	53
6A	3.25	6.6	21.45	2.0 ppm	5/NE	53
6B	3.62	7.5	27.15	2.0 ppm	5/NE	53
6C	2.07	7.7	15.94	2.0 ppm	5/NE	53
7A	2.43	7.4	17.98	3.0 ppm	2-5/NW	52
7B	1.32	10.7	14.12	3.0 ppm	2-5/NW	52
7C	0.82	11.4	9.35	3.0 ppm	2-5/NW	52
8A	2.32	6.2	14.38	3.0 ppm	2-5/NW	52
8B	2.00	9.6	19.20	3.0 ppm	2-5/NW	52
Total	**27.63**		**221.98**			

Beds were treated May 16, May 20 and May 23, 2019

NATIVE PLANT IMPACTS

Early season treatments are conducted in order to avoid damage to native aquatic plants. In fact, statistically significant declines in native plant species frequencies occurred when comparing a treatment year to the previous year in all treatment years except two. However, it is not clear if declines were the result of herbicide or normal fluctuations of growth in native species from year to year.

Table 13. Changes in Native Plant Frequency Post Monitoring Year to Year Comparisons

Year	Native Species Declines (statistically significant)	Notes
2010-2011	Duckweed (*Lemna triscula* – p=0.03) Flat-stem Pondweed (*Potamogeton zosteriformis* p=0.02) Wild celery (*Valsineria Americana* p=0.03)	Late emergence of natives in 2011
2011-2012	none	Increase in Northern Water Milfoil (*Myriophyllum sibiricum* p=0.03)
2012-2013	Northern Water Milfoil (*Myriophyllum sibiricum* p=0.003)	Late emergence of natives in 2013
2013-2014	Robbins' Pondweed (Potamogeton robbinsii p=0.01)	Increase in frequency of nine native species
2014-2015	Coontail (*Ceratophyllum desmersum* p=.0004)	Increase in frequency of seven native species
2015-2016	Northern Water Milfoil (*Myriophyllum sibiricum p<0.01)*	
2016-2017	Duckweed (*Lemna triscula)* Water star-grass *(Heteranthera dubia)* Coontail *(Ceratophyllum demersum)* Water marigold *(Bidens becki)i* White-stem pondweed *(Potamogeton praelongis)* Slender naiad *(Najas flexilis)* Wild celery *(Vallisneria Americana)* Northern Water Milfoil *(Myriophyllum sibiricum)* White water crowfoot *(Ranunculus aquatilis)* Common waterweed *(Elodea Canadensis)*	Dense growth of CLP which had poor response to herbicide treatment may have limited native plant growth
2017-2018	Not measured	No CLP Treatment 2018
2018-2019	Chara	Algae not sensitive to herbicide

LONG TERM TREATMENT EFFECTIVENESS

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 in the fall 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 was expected to aid in decisions regarding continuation or suspension of herbicide treatment. Sediment turions were analyzed within the CLP treatment beds in beginning in 2011. Turion density results are shown for each bed from 2011-2019 and in Figure 27. (Schieffer 2019)

While declines in turion density are evident, they fluctuate from year to year. There was also considerable rebound in turion density with one year of no treatment in 2018. Turion density remains comparably high in beds 6-8 where CLP treatment has been generally less effective.

Table 14. Turion Density all Treatment Beds 2011-2019

Bed	**2011 (T/m^2)**	**2012 (T/m^2)**	**2013 (T/m^2)**	**2014 (T/m^2)**	**2015 (T/m^2)**	**2016 (T/m^2)**	**2017 (T/m^2)**	**2018 (T/m2)**	**2019 (T/m2)**
2	75	27	34.7	10.9	0	16.3	0	10.75	0
3	269	65	79.4	48.8	0	119.6	54.25	107.50	75.25
4	512	47	29.8	36.2	28.7	18.1	14.5	43.00	43
5	274	161	64.5	76	75.25	65.2	16.25	96.75	75.25
All (2-5)	296	75	49.6	43.0	25.99	60.6	23.1	64.50	47.8
6	n/a	n/a	421.6	384.1	303.2	214.7	267	215.00	311.75
7	n/a	n/a	165.3	178.4	38.2	55.6	48.3	129.00	167.3
8	n/a	n/a	489.4	271.3	258	395.1	304	831.30	394.31
All (6-8)	n/a	n/a	358.8	277.9	199.8	205.5	218.55	391.78	288.7

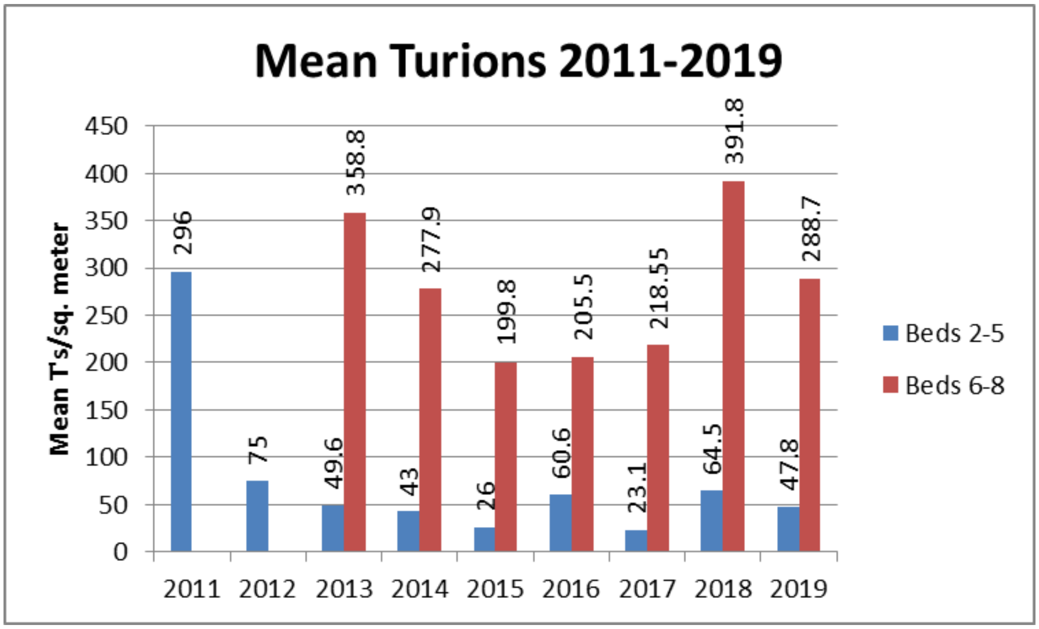

Figure 27. Bone Lake Turion Density 2011 – 2019

PRE-TREATMENT MONITORING RESULTS

Another way to examine long-term treatment effectiveness is to compare the CLP beds before treatment occurs year over year. Figure 28 illustrates that the pre-treatment frequency of CLP in treated beds has changed little since 2014 when more effective annual treatment results were evident. The selected areas to treat (the treatment beds) have remained the same since 2013. Figure 29 further illustrates little change in acres treated each year. In conclusion, while there is a significant reduction in annual CLP growth with the early season Endothall treatment, no long-term reduction in CLP growth is evident.

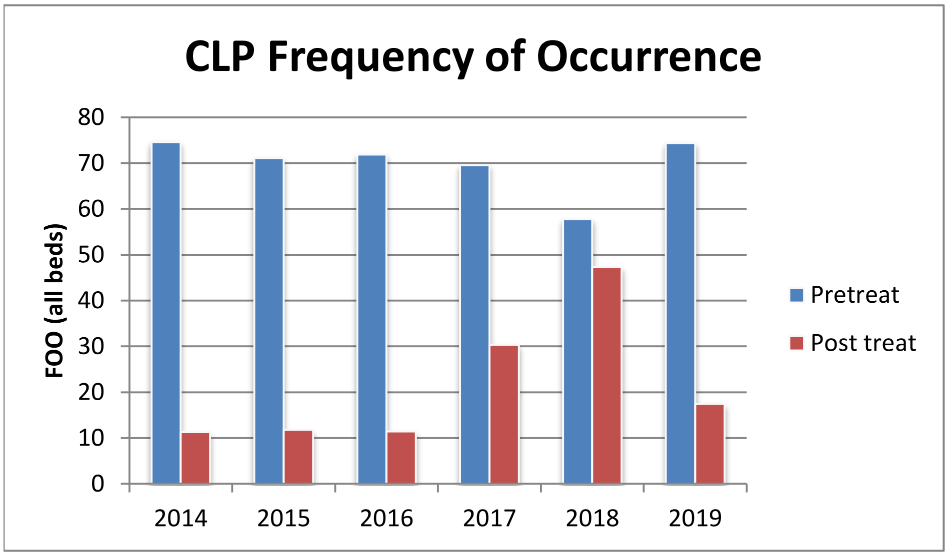

Figure 28. Pre-treatment Frequency Curly Leaf Pondweed 2014-2019

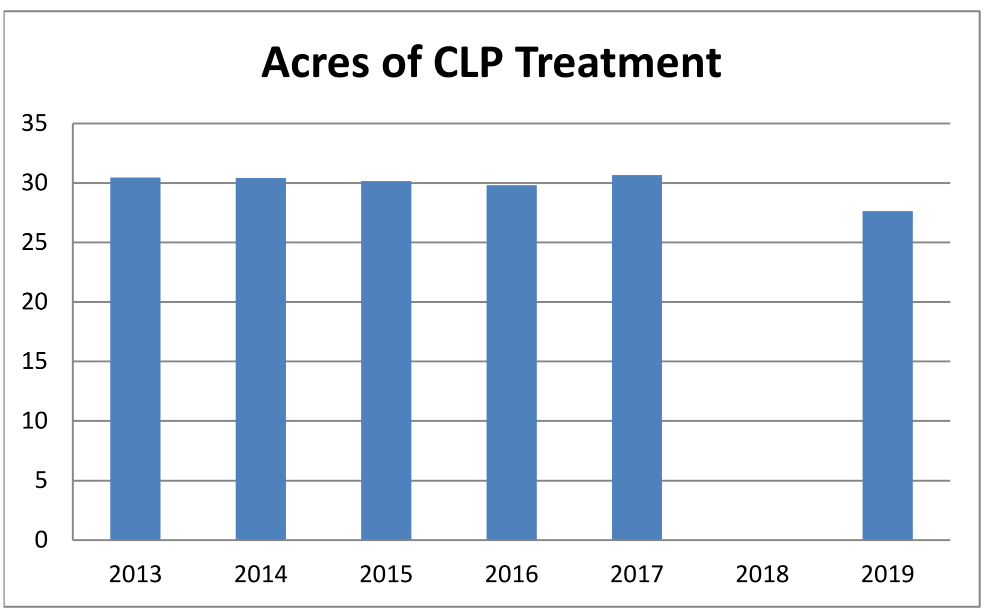

Figure 29. Acres of CLP Treatment 2013-2019

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 WDNR permit. No severe navigation impairment was identified in 2008 through 2019. 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 were 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 WDNR indicate that the navigation channels were treated in 2006. In 2007, WDNR 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 WDNR 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

