Aquatic Plant Management Plan Update

Potter Lake

March 2022

Prepared for:

Potter Lake Protection and Rehabilitation District

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Lake and Pond Solutions, LLC

Elkhorn, WI

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INTRODUCTION

The purpose of this update is to report the results of the 2021 point-intercept survey to describe the relative densities and species composition of the plant community of Potter Lake and compare it to the last Aquatic Plant Management (APM) Plan, written by Aron & Associates and approved in 2017. This plan outlines a strategy to implement an aquatic harvesting and herbicide management program that will provide for recreational lake uses through nuisance and exotic species control. High quality plant communities which help promote water quality and provide fish and wildlife habitat should be protected from unnecessary negative impacts. Through review and comparison of past plant management data, a multi-faceted plant management strategy to optimize both conservation of aquatic resources and recreational value to all lake users can be developed.

Goals and Objectives

The goals and objectives on Potter Lake continue to focus on balancing the various uses and needs while working to improve the long-term quality of the resource. The difficult task facing those who attempt to manage their lake is that user needs often conflict. Fish and wildlife need aquatic plants to thrive. Boaters and swimmers desire relief from nuisance aquatic plants. Those depending on the lake for "aesthetic viewing" desire an undisturbed lake surface.

The management of non-native plants, specifically, Eurasian water-milfoil (*Myriophyllum spicatum*), hybrid water milfoil, curly-leaf pondweed (*Potamogeton crispus*), and excessive amounts of native plants continue to be a great concern to the District. The invasive plants and very dense native plants restrict boating use in some areas of the lake. Controlling exotic plants, preventing new invasions of exotic species, and protecting diversity of the native plant population is crucial to the ecological balance of the resource.

The District desires to:

- Reduce and maintain levels of Eurasian water milfoil and hybrid water milfoil to below 5% frequency and consider whole lake management when levels exceed 20% frequency
- Minimize fragments of aquatic plants that are caused by the high volume of boating traffic and natural processes
- Control exotic and nuisance plant species and maintain recreational access for lake users by the use of selective chemical treatments and harvesting
- Preserve and enhance the natural lake environment by:
    - Educating landowners and lake users about lake ecology
    - Work with Town, County, and State governments to review existing ordinances and if necessary, develop and enforce ordinances that protect Potter Lake
    - Continued vigilance regarding watershed protection for Potter Lake
- Identify and expand local educational efforts that the District may undertake to improve the public's understanding of lake issues
- Conduct in-lake management activities with the long-range goal of minimizing necessary management
    - Conduct year-end evaluations as to the success of plant management activities and the community reaction to the activities
    - Track annual progress of lake management activities
    - Conduct water quality monitoring efforts to assist in the documentation of results

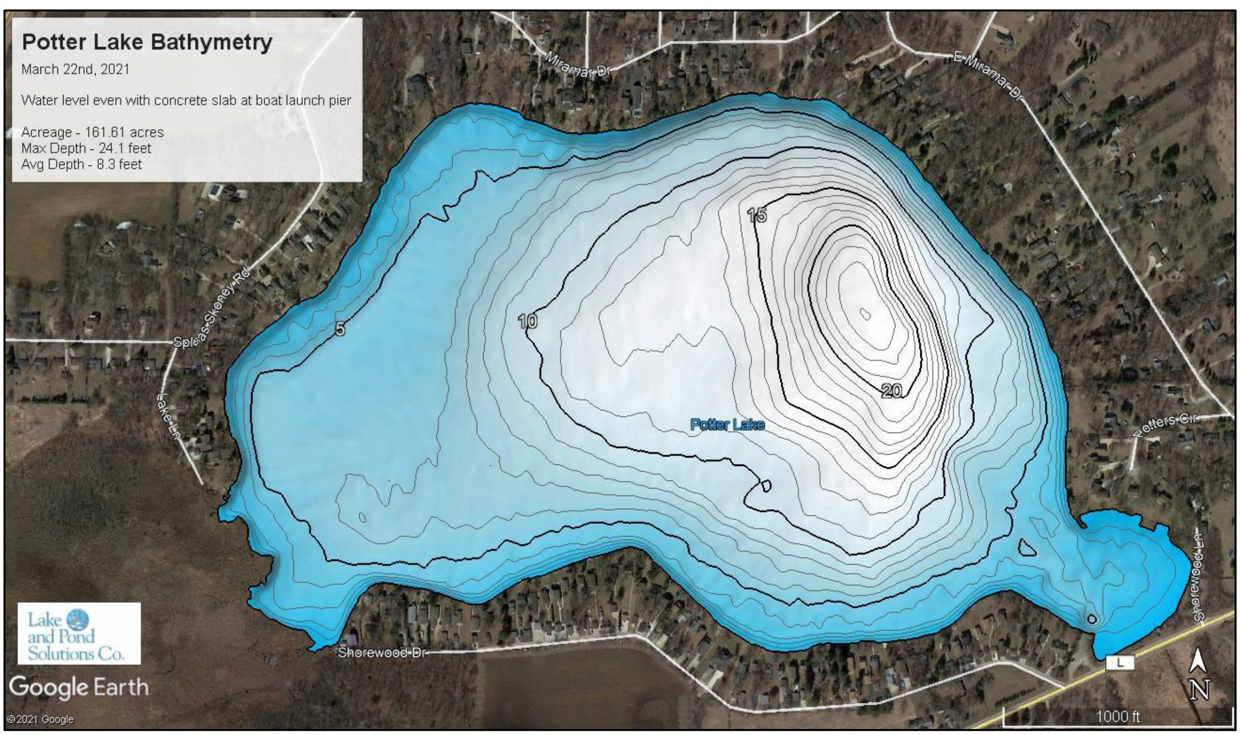
- Maintain navigational access by:
    - Aggressively treating Eurasian water-milfoil and hybrid water milfoil to prevent them from increasing their range in the Lake
    - Maintain navigational access by controlling plants as necessary to maintain that access
    - Treat filamentous algae mats on shorelines to prevent temperature increases, plant shifts, and to maintain navigational and recreational access
    - Control vegetative mats that collect on the surface
    - Control floating plant debris
- Minimize the financial costs to the District by conducting projects with long-term, cost-effective results

BACKGROUND

Waterbody Characteristics

Potter Lake is a 161.61-acre lake located in Walworth County, Wisconsin. The lake has a shoreline length of approximately 2.45 miles, a maximum depth of 26 feet, and an average depth of 8.3 feet. Potter Lake is classified as a seepage lake, with lake level partially controlled by a culver (dam) on the southeast end of the lake. The deepest section of the lake is located on the northeast quadrant while the western portion has a large shallow shelf. Figure 1 shows bathymetry from a 2021 survey. Although water was not full pool at the time of the survey, it gives general detail about the depth profiles of the lake.

Figure 1: *Potter Lake Bathymetry*

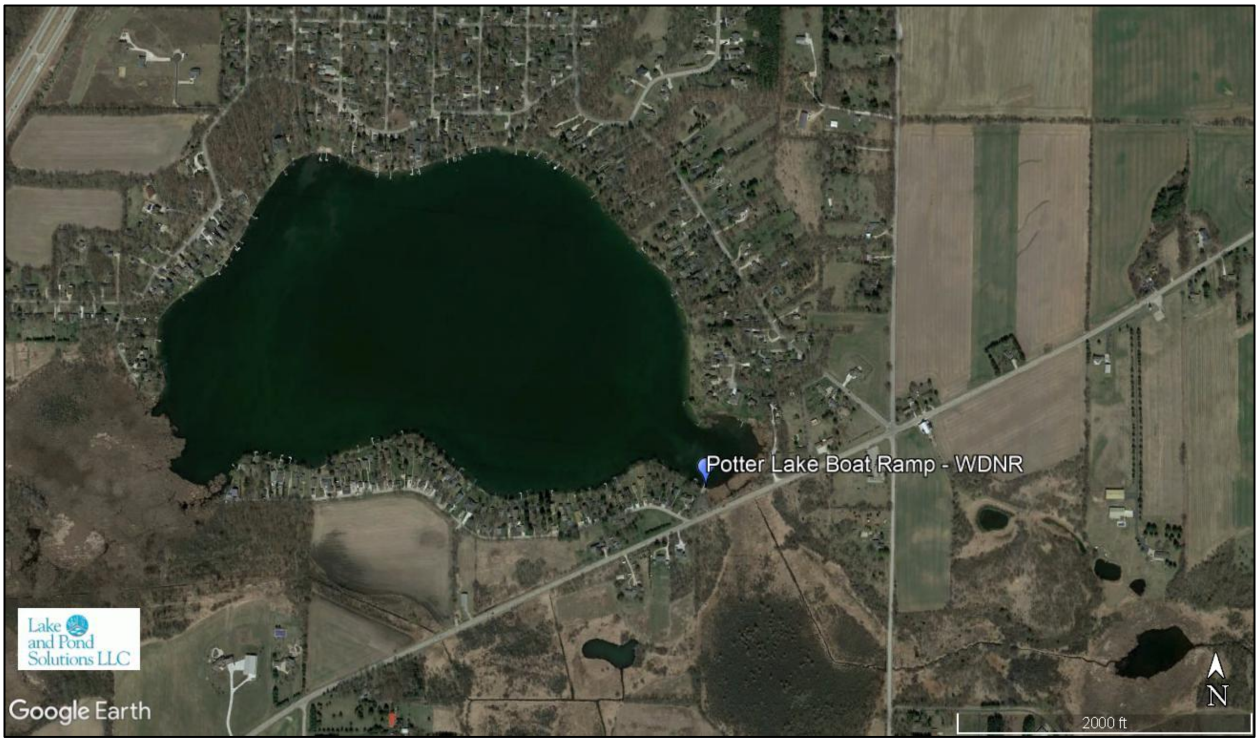


Lake and Pond Solutions Co., 2021

Access

Potter Lake has one public access point, a DNR managed boat landing in the southeast corner of the lake off County Road L (Figure 2). The access has parking for eight trailered rigs including one handicap accessible space. In 2016-2021 the landing was staffed on weekends from Memorial Day to Labor Day with a Clean Boats, Clean Waters watercraft inspector. With one landing on the lake, this provides a simple way to educate boaters and monitor the possibility of spread of aquatic invasive species.

Figure 2: *Access Points on Potter Lake*

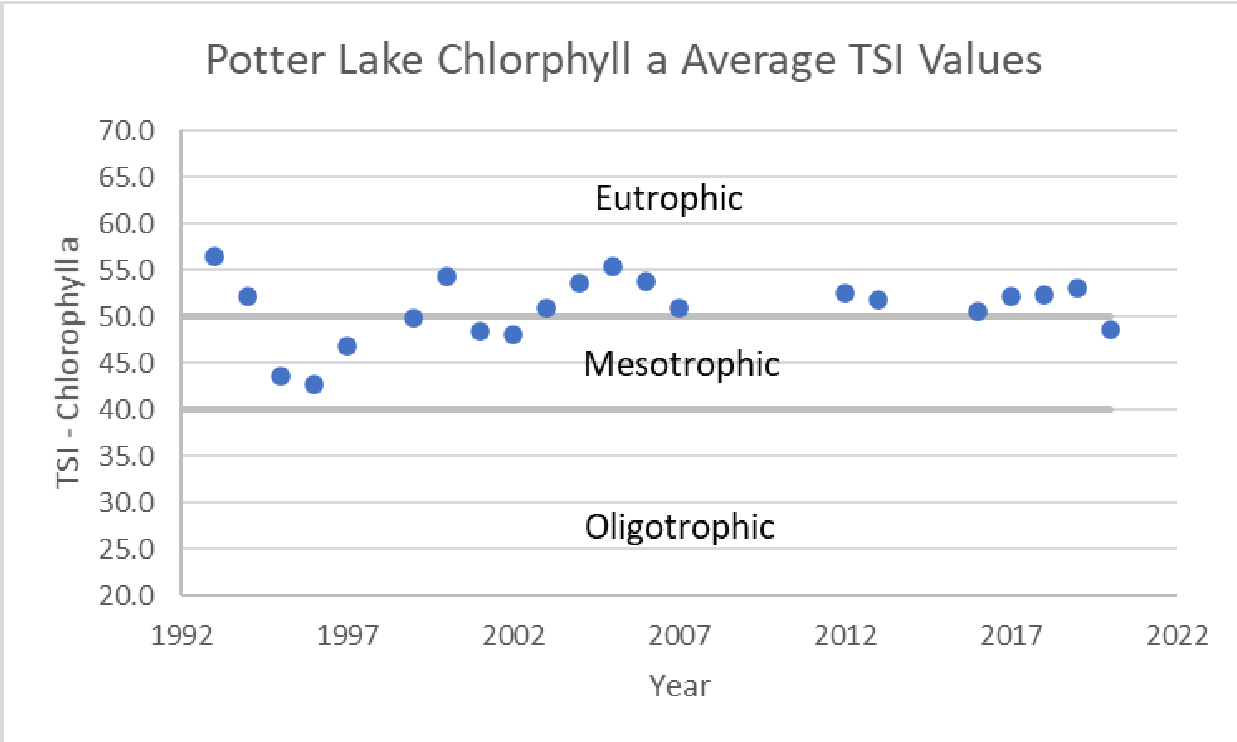


Lake and Pond Solutions LLC, 2022

Water Quality Reports and Data

Potter Lake has water quality data available through the WDNR citizen lake monitoring program and contracted USGS water quality monitoring for Secchi Disk, Total Phosphorus, and Chlorophyll-a. These three metrics can each be used to generate a Trophic State Index (TSI) developed by Carlson (1977), which is used to analyze the trophic state of a water body (the quantity of living biomass in a waterbody at a given time). This can determine the likelihood of algal blooms that could cause impaired water clarity and potentially toxic blue-green algae (cyanobacteria). Figure 3 below depicts the mean TSI for chlorophyll-a, shown to be a better predictor than the mean of all three. Over the past 20 years, Potter Lake has dipped in and out of the mesotrophic and eutrophic categories. Mesotrophic lakes are characterized by moderately clear water and increasing probability of hypolimnetic anoxia in the summer (limited oxygen in the bottom portions). Eutrophic lakes are characterized by anoxic (low oxygen) bottom waters, macrophyte (plant) problems, and bass dominated fisheries.

Figure 3: *Mean Chlorophyll a Trophic Status Index (TSI) for Potter Lake, 1992-2020*



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Historical Management

The District has conducted significant aquatic plant management activities over the years to keep Potter Lake open and available for recreational use. The District's early efforts focused on aquatic plant harvesting. As densities increased above levels that the harvesting could manage, the District switched primarily to herbicide treatments supplemented by harvesting.

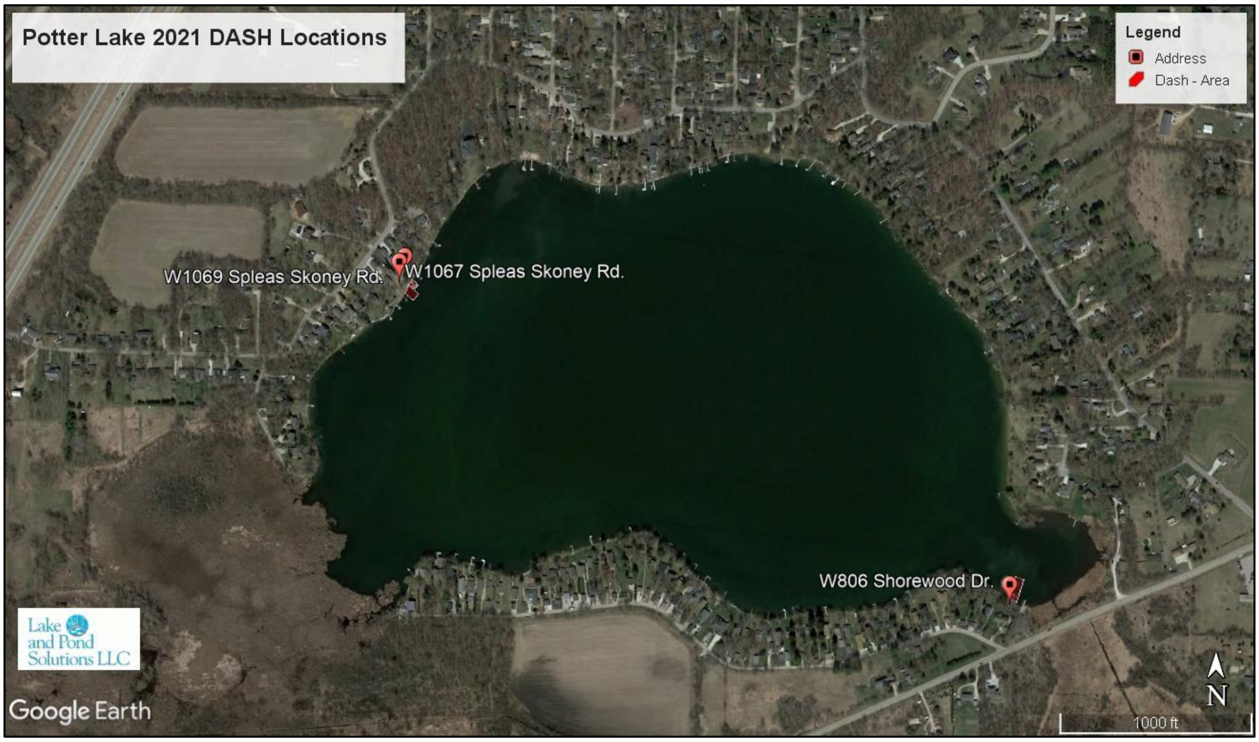
Harvesting

The District began harvesting in 1976. Eurasian watermilfoil has been the target plant for the harvesting program since the program's inception. In many years, the harvester could not keep up with the plant growth, restricting recreational use on the lake and creating significant shoreline maintenance for landowners. Although the District had not harvested since 2012, 2021 posed some difficult challenges with a resurgence in curly-leaf pondweed, Eurasian watermilfoil and historical levels of common waterweed (*Elodea canadensis*). Low lake water levels also played a role so harvesting was reinitiated to regain navigation with a total of 108 loads of vegetation being cut and removed in the 2021 season.

DASH

There were three individual properties that took out mechanical permits in 2021. Figure 4 below shows the private shoreline areas where DASH was used.

Figure 4: *2021 DASH Sites on Potter Lake*



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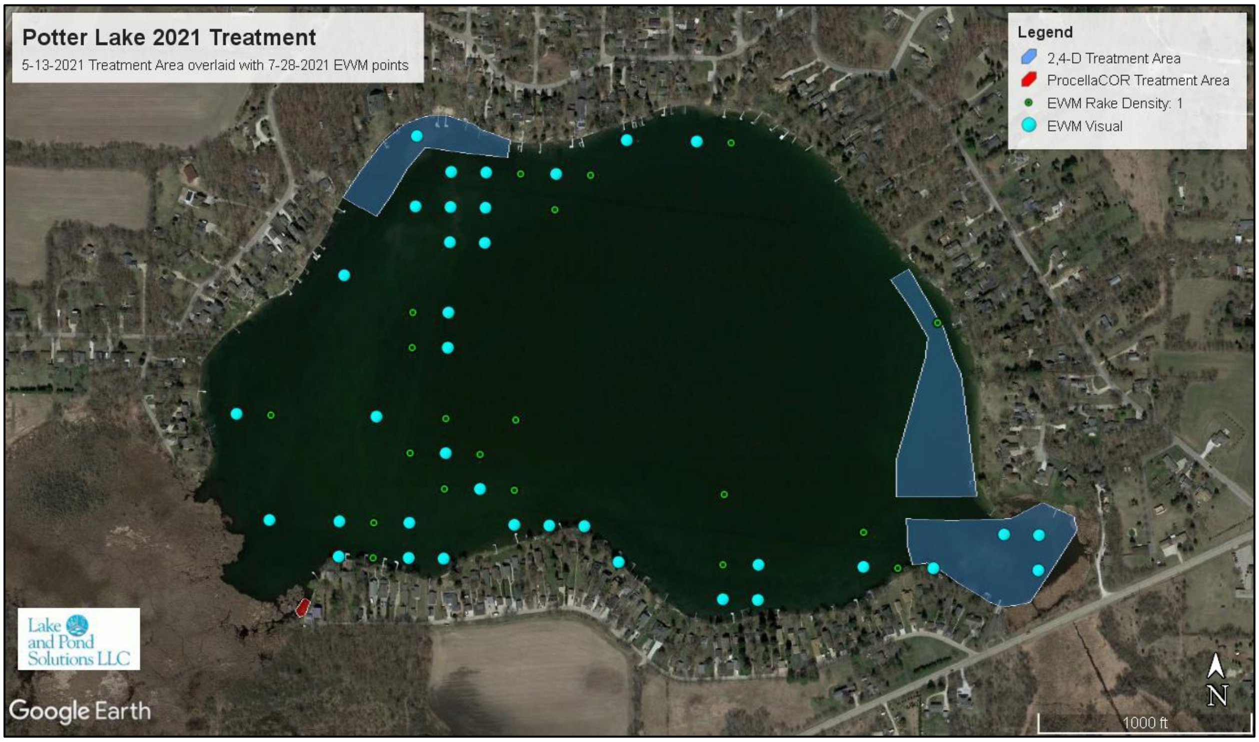
Herbicide Treatment

In September 1997, Potter Lake conducted its first whole-lake treatment for EWM using Sonar AS (liquid fluridone at 14 ppb). The treatment provided 3 years of control and by 2004, EWM frequency had increased significantly. Whole lake treatments with Sonar AS were conducted in 2004 and 2005. The back-to-back whole lake treatments were due to treatment timing issues that affected efficacy in 2004. These treatments again led to 3 years of control, but the WDNR denied requests to spot treat EWM in spring of 2007. Between 2007 and 2016, only spot treatments for EWM and CLP were conducted (some larger). Hybridized water milfoil (HWM) was confirmed in 2011.

