
Long Lake

Fond du Lac County, Wisconsin

Aquatic Plant Management Plan

April 2026



Sponsored by:

Long Lake Preservation Association

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Onterra, LLC
Lake Management Planning

Long Lake
Fond du Lac County, Wisconsin
Aquatic Plant Management Plan
April 2026

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- A. Public Participation Materials
- B. 2024 Stakeholder Survey Response Charts and Comments
- C. Point-Intercept Survey – Aquatic Plant Littoral Frequency Matrix
- D. 2024 PI Survey Species Distribution Maps
- E. Strategic Analysis of Aquatic Plant Management in Wisconsin (June 2019).
- F. Comment Response Document for the Official First Draft

1.0 INTRODUCTION

Long Lake of Fond du Lac County is fed primarily by precipitation and runoff with a watershed larger than 4 square miles. This defines the lake as a lowland drainage lake. The WDNR lists Long Lake as 423 acres with a maximum depth of 47 feet. Long Lake contains a robust aquatic plant population, with over 50 species being documented in and along the edges of the lake. The lake has a few non-native aquatic plants, which were periodically managed for a time but that has largely been discontinued. Nuisance levels of aquatic plants are mitigated with the use of contracted mechanical harvesting.

Long Lake is not only used by the adjacent landowners, but visitors to the Kettle Moraine State Forest and a boy scout camp: Camp Long Lake. The main public access location is within the State Forest campground on the southeast shore. This launch contains two launching lanes, with a boarding dock and ADA accessibility features. In addition to this public access location, the Long Lake Haven Association at Chinatown maintains a private landing and docking harbor. Long Lake has two public beaches and about 30% of its shoreland is under state ownership through the Kettle Moraine State Forest Northern unit. The State Forest campground on Long Lake holds roughly 200 camp sites. The Boy Scouts of America own and operate a camp on Long Lake, owning approximately 13% of the lake's frontage (Map 1).

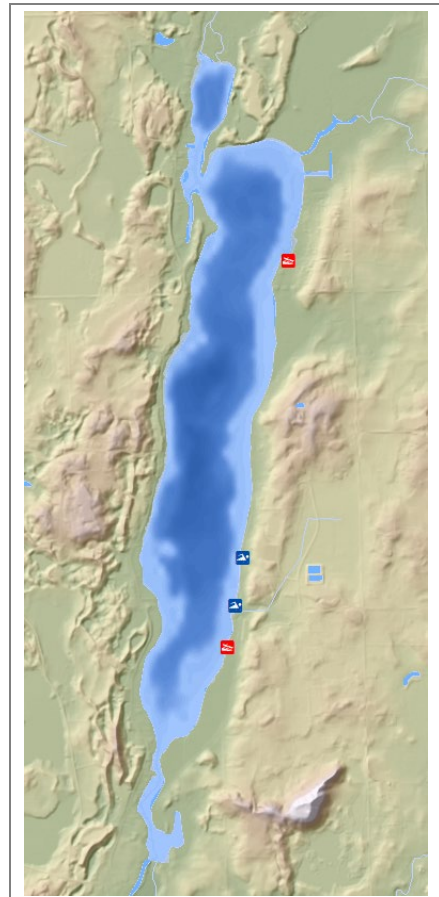


Figure 1.0-1. Long Lake, Fond du Lac County.

The Long Lake Preservation Association (LLPA) is the local citizen-based organization leading management activities on Long Lake, with the following mission statement:

“Long Lake Preservation Association is a not-for-profit association dedicated to enhancing, preserving and protecting the quality of Long and Tittle lakes including the north and south channels for future generations through effective environmental and education polices. We have been working almost 20 years toward this goal.”

With the help of Onterra, Long Lake Preservation Association (LLPA) received a WDNR Surface Water Planning Grant to contribute around 53% in the cost of the Long Lake 2026 Aquatic Plant Management Plan (APM) update. The grant was awarded in February of 2023 and includes various aquatic plant surveys in 2024, an anonymous stakeholder survey of the lake's stakeholders, and planning aspects. Monitoring the effects of active management of the CLP and EWM population has been a focus in previous aquatic plant management activities and is used to develop a more successful aquatic plant management plan for Long Lake's future.

2.0 STAKEHOLDER PARTICIPATION

Stakeholder participation is an important part of any management planning exercise. The objective of this component in the planning process is to accommodate communication between the planners and the stakeholders. The communication is educational in nature, both in terms of the planners educating the stakeholders and vice-versa. The planners educate the stakeholders about the planning process, the functions of their lake ecosystem, their impact on the lake, and what can realistically be expected regarding the management of the aquatic system. The stakeholders educate the planners by describing how they would like the lake to be, how they use the lake, and how they would like to be involved in managing it. All of this information is communicated through multiple meetings that involve a focus group called a Planning Committee. Planning committee meetings were used to deliver the study results, to gather comments, and to create management goals and actions. The highlights of this component are described below.

2.1 Strategic Planning Committee Meetings

Planning Committee Meeting I

On June 25, 2025, Eddie Heath met with the LLPA Planning Committee at the Campbellsport Public Library, including Claire Hetzel (Lakes Program) and Drew Wallace (Fisheries Program) of the WDNR. The meeting attendees were supplied with the draft report sections of the APM Plan prior to the first meeting and much of the meeting time was utilized to detail the results, discuss the conclusions and initial recommendations, and answer committee questions. This roughly four hour meeting largely consisted of a presentation of the available data from the system which served as solid foundation for developing the management goals and associated actions aimed to reach those goals in the second part of the planning committee meeting. Planning Committee members also expressed great concern of the abundance of aquatic plants in the lake during recent years, including increasing populations of CLP. A handout of the presentation is provided as Appendix A.

Planning Committee Meeting II

Over the course of the summer, a mechanical harvesting map and strategy was developed. Multiple iterations were reviewed by the LLPA Planning Committee, with involvement from WDNR.

Based upon the discussions that occurred at the first planning committee meeting, Onterra created a list of potential management goals and actions to serve as a base for discussion. On January 22, 2026, a virtual planning committee meeting was held, and each goal and action was discussed. A large portion of the meeting discussed ways to alleviate the nuisance aquatic plant issues within the lake while balancing a health lake ecosystem. As discussed in the Summary & Conclusions Section (4.0) and the Implementation Plan Section (5.0), the WDNR is amenable to the mechanical harvesting strategy created during this project, and indicated strong opposition of the use of aquatic herbicides in the Chinatown harbor. The planning committee also outlined when future studies and management plan updates would take place, in addition to resolving non-APM issues such as discouraging Canada Goose populations and restoring flow within the Watercress Creek inlet.

2.2 Management Plan Review and Adoption Process

A draft of the writing Implementation Plan Section (5.0) was distributed to planning committee members on January 27, 2026. The committee reviewed the plan and provided a few additional aspects to incorporate.

On February 6, 2026, the Official First Draft of the LLPA’s Aquatic Plan Management Plan for Long Lake was supplied to WDNR (lakes and fisheries departments) by Onterra via email. At that time, the Official First Draft was made available for public review on the LLPA’s website and advertised as an official public comment period through a combination of methods including an announcement at a public meeting and correspondence with the Long Lake Haven Association at Chinatown and Long Lake Fishing Club.

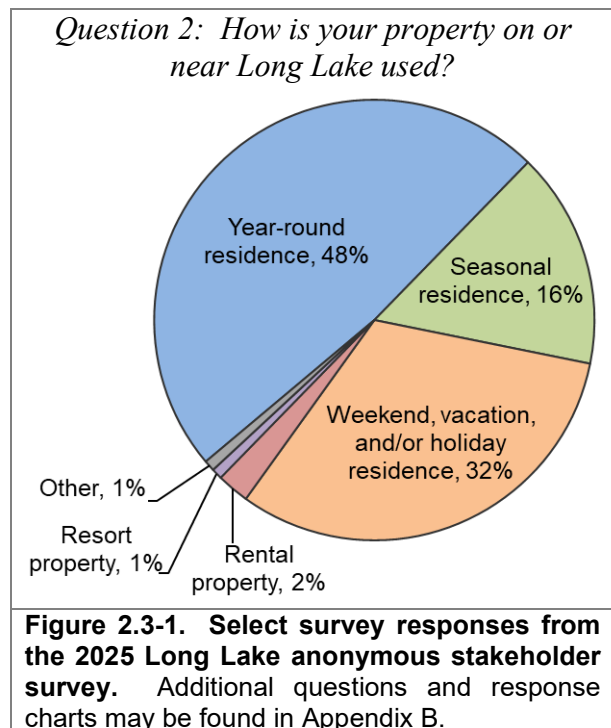
The public comment period remained active until March 16, 2026 when the WDNR comments were received. This public comment period far longer than the minimum 21-day public comment period advised in WDNR guidance. No comments from other agencies or entities were received.

2.3 Riparian Stakeholder Survey

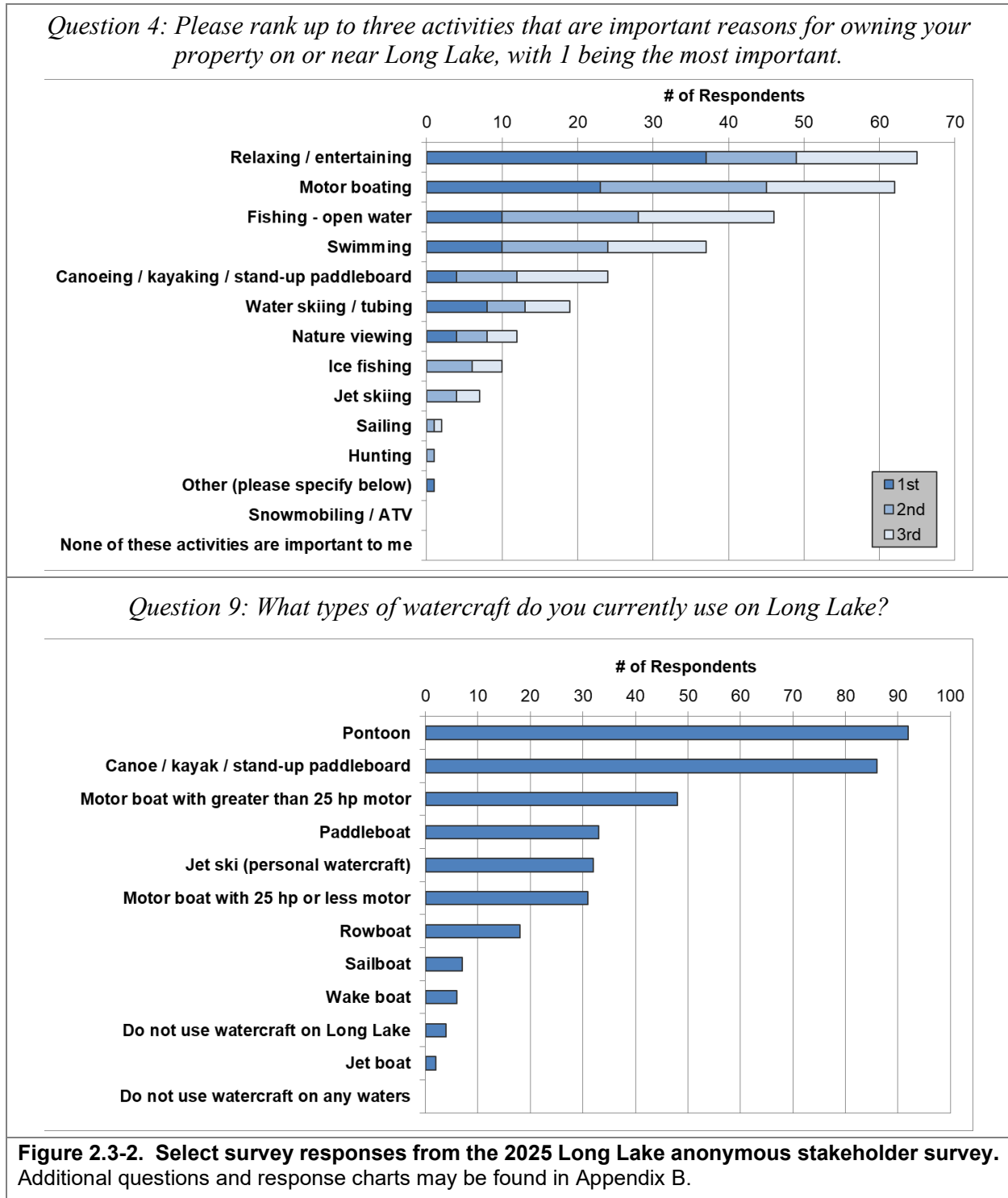
As a part of this project, a stakeholder survey was distributed to LLPA members and riparian property owners around Long Lake (includes Tittle Lake). The survey was designed by Onterra staff and the LLPA planning committee and reviewed by a WDNR social scientist. From mid-January to mid-March, 2025, the 29-question survey was posted online through Survey Monkey for survey-takers to answer electronically. If requested, a 8-page hard copy was sent with a self-addressed stamped envelope for returning the survey anonymously. The returned hardcopy surveys were entered into the online version by a third-party contractor. 54% percent of the surveys were returned. Since a 60% response rate was not reached, the results of the survey are used to represent the survey respondent and not the population projections in order to make conclusions with statistical validity. The data were analyzed and

summarized by Onterra for use at the planning meetings and within the management plan. The full survey and results can be found in Appendix B, while discussion of those results is integrated within the appropriate sections of the management plan and a general summary is discussed below.

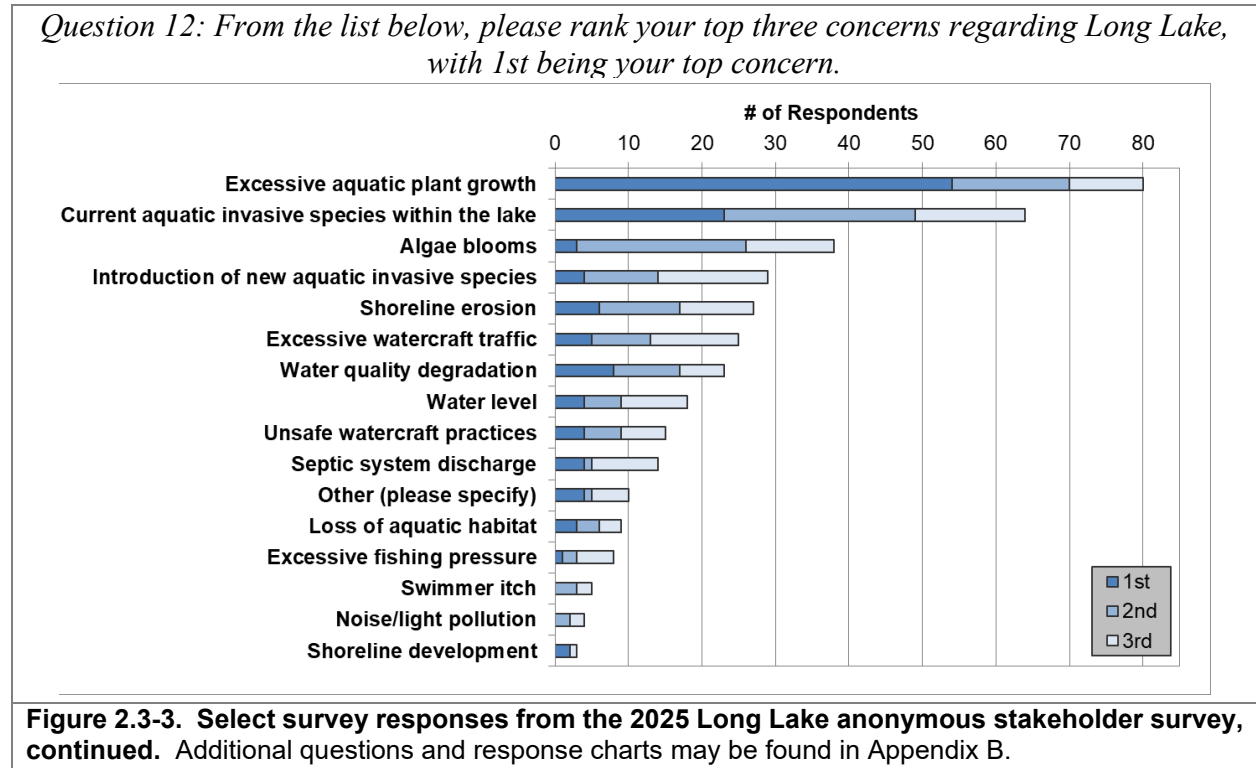
Based upon the results of the 2025 stakeholder survey, much was learned about the people who use and care for Long Lake. Including how the respondents’ properties are used around Long Lake. Almost half of the properties were said to be used as year-round residents (Figure 2.3-1).