- 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

The 2007/08 Aquatic Plant Advisory 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 – 2019.

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 feet wide and called channel N in 2009 and 2010. Early season CLP treatment of channel A was requested but not permitted by WDNR in 2012 because of tribal concerns related to wild rice growth at the north end of the lake. A portion of navigation channel A was permitted and treated in May 2019 for CLP control. This navigation channel is included in the permit application for 2020.

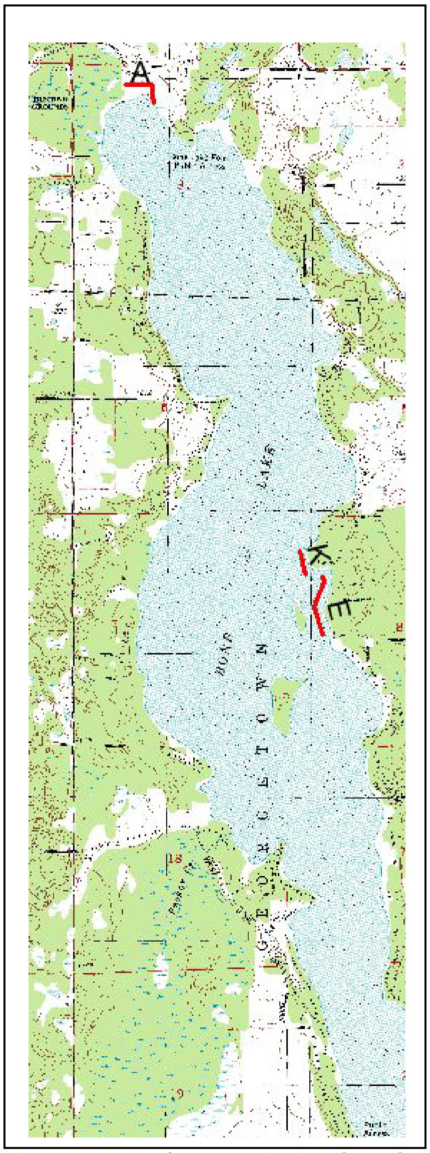

Figure 30. Bone Lake CLP Navigation Channels

CLP Navigation Channel A 2019

PRIVATE WATERFRONT HERBICIDE APPLICATION

Prior to 2007, a number of Bone Lake landowners hired private contractors to spray aquatic plants to maintain boating and swimming areas in front of their waterfront property. 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 who 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 15. There have been no individual waterfront permits issued since 2007.[16]

Table 15. Waterfront Herbicide Treatments on Bone Lake

Year	Property Owners	Maximum Allowed Acres
2007	32[17]	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 WDNR 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 WDNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management was designated in an approved aquatic plant management plan. (WDNR, 2007) This strategy is included as Appendix F. 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 WDNR has not allowed removal after January 1, 2009 unless the “impairment of navigation” and/or “nuisance” conditions are clearly documented.

There was previously high demand for this type of management on Bone Lake. Results from the 2008 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. These questions were not repeated in the 2013 or 2018 Bone Lake property owner surveys.

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

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[16] Mark Sundeen, WDNR Aquatic Plant Permit Contact, email communication February 5, 2013. Alex Smith, WDNR Lakes Biologist, telephone conversation March 11, 2020.

[17] Although 29 sites were permitted, it appears from reports that 32 were sprayed.

PLAN GOALS AND STRATEGIES

BONE LAKE AQUATIC PLANT MANAGEMENT GOALS

GOAL 1. MAINTAIN RECREATIONAL USES IMPORTANT TO LAKE RESIDENTS AND USERS WHILE PRESERVING IMPORTANT NATIVE AQUATIC PLANT FUNCTIONS AND THEIR VALUES.

GOAL 2. PREVENT INTRODUCTION OF AQUATIC INVASIVE SPECIES.

GOAL 3. MANAGE CURLY LEAF PONDWEED TO MINIMIZE NAVIGATION PROBLEMS AND PROTECT NATIVE PLANT POPULATIONS.

GOAL 4. PROTECT THE NATURAL FUNCTIONS OF DIVERSE NATIVE PLANT COMMUNITIES.

GOAL 5. EDUCATE LAKE RESIDENTS AND VISITORS ABOUT THE GOALS AND OBJECTIVES OF THE AQUATIC PLANT MANAGEMENT PLAN.

The goals above were established in the 2008 Bone Lake Aquatic Plant Management Plan and reviewed in the 2013 and 2020 plan updates. Objectives and actions were updated with input from the Aquatic Plant Advisory Committee in 2020. This input is included as Appendix D.

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 below. 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 – elected/appointed officials responsible for oversight of the lake management district.

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 is assisted by volunteers and consultants. Bob Boyd is the volunteer APM Lead. Cary Olson is the board APM contact.

AIS Network Coordinator – leads and coordinates volunteer AIS education activities 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.

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 **AIS Network Coordinator**. 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 –complete monitoring and coordination activities under the direction of the District Board and the APM Lead.

DNR – APM staff review aquatic plant management permit applications and the Aquatic Plant Management Plan.

GOAL 1. MAINTAIN RECREATIONAL USES IMPORTANT TO LAKE RESIDENTS AND USERS WHILE PRESERVING IMPORTANT NATIVE AQUATIC PLANT FUNCTIONS AND THEIR VALUES.

OBJECTIVE: MAINTAIN SUMMER NAVIGATIONAL CHANNELS WHERE NAVIGATION BECOMES SEVERELY IMPAIRED.

OBJECTIVE: ALLOW INDIVIDUAL CORRIDOR SUMMER SWIMMING AND BOAT ACCESS WHERE SEVERE NUISANCE CONDITIONS OCCUR.

OBJECTIVE: PROTECT NATIVE PLANT POPULATIONS.

ACTION ITEMS

SUMMER NAVIGATION CHANNELS

Monitor areas of navigation impairment in response to resident complaints or volunteer monitor observations to identify when and where herbicide treatment or harvesting is appropriate. To minimize impacts to native plants, treat only when and where 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 WDNR.

DEFINITION

Navigation Channels are the common navigation routes for general use.

PROCEDURE FOR SUMMER NAVIGATION CHANNEL PERMITTING AND MONITORING

(responsible parties in parenthesis)

Document impairment of navigation (provide in permit) (APM Lead with guidance from MC).

- 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.

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

- 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. (CLM) 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 3 subsequent years (although permit applications and pre and post monitoring must be completed each year).
- Prepare and send APM permit application to WDNR to receive authorization for herbicide treatment.
- WDNR informs APM Lead if treatment is authorized.
- APM Lead informs herbicide applicator when herbicide treatment is authorized by WDNR.

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.

The Lake District will 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 herbicide 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 WDNR.
- WDNR will contact herbicide applicator and owner with a notice to proceed with treatment.

GOAL 2. PREVENT INTRODUCTION OF AQUATIC INVASIVE SPECIES

OBJECTIVE: RAISE LAKE USER AND RESIDENT AWARENESS TO PREVENT AQUATIC INVASIVE SPECIES INTRODUCTION.

OBJECTIVE: MONITOR TO DETECT EARLY AIS COLONIZATION.

OBJECTIVE: BE READY TO RAPIDLY RESPOND TO THE INTRODUCTION OF AQUATIC INVASIVE SPECIES.

ACTION ITEMS

Implement *Rapid Response for Early Detection of Aquatic Invasive Species* detailed in Appendix B.

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

Continue use of cameras at the public boat landings. Monitor videos and notify enforcement authority of alleged violations in cases where plants are clearly identified.

Continue volunteer monitoring to detect presence of aquatic invasive species. Periodic sampling will cover strategic locations emphasizing areas near public access points and resorts.

Conduct monitoring focused on zebra mussels including plate sampler and/or cinder block observations, net tows and sample analysis for veligers, divers, and shallow water shoreline searches. Also look for zebra mussels during aquatic plant monitoring.

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.

Investigate decontamination systems and consider implementation at the public landings.

GOAL 3. MANAGE CURLY LEAF PONDWEED TO MINIMIZE NAVIGATION PROBLEMS AND PROTECT NATIVE PLANT POPULATIONS.

OBJECTIVE: PROTECT NATIVE PLANT POPULATIONS.

OBJECTIVE: IMPROVE SPRING NAVIGATION.

OBJECTIVE: REDUCE TURION DENSITY IN TARGETED BEDS.