In April of 2017, a whole lake treatment with SonarOne (granular fluridone) was conducted targeting EWM and HWM at 4 ppb. Two subsequent 2 ppb "bump" treatments were conducted later that year to maintain concentration along with another 2 ppb "bump" treatment in April of 2018. This treatment was successful as no EWM/HWM was found in the 2018 survey and no further EWM/HWM treatments were needed in 2018 and 2019.

Spot treatments were again needed in 2020 and 2021 as EWM/HWM started to increase. Curly-leaf pondweed was also treated in 2019 and 2020 with the decision made to harvest 2021 growth. The 2021 survey found the highest EWM frequency of occurrence (36.36%) since 2004 and indicates the lake is likely due for another whole lake treatment. Figure 5 shows the limited amounts of EWM found in previously treated areas while also identifying the level of EWM spread outside of those treatment areas. Table 1 shows the treatment history for Potter Lake over the past 6 seasons.

Figure 5: *Potter Lake 2021 EWM Treatment Areas vs Late July EWM*



Lake and Pond Solutions LLC, 2022

Table 1: *Treatment History for Potter Lake, 2016-2021*

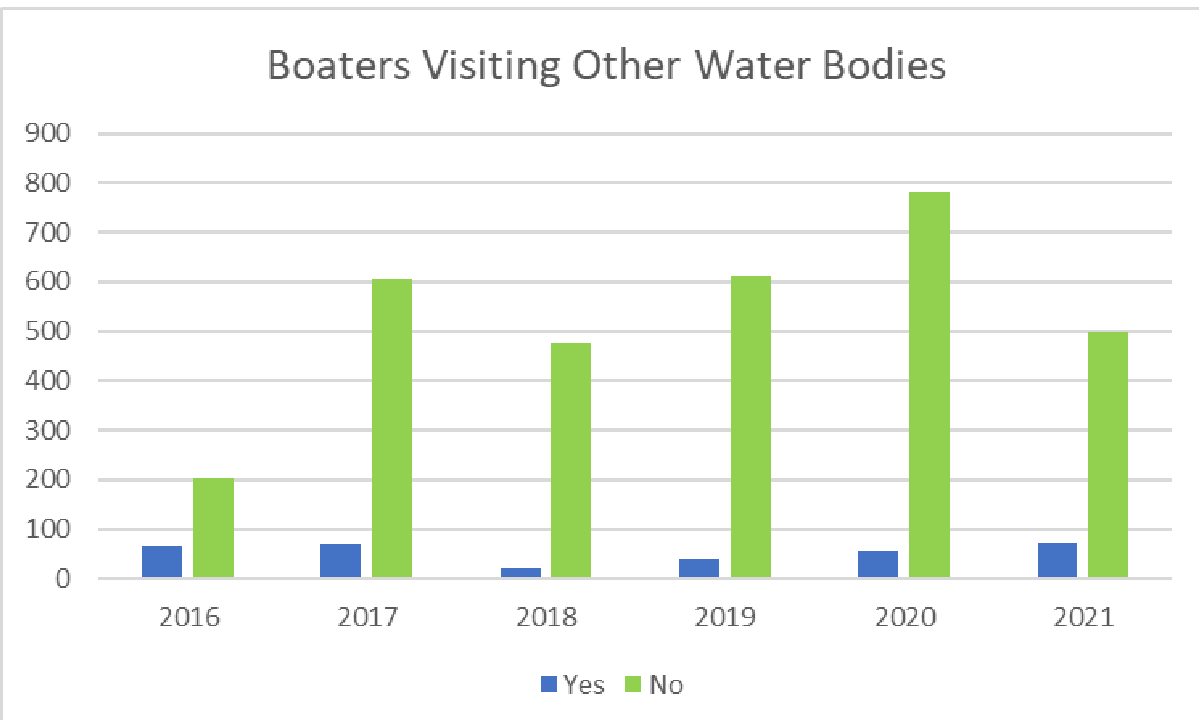
Date	Acres Treated	Quantity of Product	Concentration	Product	Target Species
5/11/2016	37.7	200 gallons	2.0 ppm	DMA4	EWM
5/11/2016	5.2	45 gallons	3.0 ppm	DMA4	EWM
7/20/2016	3.9	22.5 gallons	3.0 ppm	DMA4	EWM
7/20/2016	7.5	32.5 gallons	2.0 ppm	DMA4	EWM
4/17/2017	65.3	291.6 lbs	180ac - 4.0 ppb	SonarOne	EWM
6/8/2017	65.3	160 lbs	180ac - 2.2 ppb	SonarOne	EWM
8/14/2017	65.3	145.8lbs	180ac - 2.0 ppb	SonarOne	EWM
4/27/2018	65.3	145.8lbs	180ac - 2.0 ppb	SonarOne	EWM
5/23/2019	34.2	61.75 gallons	1.0 ppm	Aquathol-K	CLP
6/12/2020	15	21.5 gallons	1.0 ppm	Aquathol-K	CLP
6/12/2020	7	30 gallons	2.0 ppm	Weedar -64	EWM
6/12/2020	5	32.5 gallons	3.0 ppm	Weedar -64	EWM
7/7/2020	1.5	1.9 gallons	1.25 gallons/acre	Tribune	Elodea
5/13/2021	13.85	129 gallons	3.0 ppm	Weedar-64	EWM
5/13/2021	0.1	0.5 PDU (0.039 gallons)	9.62 ppb	ProcellaCOR	EWM

Lake and Pond Solutions LLC, 2022

Clean Boats, Clean Waters Summary

From 2016 to 2021, the Potter Lake access off County L was staffed on weekends from Memorial Day to Labor Day with a Clean Boats, Clean Waters (CBCW) watercraft inspector. The goal of this program is to educate boaters about the laws and risks involving transporting Aquatic Invasive Species (AIS) between lakes at public boat landings. In those six seasons, watercraft inspectors averaged 464 hours and inspected an average of 732 boats at the landing each year. One of the questions asked by the inspectors was whether the boater had used their boat on any other water bodies in the past five days. The annual results of this question from 2016 to 2021 are outlined in Figure 7 below. Over ninety percent of these boats had not used their watercraft in the past five days. Even though few boaters on this lake visit other waterbodies in a 5-day span, it is particularly helpful to educate boaters to further lower the risk of AIS spread and protect Potter Lake from future invaders. With the presence of Starry Stonewort in relatively nearby Long Lake, Wind Lake, Big Muskego Lake, and Lake Geneva, it is important to continue this program to educate boaters and lower the risk of spread.

Figure 6: *Potter Lake CBCW Boater Survey*



Lake and Pond Solutions LLC (2022), Potter Lake CBCW (2021)

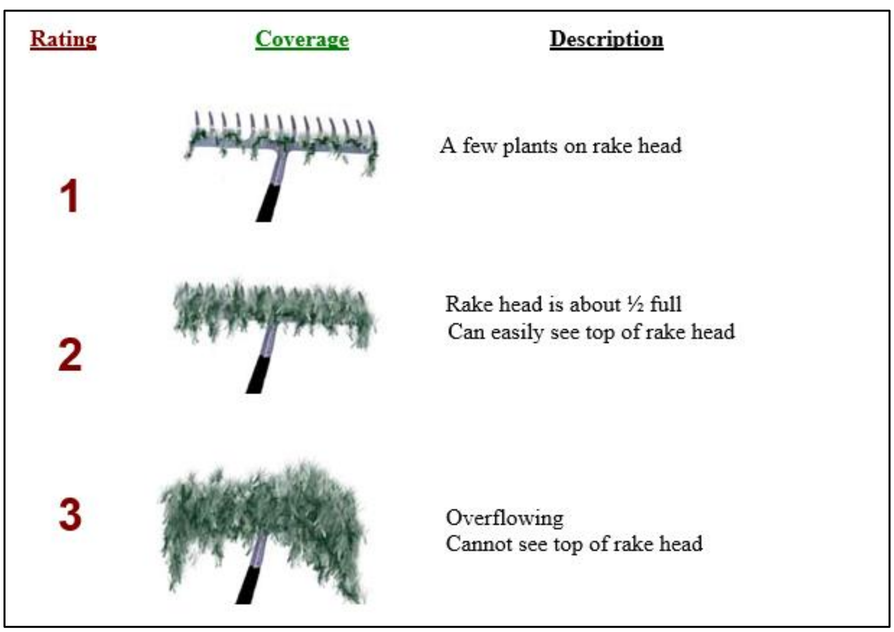
RESULTS OF THE 2021 POINT INTERCEPT SURVEY

Methods

The 2021 aquatic plant survey was conducted using some guidelines adopted by the Wisconsin Department of Natural Resources (WDNR) for point-intercept survey methods. This method utilizes a grid system that accounts for the size and morphology of the lake. The WDNR established points were transferred to a Garmin GPSMAP 64st GPS unit before sampling. At each established point, a plant sample was taken using a double-headed rake on a 15' graduated pole which was rotated twice to gather plants. A double headed rake tied to a rope was used for sites with depths greater than 15' and dragged roughly three feet along the substrate to gather plants. Depths were recorded at each point by using the graduated pole in shallower areas and a Humminbird Helix 7 MSI GPS G3 sonar unit in deeper sections. The rake fullness was rated from one to three when plants were present on the rake (Figure 7). Data collection at each survey point included depth, substrate (when possible), total rake density, species present, species-specific densities, and visuals of species not collected. Shoreline vegetation (i.e. cattails, loosestrife, phragmites) were listed as a visual for the points nearest shore to encompass emergent species that most surveys miss. Frequency of occurrence, average rake fullness, total sites with vegetation, Simpson diversity index, maximum depth of plants, average native species per site, and species richness were calculated using this data.

PLEASE NOTE: Although survey methods used by Lake and Pond Solutions, LLC are nearly identical to those of the WDNR, our interpretation of the data does vary. These differences are explained in APPENDIX A.

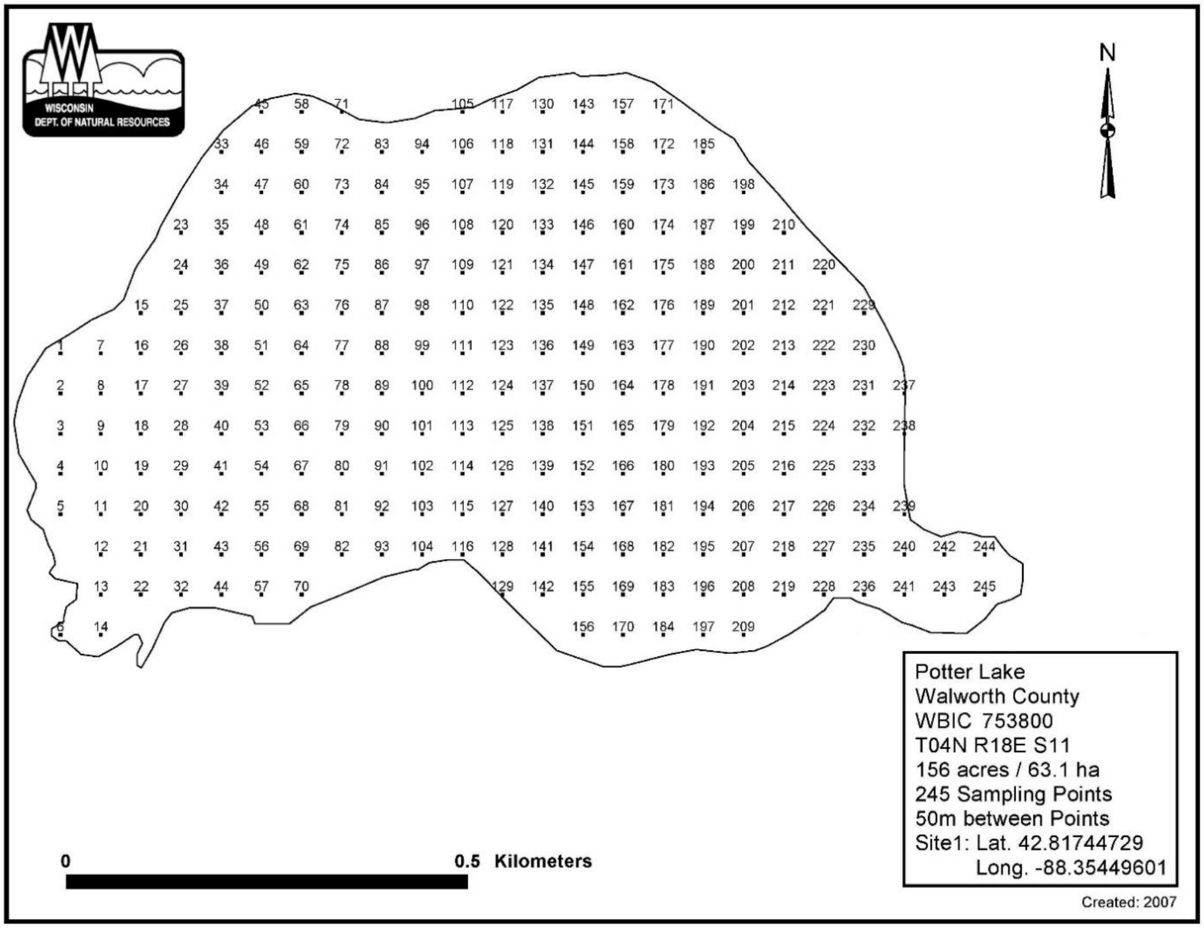
Figure 7: *Rake Sampling Criteria*



Survey Summary

The 2021 survey conducted by Lake and Pond Solutions, LLC occurred on July 28th, 2021 using the 245 pre-determined WDNR sampling points (Figure 8). Of the 244 points sampled, 154 were found to have plants (63.1%). No plants were found at a depth great than 10.5 feet and 89.02% of the points shallower than the maximum depth of plants contained vegetation. There was an average of 1.99 native species per site.

Figure 8: *WDNR Survey Points on Potter Lake*



WDNR, 2007

Table 2: *Plant Sampling Data Summary*

Statistics Summary	2021
Survey Date	July 28th
Total number of sites with vegetation / All sites sampled	154/244 (63.1%)
Maximum depth of plants	10.5'
Species richness	17
Average number of all species per site (vegetated sites only)	2.44
Average number of native species per site (vegetated sites only)	1.99
Simpson Diversity Index	0.79
Average C-Value	5.00
Floristic Quality	17.32

Lake and Pond Solutions LLC, 2022

*Table above includes visual sightings

Plant Community

The plant community sampled in July 2021 on Potter Lake consisted of seventeen species of plants (Table 3). They are arranged from most to least frequent based on the number of sites where they were found (including visuals). Also shown is the overall frequency (percentage plant was found compared to all sites), relative frequency (percent plant was found compared to vegetated sites), average rake fullness, and C-Value (discussed below).

The five most common native species ranked by relative frequency of occurrence included Common Waterweed (*Elodea canadensis*), Muskgrasses *(Chara spp.*), White water lily (*Nymphaea odorata*), Slender naiad (*Najas flexilis*), and Flat-stem pondweed (*Potamogeton zosteriformis*). Three invasive species were sampled: Eurasian Watermilfoil (*Myriophyllum spicatum*), Curly-leaf Pondweed (*Potamogeton crispus*), and Purple Loosestrife (*Lythrum salicaria*). Although there was a decent variety of species found, there were only five in relative frequencies greater than 10%. The most common aquatic plant (common waterweed) was found at over 90% of sites that had vegetation. The expansion of common waterweed and Eurasian watermilfoil coupled with low water in 2021 led to many of the navigational issues experienced.

Table 3: *Potter Lake Plant Species - July 2021*

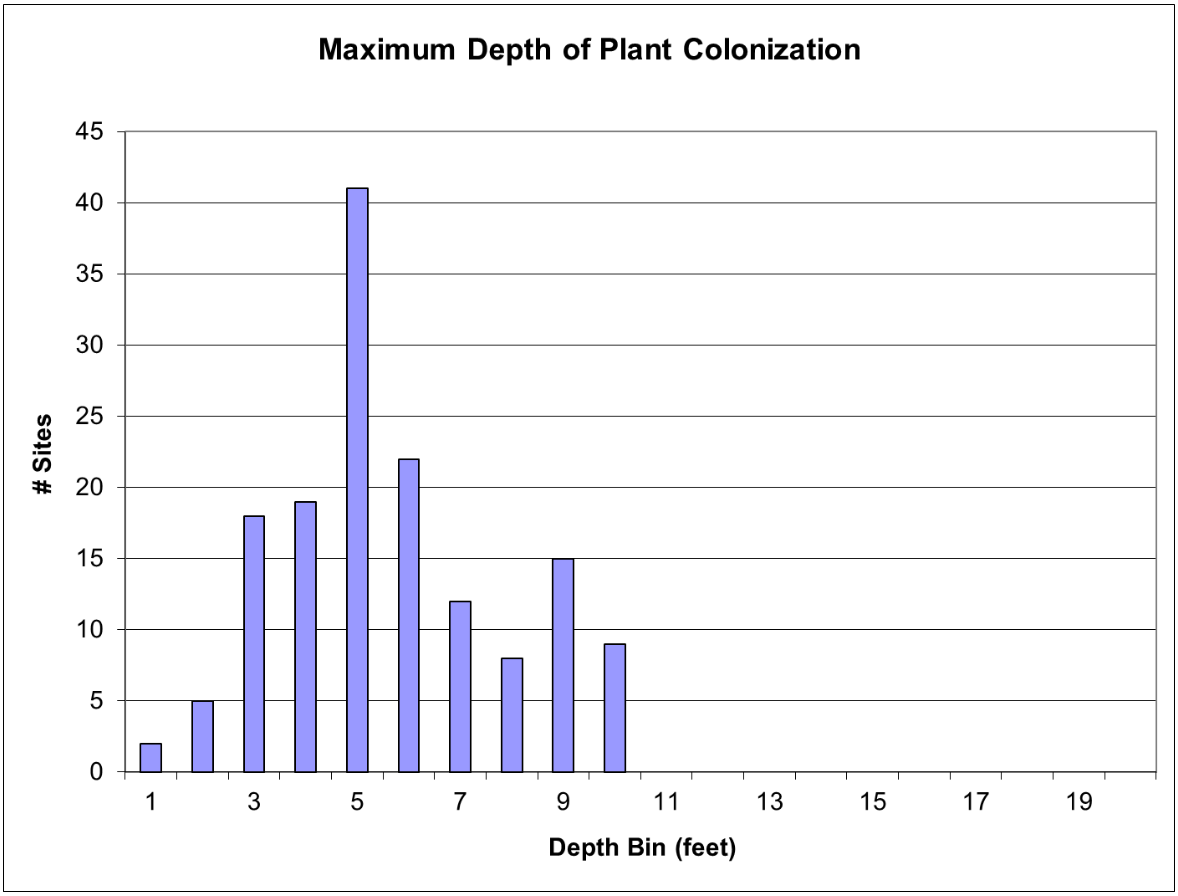
Common Name	Scientific Name	Number of Sites (incl visuals)	% Overall Frequency of Occurrence (incl visuals)	% Relative Frequency of Occurrence (incl visuals)	Average Rake Fullness	C-value
Common waterweed	*Elodea canadensis*	139	56.97	90.26	1.42	3
Muskgrasses	*Chara sp.*	71	29.10	46.10	1.22	7
Eurasian Watermilfoil*	*Myriophyllum spicatum*	56	22.95	36.36	1.00	Invasive
White water lily	*Nymphaea odorata*	17	6.97	11.04	Visual	6
Slender naiad	*Najas flexilis*	16	6.56	10.39	1.06	6
Curly-leaf pondweed*	*Potamogeton crispus*	14	5.74	9.09	1.00	Invasive
Flat-stem pondweed	*Potamogeton zosteriformis*	12	4.92	7.79	1.00	6
Sago pondweed**	*Stuckenia pectinata*	11	4.51	7.14	Visual	3
Swamp loosestrife	*Decodon verticillatus*	7	2.87	4.55	Visual	-
Water star-grass	*Heteranthera dubia*	6	2.46	3.90	1.00	6
Purple loosestrife*	*Lythrum salicaria*	5	2.05	3.25	Visual	Invasive
Leafy pondweed	*Potamogeton foliosus*	5	2.05	3.25	1.00	6
Cattail	*Typha sp.*	5	2.05	3.25	Visual	1
Spatterdock	*Nuphar variegata*	3	1.23	1.95	Visual	6
Coontail	*Ceratophyllum demersum*	2	0.82	1.30	1.00	3
Small pondweed	*Potamogeton pusillus*	2	0.82	1.30	1.00	7
Filamentous algae	*n/a*	2	0.82	1.30	Visual	-
Orange Jewelweed	*Impatiens capensis*	2	0.82	1.30	Visual	-

Lake and Pond Solutions LLC, 2022

*Denotes non-native species
**Denotes WDNR high value species

The depths that plants were found in the 2021 survey are listed in Figure 9. Sixty-five percent of the aquatic plant growth was found in 3' – 6' of water. Both the shallow shelf on the west end of the lake and the boat launch bay generally account for the vast majority of plants. Figure 10Figure 17 show the top 5 native species as well as the three invasive species found in Potter Lake (from most to least frequent).