Figures 2.3-2 and 2.3-3 highlight several other questions found within this survey. Relaxing/entertaining and motor boating were the most popular reasons for owning property on or near Long Lake. The most popular watercraft used by the survey respondents was pontoon boats followed by canoe/kayak/standup paddleboard.



Given a list of potential concerns, survey respondents ranked their top three highest concerns. Excessive aquatic plant growth along with current aquatic invasive species in the lake were common choices (Figure 2.3-4). These topics are touched upon in subsequent sections as well as within the Implementation Plan.



3.0 AQUATIC PLANTS

3.1 Primer on Aquatic Plant Data Analysis & Interpretation

Native aquatic plants are an important element in every healthy aquatic ecosystem, providing food and habitat to wildlife, improving water quality, and stabilizing bottom sediments. Because most aquatic plants are rooted in place and are unable to relocate in wake of environmental alterations, they are often the first community to indicate that changes may be occurring within the system. Aquatic plant communities can respond in a variety of ways; there may be increases or declines in the occurrences of some species, or a complete loss. Or, certain growth forms, such as emergent and floating-leaf communities may disappear from certain areas of the waterbody. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide relevant information for making management decisions.

Point-Intercept Survey

The point-intercept method as described Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010 (Hauxwell et al. 2010) have been conducted on Long Lake in 2007, 2010, 2013, 2018, and 2024 (Map 1). At each point-intercept location within the *littoral zone*, information regarding the depth, substrate type (soft sediment, sand, or rock), and the plant species sampled along with their relative abundance on the sampling rake was recorded.

A pole-mounted rake was used to collect the plant samples, depth, and sediment information at point locations of 15 feet or less. A rake head tied to a rope (rope rake) was used at sites greater than 15 feet. Depth information was collected using graduated marks on the pole of the rake (at depths < 15 ft) or using an onboard sonar unit (at depths > 15 feet). Also, when a rope rake was used, information regarding substrate type was not collected due to the inability of the sampler to accurately “feel” the bottom with this sampling device. At each point that is sampled the surveyor records a total rake fullness (TRF) value ranging from 0-3 as a somewhat subjective indication of plant biomass. The point-intercept survey produces a great deal of information about a lake’s aquatic vegetation and overall health. These data are analyzed and presented in numerous ways; each is discussed in more detail in the following section.

Species List

The species list is simply a list of all the aquatic plant species, both native and non-native, that were located during the surveys completed in Long Lake during 2024. The list also contains each species’ scientific name, common name, status in Wisconsin, and coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in growth forms that are present, can be an early indicator of changes in the ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain aquatic plant species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of the whole-lake point-intercept surveys that have been completed; plant samples were collected from plots laid out on a grid that covered the lake. Using the data

Littoral Zone is the area of a lake where sunlight is able to penetrate down to the sediment and support aquatic plant growth.

collected from these plots, an estimate of occurrence of each plant species can be determined. The occurrence of aquatic plant species is displayed as the *littoral frequency of occurrence*. Littoral frequency of occurrence is used to describe how often each species occurred in the plots that are within the maximum depth of plant growth (littoral zone), and is displayed as a percentage.

Relative frequency of occurrence uses the littoral frequency for occurrence for each species compared to the sum of the littoral frequency of occurrence from all species. These values are presented in percentages and if all of the values were added up, they would equal 100%. For example, if water lily had a relative frequency of 0.1 and we described that value as a percentage, it would mean that water lily made up 10% of the population.

Floristic Quality Assessment

The floristic quality of a lake's aquatic plant community is calculated using its native *species richness* and their *average conservatism*. Species richness is the number of native aquatic plant species that were physically encountered on the rake during the point-intercept survey. Average conservatism is calculated by taking the sum of the coefficients of conservatism (C-values) of the native species located and dividing it by species richness. Every plant in Wisconsin has been assigned a coefficient of conservatism, ranging from 1-10, which describes the likelihood of that species being found in an undisturbed environment. Species which are more specialized and require undisturbed habitat are given higher coefficients, while species which are more tolerant of environmental disturbance have lower coefficients.

For example, algal-leaf pondweed (*Potamogeton confervoides*) is only found in nutrient-poor, acid lakes in northern Wisconsin and is prone to decline if degradation of these lakes occurs. Because of algal-leaf pondweed's special requirements and sensitivity to disturbance, it has a C-value of 10. In contrast, sago pondweed (*Stuckenia pectinata*) with a C-value of 3, is tolerant of disturbance and is often found in greater abundance in degraded lakes that have higher nutrient concentrations and low water clarity. Higher average conservatism values generally indicate a healthier lake as it is able to support a greater number of environmentally sensitive aquatic plant species. Low average conservatism values indicate a degraded environment, one that is only able to support disturbance-tolerant species.

On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality. The floristic quality is calculated using the species richness and average conservatism value of the aquatic plant species that were solely encountered on the rake during the point-intercept surveys (equation shown below). This assessment allows the aquatic plant community of Long Lake to be compared to other lakes within the region and state.

$$\text{FQI} = \text{Average Coefficient of Conservatism} * \sqrt{\text{Number of Native Species}}$$

Long Lake falls within the Southeastern Wisconsin Till Plains (SWTP) *ecoregion* (Figure 3.1-1), and the floristic quality of its aquatic plant community will be compared to other lakes within this ecoregion as well as the entire State of Wisconsin. Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems within the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states. Ecoregional and state-wide medians were calculated from whole-lake point-intercept surveys conducted on 392 lakes throughout Wisconsin by Onterra and WDNR ecologists.

Species Diversity

Species diversity is often confused with species richness. As defined previously, species richness is simply the number of species found within a given community. While species diversity utilizes species richness, it also takes into account evenness or the variation in abundance of the individual species within the community. For example, a lake with 10 aquatic plant species that had relatively similar abundances within the community would be more diverse than another lake with 10 aquatic plant species where 50% of the community was comprised of just one or two species.

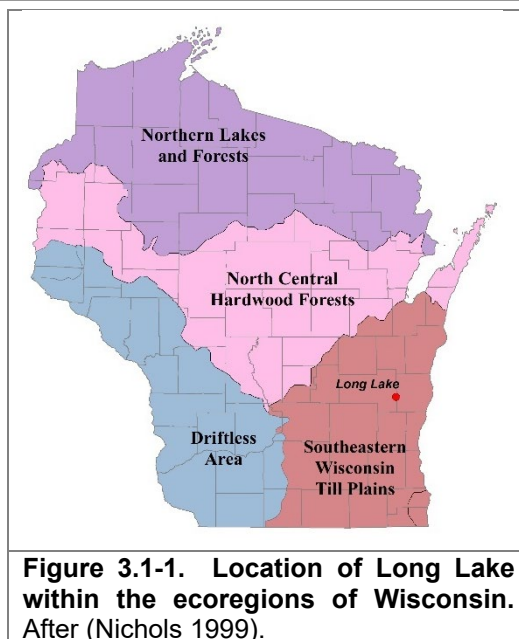
An aquatic system with high species diversity is more stable than a system with a low diversity. This is analogous to a diverse financial portfolio in that a diverse aquatic plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. Some managers believe a lake with a diverse plant community is also better suited to compete against exotic infestations than a lake with a lower diversity. However, in a recent study of 1,100 Minnesota lakes, researchers concluded that more diverse communities were not necessarily more resistant or resilient to invaders (Muthukrishnan et al. 2018).

The diversity of a lake's aquatic plant community is determined using the Simpson's Diversity Index (1-D):

$$D = \sum (n/N)^2$$

where: n = the total number of instances of a particular species
 N = the total number of instances of all species
 D is a value between 0 and 1

If a lake has a diversity index value of 0.90, it means that if two plants were randomly sampled from the lake there is a 90% probability that the two individuals would be of a different species. The Simpson's Diversity Index value from Long Lake is compared to data collected by Onterra and the WDNR Science Services on 212 lakes within the Northern Lakes and Forests (lakes only, does not include flowages) Ecoregion and on 392 lakes throughout Wisconsin.



3.2 Long Lake Aquatic Plant Survey Results

The data that continues to be collected from Wisconsin lake's is revealing that aquatic plant communities are highly dynamic, and populations of individual species have the capacity to fluctuate, sometimes greatly, in their occurrence from year to year and over longer periods of time. These fluctuations can be driven by a combination of natural factors including variations in temperature, ice and snow cover (winter light availability), nutrient availability, water levels and flow, water clarity, length of the growing season, herbivory, disease, and competition (Lacoul and Freedman 2006). Adding to the complexity of factors which affect aquatic plant community dynamics, human-related disturbances such as the application of herbicides for non-native plant management, mechanical harvesting, watercraft use, and pollution runoff also affect aquatic plant community composition (Asplund and Cook 1997); (Lacoul and Freedman 2006).

Point-intercept surveys were conducted in 2007, 2010, and 2013 by the WDNR, and 2018 and 2024 by Onterra (Map 1). The protocol of this survey is implemented by the WDNR and allows for this data to be comparable although it has historically been obtained by different entities.

This report will highlight the 2024 point-intercept survey results and will integrate comparisons to the previous surveys throughout the section. The WDNR has developed a web-based viewer that has the capability of showing the point-intercept survey results on an individual species level, which can be accessed below. Please note that the WDNR may need to find an alternative website or host for the Aquatic Plant Explorer data viewer in the future:

<https://dnr-wisconsin.shinyapps.io/AquaticPlantExplorer/>

During the five point-intercept surveys that have occurred, 56 aquatic plant species have been documented growing in or along the margins of Long Lake (Table 2.2-1). This table is organized by growth form which separates out species based on whether they are emergent species, floating-leaf, submergent, or free-floating species. Species with an "X" on the table indicates the species was physically encountered on the rake during the point-intercept survey. Other species that were observed but were not sampled on the survey rake are referred to as incidentals and are listed with an "I" on Table 2.2-1. Often these species are found growing on the shoreline or in shallow areas of the lake, including during additional survey efforts such as the Emergent and Floating-Leaf Community Mapping Survey that took place in 2013 and 2024.

In 2024, 34 native species were located on the rake sampler and one cattail species was located that is likely a native plant, but lacked flowers/fruits for positive ID. Two submergent non-native species, Eurasian watermilfoil (EWM) and curly-leaf pondweed, were located in 2024 and have been documented from earlier surveys. Several non-native emergent species were identified along the margins of Long Lake, including purple loosestrife, pale-yellow iris, and reed canary grass. Reed canary grass is a fairly ubiquitous upland plant in WI, which will not be focused upon in this report. But all other non-native species will be discussed in additional detail in Section 3.3.