OBJECTIVE: CONTINUALLY IMPROVE CLP MANAGEMENT ON BONE LAKE.

ACTION ITEMS

Identify beds and navigation channels for CLP early season chemical treatment.

Standards for when CLP treatment may be warranted:

- identified as a spring navigation concern (based partially on number of nearby residences)
- 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 0.25 acres
- bed has a coverage of at least 50%
- density rating averages >2 (on a 0-3 scale)
- 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. Pre and post monitoring will also occur in critical habitat areas adjacent to treated CLP beds. If statistically significant declines in native plants are noted in the treatment year, post treatment monitoring will be conducted in adjacent critical habitat areas for an additional 3-5 years.

Monitor and track sediment turions in treated beds. Beds currently targeted for treatment are shown in Figure 26.

Adapt treatment methods according to best available information. Adaptive management may include modifying control method including consideration of harvesting to control CLP.

- Current treatment standards specify application **rates of liquid Endothall of 2.0 to 3.0 ppm for beds and 2.5 ppm for navigation channels.**
- Treatment will occur when water temperatures are between 45 and 58 degrees F. **No treatment will occur once temperatures exceed 58 degrees F unless specifically authorized by WDNR to treat at temperatures up to 60 degrees F.** Early season treatment is necessary to protect native plant communities.
- Herbicide must be applied when conditions are calm ***as authorized by APM lead***. The maximum wind speed at time of application will be <10 mph as measured on-site. The forecast wind speed (including gusts) for the 24 hours following application will not be greater than 15 mph.

Track phosphorus removal resulting from CLP control.

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.

ADAPTIVE MANAGEMENT

Other methods, such as harvesting, may be considered to meet curly leaf pondweed management objectives in the future. Chemical treatment methods may be modified based on program experience and new information from other sources.

GOAL 4. PROTECT THE NATURAL FUNCTIONS OF DIVERSE NATIVE PLANT COMMUNITIES.

OBJECTIVE: IMPLEMENT STRICT ADHERENCE WITH TREATMENT STANDARDS AND HERBICIDE MONITORING METHODS.

OBJECTIVE: INCREASE RESIDENT'S AND LAKE USER'S UNDERSTANDING OF THE ROLE AND IMPORTANCE OF AQUATIC PLANT COMMUNITIES IN BONE LAKE AND THEIR IMPACTS ON THEM.

DISCUSSION

The plant community in Bone Lake is diverse and extensive. It is important to understand that these plants play an 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.

Acknowledge the importance of critical habitat areas in Bone Lake.

Monitor native plants (according to pre and post treatment monitoring methods) in critical habitat areas adjacent to CLP treatments. If statistically significant declines in native plants are found in the year of treatment, continue follow-up monitoring for 3-5 additional years.

Update the critical habitat area designations for Bone Lake in cooperation with the WDNR.

GOAL 5. EDUCATE LAKE RESDIENTS AND VISTORS ABOUT THE GOALS AND OBJECTIVES OF THE AQUATIC PLANT MANAGEMENT PLAN

AUDIENCE *(THE TARGET GROUP FOR AQUATIC PLANT MANAGEMENT MESSAGES):*

A. All lake residents
B. Lake users
C. Youth

MESSAGES *(WHAT INFORMATION TO RELAY):*

1. Summary of APM plan, notice of public meeting, and how to get full APM plan, communicate APM actions including investigation of management alternatives for CLP control and AIS decontamination
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, zebra mussels, and other AIS and who to contact if suspected (include illustrations)
11. Locations of nearby lakes with EWM, zebra mussels, and other AIS
12. Describe new potential invasive species including zebra mussels 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 make it illegal to transport aquatic plants on public roads
16. Describe critical habitat areas and why they are important

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
Social media, web site, *Bone Lake eNews*
Clean Boats, Clean Waters monitoring/education
Annual meeting/special meetings
Door-to-door distribution of information
Promotional items such as plastic peel-off stickers for boats, refrigerator magnets, coasters
Advertisements
Posters

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, 13, 15, 16
Mailings	A C	1, 3, 4, 6
Social media and web site updates	A B	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16
Clean Boats, Clean Waters	A B	2, 3, 4, 10, 11, 12, 13, 14, 15
Annual and special meetings	A	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
Door-to-door distribution	A	1, 2, 3, 4, 10, 13
Promotional items	A	3, 4, 10, 13

MONITORING AND ASSESSMENT

AQUATIC PLANT SURVEYS

Point intercept sampling by consultant– repeat every 5 years with next survey in 2022 (supervised by 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.

IN-LAKE MONITORING

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

BONE LAKE APM IMPLEMENTATION PLAN (2020 – 2022)

Action Items[18]	**Timeline**	**2020**		**2021**		**2022**		
		Cost	**VOL Hours**	**Cost**	**VOL Hours**	**Cost**	**VOL Hours**	**Responsible Party**
NAVIGATION CHANNELS[19]								
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	TBD		TBD		TBD		APM Lead or designee Contractor
Supervise contractor herbicide application	As needed – July or August							APM Lead or designee

[18] See Bone Lake Aquatic Plant Management Plan for action item detail.

[19] Navigation channels have not been treated during plan implementation. Bids and permits will not be sought unless there is severe navigation impairment.

Action Items[18]	Timeline	2020		2021		2022		
		Cost	VOL Hours	Cost	VOL Hours	Cost	VOL Hours	Responsible Party
INDIVIDUAL ACCESS CORRIDORS								
Inform landowners of process for permits and record conditions		TBD		TBD		TBD		
AIS PREVENTION								
Implement AIS Rapid Response Protocol	Ongoing – See Appendix B		30		30		30	AIS Network District Board
Volunteer Monitoring for AIS	Ongoing – See monitoring section							AIS Network Coord. Volunteers
Clean Boats, Clean Waters Staff	Ongoing	$12,000	30	$12,000	30	$12,000	30	CBCW Coordinator

Action Items[18]	Timeline	2020		2021		2022		
		Cost	VOL Hours	Cost	VOL Hours	Cost	VOL Hours	Responsible Party
Surveillance camera – Environmental Sentry North Landing internet fee		$5,055 $420	30	$5,100 $420	30	$5,100 $420	30	AIS Network
Decontamination Station Pilot Fishing Tournament, North Landing			40	$20,000	80	$10,000	80	AIS Network
CLP MANAGEMENT								
Treat CLP navigation channels		$0		TBD			TBD	Contractor
Continue treatment of CLP beds	Late May	$32,000		$32,000		$32,000		Contractor
Complete pre and post monitoring – including critical habitat area monitoring	June	$2,500		$2,500		$2,500		Consultant

Action Items[18]	Timeline	2020		2021		2022		
		Cost	VOL Hours	Cost	VOL Hours	Cost	VOL Hours	Responsible Party
Complete turion monitoring	June	$820		$820		$820		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
Map CLP beds throughout the lake	Annually	$600		$600			$600	Consultant
EDUCATION								
Signage improvements		$600	5	$600	5	$0	0	AIS Chair and Subcommittee
Workshops	Annually	$1,000	50	$1,000	50	$500	25	AIS Chair and Subcommittee

Action Items[18]	Timeline	2020		2021		2022		
		Cost	**VOL Hours**	**Cost**	**VOL Hours**	**Cost**	**VOL Hours**	**Responsible Party**
AIS handouts, newsletter articles, mailings, web site updates	Ongoing	$2,000	50	$2,000	50	$2,000	25	AIS Chair and Subcommittee
Annual meetings	Annually	$200	8	$200	8	$200	8	District Board
Monitoring								
Whole lake point intercept survey (2022)								

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% funding. Applications for the Clean Boats, Clean Waters Program and Education, Prevention, and Planning Projects are accepted through December 10, each year. AIS Control project applications are accepted by February 1, each year. Bone Lake has two current AIS grants. Clean Boats, Clean Waters grants are applied for annually.

AIS EDUCATION AND PLANNING GRANT (AEPP-49117)

This is a 75% grant totaling $9,461.25. The grant period is 02/15/2017 through 12/31/2020. The grant covers the update of this aquatic plant management plan and aquatic invasive species monitoring.

AIS CONTROL GRANT (ACEI-21418)

This is a 50% grant totaling $36,700. The grant period is 4/01/2018 through 6/30/2020. 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. Because of funds remaining with no CLP treatment in 2018, an extension will likely be requested for this grant.

APPENDIX A. INVASIVE SPECIES INFORMATION

CURLY LEAF PONDWEED (*POTAMOGETON CRISPUS*)

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.[19]

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.[20]

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

[20] 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[21]

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.

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

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

CURLY LEAF PONDWEED CONTROL[22]

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

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

EURASIAN WATER MILFOIL (*MYRIOPHYLLUM SPICATUM*)23

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 1). 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*

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

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

> *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 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 it 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 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 common in Bone Lake with a frequency of occurrence of 6.2%. The northern water milfoil locations shown in Figure 31 below should be carefully monitored for EWM each year. Areas with mucky sediment are also likely places for EWM establishment and should be monitored.

