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Pine Lake - Aquatic Plant Management Plan

Pine Lake Property Owners Association

Prepared by:
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Executive Summary

Pine Lake is a natural seepage lake in Waushara County and provides numerous recreational opportunities for a wide spectrum of users. Being a popular local destination with Crossways Pine Lake Camp on its shoreline and near the very popular Waupaca Chain of Lakes, Pine Lake draws a wide array of users from throughout the area and statewide. Some use patterns may be detrimental to the overall health of the lake and bring a higher risk of the introduction of new aquatic invasive species (AIS).

The aquatic plant community in Pine Lake is moderately diverse and can grow dense in some locations. Dense aquatic plant growth can impact lake users and hamper navigation, which can be made worse by the presence of AIS. There are two AIS present within Pine Lake: Eurasian water-milfoil (*Myriophyllum spicatum* – EWM) and banded mystery snail. This report focuses and aquatic plant management and, in turn, Eurasian water-milfoil.

Spread of AIS, potential impact of select uses, and locally dense aquatic plant growth are the main issues of concerns for lake users. The dense aquatic plant growth and/or AIS do hamper navigation within the lake, limit enjoyment, and cause increased expenditure on actions to alleviate them. Past management focused on aquatic plant control through targeted, small-scale spot treatments with herbicide and suction harvesting. These techniques provided only temporary control. Current issues have caused the need for understanding of what is happening and why. Development of an updated management plan for better management of the lake is needed.

This management plan provides a multi-faceted approach to address issues and recommend management options based on best fit, cost, feasibility, and desires based on direct input from the lake user survey questions. Many aquatic plant management options are evaluated and, while there is not one silver bullet, it is likely a combination of techniques over a period of several years that will begin to yield positive results. The basic plan is based on exploration of new aquatic plant management techniques with expanded actions for AIS control, overall aquatic plant community control, and protection of the lake's value to all users. Some of these actions potentially include continued harvesting, herbicide applications, protection of ecologically sensitive areas, and AIS and boat landing monitoring. It would be recommended the group start with a specific project component or area of the lake to gain early and immediate success and build off of that for future projects.

1.0 INTRODUCTION

Pine Lake is natural seepage lake located in the Town of Springwater in northern Waushara County. The water level in Pine Lake fluctuates based on groundwater elevations and has recently reached a historic high. Based on current water level elevations, Pine Lake encompasses 156-acres, has a maximum depth of 58 feet, mean depth of 27.5 feet, and 2.45 miles of shoreline. A shallow sand bar splits the lake into two basins. The western portion is shallower and highly vegetated while the eastern basin is deeper with vegetation found only at the perimeter. WDNR depth contour map data is old, outdated, and does not accurately show the depth contours. An updated depth contour map to show current conditions created from data collected as part of this plan is included as Figure 10.

Water quality of Pine Lake rates right between mesotrophic and oligotrophic and moderately productive. Water clarity is very good and provides numerous recreational opportunities. The Pine Lake Property Owners Association (the PLPOA or Association) is the main organization responsible for management activities on Pine Lake. The PLPOA is a group who supports the restoration and management of the lake with a strong tradition in conservation and resource management to protect and enhance these opportunities. The Association has been active in a number of lake management activities on Pine Lake including: aquatic plant management, water quality sampling and management, invasive species sampling, and protection of the lake. The Association contracted with Wisconsin Lake & Pond Resource, LLC (WLPR) to help develop an updated comprehensive aquatic plant management (APM) plan for Pine Lake.

2.0 LAKE USER SURVEY AND PRIMARY CONCERNS

Any management plan can only be successful if accepted by the lake users it impacts the most. If options are laid out that are not needed or feasible, a plan is set to fail due to lack of support and this management plan is no different. Prior to drafting this plan, a questionnaire was sent out to all lakeshore residents, PLPOA members, and made available to any interested lake user, and was available online for 30 days. Notification of the survey was sent out as an information postcard with a link to the online survey and an option to request a paper copy. Copies of the survey were also made available at the public boat launch and any other interested party that requested one. In total, 173 postcards were sent to all 112 lakeshore landowners and an additional 61 addresses of PLPOA members who lived off the lake. 157 unique survey responses were submitted with 12 of these completed by lake visitors, giving a return rate of 83.8%, or 145 responses, directly from the mailing. Results of the questionnaire are included in Appendix A. This questionnaire gives us a unique look at all lake users and a better understanding of issues to guide development of a plan that will not only strive to improve current lake conditions, but be successfully implemented and supported by lake users through direct response actions by the people the lake impacts the most.

In total, 157 respondents completed the survey across an array of users with a majority (80.2%) being shoreline residents – either year-round or seasonal. The remainder were visitors, off-shore residents, or other affiliations. This shows that the lake and its health is important to not only riparian owners but to all users. Responses give an opportunity to look into personal histories with Pine Lake and to create an average user profile. Overall, the average user looks like this:

- 72.3% have used the lake for over 10 years
    - Average of 35.1-year history with the lake

- Spend a significant portion of their time on the water, with averages of:
    - 15.9 days per month during open water
    - 5.8 days per month during ice cover

- Nearly all (99.3%) found their time on the water enjoyable with a variety of activities. Activities enjoyed by users are focused on a variety of different uses, including:
    - Swimming (#1)
    - Pontoon boating (#2)
    - Pleasure boating (#3)
    - Water skiing (#4)

Many responses indicated an array of enjoyment of experiences on the lake which have decreased over time.

- 28.4% indicated no change
- 13.5% indicated their use has become more enjoyable.
- 58.1% indicated their use has become less enjoyable, due to:
    - Excessive aquatic plant growth
        - 87.2% of respondents who indicated decreased enjoyment selected this option as a cause
    - Increased boat traffic

The respondents' main concerns on lake health focused on aquatic invasive species and their impact on the lake and use patterns. The primary concerns were:

- Spread of aquatic invasive species (#1)
- Excessive aquatic plant growth (#2)
    - Primarily driven by increased EWM growth
    - Negatively affected lake users 75% at least some of their time or more
- Declining water quality / increasing pollution (#3)

This plan will focus on the main two contributing factors – invasive aquatic plant growth and controlling it's spread within Pine Lake and out of the lake to other waters. Users were very knowledgeable about AIS and potential harm.

- 75% responded in kind and 98% believed there are populations of AIS in Pine Lake.
    - 99% responded that EWM was present in Pine Lake. This shows continued knowledge of the lake by its residents and users.

- 94.2% of respondents want action to manage aquatic plants, primarily the AIS Eurasian water-milfoil. There were no responses that wanted no action for management. Top management options were:
    - Herbicide control (#1)
    - Continued aquatic plant monitoring (#2)
    - Manual removal or hand pulling (#3)
    - No management was far and away the least preferred option

- Users chose the following elements as the most needed for this APM Plan:
    - Prevent the introduction of new AIS into Pine Lake and seek grant funding for AIS management efforts (#1 – tie)
    - Reduce the extent and density of existing AIS within the lake (#2)
    - Identify and explore new aquatic plant management strategies (#3)

PINE LAKE -
AQUATIC PLANT MANAGEMENT PLAN
Lake User Survey and Primary Concerns
August 17, 2022

The Pine Lake APM Plan includes a review of available lake information, aquatic plant surveys, and lake user questionnaire to determine the most appropriate management alternatives (physical, mechanical, biological or chemical) for protection and health of the lake. Though not all activities desired for management by lake users may be viable or appropriate, their input above provides a strong base to form this plan.

A public meeting to present the initial user survey results, aquatic plant survey data, and further refine the plan outline and over goals was held on July 2, 2022. Review of the draft APM plan was submitted to the Association and WDNR for comments prior to finalization. The APM plan that follows recommends specific management activities for Pine Lake based on the top management concerns indicated in the questionnaire; spread of AIS and excessive aquatic plant growth. This APM plan will help ensure not only the health of the lake but also the enjoyment by future generations of Lake users.

3.0 LAKE HISTORY & PAST MANAGEMENT

Located in northern Waushara County in the Town of Springwater, the lake has been an important fixture in the lives of residents and non-resident users. One public landing provides adequate accessibility with parking for up to 10 vehicles with trailers. Additional lake access is provided by the Pine Lake Camp, which hosts summer youth camps for 1st – 12th grade children, family camp weekends, provides rentable lodging for private events, and hosts various meetings throughout the year, including the PLPOA's annual meeting.

Excellent water quality and recreation opportunities of Pine Lake and its proximity to popular nearby waterbodies have led to a history of heavy recreational use, primarily fishing and recreational boating. Pine Lake is a biologically moderately productive lake with multiple locations of dense aquatic plant growth. Most areas of dense growth are on the shallower, western basin where clear water allows the sunlight to reach the bottom in all areas. Expanding, dense growth of Eurasian water-milfoil has created an impact on the native plant community of Pine Lake and a nuisance to navigation in multiple locations. Dense EWM growth has been a recent concern compared to the history of Pine Lake and has become the main issue for recent management. These have been dealt with in the past by various management plans and studies, including the following:

- **Pine Lake Property Owners Association:** PLPOA officially founded to protect the lake, deal with management issues, enhance the water quality, fishery, and aesthetic values of Pine Lake for future generations. The association is extremely active throughout the year to protect and maintain the quality of the lake and surrounding community. Actions include annual boat landing monitoring through Clean Boats / Clean Waters, water quality and elevation monitoring, invasive species monitoring and control, and community involvement and fundraising projects.
- **Aquatic Plant Survey – 2001**: The first documented aquatic plant survey of the lake was conducted by the WDNR as a transect survey. All 13 species identified during this survey are still present today and included: muskgrass, multiple pondweed species, Eurasian water-milfoil, water celery, and other. Additional surveys completed in 2013 and 2020.
- **Aquatic Invasive Species Identified:** The first AIS was found growing in Pine Lake – Eurasian water-milfoil (2001). EWM has been found at dense levels in Pine Lake and required near annual control. Since discovery, the EWM in the lake has been confirmed to contain spots of hybrid Eurasian / northern water-milfoil (2015).
- **AIS Control Efforts:** After the discovery of EWM in 2001, control efforts were started right away. Initial efforts focused on near-annual treatment of smaller, spot areas totaling up to 4.0 acres and primarily with the use of the active ingredient 2,4-d. Recent control efforts by year include the following:
    - **2018 –** 4.0 acres spot treatments with 2,4-D
    - **2019 –** 4.2 acres of spot treatments with 2,4-D
    - **2020 –** no action
    - **2021 –** 0.6 acres of mechanical control with Diver Assisted Suction Harvesting (DASH)
    - **2021 –** late season bed mapping that found 11.76 acres of EWM
- **Pine Lake Management Plan - 2015:** A plan focused on targeted management of Pine Lake, including for aquatic plants and invasive species, was created with assistance

from the Center for Watershed Science and Education at the University of Wisconsin – Stevens Point, Waushara County, Golden Sands Resource Conservation & Development, Inc., WDNR, and the Association. This plan laid the groundwork for aquatic plant management.

Management actions carried out for aquatic plant growth within the lake have concentrated on invasive species control through targeted, herbicide spot applications and mechanical harvesting. After creation of a management plan and continued control actions were enacted, Issues with dense plant growth still persisted in Pine Lake, as evidenced by the concerns raised in the user questionnaire. Continued problems from an increasing population of Eurasian water-milfoil, both in size and density, drive the desire to continue plant management activities. This action requires an updated plan approved by the Wisconsin Department of Natural Resources (WDNR) and led to creation of this APM plan.

4.0 AQUATIC PLANTS

Aquatic plants are vital to the health of a water body. Unfortunately, they are often negatively referred to as "weeds". The misconceptions this type of attitude brings must be overcome in order to properly manage a lake ecosystem. Rooted aquatic plants are extremely important for the well-being of a lake community and possess many positive attributes. Despite their importance, they sometimes grow to nuisance levels that hamper recreational activities and are common in degraded ecosystems. The introduction of AIS, such as Eurasian water-milfoil, often can increase nuisance conditions, particularly when they successfully out-compete native vegetation and occupy large portions of a lake.

To assess the state of the current plant community, a full point-intercept survey was completed on August 11-12, 2020 by staff from Golden Sands Resource Conservation & Development, Inc. which followed all WDNR survey protocol. The survey included sampling at 537 pre-determined locations uniformly spaced 32 meters apart to document the following at each site:

- Individual species present and their density
- Water depth
- Bottom substrate

Each location was assigned coordinates and loaded into a GPS unit, which was used to navigate to each point. Data collected at each point was then entered into a WDNR spreadsheet, which outputs various aquatic plant community indexes and data, allowing for a comparison to past data to monitor changes over time. Information on methods and all referenced tables or charts is included in Appendix B. Figure 1 illustrates the location of all sample points within the gird.

Due to a noted expansion of EWM within the lake by the PLPOA, a targeted survey to more accurately map the EWM was completed on September 9, 2021. This survey uses a meander method throughout the entire lake to document the presence of AIS, primarily EWM. Each location was fully assessed with rake throws and visual observations to verity the presence and density of EWM. All EWM areas were recorded on a GPS for mapping.

4.1 2020 POINT INTERCEPT SURVEY

In 2020, the aquatic plant survey identified a diverse community, with scattered sections of dense submersed vegetation growth, primarily as low-laying muskgrass. In total, 16 species were identified; one of them being an AIS – Eurasian water-milfoil (Table 1). All remaining species identified are common of lakes in Wisconsin and included six different species of pondweeds, which are vital to fisheries habitat.

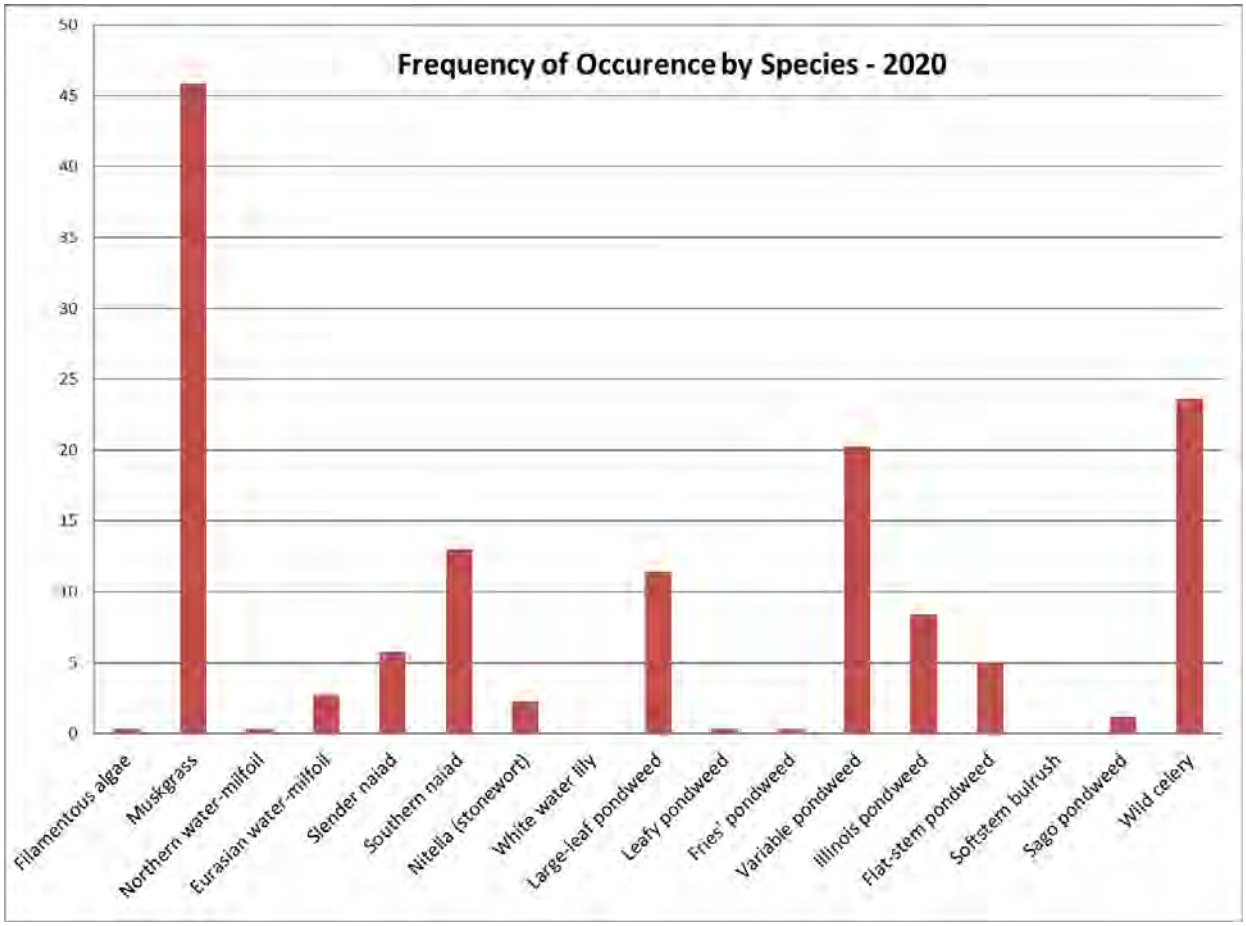
Table 1: Taxa Detected During 2020 Aquatic Plant Survey, Pine Lake, Waushara County, WI

Genus	Species	Common Name	Category
Algae	*sp.*	Filamentous algae	Algal
Chara	*sp.*	Muskgrass	Submersed
Myriophyllum	*sibiricum*	Northern water-milfoil	Submersed
Myriophyllum	***spicatum***	**Eurasian water-milfoil**	**Invasive**
Najas	*flexilis*	Slender naiad	Submersed
Najas	*guadalupensis*	Southern naiad	Submersed
Nitella	*sp.*	Nitella (stonewort)	Submersed
Nymphaea	*odorata*	White water lily	Floating-leaf
Potamogeton	*amplifolius*	Large-leaf pondweed	Submersed
Potamogeton	*foliosus*	Leafy pondweed	Submersed
Potamogeton	*friesii*	Fries' pondweed	Submersed
Potamogeton	*gramineus*	Variable pondweed	Submersed
Potamogeton	*illinoensis*	Illinois pondweed	Submersed
Potamogeton	*zosteriformis*	Flat-stem pondweed	Submersed
Schoenoplectus	*tabernaemontani*	Softstem bulrush	Emergent
Stuckenia	*pectinata*	Sago pondweed	Submersed
Vallisneria	*americana*	Wild celery	Submersed

Species sampled in Pine Lake were present in four categories: emergent, near shore species which are rooted below the water's surface with growth extending above the water (softstem bulrush – *Schoenoplectus tabernaemontani);* floating-leaf species, which are rooted on the lake bottom but with leaves that float on the water's surface *(*white water lily – *Nymphaea odorata);* algae species, which compromise a wide variety typically only identifiable to species through a microscope and primarily found as planktonic or filamentous algae; and submersed species which root on the lake bottom and remain below the water's surface (common waterweed – *Elodea canadensis*).

Table 2: 2020 Aquatic Plant Community Statistics, Pine Lake, Waushara County, WI

Aquatic Plant Community Statistics	2020
Total sites sampled	537
Total sites with vegetation	197
Total site shallower than max depth of plants	262
Frequency of occurrence at sites shallower than maximum depth of plants	75.19%
Simpson Diversity Index	0.82
Maximum Depth of Plants (Feet)	25
Taxonomic Richness (Number of Species - including visuals)	16
Average Total Rake Fullness	1.45
Average Number of Species per Site (sites less than max depth of plant growth)	1.4
Average Number of Species per Site (sites with vegetation)	1.87
Average Number of Native Species per Site (sites less than max depth of plant growth)	1.38
Average Number Native of Species per Site (sites with vegetation)	1.84



The photic zone, or area of the lake where light penetration is able to support plant growth, covered the entire western basin but only the fringe of the deeper, eastern basin. Plants were found growing to 25 feet deep. Plant growth was locally dense with 75% of this area vegetated and total rake fullness ratings of 2 or 3 common in the western basin (Figure 2). Much of the sediment was compromised of muck in deeper areas with sand in near-shore locations. A mixture of sand and organic rich muck sediment provides ideal conditions for aquatic plant growth with an excellent nutrient source and solid footing for roots to establish in.

Species richness was above average at 16 and exhibited good diversity per sample point, averaging 1.84 native species per vegetated site. A moderately even spread of aquatic plant species was found throughout the system, as exhibited by a Simpson Diversity Index (SDI) of 0.82. An SDI value closer to 1.0 indicates a healthier, more evenly spread plant community. Muskgrass (*Chara sp.*) was the most dominant species present. Muskgrass is common in many of the hardwater lakes in the central part of Wisconsin and commonly occupies a wide variety of depths. Table 4 displays frequency data by individual species. Figures 3-9 display the locations of the most common species and any AIS found during sampling.

Eurasian water-milfoil was the only AIS sampled during the 2020 survey. EWM was sampled at 7 locations, or 2.7% of photic-zone sample sites, and visually noted at another 5 sites (Figure 3). As an invasive species with aggressive growth tendencies, EWM spreads by growing from plant fragments, which can be hastened through increased boating traffic or mechanical harvesting.

4.2 2021 EURASIAN WATER-MILFOIL SURVEY

Though EWM has the potential to become an extreme nuisance and detriment to a lake's ecosystem, and has required past management in Pine Lake, the 2020 survey indicated EWM at only low frequencies. However, lake residents indicated that its growth had expanded considerably in 2021, requiring management. A mechanical harvesting permit was approved for EWM control with DASH in 2021.

Use of DASH was able to remove 621 cubic feet of EWM from the lake over the course of 40.6 hours of dive time during seven days on the water (Appendix E). Unfortunately, even after direct, targeted control efforts the EWM spread significantly. A follow-up survey was completed on September 9, 2021 to more effectively map the spread and density of EWM present.

Since the last large-scale management of for EWM there had been a significant regrowth. The 2021 survey identified EWM growing at various densities and distribution in the survey locations. The following densities were used to describe the EWM populations:

1. **Spots or Clumps** – small locations of individual plants or clumps that were not large enough to map around their perimeter.

2. **Scattered** – locations of E/HWM that had plants close enough to map as an area, but were still widely scattered. E/HWM is merely present and not a large component of the biomass.

3. **Dominant** – E/HWM identified in distinct beds. While individual plants or clumps may reach the surface, most are lower growing or not as dense. Often mixed with other vegetation.

4. **Moderately Dominant** – E/HWM occupies over half the water column with many plants or clumps at or just below the surface. Few other plant species found.

5. **Highly Dominant / Surface matted** – locations of E/HWM that were at or near the surface and occupied much of the water column. E/HWM may be the only plant found growing in these locations.

Overall, 11.76 acres of EWM were identified in 2021 (Figure 4). A majority of the EWM was located in the western basin and moderately dominant or higher. There were two larger beds of highly dominant populations that included areas of surface matting. Within the western basin the EWM was primarily found in shallow water, near-shore areas as narrow bands. Small, moderately dominant beds were found in deeper area where a break in bottom slopes allowed organic matter to accumulate. Populations of Eurasian water-milfoil undoubtedly exist outside the areas identified in 2021. A breakdown of the E/HWM present by density across Pine Lake is as follows:

Density	Acres
Dominant	3.83
Moderately Dominant	5.01
Highly Dominant/ Surface Matted	2.92
Total	**11.76**

4.3 FLORISTIC QUALITY INDEX

To compare changes in the plant community over time within Pine Lake and to similar lakes in Wisconsin, the floristic quality index (FQI) can be used. FQI provides the ability to compare aquatic plant communities based on species presence. This value varies throughout Wisconsin, ranging from 3.0 to 44.6, with a statewide average of 22.2. To achieve this, each plant species, except for AIS, is assigned a coefficient of conservatism value (C value). A plant's C value relates to a plant species' ability to tolerate disturbance. Low C values (0-3) indicate that a species is very tolerant of disturbance, while high C values (7-10) indicate species with a low tolerance of disturbance and are typically found in systems of higher water quality. Intermediate C values (4-6) indicate plant species that can tolerate moderate disturbance. The calculated FQI for Pine Lake from the 2020 plant survey is 24.01 with an average C value of 6.20 (Table 5).

Not only does FQI allow us to track changes over time within the lake, but allows for comparison of the Lake to lakes with similar environmental conditions within a delineated area, called an eco-region, to be compared. Pine Lake is located within the North Central Hardwoods Forests eco-region. Lakes within this region are typically natural lakes created by glaciation.

Pine Lake is found near the eastern border of the ecoregion within the Central Sand Ridges sub-region. Like Pine Lake, typical lakes within this area are primarily seepage lakes that formed in low areas between the ridges of deposits created by glaciation. Land use varies within the region from primarily forest to agricultural watersheds, with most lakes having at least moderate development along the shoreline.

Lakes within this eco-region have increased development around the shoreline and increased overall use. Both conditions lead to more disturbances from an expected natural condition, which leads to lower plant community metrics like FQI and coefficient of conservatism. Both of these are below the average for all Wisconsin lakes due to this.

Even after years of small-scale AIS management, AIS impacts, fluctuating water levels, and recreational use, Pine Lake displays a moderately high-quality plant community for the eco-region. Its average C value (6.20) and FQI (24.01) are near or in the upper quartile for the North Central Hardwoods Forest ecoregion. Pine Lake also ranks highly when compared to other lakes throughout the State as its FQI is also in the upper quartile (Table 6).

Table 6: FQI and Average Coefficient of Pine Lake Compared to Wisconsin and North Central Hardwood Forests Ecoregion.

	Average Coefficient of Conservatism			Floristic Quality			Number of Species		
Quartile*	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
Wisconsin Lakes	5.5	6	6.9	16.9	22.2	27.5	8	13	20
North Central Hardwood Forests	5.2	5.6	5.8	17	20.9	24.4	10	14	19
2013	**6.12**			**25.22**			**20**		
2020	**6.2**			**24.01**			**16**		

* - Values indicate highest value of the lowest quartile, mean, and lowest value of the upper quartile

Due to high shoreline development and recreational use for lakes within the region, many have a disturbed plant community. Mesotrophic/oligotrophic lakes like Pine Lake can be productive for both fisheries and aquatic plant growth, sometimes leading to denser areas of aquatic plant growth. This is true for Pine Lake and worsened by the presence of AIS. 16 native species were found during the 2020 survey with an average of 1.87 native species per sample point with vegetation present. Many sample points had more than this and up to five native species present. This native plant community is important should any AIS management be wanted. A healthy native plant population is already established and present to populate areas vacated by AIS due to potential management. Some lakes within the region with AIS growth lack a native plant community to do so.

4.4 HISTORICAL COMPARISON

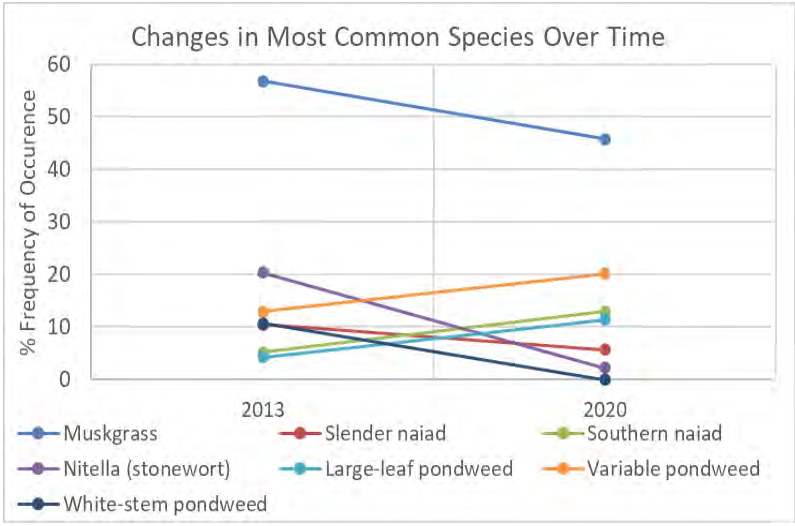
The aquatic plant community of Pine Lake has been sampled occasionally throughout its recent history. The last two surveys used the same point-intercept sampling method and provide a unique opportunity to gauge changes over the years. Aquatic plant sampling protocol recommended by WDNR are point-intercept surveys. These surveys are to be more repeatable between years. A full point-intercept survey was first completed in 2013 and repeated in 2020.

The relative plant community within the lake has fluctuated slightly over time in species composition while remaining stable overall. Species diversity, average coefficient of conservatism, and FQI all display the overall stability trend over time and are shown below for all metrics over time when comparing historical survey data (Tables 1 & 3-7).