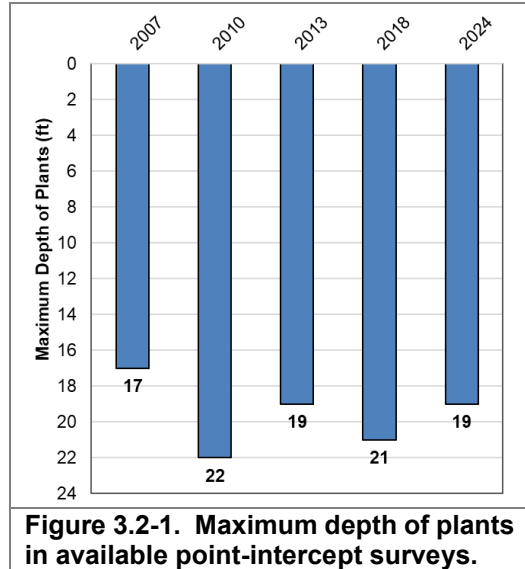
Table 3.2-1. Aquatic plant species located on Long Lake.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2007	2010	2013	2018	2024
Emergent	<i>Carex pseudocyperus</i>	Cypress-like sedge	Native	8	I				
	<i>Carex sp. 1</i>	Sedge sp. 1	Native	N/A		I			X
	<i>Decodon verticillatus</i>	Water-willow	Native	7			I		
	<i>Eleocharis robbinsii</i>	Robbins' spikerush	Native - Special Concern	10		X			
	<i>Iris pseudacorus</i>	Pale-yellow iris	Non-Native - Invasive	N/A					I
	<i>Iris spp. (sterile)</i>	Iris spp. (sterile)	Unknown (Sterile)	N/A					I
	<i>Iris versicolor</i>	Northern blue flag	Native	5					I
	<i>Lythrum salicaria</i>	Purple loosestrife	Non-Native - Invasive	N/A				I	I
	<i>Phalaris arundinacea</i>	Reed canary grass	Non-Native - Invasive	N/A					I
	<i>Phragmites australis subsp. americanus</i>	Common reed	Native	5					I
	<i>Sagittaria latifolia</i>	Common arrow head	Native	3				I	I
	<i>Schoenoplectus acutus</i>	Hardstem bulrush	Native	5	X	X	I	X	X
	<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush	Native	4				I	
	<i>Scirpus cyperinus</i>	Wool grass	Native	4					I
	<i>Typha spp.</i>	Cattail spp.	Unknown (Sterile)	N/A				I	I
<i>Zizania aquatica</i>	Southern wild rice	Native	8				I		
FL	<i>Brasenia schreberi</i>	Watershield	Native	7			X		X
	<i>Nuphar advena</i>	Yellow pondlily	Native - Special Concern	8			I		
	<i>Nuphar variegata</i>	Spatterdock	Native	6	X	X	X	X	X
	<i>Nymphaea odorata</i>	White water lily	Native	6	X	X	X	X	X
	<i>Sparganium fluctuans</i>	Floating-leaf bur-reed	Native	10	X				X
FL/E	<i>Sparganium sp.</i>	Bur-reed sp.	Native	N/A	X				I
Submergent	<i>Bidens beckii</i>	Water marigold	Native	8		X	X	X	X
	<i>Ceratophyllum demersum</i>	Coontail	Native	3	X	X	X	X	X
	<i>Chara spp.</i>	Muskgrasses	Native	7	X	X	X	X	X
	<i>Elodea canadensis</i>	Common waterweed	Native	3	X	X	X	X	X
	<i>Heteranthera dubia</i>	Water stargrass	Native	6	X	X	X	X	X
	<i>Isoetes spp.</i>	Quillwort spp.	Native	8					X
	<i>Myriophyllum farwellii</i>	Farwell's watermilfoil	Native	9	X				
	<i>Myriophyllum heterophyllum</i>	Variable-leaved watermilfoil	Native	7		X	X	X	X
	<i>Myriophyllum sibiricum</i>	Northern watermilfoil	Native	7	X	X	X	X	X
	<i>Myriophyllum sibiricum X spicatum</i>	Hybrid watermilfoil	Non-Native - Invasive	N/A				I	
	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	Non-Native - Invasive	N/A					X
	<i>Najas flexilis</i>	Slender naiad	Native	6			X	X	X
	<i>Nitella spp.</i>	Stoneworts	Native	7	X	X	X	X	X
	<i>Potamogeton amplifolius</i>	Large-leaf pondweed	Native	7	X	X	X	X	X
	<i>Potamogeton crispus</i>	Curly-leaf pondweed	Non-Native - Invasive	N/A	X	X	X	X	X
	<i>Potamogeton foliosus</i>	Leafy pondweed	Native	6	X			X	X
	<i>Potamogeton friesii</i>	Fries' pondweed	Native	8	X	X		X	X
	<i>Potamogeton gramineus</i>	Variable-leaf pondweed	Native	7					X
	<i>Potamogeton illinoensis</i>	Illinois pondweed	Native	6		X	X	X	X
	<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	Native	5	X	X	X	X	X
	<i>Potamogeton robbinsii</i>	Fern-leaf pondweed	Native	8					X
	<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	Native	6	X	X		X	X
	<i>Ranunculus aquatilis</i>	White water crowfoot	Native	8	X	X		X	X
	<i>Sagittaria sp. (rosette)</i>	Arrowhead sp. (rosette)	Native	N/A					X
<i>Stuckenia pectinata</i>	Sago pondweed	Native	3	X	X	X	X	X	
<i>Utricularia vulgaris</i>	Common bladderwort	Native	7	X	X	X	X	X	
<i>Vallisneria americana</i>	Wild celery	Native	6	X	X		X	X	
S/E	<i>Sagittaria cuneata</i>	Arrowhead	Native	7				I	
FF	<i>Lemna minor</i>	Lesser duckweed	Native	5	X	X	X	X	X
	<i>Lemna trisulca</i>	Forked duckweed	Native	6	X	X	X	X	X
	<i>Lemna turionifera</i>	Turion duckweed	Native	2					X
	<i>Spirodela polyrhiza</i>	Greater duckweed	Native	5	X	X		X	X
	<i>Wolffia spp.</i>	Watermeal spp.	Native	N/A	X	X	X	X	X

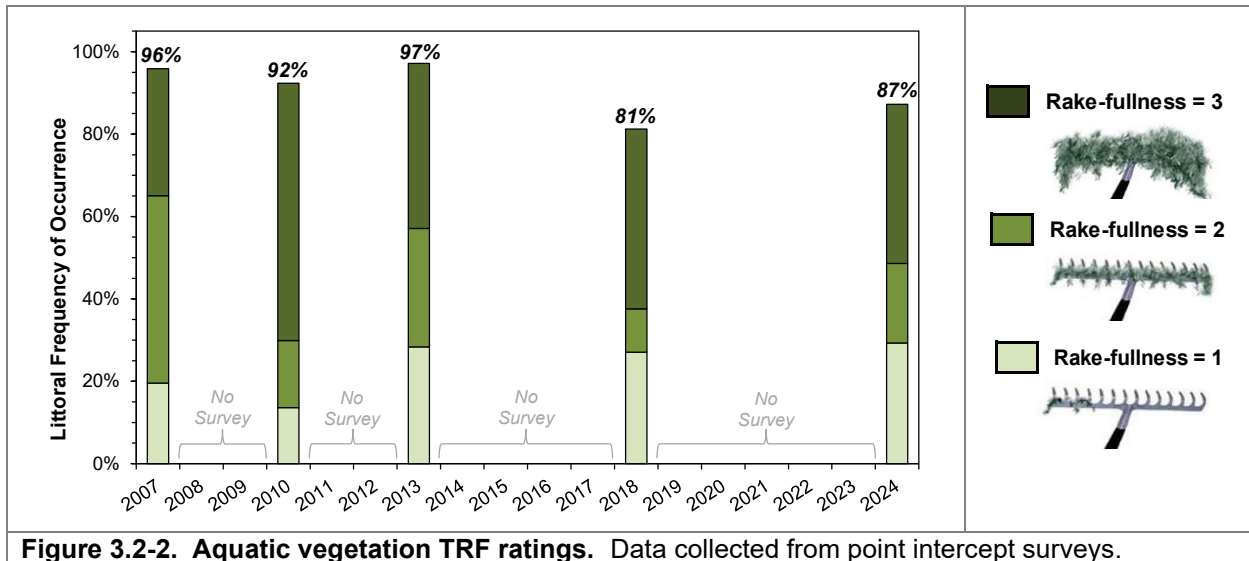
X = Located on rake during point-intercept survey; I = Incidentally located; not located on rake during point-intercept survey
 FL = Floating-leaf; FL/E = Floating-leaf & Emergent; S/E = Submergent and/or Emergent; FF = Free-floating

During the 2024 point-intercept survey, various metrics were observed and recorded. Information regarding substrate type was collected at locations sampled with a pole-mounted rake (less than 15 feet). These data indicate that 78% of the point-intercept locations contained soft organic sediments (aka muck), 21% contained sand, and 1% contained rock.

Whole-lake point-intercept surveys are used to quantify the abundance of individual species within the lake. An important component of the point-intercept survey is defining the littoral zone, or the zone at which aquatic plants can grow. The maximum depth of plant growth is typically influenced by water clarity and/or water levels although concerns about watercraft traffic and large wake-creating boats have also been suggested as possible influencers. When comparing all surveys from 2007 to 2024, the maximum depth of aquatic plant growth fluctuated from 17 ft to 22 ft according to point intercept data for those years. The recorded maximum depth of aquatic plant growth was 19 feet in 2024, which is close to the average maximum depth (19.6 ft) observed from all five surveys (Figure 3.2-1).

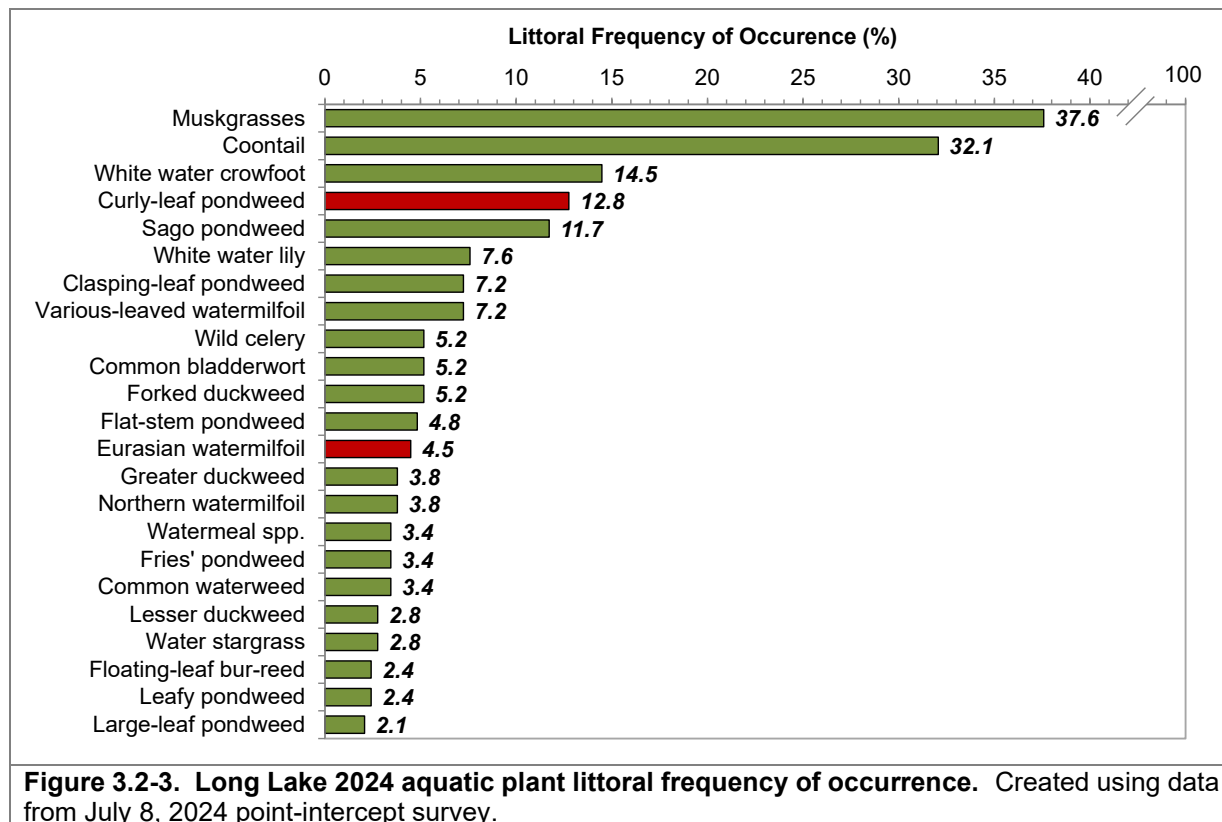


Of the 290 littoral sampling points (points that were shallower than the maximum depth of plants), 253 or 87% contained aquatic plants (Figure 3.1-3). This metric was between the lowest value in 2018 and the highest value in 2013. Total rake fullness (TRF) values from the available point-intercept surveys are also displayed on Figure 3.2-2. These data represent the aquatic plant biomass at each sampling location and does not differentiate between native or non-native vegetation. The largest dense aquatic plant area of the lake based on the survey is the southern end, south of the state park boat ramp (Map 2).

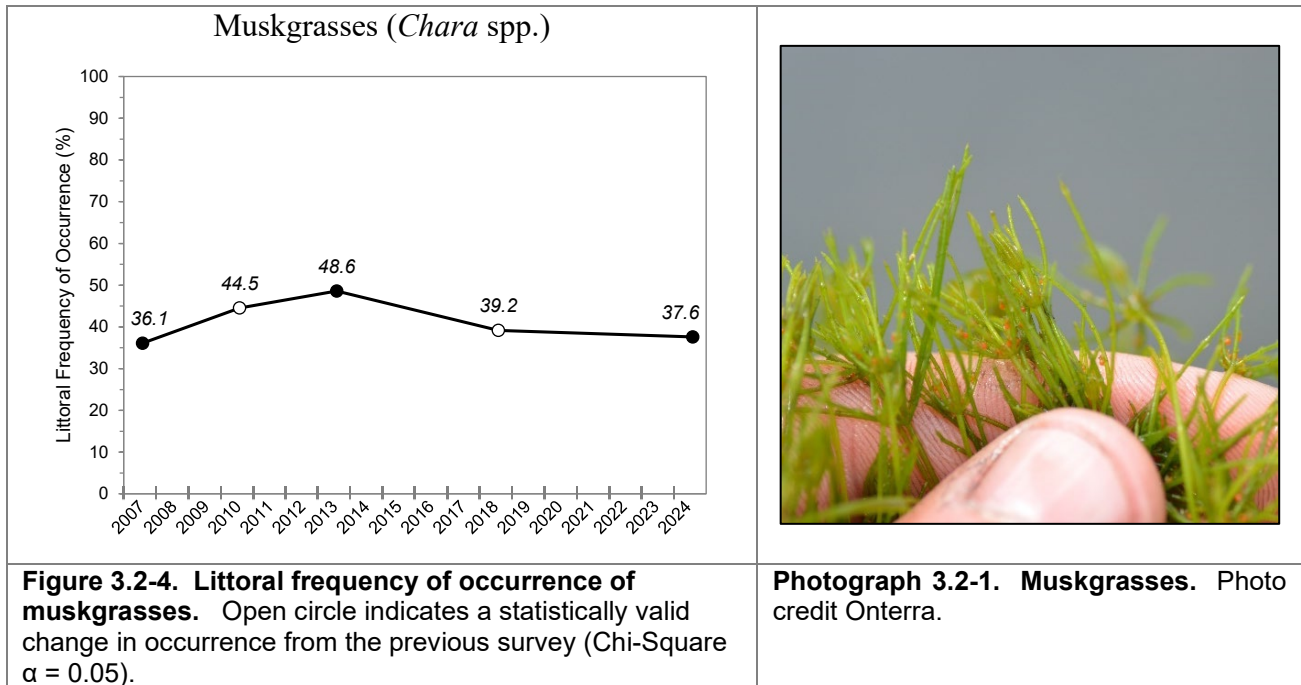


Of the 34 native aquatic plant species that were sampled during the 2024 point-intercept survey in Long Lake, muskgrasses the most frequently encountered species within the lake. Figure 3.2-3

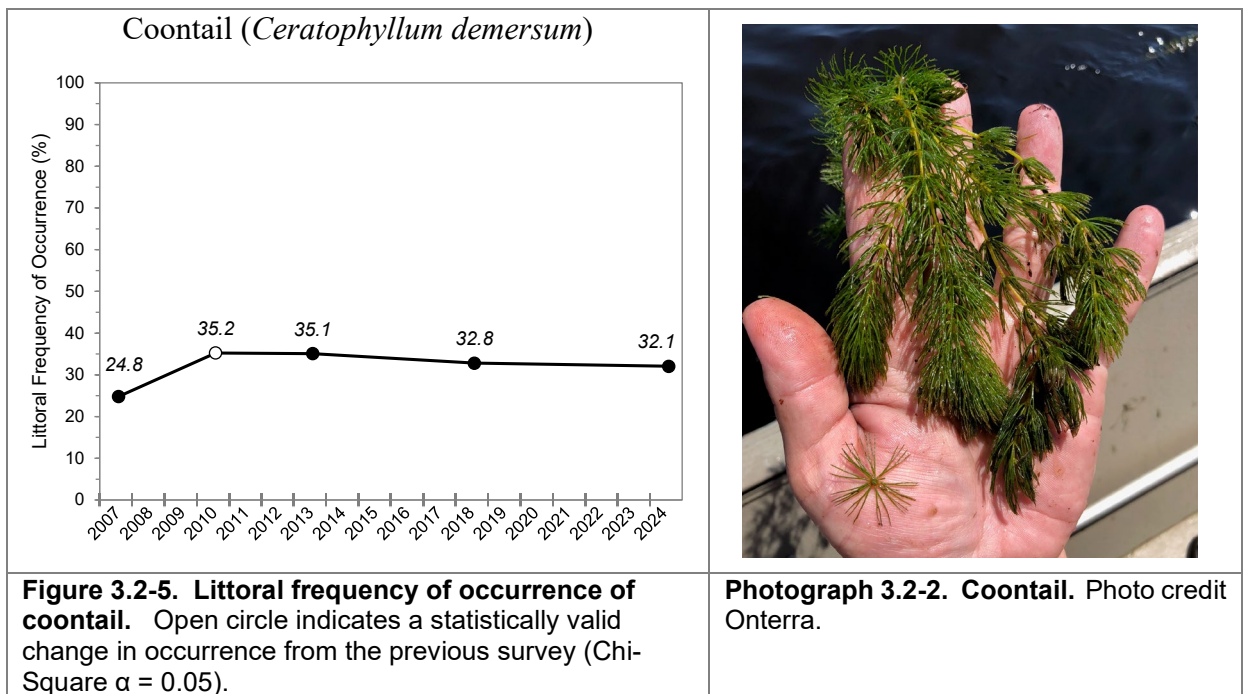
shows the frequency of species found at greater than two percent of littoral sampling locations. The occurrence of all species from each of the point-intercept surveys is included in Appendix C and Appendix D shows the distribution of the top eight native plants and the two non-native submergent from Long Lake from the 2024 point-intercept survey. Figures 3.2-4 to 3.2-9 investigate common aquatic plant population trends in Long Lake.