Figure 9: *Plant Depth Graph*

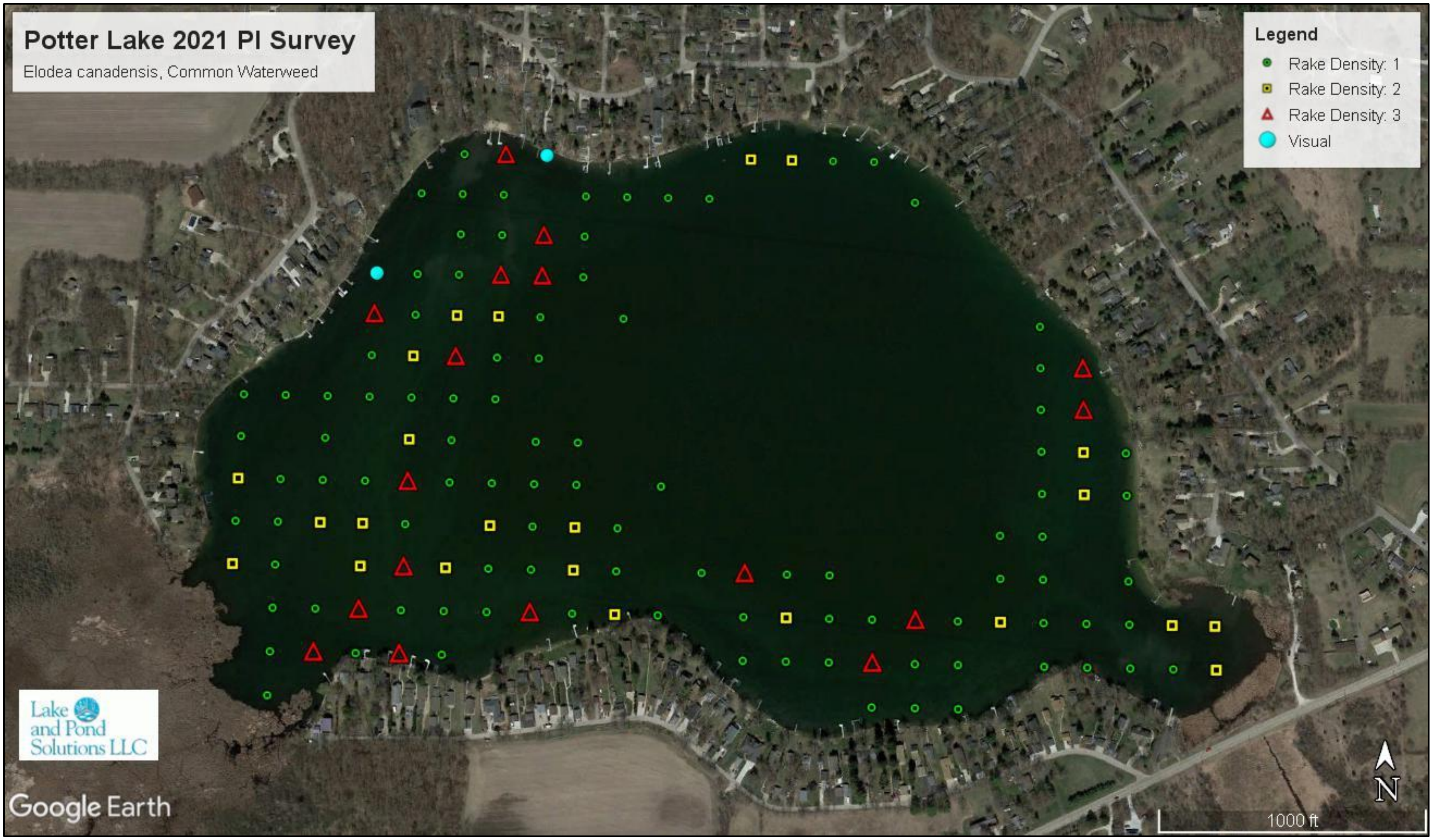


Lake and Pond Solutions LLC, 2022

High Value and Quality Species

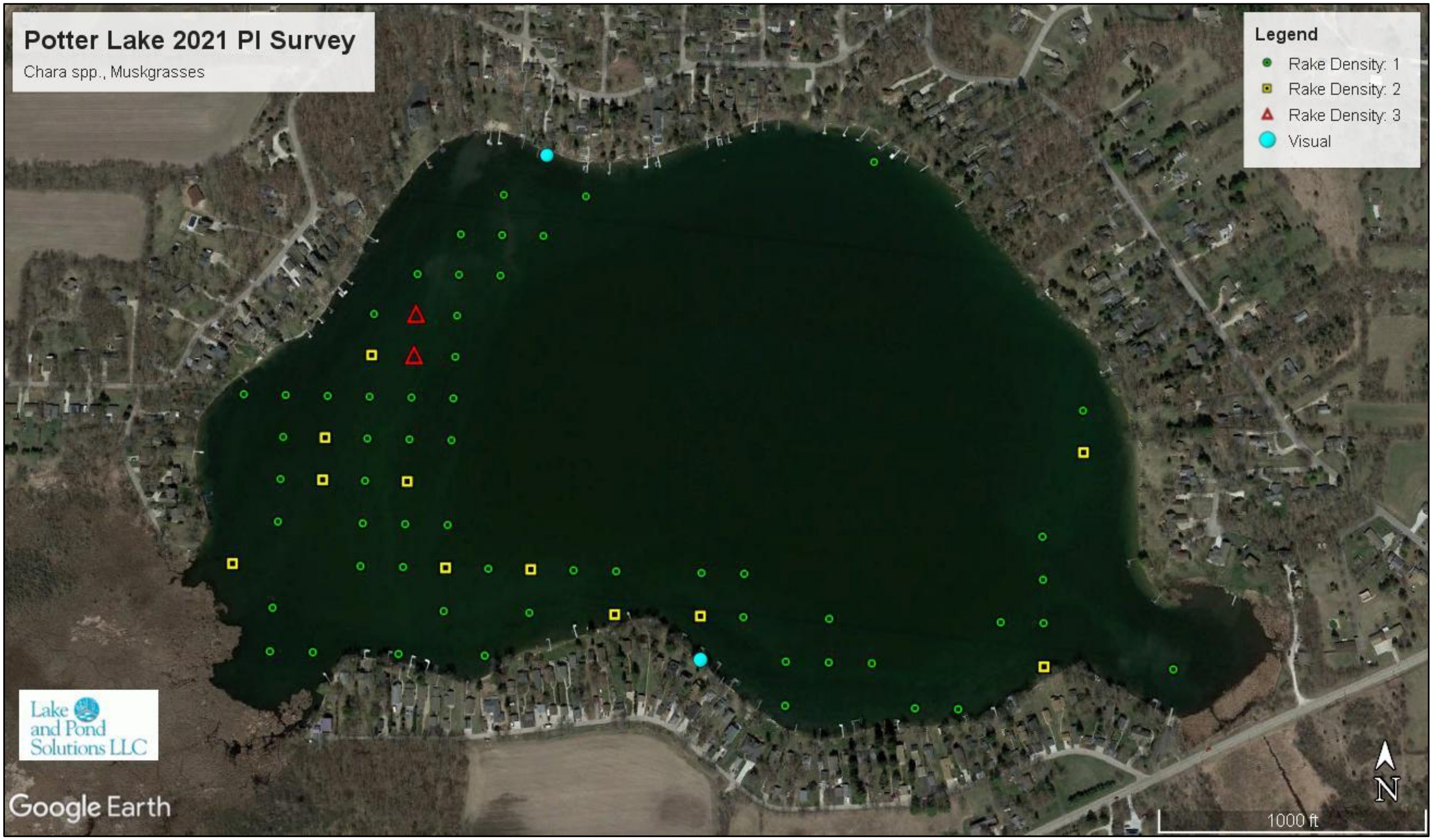
High value species were defined as plant species identified as high value in the WI DNR document NR 109.05(3)(g). For Potter Lake just one species present, Sago Pondweed, is classified as high value. Certain species were designated by LPS as quality species with a C-value greater than or equal to six. Table 3 (above) shows the C-value of species present in Potter Lake. Figure 18 depicts a sum of the number of both high value and quality species present at each survey point. This can provide a useful image of where on the water body the most sensitive and valuable species are present. The number of high value and quality species at each point ranged from zero to three, with most of the highest quality plant communities present near the north and southwest shorelines. None of the areas on Potter Lake exhibited high enough densities of these species to recommend an "ecologically significant area" designation.

Figure 10: *Potter Lake Common Waterweed, Elodea canadensis (2021)*



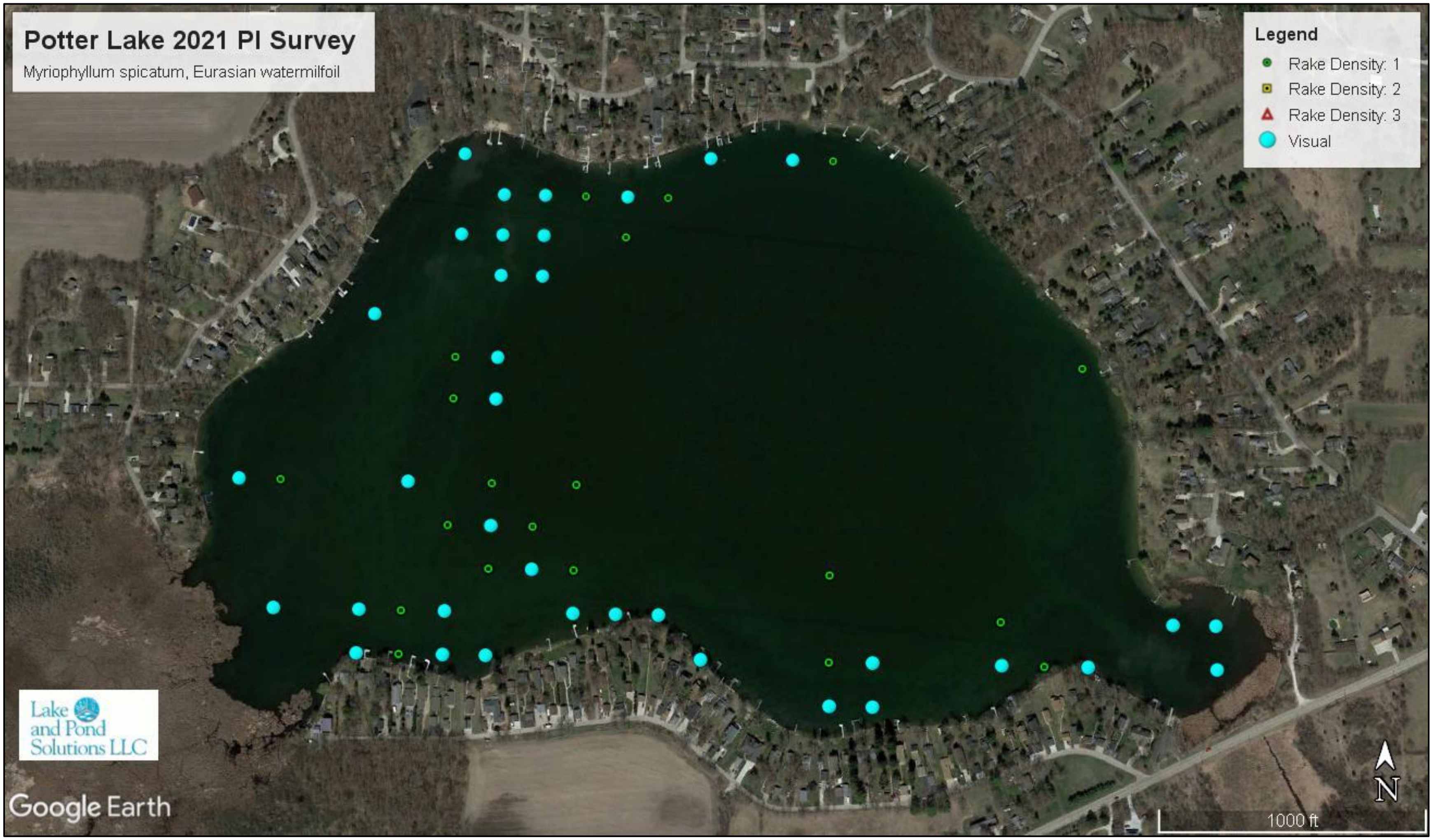
Lake and Pond Solutions LLC, 2022

Figure 11: *Potter Lake Muskgrasses, Chara spp. (2021)*



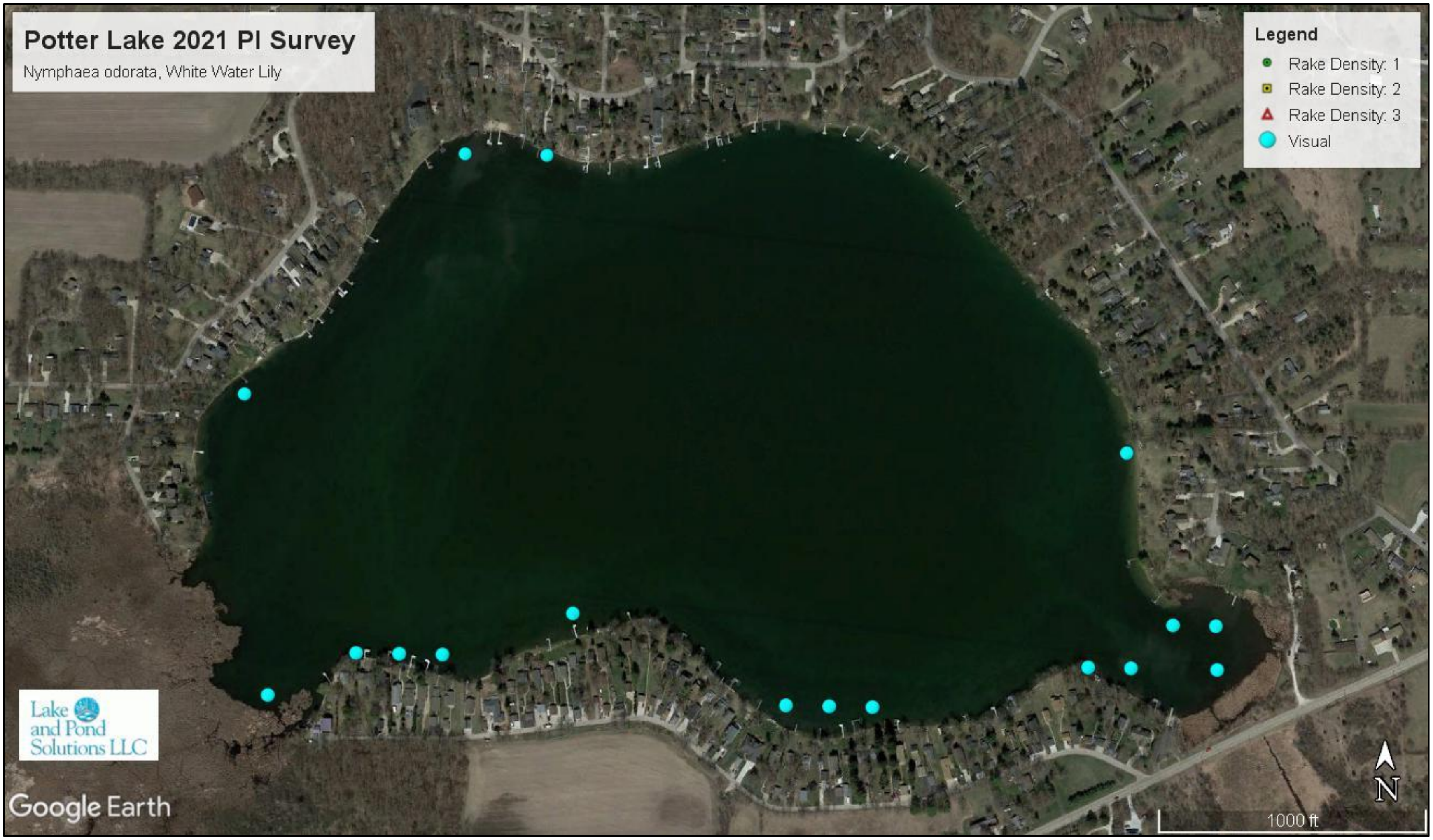
Lake and Pond Solutions LLC, 2022

Figure 12: *Potter Lake Eurasian Watermilfoil, Myriophyllum spicatum (2021) - INVASIVE*