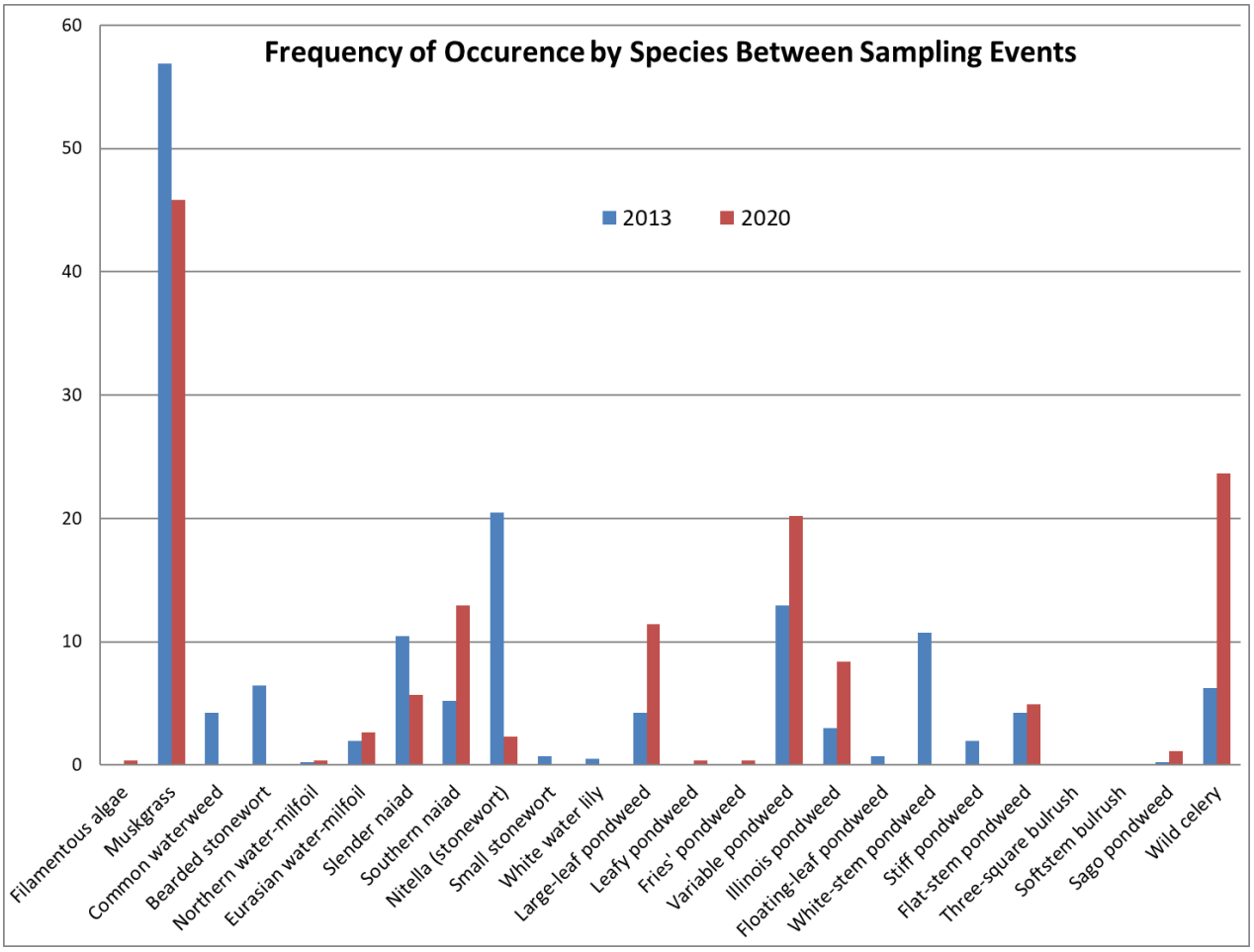
Table 7: Historical Aquatic Plant Community Statistics, Pine Lake, Waushara County, WI

	2013	2020
F.o.o. at sites shallower than maximum depth of plants	80.8	75.2
Simpson Diversity Index	0.82	0.82
Most Dominant Species	Muskgrass	Muskgrass
	Nitella	Water Celery
	Variable Pondweed	Variable Pondweed
	White-stem Pondweed	Southern Naiad
	Slender Naiad	Large-leaf Pondweed
Species Richness	20	16
Community FQI	25.22	24.01
Average Coeffecient of Conservatism	6.12	6.2

Over the most recent surveys (2013 & 2020) as shown above, the aquatic plant community has seen changes in overall species composition while maintaining many community metrics. Species sampled in prior surveys, but not identified in 2020 include common waterweed, bearded stonewort, small stonewort, floating-leaf pondweed, white-stem pondweed, stiff pondweed, and three-square bulrush. Both bearded stonewort and small stonewort are plant-like macroalgaes that look similar to nitella or muskgrass and are likely still present, but mis-categorized.



Conversely, the 2020 survey had four species sampled that were not noted in the past survey; filamentous algae, leafy pondweed, Fries' pondweed, and softstem bulrush. Composition of the plant community changes by year and the lack of finding species in 2020 that were present in past surveys and vice versa is not concerning, especially due to the healthy and diverse community found in Pine Lake. Many not found in 2020 were likely historically present in low frequencies and likely still present within the lake



Data comparison between years shows that the lake continually exhibits a dynamic and diverse aquatic plant community. Dominant species will vary year to year depending on many factors including weather patterns, community composition in year's prior, water levels and more. Some conditions may be favorable for certain species during one growing year but not others and vice versa. This is common and indicative of a healthy lake. Variance is normal and that noted within the lake is currently not a cause for concern.

To further assess changes between 2020 and the previous survey, statistical analysis was completed using a Chi-square test with a 5% Type-I error rate. This error rate is standard in ecological studies and equals that there is a 5% chance of claiming statistically significant change when no real change occurred. Only those species that display a p-value of 0.05 or lower changed significantly population-wise between years. To calculate these values, the total number of sample locations each species was found at is compared between years. Table 8 displays statistical changes, if any, for each species sampled in 2020 versus the 2013 survey.

Table 8: Statistical Significance of Species between Sampling Events, Pine Lake, Waushara Co. WI.

Species	2013 v 2020		
	P-value	Significance	+ / -
Filamentous algae	0.215685763	n.s.	+
Muskgrass	**0.001536964**	**	-
Common waterweed	**0.000507256**	***	-
Bearded stonewort	**2.61237E-05**	***	-
Northern water-milfoil	0.761362738	n.s.	+
Eurasian water-milfoil	0.206344672	n.s.	+
Slender naiad	**0.020343922**	*	-
Southern naiad	0.00069653	***	+
Nitella (stonewort)	**4.85005E-10**	***	-
Small stonewort	0.069632723	n.s.	-
White water lily	0.826192886	n.s.	-
Large-leaf pondweed	**0.000131161**	***	+
Leafy pondweed	0.215685763	n.s.	+
Fries' pondweed	0.215685763	n.s.	+
Variable pondweed	**0.019192537**	*	+
Illinois pondweed	**0.003737038**	**	+
Floating-leaf pondweed	**0.046704549**	*	-
White-stem pondweed	**1.32414E-08**	***	-
Stiff pondweed	**0.021438701**	*	-
Flat-stem pondweed	0.777892806	n.s.	+
Three-square bulrush	0.418560462	n.s.	-
Softstem bulrush	0.215685763	n.s.	+
Sago pondweed	0.17274899	n.s.	+
Wild celery	**9.20629E-10**	***	+

* - somewhat significant change, ** - moderatly significant change, *** - very significant change

n.s. - Change not significant

--- - Species was not sampled in both comparison years

In comparing 2013 and 2020 survey data statistically significant changes were noted in four species that increased and eight that decreased. Though the changes may be dynamic, they are not a cause of concern as a lake's plant community changes annually and there was a fair amount of time between surveys. Pine Lake reflects these changes, which should be viewed as natural as no significant lake management activities have taken place. It would be concerning, however, if there were a large group of significant declines without any increases.

AIS are an ever-increasing threat. Eurasian water-milfoil is the only AIS present and has remained stable according to the 2013 and 2020 point-intercept survey data. However, as noted by residents and described in section 4.2, the EWM within the lake is increasing significantly even when being actively managed. EWM spreads by fragmentation and boating through dense beds or missed fragments from mechanical harvesting often spread populations of EWM by increasing fragmentation.

5.0 AQUATIC PLANT MAINTENANCE ALTERNATIVES

Based on the goals of the stakeholders outlined above, several management alternatives are available for this APM plan. Some general alternatives are discussed below. More information on management alternatives are included in Appendix C. The following management alternatives are based on historical, aquatic plant management approaches and incorporate needs established by the questionnaire and recommendations of Wisconsin Lake & Pond Resource.

AQUATIC PLANT MAINTENANCE ALTERNATIVES

A combination of management alternatives may be used on a lake with a healthy native aquatic plant community with invasive or non-native plant species present. Maintenance alternatives tend to be more protection-oriented because no significant plant problems exist or the issues are at levels that are generally acceptable to lake user groups with no active manipulation required. These alternatives can include an educational plan to inform lake shore owners of the value of a natural shoreline and encourage the protection of the lake water quality and the native aquatic plant community.

AQUATIC INVASIVE SPECIES MONITORING

One AIS was identified within the Project Area during the 2020 full point-intercept survey. In order to monitor existing populations of current AIS and for new AIS in the future, a consistent and systematic monitoring program that conducts surveys for AIS is highly recommended. In some lake systems native aquatic plants "hold their own" and AIS never grow to nuisance levels; however, in others active management is required. The spread of AIS can be caused by several factors, including water quality.

It is recommended to complete pre- and post-treatment aquatic plant monitoring in any areas that are actively managed for AIS control to evaluate management effectiveness. Aquatic plant communities may undergo changes for a variety of reasons, including varying water levels, water clarity, nutrient levels and aquatic plant management actions. In general, lake-wide aquatic plant surveys are recommended every year to monitor changes in the overall aquatic plant community during large-scale treatments and then again, every 5 years once small scale, maintenance treatments take place to monitor the effects of the aquatic plant management activities.

In addition to invasive plants, excessive native plant growth combined with shallow water depths can cause navigational issues for lake users. These have historically been addressed through a harvesting program.

CLEAN BOATS/CLEAN WATERS CAMPAIGN

Prevention of the introduction of new AIS to the lake and spread of existing AIS from the lake was the top management priority indicated in the user survey responses. To prevent the spread of AIS from Pine Lake, a monitoring program such as Clean Boats/Clean Waters (CB/CW) is a good choice. This program is carried out by trained volunteers who inspect incoming and outgoing boats at launches. Boat landing signage also accompanies the use of CB/CW to inform lake users of proper identification of AIS and boat inspection procedures. Education of association members about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations.

CB/CW use on Pine Lake has been completed in past years. Continuing participation in this program is strongly encouraged, especially when considering the high amount of frequency of

EWM and recreational boat traffic, which increases chances for plant fragments to be picked up by boaters.

Scheduling volunteers for CB/CW landing inspection is often difficult due to time constraints for volunteers. The WDNR offers grant assistance through the Surface Waters program to pay for CB/CW landing inspectors. This establishes a set and known schedule for boat landing monitoring, offering added protection for the Lake. If acquiring CB/CW monitors becomes difficult for Pine Lake and the PLPOA it is recommended they apply through this grant to program to hire a dedicated monitor. This is often done in conjunction with County-wide AIS monitoring efforts.

AQUATIC PLANT PROTECTION AND SHORELINE MANAGEMENT

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

The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. This can be a potential issue within the lake, as Pine Lake has a large watershed with portions in agricultural use. Good candidates for shoreline restorations include areas that are mowed to the lake's edge, or that have structures directly adjacent to the lake edge. Establishing natural shoreline vegetation can sometimes be as easy as not mowing to the water's edge. Native plants can also be purchased from nurseries for restoration efforts. Shoreline restoration has the added benefits of providing wildlife habitat and erosion prevention. Or many times a simple "no mow" buffer strip 35'–50' back from the water's edge can provide effective and economical restoration for shoreline property owners. A vegetated buffer area can also prevent surface water runoff from roads, parking areas and lawns from carrying nutrients to the lake. Currently, much of the lake's shoreline is developed, providing potential avenues for increased impacts from runoff.

The second easy nutrient prevention effort is to use lawn fertilizers only when a soil test shows a lack of nutrients. Importantly, fertilizers containing phosphorus, though readily available to the consumer, are illegal for use in Wisconsin, unless a soil test shows a deficiency in phosphorus. The fertilizers commonly used for lawns and gardens have three major plant macronutrients: Nitrogen, Phosphorus and Potassium. These are summarized on the fertilizer package by three numbers. The middle number represents the amount of phosphorus. Since most Wisconsin lakes are "Phosphorus limited", meaning additions of phosphorus can cause increased aquatic plant or algae growth, preventing phosphorus from reaching the lake is a good practice. Local retailers and lawn care companies can provide soil test kits to determine a lawn's nutrient needs.

The Waushara County Land Conservation and Zoning department may be able to offer assistance with shoreline restoration projects, rain gardens and or additional shoreline protection. Interested landowners can contact the Land Conservation and Zoning department at 920-787-0453 to request additional information.

An additional option is the DNR Healthy Lakes grant program. This program provides initiative for lakeshore owners to improve their shoreline through simple and inexpensive best management practices. Deadline for application is February 1st with funding of up to $25,000 per group or $1,000 per individual on a 75% DNR / 25% applicant cost sharing. Further information can be obtained at: http:// http://healthylakeswi.com

PUBLIC EDUCATION AND INVOLVEMENT

The Association should continue to keep abreast of current AIS issues throughout the County and State. The County Land Conservation and Zoning department, WDNR Lakes Coordinator and the UW Extension are good sources of information. Many important materials can be ordered at the following website: http://www.uwsp.edu/cnr/uwexlakes/publications/

If the above hyperlink to web address becomes inactive, please contact WDNR for appropriate program and contact information.

MANUAL (HAND) REMOVAL

Native plants may be found at nuisance levels in scattered locales throughout the waterway. Manual removal efforts, including hand raking or hand pulling unwanted native plants (except wild rice in the northern region), is allowed under Wisconsin law to a maximum width of 30 feet (recreational zone) per riparian property. The intent is to provide pier, boatlift or swimming raft access in the recreation zone. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed this 30-foot recreation zone (manual removal of any native aquatic vegetation beyond the 30-foot area would require a permit from the WDNR that satisfies the requirements of Chapter NR 109, Wisconsin Administrative Code, see Appendix D). However, manual removal is not recommended because it could open a niche for non-native invasive aquatic plants to occupy. Removal of native plants also destroys habitat for fish and wildlife.

Manual removal of aquatic plants can be quite labor intensive and time consuming. This technique is well suited for small areas in shallow water. Hiring laborers to remove aquatic vegetation is an option, but also increases cost. SCUBA divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal by property owners include low cost compared to chemical control methods, quick containment of pioneering (new) populations of invasive aquatic plants and the ability for a property owner to slowly and consistently work on active management. The drawback of this alternative is that pulling aquatic plants includes the challenge of working in the water, especially deep water, the threat of letting fragments escape and colonize a new area, and the fact that control of any significant sized population is quite labor intensive, and therefore very costly; $1,500 - $2,000 per 5,000 square feet, or $10,000 - $20,000 acre depending on plant densities.

NUISANCE AQUATIC PLANT GROWTH CONTROL – MECHANICAL OR CHEMICAL

Aquatic plants may be mechanically harvested up to five feet below the water surface and one half the depth of the water column without disturbing or contacting the lake bed. Harvesting can be a practical and efficient means of controlling plant growth, as it generally removes the plant biomass from the lake. It can also be effective in controlling AIS such as curly-leaf pondweed if the plants are cut prior to the start of turion production. Harvesting can be an effective measure to control large-scale nuisance growth of aquatic plants.

The advantages of harvesting are that the harvester typically leaves enough plant material in the lake to provide shelter for fish and to stabilize the lake bottom. Navigation lanes cut by harvesting also allow predator fish, such as bass or pike, better ambush opportunities. Many times, prey like minnows or panfish, are able to hide in thick vegetation lacking predation and potentially causing stunting to the population due to too many prey individuals and not being thinned out by predators. The disadvantages of the harvesting are that it does cause fragmentation and may facilitate the spread of some plants, including EWM, and may disturb sediment in shallow water increasing water turbidity and suspended sediment issues. Another disadvantage is harvesters are limited in depths to which they can effectively operate; typically, it must be greater than 2' – 3' of water. Aquatic plant harvesting is subject to State permitting requirements which are renewable every 5 years.

In some areas of excessive plant growth, particularly in shallow water areas that can't be effectively managed using a harvester, contact herbicides can provide effective season long relief. Navigational channels 30' – 50' in width, as described in the section above, can be created using chemical herbicides. Since selectivity is not a concern for navigational treatment, contact herbicides such as diquat or more recently flumioxazin are used for submersed species. They are typically mixed with a copper-based algaecide for increased efficacy. For floating leaf species, an herbicide such as imazapyr is typically used with a surfactant or sticking agent. A combination of harvesting and treatment is sometimes a wise approach to compare length of control, costs and season long performance.

Mechanical harvesting requires significant infrastructure to complete, many times requiring the purchase of a harvester by the group and, unless already being completed, has significant startup costs.

6.0 AQUATIC PLANT MANAGEMENT ALTERNATIVES

6.1 AQUATIC INVASIVE SPECIES HERBICIDE TREATMENT

An aquatic herbicide treatment may be an appropriate way to treat larger areas of AIS and to conduct restoration of native plants. When using chemicals to control AIS, it is a good idea to reevaluate the lake's plant community and the extent of the AIS conditions before, during and after chemical treatment. The chosen herbicide may impact native plant communities including coontail, common waterweed, naiad species and others, especially during whole-lake applications and/or extended periods of herbicide exposure. The WDNR may require another aquatic plant survey and may require an AIS survey prior to approving a permit for treatment. Surveys should be included for all aquatic plant treatments and is typically a WDNR requirement.

The science regarding what chemicals are most effective, dosages, timing and how they should be applied is constantly evolving and being updated. Current WDNR and Army Corps of Engineer research has shown that herbicide applied to water diffuses off-site due to a variety of environmental and physical conditions including wind, waves, water depth, and treatment area relative to lake volume. Due to these actions, as treatment areas decrease, herbicide retention time needed for impact is lessened due to diffusion off-site because of the small amount of area treated and herbicide applied relative to the entire water volume. To combat this, it is recommended to apply at higher rates when compared to a whole-lake rate and typically with a granular herbicide with a combination of active ingredients in hopes to extend contact time.

Chemical treatment is usually a long-term commitment and requires a specific plan with a goal set for "tolerable" levels of the relevant AIS. One such landmark might be 10% or less of the littoral area being occupied by aquatic invasive plants. WDNR recommends conducting a whole-lake point-intercept survey on a five-year basis. Such a survey may reveal new AIS and at the very least would provide good trend data to see how the aquatic plant community is evolving.

Herbicides provide the opportunity for broader control over a larger area than hand pulling, and unlike harvesters, allow for a true restoration effort. Disadvantages include negative public perception of chemicals in natural lakes, the potential to affect non-target plant species (if not applied at an appropriate application rate and/or time of year), and the fact that water use restrictions may be necessary after application.

6.1.1 Curly-leaf Pondweed

Curly-leaf pondweed is the second most prevalent aquatic invasive plant species targeted for chemical treatment in the State. At present, endothall, a contact herbicide is the most common active ingredient in herbicides used for CLP management in Wisconsin. Imazamox has been used periodically in the last several years. Imazamox has shown promise in that it is a systemic herbicide for CLP control and can potentially have a much lower impact to the native plant community than a contact herbicide and appears to show increased year after treatment control than endothall. It is not entirely clear as to why this happens but it may be due to the systemic effect on turion production within the plants, resulting in fewer plants the following year.

Granular based formulations are generally more costly and used for smaller spot type treatments, while liquid formulations are less costly and generally used for larger contiguous treatment areas or whole-lake type treatments. In order to decrease any potential impact to native plants and be as selective as possible for CLP, treatments are completed in the spring when native plant growth is minimal, typically prior to 60˚ water temperatures, but perhaps most importantly prior to the start of turion production. CLP seems to prefer and flourish in mucky or highly flocculent substrate, which is found in most of Pine Lake's sediments. Given the lack locating populations of CLP during the most recent survey and large locations of appropriate substrate its presence was expected to have been more prevalent. Monitoring may be the best option for management.

6.1.2 Eurasian Water-milfoil

EWM is the most commonly managed AIS within Wisconsin lakes and the most prevalent within Pine Lake. EWM is an extremely opportunistic plant and could easily expand within Pine Lake. Should such an event take place, it is prudent to include potential management actions for EWM within this plan, to provide a quick and concise reference for management.

At present, 2,4-D has been the most common active ingredient for selective systemic herbicides used for EWM management in Wisconsin, although triclopyr use is increasing and has been commonly used in Minnesota for well over a decade. Granular based formulations are typically more costly and used for smaller spot type treatments, while liquid formulations tend to be less costly and used for larger contiguous treatment areas or whole-lake type treatments. In order to maximize effectiveness and decrease any potential impact to native plants to the greatest extent possible, treatments should be completed in the spring when native plant growth is minimal.

Current WDNR and Army Corps of Engineer research has shown that herbicide applied to water diffuses off-site due to a variety of environmental and physical conditions including wind, waves, water depth, and treatment area relative to lake volume. Due to these actions, as treatment areas decrease, herbicide retention time needed for impact is lessened due to diffusion off-site because of the small amount of area treated and herbicide applied relative to the entire water volume. To combat this, it is recommended to apply at higher rates when compared to a whole-lake rate and typically with a granular herbicide, a combination of active ingredients, or change of active ingredient in hopes to extend contact time. Recently, the active ingredient florpyrauxifen-benzyl has been approved for EWM and control. This active ingredient requires very limited contact time and has shown to offer excellent control with reduced non-target impacts in comparison to previously used modes of action.

If EWM abundance increases and requires active management within Pine Lake and smaller treatment areas (< 2.0 ac) are mapped, it is recommended to use florpyrauxifen-benzyl, a fast-

acting systemic herbicide, at appropriate rates of around 5-20 parts per billion (ppb). This approach has shown to be an effective management tool in various lakes throughout Wisconsin and is continuing to be researched for efficacy and long-term control. Unlike other active ingredients, such as fluridone, florpyrauxifen-benzyl can be successfully used at any scale, from 0.25 acres all the way up to whole-lake volume dosed applications.

It is worth noting there are various hybrid strains of EWM being genetically confirmed throughout the State and many of these are showing resistance to typical systemic herbicides. Research projects are currently underway, with the WDNR and herbicide manufacturers' testing various combination herbicides (systemic, such as 2,4-D & contact, such as endothall) at 1:2 or 1:3 ratio as well other modes of action like pigment bleaching herbicides (fluridone) in the field and lab that may be more effective on these strains of hybrid EWM, in particular on a whole-lake basis maintaining a 2-4 PPB residual for 90+ days.

Fluridone is also available in different pelletized slow-release formations that are designed to release off the carrier over extended periods of time; from several weeks to several months. These may be useful in a flowing water situation as the pellets can be placed upstream and the herbicide allowed to be carried downstream by the current as it is released off the pellet.

The size of the infestation tends to dictate the type of the treatment. Small treatment areas or beds less than 5 acres are many times consider spot treatments and usually targeted with granular type herbicides, or fast acting contact liquid herbicides. When there are multiple "spot" treatment areas within a lake, it most often makes more sense from economic and efficacy standpoints to target the "whole" lake for treatment. This typically entails calculating the entire volume of water within the lake, in acre/feet, and applying an herbicide at a low dose at a lake wide rate.

6.2 AQUATIC INVASIVE PLANT HARVESTING

MECHANICAL HARVESTING

Aquatic plants may be mechanically harvested up to five feet below the water surface or one half of the water column, whichever is less, and be a practical and efficient means of controlling plant growth as it generally removes the plant biomass from the lake. It can also be effective to control nuisance growth from AIS such as curly-leaf pondweed if the plants are.

Harvesting can also be used as a means to facilitate native aquatic plant growth by "top cutting" AIS growth that has canopied out. This is done by removing a canopy of AIS that shades out native, lower growing species, such as pondweed species. Use of a top cut only in areas of dense AIS growth, can provide additional sunlight for growth, increasing diversity and available fisheries habitat quality.

Diver Assisted Suction Harvesting (DASH) is another form of mechanical harvesting that can target populations of AIS. DASH uses divers in the water to hand pull the target species. Plant fragments are fed into a suction hose which transports them onto a nearby boat. Here, they are fed into a mesh bag to allow the material to dewater while removing the target AIS from the lake. This practice can be used to selective remove populations of AIS from individual stems mixed with native species or from denser, monotypic stands. A mechanical harvesting permit is required for DASH.

DASH can be a useful tool for pioneering, small populations of AIS. This technique is labor intensive and can be slowed by dense stands, poor visibility, and weather conditions. On a cost-per-unit basis DASH is considerably slower and more costly per acre compared to herbicide control. Use of DASH on well established beds may only offer nuisance reduction instead of AIS control.

MANUAL (HAND) REMOVAL

If a small isolated stand of AIS is present, hand pulling may be a viable option. No permit is required to remove non-native invasive aquatic vegetation as long as the removal is conducted completely by hand without mechanical assistance. All aquatic plant material must be removed from the water to minimize dispersion and re-germination of unwanted aquatic plants. Portions of the roots may remain in the sediments, so removal may need to be repeated periodically throughout the growing season. This can be a very effective control mechanism for EWM if the entire plant mass and root structure is completely removed. The drawback of this alternative is that pulling aquatic plants includes the challenge of working in the water, especially deep water, threat of letting fragments escape and colonize a new area, and control of any significant sized population is quite labor intensive and very costly. Hand harvesting costs using professionally contracted SCUBA divers are around $2,000 - $3,000 or more, per acre depending on plant densities.

7.0 OVERALL AQUATIC PLANT MANGEMENT GOALS

Pine Lake is a natural seepage lake with good water quality, a moderately healthy native aquatic plant community, and sees periods of high-intensity recreational use. A growing concern is the significant increase of EWM within the lake and its impact to the health and use of Pine Lake. Management actions recommended below are based on the findings of this APM plan and chosen to protect and enhance the conditions present:

- Users of the lake enjoy their time on the water with over 35.1 average years of experience, indicating a longevity that is important to generations of families and an increased importance on maintaining conditions for future generations (Section 2.0, pg. 2.1)

- Largely, the aquatic plant community of Pine Lake is of high quality with good diversity and includes 16 native species (Section 4.1, pg. 4.6, & Figures 5-9)

- Though of high diversity, AIS such as EWM can and do grow to nuisance levels, requiring active management through various methods since 2001 (Section 3.0, pg. 3.4)

- Aquatic invasive species are a constant threat to the quality of the lake and are present in growing rates, specifically EWM (Section 4.2, pg. 4.8, & Figures 3-4). Control of EWM should take on many facets. Additional information that is important to guide EWM control includes the following:

    - A hybrid between Eurasian and native, northern water-milfoil has been confirmed in some plants within the lake (SECTION
    - Past management with herbicides as used solely the active ingredient 2,4-D which may increase the resistance of remaining populations to its continued use (Section 3.0, pg. 3.4).
    - Targeted harvesting in 2021 did little to slow the spread of EWM within the lake (Section 4.2, pg. 4.9, Appendix E).
    - EWM currently covers 11.76 acres or more and up to highly dominant, surface-matted beds (Figure 4).

- A public user survey was conducted to gauge the perception of the lake and formulate aquatic plant management options that are not only viable for Pine Lake, but also desired by its users and able to be successful (Appendix A)

- Current management actions and high-intensity uses have shown to have minimal, if any, lasting negative impacts to the native aquatic plant over time (Section 4.4, pg. 4.10).

- Selected management actions below are the most accepted and recommended by lake users to achieve results (Appendix A).

Expansion of EWM in Pine Lake is creating a larger impact to the system and is currently at levels that may require large-scale management. Dense aquatic invasive plant growth from EWM only worsens biological and navigational issues throughout the lake and negatively impacted users of the lake 75% of the time, with 94.2% of users wanting management actions to reduce aquatic plant issues.

Only those options that will be supported by the users and Association with high likelihood of subsequent approval from the WDNR will be selected to help accomplish management goals. However, not all desired management options are viable or feasible for each situation. The user survey showed a strong desire by the public and lake users to actively control populations of Eurasian water-milfoil within Pine Lake.

A clear focus of the plan is to prevent the spread of AIS into or out of Pine Lake while reducing the extent and density of AIS (EWM) already established. Management planning will follow Integrated Pest Management (IPM) with an approach that provides a variety of control actions, active ingredients, and monitoring to gauge results. All options are disused further in Appendix C. Based on the above, the following recommended action plan includes a combination of management actions to achieve desired results.

The size of the infestation tends to dictate the type of the treatment. Small treatment areas or beds less than 5 acres are many times consider spot treatments and usually targeted with fast acting ingredients. When there are multiple "spot" treatment areas within a lake, it often makes more sense from economic and efficacy standpoints to target the "whole" lake for treatment.

This typically entails calculating the entire volume of water within the lake, in acre/feet, and applying a liquid herbicide, such as 2,4-D, at a low dose, lake-wide rate. Current WDNR and Army Corps of Engineer research has shown that herbicide applied to water diffuses off-site due to a variety of environmental and physical conditions including wind, waves, water depth, and treatment area relative to lake volume. Due to these actions, as treatment areas decrease, herbicide retention time needed for impact is lessened due to diffusion off-site because of the small amount of area treated and herbicide applied relative to the entire water volume. To combat this, it is recommended to apply at higher rates when compared to a whole-lake rate or with a combination of active ingredients in hopes to extend contact time.