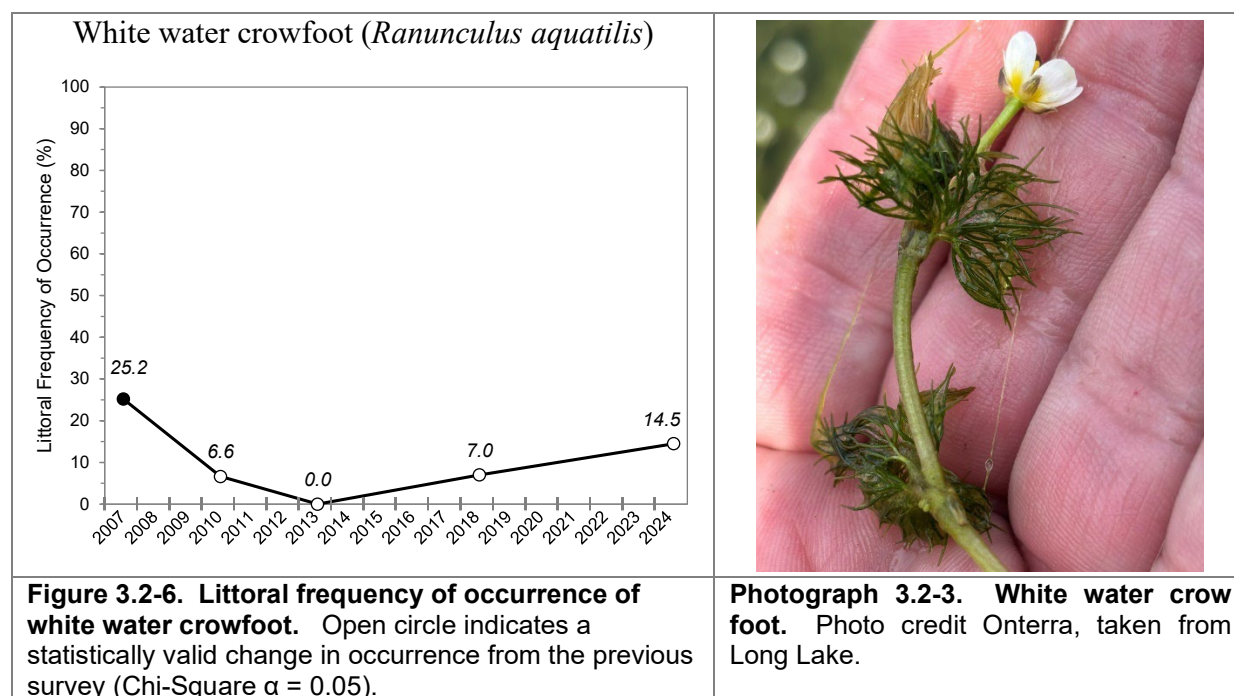
Muskgrasses are a type of macroalgae, and have been consistently the most common species in Long Lake. Dominance of the aquatic plant community by muskgrasses and other charophytes is common in hardwater, alkaline lakes, and these macroalgae have been found to more competitive against vascular plants (e.g., pondweeds, watermilfoils, etc.) in lakes with higher concentrations of calcium carbonate in the sediment (Kufel and Kufel 2002), (Wetzel 2001). Muskgrasses require lakes with good water clarity, and their large beds help to stabilize bottom sediments. While charophyte populations have slightly fluctuated over time on Long Lake, their populations are considered rather stable (Figure 3.2-4).



Coontail was the second most common aquatic plant located during the 2024 point-intercept survey of Long Lake. Coontail is unique in the fact that it does not produce true roots. Because it lacks true roots, this species derives all its nutrients directly from the water (Gross et al. 2003). This ability in combination with a tolerance for low-light conditions allows this species to become more abundant in productive waterbodies with higher nutrients and lower water clarity. Even though statistically valid population differences were confirmed between 2007-2014, coontail population trends have been stable over the period of study (Figure 3.2-5).



The third most common plant species from the 2024 point-intercept survey was white water crowfoot. This dicot species has dissected leaves growing alternative off one side of the stem. In roughly June, this species of buttercup has a small white flower that emerges above the water's surface to facilitate insect pollination. As shown on Figure 3.2-6, the population of this species has been variable over the period of study. However, it is likely that the species population variability is due to the surveys being completed at different times during the growing season. White water crowfoot is typically more abundant early in the growing season and then dies back as the summer progresses. The 2007 survey was conducted in June, the 2010 and 2013 surveys were conducted in late-August, and the 2018 and 2024 surveys were conducted in mid-July. During the early-June 2024 CLP mapping surveys, survey crews noted a high presence of white water crowfoot growing amongst curly-leaf pondweed populations, especially in the bay near the Chinatown boat landing.



Sago pondweed was the fourth most common native aquatic plant from the 2024 point-intercept survey. Sago pondweed is a disturbance-tolerant species, closely related to the genus of pondweeds (*Potamogeton* spp.). Sago pondweed populations decreased from 2007 to 2013 before steadily increasing since (Figure 3.2-7). Largely reproducing by seed, it is common for this species to have cyclic populations as it relates to conditions that favor seed germination. The population of sago pondweed in 2024 was its highest over this period of study.

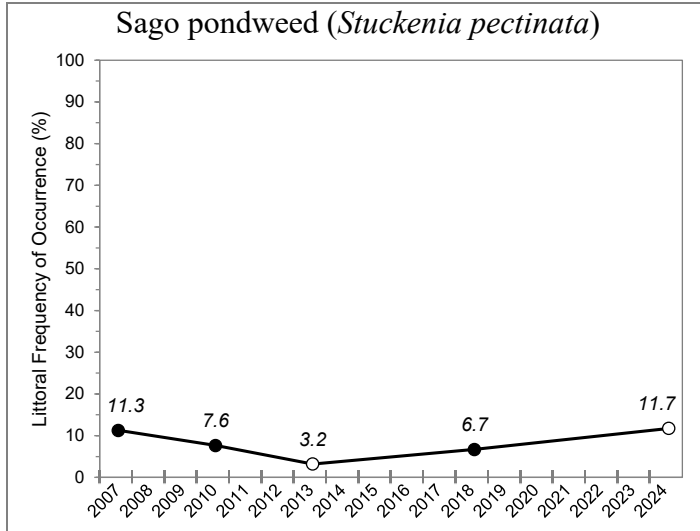


Figure 3.2-7. Littoral frequency of occurrence of sago pondweed. Open circle indicates a statistically valid change in occurrence from the previous survey (Chi-Square $\alpha = 0.05$).

Photograph 3.2-4. Sago pondweed. Photo credit Onterra.

The fifth most common native plant from the 2024 point-intercept survey was claspingleaf pondweed. This was also the most common pondweed species (*Potamogeton* spp.) in Long Lake during 2024, of the 8 total pondweed species known from the system. Claspingleaf pondweed has somewhat curled leaves that can be mistaken for curly-leaf pondweed (CLP) by the untrained eye. But unlike CLP, claspingleaf pondweed has pointed leaf tips and solid leaf margins. It gets its common name from the way its leaves wrap around the stem. Claspingleaf pondweed populations were lower in 2013 and 2018, but found to have a similar population to earlier surveys during 2024 (Figure 3.2-8).

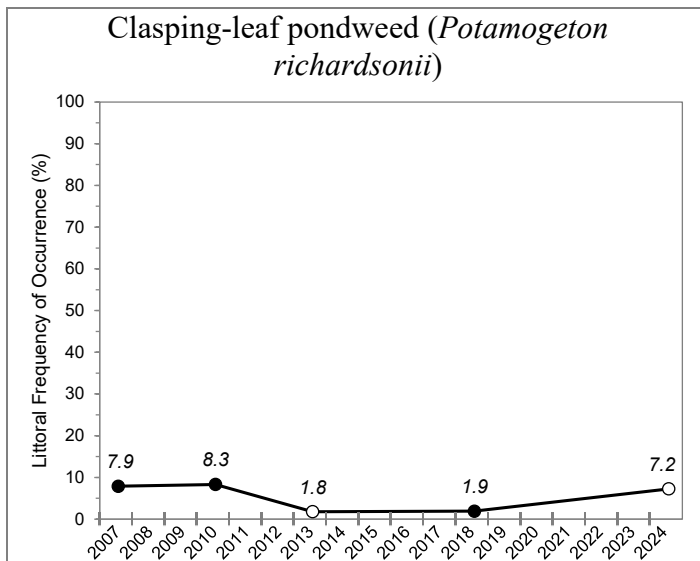
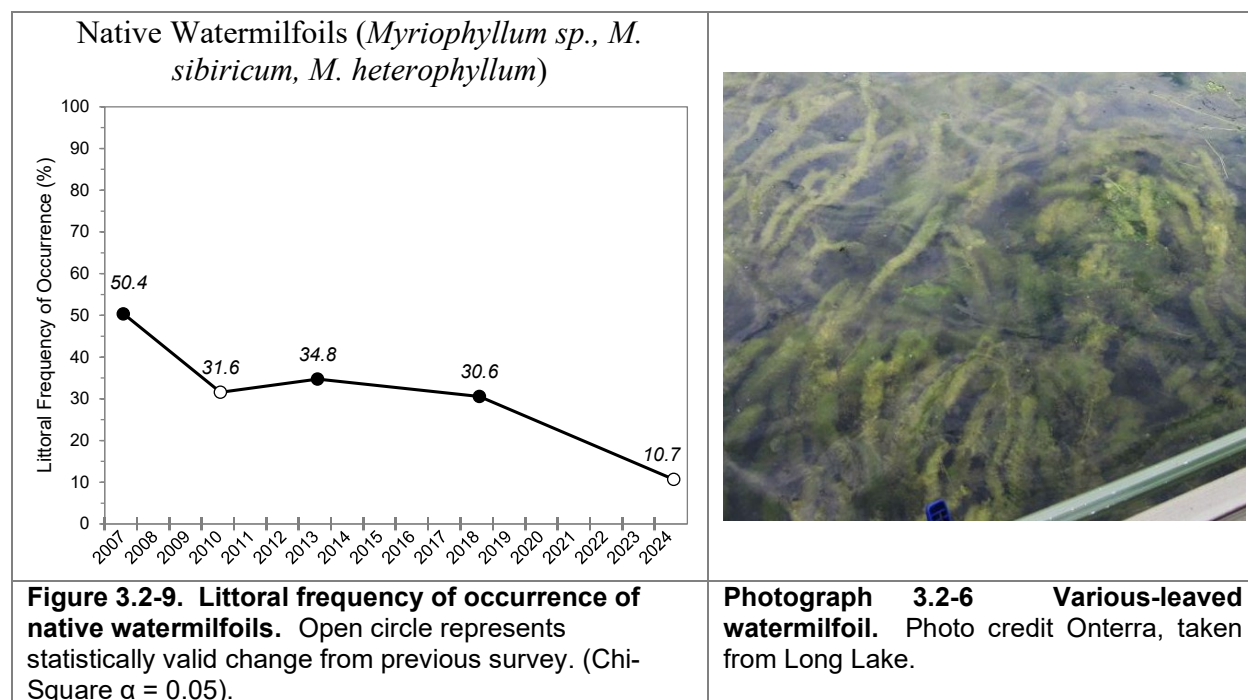


Figure 3.2-8. Littoral frequency of occurrence of claspingleaf pondweed. Open circle indicates a statistically valid change in occurrence from the previous survey (Chi-Square $\alpha = 0.05$).

Photograph 3.2-5. Claspingleaf pondweed. Photo credit Onterra.

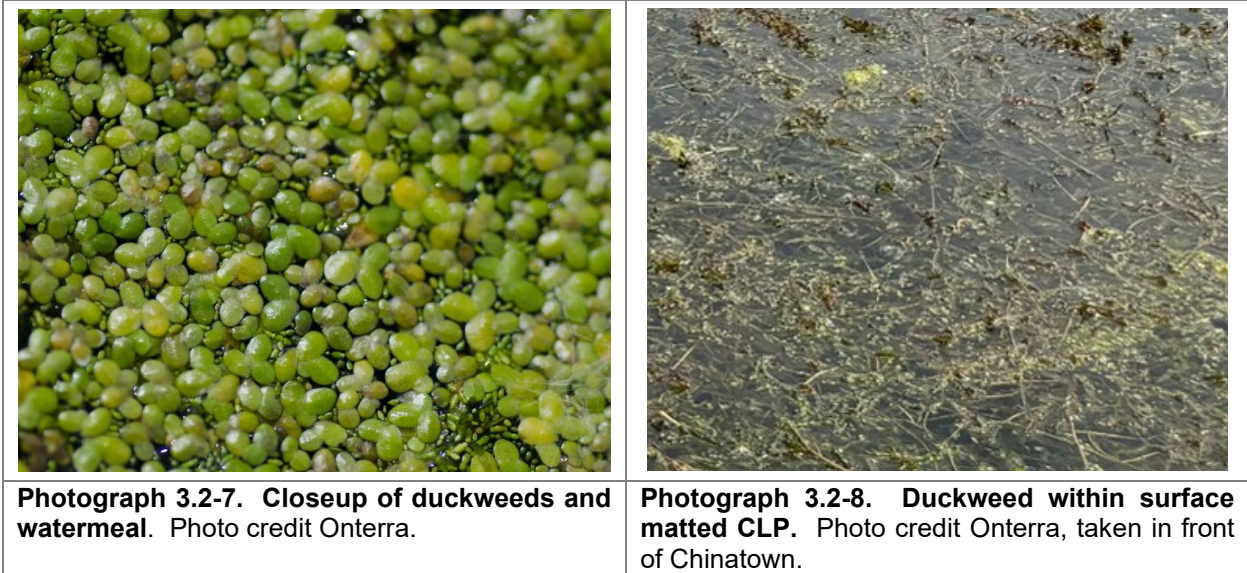
Various-leaved water milfoil, one of roughly seven native milfoil species that can be found in Wisconsin, is one of the most noticeable plants in Long Lake. Like most of the other milfoil species in Wisconsin, various-leaved water milfoil has dense whorls of finely-dissected leaves which provide habitat for periphyton and trap detritus. In Long Lake, various-leaved water milfoil can be found growing in dense beds in 4-10 feet of water. These beds provide valuable structural habitat for aquatic organisms. However, in Long Lake, some of these various-leaved water milfoil beds mat on the surface, where they can disrupt navigation (Photograph 3.2-6). In the northeastern United States there is a problematic non-native strain of various-leaved watermilfoil. In 2013, Onterra ecologists sent various-leaved watermilfoil specimens from Long Lake to Dr. Ryan Thum (currently at Montana State University) for DNA analysis. Their results revealed that the various-leaved water milfoil present in Long Lake is of the *continental* strain, and not the non-native strain found in the New England states.