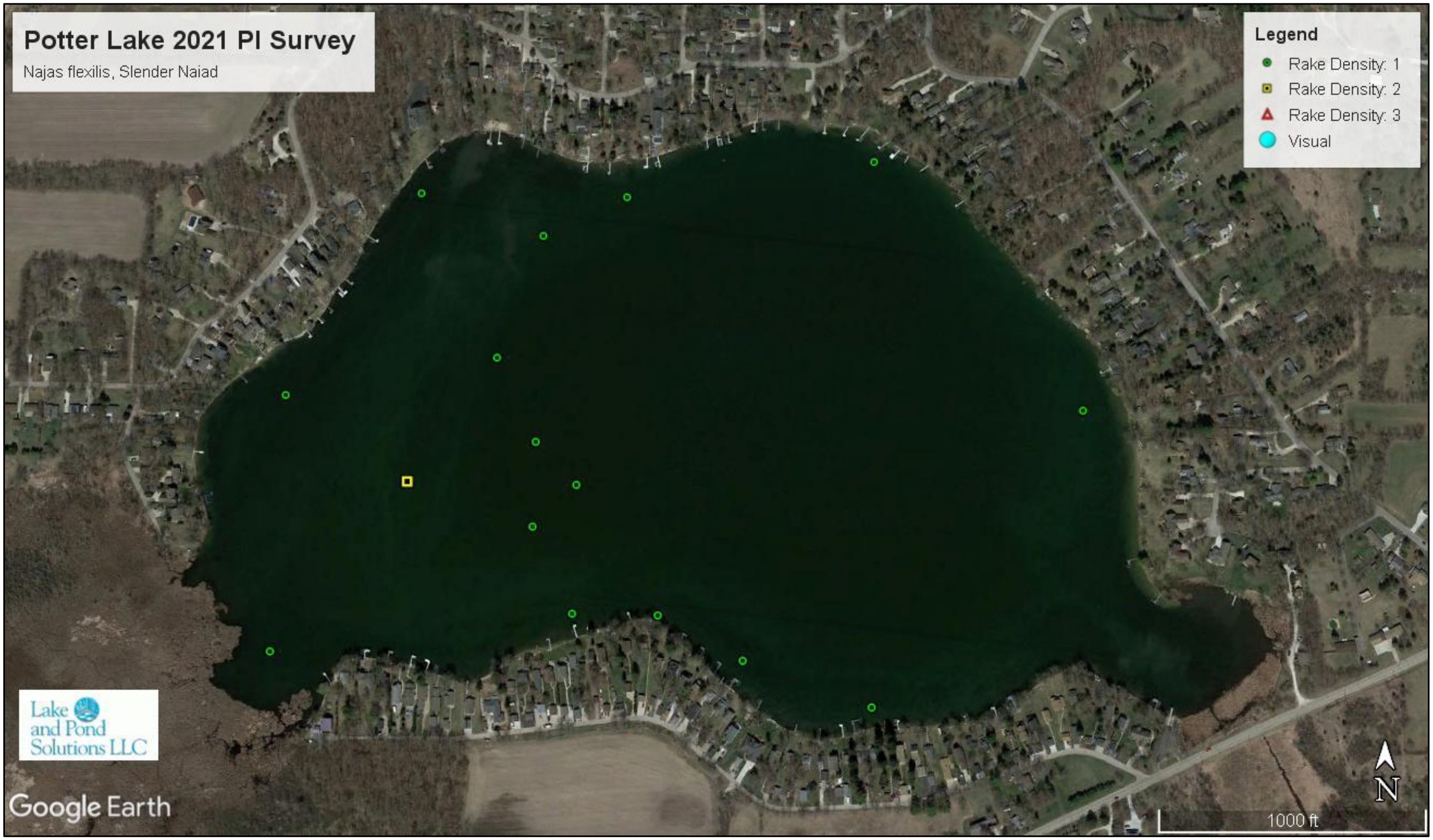
Lake and Pond Solutions LLC, 2022

Figure 13: *Potter Lake White water lily, Nymphaea odorata (2021)*



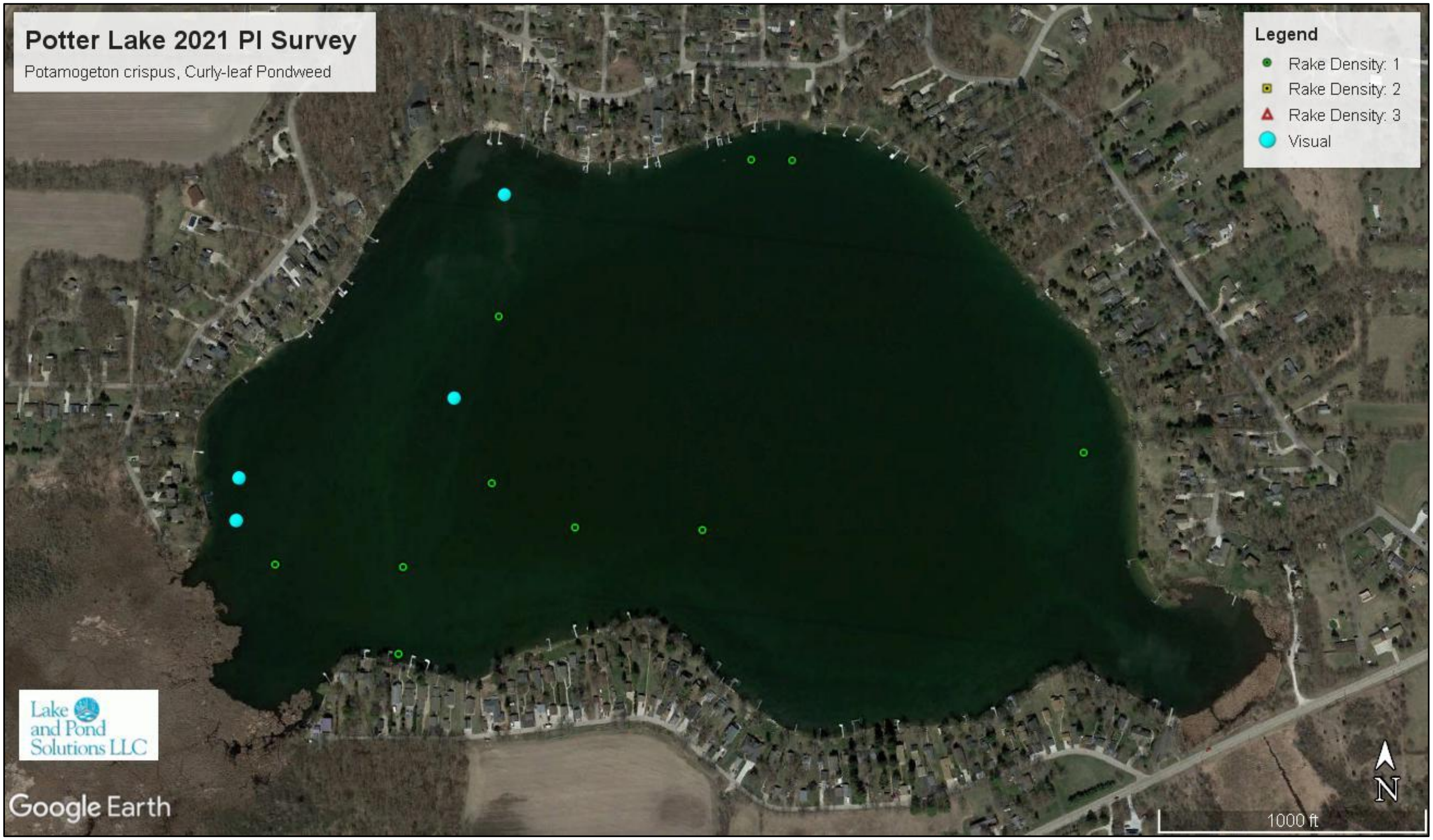
Lake and Pond Solutions LLC, 2022

Figure 14: *Potter Lake Slender naiad, Najas flexilis (2021)*



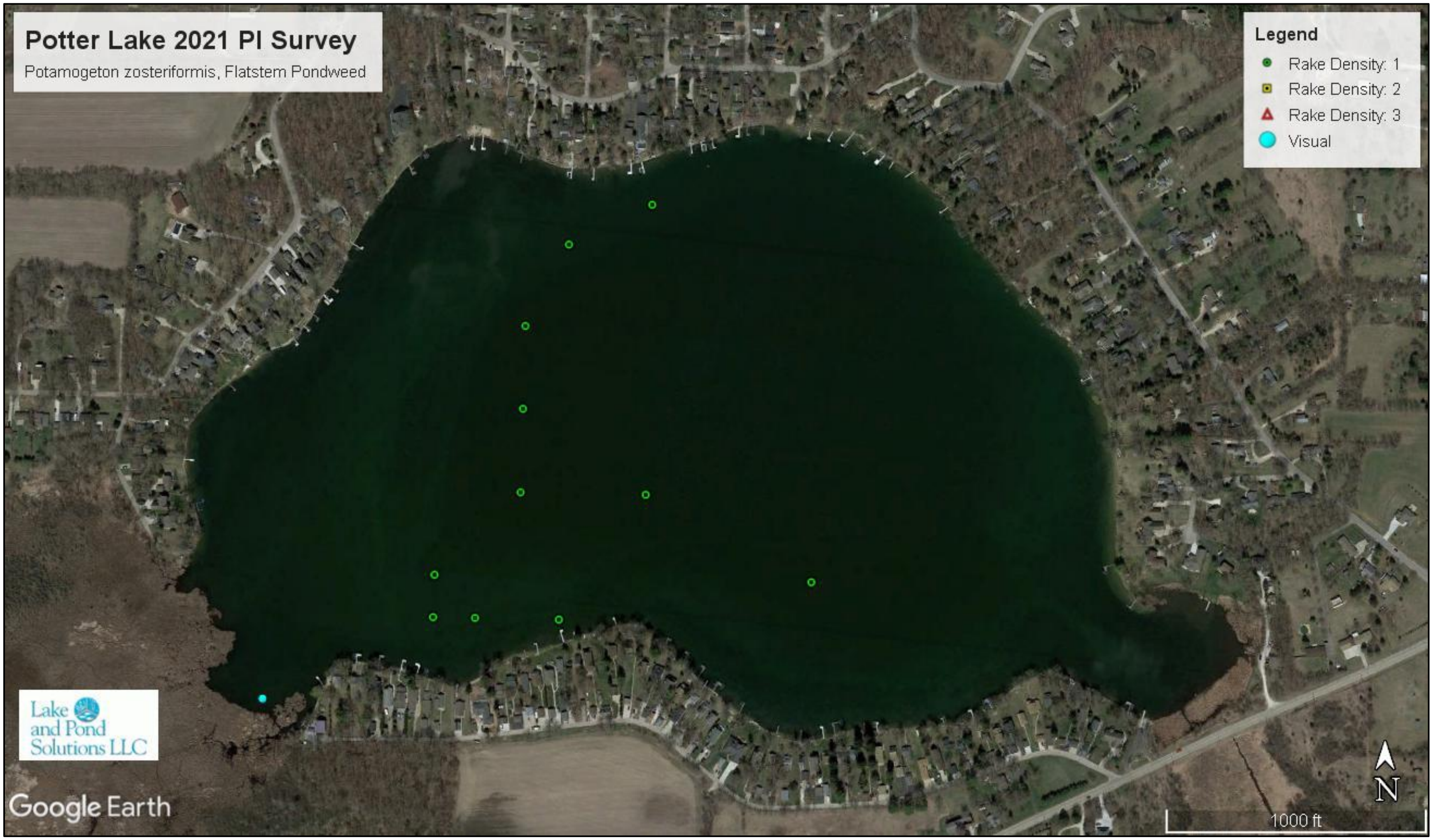
Lake and Pond Solutions LLC, 2022

Figure 15: *Potter Lake Curly-leaf pondweed, Potamogeton crispus (2021) - INVASIVE*



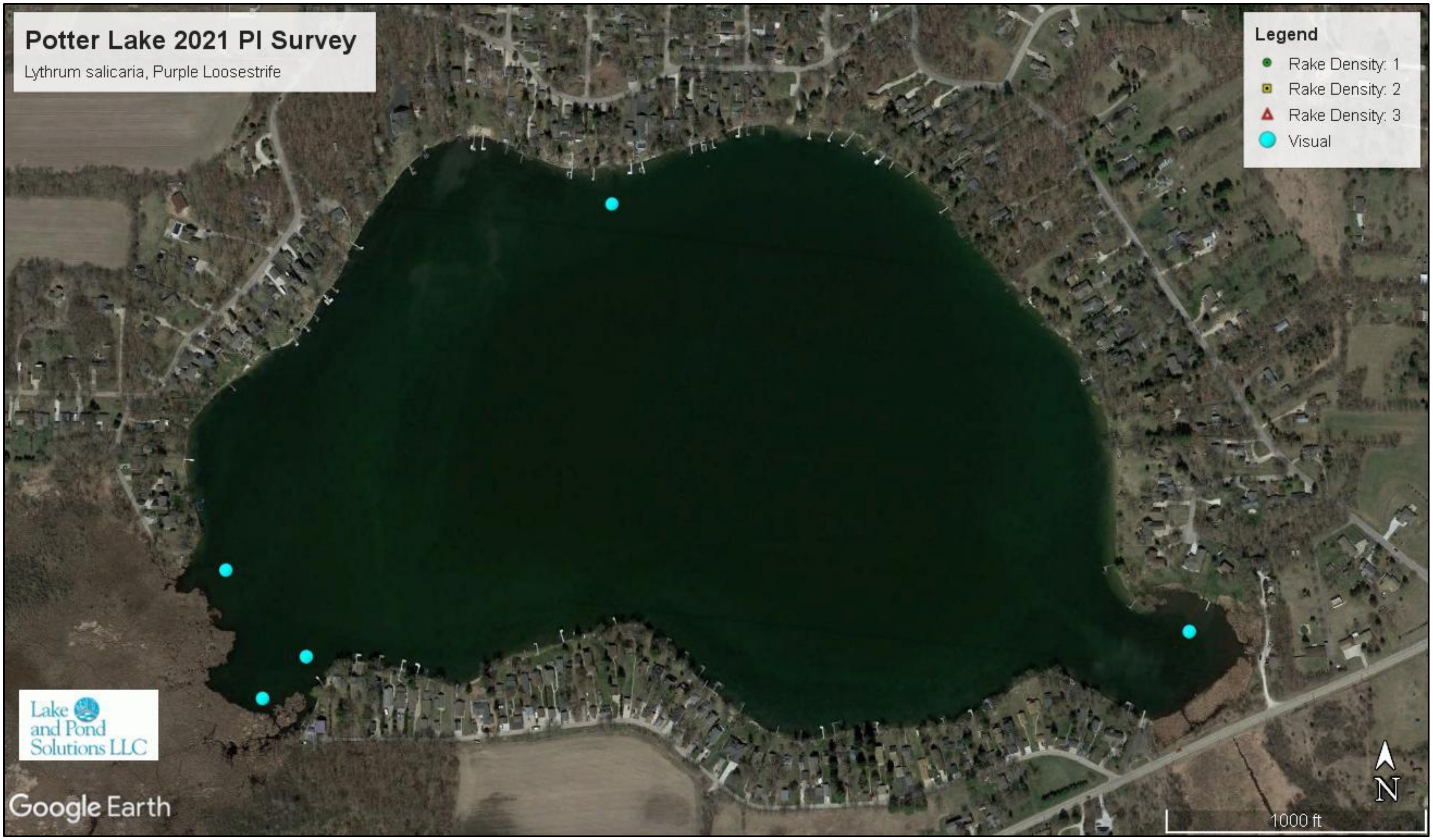
Lake and Pond Solutions LLC, 2022

Figure 16: *Potter Lake Flat-stem pondweed, Potamogeton zosteriformis (2021)*



Lake and Pond Solutions LLC, 2022

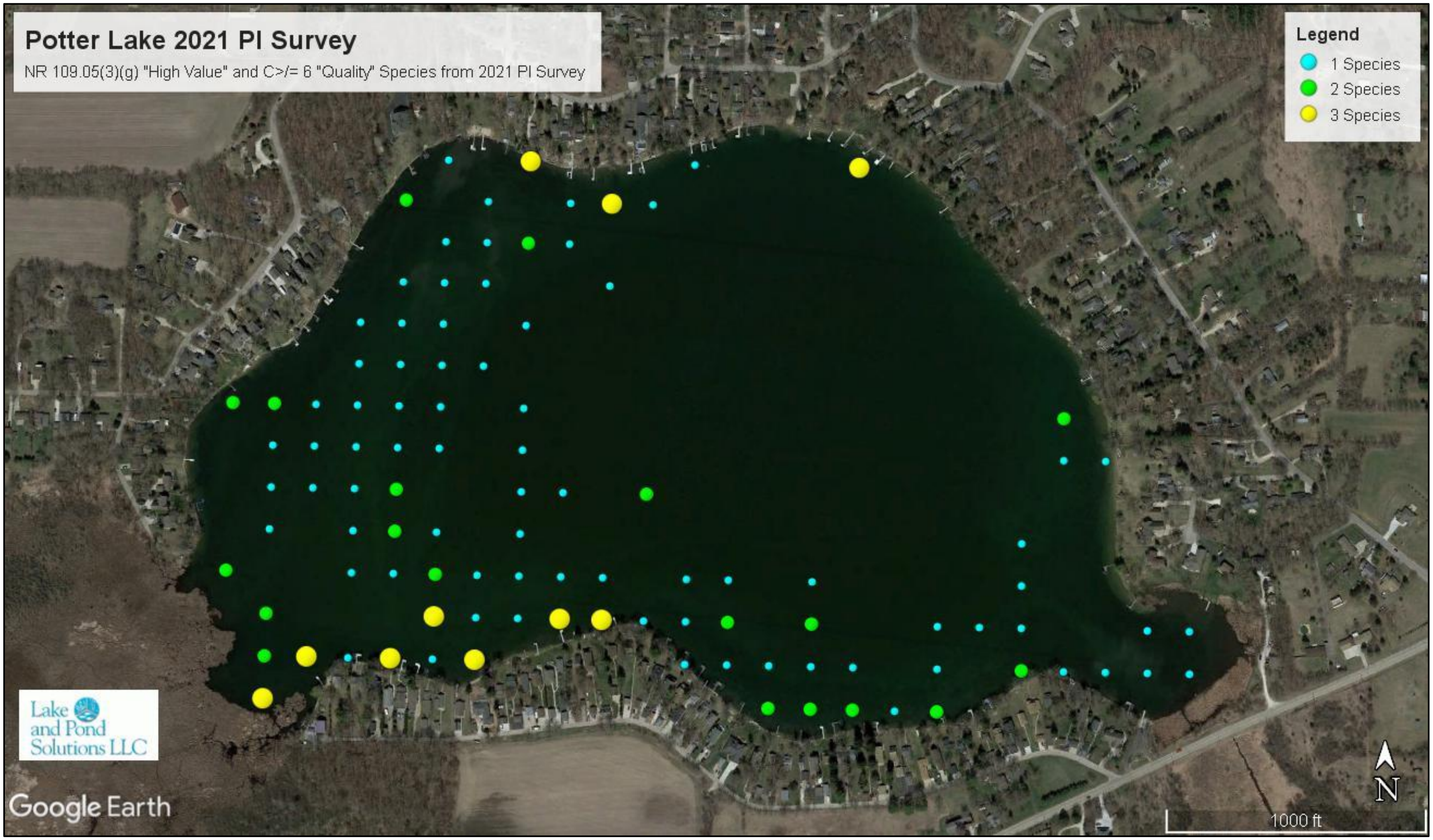
Figure 17: *Potter Lake Purple loosestrife, Lythrum salicaria (2021) - INVASIVE*



Lake and Pond Solutions LLC, 2022

*Points on map do not show the exact location of Purple Loosestrife. Instead, they represent the closest point to an on-shore visual sighting.

Figure 18: *Potter Lake Quality and High Value Species (2021)*



Lake and Pond Solutions LLC, 2022

Invasive Species

Three invasive plant species were found in Potter Lake during the 2021 survey: Eurasian Watermilfoil (*Myriophyllum spicatum*), Curly-leaf Pondweed (*Potamogeton crispus*), and Purple Loosestrife (*Lythrum salicaria*). EWM densities have surged over the past year to a relative frequency (percentage a plant was found when vegetation was present) of 36.26%. Although the CLP relative frequency was listed as 9.09%, the timing of the survey limits identification of this species. Meander surveys show a different picture and CLP is likely found at much higher percentages when prevalent in the Spring (Figure 24). Purple loosestrife is a non-native wetland plant that is a prolific seed producer. It can quickly invade wetlands, crowding out more beneficial, native plants. It has been identified in the past, although it wasn't catalogued on previous PI surveys. It is currently only found at a 3.25% relative frequency (5 sites) in the lake.