Goal: Manage AIS to improve recreation, increase use opportunities, and maintain native plants by reducing AIS abundance and frequency within the littoral zone. For Pine Lake, the littoral zone extends to an approximate depth of 25-ft and covers 87.4 acres. Only the deep basin of the eastern half of the lake is outside the littoral zone. If active AIS management is pursued, the goal should be to maintain the presence of the target species over a 3–5-year period at the following levels:

- 1 year after control: Less than 2.5% of the littoral zone (2.2 acres)
- 2-3 years after control: Less than 5% of the littoral zone (4.4 acres)
- 4-5 years after control: Less than 7.5% of the littoral zone (6.6 acres)

The following levels of AIS should be used to trigger active management of the target species, primarily EWM:

- 2.5 – 7.5% coverage of the littoral zone for small scale, spot treatment or control

Or

- Greater than 7.5% coverage of the littoral zone for large-scale control at up to whole-lake approaches

Primary Action: Continue monitoring for and mapping of AIS.

Primary Action: If populations of AIS exceed the above listed triggers pursue active management.

***Small-Scale control Action*:** Small-scale EWM control to follow-up whole-lake efforts and maintain low populations of EWM may be a necessary step to ensure the health of the lake. This may include a variety approaches and control methods based on the dominance and size of small-scale EWM control areas.

- EWM areas less than 0.25 acres
    - Monitoring only through annual surveys
    - Hand pulling by shoreline residents
    - Diver Assisted Suction Harvesting (DASH) for small, dominant stands

- EWM areas 0.25 – 0.50 acres
    - Monitoring only through annual surveys
    - Hand pulling by shoreline residents
    - DASH for stands up to moderate dominance
    - Fast-acting, selective chemical control for stands of moderate dominance or more.
        - The active ingredients florpyrauxifen-benzyl, diquat, endothall, and/or flumioxazin may be used at appropriate label rates

- EWM areas greater than 0.5 acres
    - Fast-acting, selective chemical control for stands of any density
        - The active ingredients florpyrauxifen-benzyl, diquat, endothall, and/or flumioxazin may be used at appropriate label rates

***Large Scale Control Action*:** Targeted, whole-lake based control efforts. This may include a variety of active ingredients and be dosed at up to whole-lake volume rates.

- If possible, control should be completed to time application to early/mid spring when plants are young

- Application may be completed using a variety of active ingredients and rates. Some recommended active ingredients and application rates are as follows:

    - Active ingredient 2,4-D at 0.25-0.40 PPM and active ingredient endothall at 0.6-0.80 PPM at whole-lake volume rates. Due to past use of 2,4-D within Pine Lake, the EWM present is likely tolerant to 2,4-D. Use of this method is likely to see shorter-lasting results than options below.

    - Active ingredient fluridone at 4-16 PPB whole-lake volume rates with follow-up "bump" applications to maintain 6 PPB in water for 120+ days. Target rates may be reduced by product uptake, loss through water flow out of the lake, and loss through natural degradation. Residual sampling of in-water concentrations should be completed approximately every 21 days after the initial application to properly dose and time "bump" applications.

    - Active ingredient florpyrauxifen-benzyl dosed at 5 - 11 PPB within areas of direct application only. Due to the fast-acting nature of florpyrauxifen-benzyl, applications do not need to take into account the entire lake's volume for dosing.

- An aquatic invasive species assessment survey should be completed 1-year prior to assess conditions and verify they exceed management triggers above. In addition, the survey should be repeated 1-year post control activities to gauge results. The assessment survey may be completed as a whole-lake point intercept survey or targeted AIS meander survey. Bed locations and dominance should be mapped to accurately assess conditions.

Goal: Obtain financial assistance for AIS management activities.

Primary Action: Apply for an AIS Established Population Control Grant through the WDNR's Surface Water Grant program for large-scale AIS control projects. The deadline for application is February 1 and can fund up to 75% of eligible project costs.

Goal: Enhance monitoring within Pine Lake through the WDNR Citizen Lake Monitoring Network and support CB/CW efforts.

Primary Action: Begin monitoring for water quality through secchi readings, chlorophyll-a, and total phosphorus. Samples should be taken once monthly between May – September or at least 3 times a year spaced 30 days apart, or at a bare minimum once a year mid-summer.

Primary Action: Continue participation in the Clean Boats / Clean Waters program and commit to a minimum of 100 hours of monitoring per year

There are multiple resources and organizations able to help achieve plan goals and related actions. Contacts for those referenced in the plan and additional groups are included as follows.

Golden Sands Resource Conservation and Development Council, Inc.
1100 Main Street Suite 150
Stevens Point, WI 55481
(715) 343-6215
info@goldensandsrcd.org

Wisconsin Department of Natural Resources
Ted Johnson – Water Resources Management Specialist - Senior
(920) 424-2104
TedM.Johnson@wisconsin.gov

Waushara County Land Conservation and Zoning
Ed Hernandez – Deputy Director – Land Conservation
(920) 787-0453 ext 472
Ed.Hernandez@co.waushara.wi.us

University of Wisconsin – Extension Lakes
(715) 346-2116
uwexlakes@uwsp.edu

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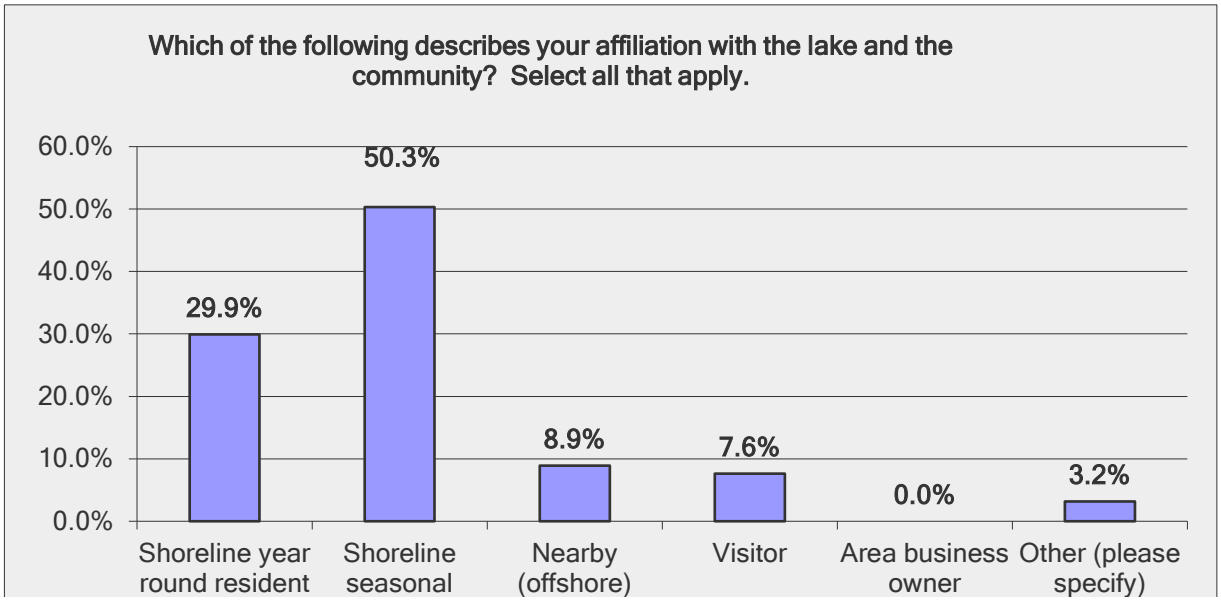
APPENDIX A – PUBLIC SURVEY RESULTS

Which of the following describes your affiliation with the lake and the community? Select all that apply.

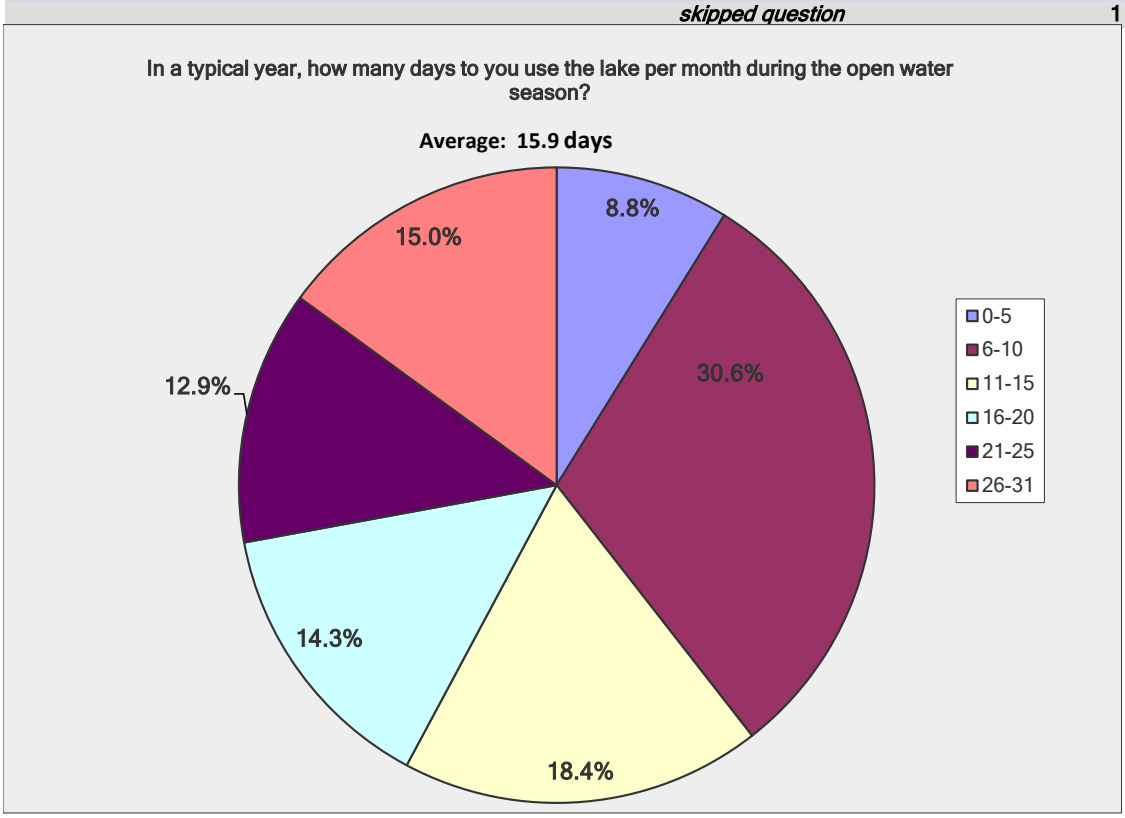
Answer Options	Response Percent	Response Count
Shoreline year round resident	29.9%	47
Shoreline seasonal resident	50.3%	79
Nearby (offshore) resident	8.9%	14
Visitor	7.6%	12
Area business owner	0.0%	0
Other (please specify)	3.2%	5
	answered question	157
	skipped question	0

Other (please specify)

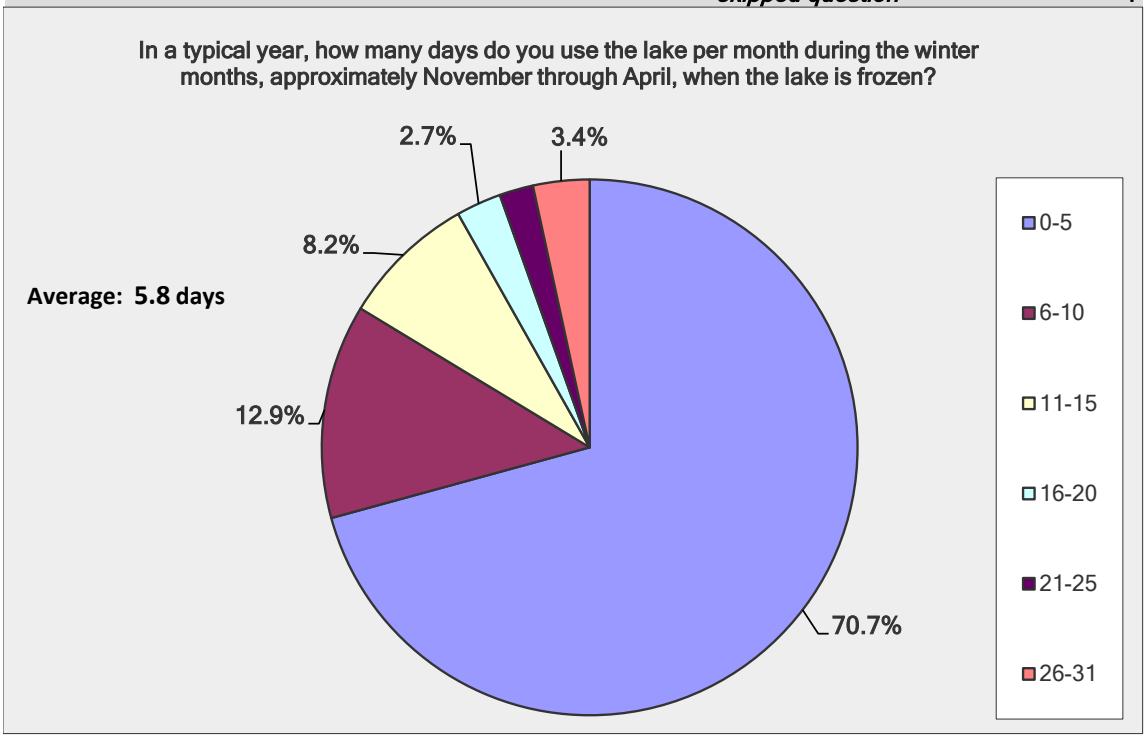
Property owner
N7071 E. Pine Lake Lane
Former resident
Parents own property on the lake
My parents are the shoreline property owner



In a typical year, how many days do you use the lake per month during the open water months, approximately May through October		
Answer Options	**Response Percent**	**Response Count**
0	0.0%	0
1	1.4%	2
2	2.7%	4
3	0.7%	1
4	2.7%	4
5	1.4%	2
6	6.8%	10
7	2.7%	4
8	4.1%	6
9	0.0%	0
10	17.0%	25
11	0.7%	1
12	4.1%	6
13	2.0%	3
14	2.7%	4
15	8.8%	13
16	0.7%	1
17	2.7%	4
18	1.4%	2
19	0.0%	0
20	9.5%	14
21	0.0%	0
22	0.0%	0
23	0.0%	0
24	1.4%	2
25	11.6%	17
26	0.0%	0
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	15.0%	22
31	0.0%	0
	answered question	**147**
	skipped question	**1**

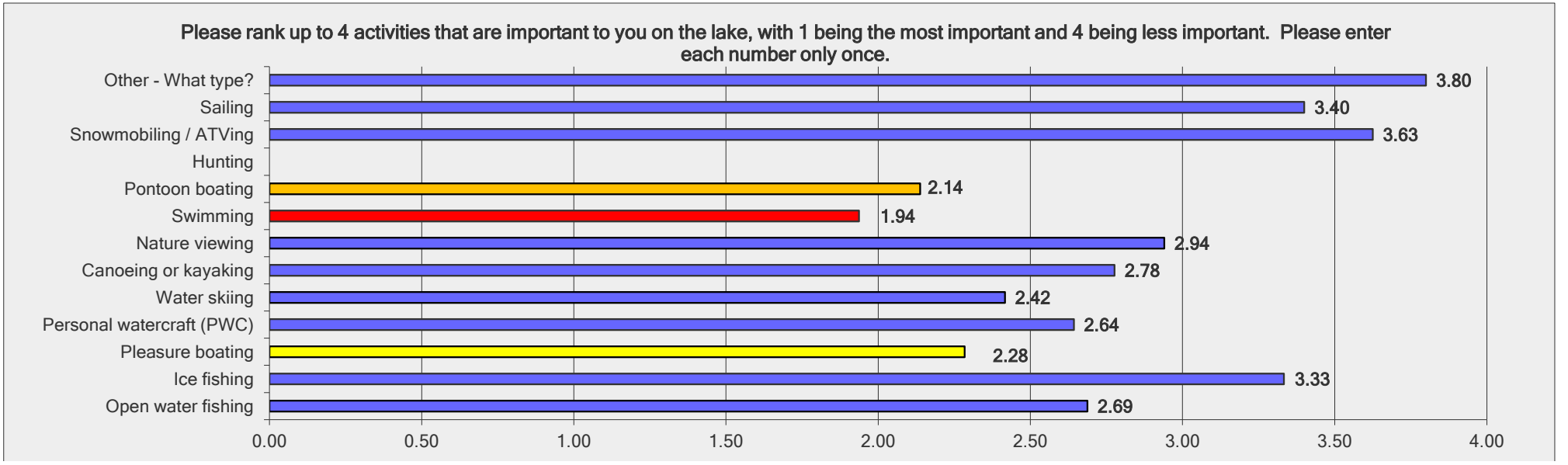


In a typical year, how many days do you use the lake per month during the winter months when the lake is frozen, approximately November through April?		
Answer Options	Response Percent	Response Count
0	25.2%	37
1	5.4%	8
2	9.5%	14
3	10.2%	15
4	10.9%	16
5	9.5%	14
6	1.4%	2
7	1.4%	2
8	1.4%	2
9	0.0%	0
10	8.8%	13
11	0.0%	0
12	2.0%	3
13	0.7%	1
14	0.7%	1
15	4.8%	7
16	0.0%	0
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	2.7%	4
21	0.0%	0
22	0.0%	0
23	0.0%	0
24	0.7%	1
25	1.4%	2
26	0.0%	0
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	3.4%	5
31	0.0%	0
	answered question	147
	skipped question	1



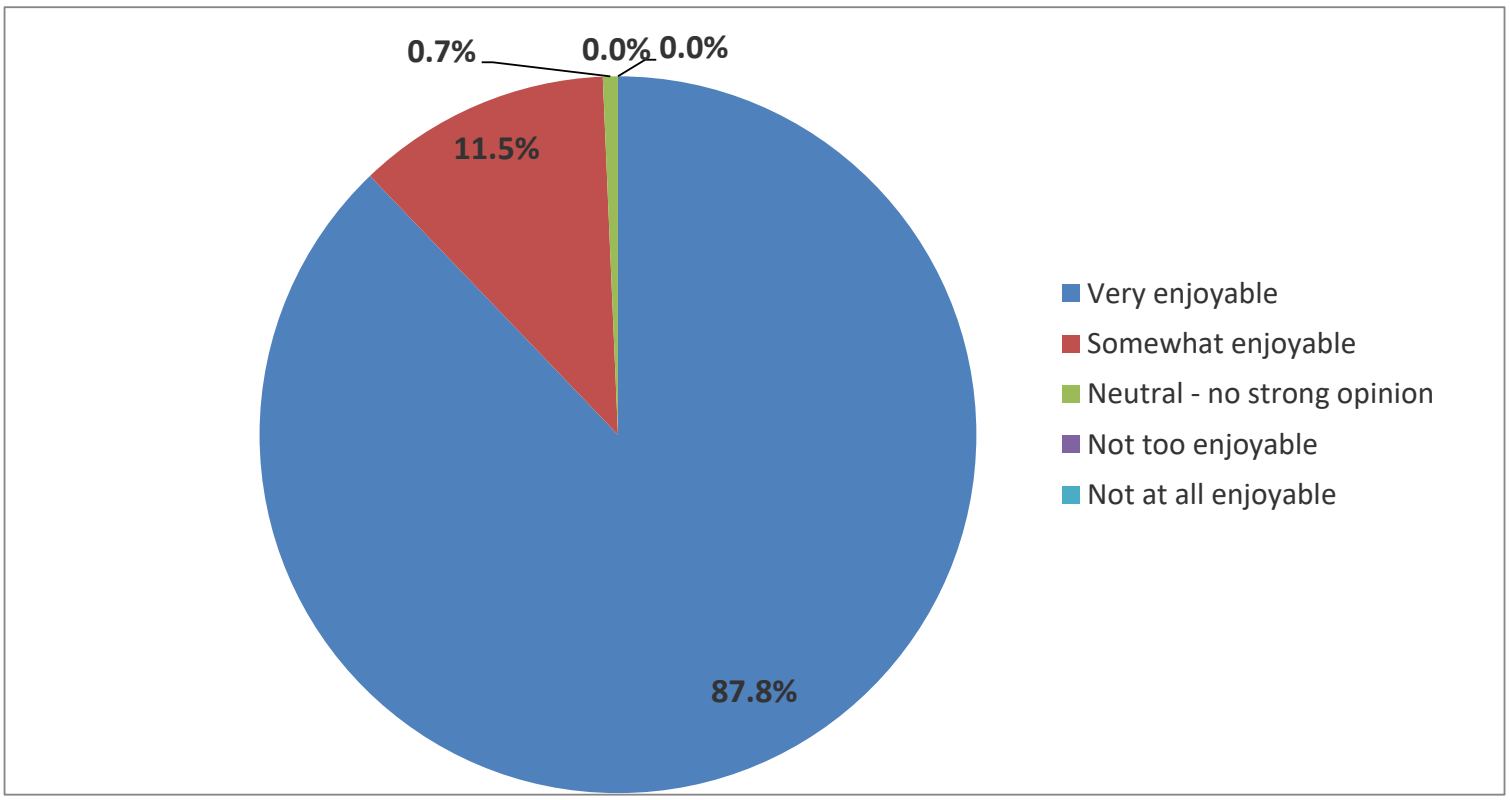
Please rank up to 4 activities that are important to you on the lake, with 1 being most important and 4 being less important. Please enter each number only once.

Answer Options	1	2	3	4	Rating Average	Response Count
Open water fishing	13	24	18	25	2.69	80
Ice fishing	1	4	7	15	3.33	27
Pleasure boating	31	19	20	18	2.28	88
Personal watercraft (PWC)	1	6	4	3	2.64	14
Water skiing	7	5	7	5	2.42	24
Canoeing or kayaking	11	29	24	30	2.78	94
Nature viewing	7	7	18	18	2.94	50
Swimming	52	24	25	10	1.94	111
Pontoon boating	17	22	13	6	2.14	58
Hunting	0	0	0	0	0.00	0
Snowmobiling / ATVing	0	1	1	6	3.63	8
Sailing	0	0	3	2	3.40	5
Other - What type?	0	0	1	4	3.80	5
Other (please specify)	Tubing, safe swimming and boating, all activities, snow shoeing & cross-country skiing					
					answered question	140
					skipped question	8



Overall, how would you rate the enjoyment of your experiences on Pine Lake?

Answer Options	Very enjoyable	Somewhat enjoyable	Neutral - no strong opinion	Not too enjoyable	Not at all enjoyable	Rating Average	Response Count
	130 87.8%	17 11.5%	1 0.7%	0 0.0%	0 0.0%	1.13	148
						answered question	148
						skipped question	0

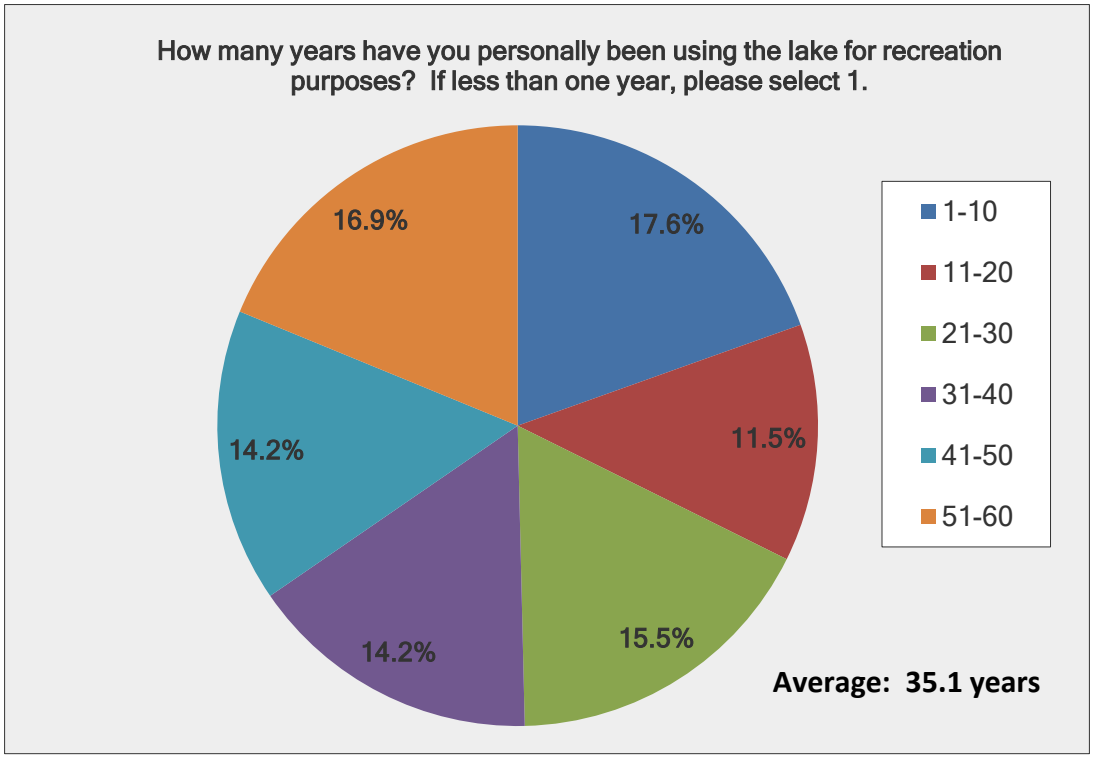


How many years have you personally been using the lake for recreation purposes? If less than one year, please select 1.

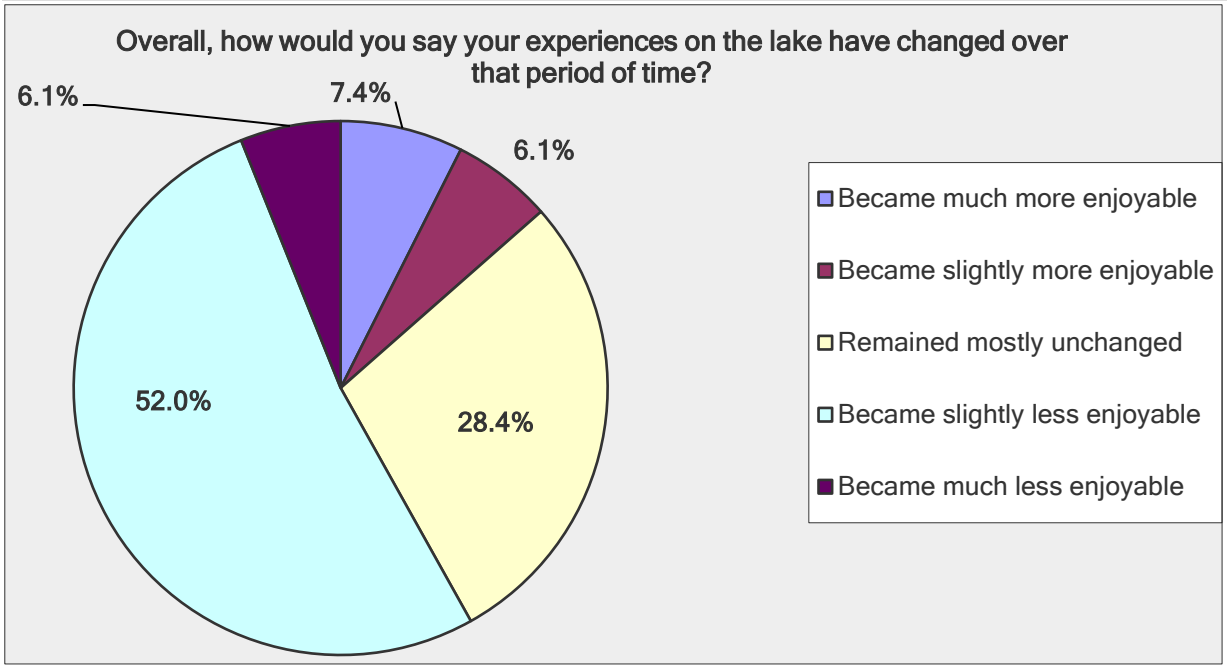
Answer Options	Response Percent	Response Count
1	2.7%	4
2	3.4%	5
3	3.4%	5
4	2.7%	4
5	2.0%	3
6	2.0%	3
7	0.0%	0
8	0.7%	1
9	0.0%	0
10	0.7%	1
11	0.7%	1
12	1.4%	2
13	1.4%	2
14	0.7%	1
15	2.7%	4
16	0.7%	1
17	2.0%	3
18	0.0%	0
19	0.0%	0
20	2.0%	3
21	0.0%	0
22	1.4%	2
23	0.0%	0
24	0.7%	1
25	4.7%	7
26	1.4%	2
27	0.0%	0
28	0.7%	1
29	1.4%	2
30	5.4%	8
31	0.0%	0
32	1.4%	2
33	1.4%	2
34	0.0%	0
35	3.4%	5
36	0.7%	1
37	2.0%	3
38	1.4%	2
39	2.0%	3
40	2.0%	3
41	2.0%	3
42	2.0%	3
43	0.0%	0
44	0.0%	0
45	2.0%	3
46	0.0%	0
47	0.7%	1
48	1.4%	2
49	1.4%	2

How many years have you personally been using the lake for recreation purposes? If less than one year, please select 1.		
50	4.7%	7
51	0.0%	0
52	0.7%	1
53	2.0%	3
54	2.7%	4
55	3.4%	5
56	0.7%	1
57	2.0%	3
58	2.7%	4
59	0.0%	0
60	2.7%	4
61	1.4%	2
62	0.7%	1
63	0.0%	0
64	0.7%	1
65	0.0%	0
66	0.0%	0
67	0.0%	0
68	0.0%	0
69	0.7%	1
70	2.0%	3
71	0.0%	0
72	0.0%	0
73	0.0%	0
74	0.7%	1
75	1.4%	2
76	0.7%	1
77	0.7%	1
78	0.0%	0
79	0.0%	0
80	0.7%	1
81	0.0%	0
82	0.0%	0
83	0.0%	0
84	0.0%	0
85	0.0%	0
86	0.0%	0
87	0.7%	1
88	0.0%	0
89	0.0%	0
90	0.0%	0
91	0.0%	0
92	0.0%	0
93	0.0%	0
94	0.0%	0
95	0.0%	0
96	0.0%	0
97	0.0%	0
98	0.0%	0
99	0.0%	0
100	0.0%	0
	answered question	148
	skipped question	0

How many years have you personally been using the lake for recreation purposes? If less than one year, please select 1.