Two native watermilfoil species are found in Long Lake, various-leaved watermilfoil and northern watermilfoil. Because of the uncertainty of accurately distinguishing these two species in earlier surveys, they are lumped within the following analysis. The population of native watermilfoils has been steadily decreasing over time, with the combined occurrence of 10.7% in 2024 marking its lowest population levels over this period of study (Figure 3.2-9).



An interesting type of free-floating vegetation collectively called “duckweeds” is also common in parts of Long Lake, especially in areas with less frequent turnover of water like some of the channels off the lake. They are also commonly found mixed inside of water lilies and other shallow water areas. These free-floating plants are made up largely of lesser duckweed (*Lemna minor* & *L. turionifera*) and watermeal species (*Wolffia* spp.); with lesser amounts of forked duckweed (*Lemna trisulca*) and greater duckweed (*Spirodela polyrhiza*) (Photograph 3.2-7). These species can vary in abundance at any given time and are influenced by flow or wind driven water movement since they are not rooted in the sediment. During June 2024 when dense matted areas

of curly-leaf pondweed were present, duckweeds were commonly mixed in these mats (Photography 3.2-8).



Since each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). Figure 3.2-10 displays the relative frequency of occurrence of aquatic plant species from each of the point-intercept surveys on Long Lake. In 2024, 41% of the overall plant population of Long Lake was comprised of three species: muskgrasses, coontail, and native watermilfoils. These same three species comprised almost 78% of the overall aquatic plant community in 2013.

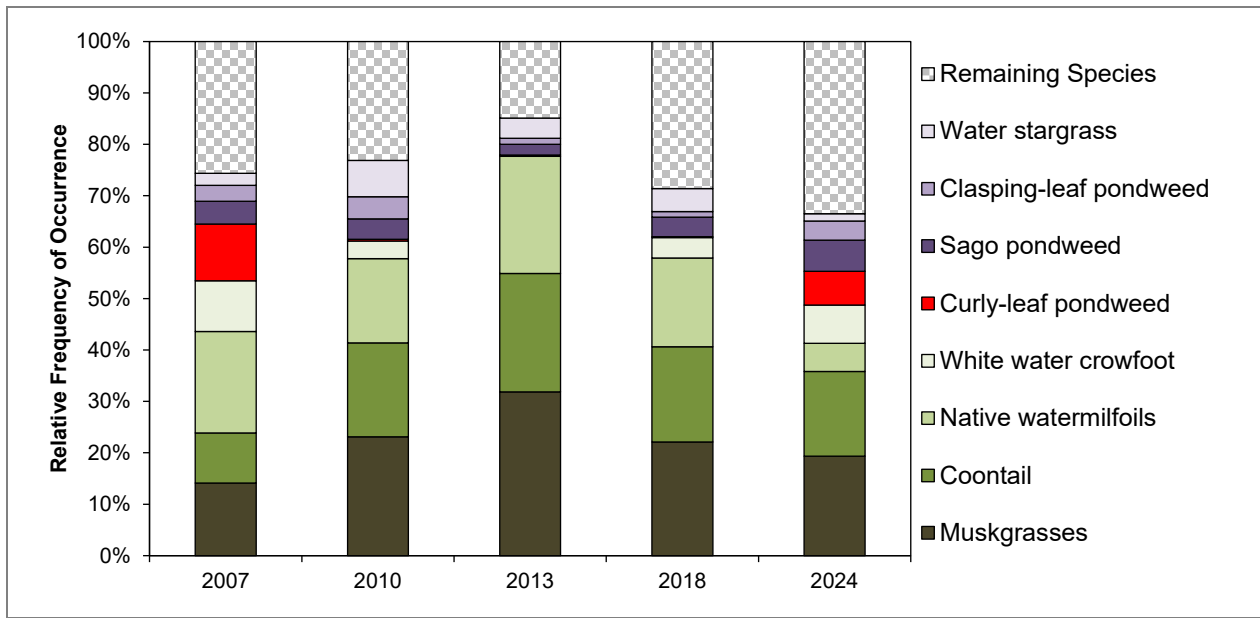
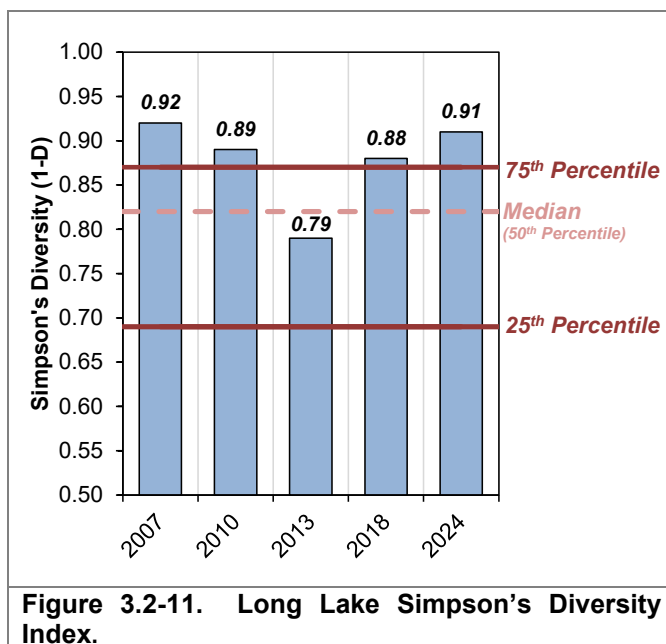


Figure 3.2-10. Relative frequency of occurrence of aquatic plants in Long Lake.

Lakes with diverse aquatic plant communities are thought to have higher resilience to environmental disturbances and greater resistance to invasion by non-native plants. In addition, a plant community with a mosaic of species with differing morphological attributes provides zooplankton, macroinvertebrates, fish, and other wildlife with diverse structural habitat and various sources of food. Since Long Lake contains a high number of native aquatic plant species, one may assume the aquatic plant community also has high species diversity. However, species diversity is also influenced by how evenly the plant species are distributed within the community. And as investigated by the relative frequency metric, three species have historically dominated the overall vegetative community of Long Lake.

While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Long Lake's diversity values rank. Using data collected by Onterra, quartiles were calculated for lakes within the Southeastern WI Till Plains (SWTP) Ecoregion (Figure 3.1-1). In 2013 when three species dominated that aquatic plant community, Long Lake had the lowest species diversity metric at 0.79 (Figure 3.2-11). The 2013 metric was lower than the median of lakes within the SWTP ecoregion. These three species comprised a lower percentage of the plant community in 2024, which is why the diversity metric is much higher. Except for 2013, the diversity of Long Lake has been within the top 25th percentile of lakes within the SWTP ecoregion.



Another important metric is the Floristic Quality Index (FQI). As discussed in the primer section, the calculations used for the FQI for a lake's aquatic plant community are based on the aquatic plant species that were encountered on the rake during the point-intercept survey and does not include incidental species. Long Lake's native aquatic plant species richness was observed to be much higher than in previous surveys. This does not mean that there were new species that were introduced to the lake, but more likely that the species were at low abundance and went undetected at early surveys. The 2024 native species richness was above the 75th percentile of lakes within the SWTP and lakes within all of WI (Figure 3.2-13, left frame).

The 2024 average conservatism value of 6.2 was slightly higher than all previous surveys from Long Lake (Figure 3.2-12, center frame). This metric is much higher than the median value of lakes within the SWTP (5.4) and similar to the median value of lakes in the entire state (6.3). Having a high average conservatism value indicates the aquatic plants found within the lake or more indicative of high quality habitat, whereas lower values would indicate more disturbance tolerant species.

The floristic quality metric combines each survey's species richness and average conservatism values. With both metrics already being high by themselves, the floristic quality measurement of

35.9 is much higher than other lakes state-wide and within the SWTP ecoregion (Figure 3.2-12, right frame).

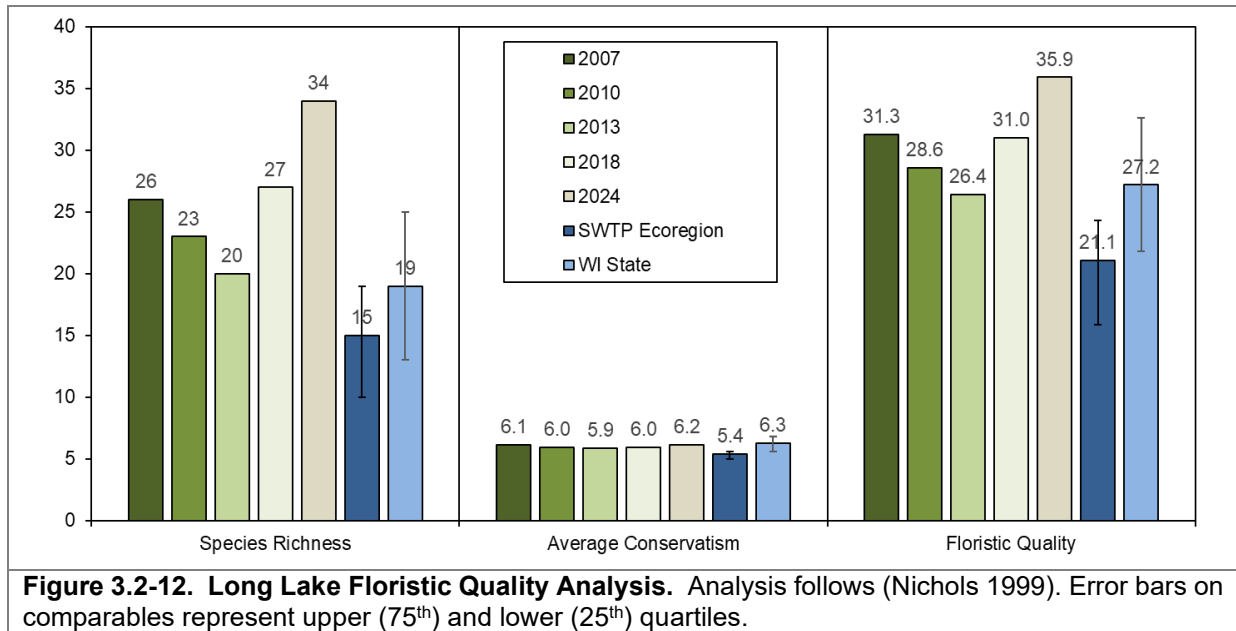
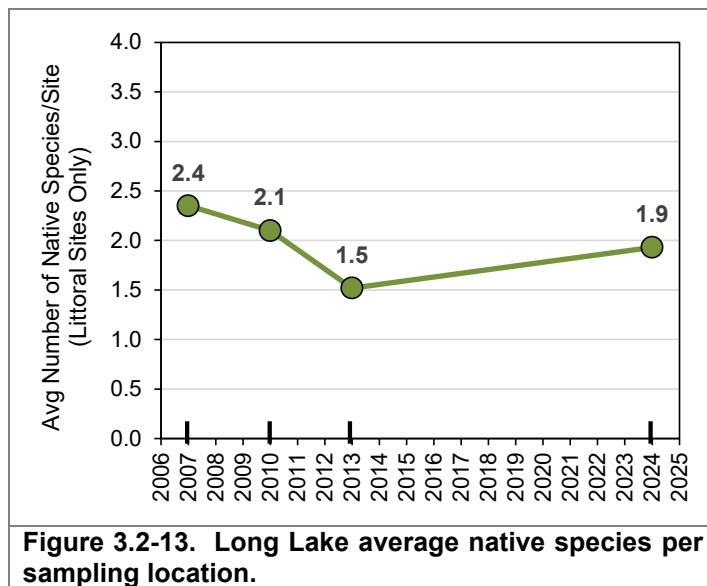


Figure 3.2-13 shows the average of native species per sampling location from each survey. This metric was highest in 2007 at an average of 2.4 native species per sampling location, and lowest in 2013 at 1.5 native species per location. The 2024 metric is roughly the average of the four datasets. Map 3 shows the number of native species at each sampling point during the 2024 point-intercept survey. Areas with generally higher species richness can be observed in a few areas of the lake, which roughly align with the WDNR’s sensitive area designations on the lake.



While the name has changed from *sensitive area designations* to *critical habitat designation*, the goal remains to ensure important areas of the waterbody are protected from human activity and disturbances. These areas are designated through a formal process by the WDNR, and give regulators stronger ability to deny certain permits that may threatened the intrinsic value of these areas. For Long Lake, the areas chosen were put into effect to protect the shoreline habitat. The four areas in Long and Tittle Lake are shown on the inset map of Map 3, which all together total 55.8 acres.

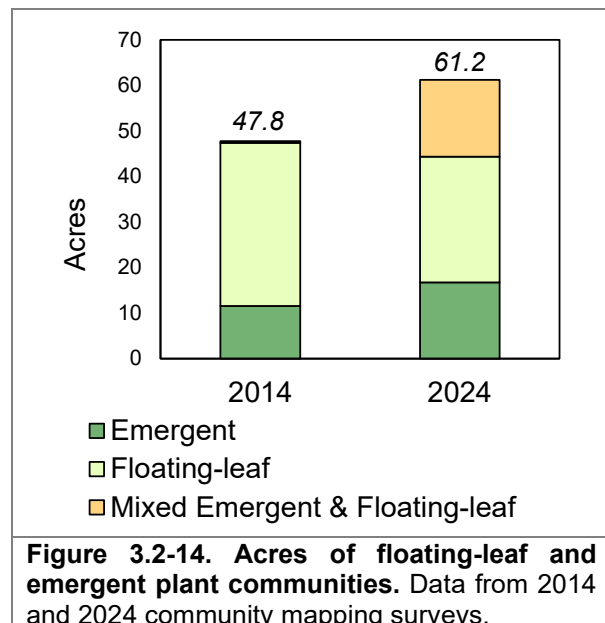
The nearshore areas of a lake are often under represented by the point-intercept aquatic plant survey. A key component of any aquatic plant community assessment is the delineation of the

emergent and floating-leaf aquatic plant communities within each lake as these plants are often underrepresented during the point-intercept survey. Many of these areas have been designated as *sensitive area designations*. The emergent and floating-leaf community mapping survey (often referred to as *community mapping survey*) creates a snapshot of these important communities within each lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with future surveys. Examples of emergent plants include cattails, rushes, sedges, grasses, bur-reeds, and arrowheads, while examples of floating-leaf species include the water lilies.