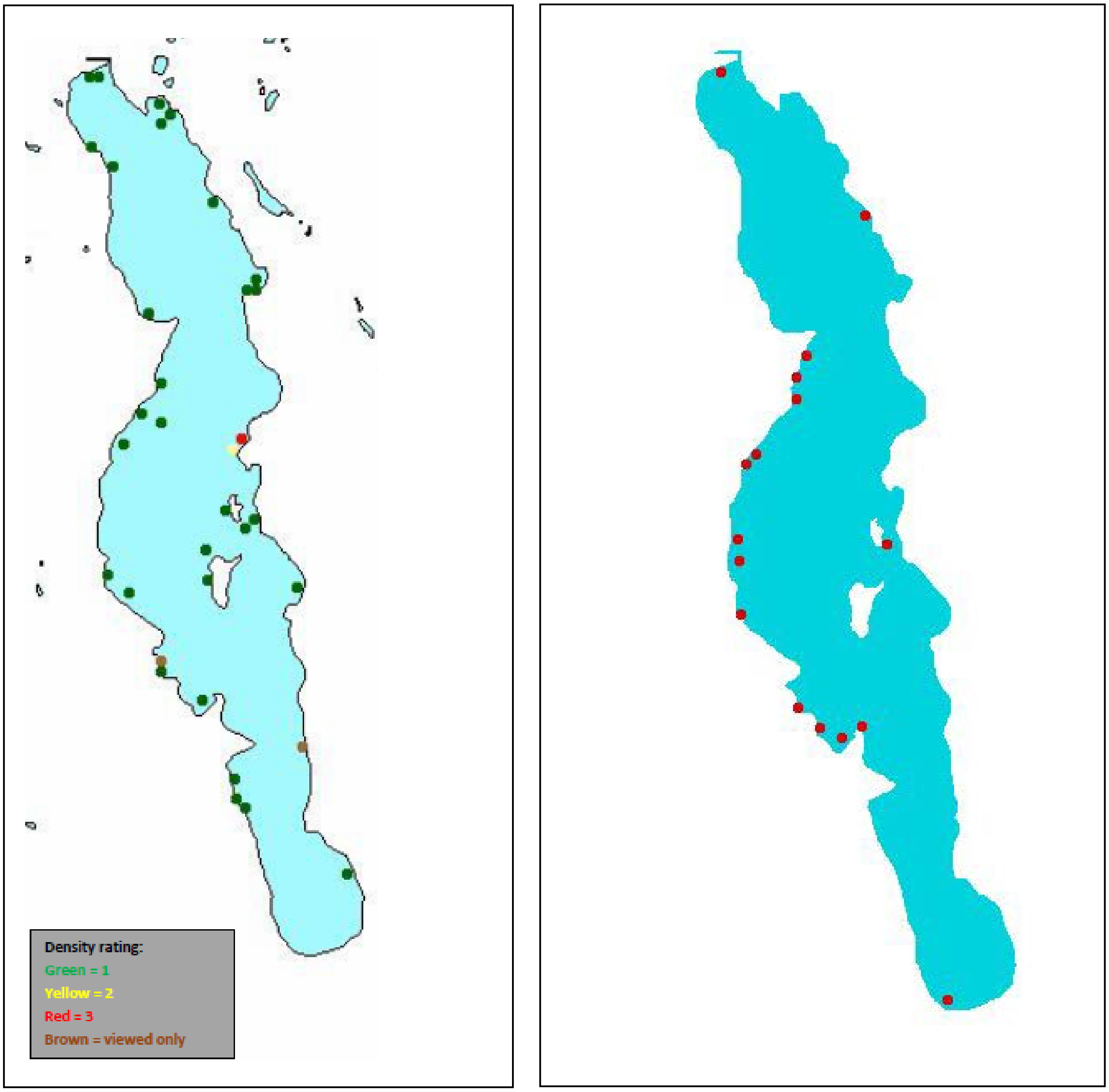

Figure 31. Northern Water Milfoil Locations in 2012 (left) and 2007 (right)

PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*)[24]

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

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

Purple loosestrife was found at the Bone Lake North Landing in 2015. Volunteers clipped and bagged the plants and treated with Glyphosate that same year. Volunteers returned and resprayed additional plants in a subsequent year. Volunteers will continue to monitor this area and remove purple loosestrife when it is found.

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 1930s, but remained uncommon until the 1970s. 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.

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

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 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 difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

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

ECOLOGICAL IMPACTS

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

MECHANICAL CONTROL

Purple loosestrife 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 carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with 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.

A WDNR permit must be obtained 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. The coordinator 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 marmoratu*s) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

ZEBRA MUSSELS (*DREISSENA POLYMORPHA*)

The zebra mussel is a tiny (1/8-inch to 2-inch) bottom-dwelling clam native to Europe and Asia. Zebra mussels were introduced into the Great Lakes in 1985 or 1986, and have been spreading throughout them since that time. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with alternating dark- and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals.

Zebra mussels were first found in Wisconsin waters of Lake Michigan in 1990. They are now found in a number of inland Wisconsin waters. Zebra mussels are the only freshwater mollusks that can firmly attach themselves to solid objects. They are generally found in shallow (6-30 feet deep), algae-rich water.

Zebra mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals, and debris for food. This process can lead to increased water clarity and a depleted food supply for fish and other aquatic organisms. The higher light penetration fosters growth of rooted aquatic plants which, although creating more habitat for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers, and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since zebra mussels avoid consuming this type of algae but not others.

Once zebra mussels are established in a water body, little can be done to control them. It is therefore crucial to take all possible measures to prevent their introduction in the first place. Be sure to follow the Clean Boats, Clean Waters procedure in preventing the spread of aquatic hitchhikers. In addition to these measures, boaters can take specific precautions in protecting their motors from zebra mussels.

Zebra mussels were found in nearby Deer Lake in 2016 and adult and larval zebra mussels have since been confirmed there. An annual musky tournament is held on alternate days on Deer Lake and Bone Lake, so zebra mussel introduction from Deer Lake is a concern.

CONTROL

No selective method has been developed that succeeds in controlling zebra mussels in the wild without also harming other aquatic organisms. To a certain extent, ducks and fish will eat small zebra mussels, but not to the point of effectively controlling their populations. As of yet, no practical and effective controls are known, again emphasizing the need for research and prevention.

JAPANESE KNOTWEED (*POLYGONUM CUSPIDATUM*)

DESCRIPTION

Japanese knotweed is an herbaceous perennial that forms large colonies of erect, arching stems resembling bamboo. Stems are round, smooth, hollow, and reddish-brown. Plants reach up to 10 feet.

IDENTIFICATION

Leaves: Simple, alternate, 3-4 inches wide and 4-6 inches long. Leaves are egg shaped to nearly triangular and more heart-shaped on young shoots. They have long petioles that are broad at the base and narrow to a fine point. The upper surface is dark green while the lower surface is pale green.

Flowers: Creamy white or greenish; tiny 0.125 inch wide; borne in plume-like clusters in upper leaf axils near the end of stems which bloom August through September.

Fruits and seeds: Seeds are small, triangular, shiny, black produced by female plants; rare since colonies seldom have both male and female plants. The seed is enclosed in a winged calyx that contributes to its buoyancy. The seeds have no dormancy requirement and germinate readily.

Roots: Roots are present along the rhizome and extend deeply into the soil creating a dense impenetrable mat.

CONTROL

Mechanical: Hand-pull young plants; dig or till when soil is soft. Plants should be pulled up by the root crown, trying to remove as much of the rhizomes as possible, because any rhizomes remaining in the soil will produce new plants at each node. It is possible to eradicate small patches of knotweed with repeated and persistent cutting of the plants.

Chemical: Plants are more susceptible to herbicides if they are cut when 4-5 feet tall and the regrowth treated around 3 feet tall. Foliar application of glyphosate with a surfactant, triclopyr formulated for use with water, dicamba, or imazapyr may be effective on large populations. Tests involving large-bore needle injection of glyphosate into the lower nodes of each stem have been successful.

APPENDIX B. RAPID RESPONSE FOR EARLY DETECTION OF AQUATIC INVASIVE SPECIES[26]

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 suspected Aquatic Invasive Species (AIS). Signs at public and resort landings will direct anyone who identifies suspected AIS to contact the AIS Network Coordinator. The following are the steps that will be taken if AIS are suspected in Bone Lake.

3. If the suspected AIS is tentatively confirmed, the AIS Network 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 AIS in Bone Lake.

4. Mark the location of suspected AIS, and confirm if it is AIS.

   Within 48 hours of a credible report of AIS in Bone Lake, the location of the suspected AIS will be marked, and a GPS waypoint will be entered for the location.

   Within 72 hours of a credible report of AIS in Bone Lake, the PC LWRD or the WDNR will examine the suspected AIS to confirm identification.

   If a plant:

   > Take a digital photo of the plant in the setting where it was found (if possible). Then collect 5 to 10 intact specimens. Try to get the root system and all leaves as well as seed heads and flowers when present. Place in a zip lock bag with no water. Place on ice and transport to refrigerator. Two entire intact rooted adult specimens of the suspect plants will be collected, bagged, and delivered to the WDNR (810 West Maple Street, Spooner, WI 54801).

   If an animal other than a fish:

   > Take a digital photo of the animal in the setting where it was found (if possible). Then collect up to five specimens. Place in a jar with water; put on ice and transport to refrigerator. Transfer specimen to a jar filled with rubbing alcohol (except for Jellyfish – leave in water). Deliver to WDNR as above.

5. Communicate results of the examination of the suspected AIS.

   Identification results will be shared with the BLMD, PC LWRD, WDNR, APM consultants.

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[26] The attached Exhibit A is a contact list for various persons involved in implementing this protocol. This list will be updated annually.

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

If the presence of AIS in Bone Lake is confirmed, Bone Lake residents will be informed of the new AIS in Bone Lake via the BLMD web site, the next BLMD newsletter, and other means of communication. The notices will inform all lake users of the approximate location of the AIS and direct them to stay away from the area if needed.

The AIS Network Coordinator will coordinate these activities with the board Communication Committee Chair.

6. Determine the extent of the AIS.

   The AIS Network Coordinator will coordinate these activities and draw on the resources of the BLMD, PC LWRD, and WDNR, and others to determine the extent as soon as possible.