Overall, how would you say your experiences on the lake have changed over that period of time?		
Answer Options	**Response Percent**	**Response Count**
Became much more enjoyable	7.4%	11
Became slightly more enjoyable	6.1%	9
Remained mostly unchanged	28.4%	42
Became slightly less enjoyable	52.0%	77
Became much less enjoyable	6.1%	9
	answered question	148
	skipped question	0

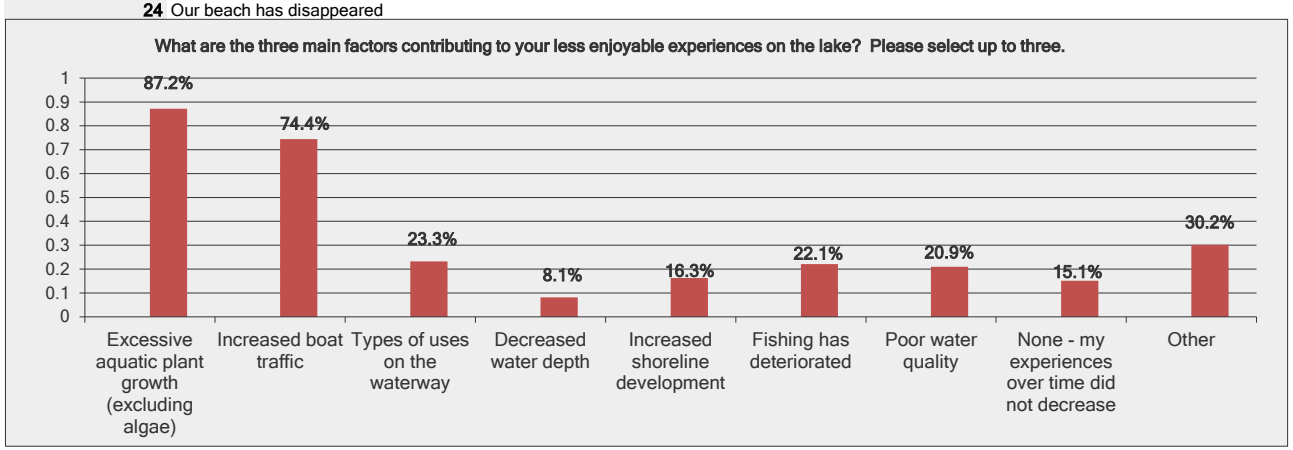


If your experience using the lake over time has become less enjoyable what do you consider the three main factors contributing to your less enjoyable experiences on the lake? Please select up to three.

Answer Options	Response Percent	Response Count
Excessive aquatic plant growth (excluding algae)	87.2%	75
Increased boat traffic	74.4%	64
Types of uses on the waterway	23.3%	20
Decreased water depth	8.1%	7
Increased shoreline development	16.3%	14
Fishing has deteriorated	22.1%	19
Poor water quality	20.9%	18
None - my experiences over time did not decrease	15.1%	13
Other	30.2%	26
	answered question	86
	skipped question	62

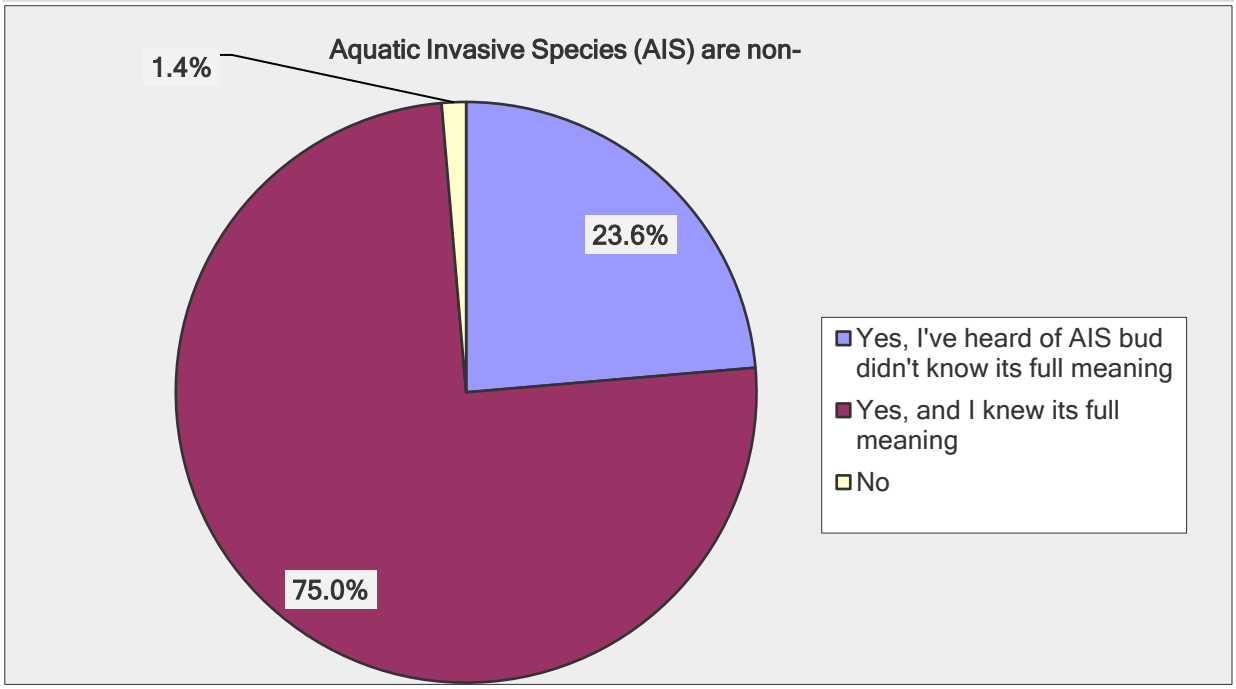
Other (please specify)

1	Increased water depth
2	Wake surfing
3	Now wake water levels
4	Boaters getting to close to dock/shore and causing large waves
5	Excessivley high water
6	Increase water levels reducing shoreline
7	Increased water depth
8	Muskrats
9	power boat traffic interfering with sailing
10	DOGS - TOO NOISY, INVASIVE AND PLENTIFUL
11	lake was closed for boating due to high water
12	Wake boats that are too large causing erosion, jet skis not always following boating rules, excessive milfoil
13	Excessive shoreline lighting at night limits stargazing
14	High water / no wake
15	ceratin fishing species have decreased a lot
16	swimmer itch, due to lack water movement during no wake order
17	increased water depth
18	loss of sandy beach
19	high water
20	high water
21	Boatind restrictions, the unauthorized buoy blocking the point, jet boats that are too big for our lake
22	Increased water table
23	Too many regulations
24	Our beach has disappeared

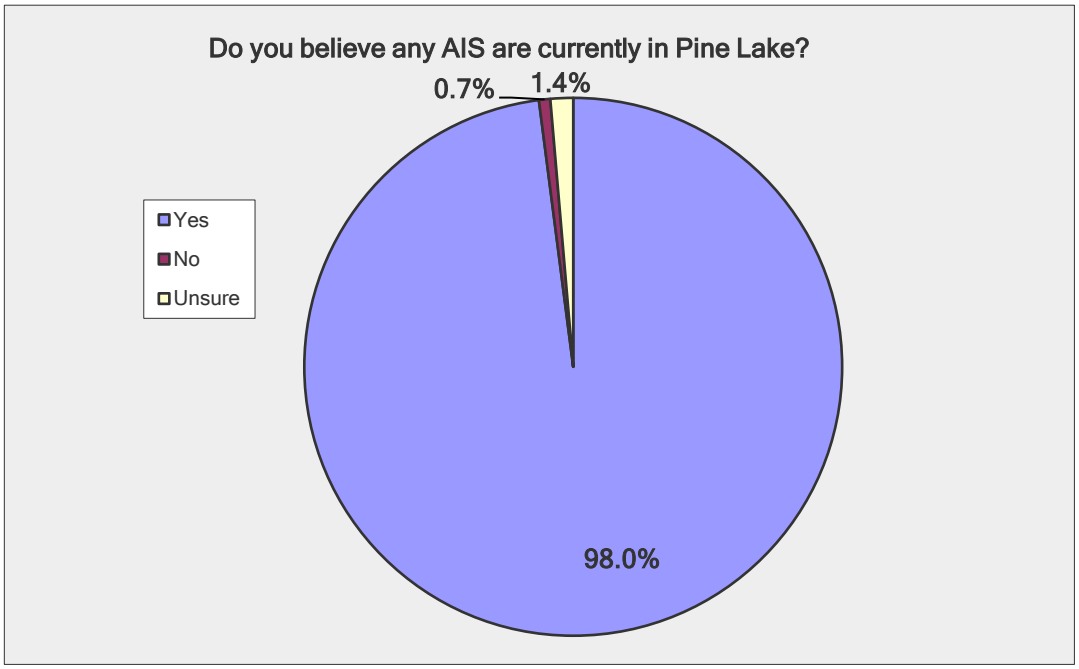


Aquatic Invasive Species (AIS) are non-native plants or animals that can out-compete their native counterparts and can potentially cause many problems within the lake and/or an ecosystem. Prior to this survey, have you heard the term Aquatic Invasive Species or AIS and did you know what it meant?

Answer Options	Response Percent	Response Count
Yes, I've heard of AIS bud didn't know its full meaning	23.6%	35
Yes, and I knew its full meaning	75.0%	111
No	1.4%	2
	answered question	148
	skipped question	0

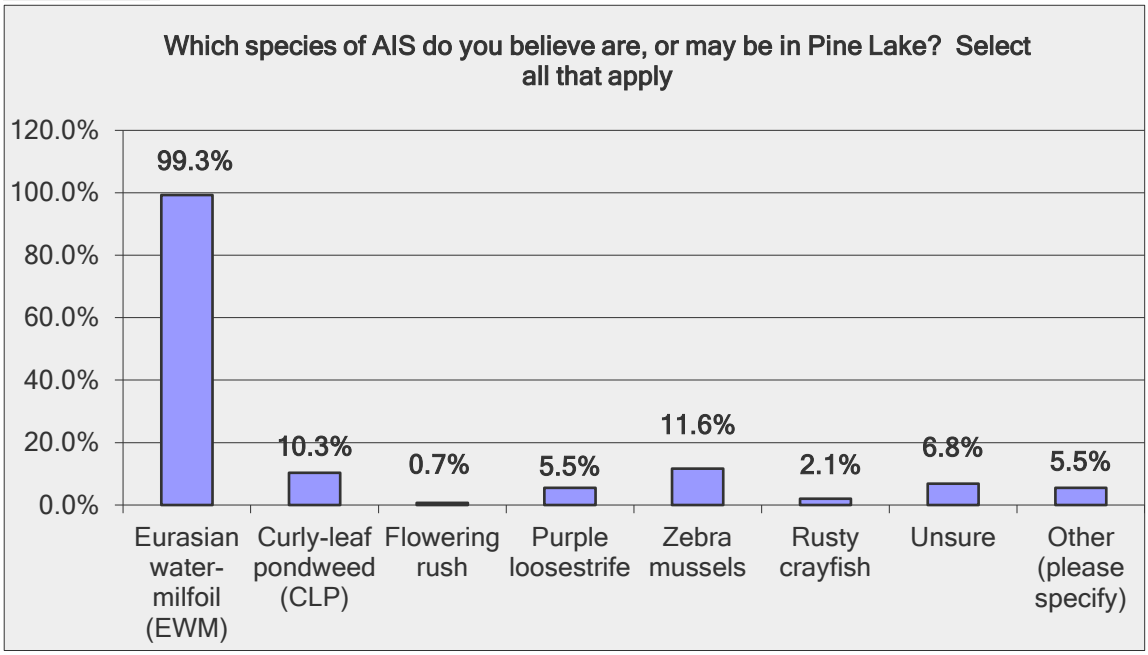


Do you believe any AIS are currently in Pine Lake?		
Answer Options	**Response Percent**	**Response Count**
Yes	98.0%	144
No	0.7%	1
Unsure	1.4%	2
	answered question	**147**
	skipped question	**1**



Which species of AIS do you believe are, or may be in Pine Lake? Select all that apply		
Answer Options	**Response Percent**	**Response Count**
Eurasian water-milfoil (EWM)	99.3%	145
Curly-leaf pondweed (CLP)	10.3%	15
Flowering rush	0.7%	1
Purple loosestrife	5.5%	8
Zebra mussels	11.6%	17
Rusty crayfish	2.1%	3
Unsure	6.8%	10
Other (please specify)	5.5%	8
	answered question	146
	skipped question	1

Other (please specify)	
1	Phragmites
2	Muskrats
3	Banded mistery snail
4	Not sure what else there seems to be more over the years
5	phragmites
6	muskrats!!
7	muskrats

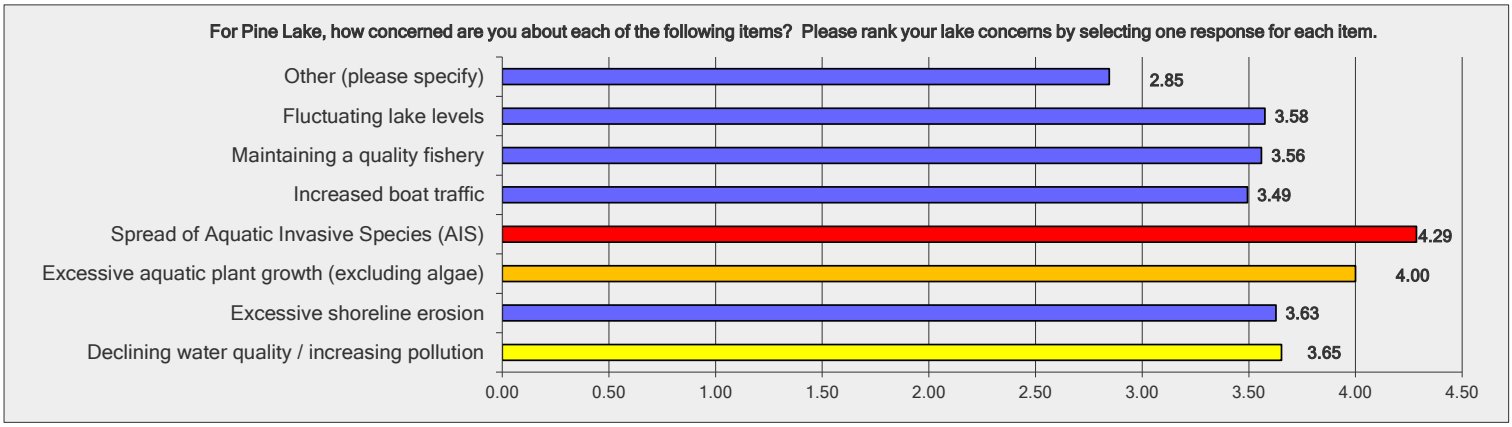


For Pine Lake, how concerned are you about each of the following items? Please rank your lake concerns by circling one response for each item.

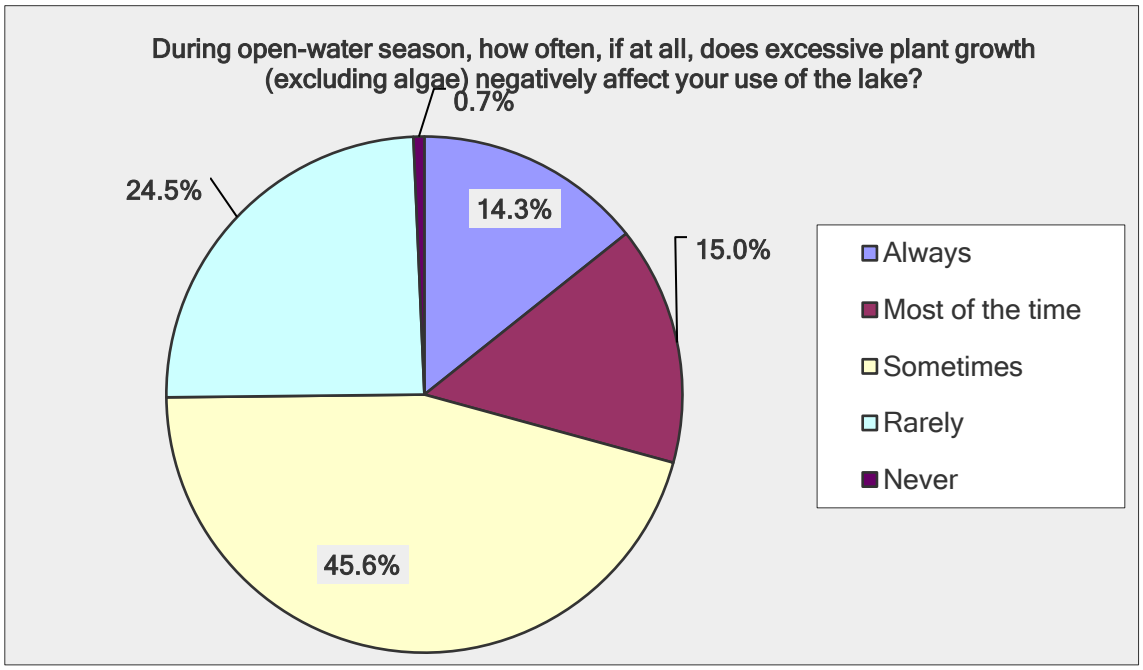
Answer Options	Very Unconcerned	Somewhat Unconcerned	Neutral	Somewhat Concerned	Very Concerned	Unsure - need more information	Rating Average	Response Count
Declining water quality / increasing pollution	12	17	24	51	43	1	3.65	148
Excessive shoreline erosion	14	20	20	43	48	3	3.63	148
Excessive aquatic plant growth (excluding algae)	16	7	13	35	75	2	4.00	148
Spread of Aquatic Invasive Species (AIS)	18	4	3	15	107	1	4.29	148
Increased boat traffic	20	10	37	39	42	0	3.49	148
Maintaining a quality fishery	12	13	39	41	38	4	3.56	147
Fluctuating lake levels	12	23	26	39	46	2	3.58	148
Other (please specify)	22	1	56	6	12	47	2.85	144
							answered question	148
							skipped question	0

Other (please specify)

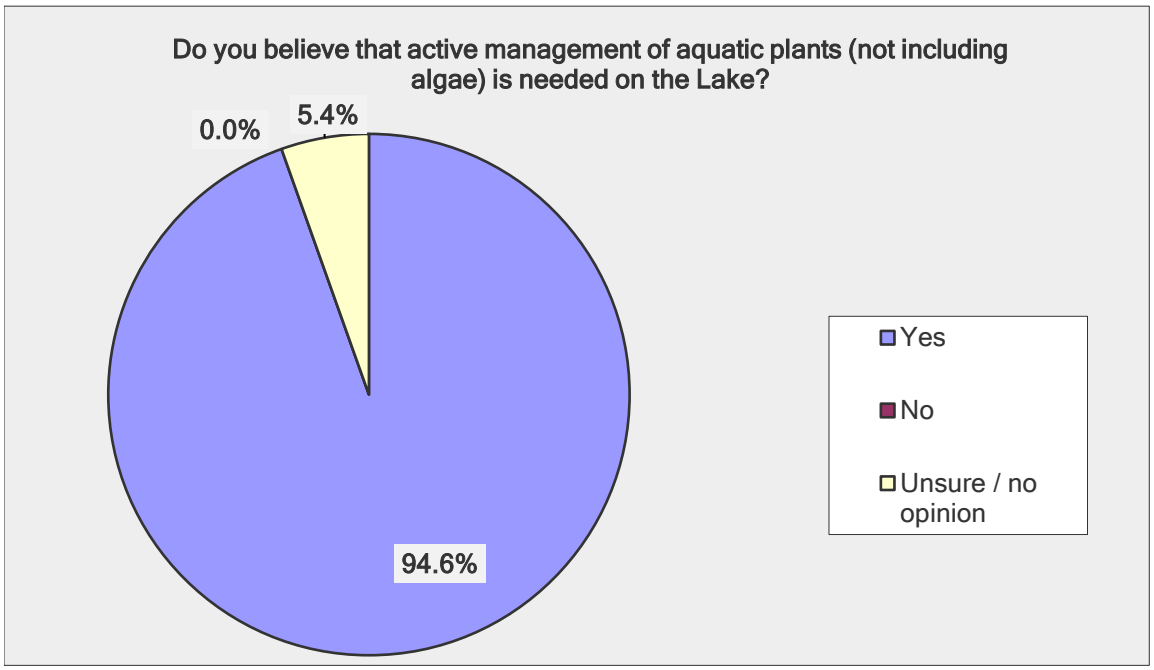
1. nothing
2. Very concerned about Eurasian milfoil.
3. Excessive weed growth is adding to dangerous swimming conditions for our children. The weeds are also getting wrapped around boat propellers and sucked up into inboard motors this I turn can potentially cause costly repairs this intu
4. Wake boats and their shoreline impact
5. Safety concerns-Large speed boats & deep bottom surfing boats. Creates shoreline erosion.
6. High water levels. And someone narrowing the public access to the lake so that snowmobiles can't fit through. I know who it is!
7. We're concerned about the lake in general. Our home is an LLC yo be passed down to nieces/nephews & their kids. Friends on Long Lake (Waushara Co.) Left Long Lake due to the same reasons you list here. We want to preserve Pine Lake for future generations.
8. I'm concerned why the boat landing remains flooded.
9. nothing.
10. Disregard of fisherman and their rights vs. boaters speed
11. Needed to check to continue
12. Boaters, etc following the DNR boating rules
13. none
14. The muck on the small side
15. Large wake boats causing lake and property damage
16. wake boarding behind boats
17. longevity
18. no lake supervision of jet skis by DNR
19. I have zero faith in the dnr
20. No need for other info.
21. PET CONTROL
22. Boat launch has been underwater for the last few years.
23. It seems like the lake gets excessively fished. I recommend a fee at the landing to help with AIS costs.
24. Jet ski rules not always followed
25. Irresponsible boat and PWC drivers
26. rental property without restrictions, enforcement of number of people allowed per septic system
27. high water is a problem but the cycle is changing.



During open-water season, how often, if at all, does excessive plant growth (excluding algae) negatively affect your use of the lake?		
Answer Options	**Response Percent**	**Response Count**
Always	14.3%	21
Most of the time	15.0%	22
Sometimes	45.6%	67
Rarely	24.5%	36
Never	0.7%	1
	answered question	**147**
	skipped question	**1**

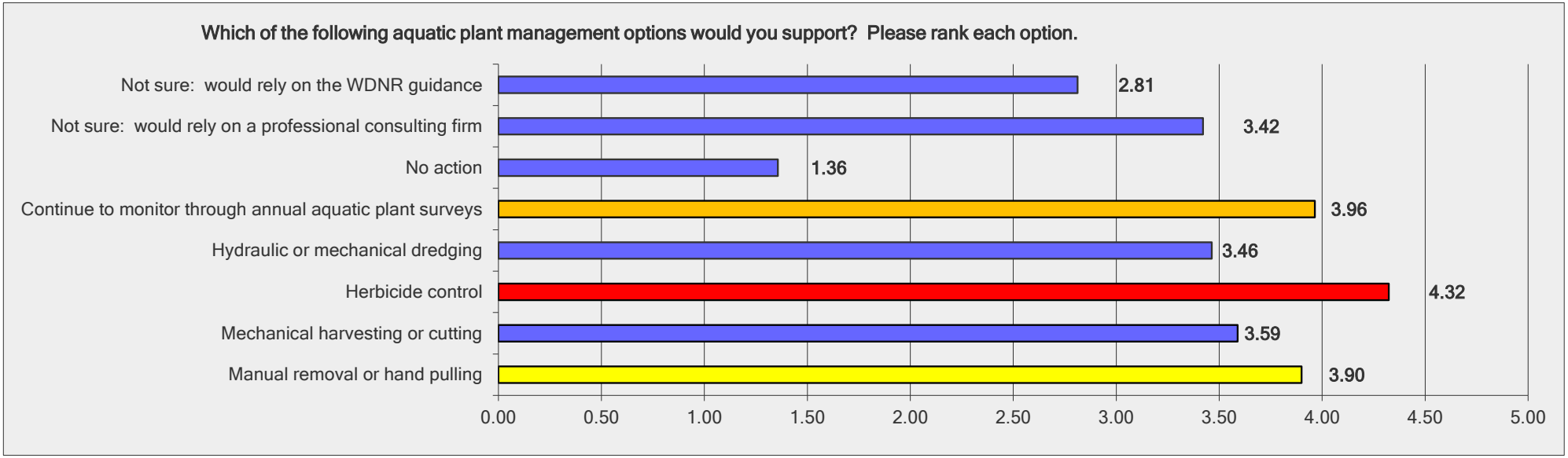


Do you believe that active management of aquatic plants (not including algae) is needed on the Lake? Active management may include any of the following: manual removal, mechanical harvesting, chemical control		
Answer Options	**Response Percent**	**Response Count**
Yes	94.6%	139
No	0.0%	0
Unsure / no opinion	5.4%	8
	answered question	**147**
	skipped question	**1**



For each of following aquatic plant and/or algae management options please tell us the extent you would support or oppose each potential option for Pine Lake? Please rank each option.

Answer Options	Strongly Oppose	Oppose	Neutral	Support	Strongly Support	Unsure - need more information	Rating Average	Response Count
Manual removal or hand pulling	5	13	25	45	52	8	3.90	148
Mechanical harvesting or cutting	12	17	22	46	37	13	3.59	147
Herbicide control	5	4	12	36	79	12	4.32	148
Hydraulic or mechanical dredging	12	14	28	43	26	23	3.46	146
Continue to monitor through annual aquatic plant	6	9	24	47	55	7	3.96	148
No action	105	22	11	2	0	7	1.36	147
Not sure: would rely on a professional consulting firm	8	12	53	36	24	15	3.42	148
Not sure: would rely on the WDNR guidance	26	22	49	23	13	15	2.81	148
							answered question	145
							skipped question	0

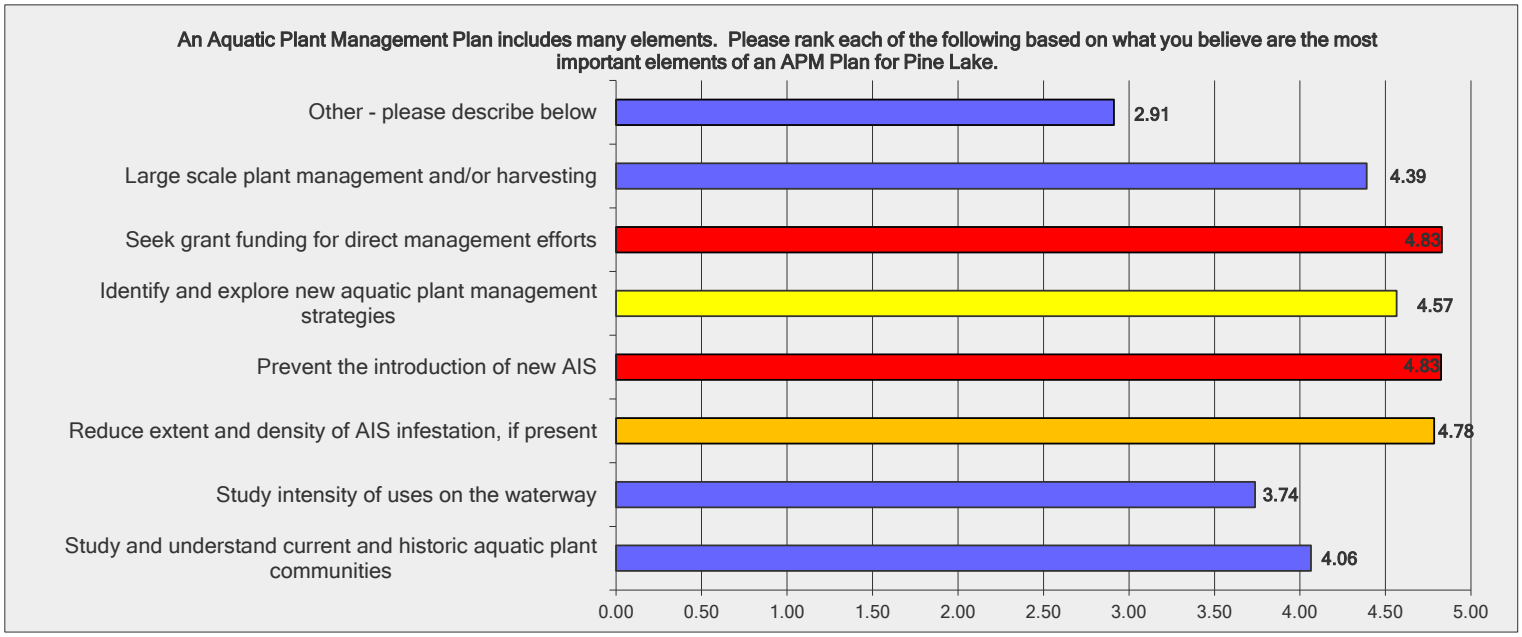


An Aquatic Plant Management Plan includes many elements. For each of the following, please tell us how necessary or unnecessary you believe each element is for Pine Lake.