As invasive species increase in Potter Lake, the native plant diversity is threatened. Dense beds of exotics outcompete native plants and cause their decline. Fisheries are affected as panfish evade predation by game fish in dense beds of invasive vegetation. Recreational interests are also negatively affected. Transient boaters must conduct regular disinfections to prevent transporting invasives between lakes. Long stems of Eurasian water milfoil (EWM) and curly-leaf pondweed (CLP) can cause navigational and recreational issues while also displacing native species and increasing water temperatures and stagnation.

Invasive species can also hurt property owners and local economies as floating plant fragments choke shorelines, decrease property values, and reduce tourism. A UW-Madison paper noted that lakes invaded with EWM experienced an average decrease in land values by 13% after invasion (Horsch, 2008). The author's correspondence with a local realtor estimates that a $250,000 home on a lake with severe EWM problems sells for $30,000 - $40,000 less than if it were on a similar lake without EWM. Horsch also notes that in a 2004 publication by UW-Extension Lakes, they estimate that EWM cost Wisconsin citizens millions of dollars in treatment prevention programs and lost tourism revenue annually while the University of Minnesota says similar estimates exist for other states.

Floristic Quality

Floristic quality (Swink and Wilhelm, 1994) is a rapid assessment metric designed to evaluate the similarity of the flora of a defined area to undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts. For any area (lake in this case), floristic quality (I) equals the average coefficient of conservatism (C-value) times the square root of the number of native species ($\sqrt{N}$).

The coefficient of conservatism (C-value) was assigned to 128 aquatic plants, compared to regional studies, and reviewed by biologists familiar with Wisconsin lake plants. They range from 0 to 10 with 10 being assigned to species most sensitive to disturbance. These final C-values were used in calculating the Floristic Quality Index for Potter Lake.

The C-Value over the last four surveys has ranged from 5.0 to 5.6, averaging slightly below the STP Average. The number of native species present has ranged from eight to twelve, also below the statewide and STP average. Despite this, the number of native species and floristic quality have been slowly increasing since 2016.

Table 4: *Floristic Quality Index for Potter Lake, 2016-2021*

	2016	2017	2018	2021	STP Average	WI Average	WI 75th Percentile
Avg. C-Value	5.0	5.3	5.6	5.0	5.6	6.0	6.9
# of natives (N)	9	8	10	12	14	13	20
Floristic Quality	15.0	14.9	17.7	17.3	20.9	22.2	27.5

Lake and Pond Solutions LLC (2022)

COMPARISON OF SURVEYS

Point-intercept plant surveys were conducted on Potter Lake in 2016, 2017, 2018, and 2021. Tables 5 -7 below show a comparison of the plant communities during these surveys. It is especially important to look at the changes between 2016 and 2021 which demonstrates the change in the plant community from the last whole lake fluridone treatment in 2017/2018. Overall, increases were observed in the total sites with vegetation (+19), species richness (+6 species), average native species per site (+0.15 species), and floristic quality (+2.32). The maximum depth of plants, Simpson Diversity Index, and average C-value remained the same. This indicates that the native community in the lake has only improved since the fluridone treatment.

Table 5: *Overview of 2016-2021 Potter Lake Point Intercept Surveys*

Summary Statistics	2016	2017	2018	2021
Survey Date	June 28th	July 1st	July 17th	July 28th
Total number of sites with vegetation / All sites sampled	135/243 (55.5%)	108/243 (44.4%)	97/243 (39.9%)	154/244 (63.1%)
Maximum depth of plants	10.75'	9'	11.5'	10.5'
Species richness	11	9	11	17
Average number of all species per site (vegetated sites only)	2.08	2.06	1.48	2.44
Average number of native species per site (vegetated sites only)	1.84	1.97	1.47	1.99
Simpson Diversity Index	0.78	0.80	0.66	0.79
Average C-Value	5.00	5.25	5.60	5.00
Floristic Quality	15.00	14.85	17.71	17.32

Lake and Pond Solutions LLC (2022), Aron and Associates (2016 – 2018)

Of the fourteen native species found in the 2021 survey, only seven were also found in 2016; however, two native species were found in 2016 that were not found in 2021 (floating species at extremely low levels). This results in a net gain of five native species from 2016 to 2021. One species, Elodea canadensis, was almost 49% percent more frequent than in the 2016 survey and 88% more frequent than in the 2018 survey. The 90.26% relative frequency for Elodea was the highest relatively frequency ever recorded on the lake. This species raised concern for boaters and lake users as dense growth reached the surface and began to restrict access. The large increase is potentially due to a warm spring, lower water levels, and increased light penetration due to below average precipitation in the 2021 season. Double-digit Elodea and Eurasian water milfoil increases since 2018 could have led to the double-digit reductions in chara spp. and sago pondweed.

Table 6: *Comparison of plant frequency of past point intercept plant surveys on Potter Lake*

Species		% Frequency			
Scientific Name	**Common Name**	**2016**	**2017**	**2018**	**2021**
Elodea canadensis	Common waterweed	41.48	20.37	2.06	90.26
Chara sp.	Muskgrasses	80.00	64.81	80.41	46.10
Myriophyllum spicatum**	**Eurasian water-milfoil**	**6.67**	**27.78**	**-**	**36.36**
Nymphaea odorata	White water lily	2.22	4.63	6.19	11.04
Najas flexilis	Slender naiad	10.37	3.70	-	10.39
Potamogeton crispus**	**Curly-leaf pondweed**	**25.19**	**-**	**2.06**	**9.09**
Potamogeton zosteriformis	Flat-stem pondweed	6.67	48.15	12.37	7.79
Stuckenia pectinata	Sago pondweed	23.70	25.93	18.56	7.14
Decodon verticillatus	Swamp loosestrife	-	-	-	4.55
Heteranthera dubia	Water star-grass	-	-	15.46	3.90
Lythrum salicaria**	**Purple loosestrife**	**-**	**-**	**-**	**3.25**
Potamogeton foliosus	Leafy pondweed	-	-	-	3.25
Typha sp.	Cattail	-	-	-	3.25
Nuphar variegata	Spatterdock	-	-	-	1.95
Ceratophyllum demersum	Coontail	9.63	9.26	2.06	1.30
Impatiens capensis	Orange Jewelweed	-	-	-	1.30
n/a	Filamentous algae	-	-	-	1.30
Potamogeton pusillus	Small pondweed	-	-	-	1.30
Lemna minor	Small duckweed	0.74	-	-	-
Nitella sp.	Nitella	-	-	1.03	-
Nuphar advena	Yellow pond lily	X	0.93	5.15	-
Ultricularia vulgaris	Common bladderwort	1.48	-	1.03	-
TOTAL SPECIES EXCLUDING ALGAE		11	9	11	17
TOTAL INVASIVE SPECIES		2	1	1	3
TOTAL EMERGENT SPECIES		0	0	0	4

Lake and Pond Solutions LLC (2022), Aron and Associates (2016 – 2018)

****Denotes non-native species**

Eurasian Watermilfoil (EWM) was the third most frequently identified species at over 36% relative frequency. This represents the largest percent frequency since 2004 and a higher frequency than was found prior to the last whole lake fluridone treatment in 2017. The frequency reported in 2021 would likely be higher had it not been for successful EWM treatment with 2,4-D. With the frequency now elevated, a whole lake treatment may be a good option to pursue for control of EWM. Harvesting will also be a necessity if elodea levels continue to mirror what was found in 2021.

Table 7: *Comparison of plant rake fullness of past point intercept plant surveys on Potter Lake*

Species		Rake Fullness (1-3)			
Scientific Name	**Common Name**	**2016**	**2017**	**2018**	**2021**
Elodea canadensis	Common waterweed	1.82	1.09	1.00	1.42
Chara sp.	Muskgrasses	1.80	2.01	1.82	1.22
Myriophyllum spicatum**	**Eurasian water-milfoil**	**1.13**	**1.04**	**-**	**1.00**
Nymphaea odorata	White water lily	1.00	visual	visual	Visual
Najas flexilis	Slender naiad	1.07	1.00	-	1.06
Potamogeton crispus**	**Curly-leaf pondweed**	**1.06**	**-**	**1.00**	**1.00**
Potamogeton zosteriformis	Flat-stem pondweed	1.00	1.16	1.08	1.00
Stuckenia pectinata	Sago pondweed	1.00	1.00	1.07	Visual
Decodon verticillatus	Swamp loosestrife	-	-	-	Visual
Heteranthera dubia	Water star-grass	-	-	1.47	1.00
Lythrum salicaria**	**Purple loosestrife**	**-**	**-**	**-**	**Visual**
Potamogeton foliosus	Leafy pondweed	-	-	-	1.00
Typha sp.	Cattail	-	-	-	Visual
Nuphar variegata	Spatterdock	-	-	-	Visual
Ceratophyllum demersum	Coontail	1.00	1.10	1.00	1.00
Impatiens capensis	Orange Jewelweed	-	-	-	1.00
n/a	Filamentous algae	-	-	-	Visual
Potamogeton pusillus	Small pondweed	-	-	-	Visual
Lemna minor	Small duckweed	visual	-	-	-
Nitella sp.	Nitella	-	-	2.00	-
Nuphar variegata	Yellow pond lily	-	visual	visual	-
Ultricularia vulgaris	Common bladderwort	1.00	-	visual	-
Average Rake Fullness		**-**	**-**	**1.82**	**1.50**

Lake and Pond Solutions LLC (2022), Aron and Associates (2016 – 2018)

****Denotes non-native species**

PLANT MANAGEMENT ALTERNATIVES

Control of exotic or nuisance plant species is an uphill battle especially in many lakes. Realistic expectations are important in aquatic plant management, and it is unlikely that exotic plants species can ever be completely removed from a lake system. A combination of lake management techniques and public education are most effective in minimizing the long- term impact of exotic plant species in a lake. Dr. John Madsen (formerly a research biologist with the US Army Engineer Research and Development Center) sums up management alternatives best:

"Despite the views of some, there is no single cure-all solution to aquatic plant problems, no single "best choice". For that matter, several of these techniques can be made to work for most aquatic plant problems, given enough time and money. None of these techniques are evil or inherently unacceptable; likewise, none of these techniques are without flaws or potential environmental impacts. Rather, it is up to each management group to select the most appropriate techniques for their situation given a set of social, political, economic and environmental conditions."

The concept of integrated pest management involves consideration of biological, chemical, and physical means to control a nuisance species. A rotation of different methods can provide a thorough management strategy for nuisance plant control. Rotating different chemical products used to treat nuisance species can achieve greater efficacy and reduce chemical resistance. No management, drawdown, nutrient inactivation, dredging, bottom screens, biomanipulation, native species reintroduction, hand controls, herbicide treatment, harvesting, DASH, and lake use ordinances were all evaluated as management options for Potter Lake.

No Management

Under this alternative, aquatic plants would be left to occur naturally with no active management and continue to expand their ranges. The downside of not managing the plant community is that it allows exotic species to flourish because of their completive nature. Potter Lake's plant community already consists of three invasive species, Eurasian Water-Milfoil (EWM), Curly-Leaf Pondweed (CLP), and Purple Loosestrife. EWM has the ability to outcompete native species in two ways. EWM is one of the first plant species to start growing in the spring, which blocks the space needed for native plant growth. Once established, it forms dense surface mats that block sunlight further reducing native plants. Expanded areas of Eurasian water-milfoil may also impact the fishery by increasing the areas for panfish to hide from predators, leading to over population and stunted growth. CLP is similar in that it emerges early in spring and often creates a dense canopy which retards native growth. Different than EWM, CLP often dies back in June with increasing water temperatures. It can re-emerge later in the season as conditions become more favorable. The reproductive structures or "turions" can last many years. Purple Loosestrife is a prolific seed producer that can outcompete native shoreline / wetland vegetation and will continue to expand its range if left alone.

While the short-term monetary cost of "No Management" is nothing, the long-term ecosystem cost is much higher. Unmanaged, exotic species can have severe negative effects on water quality, native plant distribution, abundance and diversity, and the abundance and diversity of aquatic insects and fish (Madsen, 2000).

Conclusion – Although "no management" is technically feasible for Potter Lake, it should not be considered for the best, long term interest of the water resource.

Drawdown

Drawdown can be used to control some plant growth by dropping the lakes water level for a period of time and exposing the plants to extreme temperatures, drying and freezing. Some plants respond very favorably to drawdown, while other plants react negatively or unpredictably. Some lakes have had good success with extended drawdowns that thoroughly freeze the lakebed, especially those areas with soft sediments in shallow shoreline areas. Besides the effects to the plant community, drawdown can have a negative impact on animal communities. Spawning areas are no longer accessible to fish and shoreline areas become unsuitable for amphibian hibernation.

Costs associated with drawdowns depend on many variables. Lowering and raising the lake by pumps requires equipment, electricity, and staff while the ability to open a gate to lower the lake and close the gate to raise the water level can help minimize cost.

Conclusion - Drawdown for the purpose of aquatic plant control on Potter Lake is not recommended at this time due to the impacts on recreation and wildlife communities along with the limitations of the control structure.

Nutrient Inactivation

Nutrient inactivation is used to bind soluble nutrients, primarily phosphorus, into an insoluble/unusable form thereby reducing growth. One of the most common substances used is aluminum sulfate (alum). The alum treatment binds the phosphorus which precipitates out of the water column creating a floc formation covering the bottom sediments. Nutrient inactivation is commonly done for algal or phytoplankton control. Alum treatments typically improve water clarity and if careful consideration is not taken toward reducing additional nonpoint source phosphorus pollution, an increase in aquatic plant growth may occur. Additionally, lakes with a large population of rough fish (carp and bullhead) may see little effect from an alum application as the floc can be agitated releasing nutrients back into the water body.

Alum treatments are typically done in large expanses with water depths greater than five feet. This allows the largest amount of phosphorus to be bonded as the alum descends in the water column. Because of the large-scale treatment methods, alum treatments need to be performed by certified pesticide applicators under a WDNR approved permit. The treatment would likely cost hundreds of thousands of dollars for Potter Lake.

Conclusion – Due to limited algae growth, a larger shallow area, and high cost, nutrient inactivation is not recommended for Potter Lake.

Dredging

Dredging is most often used to increase depths for navigation in shallow waters, like channels, rivers and harbors. To be considered for aquatic plant control, dredging would need to bring the lakebed to depths past the littoral zone of the lake. Dredging is the costliest form of plant management control with costs ranging from $5.00 per cubic yard up to $20.00 or more per cubic yard depending on site conditions, methods used and disposal costs. The WDNR highly regulates dredging and if considered would need permit approval. Dredging can lead to a decrease in plant species diversity and cause a shift toward disturbance tolerant species such as Eurasian Water-milfoil (Nichols, 1984).

Conclusion – Due to cost and scale, widespread dredging is not recommended as a method for aquatic plant management on Potter Lake. It may be an option to consider on a local scale for the channel on the SW end of the lake and the boat launch if depths continue to decrease over time.

Bottom Screens

Bottom screens are similar to window screens that are placed on the lake bottom to control plant growth. Screens come in rolls that are spread out along the bottom and anchored by stakes, rods, or other weights. Screens create little environmental disturbance if confined to small areas that are not important fish or wildlife habitat. Although they are relatively easy to install over small areas, installation in deep water may require SCUBA gear. Care must be taken to use screens where sufficient water depth exists, reducing the opportunity for damage by outboard motors. Bottom screens cost more than $350 for a 500 sq. ft. roll and must be removed in fall and reinstalled in spring. Because of the high cost, most bottom screen applications are best used in small scale scenarios including swim beaches or confined navigational lanes. Large scale applications are not recommended or typically allowed by the WDNR because of the negative impact on native plants.

Conclusion – Bottom screens are contradictory to the WDNR goal of protecting native plants so they are not viable for use on Potter Lake.

Biomanipulation

The use of biological controls for aquatic plant management purposes is currently very limited. Most of these controls are theoretically possible, however they have limited applications. Careful consideration should be used when picking a bio-manipulation technique because there are a number of instances where the use of biological controls caused new problems when a non-target organism was preferred. Biological controls also produce slower, less reliable results compared to mechanical control activities or herbicide applications.

Conclusion – There are currently no viable biomanipulation options for Potter Lake.

Native Species Reintroduction

Native plants are being re-introduced into lakes to try to diminish the spread of exotics and to reduce the need for more costly plant management tools. Native plants are usually less of a management problem because they tend to grow in less dense populations, are more often low-growing and have natural predation to keep them in balance. Encouraging landowners with developed shorelines to incorporate planting of native emergent plant species such as bulrushes, pickerelweed, smartweed, iris, sedges and associated upland plantings should be considered. The emergent plant species would provide a buffer zone between the water and shoreline thereby reducing the effects of wave action erosion and reduce some nutrient runoff into the lake. The emergent plants would also provide important habitat for fish, reptiles, amphibians, macro invertebrates and may increase the aesthetic value of the lake in general.

Costs to conduct plantings vary with the number and type of plants and whether volunteers or paid staff does the work. Successful plantings can be affected by a number of factors, including health of the new plants, weather, timing, bottom substrate, water clarity and waterfowl grazing. The WDNR should be consulted before conducting any planting activities to ensure the protection of the lakes' water resources, the necessity of a permit and the likelihood of success.

Conclusion - Shoreline plantings can be considered. Individual landowners are encouraged to allow the upland shoreline edge to re-vegetate into a stable buffer zone. This can be accomplished through a "no mow zone" which tends to work well on lakes with marsh fringes. These buffer zones would provide habitat for birds, turtles, frogs and other wildlife while also helping to filter out nutrients and sediments from manicured lawns that contribute to an increase of in-lake nuisance aquatic plant growth. Although an established buffer will require less work than a developed shoreline, there will be maintenance required. This may include cutting, mowing, or elimination of undesirable or exotic species such as sandbar willow, phragmites and purple loosestrife. Landowners should consult with a professional to determine specific maintenance requirements for their shoreline buffers. A permit issued by the WDNR will be needed for aquatic plantings.

Hand Controls

Hand controls are a method of aquatic plant control on a small scale which consists of hand pulling or raking plants. Rakes with ropes attached are thrown out into the water and dragged back into shore. Skimmers or nets can be used to scrape filamentous algae or duckweed off the lake surface. These methods are more labor intensive and should be used by individuals to deal with localized plant problems such as those found around piers or swimming areas. Hand controls are inexpensive when compared to other techniques with various rakes and cutters available for under $130. Although labor intensive, hand controls, especially using rakes, is an effective way to remove plants from a small near shore area.

Current NR 109 allows riparian landowners to manually remove aquatic vegetation including native species and invasives like Eurasian water-milfoil and Curly-leaf pondweed within their "riparian zone" without permits as long as the resident's riparian zone is considered a single area that is no more than 30 feet wide as measured parallel to the shoreline. It can include swimming and pier areas as long as it is not a listed WDNR Sensitive Area. The 30-foot area must remain the same each year. It is illegal to remove native plants outside the 30-foot wide area without a permit.

Conclusion – Hand controls may be used by individual landowners to clear swimming areas or pier areas. Landowners should be encouraged to be selective in their clearing, again focusing on Eurasian water-milfoil, Curly-leaf pondweed, and Purple Loosestrife. A natural area of native vegetation is recommended both on the shoreline and in the water because leaving a void will allow exotic invasive species to re-establish. Before conducting any large-scale hand control management, refer to Wisc. Admin Code NR 109 and consult with the local WDNR lakes biologist regarding any permits needed for removal of plants.

Herbicide and Algaecide Treatment

Herbicide and algaecide treatments of aquatic plants and algae in lakes are governed by WDNR under Wisc. Admin Code NR107 and each product is registered by the EPA. Herbicide treatment for the control of aquatic plants is one of the more controversial methods of aquatic plant control with debates over the toxicity and long-term effects of these products. Currently, no product can be labeled for aquatic use if it poses more than a one in one million chance of causing significant damage to human health, the environment or wildlife resources (Madsen, 2000). In addition, the product must not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Modern herbicides have been tested extensively and it can take $20 - $40 million and 8 – 12 years to successfully navigate the registration process and its accompanying series of laboratory and field testing (Getsinger, 1991).