7. Select a control plan for the AIS.

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

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

   Control methods for plants may include hand pulling, use of divers to manually or mechanically remove the AIS 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 AIS and will not be guided by a desire to incrementally manage the AIS.

   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 the AIS.

9. Follow up.

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

Visually survey the entirety of Bone Lake to determine whether AIS has spread to other parts of the lake. This survey may be carried out by AIS Network volunteers or monitoring consultant.

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

EXHIBIT A

BONE LAKE MANAGEMENT DISTRICT

Chair	Phil Foster	715-553-0719	philsuefoster@lakeland.ws
Board APM Contact	Cary Olson	612-581-6626	caryolson@comcast.net
AIS Network Coord.	Bob Boyd	715-553-0629	boydsnest2048@outlook.com

POLK COUNTY LAND and WATER RESOURCES

	Katelin Anderson	715-485-8637	katelin.anderson@co.polk.wi.us

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants	Alex Smith	715-635-4124	alex.smith@wisconsin.gov
Permits and AIS Notice			

CHEMICAL APPLICATIOR RETAINED BY BONE LAKE MANAGEMENT DISTRICT

Lake Restoration		763-428-1543	

LAKE MANAGEMENT CONSULTANTS/DIVERS

Harmony Environmental	Cheryl Clemens	715-268-9992	harmonenv@amerytel.net
Ecological Integrity Service	Steve Schieffer	715-554-1168	ecointegservice@gmail.com

APPENDIX C. AQUATIC PLANT MANAGEMENT METHODS

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 30 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.[27]

MANUAL REMOVAL[28]

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

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

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

can be used to clear nuisance growth in riparian area corridors up to 30 feet wide. Recent costs for hand-pulling EWM using divers on Minocqua and Kawaguesaga Lakes in Oneida County were about $28,000 to remove an estimated <4,000 lbs.

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 1 to 6 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 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 do not 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 2020 Aquatic Plant Advisory Committee does not recommend contract harvesting because of the threat of introduction of aquatic invasive species into Bone Lake. A Lake District owned harvester may be considered as an option for CLP and native plant navigational impairment in the future.

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 easy to work in. Divers can remove the plant and root crowns with little problem. Hard substrates pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment.

Diver Assisted Suction Harvesting (DASH)

With Diver Assisted Suction Harvesting (DASH) divers hand pull aquatic invasive plants from the lake-bed. A suction line transports removed plants to the surface. This method is probably most appropriate for relatively small and less dense areas of invasive plant growth. Poor water clarity will make it more difficult to use DASH.[29]

The Tomahawk Lake Association (TLA) developed and has used a DASH system for several years, although they call their system a hydraulic conveyor system (HCS). HCS is an automated system that removes, filters, and bags harvested EWM after it has been hand harvested from the lake bed by divers. The TLA HCS includes a floating chassis, a "jet pump" water system, a three tiered separation system, and a Hookah diver air supply system.[30] Use of the TLA HCS began in the summer of 2007. A second generation HCS began operation in 2011. Capital costs for the system are just over $25,000, and annual operating costs are about $31,000. The TLA harvested about 20,000 lbs. each year through 2014.

Figure 32. DASH Contract Harvesting

Because of the mechanical elements of the system, a WDNR aquatic plant management harvesting permit is required. Contracted DASH systems are available. Decontamination of the system is especially important with a

[29] Wisconsin Lakes Convention Presentation. 2016.

[30] Wisconsin Lakes Convention presentation, TLA Hydraulic Conveyor System. Ned Greedy, 2014.

contracted DASH system that moves between lakes. A recent estimate for 2017 from a contractor was $2,500/day with harvesting amounts varied with total EWM acreage and density. With high density, the contractor reported removing 3,000 pounds in a single day.[31]

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[32]

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.

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 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.

While this theory has worked in practice for control of some nonnative aquatic plants, results have been varied (Madsen, 2000). 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. Beetles are commonly used to control purple loosestrife populations in Wisconsin with good success.

Purple Loosestrife Biocontrol[33]

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[31] TSB Lakefront Restoration Email Communication. January 2017.

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

[33] http://dnr.wi.gov/topic/Invasives/loosestrife.html.

Biocontrol may be the most viable long term method for purple loosestrife control. The WDNR and University of Wisconsin-Extension (UWEX), along with hundreds of citizen cooperators, have been introducing natural insect enemies of purple loosestrife, from its home in Europe to infested wetlands in the state since 1994. Careful research has shown that these insects are dependent on purple loosestrife and are not a threat to other plants. Insect releases monitored in Wisconsin and elsewhere have shown that these insects can effectively decrease purple loosestrife size and seed output, thus letting native plants reduce its numbers naturally through enhanced competition.

A suite of four different insect species has been released as biological control organisms for purple loosestrife in North America and Wisconsin. Two leaf beetle species called "Cella" beetles that feed primarily on shoots and leaves were the first control insects to be released in Wisconsin and are the insects available from WDNR for citizens to propagate and release into their local wetlands. A root-mining weevil species and a type of flower-eating weevil have also been released and are slowly spreading naturally. The Purple Loosestrife Biocontrol Program offers cooperative support, including free equipment and starter beetles from WDNR and UWEX, to all state citizens who wish to use these insects to reduce their local purple loosestrife.

The length of time required for effective biological control of purple loosestrife in any particular wetland ranges from one to several years depending on factors such as site size and loosestrife densities. The process offers effective and environmentally sound control of the plant, not elimination, in most cases. It is also typically best done in some combination with occasional use of more traditional control methods such as digging and herbicide use. Biocontrol with beetles may be appropriate at some point in time should purple loosestrife become well-established around Bone Lake.

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[34]

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

DREDGING

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 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 was 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

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 1 to 2 years (Ludlow 1995), it is most commonly applied to Eurasian water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980). Drawdown requires a mechanism to lower water levels.

Although drawdown 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 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.

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

BENTHIC BARRIERS

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

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.[35]

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 herbicide but can also be used selectively under certain circumstances.

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

SELECTIVE HERBICIDES

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

ENVIRONMENTAL CONSIDERATIONS

Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community 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.[36] Chemicals recently used in Bone Lake are listed and described in Table 16 below.

Table 16. 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

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

COPPER[37]

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.

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 WDNR staff and tested at the State Laboratory of Hygiene in 2000.

2,4-D

2,4-D photodegrades on leaf surfaces after applied 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.

Recent WDNR studies contradict the above information. Under certain conditions, residual concentrations of 2,4-D above 100 ug/L may be present well past label irrigation restriction guidelines of 21 days. Degradation takes longer in some lakes:

- Oligotrophic (low-nutrient) lakes
- Low alkalinity lakes
- Lakes with no history of herbicide usage
- When water temperatures are cool. (WDNR, 2011)

Granular formulations of 2,4-D and other herbicides dissipate at about the same rate as liquid formulations of herbicides (WDNR, 2011).

Some recent studies indicate a need to consider the long-term effects of 2,4-D use. One is the effect on the endocrine system and reproduction of fat head minnows (DeQuattro, 2015). There is also some evidence that hybrid EWM can acquire resistance to 2,4-D (LaRue et al, 2013).

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

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.

Endothall is a contact herbicide that prevents certain plants from making the proteins they need. Factors such as density and size of the plants present, water movement, and water temperature determine how quickly endothall works. Under favorable conditions, plants begin to weaken and die within a few days after application. (WDNR Fact Sheet 2012)

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. 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.

FLORPYRAUXIFEN-BENZYL

Florpyrauxifen-benzyl was registered with the EPA for aquatic use in 2017. Florpyrauxifen-benzyl is a systemic herbicide that is taken up by aquatic plants. The herbicide is a member of a new class of synthetic auxins, the arylpicolinates, that differ in binding affinity compared to other currently registered synthetic auxins. The herbicide mimics the plant growth hormone auxin that causes excessive elongation of plant cells that ultimately kills the plant. (WDNR Fact Sheet 2018)

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:[38]

Studies have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 - 60 degree F water, and 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. 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.[39]

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[38] Research in Minnesota on Control of Curly Leaf Pondweed. Minnesota Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

[39] Personal communication, Frank Koshere. March 2005.

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. Florpyrauxifen-benzyl was registered with the EPA for aquatic use in 2017. 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.

2,4-D is frequently used to target EWM (a dicot) over many other native plants (monocots).

However, large-scale treatments can result in significant damage to both monocots and dicots.