Emergent and floating-leaf plant communities are a wetland community type dominated by species such as cattails, bulrushes, and water lilies. Like submersed aquatic plant communities, these communities also provide valuable habitat, shelter, and food sources for organisms that live in and around the lake. In addition to those functions, floating-leaf and emergent plant communities provide other valuable services such as erosions control and nutrient filtration. These communities also lessen the force of wind and waves before they reach the shoreline which serves to lessen erosion. Their root systems help stabilize bottom sediments and reduce sediment resuspension. In addition, because they often occur in near-shore areas, they act as a buffer against nutrients and other pollutants in runoff from upland areas.

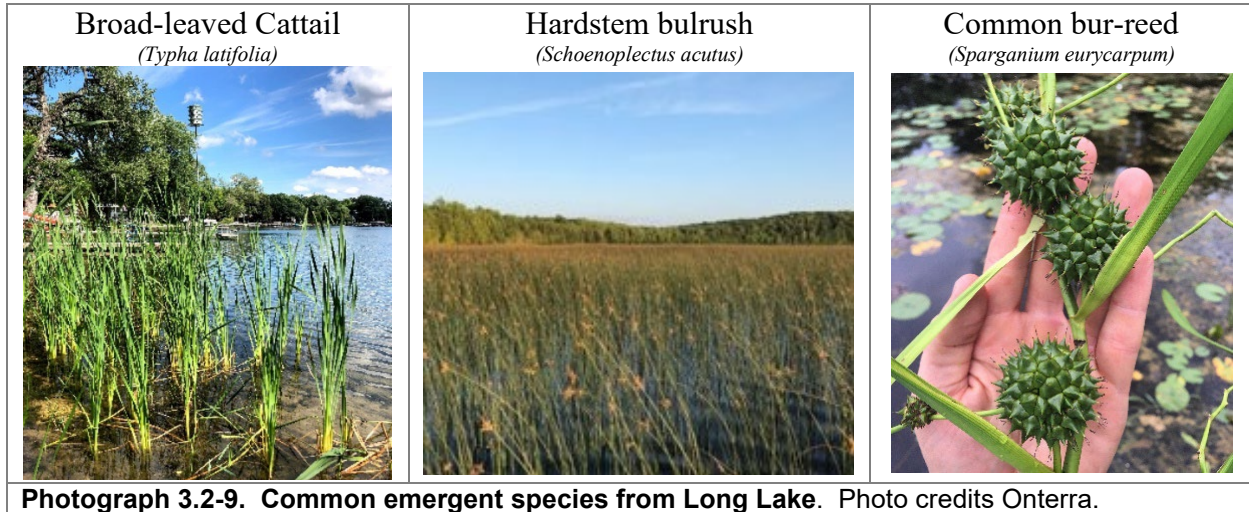
This is important to note because these communities are often negatively affected by recreational use and shoreland development. (Radomski and Goeman 2001) found a 66% reduction in vegetation coverage on developed shorelands when compared to the undeveloped shorelands in Minnesota lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelands.

In 2024, Onterra ecologists also conducted a survey aimed at re-mapping emergent and floating-leaved plant communities in Long Lake. An earlier survey using the same methodology was completed a decade earlier in 2014. The emergent and floating-leaf aquatic plant communities in Long Lake were mapped using a Trimble Global Positioning System (GPS) with sub-meter accuracy. Map 4 displays the results of the 2024 community mapping survey. Please note that small colonies, those less than approximately 40-ft in width, are mapped with point-based methods. The margins of larger colonies are delineated with area-based methods, essentially a polygon defining the colonies footprint. The footprint of these colonies can be measured with acreage, whereas point-based occurrences cannot. The acreage of the communities mapped with polygon-based mapping methodologies is shown in Figure 3.2-14.

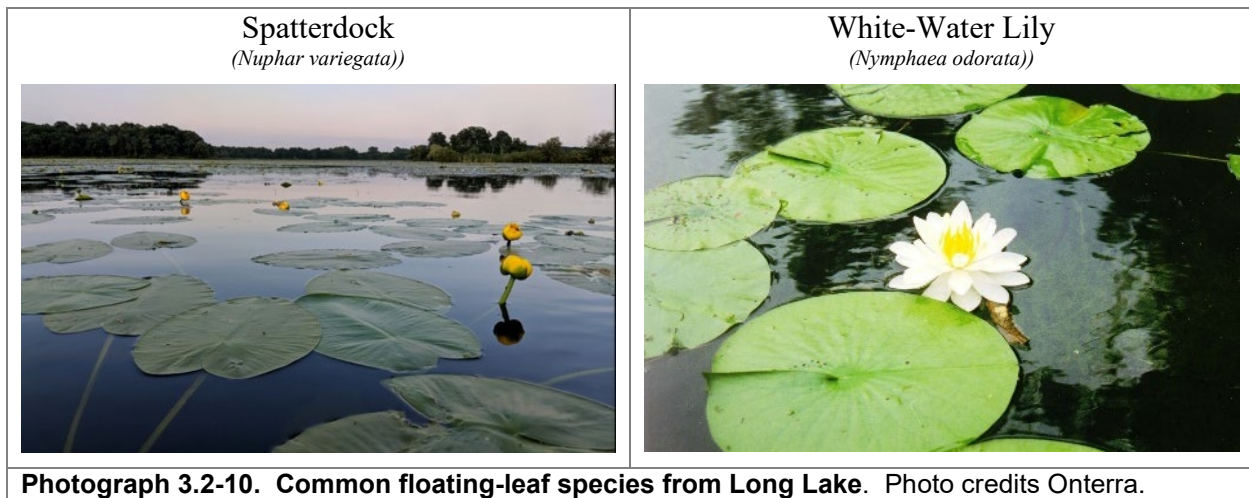


The most abundant emergent aquatic plant in Long Lake cattail – largely the native broad-leaved cattail species but some narrow-leaved cattail and/or hybrid between the two are prevalent

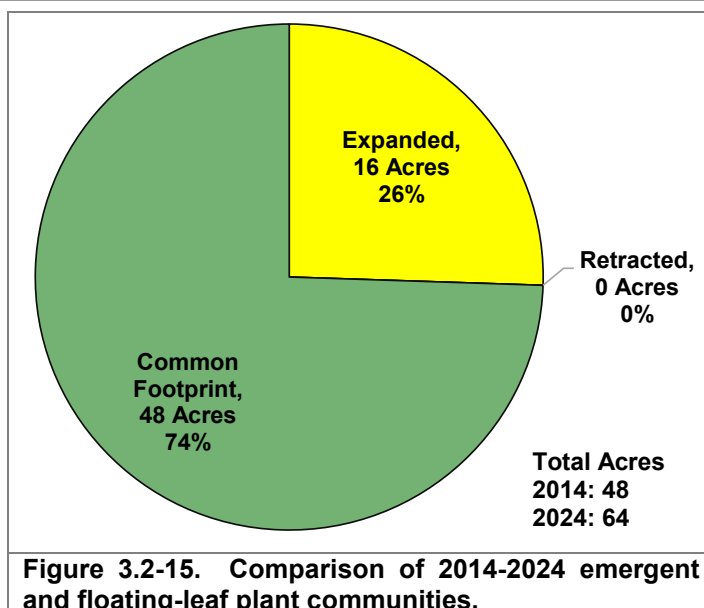
throughout Wisconsin and may be intermixed (Photograph 3.2-9). Other emergent species include bur-reeds and bullrush species, along with the non-native emergent species discussed in the following section (3.3). Emergent plant species are important for sediment stabilization and absorbing wave energy, thereby protecting shorelines from erosion. They also offer important spawning, nesting, and foraging habitat for numerous species of insects, fish, birds, and waterfowl. Emergent plant communities have declined on my lakes due to unnatural water level conditions, shoreland development, competitiveness of invasive species, and high-speed boating.



The most common floating-leaf species was spatterdock, with some white-water lily and floating-leaf bur-reed also present in the system (Photograph 3.2-10). Collectively known by most as *waterlilies*, these species provide important nursery habitat and forage cover for many fish species.



Examination of the 2014 and 2024 data together shows that majority of the emergent and floating-leaf communities remained the same between the two surveys (Map 5, Figure 3.2-15). Emergent and floating-leaf plant communities often recede or expand in response to changes in water levels and human activity. On Long Lake, no areas of retractions were observed over this decade, with 16 acres of expansion. Most of this expansion is lake-ward, perhaps a result of compliance with slow-no-wake in near-shore zones protecting these valuable habitats. First, a 200 ft slow-no-wake ordinance for all watercraft was put into place. The LLPA places and maintains buoys around the lake outlining this area. The LLPA also supports the Water Patrol, an augmented enforcement entity of the Town of Osceola that enforces slow-no-wake zones, AIS watercraft inspections, and full lake slow-no-wake emergency rules that go into effect during high water to protect shorelines from erosion.



Nuisance Aquatic Plant Management

The LLPA has a history of mechanically harvesting native aquatic plants to alleviate conditions caused by excessive native plants. Previous mechanical harvesting plans were slightly informal, indicating approximate areas of the lake that were targeted. The historic mechanical harvesting efforts were conducted approximately at the end of riparian docks to reduce plant material within this high use area of the lake. Previous mechanical harvesting reports indicate that the vast majority was various-leaved water milfoil (informally around 90%), lesser amounts of white water crowfoot (buttercup) and common waterweed (informally around 3% each), and trace amounts of coontail, muskgrasses, and pondweed species. In more recent years, curly-leaf pondweed (CLP) has become a nuisance and early-season harvesting to target that species has been sought.

Table 3.2-2. 2021-2024 Mechanical harvesting records. Data provided by LLPA.

Year	Hours Spent	Cubic Yards Removed
2025	38.00	210
2024	56.00	90
2023	42.25	100
2022	56.00	250
2021	43.50	160
2020	64.75	200
2019	52.00	84
2018	34.00	35
2017	53.50	105
2016	57.00	175
Total since 2016		1409

Starting in 2016, the LLPA constructed a more precise plan that gives comprehensive guidance on the use of a mechanical harvesting operation, consistent with the WDNR’s administrative code (NR109) that permits mechanical harvesting. The LLPA relies on contracted mechanical harvesting for the effort, using the Chinatown Landing for offloading plant material. In recent years, the LLPA has adopted a slightly modified version of the harvest plan developed in 2016,

with Figure 3.2-16 outlining the areas targeted and Table 3.2-2 documenting the amount of effort applied. As outlined within the Implementation Plan Section (5.0), a revised mechanical harvesting plan was constructed as part of this project, building off the areas shown in Figure 3.2-16.

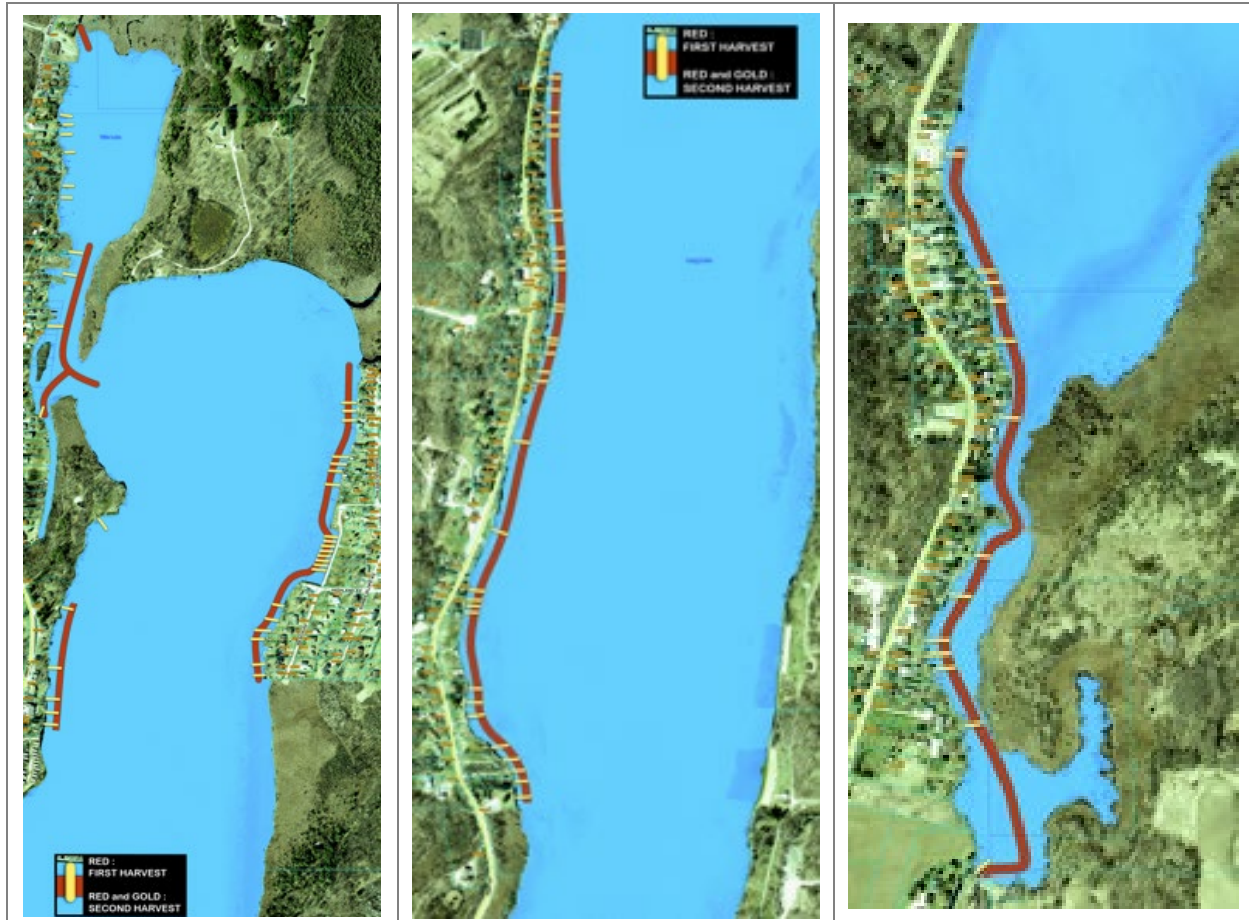


Figure 3.2-16. Long Lake mechanical harvesting sites. Image provided by LLPA.

As discussed in Section 2.0, the stakeholder survey asks many questions pertaining to perception of the lake and how it may have changed over the years. Of the 128 returned surveys, 103 respondents indicated that aquatic plants impacted their ability to *swim* on the lake, with impacts to *motor boating*, *aesthetics*, and silent sport activities having slightly less respondents (Figure 3.2-17). A similar number of respondents indicated *fishing was* and *was not* negatively impacted by aquatic plant abundance on Long Lake.

Question 18: Has the aquatic plant population ever had a negative impact on your enjoyment of Long Lake?