Prior to any treatment, a permit is required from the WDNR. Only Wisconsin approved and EPA registered herbicides may be used, following all label directions, use applications, application rates and use restrictions. In most situations, herbicides may only be applied by licensed applicators certified in aquatic application by the Wisconsin Department of Agriculture, Trade, and Consumer Protection. Proper handling and application techniques must be followed, including those to protect the applicators. All applications must comply with current laws in the State of Wisconsin.

Although individuals may apply for permits to apply aquatic herbicides, residents are strongly encouraged to work with the PLPRD on any questions or concerns about aquatic plants prior to undertaking any plant management activities. It is recommended that individuals do not purchase and apply aquatic herbicides themselves because the products may be completely ineffective if they are used to treat the wrong plant species. Also, unregulated, uneducated use may result in overuse and cause damage to the beneficial plant species, fish, wildlife and humans.

Aquatic herbicide usage can provide excellent plant control when properly applied but it is important to remember that native aquatic plants are an integral part of a lake ecosystem. For instance, a public swimming beach might use a non-selective herbicide to control aquatic plants in a relatively small area. Early season treatments targeting only invasive species such as Eurasian water-milfoil or Curly-leaf pondweed have been very effective in limiting the impact to native species while providing season long control.

Identification of the target species is very important because product selection and treatment timing will affect results. Herbicides labeled for aquatic use are either classified as contact or systemic. Contact herbicides do not translocate throughout the plant but kill the exposed portions of the plant that they come into contact with. Typically, these herbicides are faster acting but do not have a sustained effect, meaning they do not kill root crowns, roots or rhizomes. Contact herbicides are frequently used to provide short-term nuisance relief. In contrast, systemic herbicides are translocated throughout the plant. They are slower acting but often result in the mortality of the entire plant.

There are many different types of products that can be considered based on the target species, acceptable non-target impacts, length of desired control, and use restrictions. These include chelated copper, glyphosate, imazapyr, 2,4-D, diquat, endothall, flumioxazin, carfentrazone, fluridone, and florpyrauxifen-benzyl. Defining expectations and choosing the right product will make the difference between a perceived success or failure. The average cost of commercial aquatic herbicide treatments can range from $250 - $1,000 per acre and vary greatly depending on the target plant(s) and herbicide(s) uses. Permits are needed from the WDNR including approved products, quantities, and application area, and timing.

Conclusion - Herbicide treatments should be considered as a viable management tool on Potter Lake. These treatments should focus on targeting exotic species like Eurasian water-milfoil (EWM), Curly-leaf pondweed (CLP), and Purple loosestrife. If CLP becomes a widespread problem, then treatments should be planned early in the season to try to prevent the production of turions, an important method of reproduction for the plant. Also, for large expanses of EWM, early season treatments are encouraged before plant biomass increases and while native plant growth is minimal. Native aquatic plant beds should only be treated for nuisance conditions that may be affecting navigation. Destruction of any native plant populations will increase potential problems from exotic species. Management of Purple loosestrife should be conducted in early to mid-August to control these invasive species before they increase their current ranges.

Harvesting

Harvesting is another lake management tool that is frequently used to control aquatic plants and is governed by WDNR under Wisc. Admin Code NR109. In the past, the presumption was that eventually plant growth in a lake with harvesting practices would cease to be a problem when nutrients have been removed. However, a lack of plant growth after harvesting will not normally be seen because incoming nutrients from the watershed will usually offset any nutrients removed during harvesting (Engel, 1990).

Harvesting is non-selective, that is, it harvests all plants in its path. "Top cutting" of plant beds has become an important strategy to apply. In an area with a mix of plant species including Eurasian Watermilfoil (EWM), "top cutting" the plant bed will remove the canopy of the exotic plant. With the canopy gone, native species can again begin to flourish. Sometimes, native plant beds can reach nuisance levels and impede navigation. "Top cutting" these areas leaves enough beneficial growth behind while opening otherwise impassible areas for navigation. Harvesting can also be used to create openings and edges in dense vegetation allowing predatory fish to more effectively seek out panfish that may otherwise become stunted. Harvesting should only be done in waters deeper than three feet leaving at least one foot of plant material. This will decrease damage done to the equipment by bottom sediments or debris, minimize bottom sediment disruption reducing the chances of re-entry by exotic plant species and reduce disruption toward fish spawning and nursery areas.

Another aspect of harvesting operations is shoreline pickup programs. These programs help control floating plant material and plant debris that is washed up on shore by wind, wave, recreational use and harvesting operations. Many lakes with high amounts of invasive species like Eurasian Water-Milfoil benefit from shoreline pickup programs, by reducing the amount of floating plant material that would have otherwise started to re-colonize in the near shore areas. When a shoreline pickup program is used, plant debris should be placed on the ends of piers for retrieval. This will remove the need for harvesters to go near shore minimizing the disruption toward sediment and rooted plants.

Harvesting is a very costly management alternative with high initial equipment costs as well as long-term operational expenses. A harvesting program requires a variety of equipment and includes, but not limited to, a harvester, trailer, truck to haul cut plants, and a conveyor to move plants from the harvester to the truck. Along with equipment, a location to dump cut vegetation is needed. Another major component is staffing the program which usually depends on the size of the harvesting operation and/or lake. Smaller lakes typically have 1 to 2 harvesters which are run by volunteers or part time paid staff. Larger lake harvesting operations tend to have 2 or more harvesters and have full time paid staff to conduct daily and seasonal maintenance, as well as repairs. Some local lakes even employ college students due to their availability during the summer.

Conclusion – Harvesting is a viable management strategy for aquatic plant management on Potter Lake and has been used in the past. It should be conducted on an as needed basis and may not be necessary at all in years after a whole lake herbicide treatment.

DASH

Diver Assisted Suction Harvesting (DASH) is a management option where a certified diver maintains control of a hydraulic pump and pulls selected plants by the root, feeding them into the intake hose. The plant is transferred to a collection station that can range from a mesh onion-sack to large on-shore drainage bags. The advantage of DASH includes the ability to select the target plant for removal. The disadvantage is the slow nature of the process and high cost due to specialty trained staff and equipment. Also, as operations begin in a DASH location, underwater visibility rapidly diminishes, further reducing the speed of removal. Low visibility and human error also contribute to missed plants or improper removal (not removing the roots). It is also common to do relative damage to non-target species through the tangled nature of aquatic plants and the hydraulic hose flattening areas as the diver(s) are searching for target plants. Mollusks, crustaceans, insects and other species that live in and around the lake bottom, on or within the plants are also inevitable bycatch. DASH should be used in instances of very small and relatively dense patches of invasive plant species that are ideally located on solid substrate. Deeper patches of target plants on a sand or gravel substrate with few native species is also ideal.

In 2021, DASH was used on individual private shoreline sites on Potter Lake (Figure 4). As a management strategy for invasive plants, DASH is most likely limited to isolated shoreline sites. With the broad distribution and lower water clarity on Potter Lake, DASH is not a viable option for mitigation of invasive plants on a larger scale than individual sites. Table 8 below shows a cost and time comparison for DASH, 2,4-D, and harvesting. This quantifies just how cost prohibitive DASH can be, particularly on a larger scale.

Table 8: *DASH Cost and Time Comparison*

Acreage	DASH*	Chemical (2,4-D)	Harvesting**
1 acre	$12,000 - 4-7 days	$1,000 – 1.25 hours	$1,200 – 45 min.
5 acres	$60,000 – 1 month	$4,500 – 2.5 hours	$6,000 – 3.5 hours
20 acres	$240,000 – 1 season	$15,000 – 5 hours	$24,000 – 1 day
100 acres	$1,200,000 – years	$60,000 – 2 days	$120,000 – 1+ weeks

*Based on www.aquaticinvasivecontrol.com and local contractors
**Based on www.ecy.wa.gove and www.lakesaquaticweedremoval.com

Conclusion – DASH has been used in the past and could continue to be used if needed on a small scale on individual lakefront shorelines. This may not be necessary in years after a whole lake treatment due to reduction of invasive species.

Local Ordinances and Use Restrictions

Local lake ordinances have long been used to control activities on lakes. Local communities may adopt ordinances to protect public health, safety and welfare. Any proposed ordinances are sent to the WDNR for review to be sure they comply with State Statutes. Once approved by WDNR, communities may then finalize and enforce the ordinances. Costs associated with ordinance development depend upon the problem, potential solutions, municipal cooperation and municipal legal reviews. Grants are available through the WDNR to assist with the cost of developing ordinances.

Historically, public health, safety and welfare were interpreted to mean peoples' physical issues associated with using the lake. Speeding and reckless uses endanger lives and are usually controlled through local ordinances. Recently there has been a growing realization that the lake's health has a bearing on public welfare. Lake use activities conducted in inappropriate areas of lakes can be very damaging to the lake ecosystem. Spawning habitat can be destroyed along with disrupting aquatic plant communities, shifting the plant communities to become less beneficial. With the state's acceptance of the environmental health premise, communities are looking at lake use zoning. Some have shoreline zones that are no slow wake, while others have restricted some or all of the lake to no-motors. Protection of specific species or valuable areas can be achieved by developing an ordinance to minimize intrusions.

It is important to keep in mind the following in the development of ordinances:

- Any proposed ordinance must have prior review by the WDNR.
- An ordinance must not discriminate on a particular craft
- An ordinance must be clearly understood and posted. Buoys (which must also be approved by the WDNR) should warn boaters of areas to avoid.
- Any ordinance should address a specific problem. If boating damages a sensitive area of the lake, allowing boats in the area on alternating days does not achieve the protection sought.
- An ordinance must be reasonable and realistic. An ordinance that creates a slow no wake zone that affects all of the lake area less than three feet deep may not be enforceable. The general public could not know the extent of that area. A more reasonable approach would be to review the desired area and develop a plan based on a specific distance from shore. Buoys could then be used to identify that area.
- Any proposed ordinance should be studied to ensure that it does not aggravate a different problem. For example, many communities have shoreline slow no wake zones that exceed that of state law. On a small lake, enlarging that shoreline zone may provide more resource protection. It may also further concentrate other lake use activities such as skiing into an area too small to be safe.

Any attempts to restrict lake use should be weighed along with the social and economic impacts. It is well documented that those most involved with lakes and lake protection are those same people who spend the most time on or around lakes. They either live on or have easy access to a lake. It is very difficult to convince outsiders that lake quality is a concern or that funds should be spent because they do not have a personal involvement. Reducing public use of a lake will have a direct effect on their involvement and possibly their social and economic concern about a lake. Lake ordinances should be developed to protect health or safety, not to restrict a specific user group.

Conclusion – Lake ordinances and restrictions may be a viable option for Potter Lake, however, they should be carefully developed and studied to ensure that they address the problems without undue restrictions. The restrictions on stopping aquatic hitchhikers are particularly important and should continue to be well documented with signage at the boat launch and within the CBCW program.

RECOMMENDATIONS

For the purpose of these recommendations, nuisance species shall be defined as those native species which produce excessive biomass as to hinder realistic lake uses and may include multiple species in navigational lanes. Invasive species include Eurasian Water-Milfoil, Curly-leaf pondweed, and Purple loosestrife. Limiting disruption of non-nuisance, native aquatic plant beds should be a priority to meet long-term management goals. The protection of the desirable species will provide natural “seedbanks” or “plantbanks” for re-establishment into other areas of the lake. ***Selection of management areas and techniques should always be based on present conditions.***

Harvesting

The Potter Lake Protection and Rehabilitation District (PLPRD) owns and operates a 1985 Aquarius Systems Harvester, two 1995 Aquarius Systems shoreline conveyors, and a 1997 GMC truck. Harvesting has historically been conducted on Potter Lake with the goal of opening lanes in dense invasive and nuisance vegetation to allow easier access to recreational opportunities. The district harvests only when necessary and harvested a total of 108 loads of vegetation in the 2021 season.

The 1985 Aquarius Systems harvester can cut a path eight feet wide and up to a maximum of three feet deep. The primary targets for harvest include two invasive species, Eurasian Watermilfoil and Curly-leaf Pondweed. Nuisance native species, including but not limited to Elodea, can be harvested if growth reaches within a foot of the surface and becomes a navigational issue. Vegetation should be 'topped", which is a harvesting practice where only the top ¼ of the plant is cut. This process allows the cut plants to survive but also allows other native plants to establish thus increasing diversity. It has been shown that harvesting channels in dense beds of vegetation can improve size structure and growth rates for Largemouth Bass (*Micropterus salmoides*) and Bluegill (*Lepomis macrochirus*) (Olson et al. 1998). This is due to new open pockets in the vegetation that allows for more efficient predation on young bluegill by visual predatory largemouth bass, allowing less stunting in bluegill and better growth rates for bass. This additional fishery benefit adds to the value of a harvesting program in a system with dense macrophytes.

The key goal of the harvesting program must be the adequate control of aquatic plants in common use areas of the lake, while protecting the integrity of the native species lake wide. During the growing season it would be highly desirable to dispatch a "weed scout" to determine area specific management strategies for that harvesting period. The weed scout could be any reasonably trained person familiar with overall aquatic plant management strategies and basic plant identification. By executing spot monitoring of the aquatic plant communities, priority harvesting zones and a harvesting plan can be formulated.

The priority for harvest should be in the 50' (blue) and 20' (purple) navigational channels specified in the harvesting map (Figure 19). The second priority for harvest should be the 10' navigation channel zone (yellow) to provide landowner access to open water. Please note that this area is not meant for complete harvest but is provided to show potential area for selected navigational channels starting at 3' of depth. The Top Harvest Only area (green) may be harvested if growth is comprised of either Eurasian Watermilfoil or Curly-leaf Pondweed. Alternatively, nuisance growth nearing the surface in this area could be "topped" to allow for more recreational opportunities. Areas that aren't marked with a color represent undeveloped shoreline, water shallower than 3' deep, and deeper water that would likely not have excess growth.

Harvested plant material will be off-loaded at the West end of the lake and the PLPRD uses three disposal sites for vegetation from the harvester. The exact disposal locations and routes taken to these sites are delineated in Figure 20 -Figure 23 below. It is important to note that any larger fish and turtles should be removed from cut vegetation and returned to the lake.

Proper staff training is an important step in the harvesting program. Front-line workers have a direct impact on the management of the lake during daily operations. Plant identification, permit compliance, and safety are important items to consider.

Important features of mechanical harvesting guidance include:

1. WDNR permit is required
2. Harvesting operations shall not operate in waters less than 3' deep unless critical to channel navigation and should not disturb plants that are at or below one foot above the lake bottom. Harvesting also should not be needed in water depths over 10' deep.
3. Harvesting lanes are designated at 50' wide (Slow speed navigational channel - blue), 20' wide (boat launch bay channels - purple), and 10' wide (resident navigational channels - yellow). Growth each year may dictate a shift in lanes and harvesting priorities.
4. Mid-lake areas marked "Top harvest ONLY" should only be harvested for invasive species OR nuisance species nearing the surface and threatening navigation.
5. Limit excessive harvesting of EWM to prevent fragmentation and spread.
6. Harvesting should not occur in early spring to prevent physical disturbance of fish spawning sites
7. Larger fish and turtles should be removed from cut vegetation and returned to the lake.
8. Steps should be taken to reduce floaters from the harvesting operation.
9. Figures 19 – 23 show the harvesting off-load site, disposal sites, and routes.

Above elements are also summarized in the* MANAGEMENT RECOMMENDATIONS OVERVIEW*Error! Reference source not found.*** *at the end of the document.*

Figure 19: *Potter Lake Harvesting Map*

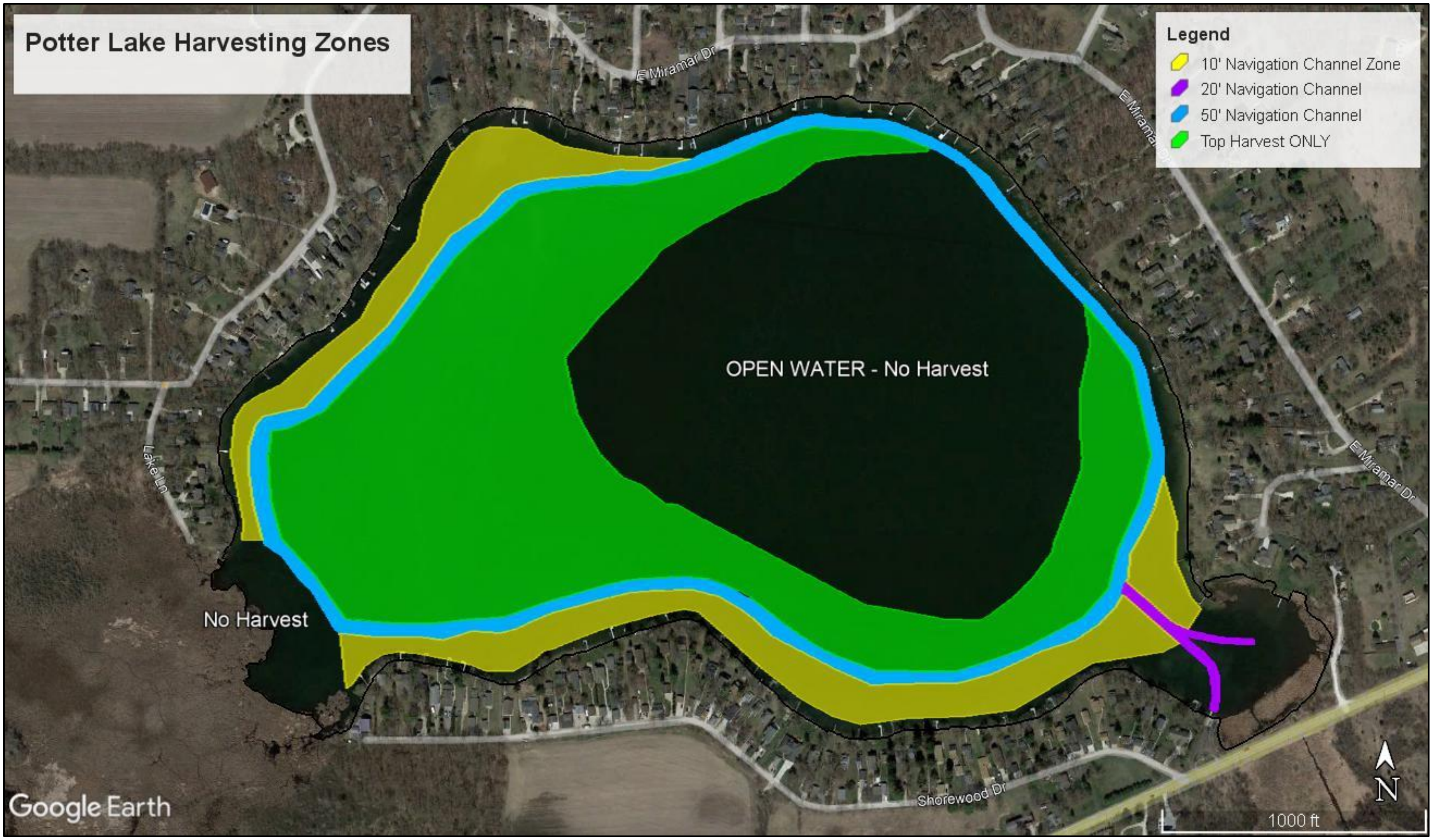


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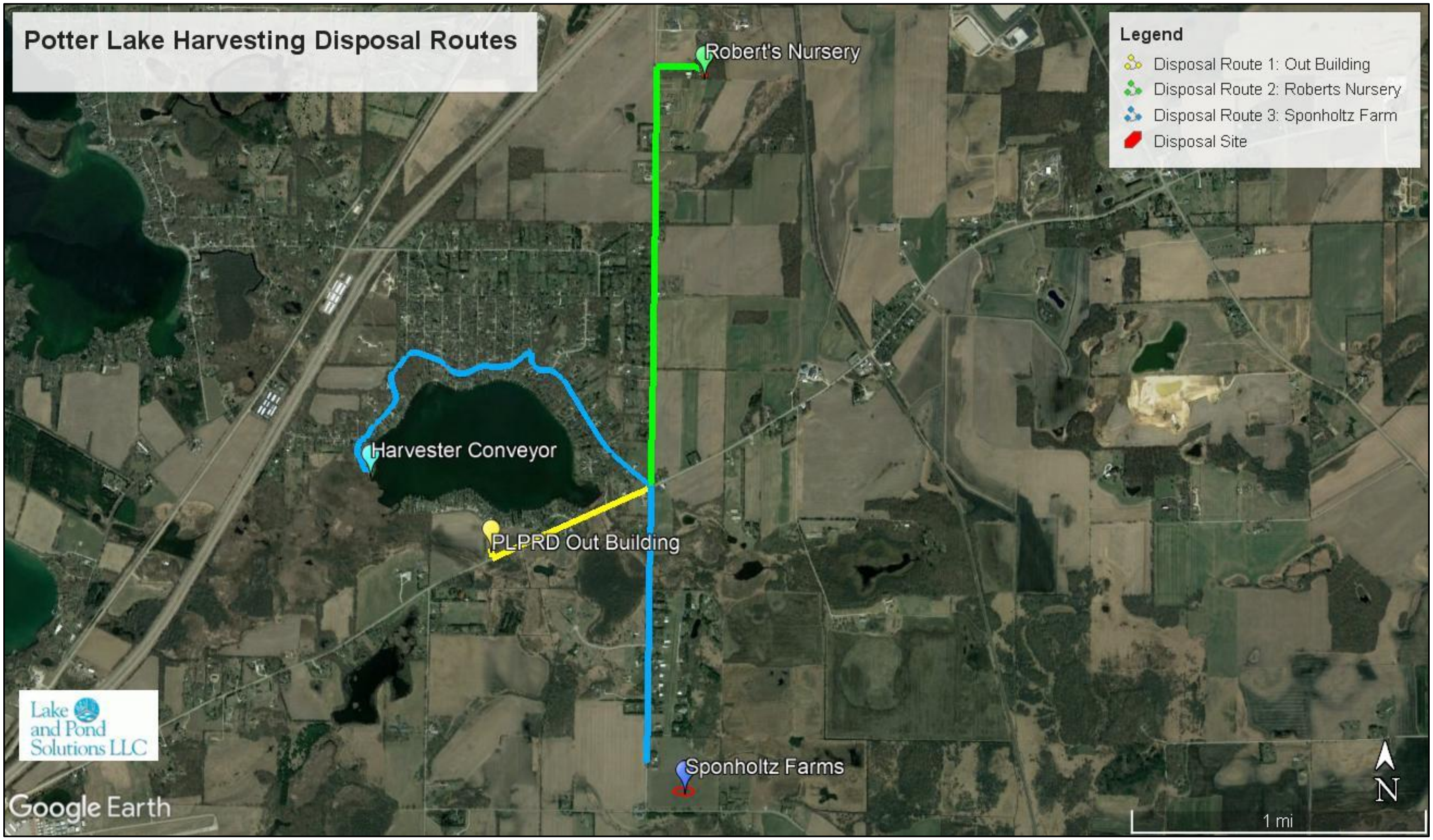
Figure 20: *Potter Lake Harvesting Disposal Routes*