Answer Options	Definitely not necessary	Somewhat Unnecessary	Neutral	Somewhat Needed	Definitely needed	Unsure - need more information	Rating Average	Response Count
Study and understand current and historic aquatic plant	6	6	21	47	60	6	4.06	146
Study intensity of uses on the waterway	8	15	27	47	44	6	3.74	147
Reduce extent and density of AIS infestation, if present	1	1	8	8	126	3	4.78	147
Prevent the introduction of new AIS	1	0	5	11	126	3	4.83	146
Identify and explore new aquatic plant management	2	2	7	32	95	9	4.57	147
Seek grant funding for direct management efforts	1	0	5	10	125	6	4.83	147
Large scale plant management and/or harvesting	1	4	15	26	72	21	4.39	139
Other - please describe below	6	1	21	2	4	14	2.91	48
Other (please specify)								
							answered question	144
							skipped question	1

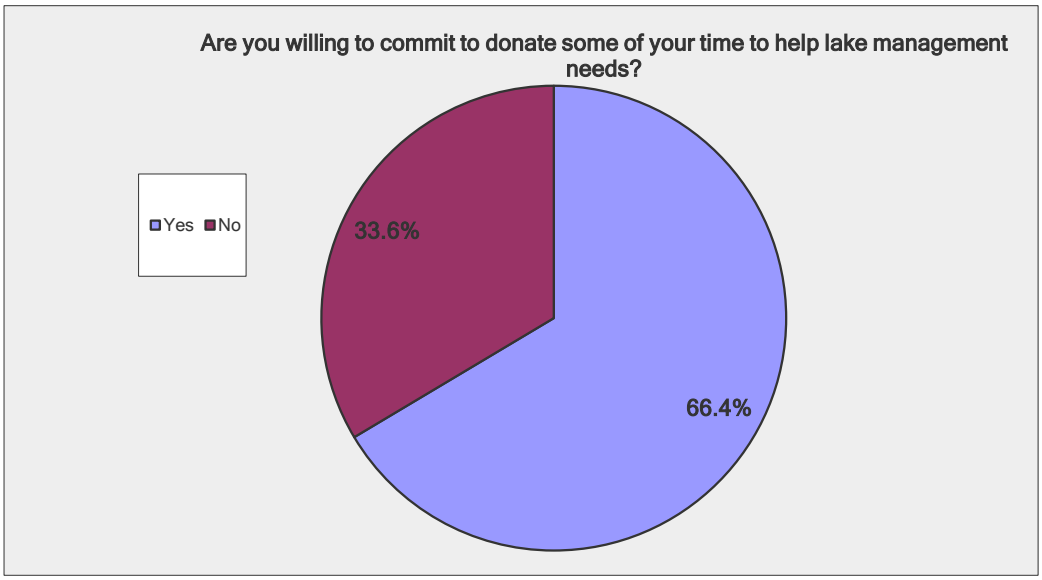
Other (please specify)

1	Visiting boat inspections
2	If we are forced to wait longer to treat the problem areas, it will most definitely get much worse.
3	I strongly believe that chemical treatment is needed to control the weeds. Manual harvesting and pulling was performed a year ago and the weeds
4	is needed. Since the lake is open to the public there should be a fee to launch their boats on the lake to offset the cost of maintaining the lake's weed problem.
5	I would need to know Costa associated with all of these options before I can truly weight them
6	just get it done. you can plainly see it, don't wait any longer!!!
7	funding should be from WDNR and not owners due to daily use by outsiders



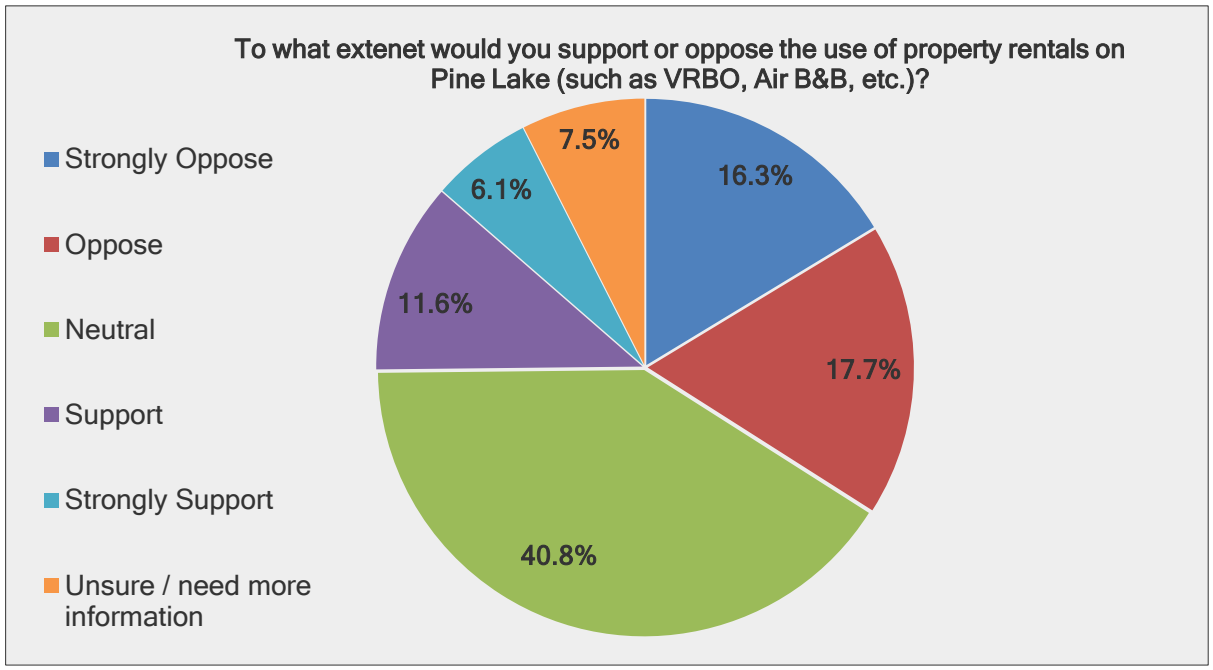
Are you willing to commit to donate some of your time to help lake management needs? Such as "Clean Boats / Clean Water" inspecitons, lake water sampling, etc.? Please not this not regarded as a formal commitment but will be used to gauge potential participation of area stakeholders.

Answer Options	Response Percent	Response Count
Yes	66.4%	97
No	33.6%	49
If Yes, how many hours per summer are you willing to commit?	15.9 hrs	average
	answered question	146
	skipped question	2



To what extent would you support or oppose the use of property rentals on Pine lake (such as VRBO, Air B&B, etc.)?

Answer Options	Response Percent	Response Count
Strongly Oppose	16.3%	24
Oppose	17.7%	26
Neutral	40.8%	60
Support	11.6%	17
Strongly Support	6.1%	9
Unsure / need more information	7.5%	11
	answered question	147
	skipped question	1



Do you have any comments or concerns regarding property rentals on Pine Lake?

Answer Options	Response Count
answered question	90
skipped question	54

Number	
1	They have increasingly become a nuisance with loud parties into late hours.
2	Renters do not respect property rights of owners.
3	Rentals to those willing to follow rules and not be disorderly
4	No problem if renters respect the lake. Families, individuals, couples OK. Not a place to party.
5	LOOSE DOGS AND LOUD NOISE. GARBAGE LEFT IN AND AROUND LAKE AREAS.
6	Education of the renters of the rules of the lake.
7	I know of a couple rentals and have found the renters to be very responsible and nice. I strongly believe property owners should have the right to rent their homes (even thou I do not do it).
8	The rules are sometimes broken and the cottage with 3 levels to rent gets very noisy.
9	Some rentals rent to too many people at one time.
10	I would want the renters to ensure their boats are clean before launching; same as I would anyone launching a boat.
11	We are concerned about renters that do not take care of the lake and surrounding environment
12	In my opinion and to what I have witnessed is that owners, Visitors and vacationers very respectful of properties lake and people
13	As long as the renters abide by lake rules regarding clean boats and no wake hours
14	No most are friendly and don't have huge boats
15	WOULD STRONGLY OPPOSE MULTI-UNIT CONDOS OR MULTIPLE HOME DEVELOPMENTS THAT HAVE DIRECT ACCESS TO THE LAKE.
16	They drive into mifiol area because they are not marked
17	Until the milfoil is under control, I would oppose air bnb rentals because they do not know where the milfoil beds are located and drive right through them spreading the milfoil throughout the lake. If the milfoil situation is resolved, I have no problem with air bnbs
18	May contribute to overuse of the lake
19	My only concern would be about people using the lake that don't know or follow the lake rules or take care of the lake with the love we do. I will say, I haven't ever had a problem with folks renting
20	No if people want to rent out that's fine by me
21	Property owners should advise renters of boating rules & regulations and respect for neighbors with noise levels & property clean up.
22	Not quite sure how this is relevant to the topic.
23	Not in favor of rentals unless it's someone you know. We've had family & friends stay at our place but they respected the lake & property. Strangers may
24	They are very loud. They do not realize how much voices and music carry
25	Concerned about increased boat traffic, jet ski usage. Also noise
26	Not at this time
27	If they are respectful of the lake and other families I have no problem with VRBO.
28	Perhaps limiting boats per rental
29	Noise/late nights/added boat traffic/unsafe behavior
30	Lake rules need to posted at rentals and if they are consistently broken then that rental should be stopped
31	It the property owners right.
32	That's the owners choice!
33	Make sure they know about boating rules and regulations also about possible quiet times and keep fireworks time/hours limits
34	I'm fine with them as long as the guests keep the water clean. Could we require them to put up a sign reminding visitors to not polute the lake and to clean their boats when going from lake to lake?
35	Visitors typically don't follow established rules (i.e. no-wake hours)
36	septic system failure
37	I hope people don't bring their own water craft (boats and such). Is there a way that can be forbidden?
38	They need to know and understand boating rules if using motorized boats. Buying houses just to turn them into rentals is also a concern.
39	They need to be well managed to respect the shoreline residents. Noise being a large factor.
40	why not?
41	No
42	no
43	you have no legal right to deny them
44	I feel private property owners have the right to rent their property responsibly
45	No
46	No
47	No concerns at all. I enjoy watching visitors and residence enjoying the lake. I have noticed Most visitors are respectful to the lake, residence and others.
48	Lake boating... rules need to be clearly communicated and enforced. Not just for renters, but for all lake boaters. Boats are coming far too close to the shoreline, docks and swim platforms.
49	I have found vacationers and visitors to pine lake to be highly respectful of other, property and pine lake in general
50	SHOULD BE UP TO THE INDIVIDUAL PROPERTY OWNER
51	Renters seem not to care as much: noise level, boating rules, taking care of shore, lake, etc.
52	noise
53	There has been an increase in unsafeboating, hour violations, and late night noise the past few years as rentals have increased. We feel there may be a correlation as many renters may not have a committment to the lake or lake residents due to their temporary time here.
54	Limitation on number of guests.
55	too many people for the septic; too much noise; visitors have no care for the lake
56	My concern would be large rental properties that would bring a lot of noise. Small, cottage rentals aren't really a problem.
57	Should be some limits on numbers allowed per property as well as a way to contact someone for noise/party issues
58	No
59	I would like restrictions on boats and how many people in 1 rental. But becomes a problem when they become a big party house. and these renters
60	No.
61	No
62	Boats coming from lakes with a lot of zebra muscles
63	OWNERS RENT TO PEOPLE WHO DO NOT RESPECT NEIGHBORS ORBOATING TRADITIONS

64	Don't like rentals on the lake, because renters don't seem to care about the area as much as us actual homeowners in the area do.
65	People who rent have no vested interest in the lake. They are here to have a good time and do not give any thought to this being some ones permanent home. They party into the early morning and play music loudly. They bring water craft onto the lake and don't know boating laws.
66	Too many people per rental. Puts stress on septic systems that may fail and contaminate the lake. Too much boat/PWCs congestion. Many renters don't know the rules or just don't care to abide them. They don't respect what a great resource Pine Lake is to those of us that live here. To them it is just a place to vacation once a year.
67	Na
68	not really
69	They are uninformed about rule and regulations. They have no skin in the game eg nothing to lose because they are not owners.
70	I feel some renters (not all) don't follow the lake rules and drive way to fast on our road!
71	first, I don't think it can be controlled. What needs to be controlled is how people use the lake. There are two main issues, as I see it, that non-owners have when using the lake: 1) they don't know the safety rules when using power boats and PWCs. 2) AIS issues
72	Rentals are generally less concerned about their behavior and "rules" of the lake than owners are. In addition, it is hard to know who to address problems with if they are renters.
73	None
74	Renters don't always know or follow rules regarding no wake hours.
75	we would like to have a listing of any rentals so we are aware. also, we could recommend to family/friends if we know of these.
76	Each rental should limit renters to one Boat or PWC
77	Renters don't have same concerns as ownerd
78	I would not support continued development around the lake as I do not think a lake this size could support additional homes development. I believe allowing the homes currently on the lake to continue to rent their properties is important.
79	No
80	Overuse of septic systems, many renters don't respect the lake or property owners.
81	I do not rent my cottage out but I would be very mad if someone told me I couldn't.
82	The care of the lake is not there because no ownership
83	No building of apartment rental type units
84	no
85	Full time rentals are bad for the lake. Are packed with people who don't care about the lake, don't observe the regulations, add unnecessary pressure on septic systems and wells. Too many cars with drivers who don't watch for children. Need to outlaw them.
86	Have a good time, but respect thr rules of the lake.
87	Renters seem to frequently ignore boat safety rules/laws
88	number of people allowed
89	too many people allowed in one place (up to 35 at a VRBO) Noise control
90	who are we to say someone can't use their property as they wish.
91	Only that they respect the lake and others that use it
92	Rentals, except family, are a problem. Need more study of the situation and most family would not be renting anyway and would be aware of the rules - speed etc.
93	People who rent or come for weekend don't follow rules - burning - especially in dry times - set by county. Don't necessarily follow rules
94	They become party houses. We've had a rental property that held large outside parties at night - sometimes until 2 or 3 am in the morning. Had to call the sherrif dept. several times. Fireworks after 12pm also bad. 4-5 families stay in one house - 12 or more cars in driveway for 1 to 2 weeks in the summer

If you have any additional general comments about the Pine Lake Property Owners Association, lake planning process, or something that you felt wasn't addressed in this survey please enter them here.

Answer Options	Response Count
answered question	90
skipped question	54

Number	
1	Great work team
2	Expand no wake hours.
3	No No Wake Buoy's in the middle of both lakes
4	The association could do a better job keeping people informed. We made a donation toward weed clean-up and never received any updates and recently found out it will not be used this year as originally announced with the donation request. Plus, DNR grants are available with other lakes using an consultant to help write the grant that have gotten approved (like Gilbert Lake). If you ask and receive money from people, I believe you have an obligation to keep them informed if the plan or time table has changed for which the donation was made for.
5	No
6	Keep us informed about what is happening and if plans change to what treatment plan may be used or not used, please let us know.
7	Thanks for your hard work keeping pine lake great!
8	Thank you for the hard work you do for all of us!
9	I wish we could do something about the underwater boat landing. Maybe a truck load of gravel or two
10	I love Pine Lake & our Pine Lake Family. Whatever we can do to save our beautiful lake is fine with me.
11	Thank you for your work. Maintaining our lake quality is very important
12	I'd like to see the trees removed that were dropped by the sandbar. How do we know those trees is not part of the cause of AIS in Pine Lake?
13	I appreciate your efforts to keep our lake a special place for generations
14	I would be strongly opposed to managing the milfoil during the summer months of June-August when recreational activities are at their peak.
15	A few voices on the lake should not over rule the majority on the Lake. If we do not protect the lake now it may soon be too late.
16	Would like the lake water levels published on a continual basis.
17	N/A
18	Na
19	Thank you for your leadership to move forward on a plan to reduce the invasive species in the lake.
20	The MILFOIL weeds are getting out of control and are presenting as hazardous and dangerous condition to myself and others including the children while swimming. The increased MILFOIL weeds are even getting tangled around my motor while out on a casual boat ride. This is a potential hazard and danger as the increased risk of becoming stranded out on the lake has increased. Thank you for the opportunity to survey.
21	Over last 10 years has brought an excessive number of jet skis, number of watercraft per property and boats that are too large for the lake. Specifically wake boats that cause shore erosion resulting in damage to the lake and properties on the lake. During times of high water, no-wake should be the norm and something the vast majority of owners desire. The local township should not have the final say when it comes to wake/no-wake.
22	The milfoil growth has gotten out of hand . In my opinion I would say that the increase in Milford weeds is a hazard and unnecessary danger to our children as well experienced swimmers in the lake. There has been an increase in milfoil weeds and other weeds getting wrapped around my boat propeller this is also very dangerous as I and my visitors can easily get stranded in the lake. Thank you for this opportunity to take the survey.
23	THANKS FOR CONTINUOUSLY WORKING ON IMPROVING THE LAKE QUALITY
24	The lake boat traffic is not monitored enough by a sheriff or DNR. Jet skis especially.
25	A continued thank you for keeping these issues in the cross hairs.
26	Thank you for undertaking this project which is much needed for the lake. It must be frustrating to deal with the DNR and their moving target of regulations when all you want is to ensure the continued health of Pine Lake
27	So appreciate all you are doing for the lake!!!!!!
28	No.
29	We need to take action on Milfoil immediately.
30	Water levels
31	None
32	The lake doesn't get any larger but the boats do both in numbers and size. Wakeboard boats create waves that make waves that are dangerous to other boats as well as swimmers. They should not be allowed to fill any ballast tanks. Jet skis seem to not know the laws for their operation. I have never seen a jet ski not break the 200 feet from shore rule.
33	Light Pollution-Large yard beam lights that shine on the lake at night are obnoxious. There is a lighthouse decoration light on the big lake that shines in our window every night throughout the year. Very annoying. Could
34	Taking our early Spring Kayak cruise around the lake, The water clarity was the worst it's ever been and smelly. Now I have been told that the run off of lawn chemicals is a factor . But yet there are so many people still using them so they have the beautiful manicured lawns.
35	I'm generally concerned with the public access to the lake -- some members of the public are loud and not respectful of wake rules. In addition, they also could be contributing to the milfoil problem by bringing it from other places.
36	None
37	Would mechanical cutting of weeds further spread the milfoil through fragments?
38	As I said earlier in the survey about the fee at the landing. I would be more than happy to pay a fee every time I land my boat. Right now the only people paying for the lake costs are shoreline owners and this may possibly cut down on overfishing as well. Thank you for putting together this survey, its nice to our opinion is valued.
39	Need to outlaw large wake boats like other states are beginning to do. Waves too big and dangerous to other boats and people/children on shore. Inconsiderate operators.
40	the board is doing a great job!
41	the board is great!
42	AIS is being introduced primarily by outside boaters not property owners so WDNR should carry burden of costs for lake AIS management
43	We have an excellent lake because we have been chemically treating milfoil. It is critical that we are allowed to treat it immediately while it still can be effective !! P.s. Jetskis are a problem - don't follow the rules about safety
44	I don't think people who don't live here - just anyone from Waupaca, Wautoma, etc. - should use the lake without permission. Some of them leave trash etc. and don't care enough about the lake to take care of it. We, homeowners, pay the taxes for state care of the lake - and private care and the cost and work to keep it clean
45	Upset with milfoil treatment whe people couldn't wait for another week/month but used boat and went fast in areas where it was treated - waste of $$. Even if area is "roped" (buoys, etc.) who will enforce it?

APPENDIX B – SUPPORTING AQUATIC PLANT DOCUMENTATION

Appendix B – Supporting Aquatic Plant Documentation

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

Taxonomic richness (the total number of taxa detected)

- **Maximum depth of plant growth**
- **Community frequency of occurrence** (number of intercept points where aquatic plants were detected divided by the number of intercept points shallower than the maximum depth of plant growth)
- **Mean intercept point taxonomic richness** (the average number of taxa per intercept point)
- **Mean intercept point native taxonomic richness** (the average number of native taxa per intercept point)
- **Taxonomic frequency of occurrence within vegetated areas** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points where vegetation was present)
- **Taxonomic frequency of occurrence at sites within the photic zone** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points which are equal to or shallower than the maximum depth of plant growth)
- **Relative taxonomic frequency of occurrence** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the sum of all species' occurrences)
- **Mean density** (the sum of the density values for a particular species divided by the number of sampling sites)
- **Simpson Diversity Index (SDI)** is an indicator of aquatic plant community diversity. SDI is calculated by taking one minus the sum of the relative frequencies squared for each species present. Based upon the index of community diversity, the closer the SDI is to one, the greater the diversity within the population.

Floristic Quality Index (FQI) (This method uses a predetermined Coefficient of Conservatism (C), that has been assigned to each native plant species in Wisconsin, based on that species' tolerance for disturbance. Non-native plants are not assigned conservatism coefficients. The aggregate conservatism of all the plants inhabiting a site determines its floristic quality. The mean C value for a given lake is the arithmetic mean of the coefficients of all native vascular plant species occurring on the entire site, without regard to dominance or frequency. The FQI value is the mean C times the square root of the total number of native species. This formula combines the conservatism of the species present with a measure of the species richness of the site.

Table 3: 2013 & 2020 Aquatic Plant Community Statistics, Pine Lake, Waushara County, WI

Aquatic Plant Community Statistics	2013	2020
Total sites sampled	407	537
Total sites with vegetation	324	197
Total site shallower than max depth of plants	401	262
Frequency of occurrence at sites shallower than maximum depth of plants	80.80%	75.19%
Simpson Diversity Index	0.82	0.82
Maximum Depth of Plants (Feet)	36	25
Taxonomic Richness (Number of Species - including visuals)	20	16
Average Total Rake Fullness	1.53	1.45
Average Number of Species per Site (sites less than max depth of plant growth)	1.51	1.4
Average Number of Species per Site (sites with vegetation)	1.88	1.87
Average Number of Native Species per Site (sites less than max depth of plant growth)	1.49	1.38
Average Number Native of Species per Site (sites with vegetation)	1.86	1.84

Table 4: 2013 & 2020 Frequency of Occurrence of Aquatic Plant Species, Pine Lake, Waushara Co., WI

Species	Frequency of Occurence by Year	
	2013	2020
Filamentous algae	---	0.38
Muskgrass	56.86	45.8
Common waterweed	4.24	---
Bearded stonewort	6.48	---
Northern water-milfoil	0.25	0.38
Eurasian water-milfoil	**2**	**2.67**
Slender naiad	10.47	5.73
Southern naiad	5.24	12.98
Nitella (stonewort)	20.45	2.29
Small stonewort	0.75	---
White water lily	0.5	0*
Large-leaf pondweed	4.24	11.45
Leafy pondweed	---	0.38
Fries' pondweed	---	0.38
Variable pondweed	12.97	20.23
Illinois pondweed	2.99	8.4
Floating-leaf pondweed	0.75	---
White-stem pondweed	10.72	---
Stiff pondweed	2	---
Flat-stem pondweed	4.24	4.96
Three-square bulrush	0*	---
Softstem bulrush	---	0*
Sago pondweed	0.25	1.15
Wild celery	6.23	23.66

* - recorded as visual only

--- - species not sampled

Table 5: FQI Breakdown by species for Pine Lake, Waushara County, Wisconsin.

Common Name*	Coefficient of Conservatism	
	2013	2018
Muskgrass	7	7
Common waterweed	3	---
Northern water-milfoil	6	6
Slender naiad	6	6
Southern naiad	8	8
Nitella (stonewort)	7	7
White water lily	6	6
Large-leaf pondweed	7	7
Leafy pondweed	---	6
Fries' pondweed	---	8
Variable pondweed	7	7
Illinois pondweed	6	6
Floating-leaf pondweed	5	---
White-stem pondweed	8	---
Stiff pondweed	8	---
Flat-stem pondweed	6	6
Three-square bulrush	5	---
Softstem bulrush	---	4
Sago pondweed	3	3
Wild celery	6	6
Total Species	**17**	**15**
Mean C	**6.12**	**6.20**
Floristic Quality Index (FQI)	**25.22**	**24.01**

* - only species sampled or visually observed and with assigned coefficients are included

--- Species was not sampled

APPENDIX C – ADDITIONAL MANAGEMENT OPTIONS

Management Options for Aquatic Plants

Option	Permit Needed	How it Works	Pros	Cons
No Management	No	No active plant management	Possible protects native species that can enhance water quality and provide habitat for aquatic fauna: • No financial cost • No system disturbance • No harmful effects of chemicals • Permit not required	May allow small populations of invasive plants to become larger and more difficult to control later • Requires intensive monitoring
Mechanical Control	Required under NR 109	Plants reduced by mechanical means	Flexible control	Must be repeated, often more than once per season, sometimes weekly
		Wide range of techniques from manual to mechanized	Can balance habitat and recreational needs	Can suspend sediments and increase highly turbidity and nutrient release
a. Handpulling/ Manual raking	Yes/No	Scuba divers or snorkelers remove plants are removed with a rake	Little to no damage done to lake or to native plant species	Very labor intensive and costly by hand or plants
		Works best in soft sediments	Can be highly selective Can be done by shoreline property owners within an area <30 ft wide or removing EWM or CLP Can be very effective at removing problems particularly following early detection of an invasive specie	Needs to be carefully monitored Roots, runners and even fragments of some without permits species (including EWM) will start new where selectively planted, so all of plant must be removed Small scale control only plants Can be very costly if subcontracted
b. Harvesting	Yes	Plants are “mowed” at depths of 2-5 ft., collected with a conveyor and off loaded onto shore	Immediate results	Not selective in species removed
		Harvest invasives only if invasive is already present throughout the lake	Good for CLP management if cut prior to turion production and is then cut to be kept in check through its growth cycle Usually minimal impact to the lake Harvested lanes through dense weed beds can increase growth and forage ability of some fish Can remove some nutrients from the lake	Fragments of EWM can re-root Difficulty in finding disposal sites Can remove some small fish and reptiles from lake Initial cost of harvester expensive High transport, maintenance and operational costs Liability if owned
Biological Control	Yes	Living organisms (e.g. insects or fungi) eat or infect plants	Self sustaining organism will over winter resume eating its host the next year Lowers density of problem plant to allow growth of natives	Effectiveness will vary as control agent’s population fluctuates Provides moderate control – complete control unlikely Control response may be slow. Must have enough control agent to be effective

Management Options for Aquatic Plants

a. Weevils on EWM	Yes	Native weevil prefers EWM to other native water milfoil	Native to Wisconsin: Weevil cannot "escape" and become a problem Selective control of target species Longer term control with limited management	Excessive cost need to stock large numbers, even if some already present and are costly **$1.00/each** Need good habitat for over wintering on shore (leaf litter) associated with undeveloped shorelines High Panfish populations decrease densities through predation
b. Pathogens	Yes	Fungal/bacterial/viral pathogen introduced to target species to induce mortality	May be species specific May provide long term control Few dangers to humans or animals	Largely experimental; effectiveness and longevity unknown Possible side effects not understood
c. Allelopathy	Yes	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long term, maintenance free control Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermill foil growth	Initial transplanting slow and labor intensive Spikerushes native to Wisconsin and have not effectively limited EWM growth Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d. Restoration of native plants	Possibly, strongly recommend plan and consultation with DNR	Diverse native plant community established to help repel invasive species	Native plants provide food and habitat for aquatic fauna Diverse native community more repellant to invasive species Supplements removal techniques	Initial transplanting slow and labor intensive Nuisance invasive plants may outcompete plantings Largely experimental; few well documented successful cases and very costly
Physical Control	Required under Ch. 30/NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Drawdown	Yes, may require Environmental Assessment	Lake water lowered; plants killed when sediment dries, compacts or freezes	Can be effective for EWM, especially when done over winter, provided drying and freezing occur. Sediment compaction is possible over winter.	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling
		Must have a water level control or device or siphon	Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction	Species growing in deep water (e.g. EWM) that survive may increase, particularly if desired native species are reduced
		Season or duration of drawdown can change effects	Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization and increased water quality Successful for EWM	May impact attached wetlands and shallow wells near shore Not a good control measure for CLP