- Dicots susceptible to both 2,4-D and fluridone include native water milfoils (particularly northern), bladderworts, water lilies, and coontail.
- Monocot species such as elodea, several narrow leaf pondweeds, and naiads are also impacted by fluridone and some 2,4-D use.
- Fewer natives are affected at lower dosages. (WDNR, 2011)

Wisconsin DNR research indicates that larger scale treatments seem to have more consistent reduction from herbicide use than smaller treatments. These results are based upon data collection in many Wisconsin lakes where herbicides were used for EWM control. (Nault, 2015)

Herbicides can dissipate off of a small treatment site very rapidly. 2,4-D dissipated rapidly after treatment after it was applied to 98 small (0.1-10 acre) treatment areas across 22 study lakes with application rates of 2-4 parts per million (ppm). The following results were found:

- Initial 2,4-D concentrations detected in the water column were well below application targets.
- Herbicide moved quickly away from treatment sites within a few hours after treatment.
- The rapid dissipation of herbicide indicates that the concentrations in target areas may be lower than what is needed for effective EWM control. (Nault, 2012)

Florpyrauxifen-benzyl (ProcellaCOR) has been used since 2017 to control Eurasian water milfoil (EWM). Early results on Cedar Lake in St. Croix County, WI are favorable with good control of EWM. On June 6, 2019 the herbicide ProcellaCOR (Florpyrauxifen-benzyl) was utilized to reduce *Myriophyllum spicatum* (EWM) in two beds totaling 12.2 acres. The frequency of occurrence (FOO) had a significant reduction ($p<0.0001$ from chi square analysis) with an FOO of 59.5% within the treatment bed before treatment to 0% after treatment. There was one significant reduction in native species (*Potamogeton pusillus*) and three significant increases in native species (based upon chi square analysis before and after treatment). (Schieffer, 2019)

APPENDIX D. PUBLIC INPUT FOR AQUATIC PLANT MANAGEMENT PLAN 2020

ADVISORY COMMITTEE MEETINGS

Meeting 1:
Saturday, February 8, 9:30 a.m. to noon

Attendees:
Cris Dueholm
Bob Boyd
Dick Mackie
Karen Engelbretson
Cary Olson
Alex Chorewycz
Steve Schieffer, Consultant
Cheryl Clemens, Consultant

Introductions, APM planning process (Cheryl)
Slide show, #1 - #6

Brainstorm/identify concerns related to aquatic plants and invasive species (Committee)
Sensitive/Critical Habitat Areas

- Using chemicals near/in
- Promote sensitive area importance
- Review/update SAs based on new information (bird, frog/toad surveys)

Change prevention efforts to focus on all AIS rather than just EWM (Goal 2)

Review provisions related to control of native plants for nuisance and impaired navigation – should we remove these provisions which allows permits for chemical control for individuals and common navigation channels? (Goal 1)

Education should address alternative states of shallow lakes: aquatic plants vs. algae

Review/update goals from 2013 APM plan (Cheryl)
Slides #7 and #8
See updates goals and objectives from Table of Contents

Goal 2 – list priority potential AIS

Review curly leaf pondweed management efforts and future management options (Steve)

Slides #9 - #21

CLP has likely spread as much as it is going to in Bone Lake

Consider objectives for CLP management –

- Is P removal with CLP control cost effective? Not with chemical treatment $14,400/kg
- Is maintaining early season navigation important? Initial feedback seems to be yes. No owner survey this time.

CLP beds most important for early season navigation 2 – 5, 7

Do not consider contract harvesting because of potential for AIS introduction

Alternatives for CLP Control

No control

Chemical control

  Focus on navigation improvements only

  Focus on P control - treat all beds where treatment likely successful (status quo)

Harvester with owned equipment

  Focus on navigation improvements only

  Focus on P control – harvest all beds where growth reaches height that can be harvested

Questions to answer

Need an analysis for cost of harvesting and P removal from harvesting (Steve will do, with information from Wapo/Bear Trap)

Importance of CLP removal for property owners? Can committee members get some input from residents?

NEXT MEETING: Friday, February 29, 9 a.m. to noon

Select CLP objectives and strategy

Discuss Goal 1: navigation and nuisance permits

Aquatic invasive species (including Zebra Mussel) prevention and monitoring

Review and update educational strategies

Implementation plan

Meeting 2:
Saturday, February 29, 9:30 a.m. to noon

Attendees:
Cris Dueholm
Bob Boyd
Dick Mackie
Karen Engelbretson
Cary Olson (by phone)
Alex Chorewycz
Steve Schieffer, Consultant
Cheryl Clemens, Consultant

Plan Goals and Strategies tracked changes dated 03/02/20 also show results of this meeting. All committee recommendations included below were by consensus of the committee.

Finalize CLP strategy

Cost of phosphorus removal via CLP harvesting (based on Wapo/Bear Trap example) is similar to that of chemical control which is higher than other removal efforts.

Objectives:

- Remove water quality objective for CLP goal, but still track P removal from CLP control
- Take out specific turion objective, but still track turion results

Actions:

- Control CLP using early season chemical control with a focus on improving spring navigation, target beds based on likely success of treatment, develop criteria for bed selection
- Consider harvesting or other methods in the future (adaptive management)
- No specific procedures for CLP treatment in individual corridors will be in the APM plan

Navigation Management

- Keep procedures for chemical treatment for navigation channels and for individual corridor access in the APM plan. These procedures provide guidance for legal, permitted means to control severe nuisance and navigation impairment from native plant growth. Do not include a map of potential navigation channels in the APM plan.

Critical Habitat/Sensitive Area Protections

- Monitor native plants (according to pre and post treatment monitoring methods) in sensitive areas where sensitive areas are adjacent to CLP treatments. If statistically significant declines in native plants are found in the year of treatment, continue follow-up monitoring for 3-5 additional years.
- Update the Critical Habitat/Sensitive Areas designations for Bone Lake in cooperation with the WDNR.

AIS Prevention

- Investigate decontamination systems and consider implementation at the North Landing.

Education

- Educational audiences, messages, and methods were updated *(see Goals and Strategies tracked changes).*

Additional Comments

- A map with place names should be included in the APM plan.
- Incorporate the 2018 public survey information into the APM plan.

Schedule for completion and public review process

Draft Plan for Committee Review	March 11, 2020
Comments back from Committee	March 20, 2020
Plan and Exec. Summary for Public Review	
(post on web site, at library)	March 25, 2020
Comments from Public Due (to Harmony)	April 10, 2020
BLMD Commissioners Meeting	April 18, 2020
Plan submitted to DNR	May 1, 2020
60 Day Review	

SLIDES FROM MEETINGS FOLLOW ON NEXT PAGE

Why Complete an APM Plan?

- Protect fish and wildlife habitat
- Lake is a public resource
- Understand and address plant concerns
- Identify available management methods
- Coordinate and communicate mngt. actions

APM Plan Development Process

Completed background information

Aquatic Plants
Water Quality
Fisheries
Watershed
Sensitive Areas

APM Plan Development Process (2008 and 13)

Identified plan goals
Developed objectives
Chose action steps
Planned implementation – timeline, budget, responsible parties

2019 Update Focus

- CLP Management
- AIS Prevention
- Background Updated
- 2013 APM Plan available Bone Lake website

Plan Goals

Goal 1. *Maintain recreational uses.*

Goal 2. *Prevent the introduction of aquatic invasive species.*

Goal 3. *Manage curly leaf pondweed.*

Goal 4. *Protect the natural functions of diverse native plants.*

Plan Goals

- 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.

Curly Leaf Pondweed

CLP Management

Photo from peteport.com/portage

Targeted Herbicide Treatment

•Early season treatment means few natives growing

•Water temps between 50 and 60

•Treated with Endothall (brand = Aquathol K)

•Endothall is a broad spectrum herbicide

•Breaks down rapidly (1-2 weeks)

•Varying results – wind, concentration, flowing water

CLP in Bone Lake

2007: 87 acres

2012: 68 acres plus 12.7 acres

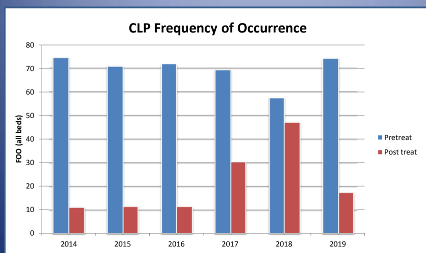
2017: 51 acres plus 31 acres

Annual CLP Treatment Effectiveness

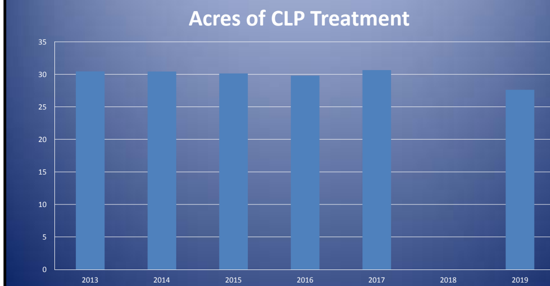
Bed	Frequency of Occurrence Following Treatment										
	2019	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
2	5.9	10.0	6.2	16.7	8.0	22.0	35	31	38	77	73
3	14.3	27.3	22.7	13.6	4.5	11.8	12	60	55	95	78
4	20.0	22.7	11.4	2.2	2.2	2.9	6	61	42	55	100
5	17.8	26.5	18.2	5.9	8.8	0.0	39	79	58		
6	26.8	15.0	1.8	18.8	4.8	7.8					
7	11.1	34.1	20.9	15.6	23.3	8.5					
8	5.7	81.8	12.1	8.8	31.2	18.2					
All beds	17.5	30.4	11.5	11.8	11.3	9.3	22	59			

Impacts to Native Plants – measured pre and post treatment

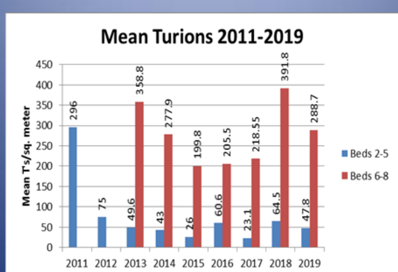
Annual CLP Treatment Effectiveness



Long-Term CLP Treatment Effectiveness



Long-Term CLP Treatment Effectiveness



Plan Objective: 10/m2 – too low

GOAL 3. MANAGE CURLY LEAF PONDWEED TO MINIMIZE NAVIGATION PROBLEMS, PREVENT ITS SPREAD, *LOWER PHOSPHORUS CONTRIBUTION TO ALGAE BLOOMS* AND PROTECT NATIVE PLANT POPULATIONS.

- OBJECTIVE: IMPROVE BONE LAKE WATER QUALITY (COST EFFECTIVE?)
- OBJECTIVE: PROTECT NATIVE PLANT POPULATIONS (SATISFACTORY?)
- OBJECTIVE: ALLEVIATE SPRING NAVIGATION CONCERNS (YES)
- OBJECTIVE: IMPROVE EARLY SEASON SWIMMING AND BOAT ACCESS (YES)
- OBJECTIVE: REDUCE TURION DENSITY IN TARGETED BEDS TO 5-10 TURIONS/M2. (NOT REALISTIC – LONG TERM CONTROL NOT HAPPENING)
- OBJECTIVE: CONTINUALLY IMPROVE CLP MANAGEMENT ON BONE LAKE
  (WOULD OTHER MANAGEMENT METHODS WORK BETTER?)