Lake and Pond Solutions LLC (2022)

Figure 21: *PLPRD Out Building Disposal Site*

Lake and Pond Solutions LLC (2022)

Figure 22: *Roberts Nursery Disposal Site*

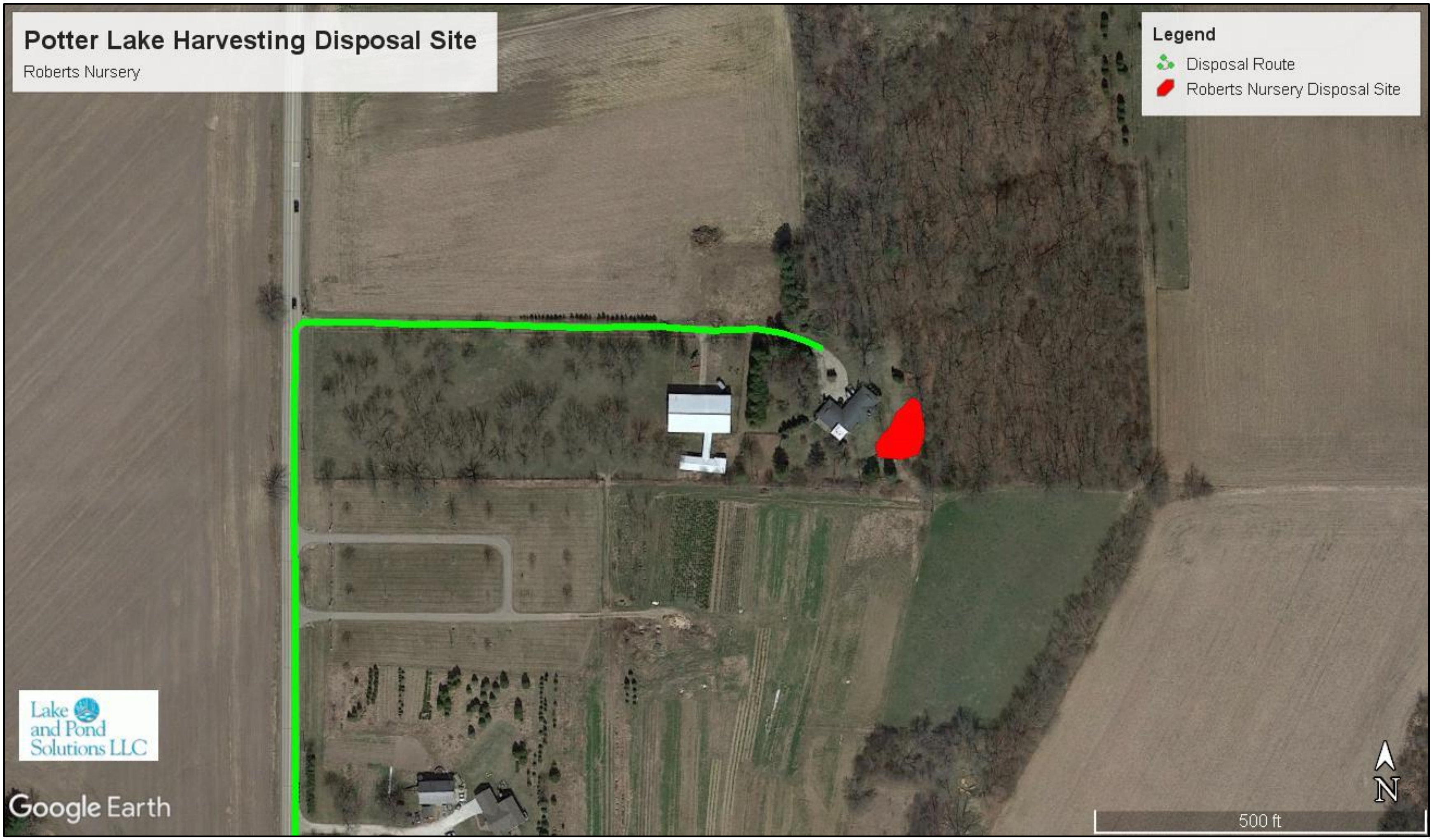


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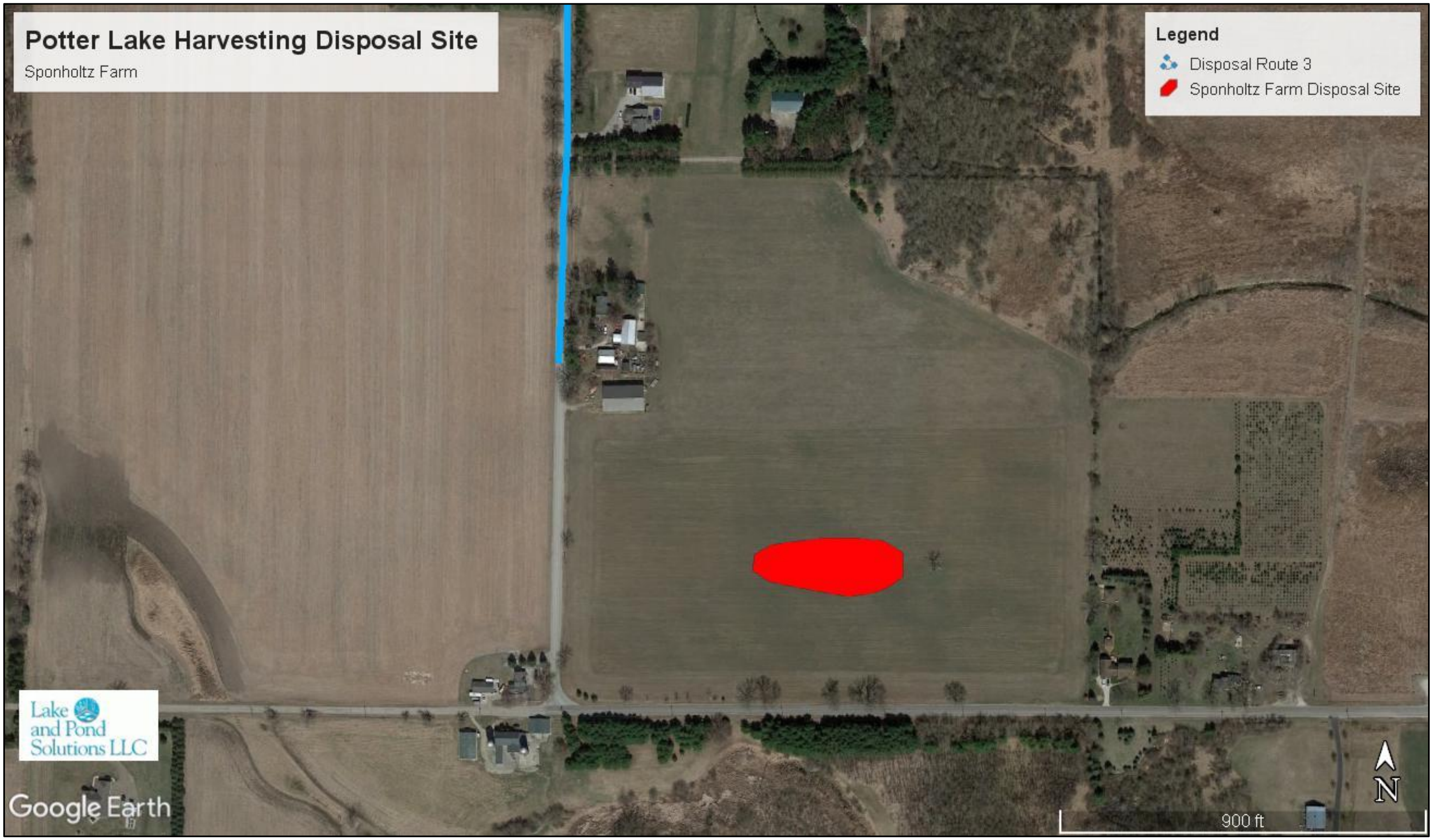
Figure 23: *Sponholtz Farm Disposal Site*



Lake and Pond Solutions LLC (2022)

Herbicide Treatment

The use of approved aquatic herbicides should be assessed on an annual basis in coordination with a certified and licensed professional applicator, the PLPRD, and the WDNR. Early season treatments should be utilized for control of Eurasian Watermilfoil and Curly-leaf pondweed to minimize the impacts to native plants and before plant biomass and densities become prohibitive. Aquatic herbicides could also be used to treat nuisance aquatic plant species near-shore as needed to create access and/or navigation channels. Permits must be obtained through the WDNR before undertaking any kind of treatment. All recommendations are based on the 2021 PI survey; ***conditions are subject to change and recommendations should be reanalyzed each year based on current information.***

The relative frequency of EWM in the 2021 survey was elevated to 36.36% of vegetated points and was distributed throughout most areas of the lake less than 10' deep (Figure 12). Visual sightings accounted for sixty-four percent of the survey's points, while the other thirty-six percent of the points had a rake density of 1. Treatments for EWM are typically performed with 2,4-D, ProcellaCOR, or fluridone. 2,4-D is not as desirable when hybridized milfoil is present since it can be much less effective. Figure 24 shows the EWM observed in our May 2021 meander survey (blue points), while Figure 25 shows the success of the 2021 2,4-D treatment and the spread of EWM throughout the season. Due to the current widespread nature of milfoil, the previously confirmed presence of hybridized milfoil, and plant data showing positive results after fluridone application, our current recommendation for 2022 would be to control EWM with a whole lake fluridone treatment. In years without a whole lake treatment, spot treatments with ProcellaCOR are favored over higher rate 2,4-D treatments as a way to extend control.

While Curly-leaf Pondweed (CLP) was not found at high frequencies (below ten percent) in the last two surveys, it is still an issue for the lake each Spring. Typically, CLP senesces (dies back) in early to mid-July, so the late July survey dates likely don't capture its true range. The plant is found to release large amounts of phosphorus after it breaks down in mid-summer, which can potentially cause algal blooms (WDNR 2012). Following this breakdown, the now empty beds of CLP will see increased light penetration and nutrients, potentially allowing a disturbance tolerant species like EWM to rapidly take hold in areas where CLP previously dominated. CLP also produces turions (vegetated seeds) that can lay dormant for many years. There used to be thoughts that treating this invasive early and consistently each year would lead to eradication. Unfortunately, that hasn't been the case as recent research has shown the turions can lay dormant for more than 10 years. It still is important to look at controlling CLP though, since a mass die-off in mid-summer could lead to a reduction in dissolved oxygen and an increased potential of algal blooms. Figure 24 shows the CLP that was present in May 2021 during the invasive meander survey. This survey shows a much different picture regarding the true extent of CLP. Growth mainly encompasses the shallow western flat of the lake and it was the impotence behind the PLPRD request to harvest in 2021. In years without a whole lake treatment, early season spot treatments with endothall (Aquathol K) would be the recommended control method to improve navigation, reduce the turion bank, protect the lake from a large CLP die-off in mid-summer.

Figure 24: Potter Lake Invasive Meander Survey, 5-5-2021

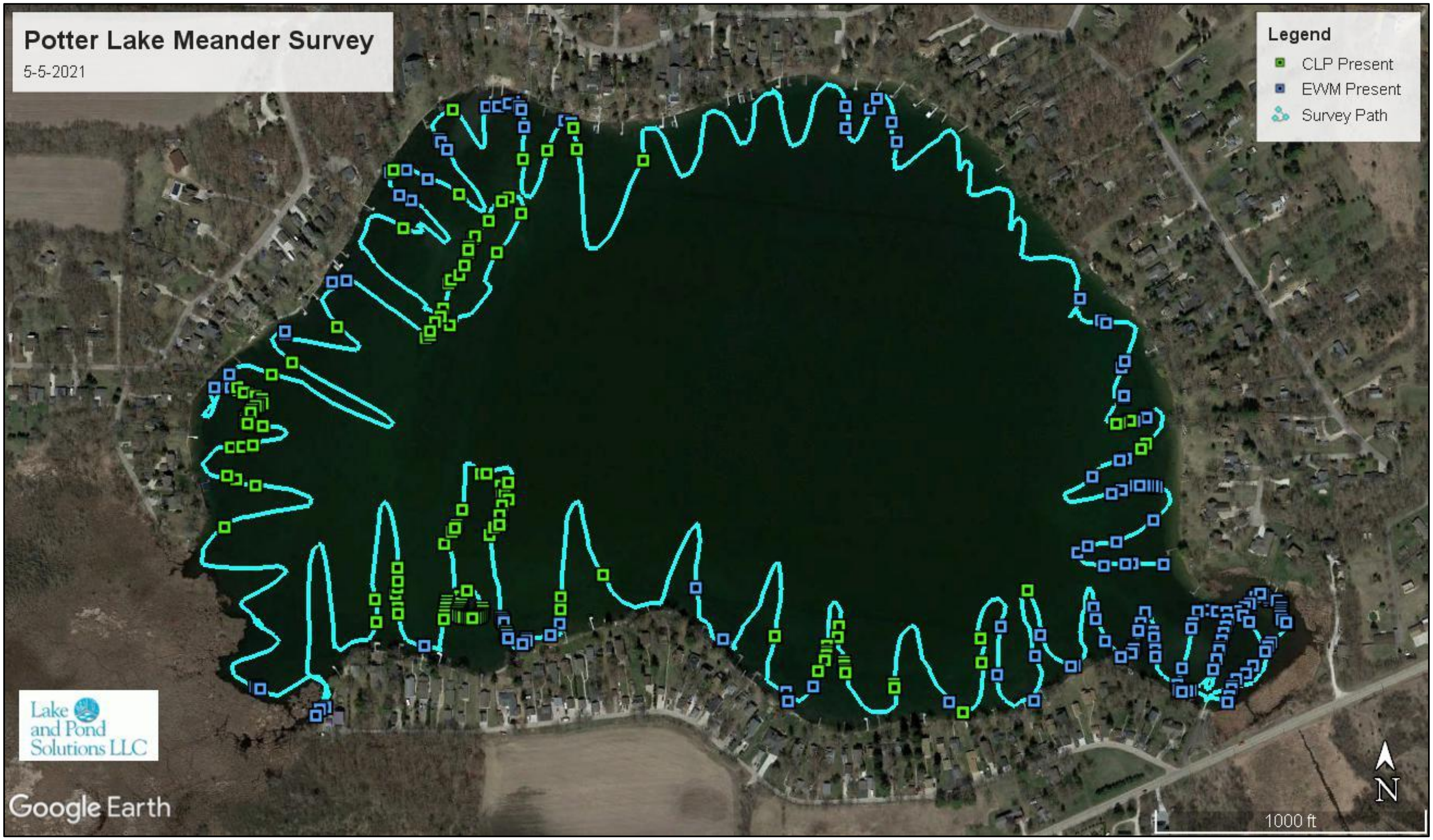


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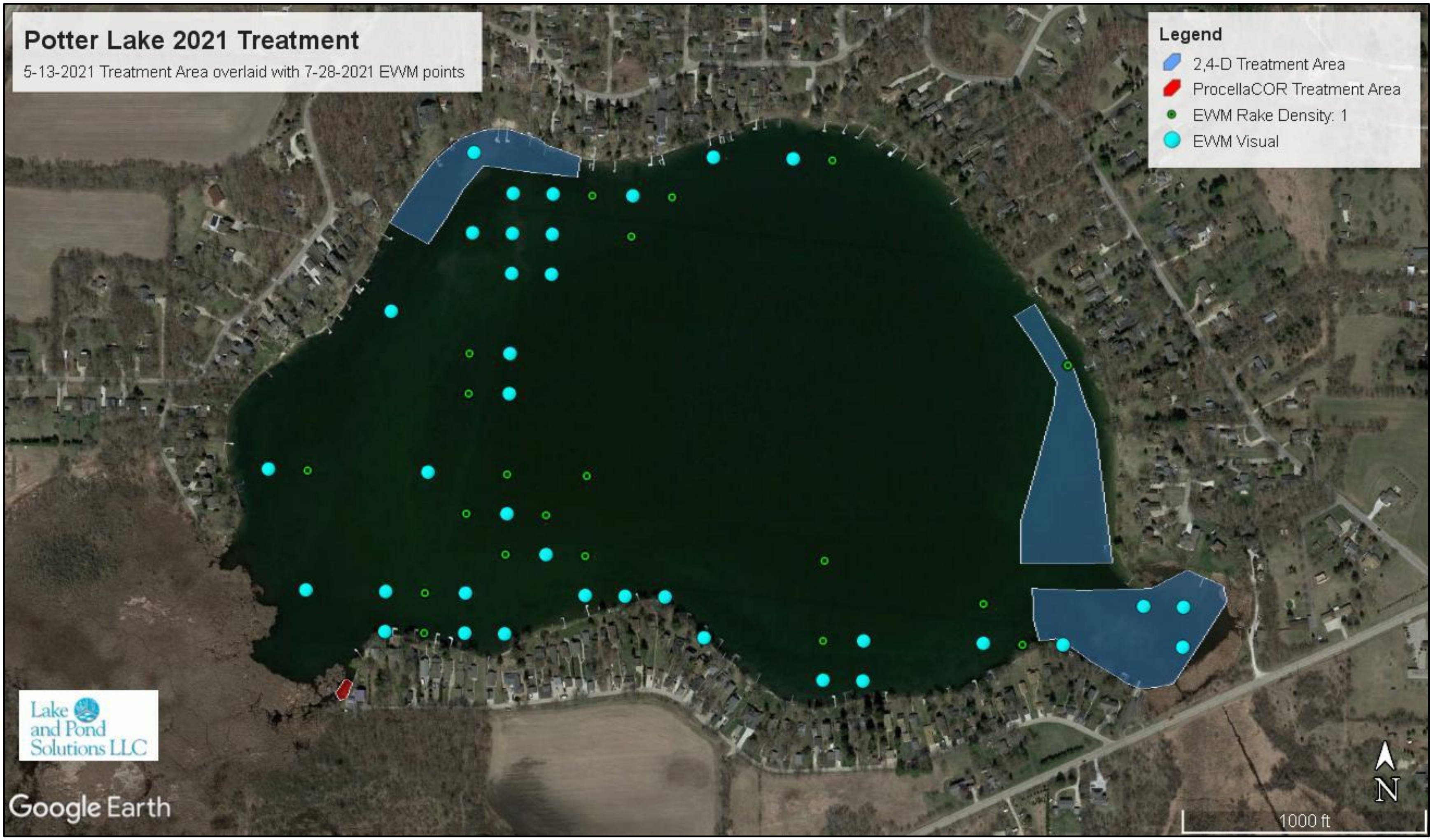
Figure 25: Potter Lake 2021 Treatment Areas Overlaid with EWM Points from 2021 PI Survey



Lake and Pond Solutions LLC (2022)

Purple Loosestrife was found for the first time in the 2021 survey, possibly because it was not catalogued previously. With a frequency of three percent (five sites), treatment is not critical at this stage. However, the frequency of this species should be monitored because spread can occur quickly and overtake native emergent plants. Plants are easily identified later in the summer when they begin flowering. Hand removal or a late summer treatment with glyphosate would be the recommended control methods.