Management Options for Aquatic Plants

			Low cost if not a hydroelectric dam Restores natural water fluctuation important for all aquatic ecosystems	Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning Winter drawdown must start in early fall or will kill hibernating reptiles and amphibians Controversial
b. Dredging	Yes	Plants are removed along with sediment	Increases water depth	Expensive
		Most effective when soft sediments overlay harder substrate	Removes nutrient rich sediments	Increases turbidity and releases nutrients
		For extremely impacted systems	Removes soft bottom sediments that may have high oxygen demand	Exposed sediments may be recolonized by invasive species
		Extensive planning and permitting required		Sediment testing is expensive Removes benthic organisms Dredged materials must be disposed if Severe impact on lake ecosystem
c. Dyes	Yes	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity Usually non-toxic, degrades naturally over a few weeks	Appropriate for very slam water bodies Should not be used in pond or lake with outflow Impairs aesthetics Affects to microscopic organisms unknown
d. Mechanical circulation (Solarbees)	Yes	Water is circulated and oxygenated	Reduces blue green algae	Method is experimental; no published studies have been done
		Oxygenation of water decreases ammonium-nitrogen, which is a preferred nutrient source of EWM, theoretically limiting EWM growth (has not been demonstrated scientifically)	May reduce levels of ammonium-nitrogen in the water and at the sediment interface, which could reduce EWM growth Oxygenated water may reduce phosphorus release from sediments if mixing is complete Reduces chance of fish kills by aerating water	Although EWM prefers ammonium-nitrogen to nitrate, it will uptake nitrate efficiently, so EWM growth may not be affected Units are aesthetically unpleasing Units could be a navigational hazard
e. Non-point source nutrient control	No	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use)	Attempts to correct source of problem, not treat symptoms Could improve water clarity and reduce occurrences of algal blooms	Results can take years to be evident due to internal recycling of already resent lake nutrients Expensive

Management Options for Aquatic Plants

			Native plants may be able to compete invasive species better in low nutrient conditions	Requires landowner cooperation and regulation Improved water clarity may increase plant growth
Chemical Control	Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae	Some flexibility for different situations	Possible toxicity to aquatic animals or humans, especially applicators
		Results usually within 10 days of treatment, but repeat treatments usually needed	Some can be selective if applied correctly Can be used for restoration activities	May kill desirable plant species, e.g. native water milfoil or native pondweeds Treatment set back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape Controversial
a. 2,4-D (DMA-4; Sculpin	Yes	Systemic[1] herbicide selective to broadleaf[2] plants that inhibit cell division in new tissue	Moderately to highly effective; especially on EWM	May cause oxygen depletion after plants die and decompose
		Applied as liquid or granules during early growth phase	Monocots, such as pondweeds (e.g. CLP) and many other native species not affected Can be used in synergy with endotholl for early season CLP and EWM treatments Widely used aquatic herbicides	Cannot be used in combination with copper herbicides (used for algae) Toxic to fish
b. Endothall (Aquathol)	Yes	Broad-spectrum[3], contact [4] herbicide that inhibits protein synthesis	Especially effective on CLP and also effective on EWM	Kills many native pondweeks
		Applied as liquid or granules	May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring Can be selective depending on concentration and seasonal timing Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds	Not as effective in dense plant beds Not to be used in water supplies Toxic to aquatic fauna (to varying degrees)
c. Diquat (Reward)	Yes	Broad-spectrum, contact herbicide that disrupts cellular functioning	Mostly used for water-milfoil and duckweed	May impact non-target plants, especially native pondweeds, coontail, elodea, naiads
		Applied as liquid, can be combined with copper treatment	Rapid action Limited direct toxicity on fish and other animals	Toxic to aquatic invertebrates Needs to be reapplied several years in a row

Management Options for Aquatic Plants

				Ineffective in muddy or cold water (<50°F)
d. Fluridone (Sonar)	Yes	Broad-spectrum, systemic pigment bleaching herbicide that inhibits photosynthesis, some reduction in non target effects can be achieved by lowering dosage	Effective on EWM for 2 to 4+ years Applied at very low concentration typically on lake wide basis of less than 8 PPB Specific granular formulation release over extended periods of time 30 – 60 days eliminating peaks and lessening impacts to non targets (natives)	Affects some non-target plants, particularly native milfoils, coontails, elodea and naiads, even at low concentrations. These plants are important to combat invasive species Requires long contact time: 60-90 + days Requires residual monitoring
			Slow decomposition of plants may limit decreases in dissolved oxygen Low toxicity to aquatic animals	Demonstrated herbicide resistance in hydrilla subjected to repeat treatments Unknown effect of repeat whole lake treatments on lake ecology
e. Glyphosate (Rodeo)	Yes	Broad spectrum, systemic herbicide that disrupts enzyme formation and function	Effective on floating and emergent plants such as purple loosestrife	Effective control for 1-5 years
		Usually used for purple loosestrife stems or cattails	Selective if carefully applied to individual plants	Ineffective in muddy water
		Applied as liquid spray or painted on loosestrife stems	Non-toxic to most aquatic animals at recommended dosages	Cannot be used near potable water intakes No control of submerged plants
f. Triclopyr (Renovate)	Yes	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher does (e.g. coontail)
		Applied as liquid spray or liquid	More effective on dicots, such as purple loosestrife; may be more effective than glyphosate Results in 3-5 weeks Low toxicity to aquatic animals No recreational use restrictions following treatment	May be toxic to sensitive invertebrates at higher concentrations Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm) Sensitive to UV light; sunlight can break herbicide down prematurely Relatively new management option for aquatic plants (since 2003)
g. Copper compounds (Cutrine, Captain)	Yes	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
		Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Short term results Small-scale control only, because algae are easily windblown

Management Options for Aquatic Plants

					Toxic to invertebrates, trout and other fish, depending on the hardness of the water Long-term effects of repeat treatments to benthic organism unknown Clear water may increase plant growth
h.	**Lime slurry**	Yes	Applications of lime temporarily raise water pH, which limits the availability of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP Prevents release of sediment phosphorus, which reduces algal growth Increases growth of native plants beneficial as fish habitat	Relatively new technique, so effective dosage levels and exposure requirements are not yet known Short-term increase in turbidity due to suspended lime particles High pH detrimental to aquatic invertebrates May restrict growth of some native plants
i.	**Alum (aluminum sulfate)**	Yes	Remove phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus	Most often used against algal problems Lasts up to 5 years	Most not eat fish for 30 days from treatment area
			Dosage must consider pH, hardness and water volume	Improves water clarity	Minimal effect on aquatic plants, or increased light penetration may increase aquatic plants Potential ecosystem toxicity issues for aquatic animals, including fish at some concentrations
j.	**Phoslock**	yes	Remove/sequesters phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus	Most often used against algal problems/blooms Improves water quality	Higher cost than Alum
			Dosing based on water quality parameters and volumes	Lasts up to 5 years Made from natural materials/carriers and tends to be more environmentally friendly than alum	

***EWM** - Eurasian water-milfoil
***CLP** - Curly-leaf pondweed

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

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

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

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

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

Option	How it Works	Pros	Cons
Biological Control			
a. Carp	Plants eaten by stocked carp	Effective at removing aquatic plants Involves species already present in Madison lakes	Illegal to transport or stock carp in Wisconsin Carp cause resuspension of sediments, increased water temperature, lower dissolved oxygen levels and reduction of light penetration Widespread plant removal deteriorates habitat for other fish and aquatic organisms Complete alteration of fish assemblage possible Dislodging of plants such as EWM or CLP turions can lead to accelerated spreading of plants
b. Crayfish	Plants eaten by stocked crayfish	Reduces macrophyte biomass	Illegal to transport or stock crayfish in Wisconsin Control not selective and may decimate plant community Not successful in productive, soft-bottom lakes with many fish predators Complete alteration of fish assemblage possible
Mechanical Control			
a. Cutting (no removal)	Plants are “mowed” with underwater cutter	Creates open water areas rapidly Works in water up to 25 ft	Root system remains for regrowth Fragments of vegetation can re-root and spread infestation throughout the lake Nutrient release can cause increased algae and bacteria and be a nuisance to riparian property owners Not selective in species removed small-scale control only
b. Rototilling	Sediment is tilled to uproot plant roots and stems	Decreases stem density, can affect entire plant	Creates turbidity
	Works in deep water (up to 17 ft)	Small scale control May provide long-term control	Not selective in species removed Fragments of vegetation can re-root Complete elimination of fish habitat

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

			Releases nutrients Increased likelihood of invasive species recolonization
c. Hydroraking	Mechanical rake removes plants from lake Works in deep water (14 ft)	Creates open water areas rapidly	Fragments of vegetation can re-root May impact lake fauna Creates turbidity Plants regrown quickly Requires plant disposal
Physical Control			
a. Fabrics/Bottom Barriers	Prevents light from getting to lake bottom	Reduces turbidity in soft substrate areas Useful for small areas	Eliminates all plants, including native plants important for a healthy lake ecosystem May inhibit spawning by some fish Need maintenance or will become covered in sediment and ineffective Gas accumulation under blankets can cause them to dislodge from the bottom Affects benthic invertebrates Anaerobic environment forms that can release excessive nutrients from sediment

APPENDIX D – WI ADMIN CODES NR 107 & NR 109

Chapter NR 107

AQUATIC PLANT MANAGEMENT

Note: Chapter NR 107 as it existed on February 28, 1989 was repealed and a new Chapter NR 107 was created effective March 1, 1989.

NR 107.01 Purpose. The purpose of this chapter is to establish procedures for the management of aquatic plants and control of other aquatic organisms pursuant to s. 227.11 (2) (a), Stats., and interpreting s. 281.17 (2), Stats. A balanced aquatic plant community is recognized to be a vital and necessary component of a healthy aquatic ecosystem. The department may allow the management of nuisance–causing aquatic plants with chemicals registered and labeled by the U.S. environmental protection agency and labeled and registered by firms licensed as pesticide manufacturers and labelers with the Wisconsin department of agriculture, trade and consumer protection. Chemical management shall be allowed in a manner consistent with sound ecosystem management and shall minimize the loss of ecological values in the water body.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **correction made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.02 Applicability. Any person sponsoring or conducting chemical treatment for the management of aquatic plants or control of other aquatic organisms in waters of the state shall obtain a permit from the department. Waters of the state include those portions of Lake Michigan and Lake Superior, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other ground or surface water, natural or artificial, public or private, within the state or its jurisdiction as specified in s. 281.01 (18), Stats.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **correction made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.03 Definitions. (1) "Applicator" means the person physically applying the chemicals to the treatment site.

(2) "Chemical fact sheet" means a summary of information on a specific chemical written by the department including general aquatic community and human safety considerations applicable to Wisconsin sites.

(3) "Department" means the department of natural resources.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.04 Application for permit. (1) Permit applications shall be made on forms provided by the department and shall be submitted to the district director for the district in which the project is located. Any amendment or revision to an application shall be treated by the department as a new application, except as provided in s. NR 107.04 (3) (g).

Note: The DNR district headquarters are located at:

1. Southern — 3911 Fish Hatchery Road, Fitchburg 53711
2. Southeast — 2300 N. Dr. Martin Luther King Jr. Dr., Box 12436, Milwaukee 53212
3. Lake Michigan — 1125 N. Military Ave., Box 10448, Green Bay 54307
4. North Central — 107 Sutliff Ave., Box 818, Rhinelander 54501
5. Western — 1300 W. Clairemont Ave., Call Box 4001, Eau Claire 54702
6. Northwest — Hwy 70 West, Box 309, Spooner 54801

(2) The application shall be accompanied by:

(a) A nonrefundable permit application fee of $20, and, for proposed treatments larger than 0.25 acres, an additional refundable acreage fee of $25.00 per acre, rounded up to the nearest whole acre, applied to a maximum of 50.0 acres.

1. The acreage fee shall be refunded in whole if the entire permit is denied or if no treatment occurs on any part of the permitted treatment area. Refunds will not be prorated for partial treatments.

2. If the permit is issued with the proposed treatment area partially denied, a refund of acreage fees shall be given for the area denied.

(b) A legal description of the body of water proposed for treatment including township, range and section number;

(c) One copy of a detailed map or sketch of the body of water with the proposed treatment area dimensions clearly shown and with pertinent information necessary to locate those properties, by name of owner, riparian to the treatment area, which may include street address, local telephone number, block, lot and fire number where available. If a local address is not available, the home address and phone number of the property owner may be included;

(d) A description of the uses being impaired by plants or aquatic organisms and reason for treatment;

(e) A description of the plant community or other aquatic organisms causing the use impairment;

(f) The product names of chemicals proposed for use and the method of application;

(g) The name of the person or commercial applicator, and applicator certification number, when required by s. NR 107.08 (5), of the person conducting the treatment;

(h) A comparison of alternative control methods and their feasibility for use on the proposed treatment site.

(3) In addition to the information required under sub. (2), when the proposed treatment is a large–scale treatment exceeding 10.0 acres in size or 10% of the area of the water body that is 10 feet or less in depth, the application shall be accompanied by:

(a) A map showing the size and boundaries of the water body and its watershed.

(b) A map and list identifying known or suspected land use practices contributing to plant–related water quality problems in the watershed.

(c) A summary of conditions contributing to undesirable plant growth on the water body.

(d) A general description of the fish and wildlife uses occurring within the proposed treatment site.

(e) A summary of recreational uses of the proposed treatment site.

(f) Evidence that a public notice of the proposed application has been made, and that a public informational meeting, if required, has been conducted.

1. Notice shall be given in 2 inch x 4 inch advertising format in the newspaper which has the largest circulation in the area affected by the application.

2. The notice shall state the size of the proposed treatment, the approximate treatment dates, and that the public may request within 5 days of the notice that the applicant hold a public informational meeting on the proposed application.

a. The applicant will conduct a public informational meeting in a location near the water body when a combination of 5 or more individuals, organizations, special units of government, or local units of government request the meeting in writing to the applicant

with a copy to the department within 5 days after the notice is made. The person or entity requesting the meeting shall state a specific agenda of topics including problems and alternatives to be discussed.

b. The meeting shall be given a minimum of one week advance notice, both in writing to the requestors, and advertised in the format of subd. 1.

(g) The provisions of pars. (a) to (e) shall be repeated once every 5 years and shall include new information. Annual modifications of the proposed treatment within the 5–year period which do not expand the treatment area more than 10% and cover a similar location and target organisms may be accepted as an amendment to the original application. The acreage fee submitted under sub. (2) (a) shall be adjusted in accordance with any proposed amendments.

(4) The applicant shall certify to the department that a copy of the application has been provided to any affected property owners' association, inland lake district, and, in the case of chemical applications for rooted aquatic plants, to any riparian property owners adjacent to and within the treatment area.

(5) A notice of the proposed treatment shall be provided by the department to any person or organization indicating annually in writing a desire to receive such notification.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.05 Issuance of permit. (1) The department shall issue or deny issuance of the requested permit between 10 and 15 working days after receipt of an acceptable application, unless:

(a) An environmental impact report or statement is required under s. 1.11, Stats. Notification to the applicant shall be in writing within 10 working days of receipt of the application and no action may be taken until the report or statement has been completed; or

(b) A public hearing has been granted under s. 227.42, Stats.

(2) If a request for a public hearing is received after the permit is issued but prior to the actual treatment allowed by the permit, the department is not required to, but may, suspend the permit because of the request for public hearing.

(3) The department may deny issuance of the requested permit if:

(a) The proposed chemical is not labeled and registered for the intended use by the United States environmental protection agency and both labeled and registered by a firm licensed as a pesticide manufacturer and labeler with the Wisconsin department of agriculture, trade and consumer protection;

(b) The proposed chemical does not have a current department aquatic chemical fact sheet;

(c) The department determines the proposed treatment will not provide nuisance relief, or will place unreasonable restrictions on existing water uses;

(d) The department determines the proposed treatment will result in a hazard to humans, animals or other nontarget organisms;

(e) The department determines the proposed treatment will result in a significant adverse effect on the body of water;

(f) The proposed chemical application is for waters beyond 150 feet from shore except where approval is given by the department to maintain navigation channels, piers or other facilities used by organizations or the public including commercial facilities;

(g) The proposed chemical applications, other than those conducted by the department pursuant to ss. 29.421 and 29.424, Stats., will significantly injure fish, fish eggs, fish larvae, essential fish food organisms or wildlife, either directly or through habitat destruction;

(h) The proposed chemical application is in a location known to have endangered or threatened species as specified pursuant to s. 29.604, Stats., and as determined by the department;

(i) The proposed chemical application is in locations identified by the department as sensitive areas, except when the applicant demonstrates to the satisfaction of the department that treatments can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

1. 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.

2. The department shall notify any affected property owners' association, inland lake district, and riparian property owner of locations identified as sensitive areas.

(4) New applications will be reviewed with consideration given to the cumulative effect of applications already approved for the body of water.

(5) The department may approve the application in whole or in part consistent with the provisions of subs. (3) (a) through (i) and (4). Denials shall be in writing stating reasons for the denial.

(6) Permits may be issued for one treatment season only.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **corrections in (3) (g) and (h) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.06 Chemical fact sheets. (1) The department shall develop a chemical fact sheet for each of the chemicals in present use for aquatic nuisance control in Wisconsin.

(1m) Chemical fact sheets for chemicals not previously used in Wisconsin shall be developed within 180 days after the department has received notice of intended use of the chemical.

(2) The applicant or permit holder shall provide copies of the applicable chemical fact sheets to any affected property owners' association and inland lake district.

(3) The department shall make chemical fact sheets available upon request.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.07 Supervision. (1) The permit holder shall notify the district office 4 working days in advance of each anticipated treatment with the date, time, location, and proposed size of treatment. At the discretion of the department, the advance notification requirement may be waived.

(2) Supervision by a department representative may be required for any aquatic nuisance control project involving chemicals. Supervision may include inspection of the proposed treatment area, chemicals, and application equipment before, during or after treatment. The inspection may result in the determination that treatment is unnecessary or unwarranted in all or part of the proposed area, or that the equipment will not control the proper dosage.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.08 Conditions of the permit. (1) The department may stop or limit the application of chemicals to a body of water if at any time it determines that chemical treatment will be ineffective, or will result in unreasonable restrictions on current water uses, or will produce unnecessary adverse side effects on nontarget organisms. Upon request, the department shall state the reason for such action in writing to the applicant.

(2) Chemical treatments shall be performed in accordance with label directions, existing pesticide use laws, and permit conditions.

(3) Chemical applications on lakes and impoundments are limited to waters along developed shoreline including public parks except where approval is given by the department for projects of public benefit.

(4) Treatment of areas containing high value species of aquatic plants shall be done in a manner which will not result in adverse long–term or permanent changes to a plant community in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in spe-

cific aquatic ecosystems, including *Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Potamogeton pectinatus, Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania aquatica, Zannichellia palustris* and *Brasenia schreberi.*

(5) Treatment shall be performed by an applicator currently certified by the Wisconsin department of agriculture, trade and consumer protection in the aquatic nuisance control category whenever:

(a) Treatment is to be performed for compensation by an applicator acting as an independent contractor for hire;

(b) The area to be treated is greater than 0.25 acres;

(c) The product to be used is classified as a "restricted use pesticide"; or

(d) Liquid chemicals are to be used.

(6) Power equipment used to apply liquid chemicals shall include the following:

(a) Containers used to mix and hold chemicals shall be constructed of watertight materials and be of sufficient size and strength to safely contain the chemical. Measuring containers and scales for the purpose of measuring solids and liquids shall be provided by the applicator;

(b) Suction hose used to deliver the chemical to the pump venturi assembly shall be fitted with an on–off ball–type valve. The system shall also be designed to prevent clogging from chemicals and aquatic vegetation;

(c) Suction hose used to deliver surface water to the pump shall be fitted with a check valve to prevent back siphoning into the surface water should the pump stop;

(d) Suction hose used to deliver a premixed solution shall be fitted with an on–off ball–type valve to regulate the discharge rate;

(e) Pressure hose used to discharge chemicals to the surface water shall be provided with an on–off ball–type valve. This valve will be fitted at the base of the hose nozzle or as part of the nozzle assembly;

(f) All pressure and suction hoses and mechanical fittings shall be watertight;

(g) Equipment shall be calibrated by the applicator. Evidence of calibration shall be provided at the request of the department supervisor.

(h) Other equipment designs may be acceptable if capable of equivalent performance.

(7) The permit holder shall be responsible for posting those areas of use in accordance with water use restrictions stated on the chemical label, but in all cases for a minimum of one day, and with the following conditions:

(a) Posting signs shall be brilliant yellow and conspicuous to the nonriparian public intending to use the treated water from both the water and shore, and shall state applicable label water use restrictions of the chemical being used, the name of the chemical and date of treatment. For tank mixes, the label requirements of the most restrictive chemical will be posted;

(b) Minimum sign dimensions used for posting shall be 11 inches by 11 inches or consistent with s. ATCP 29.15. The department will provide up to 6 signs to meet posting requirements. Additional signs may be purchased from the department;

(c) Signs shall be posted at the beginning of each treatment by the permit holder or representing agent. Posting prior to treatment may be required as a permit condition when the department determines that such posting is in the best interest of the public;

(d) Posting signs shall be placed along contiguous treated shoreline and at strategic locations to adequately inform the public. Posting of untreated shoreline located adjacent to treated shoreline and noncontiguous shoreline shall be at the discretion of the department;

(e) Posting signs shall be made of durable material to remain up and legible for the time period stated on the pesticide label for water use restrictions, after which the permit holder or representing agent is responsible for sign removal.

(8) After conducting a treatment, the permit holder shall complete and submit within 30 days an aquatic nuisance control report on a form supplied by the department. Required information will include the quantity and type of chemical, and the specific size and location of each treatment area. In the event of any unusual circumstances associated with a treatment, or at the request of the department, the report shall be provided immediately. If treatment did not occur, the form shall be submitted with appropriate comment by October 1.

(9) Failure to comply with the conditions of the permit may result in cancellation of the permit and loss of permit privileges for the subsequent treatment season. A notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder accompanied by a statement of appeal rights.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89**;** correction in (7) (b) made under s. 13.93 (2m) (b) 7., Stats., Register, September, 1995, No. 477.

NR 107.09 Special limitation. Due to the significant risk of environmental damage from copper accumulation in sediments, swimmer's itch treatments performed with copper sulfate products at a rate greater than 10 pounds of copper sulfate per acre are prohibited.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.10 Field evaluation use permits. When a chemical product is considered for aquatic nuisance control and does not have a federal label for such use, the applicant shall apply to the administrator of the United States environmental protection agency for an experimental use permit under section 5 of the federal insecticide, fungicide and rodenticide act as amended (7 USC 136 et seq.). Upon receiving a permit, the permit holder shall obtain a field evaluation use permit from the department and be subject to the requirements of this chapter. Department field evaluation use permits shall be issued for the purpose of evaluating product effectiveness and safety under field conditions and will require in addition to the conditions of the permit specified in s. NR 107.08 (1) through (9), the following:

(1) Treatment shall be limited to an area specified by the department.

(2) The permit holder shall submit to the department a summary of treatment results at the end of the treatment season. The summary shall include:

(a) Total chemical used and distribution pattern, including chemical trade name, formulation, percent active ingredient, and dosage rate in the treated water in parts per million of active ingredient;

(b) Description of treatment areas including the character and the extent of the nuisance present;

(c) Effectiveness of the application and when applicable, a summary comparison of the results obtained from past experiments using the same chemical formulation;

(d) Other pertinent information required by the department; and

(e) Conclusions and recommendations for future use.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.11 Exemptions. (1) Under any of the following conditions, the permit application fee in s. NR 107.04 (2) (a) will be limited to the basic application fee:

(a) The treatment is made for the control of bacteria on swimming beaches with chlorine or chlorinated lime;

(b) The treatment is intended to control algae or other aquatic nuisances that interfere with the use of the water for potable purposes;

(c) The treatment is necessary for the protection of public health, such as the control of disease carrying organisms in sanitary sewers, storm sewers, or marshes, and the treatment is sponsored by a governmental agency.

(2) The treatment of purple loosestrife is exempt from ss. NR 107.04 (2) (a) and (3), and 107.08 (5).

(3) The use of chemicals in private ponds is exempt from the provisions of this chapter except for ss. NR 107.04 (1), (2), (4) and (5), 107.05, 107.07, 107.08 (1), (2), (8) and (9), and 107.10.

(a) A private pond is a body of water located entirely on the land of an applicant, with no surface water discharge or a discharge that can be controlled to prevent chemical loss, and without access by the public.

(b) The permit application fee will be limited to the non–refundable $20 application fee.

(4) The use of chemicals in accordance with label instructions is exempt from the provisions of this chapter, when used in:

(a) Water tanks used for potable water supplies;

(b) Swimming pools;

(c) Treatment of public or private wells;

(d) Private fish hatcheries licensed under s. 95.60, Stats.;

(e) Treatment of emergent vegetation in drainage ditches or rights–of–way where the department determines that fish and wildlife resources are insignificant; or

(f) Waste treatment facilities which have received s. 281.41, Stats., plan approval or are utilized to meet effluent limitations set forth in permits issued under s. 283.31, Stats.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **corrections in (4) (d) and (f) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

NR 109.01 Purpose. The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.715, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. This chapter identifies other permits issued by the department for aquatic plant management that contain the appropriate conditions as required under this chapter for aquatic plant management, and for which no separate permit is required under this chapter**.** Introduction and control of aquatic plants shall be allowed in a manner consistent with sound ecosystem management, shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water. The purpose of this chapter is also to prevent the spread of invasive and non–native aquatic organisms by prohibiting the launching of watercraft or equipment that has any aquatic plants or zebra mussels attached.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.02 Applicability. A person sponsoring or conducting manual removal, burning or using mechanical means or aquatic plant inhibitors to control aquatic plants in navigable waters, or introducing non–native aquatic plants to waters of this state shall obtain an aquatic plant management permit from the department under this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.03 Definitions. In this chapter:

(1) "Aquatic community" means lake or river biological resources.

(2) "Beneficial water use activities" mean angling, boating, swimming or other navigational or recreational water use activity.

(3) "Body of water" means any lake, river or wetland that is a water of this state.

(4) "Complete application" means a completed and signed application form, the information specified in s. NR 109.04 and any other information which may reasonably be required from an applicant and which the department needs to make a decision under applicable provisions of law.

(5) "Department" means the Wisconsin department of natural resources.

(6) "Manual removal" means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.

(7) "Navigable waters" means those waters defined as navigable under s. 30.10, Stats.

(8) "Permit" means aquatic plant management permit.

(9) "Plan" means aquatic plant management plan.

(10) "Wetlands" means an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.04 Application requirements and fees. **(1)** Permit applications shall be made on forms provided by the department and shall be submitted to the regional director or designee for the region in which the project is located. Permit applications for licensed aquatic nursery growers may be submitted to the department of agriculture, trade and consumer protection.

Note: Applications may be obtained from the department's regional headquarters or service centers. DATCP has agreed to send application forms and instructions provided by the department to aquatic nursery growers along with license renewal forms. DATCP will forward all applications to the department for processing.

(2) The application shall be accompanied by all of the following unless the application is made by licensed aquatic nursery growers for selective harvesting of aquatic plants for nursery stock. Applications made by licensed aquatic nursery growers for harvest of nursery stock do not have to include the information required by par. (d), (e), (h), (i) or (j).

(a) A nonrefundable application fee. The application fee for an aquatic plant management permit is:

1. $30 for a proposed project to manage aquatic plants on less than one acre.

2. $30 per acre to a maximum of $300 for a proposed project to manage aquatic plants on one acre or larger. Partial acres shall be rounded up to the next full acre for fee determination. An annual renewal of this permit may be requested with an additional application fee of one–half the original application fee, but not less than $30.

(b) A legal description of the body of water including township, range and section number.

(c) One copy of a detailed map of the body of water with the proposed introduction or control area dimensions clearly shown. Private individuals doing plant introduction or control shall provide the name of the owner riparian to the management area, which includes the street address or block, lot and fire number where available and local telephone number or other pertinent information necessary to locate the property.

(d) One copy of any existing aquatic management plan for the body of water, or detailed reference to the plan, citing the plan references to the proposed introduction or control area, and a description of how the proposed introduction or control of aquatic plants is compatible with any existing plan.

(e) A description of the impairments to water use caused by the aquatic plants to be managed.

(f) A description of the aquatic plants to be controlled or removed.

(g) The type of equipment and methods to be used for introduction, control or removal.

(h) A description of other introduction or control methods considered and the justification for the method selected.

(i) A description of any other method being used or intended for use for plant management by the applicant or on the area abutting the proposed management area.

(j) The area used for removal, reuse or disposal of aquatic plants.

(k) The name of any person or commercial provider of control or removal services.

(3) (a) 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.

(b) Within 30 days of receipt of the plan, the department shall notify the applicant of any additional information or modifications to the plan that are required. If the applicant does not submit the additional information or modify the plan as requested by the department, the department may dismiss the aquatic plant management permit application.

(c) The department shall approve the aquatic plant management plan before an application may be considered complete.