Estimated P Reduction from CLP Control

• 30 acres controlled with herbicide treatment	Estimated 25 kg reduced each year with CLP control Cost is $36,000 50% is grant funded but not guaranteed $14,400 per kg (over 10 years)

Estimated Annual Cost of P Control*

Curly Leaf Pondweed:	**$14,400/kg**
Septic Systems:	**$8,333/kg**
Waterfront/Watershed:	**$9,490/kg**
Alum:	**$1,780/kg**

***septic systems, runoff management, alum costs spread over 10 years**

Changes to CLP Control?

- Should beds be added or eliminated?
  - BEDS 6, 7, 8
  - Add bed near North Landing?
- Other control methods available?

CLP Management: Harvesting

Harvesting
Used with extensive growth
White Ash Lake
Rice Lake
Lake Wapogasset and Bear Trap
Apple River P&R District

Considerations
•Timing
•Plant fragments
•Fish kill
•Temporary fix
•Own vs. leasing
•Contracted harvesting
•Cost

CLP Management: Harvesting

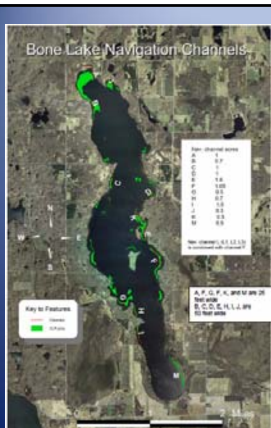
Capital Investment
Apple River: $154K **(7 ft. harvester, conveyor, trailer – 2012)**
$221K **(10 ft harvester, conveyor, trailer – 2020)**
Balsam: $175K **(7 ft. harvester, conveyor, trailer – 2016)**
Wapo/Bear: $20,800 **(annual payment)**

O&M (2019)
Apple River: $28,500 **(labor $20K)**
Balsam: $6,000 **(approx.)**
Wapo/Bear: $18,000 **(approx., labor $13K.)**

Estimated 10 Year Cost of Annual P Control*

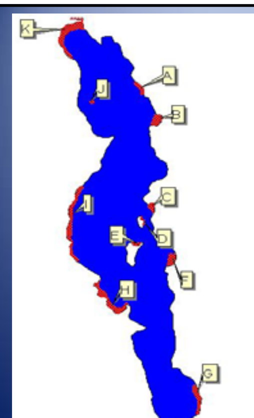
Curly Leaf Pondweed:	**$14,400/kg**
CLP Harvesting (WAPO/BEAR)	**$15,000/kg**
Septic Systems:	**$8,333/kg**
Waterfront/Watershed:	**$9,490/kg**
Alum:	**$1,780/kg**

***septic systems, runoff management, alum costs lifespan assumed to be 10 years. CLP costs repeat annually.**



Potential Navigational Channels 2008 plan (left) 2009 permit (right)

Used for CLP treatment only: 2009 – 2012: A, K, E



Potential Navigational Channels 2009 permit (right) Sensitive Areas (left)

WDNR Sensitive Areas: 1989

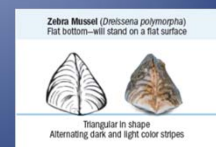
CLP Treatment Beds: 2019

CLP Following Treatment : 2017

Zebra Mussels

Jeremy Williamson, Polk County Land and Water Resources Department

¼ to 1 ½ inches long
Alternating dark/ light colored stripes



Zebra Mussel Distribution

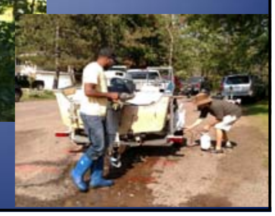
Introduced to Great Lakes in 1980's

- MN Lakes
- Southeastern WI
- Big and Middle McKenzie Lake, Burnett/Washburn County (2016)
- St. Croix River, south of Stillwater

Wisconsin Department of Natural Resources

Zebra Mussel Prevention

Decontamination Station



Zebra Mussel Monitoring

- Involve: volunteers, lake service providers, professionals
- Plate samplers or cinder blocks
- Shoreline searches
- Veliger tows with nets

Zebra Mussel Monitoring

Minnehaha Creek Watershed District AIS Early Detector How-To Guide

Decontamination Systems

CONSIDERATIONS

Equipment selection

Decon System Placement:

- Lake Access

Participation:

- Required
- Voluntary
- Priorities

Operation:

- Staffing
- Equipment

Decontamination Basics

If recreational equipment has been left in the water for more than a day

- *Spray/rinse* hull and other external areas
  - high pressure (2,500 psi)
  - hot water (140F for 10 sec).
- *Rinse/flush* motors with hot water (120F) for 2 minutes.
- *Rinse/flush* interior compartments with hot water (120F)
- Dry everything for *five days* or more OR *wipe* with a towel *before reuse.*

VOLUNTARY GUIDELINES TO PREVENT THE INTRODUCTION AND SPREAD OF AQUATIC INVASIVE SPECIES (Federal)
Aquatic Nuisance Species Task Force
November 2013

Committee Comments

Bone Lake APM 03/02/2020 Draft Plan Goals and Strategies

Bob Boyd (telephone 03/03/20) – *all changes made, CC*

Page 60: text box, bullet 5, change pesticide to herbicide for clarity (an herbicide is a type of pesticide, but might be misinterpreted).

Page 61: 4th Action Item (highlighted), end sentence after resorts (rest refers only to Eurasian water milfoil).

Page 62: Remove objective "Improve early season swimming and boat access," it is redundant to navigation improvement and not the focus of the CLP control program

Standards for treatment (highlighted), agreed with Steve and Cheryl's recommendation to increase minimum bed size to 0.25 acres (have seen effective treatment at 0.29 acres, and can navigate around smaller beds).

Page 63: Last action item (adapt management) 2nd bullet, at end of sentence add "or 60 degrees if authorized by WDNR."

From: Cary Olson [mailto:caryolson@comcast.net]
Sent: Wednesday, March 4, 2020 2:28 PM
To: 'Cheryl Clemens'; 'Cris and Lyn Dueholm'; 'Bob Boyd'; 'alex chorewycz'; 'Dick and Sally Mackie'; 'Karen Engelbretson'
Cc: 'Steve Schieffer'
Subject: RE: Bone Lake APM Committee MTG 2 02/29/2020 notes

Hi Cheryl,

Thanks for providing the leadership and poking to get this done. Everything is good to me from what I heard and read through in your notes.

Cary

From: Cary Olson [mailto:caryolson@comcast.net]
Sent: Wednesday, March 4, 2020 2:44 PM
To: 'Cheryl Clemens'; 'Cris and Lyn Dueholm'; 'Bob Boyd'; 'alex chorewycz'; 'Dick and Sally Mackie'; 'Karen Engelbretson'
Cc: 'Steve Schieffer'
Subject: RE: Bone Lake AIS Rapid Response Plan

This looks fine to me. No comments

Cary

From: Karen Engelbretson [mailto:karen@kje.design]
Sent: Thursday, March 5, 2020 2:36 PM

To: Cheryl Clemens
Subject: Re: Bone Lake APM Committee MTG 2 02/29/2020 notes

Hi Cheryl,

I've reviewed the APM Bone 2020 Goals and Objectives 030220 document.

Here's a change for pg 66, Methods

probably should add "Bone Lake eNews"

Could be added to the line Social media and website

Social media, website, Bone Lake eNews

Review Appendix, Rapid Response

I worked on the very first one of these plans so perhaps my comments are out of date now...

Page D-2, Item 5

Would this be the place to mention marking the location of the AIS with a buoy or buoys? We had buoys made way back when. I don't see marking an invasive location anywhere in this document.

Page D-4

I recall when we first drafted a rapid response plan we had included a diver contractor, similar to listing the chemical applicator.

Exhibit A: Do we need to add a dive company since divers and underwater inspections are a part of the plan?

We used to have a partially completed AIS control grant application. Is that still a thing to do?

Aquatic Plants Along Your Shoreline

Update contact information to include Cary Olson.

That's the extent of my comments. Thanks for your fine work on this,

Karen

Karen Engelbretson
Secretary
Bone Lake Management District
Bone Lake, Polk County, WI
651-395-0969 mobile

Thanks very much, Karen. I appreciate your careful review.

I am copying Bob on this because we updated the Rapid Response Protocol together. We took out the buoys and the diver on purpose.

The buoys seemed to attract people to the EWM when Cedar Lake borrowed them from Bone Lake. As a result, we viewed them as counter-productive.

A diver was included originally when the response was for EWM, but a diver isn't a likely way to look for AIS (including EWM and zebra mussels) especially when water clarity isn't good – other methods are more efficient and cost effective. We could add divers to the contacts if you think that would be helpful.

The forms are standardized now, so it would be easy to update a current application for an AIS response.

I sent the publication "Aquatic Plants Along your Shoreline" to show what we did in 2009. Do you think the BLMD should still use this publication?

Cheryl

From: Karen Engelbretson [mailto:karen@kje.design]
Sent: Thursday, March 5, 2020 2:54 PM
To: Cheryl Clemens
Subject: Re: Bone Lake APM Committee MTG 2 02/29/2020 notes

Managing Aquatic Plants Along Your Shoreline should be available to property owners. We could create a specific trifold brochure for it.

If so, it should include more of the goals of the plan that we've revised and include info about protecting native plant communities.