Elodea, despite being a native species, has shown densities and nuisance tendencies on Potter Lake that can restrict access for lake users. In some cases, such as waters too shallow for a harvester, treatment may be considered for nuisance species in specified channels specifically for lake access, such as a channel out from the boat landing. In 2020, six channels were treated for lake access through dense Elodea. With the frequency of Elodea up to over eighty percent in the 2021 survey, nuisance treatments in the future should be considered if growth becomes dense enough to restrict boating access. Diquat dibromide and or endothall is preferred for nuisance treatments and only when growth begins to hamper recreation and navigation.

Important features of herbicide treatment guidance include:

1. Perform selective spring treatment for Eurasian watermilfoil
    a. WDNR permit would be required.
    b. Since EWM locations and densities can change, a pre-treatment meander survey should be performed each Spring to accurately target current growth.
    c. Whole lake options should be considered with EWM relative frequency exceeds 20%.
    d. EWM treatment should ideally occur in the Spring when invasive species biomass is low and prior to extensive native growth. **Product selection and treatment areas should be based on present conditions.**
        i. Whole Lake Treatment
            1. <u>Current Recommendation</u>: Based on expanding EWM populations that exceed 20%, a whole lake fluridone treatment is recommended in the spring of 2022 using SonarONE at 4 ppb with up to two 2 ppb "bumps" throughout the season (as needed and determined by a FasTest).
        ii. Spot Treatment
            1. <u>Current Recommendation</u>: Spot treatments for EWM would likely not be needed in the year of a whole lake fluridone treatment.
            2. <u>Additional Options</u>: Spot treatments using 2,4-D at rates over 3 ppm or ProcellaCOR EC using 2 – 5 PDU/acre-foot would be suitable options for spot control of EWM.
2. Perform selective spring treatments for Curly-leaf Pondweed
    a. WDNR permit would be required
    b. Since CLP locations and densities can change, a pre-treatment meander survey should be performed each Spring to accurately target current growth.
    c. CLP treatment should ideally occur in the Spring when invasive species biomass is low and prior to extensive native growth. **Product selection and areas should be based on present conditions.**
        i. Spot Treatment

1. Current Recommendation: If a whole lake fluridone treatment for EWM is performed, CLP treatment would not be recommended during the year of treatment.
2. Additional Options: In years when no fluridone application occurs, early season CLP treatment can be considered. These treatments should focus on larger treatment areas (>1 acre) and Aquathol K (endothall) is an acceptable product for use. Target rates for spot treatments should focus on the higher concentrations allowed by label.

3. Non-selective treatments for nuisance plant growth
    a. WDNR permit would be required.
    b. Should only be considered to allow access and if mechanical harvesting is not viable or cost effective. This would include an area around the boat launch (TBD), 30' navigational channels from the boat launch and 20' navigational channels from residential properties.
    c. Weighting agents should be used to reduce product drift.
    d. **Product selection and area should be based on present conditions.**
4. Perform selective late summer treatments for purple loosestrife
    a. WDNR permit NOT required.
    b. Perform treatment before seed dispersal (hand removal is also suitable).
    c. Care should be taken to preserve surrounding native vegetation.
        i. Spot Treatment
            1. Current Recommendation: 1.5% solution of glyphosate (4 pints per acre) applied with hand-held equipment. A non-ionic surfactant or methylated seed oil (MSO) should also be added to aid in product penetration and uptake.

Diver Assisted Suction Harvesting (DASH)

Although expensive, DASH was used in 2021 on Potter Lake by private individuals. Permits taken out listed EWM as the main reason for control although survey work performed in 2021 showed a different outcome. It is important to have realistic expectations for DASH and ensure that these private permits are being adhered to. DASH could continue to be used on a small-scale basis for individual lakefront shorelines.

Manual Control

Current NR 109 allows riparian landowners to manually remove aquatic vegetation including native species and invasives like Eurasian water-milfoil and Curly-leaf pondweed within their "riparian zone" without permits as long as the resident's riparian zone is considered a single area that is no more than 30 feet wide as measured parallel to the shoreline. It can include swimming and pier areas as long as it is not a listed WDNR Sensitive Area. The 30-foot area must remain the same each year. It is illegal to remove native plants outside the 30-foot wide area without a permit. Hand controls may be used by individual landowners to clear swimming areas or pier areas. Landowners should be encouraged to be selective in their clearing, again focusing on Eurasian watermilfoil, curly-leaf pondweed, and purple loosestrife. A natural area of native vegetation is recommended both on the shoreline and in the water because leaving a void will allow invasive species to re-establish.

Public Information and Education including CBCW

It is extremely important to provide information to lake property owners and lake users on the benefits of a healthy aquatic plant community including the management issues involved in controlling nuisance and invasive aquatic plants. Annual meetings, newsletters, and informational materials provided by the University of Wisconsin-Extension, Aquatic Ecosystem Restoration Foundation (AERF), and the Wisconsin Department of Natural Resources can assist lake users in understanding the many areas of aquatic plant management and ways to protect lakes from other invasive species. Currently, annual meetings and newsletters are the main form of communication between the District and lake residents.

It is recommended that the PLPRD consider the WDNR – Citizen Lake Monitoring Program, which assists in monitoring overall health of the lakes. The District did have a resident that took samples up until 2003 and the USGS took samples through 2020. Volunteer data collection could provide secchi disk, chlorophyll a, and total phosphorus data. An outside consultant could collect this data as well.

The PLPRD should continue with the Clean Boats, Clean Waters Program as it provides valuable contact with recreational boaters at the launch site. Boat inspectors help perform boat and trailer checks, hand out informational brochures, and educate boaters on how to prevent the spread of aquatic invasive species.

RAPID RESPONSE PLAN

Rapid response to a new aquatic invasive is imperative. The first step is ensuring that it is, in fact, an invasive species not previously found on the waterbody.

If a suspected invasive species is found:

- Take a digital photo of the plant in the setting where it was found and mark with a GPS (if possible). Then collect 5 – 10 intact specimens. Try to get the root system, all leaves as well as seed heads and flowers when present. Place in a Ziploc bag with no water. Place on ice and transport to refrigerator.

- Fill out form http://dnr.wi.gov/lakes/forms/3200-125-plantincident.pdf.

- Contact the WDNR Aquatic Invasive Program Coordinator (currently Amy Kretlow) and deliver the specimens, report, digital photo, and coordinates (if available). Do this as soon as possible; but no later than 4 days after the plant is discovered. A PLPRD board member and current lake consultant should also be notified.

Upon determination of species, a coordinated response plan should be developed in consultation with the DNR, the County, and lake consultants as needed.

*The Rapid Response Plan language was developed in coordination with Craig Helker (WNDR)

SUMMARY

Potter Lake continues to support a healthy plant community, as well as multiple forms of outdoor recreation. The 2021 plant survey conducted in late July found substantial increases in both Common Waterweed (*Elodea canadensis*) and Eurasian watermilfoil *(Myriophyllum spicatum*) with distribution spread throughout the lake. These increases threatened lake recreation and may be the cause of the 2021 declines of Muskgrass (*Chara spp*.) and Sago Pondweed (*Stuckenia pectinata*). A warm spring, extreme drought, and low water levels are other potential culprits that plagued the 2021 season. Since the last whole lake fluridone treatment in 2017/2018, the number of sites with vegetation, species richness, average natives per site, and floristic quality have all increased. It is clear that past management efforts have been successful in reducing invasives while providing navigation access and balancing environmental impact. Future management strategies should continue to focus on reducing invasives and balancing native species growth.

The Potter Lake Protection and Rehabilitation District should continue to utilize both mechanical harvesting and herbicides to manage the plant community on Potter Lake. Harvesting should be focused on improving navigation and recreational opportunities while treatments should be focused on invasive species reduction utilizing early season treatments. Should vegetation become dense enough to restrict boating access, mid-season treatments for either invasive species or dense native species could be considered. With Purple Loosestrife surveyed for the first time in the 2021 survey, this species should be monitored closely for spread and considered for treatment or hand removal.

The lake district has supported a Clean Boats, Clean Waters program on Potter Lake the last six years, and inconsistently in years prior. This program is a great way to reach out and educate the public about reducing the risk of AIS spread to and from Potter Lake. Water quality monitoring through both USGS and volunteer citizen lake monitoring have been conducted on Potter Lake. Continuing data collection is a great way to monitor the health of the system and allow the public access to accurate water quality data.

With the demand for recreational opportunities by lake users, the PLPRD has demonstrated an ongoing effort to effectively manage the aquatic resources while providing for multiple use recreation. In the 2021 season, recreation was limited by curly-leaf pondweed, elodea, and Eurasian watermilfoil. Initiating another whole lake fluridone treatment and selected harvesting may be necessary to improve recreational opportunities and strengthen the native plant community. The Management Recommendations Overview on the next page highlights elements in this plan revision.

MANAGEMENT RECOMMENDATIONS OVERVIEW

<u>HARVESTING</u>

- WDNR permit is required
- Harvesting operations shall not operate in waters less than 3' deep unless critical to channel navigation and should not disturb plants that are at or below one foot above the lake bottom. Harvesting also should not be needed in water depths over 10' deep.
- Harvesting lanes are designated at 50' wide (Slow speed navigational channel - blue), 20' wide (boat launch bay channels - purple), and 10' wide (resident navigational channels - yellow). Growth each year may dictate a shift in lanes and harvesting priorities. See Figure 19.
- Mid-lake areas marked "Top harvest ONLY" should only be harvested for invasive species OR nuisance species nearing the surface and threatening navigation.
- Limit excessive harvesting of EWM to prevent fragmentation and spread.
- Harvesting should not occur in early spring to prevent physical disturbance of fish spawning sites
- Larger fish and turtles should be removed from cut vegetation and returned to the lake.
- Steps should be taken to reduce floaters from the harvesting operation.
- Figures Figure 20 - Figure 23 show the harvesting off-load site, disposal sites, and routes.

<u>HERBICIDE TREATMENT</u>

1. Perform selective spring treatment for Eurasian watermilfoil
    a. WDNR permit would be required.
    b. Since EWM locations and densities can change, a pre-treatment meander survey should be performed each Spring to accurately target current growth.
    c. Whole lake options should be considered with EWM relative frequency exceeds 20%.
    d. EWM treatment should ideally occur in the Spring when invasive species biomass is low and prior to extensive native growth. **Product selection and treatment areas should be based on present conditions.**
        i. Whole Lake Treatment
            1. <u>Current Recommendation</u>: Based on expanding EWM populations that exceed 20%, a whole lake fluridone treatment is recommended in the spring of 2022 using SonarONE at 4 ppb with up to two 2 ppb "bumps" throughout the season (as needed and determined by a FasTest).
        ii. Spot Treatment
            1. <u>Current Recommendation</u>: Spot treatments for EWM would likely not be needed in the year of a whole lake fluridone treatment.
            2. <u>Additional Options</u>: Spot treatments using 2,4-D at rates over 3 ppm or ProcellaCOR EC using 2 – 5 PDU/acre-foot would be suitable options for spot control of EWM.
2. Perform selective spring treatments for Curly-leaf Pondweed
    a. WDNR permit would be required
    b. Since CLP locations and densities can change, a pre-treatment meander survey should be performed each Spring to accurately target current growth.

c. CLP treatment should ideally occur in the Spring when invasive species biomass is low and prior to extensive native growth. **Product selection and areas should be based on present conditions.**
    i. Spot Treatment
        1. Current Recommendation: If a whole lake fluridone treatment for EWM is performed, CLP treatment would not be recommended during the year of treatment.
        2. Additional Options: In years when no fluridone application occurs, early season CLP treatment can be considered. These treatments should focus on larger treatment areas (>1 acre) and Aquathol K (endothall) is an acceptable product for use. Target rates for spot treatments should focus on the higher concentrations allowed by label.

3. Non-selective treatments for nuisance plant growth
    a. WDNR permit would be required.
    b. Should only be considered to allow access and if mechanical harvesting is not viable or cost effective. This would include an area around the boat launch (TBD), 30' navigational channels from the boat launch and 20' navigational channels from residential properties.
    c. Weighting agents should be used to reduce product drift.
    d. **Product selection and area should be based on present conditions.**
4. Perform selective late summer treatments for purple loosestrife
    a. WDNR permit NOT required.
    b. Perform treatment before seed dispersal (hand removal is also suitable).
    c. Care should be taken to preserve surrounding native vegetation.
        i. Spot Treatment
            1. Current Recommendation: 1.5% solution of glyphosate (4 pints per acre) applied with hand-held equipment. A non-ionic surfactant or methylated seed oil (MSO) should also be added to aid in product penetration and uptake.

DIVER ASSISTED SUCTION HARVESTING (DASH)

- WDNR permit is required.
- DASH could continue to be used on a small-scale basis for individual lakefront shorelines.

MANUAL CONTROLS

- WDNR permit may be required.
- Hand controls may be used by individual landowners to clear swimming areas or piers.
    - Single area that is no more than 30 feet wide as measured parallel to the shoreline does NOT require a WDNR permit. Must remain the same each year.
    - Permit IS required if manually removing vegetation outside the 30-foot-wide zone.
    - Landowners should be encouraged to be selective in their removal.

LAKE MONITORING AND EDUCATION

- Continue with annual meetings and newsletters to educate homeowners.
- From 2016 through 2020, USGS was contracted to collect water quality data including secchi disk, chlorophyll-a, and total phosphorus. The PLPRD should find a volunteer citizen monitor or contract with an outside consultant to collect water quality data.
- The Clean Boats, Clean Waters Program should be continued since it provides a valuable contact with boaters at the Potter Lake launch site.

****Conditions are subject to change and recommendations should be reanalyzed each year based on current information***

APPENDIX A

The table below compares the Wisconsin Department of Natural Resources (WDNR) interpretation of the data collected via Point-Intercept (PI) Survey with how Lake and Pond Solutions LLC (LPS) views the same data set. During a PI survey and according to WDNR protocol, any plant species within 5' of the boat is recorded as a visual. LPS takes this a step further to include emergent species when that sample point is the closest point to the shoreline (this action resulted in the documentation of Purple Loosestrife). LPS includes these visuals in calculations to give a more representative analysis of the plant community within the lake. The WDNR chooses to view a lake's plant community based on only plants that were physically removed by the sample rake.

The Frequency of Occurrence is viewed differently as well. LPS calculates the relative frequency of occurrence (FOO), meaning a species frequency is based off of how many sample points the plant was found divided by the number of all the sites that contained any vegetation, including visuals. The WDNR calculation of FOO focuses on the number of sites a plant was found divided by the number of sites that are shallower than the maximum depth of plants. Not all sites that are shallower than the max depth of plants contain vegetation, and for many different reasons. Ultimately, WDNR tables show lower plant species frequency due to the exclusion of visuals and inclusion of additional points without plants.

LPS Frequency of Occurrence Calculation

Relative FOO = # of sites a species was found *including* visuals / # of sites with plants

DNR Frequency of Occurrence Calculation

FOO = # of site a species was found *excluding* visuals / # of sites less than the max depth of plants

The combination of whether or not to include visuals and how to represent frequency of occurrence (i.e. % of sites with vegetation versus % of sites less than the max depth of plants) can lead to some significant differences (Figure 26). By excluding visuals, seven plant species along with filamentous algae are excluded from the WDNR frequency of occurrence. Six of those seven are native plants (White Water Lily, Sago Pondweed, Swamp Loosestrife, Cattails, Spatterdock, and Orange Jewelweed) while one is an invasive that was found for the first time (Purple Loosestrife).

Besides differing species frequencies; representation of the top 5 species, # of sites with vegetation, Simpson Diversity Index, average natives per site, and floristic quality indices are altered using the WDNR method (Table 9). This can have a significant impact to how future management is to be viewed and addressed.

Lake and Pond Solutions, LLC has chosen to stand behind the method of analysis and interpretation in this Plan and all reference to past PI survey data and statistics were corrected to match our method of reporting. This Appendix was provided as an alternative way to represent the data as requested by WDNR.

Figure 26: *LPS vs WDNR Frequency of Occurrence*

Common Name	Scientific Name	Number of Sites Species was Found on Rake	Number of Sites Where Species was Visually Observed	LPS % Relative Frequency of Occurrence incl visuals	WDNR % Frequency of Occurrence w/out visuals
Common waterweed	*Elodea canadensis*	137	2	90.26	79.19
Muskgrasses	*Chara sp.*	69	2	46.10	39.88
Eurasian Watermilfoil*	*Myriophyllum spicatum*	36	20	36.36	11.66
White water lily	*Nymphaea odorata*	0	17	11.04	0.00
Slender naiad	*Najas flexilis*	16	0	10.39	9.25
Curly-leaf pondweed*	*Potamogeton crispus*	10	4	9.09	5.78
Flat-stem pondweed	*Potamogeton zosteriformis*	11	1	7.79	6.36
Sago pondweed**	*Stuckenia pectinata*	0	11	7.14	0.00
Swamp loosestrife	*Decodon verticillatus*	0	7	4.55	0.00
Water star-grass	*Heteranthera dubia*	2	4	3.90	1.16
Purple loosestrife*	*Lythrum salicaria*	0	5	3.25	0.00
Leafy pondweed	*Potamogeton foliosus*	4	1	3.25	2.31
Cattail	*Typha sp.*	0	5	3.25	0.00
Spatterdock	*Nuphar variegata*	0	3	1.95	0.00
Coontail	*Ceratophyllum demersum*	1	1	1.30	0.58
Small pondweed	*Potamogeton pusillus*	2	0	1.30	1.16
Filamentous algae	*n/a*	0	2	1.30	0.00
Orange Jewelweed	*Impatiens capensis*	0	2	1.30	0.00
TOTAL NUMBER OF SPECIES FOUND BY METHOD		10	16		

Lake and Pond Solutions LLC (2022)

Table 9: *LPS vs WDNR Statistical Difference*

REPORTING	# of Sites w/ Vegetation	Simpson Diversity Index	Average Native Species Per Site (Veg Sites)	Avg C-Value	# of Native Species Used for FQI	Floristic Quality (FQI)
LPS Method	154	0.79	1.99	5.0	12	17.32
WDNR Method	147	0.67	1.67	5.5	8	15.56

Lake and Pond Solutions LLC (2022)

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