(4) The permit sponsor may request an annual renewal in writing from the department under s. NR 109.05 if there is no change proposed in the conditions of the original permit issued.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.05 Permit issuance. (1) The department shall issue or deny issuance of the requested permit within 15 working days after receipt of a completed application and approved plan as required under s. NR 109.04 (3).

(2) The department may specify any of the following as conditions of the permit:

(a) The quantity of aquatic plants that may be introduced or controlled.

(b) The species of aquatic plants that may be introduced or controlled.

(c) The areas in which aquatic plants may be introduced or controlled.

(d) The methods that may be used to introduce or control aquatic plants.

(e) The times during which aquatic plants may be introduced or controlled.

(f) The allowable methods used for disposing of or using aquatic plants that are removed or controlled.

(g) Annual or other reporting requirements to the department that may include information related to pars. (a) to (f).

(3) The department may deny issuance of the requested permit if the department determines any of the following:

(a) Aquatic plants are not causing significant impairment of beneficial water use activities.

(b) The proposed introduction or control will not remedy the water use impairments caused by aquatic plants as identified as a part of the application in s. NR 109.04 (2) (e).

(c) The proposed introduction or control will result in a hazard to humans.

(d) The proposed introduction or control will cause significant adverse impacts to threatened or endangered resources.

(e) The proposed introduction or control will result in a significant adverse effect on water quality, aquatic habitat or the aquatic community including the native aquatic plant community.

(f) The proposed introduction or control is in locations identified by the department as sensitive areas, under s. NR 107.05 (3) (i) 1., except when the applicant demonstrates to the satisfaction of the department that the project can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

(g) The proposed management will result in significant adverse long–term or permanent changes to a plant community or a high value species in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in specific aquatic ecosystems, including Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Stuckenia pectinata (Potamogeton pectinatus), Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania spp., Zannichellia palustris and Brasenia schreberi.

(h) If wild rice is involved, the stipulations incorporated by *Lac Courte Oreilles v. Wisconsin*, 775 F. Supp. 321 (W.D. Wis. 1991) shall be complied with.

(i) The proposed introduction or control will interfere with the rights of riparian owners.

(j) The proposed management is inconsistent with a department approved aquatic plant management plan for the body of water.

(4) The department may approve the application in whole or in part consistent with the provisions of sub. (3). A denial shall be in writing stating the reasons for the denial.

(5) (a) The department may issue an aquatic plant management permit on less than one acre in a single riparian area for a 3–year term.

(b) The department may issue an aquatic plant management permit for a one–year term for more than one acre or more than one riparian area. The permit may be renewed annually for up to a total of 3 years in succession at the written request of the permit holder, provided no modifications or changes are made from the original permit.

(c) The department may issue an aquatic plant management permit containing a department–approved plan for a 3 to 5 year term.

(d) The department may issue an aquatic plant management permit to a licensed nursery grower for a 3–year term for the harvesting of aquatic plants from a publicly owned lake bed or for a 5–year term for harvesting of aquatic plants from privately owned beds with the permission of the property owner.

(6) The approval of an aquatic plant management permit does not represent an endorsement of the permitted activity, but represents that the applicant has complied with all criteria of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03**; reprinted to restore dropped language from rule order, Register October 2003 No. 574.**

NR 109.06 Waivers. The department waives the permit requirements under this chapter for any of the following:

(1) Manual removal or use of mechanical devices to control or remove aquatic plants from a body of water 10 acres or less that is entirely confined on the property of one person with the permission of that property owner.

Note: A person who introduces native aquatic plants or removes aquatic plants by manual or mechanical means in the course of operating an aquatic nursery as authorized under s. 94.10, Stats., on privately owned non–navigable waters of the state is not required to obtain a permit for the activities.

(2) A riparian owner who manually removes aquatic plants from a body of water or uses mechanical devices designed for cutting or mowing vegetation to control plants on an exposed lake bed that abuts the owner's property provided that the removal meets all of the following:

(a) 1. Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the

shoreline provided that any piers, boatlifts, swimrafts and other recreational and water use devices are located within that 30–foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method; or

2. Removal of nonnative or invasive aquatic plants as designated under s. NR 109.07 when performed in a manner that does not harm the native aquatic plant community; or

3. Removal of dislodged aquatic plants that drift on–shore and accumulate along the waterfront.

(b) Is not located in a sensitive area as defined by the department under s. NR 107.05 (3) (i) 1., or in an area known to contain threatened or endangered resources or floating bogs.

(c) Does not interfere with the rights of other riparian owners.

(d) If wild rice is involved, the procedures of s. NR 19.09 (1) shall be followed.

(4) Control of purple loosestrife by manual removal or use of mechanical devices when performed in a manner that does not harm the native aquatic plant community or result in or encourage re–growth of purple loosestrife or other nonnative vegetation.

(5) Any aquatic plant management activity that is conducted by the department and is consistent with the purposes of this chapter.

(6) Manual removal and collection of native aquatic plants for lake study or scientific research when performed in a manner that does not harm the native aquatic plant community.

Note: Scientific collectors permit requirements are still applicable.

(7) Incidental cutting, removal or destroying of aquatic plants when engaged in beneficial water use activities.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.07 Invasive and nonnative aquatic plants. (1) The department may designate any aquatic plant as an invasive aquatic plant for a water body or a group of water bodies if it has the ability to cause significant adverse change to desirable aquatic habitat, to significantly displace desirable aquatic vegetation, or to reduce the yield of products produced by aquaculture.

(2) The following aquatic plants are designated as invasive aquatic plants statewide: Eurasian water milfoil, curly leaf pondweed and purple loosestrife.

(3) Native and nonnative aquatic plants of Wisconsin shall be determined by using scientifically valid publications and findings by the department.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.08 Prohibitions. (1) No person may distribute an invasive aquatic plant, under s. NR 109.07.

(2) No person may intentionally introduce Eurasian water milfoil, curly leaf pondweed or purple loosestrife into waters of this state without the permission of the department.

(3) No person may intentionally cut aquatic plants in public/navigable waters without removing cut vegetation from the body of water.

(4) (a) No person may place equipment used in aquatic plant management in a navigable water if the person has reason to believe that the equipment has any aquatic plants or zebra mussels attached.

(b) This subsection does not apply to equipment used in aquatic plant management when re–launched on the same body of water without having visited different waters, provided the re–launching will not introduce or encourage the spread of existing aquatic species within that body of water.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.09 Plan specifications and approval. (1) Applicants required to submit an aquatic plant management plan, under s. NR 109.04 (3), shall develop and submit the plan in a format specified by the department.

(2) The plan shall present and discuss each of the following items:

(a) The goals and objectives of the aquatic plant management and protection activities.

(b) A physical, chemical and biological description of the waterbody.

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

(e) An evaluation of chemical, mechanical, biological and physical aquatic plant control methods.

(f) Recommendations for an integrated aquatic plant management strategy utilizing some or all of the methods evaluated in par. (e).

(g) An education and information strategy.

(h) A strategy for evaluating the efficacy and environmental impacts of the aquatic plant management activities.

(i) The involvement of local units of government and any lake organizations in the development of the plan.

(3) The approval of an aquatic plant management plan does not represent an endorsement for plant management, but represents that adequate considerations in planning the actions have been made.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.10 Other permits. Permits issued under s. 30.12, 30.20, 31.02 or 281.36, Stats., or under ch. NR 107 may contain provisions which provide for aquatic plant management. If a permit issued under one of these authorities contains the appropriate conditions as required under this chapter for aquatic plant management, a separate permit is not required under this chapter. The permit shall explicitly state that it is intended to comply with the substantive requirements of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.11 Enforcement. (1) Violations of this chapter may be prosecuted by the department under chs. 23, 30 and 31, Stats.

(2) Failure to comply with the conditions of a permit issued under or in accordance with this chapter may result in cancellation of the permit and loss of permit privileges for the subsequent year. Notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

APPENDIX E – 2021 DASH CONTROL REPORT

Pine Lake EWM Removal Report 2021

PO Box 1134 Minocqua, WI 54548

Pine Lake EWM Manual Removal Summary 2021

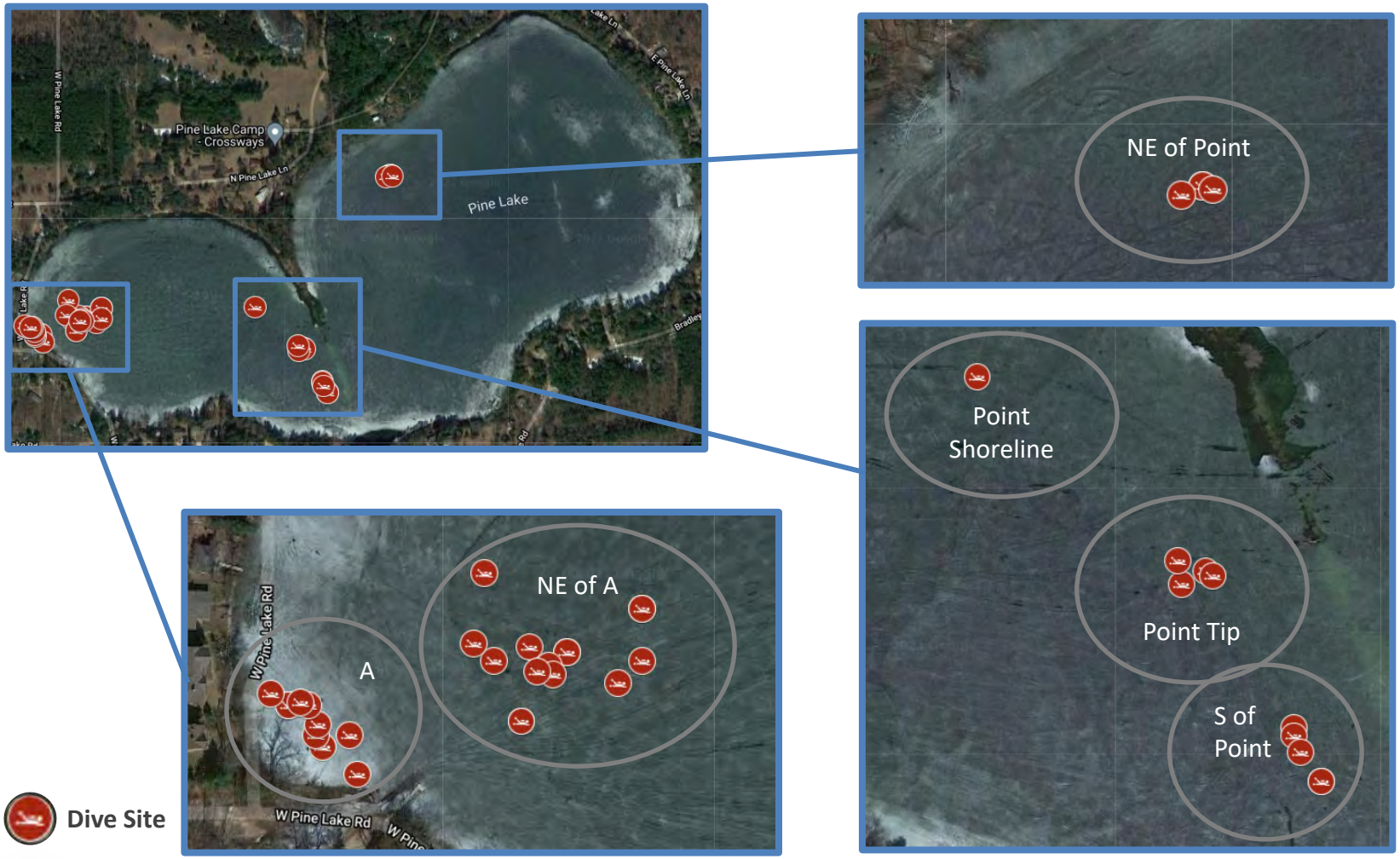
Dive Background: On June 16th, 28th-30th and July 19th-21st , Aquatic Plant Management LLC (APM) conducted 7 days of Diver Assisted Suction Harvesting of Eurasian Watermilfoil (EWM) on Pine Lake in Waushara County, WI. The dive team focused their efforts at 6 sites identified by during a 2020 point intercept survey and prioritized by the Pine Lake Property Owner's Association. In total APM was able to remove **621.0 cubic feet of EWM** from Pine Lake.

Date	Weather Conditions	Water Temp (F)	Underwater Dive Time (hrs)	AIS Removed (cubic ft)
6/16/2021	Sunny	72	6.0	66.0
6/28/2021	Partly Cloudy	76	6.3	140.0
6/29/2021	Periods of rain	76	4.9	93.0
6/30/2021	Sunny	76	4.4	63.5
7/19/2021	Sunny	77	6.1	108.0
7/20/2021	Sunny	77	6.8	71.5
7/21/2021	Cloudy	77	6.1	79.0
Grand Total			**40.6**	**621.0**

Dive Location	Avg. Water Depth	# of Dives	Underwater Dive Time	AIS Removed (cubic feet)
A	6.7	11	9.9	121.5
NE of A	8.2	15	14.8	271.5
NE of Point	18.5	4	2.9	39.5
Point Shoreline	11.0	1	1.8	33.0
Point Tip	10.6	4	4.0	44.0
S of Point	12.0	5	7.2	111.5
Grand Total	**9.6**	**40**	**40.6**	**621.0**

Dive Highlights and Recommendations: The APM dive teams spent over 60% of the time in and northeast of site A, where they were finding and removing large quantities of biomass. Other sites near the point in the center of the lake were in deep (10+ feet) water, which DASH is the most suitable manual removal method (versus traditional hand harvesting. Overall, Pine Lake should take an Integrated Pest Management (IPM) approach and evaluate different strategies to manage the EWM population on the lake. Continued monitoring and management efforts are important to prevent the spread of EWM throughout Pine Lake.

Map of Pine Lake Dive Sites



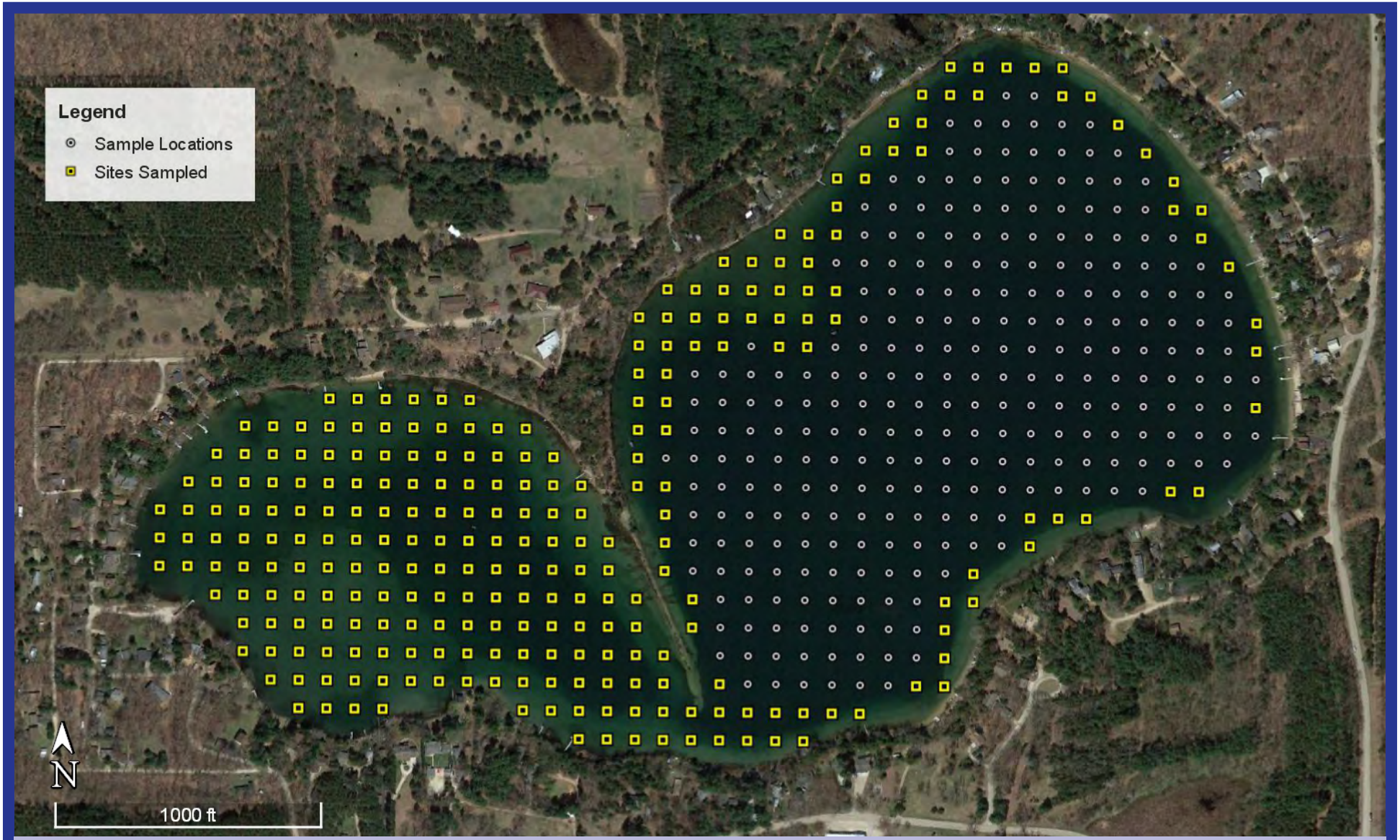
Detailed Diving Activities - June

Date	Dive Location	Latitude	Longitude	Underwater Dive Time (hrs)	AIS Removed (cubic ft)	AIS Density	Avg Water Depth (ft)	Native Species	Native By-Catch	Substrate Type
6/16/2021	A	44.23137	-89.17101	1.08	6.0	Clumps	2.5	Wild Celery	1.0	Organic/Sand
6/16/2021	A	44.23123	-89.17097	1.08	6.0	Clumps	6.0	Wild Celery	0.5	Organic
6/16/2021	A	44.23133	-89.17115	1.50	14.0	Highly Dominant	7.0	Wild Celery	1.0	Organic
6/16/2021	A	44.23137	-89.17118	0.58	8.0	Highly Dominant	7.0	Wild Celery	0.5	Organic
6/16/2021	A	44.23141	-89.17117	0.58	12.0	Highly Dominant	7.0	Wild Celery	0.5	Organic
6/16/2021	A	44.23148	-89.17122	1.17	20.0	Highly Dominant	8.0	Wild Celery	1.0	Organic
6/28/2021	NE of A	44.23167	-89.16991	1.17	8.0	Dominant	8.5	Pondweeds	0.5	Organic
6/28/2021	NE of A	44.23167	-89.16991	1.67	53.0	Dominant	8.5	Pondweeds	2.0	Organic
6/28/2021	NE of A	44.23183	-89.16953	1.00	10.0	Dominant	8.5	Pondweeds	0.5	Organic
6/28/2021	NE of A	44.23183	-89.16953	0.83	24.0	Dominant	8.5	Pondweeds	0.5	Organic
6/28/2021	NE of A	44.23156	-89.16965	1.67	45.0	Dominant	8.5	Pondweeds	0.5	Organic
6/29/2021	NE of A	44.23164	-89.16953	0.42	4.0	Scattered	8.5	Pondweeds	0.0	Organic
6/29/2021	NE of A	44.23169	-89.17010	0.58	12.0	Clumps	8.5	Pondweeds	0.0	Organic
6/29/2021	NE of A	44.23196	-89.17033	0.75	15.0	Dominant	8.5	Pondweeds	0.5	Organic
6/29/2021	A	44.23148	-89.17132	0.83	19.5	Dominant	8.5	Pondweeds	0.5	Organic
6/29/2021	A	44.23148	-89.17132	0.50	9.0	Dominant	8.5	Pondweeds	0.0	Organic
6/29/2021	A	44.23148	-89.17132	0.25	3.0	Scattered	8.5	Pondweeds	0.0	Organic
6/29/2021	NE of A	44.23164	-89.17028	0.58	15.5	Dominant	8.5	Pondweeds	0.5	Organic
6/29/2021	NE of A	44.23170	-89.17038	1.00	15.0	Dominant	8.5	Pondweeds	0.0	Organic
6/30/2021	NE of A	44.23142	-89.17014	1.00	17.0	Dominant	8.5	Pondweeds	0.0	Organic
6/30/2021	NE of Point	44.23416	-89.16244	0.92	4.0	Dominant	18.5	Pondweeds	0.0	Organic/Gravel
6/30/2021	NE of Point	44.23416	-89.16244	0.67	10.0	Dominant	18.5	Pondweeds	0.0	Organic/Gravel
6/30/2021	NE of Point	44.23413	-89.16254	0.58	13.5	Dominant	18.5	Pondweeds	0.0	Organic/Gravel
6/30/2021	NE of A	44.23142	-89.17014	0.50	7.0	Clumps	8.5	Pondweeds	0.0	Organic
6/30/2021	NE of Point	44.23415	-89.16239	0.75	12.0	Dominant	18.5	Pondweeds	0.0	Organic/Gravel
Total	**25**			**21.66**	**362.5**				**10.0**	

Detailed Diving Activities - July

Date	Dive Location	Latitude	Longitude	Underwater Dive Time (hrs)	AIS Removed (cubic ft)	AIS Density	Avg Water Depth (ft)	Native Species	Native By-Catch	Substrate Type
7/19/2021	NE of A	44.23162	-89.17000	2.00	18.0	Clumps	7.0	None	0.0	Organic
7/19/2021	Point Tip	44.23112	-89.16458	1.00	21.0	Clumps	10.0	None	0.0	Organic
7/19/2021	S of Point	44.23054	-89.16412	1.42	41.0	Clumps	12.0	None	0.0	Organic
7/19/2021	NE of A	44.23159	-89.16998	1.00	16.0	Clumps	7.0	None	0.0	Organic
7/19/2021	NE of A	44.23160	-89.17006	0.67	12.0	Clumps	7.0	None	0.0	Organic
7/20/2021	S of Point	44.23051	-89.16412	2.92	18.5	Clumps	12.0	None	0.0	Organic
7/20/2021	Point Tip	44.23110	-89.16454	1.92	17.0	Clumps	10.0	None	0.0	Organic
7/20/2021	S of Point	44.23034	-89.16398	0.67	16.0	Scattered	12.0	None	0.0	Organic
7/20/2021	S of Point	44.23034	-89.16398	1.25	20.0	Scattered	12.0	None	0.0	Organic
7/21/2021	Point Tip	44.23107	-89.16470	0.67	3.0	Clumps	10.5	None	0.0	Organic
7/21/2021	A	44.23152	-89.17141	1.00	6.0	Scattered	4.0	Pondweeds	3.0	Organic
7/21/2021	A	44.23149	-89.17126	1.33	18.0	Clumps	7.0	Pondweeds	0.5	Organic
7/21/2021	S of Point	44.23045	-89.16409	0.92	16.0	Scattered	12.0	Pondweeds	0.0	Organic
7/21/2021	Point Tip	44.23116	-89.16472	0.42	3.0	Scattered	12.0	None	0.0	Organic
7/21/2021	Point Shoreline	44.23184	-89.16576	1.75	33.0	Clumps	11.0	None	0.0	Organic
Total	**15**			**18.94**	**258.5**				**3.5**	

FIGURES



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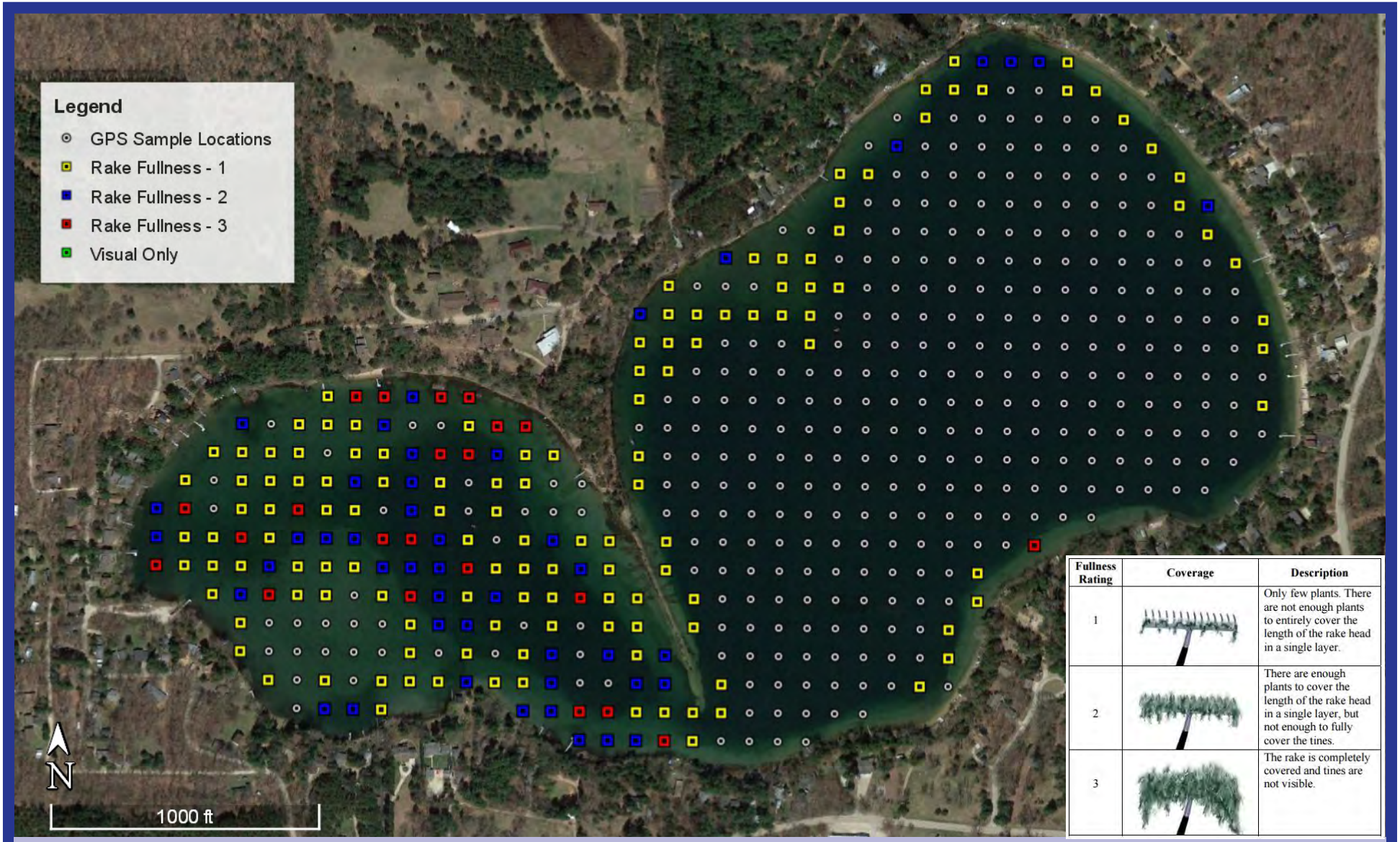
Sample Site Locaitions

Pine Lake, Waushara County

Figure 1
Surveyed: August 11-12, 2020



Fullness Rating	Coverage	Description
1		Only few plants. There are not enough plants to entirely cover the length of the rake head in a single layer.
2		There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines.
3		The rake is completely covered and tines are not visible.