Do we have budget to update this document into a brochure for property owners in this current work or would we need to go to the board with this? I think property owners should know what is the right and lawful thing to do.

Thanks, Karen

From: alex chorewycz [mailto:achorewycz@yahoo.com]
Sent: Sunday, March 8, 2020 5:59 PM
To: Cris and Lyn Dueholm; Bob Boyd; 'cary olson'; 'Dick and Sally Mackie'; Karen Engelbretson; Cheryl Clemens
Cc: Steve Schieffer
Subject: Re: Bone Lake AIS Rapid Response Plan

No changes/comments etc. Thanks for your work.

Alex

From: Lyn & Cris Dueholm [mailto:lcdueholm@lakeland.ws]
Sent: Saturday, March 7, 2020 10:26 AM
To: 'Cheryl Clemens'
Subject: Bone lake plan

Hi Cheryl,

Sorry am late with this, but did read and checked the map and found it to be what we talked about at the meeting.

Thanks for all of the hard work that you do for our lake.

The updated AIS Rapid Response that you added seems to also hit the point and address issues. It make sense to add all AIS, As time goes on we will see something different and we should be more visionary than quickly trying to attack the problem when it may be too late.

Thanks again

Cris

-----Original Message-----
From: Richard Mackie [mailto:seesallyrun@lakeland.ws]
Sent: Saturday, March 7, 2020 9:05 AM
To: Cheryl Clemens
Subject: APM Plan

Updated - clarified - decluttered. Thanks Cheryl - Dick M.

Comments executive summary and implementation plan (03/10/20)

From: Bob Boyd [mailto:boydsnest2048@outlook.com]
Sent: Tuesday, March 10, 2020 5:07 PM
To: Cheryl Clemens; Cris and Lyn Dueholm; alex chorewycz; 'cary olson'; 'Dick and Sally Mackie'; Karen Engelbretson
Cc: Steve Schieffer
Subject: RE: Bone Lake APM Summary and implementation tables

My thoughts for now after a quick read today.

Executive summary good to go.

Implementations table thoughts. I need to read it some more yet

I would like to include a decontamination pilot, cost, timing and design need to be figured out.

Hot/warm water, high pressure, runoff containment, portable, lots of stuff to think about.

You could put in plenty of volunteer hours in the chart to figure out how to build and operate it, what year try it out??.

Bob

Cheryl,

Plan review

I focused on the goals and everything after that. One picky thing here...

Page 61

Objective: Protect Native Plant Populations

Paragraph beginning pre and post monitoring procedures..

Should “sensitive” areas be changed to “critical habitat/sensitiveareas”

Do we need to explain here that treatment early in the season is necessary to protect native plant communities? or is that adequately covered elsewhere?

Executive summary

no changes

Implementation Tables

pg 70: The AIS Handouts budget could cover the trifold on CLP treatment and native plant communities if that’s what you’ve intended

Annual Meetings: this $500 is specific to APM programming?

That’s the extent of my review. Thanks, Cheryl, for this document and the meetings you led. I’m proud to be part of this planning.

Karen

Karen Engelbretson
Secretary
Bone Lake Management District
Bone Lake, Polk County, WI
651-395-0969 mobile

Bone Lake APM Public Review

Comments accepted through April 10, 2020

Hi Cheryl

Great job on leading the committee thru the APM

One very minor item is the camera cost is around $5k - see attached estimate for this year. Last year we spent around $5500 for both landings - total cost. Thank you. Updated.

Also the last survey was done 2019 vs 2018 - that is what I remember anyway but do not have the actual survey here. The survey was completed in 2018.

Looking forward to hearing more about the boat wash stations. The concept is great but seems we would to close other landings or require all boats being launched at all landings to go thru them

Phil

-----Original Message-----
From: philsuefoster [mailto:philsuefoster@lakeland.ws]
Sent: Sunday, April 5, 2020 8:45 PM
To: Cheryl Clemens
Subject: Re: APm

looking at summary again, I guess the only things I would suggest

include would be:

- under invasive species -- That we will be maintain at both public

landings our CBCW and camera activity. Addition made.

- under the CLP goal - maybe indicate the # of acres we intend to spray as I am not sure of what the intended change is regarding CLP treatment from what we have been doing. The dollars are about the same but the wording seems to indicate we will be reducing the # of acres. # of acres have not been determined at this time. The plan direction would be to use the criteria in the plan and available budget to select treatment locations and therefore number of acres.

Anyway, nothing major but might help other readers as well

thanks

Phil

On 2020-04-05 14:31, philsuefoster wrote:

HI

A couple of comments on the APM

1. Please look on page 15 in the Remove Internal load. I believe the one sentence states removing external load and it should be Internal Load. Correction made

2. In the executive summary, it seems we could be more specific on what things we are going to keep doing. I had to look in the detail

to find the answer to this. I will come back by tomorrow and give a couple of items after rereading it

pHil

The following comments are proposing specific areas for CLP treatment.

From: Robert Atkinson [mailto:atkinsonlaw@comcast.net]
Sent: Friday, April 10, 2020 11:57 AM
To: harmonyenv@amerytel.net
Subject: Comments on the Bone Lake Aquatic Plant Management Plan

Harmony Environmental 516 Keller Ave. S. Amery, WI 54001

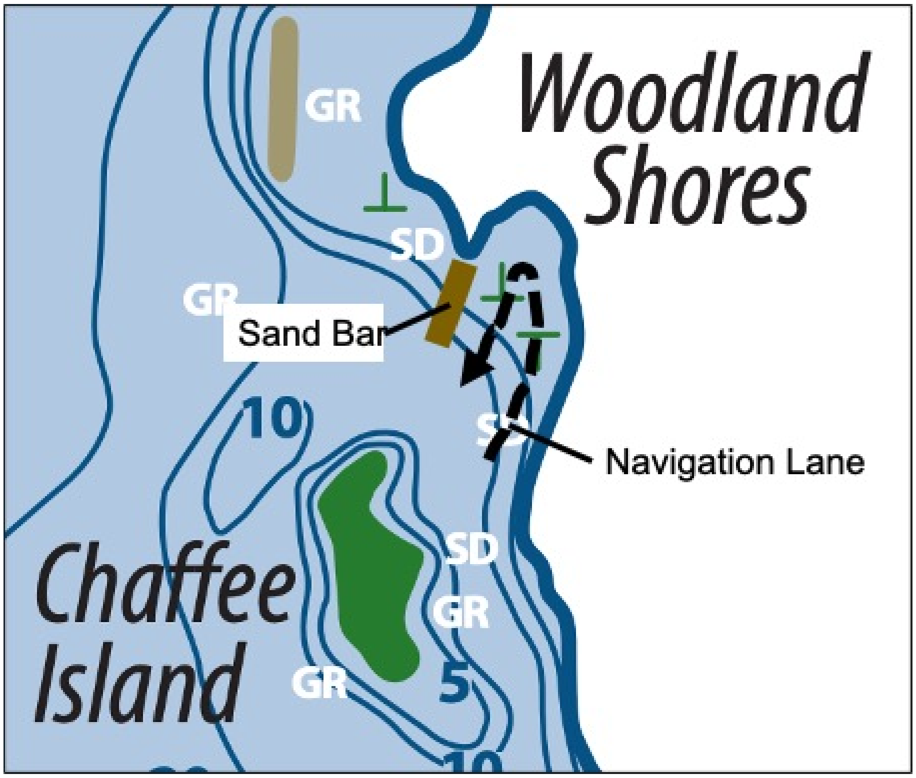
To whom it may concern:

Thank you for drafting the comprehensive Plan. For the following reasons, I am requesting that one of the curly leaf pondweed (CLP) areas be treated more fully.

I am a property owner at 2268 Woodland Shores with approximately 180 feet of shoreline on Bone Lake, in the small bay North East of Chaffe Island. This bay, as well as the immediate surrounding area, has an abundance of CLP as personally observed and as noted on page 40 of the Plan, and is a site designated for treatment. However, after observing the treatment first hand, I noticed that only the outskirts of the bay are treated and areas inside the bay are left untreated. When I raised this issue at the annual meeting I was given two reasons for this: (1) there is wild rice in the area; and (2) the bay is too shallow to navigate.

With regard to the presence of wild rice, I believe this concern is unwarranted. First, I routinely go through the bay for access and fishing (I have a dock and two boats in the water) and have never observed any wild rice. Second, as provided on pages 36-37 of the Plan, the presence of wild rice is limited to the North end of the lake.

With regard to the bay being too shallow to navigate, I believe this concern could be addressed by following the same channel of navigation used by land owners along the bay. As shown in the illustration below, there is a sand bar that prevents entry into the bay from the West, but there is a nice navigation lane that parallels the shore if approached from the South.



I would ask that the entire bay be treated for CLP since it is designated for such treatment and is accessible.

Thank you for your consideration.

Bob Atkinson

2268 Woodland Shores

From: Jason & Heather Elder <theeldersmn@gmail.com>

Subject: Aquatic Plant Mgmt Plan Re: Bone Lake Management District eNews

Date: April 10, 2020 at 4:56:16 PM CDT

To: Bone Lake Management District <eNews@BoneLakeWI.com>

My comments regarding the **Aquatic Plant Management Plan Review…** The map online appears to include the entrance to and just south of the lagoon in the north end. This is a must have. The area has become nearly impassable during high weed season. If the map accurately indicates the planned treatment area, which appears to be a thin line tight to the shoreline / docks, I would recommend we treat a wider line, broadening the area slightly to the west. Please see brown area in below feeble attempt to depict. Please let me know if you have clarifying questions.

APPENDIX E. REFERENCES

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APPENDIX F. 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
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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.