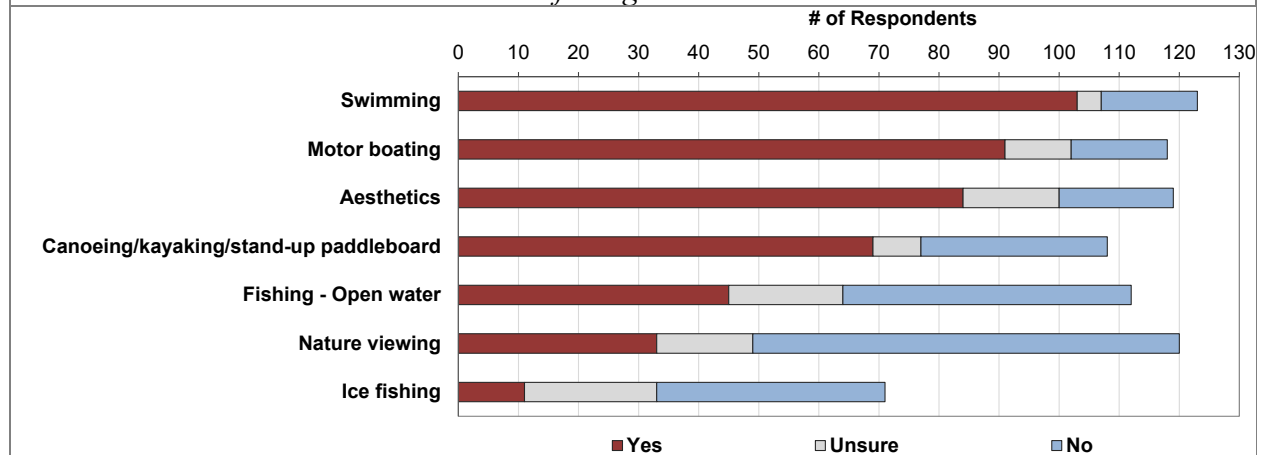


Figure 3.2-17. Select survey responses from the Long Lake Stakeholder Survey. Additional questions and response charts may be found in Appendix B.

As shown in Figure 3.2-18 (left frame), 75% of stakeholder respondents indicated they were supportive (pooled *completely supportive* and *moderately supportive* responses) of the ongoing mechanical harvesting activities on Long Lake, whereas 14% opposed (pooled *completely oppose* and *moderately oppose* responses). While a much lower response rate was recorded during the 2014 stakeholder survey, only 3% opposed the mechanical harvesting strategy at that time, with 85% support (pooled *completely supportive* and *moderately supportive* responses).

During 2024, stakeholders were asked what time of the year aquatic plant growth impacted their use of the lake (Figure 3.2-18, right frame). While the three summer months (*June, July, August*) had the highest number of responses, 41 respondents indicated that aquatic plant impacts occurred *before June 1*.

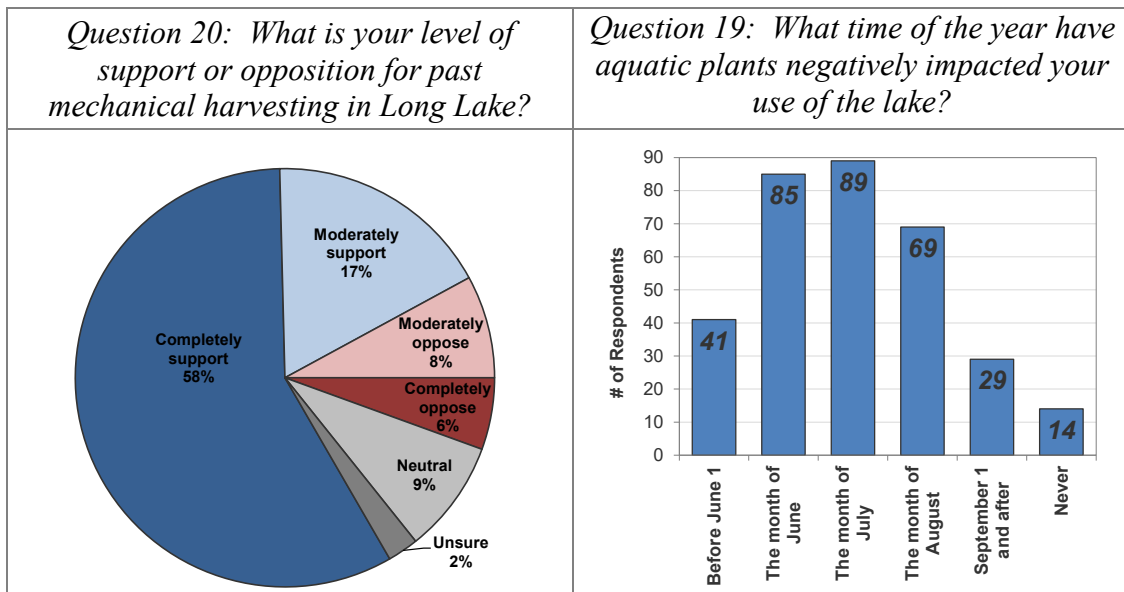


Figure 3.2-18. Select survey responses from the Long Lake Stakeholder Survey. Additional questions and response charts may be found in Appendix B.

3.3 Non-native Aquatic Plants in Long Lake

Non-native species are those that have natural habitats in other parts of the world, but when they arrive in a new environment, lack the mechanisms they have evolved with that keeps their populations balanced. Table 3.3-1 lists the non-native species known from Long Lake and the year they were verified.

Table 3.3-1. Non-native species confirmed from Long Lake. Extracted and modified from:

<https://apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=38700&page=invasive>

Species Name	WDNR Status	Year Found
Pale Yellow Iris	In Verification Process	2024
Banded Mystery Snail	Verified and Vouchered	2013
Chinese Mystery Snail	Verified and Vouchered	2013
Curly-Leaf Pondweed	Verified and Vouchered	2007
Eurasian Watermilfoil	Verified and Vouchered	2002
Hybrid Eurasian Watermilfoil	Verified through DNA	2013
Purple Loosestrife	Verified and Vouchered	2011
Zebra Mussel	Verified and Vouchered	2001

Because of their tendency to upset the natural balance of an aquatic ecosystem, non-native plant species are paid particular attention to during the aquatic plant surveys. This list includes the following submergent species: Eurasian watermilfoil (EWM), hybrid EWM (HWM), and curly-leaf pondweed (CLP), and two wetland species: purple loosestrife and pale yellow iris. These plants will be discussed in species-specific sub-sections below.

It is important to note that two types of surveys are discussed in the subsequent materials: 1) point-intercept surveys and 2) AIS mapping surveys. Overall, each survey has its strengths and weaknesses, which is why both are utilized in different ways as part of this project.

As discussed within Section 3.2, the point-intercept survey provides a standardized way to gain quantitative information about a lake’s aquatic plant population through visiting predetermined locations (Map 1) and using a rake sampler to identify all the plants at each location (Photograph 3.3-1). The survey methodology allows comparisons to be made over time, as well as between lakes. The point-intercept survey is most often applied at the whole-lake scale, but focused point-intercept surveys are often associated with management monitoring, such as herbicide treatment or mechanical harvesting.

While the point-intercept survey is a valuable tool to understand the overall plant population of a lake, it does not offer a full account (census) of where a particular species exists in the lake. CLP and EWM grow high in the water column than most native plants, which can exacerbate recreation and navigation impediments. This factor allows these species to typically be mapped through surface observation. During an AIS mapping survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photograph 3.3-2). Field crews may supplement the visual survey by deploying a submersible camera along with periodically doing rake tows. The AIS population is mapped using sub-meter GPS technology by using either 1) point-based or 2) area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and are qualitatively attributed a density rating based upon a five-tiered scale from *highly scattered* to *surface matting*. Point-based techniques were applied to AIS locations that were considered as *small plant colonies* (<40 feet in diameter), *clumps of plants*, or *single or few plants*.



Photograph 3.3-1. Point-intercept survey on a WI lake. Photo credit Onterra.



Photograph 3.3-2. EWM mapping survey on a Wisconsin lake. Photo credit Onterra.

Curly-leaf pondweed

Curly-leaf pondweed (CLP) is a non-native, invasive submersed aquatic plant native to Eurasia (Photograph 2.3-1). Like our native pondweeds, CLP produces alternating leaves along a long, slender stem. The leaves are linear in shape with a blunt tip, and the margins are wavy and conspicuously serrated (saw-like). The plants are often brownish/green in color. Long Lake has a number of native pondweed species, some of which are similar in appearance to and may be mistaken for CLP

CLP is typically at peak growth early in the growing season, often naturally senescing (die-back) by the Independence Day Holiday. The advanced growth in spring gives the plant a significant head start over native vegetation. In certain lakes, CLP can become so abundant that it hampers recreational activities within the lake. In instances where large CLP populations are present, its mid-summer die-back can cause significant algal blooms spurred from the release of nutrients during the plants' decomposition (James et al. 2002). However, in many lakes, CLP appears to integrate itself within the community without becoming a nuisance or having a measurable impact to the ecological function of the lake.

The theoretical goal of CLP management is to kill the plants each year before they are able to produce and deposit new turions. Not all of the turions produced each year sprout new plants the following year; many lie dormant in the sediment to sprout in subsequent years. This results in a sediment turion bank being developed. Normally a control strategy for an established CLP population includes multiple years (5 or more) of controlling the same area to deplete the existing turion bank within the sediment with herbicide application. In instances where a large turion base may have already built up, lake managers and regulators question whether the repetitive annual herbicide strategies may be imparting more strain on the environment than the existence of the invasive species. Properly timed mechanical harvesting may reduce the rate of turion replacement into the sediment each year, but may be insignificant to having a meaningful impact on the overall population.

CLP was first documented from Long Lake in 2007. The LLPA initiated herbicide management of the CLP population in 2007 and continued until 2018 (Figure 3.3-1). In 2018, an updated Aquatic Plant Management Plan was created that discontinued management of CLP as its populations were relatively low at that time and the LLPA believed that the financial costs and

ecological risks of using aquatic herbicides were not commensurate with the results being achieved. The LLPA instead relied on mechanical harvesting to mitigate nuisance plant conditions.

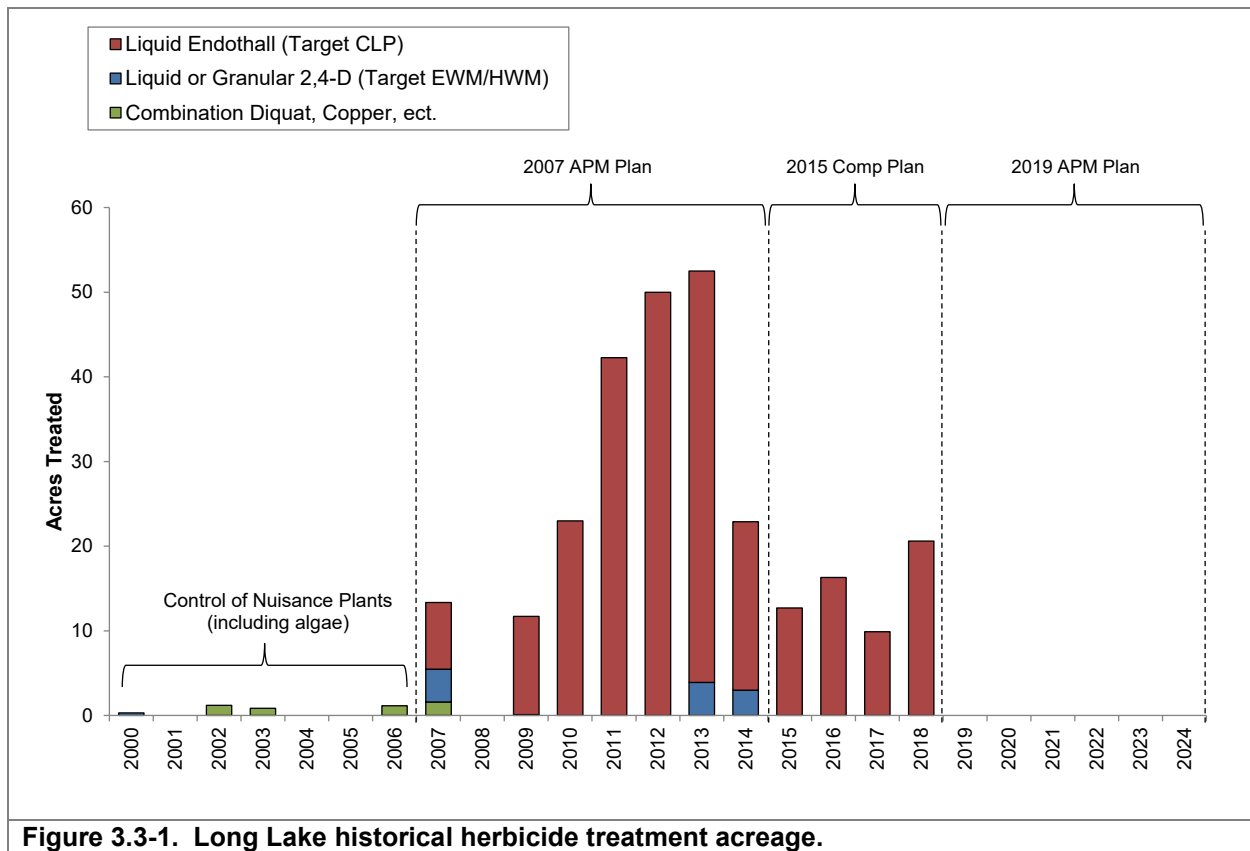
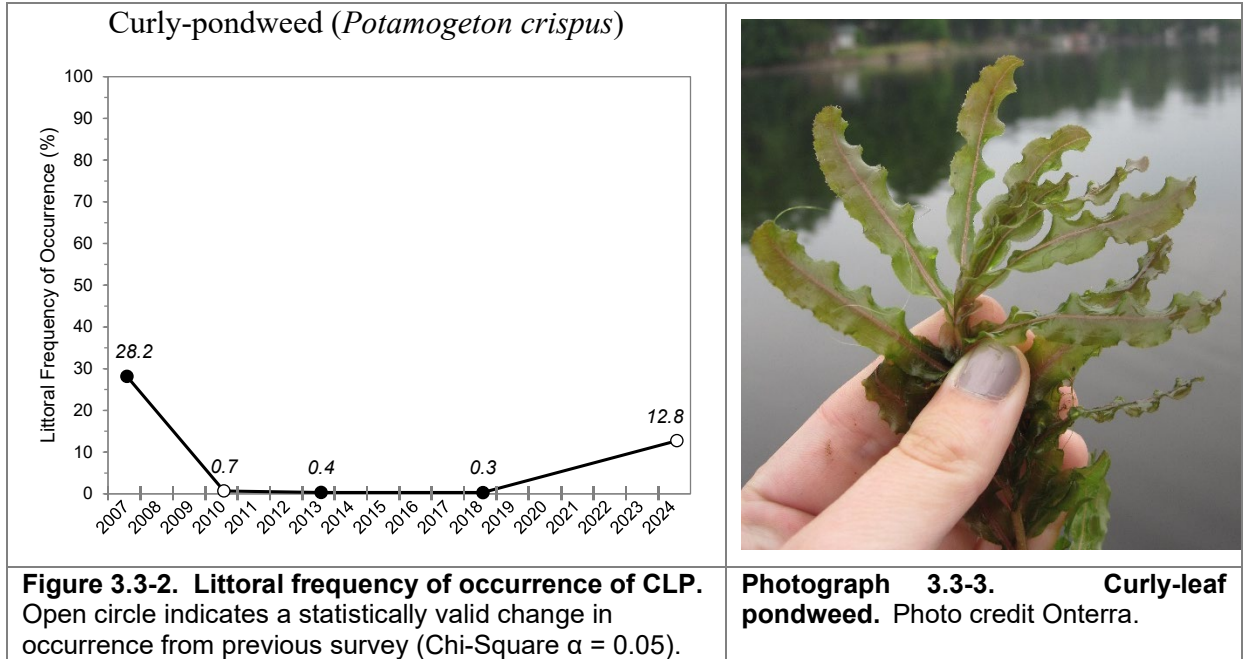


Figure 3.3-1. Long Lake historical herbicide treatment acreage.