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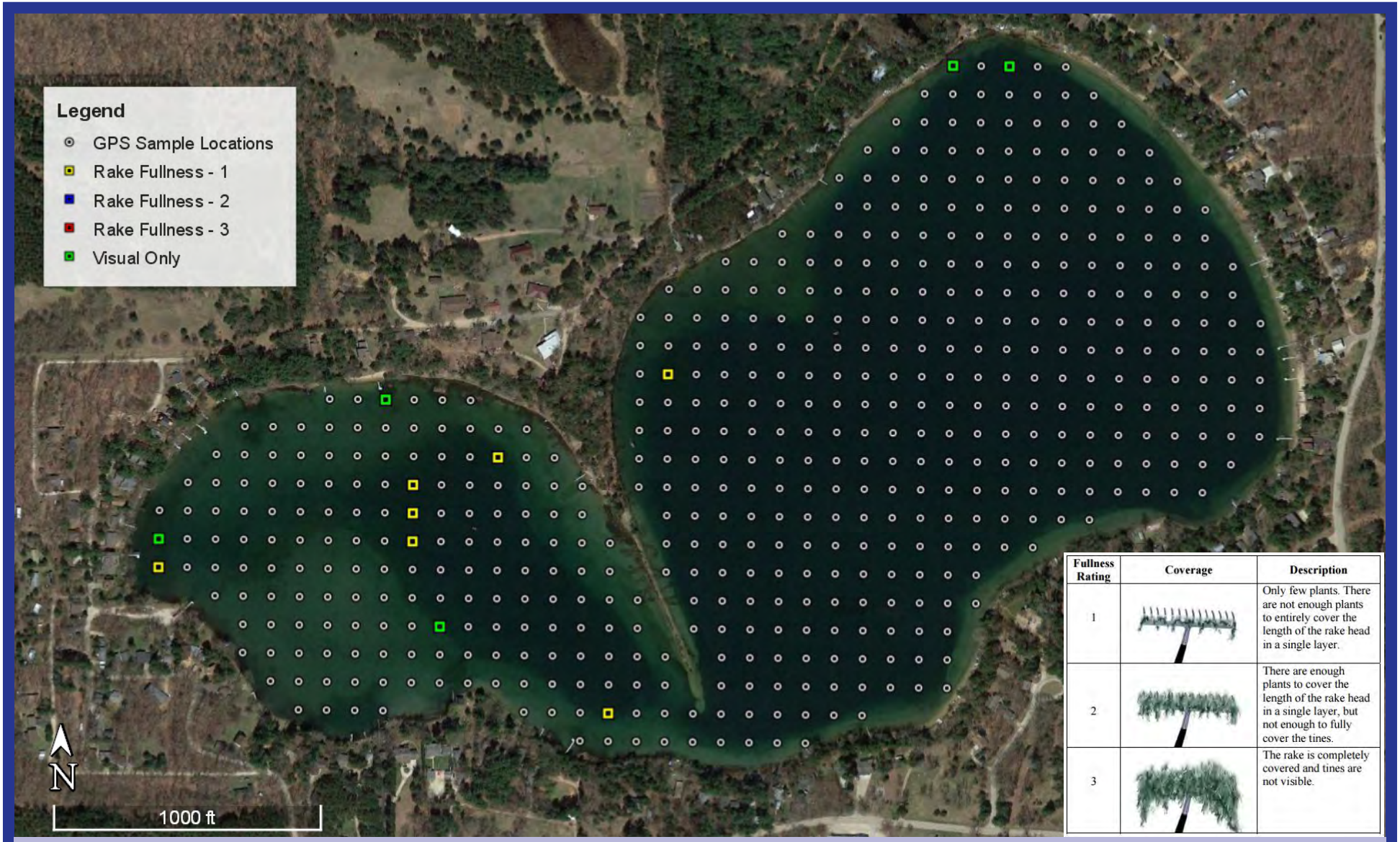
Total Rake Fullness

Pine Lake, Waushara County

Figure 2
Surveyed: August 11-12, 2020



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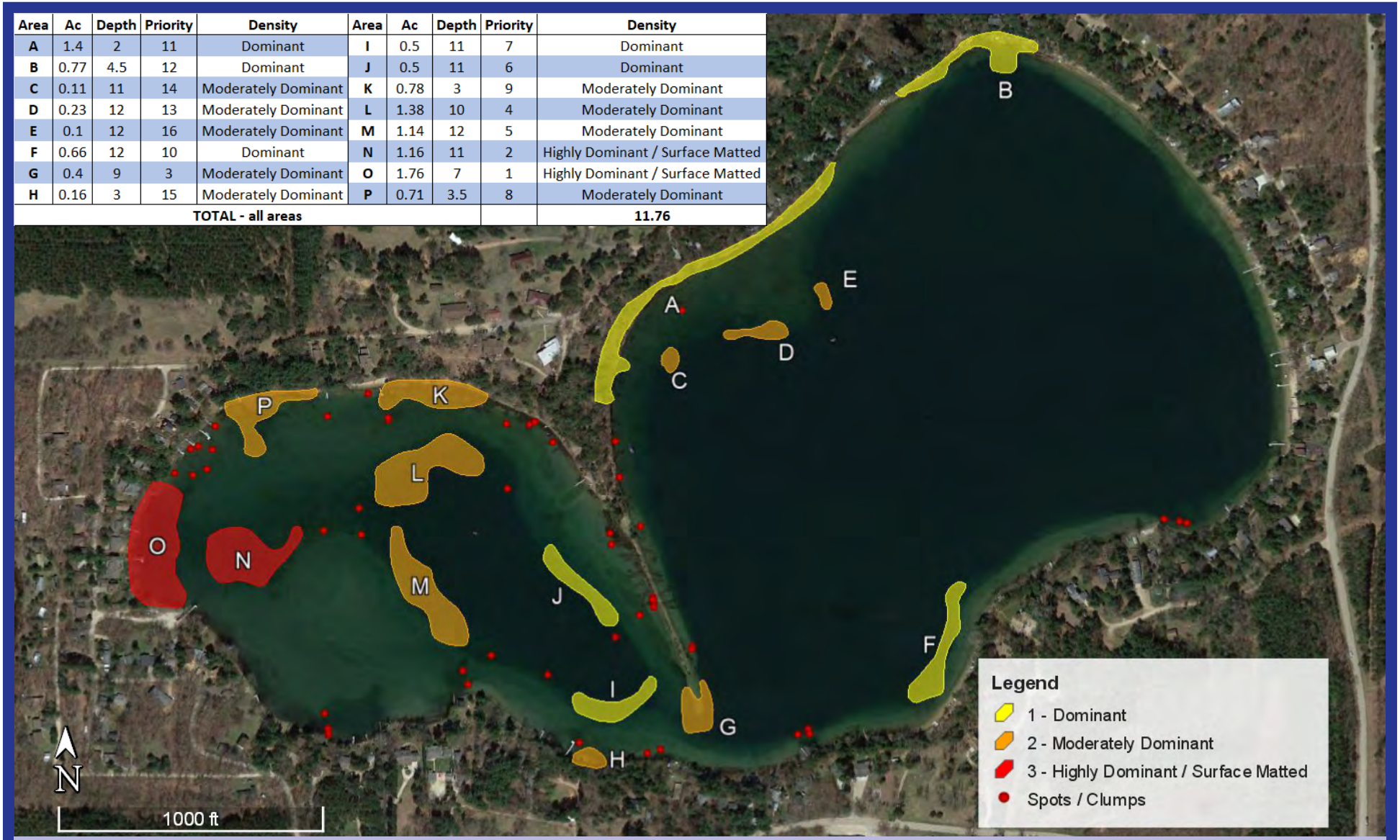
Eurasian Water-milfoil

Myriophyllum spicaturm

Pine Lake, Waushara County

Figure 3
Surveyed: August 11-12, 2020

Area	Ac	Depth	Priority	Density	Area	Ac	Depth	Priority	Density
A	1.4	2	11	Dominant	I	0.5	11	7	Dominant
B	0.77	4.5	12	Dominant	J	0.5	11	6	Dominant
C	0.11	11	14	Moderately Dominant	K	0.78	3	9	Moderately Dominant
D	0.23	12	13	Moderately Dominant	L	1.38	10	4	Moderately Dominant
E	0.1	12	16	Moderately Dominant	M	1.14	12	5	Moderately Dominant
F	0.66	12	10	Dominant	N	1.16	11	2	Highly Dominant / Surface Matted
G	0.4	9	3	Moderately Dominant	O	1.76	7	1	Highly Dominant / Surface Matted
H	0.16	3	15	Moderately Dominant	P	0.71	3.5	8	Moderately Dominant
TOTAL - all areas									11.76



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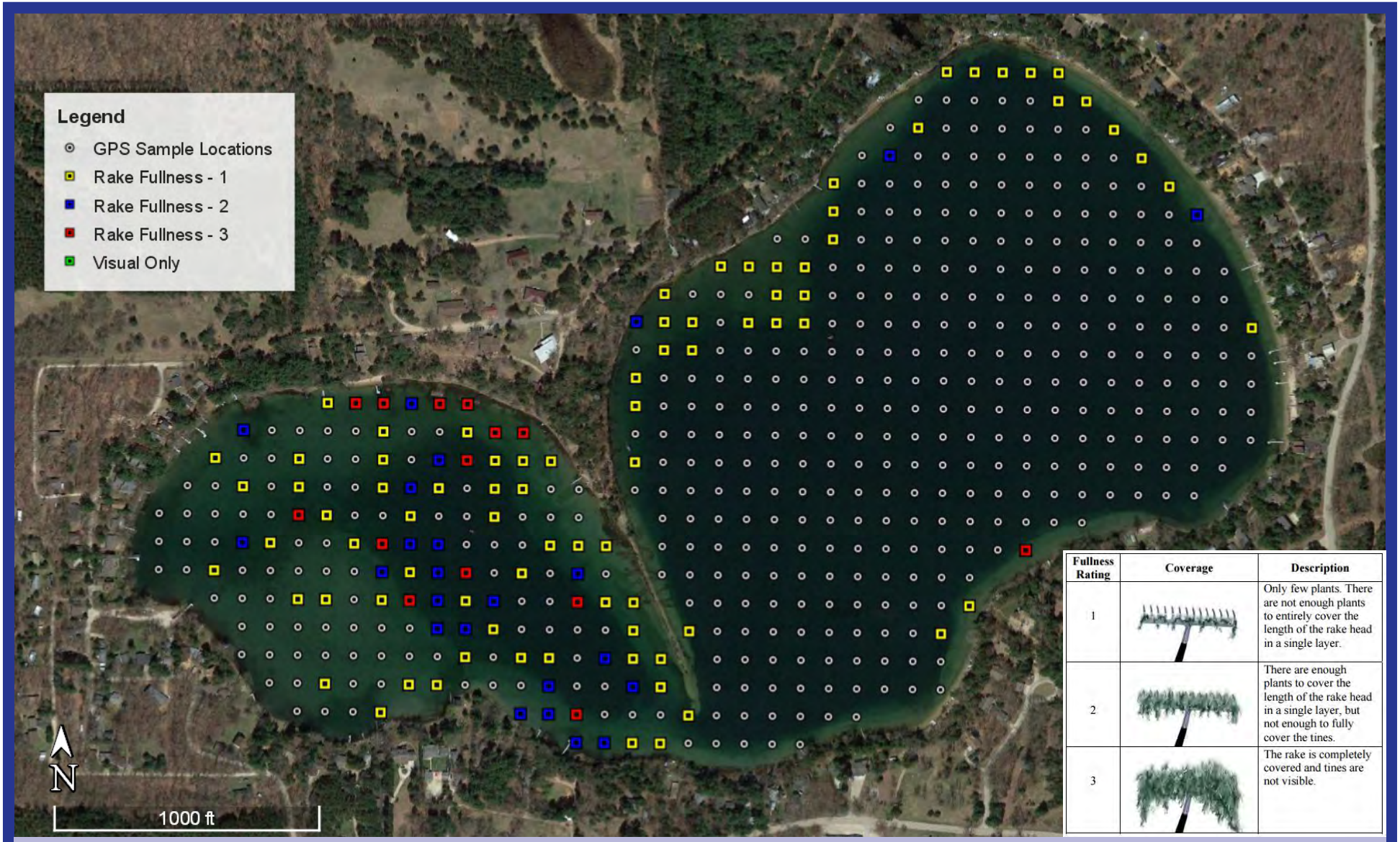
Eurasian Water-milfoil Locations

Myriophyllum spicaturm

Pine Lake, Waushara County

Figure 4
Surveyed: September 9, 2021



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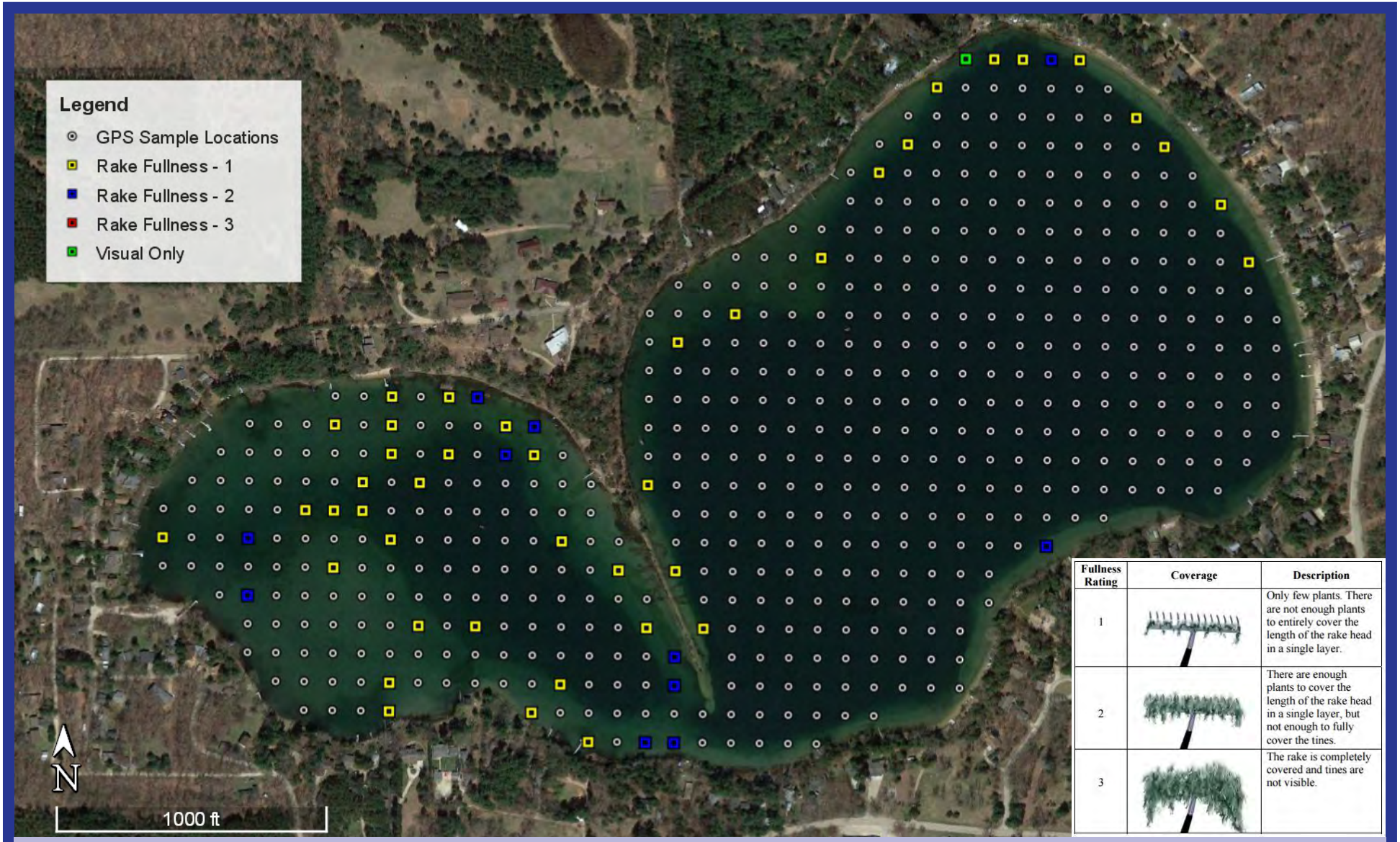
Muskgrass (chara)

Chara sp.

Pine Lake, Waushara County

Figure 5
Surveyed: August 11-12, 2020



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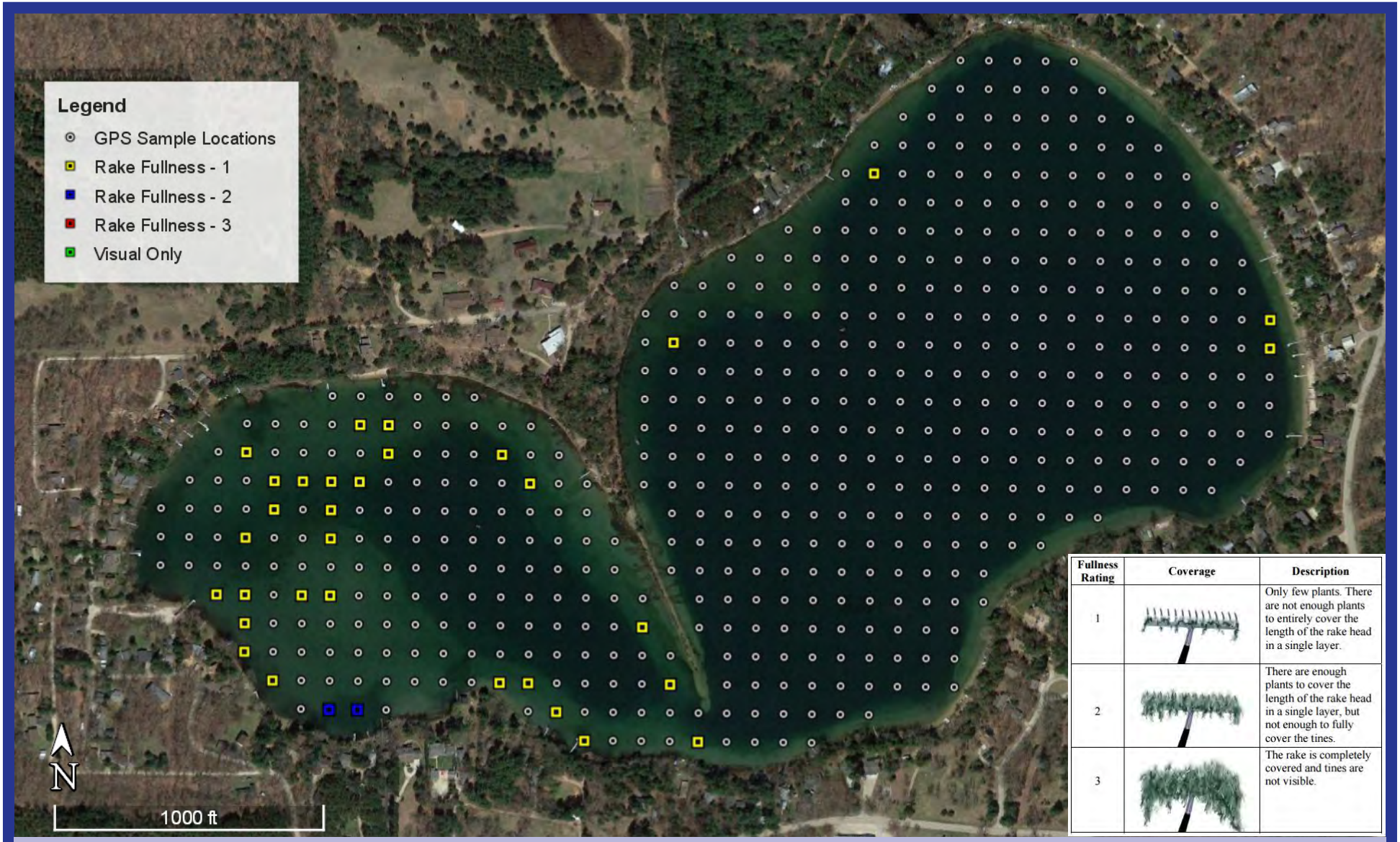
Variable Pondweed

Potamogeton gramineus

Pine Lake, Waushara County

Figure 7
Surveyed: August 11-12, 2020



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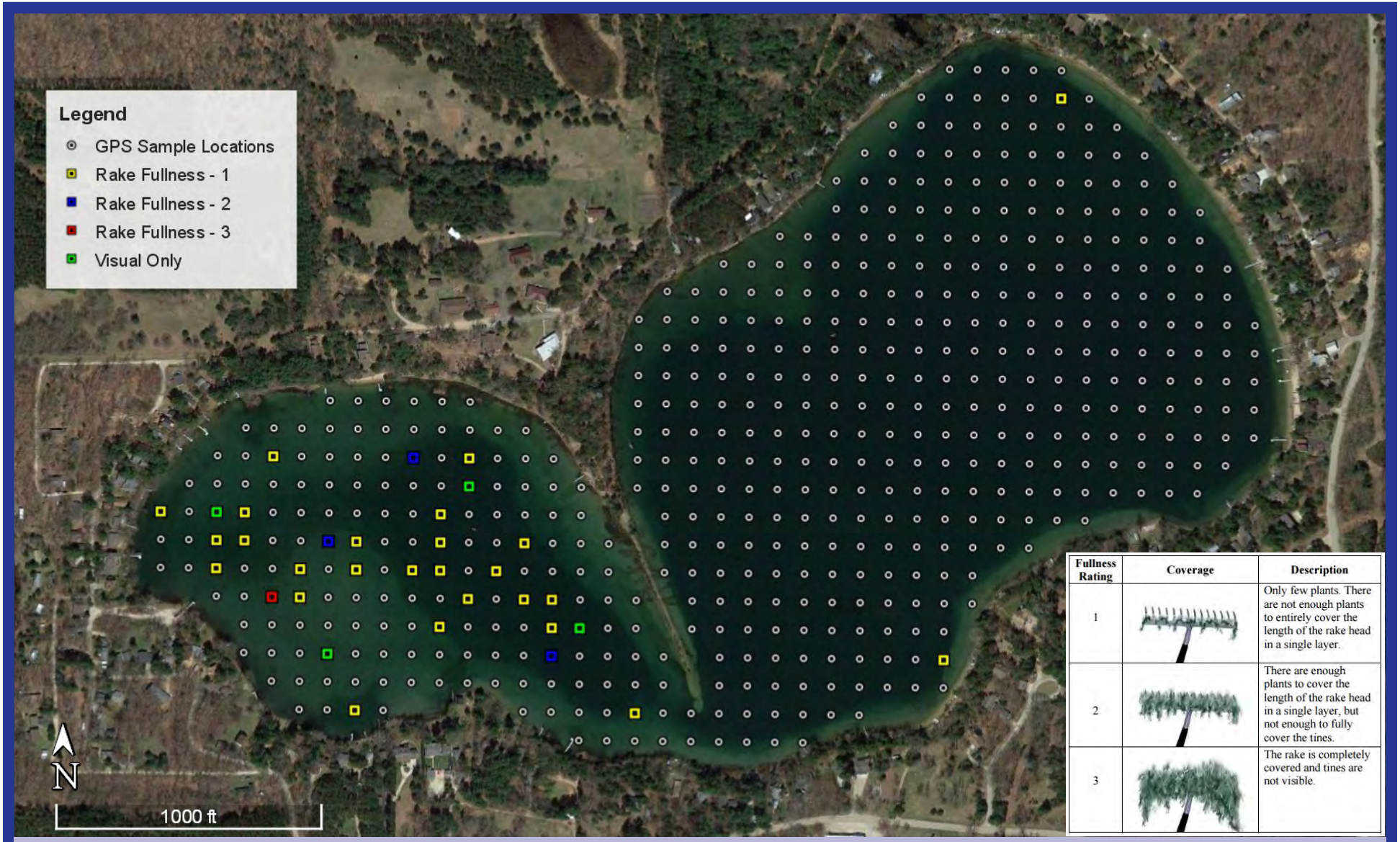
Southern Naiad

Najas guadalupensis

Pine Lake, Waushara County

Figure 8
Surveyed: August 11-12, 2020



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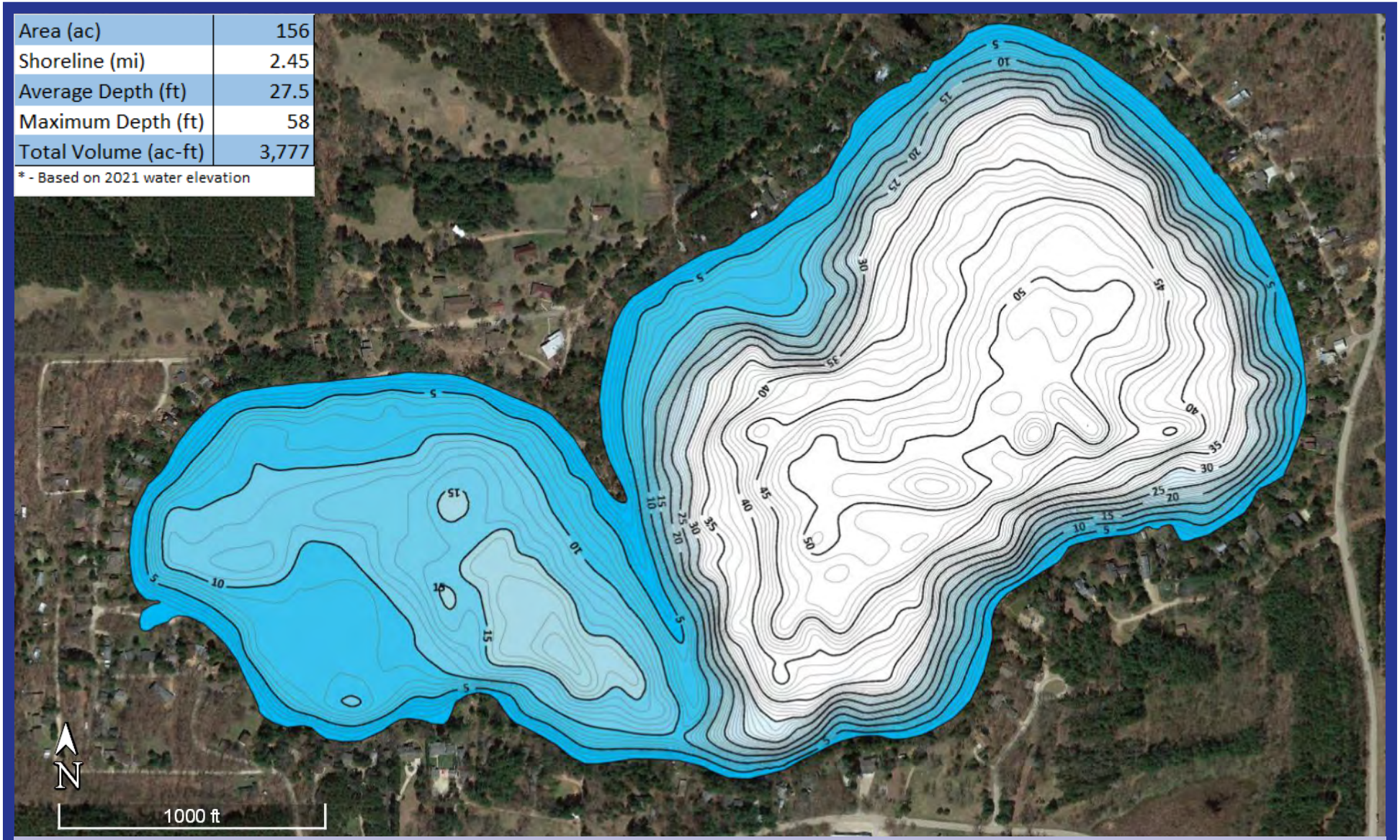
Large-leaf Pondweed

Potamogeton amplifolius

Pine Lake, Waushara County

Figure 9
Surveyed: August 11-12, 2020



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Updated Bathymetric Map

Pine Lake, Waushara County

Figure 10
Surveyed: September 9, 2021

TABLES

Table 3: 2013 & 2020 Aquatic Plant Community Statistics, Pine Lake, Waushara County, WI

Aquatic Plant Community Statistics	2013	2020
Total sites sampled	407	537
Total sites with vegetation	324	197
Total site shallower than max depth of plants	401	262
Frequency of occurrence at sites shallower than maximum depth of plants	80.80%	75.19%
Simpson Diversity Index	0.82	0.82
Maximum Depth of Plants (Feet)	36	25
Taxonomic Richness (Number of Species - including visuals)	20	16
Average Total Rake Fullness	1.53	1.45
Average Number of Species per Site (sites less than max depth of plant growth)	1.51	1.4
Average Number of Species per Site (sites with vegetation)	1.88	1.87
Average Number of Native Species per Site (sites less than max depth of plant growth)	1.49	1.38
Average Number Native of Species per Site (sites with vegetation)	1.86	1.84

Table 4: 2013 & 2020 Frequency of Occurrence of Aquatic Plant Species, Pine Lake, Waushara Co., WI

Species	Frequency of Occurence by Year	
	2013	2020
Filamentous algae	---	0.38
Muskgrass	56.86	45.8
Common waterweed	4.24	---
Bearded stonewort	6.48	---
Northern water-milfoil	0.25	0.38
Eurasian water-milfoil	**2**	**2.67**
Slender naiad	10.47	5.73
Southern naiad	5.24	12.98
Nitella (stonewort)	20.45	2.29
Small stonewort	0.75	---
White water lily	0.5	0*
Large-leaf pondweed	4.24	11.45
Leafy pondweed	---	0.38
Fries' pondweed	---	0.38
Variable pondweed	12.97	20.23
Illinois pondweed	2.99	8.4
Floating-leaf pondweed	0.75	---
White-stem pondweed	10.72	---
Stiff pondweed	2	---
Flat-stem pondweed	4.24	4.96
Three-square bulrush	0*	---
Softstem bulrush	---	0*
Sago pondweed	0.25	1.15
Wild celery	6.23	23.66

* - recorded as visual only

--- - species not sampled

Table 5: FQI Breakdown by species for Pine Lake, Waushara County, Wisconsin.

Common Name*	Coefficient of Conservatism	
	2013	2018
Muskgrass	7	7
Common waterweed	3	---
Northern water-milfoil	6	6
Slender naiad	6	6
Southern naiad	8	8
Nitella (stonewort)	7	7
White water lily	6	6
Large-leaf pondweed	7	7
Leafy pondweed	---	6
Fries' pondweed	---	8
Variable pondweed	7	7
Illinois pondweed	6	6
Floating-leaf pondweed	5	---
White-stem pondweed	8	---
Stiff pondweed	8	---
Flat-stem pondweed	6	6
Three-square bulrush	5	---
Softstem bulrush	---	4
Sago pondweed	3	3
Wild celery	6	6
Total Species	**17**	**15**
Mean C	**6.12**	**6.20**
Floristic Quality Index (FQI)	**25.22**	**24.01**

* - only species sampled or visually observed and with assigned coefficients are included

--- Species was not sampled