Mid-summer point-intercept surveys occur after much of the CLP has already senesced for the season, so it often under-represents what the population was earlier in the season. The 2007 point-intercept survey was conducted by WDNR during mid-June, allowing these data to capture the CLP population before it died back for the year. However, surveys this early in the growing season may not ideally capture the populations of other native plant species. Surveys conducted in 2010 and 2013 by WDNR were conducted in late-August and early-September, which were too late to capture CLP abundance. In 2018 and 2024, point-intercept surveys conducted by Onterra occurred in mid-July, attempting to balance being early enough to capture the CLP population, but late enough to also capture the native plant community.

The 2024 point-intercept survey located CLP at 12.8% of littoral sampling points (Figure 3.3-2). As discussed above, the population may potentially have been higher if the sampling occurred a month earlier. The distribution of CLP during the 2024 point-intercept survey is displayed in Appendix D.



The Early Season CLP Mapping survey is conducted towards the beginning of the growing season when CLP is typically at its peak growth stage and highest population level for the year. It is important to note that Figure 3.3-3 only accounts for CLP that was mapped with area-based mapping (polygons) and does not account for any occurrences mapped with point-based attributes such as *single plants, clumps of plants, or small plant colonies*. Map 6 displays the CLP population from 2015-2018, the last surveys conducted before 2024.

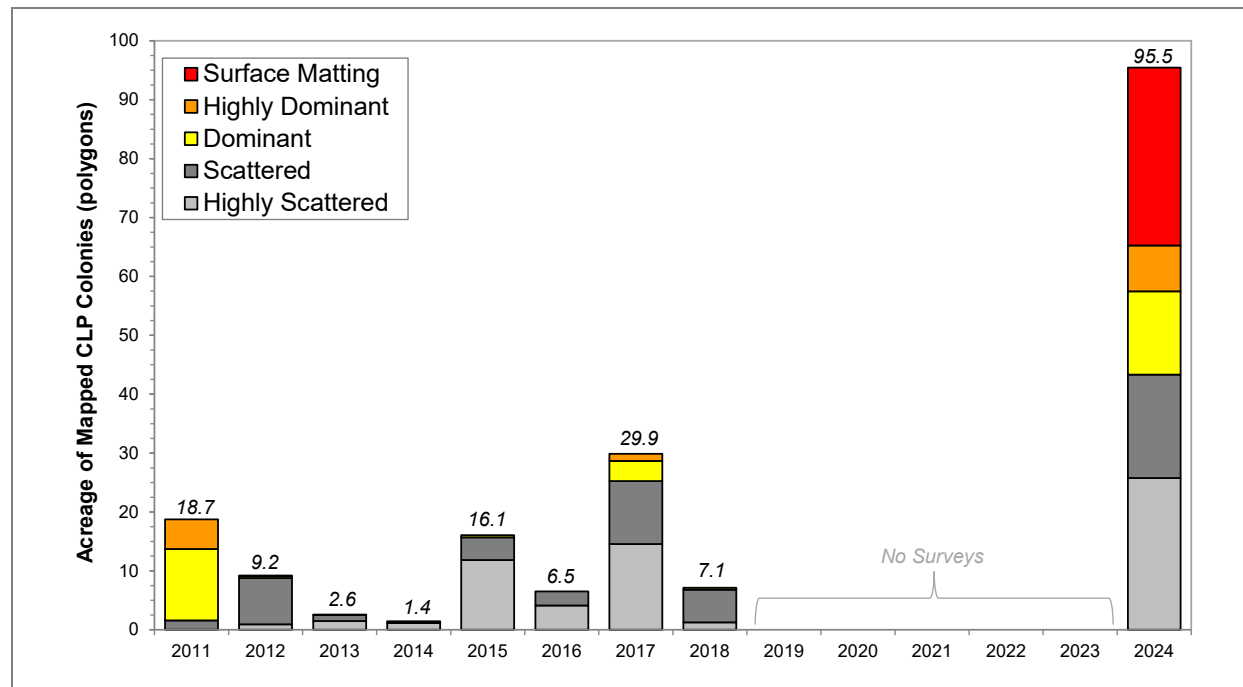


Figure 3.3-3. Long Lake acreage of colonized CLP (polygons) from 2008-2024. Created using data from Onterra early season CLP mapping surveys.

The 2024 survey took place during the first week of June, identifying 95.5 acres of colonized CLP and numerous other locations around the lake that were mapped with point-based mapping techniques (Map 7, Figure 3.3-3). During 2024, CLP was primarily growing in 3-7 feet and at density levels that were impacting navigation and recreation in many areas of the lake.

Eurasian Watermilfoil

Eurasian watermilfoil (EWM) is a submergent aquatic plant species native to Europe, Asia and North Africa, that has spread to most Wisconsin counties. Eurasian watermilfoil is unique in that its primary mode of propagation is not by seed, but by shoot fragmentation, which has supported its transport between lakes via boats and other equipment. In addition to its propagation method, EWM has two other competitive advantages over native aquatic plants, 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it sometimes does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian watermilfoil can create dense stands and dominate submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating. However, in some lakes, EWM appears to integrate itself within the community without becoming a nuisance or having a measurable impact to the ecological function of the lake.

EWM was officially documented in Long Lake in 2002. Onterra submitted watermilfoil plant samples to Dr. Ryan Thum (now at Montana State University) for genetic testing. The laboratory analysis indicated that Long Lake contains populations of both pure-strain EWM and populations of hybrid EWM (*Myriophyllum spicatum x sibiricum*, HWM). Some strains of HWM can grow faster, become more invasive, and be less susceptible to chemical control strategies than pure-strain EWM. Unless specifically indicated, this report will use “EWM” when discussing the collective invasive watermilfoil (EWM and HWM) population of Long Lake.

In 2015, the WDNR investigated the most recent point-intercept data from almost 400 Wisconsin Lakes that had confirmed EWM populations (Nault 2016). These data show that approximately 65% of these lakes had EWM populations of 10% or less (Figure 3.3-4). At these low population levels, there may not be impacts to recreation and navigation, nor changes in ecological function. So while EWM can clearly become problematic in some lakes, it is more common to be found in low abundance on many lakes.

EWM populations were below levels that could be measured with the point-intercept survey methodology until 2018, when one littoral sampling location contained EWM. In 2024, 13 sampling locations, or 4.5% of littoral sampling locations contained EWM (Figure 3.3-5). While this is a large and statistically valid increase, the EWM population is quite low in Long Lake. The distribution of EWM during the 2024 point-intercept survey is displayed in Appendix A.

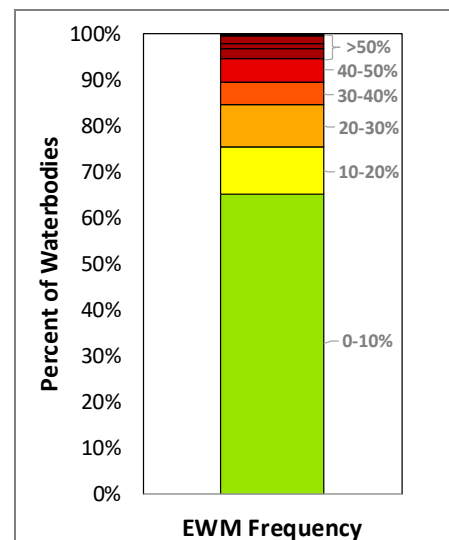
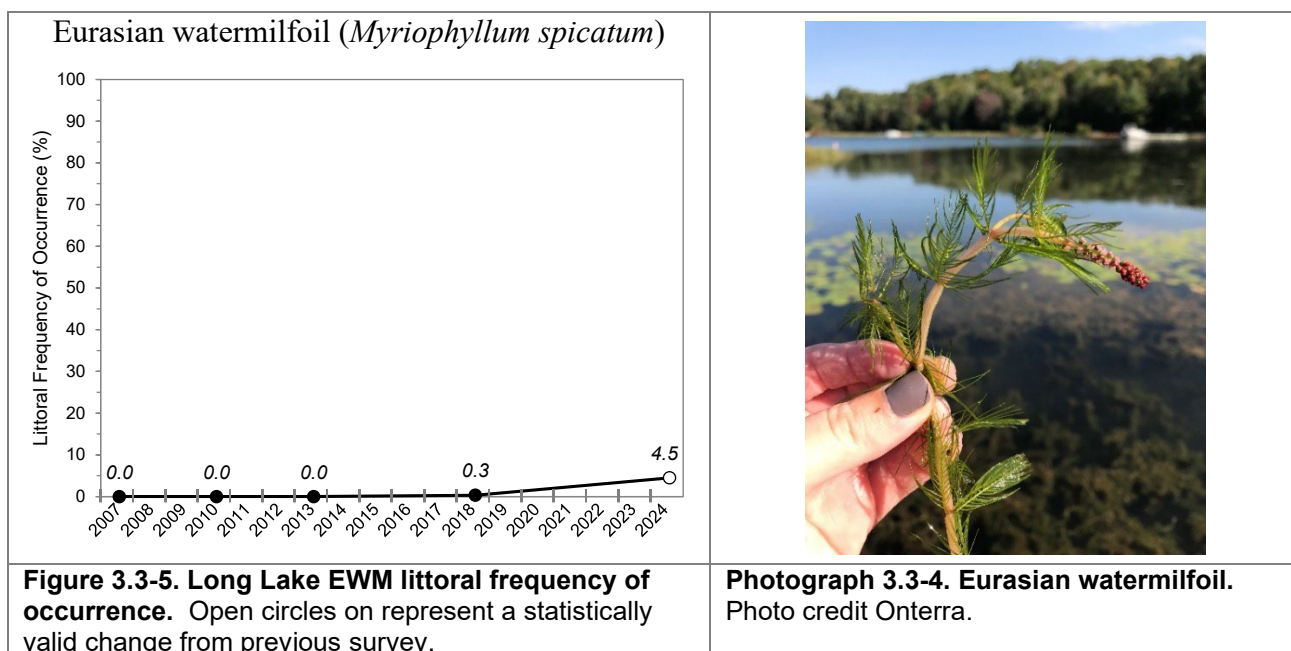


Figure 3.3-4. EWM littoral frequency of occurrence in 397 WI lakes with EWM populations. Data provided by and used with permission from WDNR.



The Late Season EWM Mapping survey is conducted towards the end of the growing season because EWM is typically at its peak growth stage and highest population level for the year at that time. It is important to note that complicated dynamics over the summer may result in EWM population declines compared to the beginning of the season on some waterways. Regardless, the late season survey documents the EWM population that the system has going into winter and will be emerging with in spring of next year, so it is the ideal time to drive management decisions for the following year.

Map 8 displays the EWM population from 2015-2018, the last surveys conducted before 2024. Almost all EWM occurrences during this time period were mapped with point-based methods, with less than 0.2 acres in any survey consisting of polygon-based mapping techniques.

On August 8, 2024, multiple Onterra crews systematically searched Long Lake for EWM occurrences. Almost the entirety of the EWM population consistent of *single or few* EWM occurrences (Map 9). The EWM population was a little denser in two spots, such that *highly scattered* EWM colonies were delineated that totaled 1.5 acres between the two. At this time, there are no areas were EWM is impacting navigation, recreation, and other lake uses. The EWM population is also well below thresholds that would cause changes in ecosystem function.

Pale-yellow Iris

Pale yellow iris (*Iris pseudacorus*) is a large, showy iris with bright yellow flowers (Photograph 3.3-5). Native to Europe and Asia, this species was sold commercially in the United States for ornamental use and has since escaped into Wisconsin's wetland areas forming large monotypic colonies and displacing valuable native wetland species. This species was first recorded in Wisconsin in 1938 and now has scattered populations throughout the state. Pale-yellow iris is typically in flower during the second half of June. The foliage of pale-yellow iris and northern/southern blue flag iris (a valuable native species) is too similar to make a definitive identification based off of the foliage alone. Positive identification needs to come from the flowers or the seed pods, which develop after the flower is pollinated.



Photograph 3.3-5. Pale-yellow iris in shoreland area. Photo credit Onterra.

During the June CLP mapping survey, Onterra ecologists also surveyed for iris species along the shoreline of Long Lake (Map 10). The crew located six occurrences of pale-yellow iris, two occurrences of iris species that did not have flowers (i.e. sterile), and one occurrence of native blue flag iris (likely *Iris versicolor*).

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) is a perennial herbaceous plant native to Europe that was likely brought over to North America as a garden ornamental (Photograph 3.3-6). This plant escaped from its garden landscape into wetland environments where it is able to outcompete native plants for space and resources. First detected in Wisconsin in the 1920's, it has now spread to all of the state's 72 counties. Purple loosestrife largely spreads by seed, but also can vegetatively spread from root or stem fragments.

If purple loosestrife is to be cut or pulled, the ideal timing is from late-June to early-August when it is in flower, so easily identified, but before it produces seeds. Purple loosestrife produces many tiny seeds which can be easily spread when the plant is shaken. If manual removal takes place after the plant has gone to seed, the flower spikes must first be carefully bent over a bag and cut off into the bag so as not to spread the seeds. The rest of the plant can then be removed (MN DNR, 2020).



Photograph 3.3-6. Purple loosestrife. Photo credit Onterra.

During the 2024 community mapping survey, Onterra ecologists also surveyed for purple loosestrife along the shoreline of Long Lake (Map 10). The crew located approximately 20 locations containing purple loosestrife occurrences.

4.0 SUMMARY & CONCLUSIONS

The design of this project was intended to fulfill three primary objectives.

- 1) Collect detailed information regarding the aquatic plant community of Long Lake, with emphasis on nuisance aquatic plants including aquatic invasive species (AIS)
- 2) Collect sociological information from Long Lake riparians regarding their use of the lake and their thoughts pertaining to the past and current condition of the lake and its management.
- 3) Create an updated aquatic-plant management plan for the LLPA considering the evolution of BMPs and changes on regulatory support for various techniques since the previous management planning effort.

The three objectives were fulfilled during the project and have led to a good understanding of Long Lake's aquatic plant community, the lake in general, and the perceptions and preferences of riparian property owners.

One aspect of this project investigated the health of the nearshore emergent (e.g. bulrushes, cattails) and floating-leaf (e.g. water lilies) plant communities of Long Lake. These communities provide valuable habitat, shelter, and food sources for organisms that live in and around the lake. In addition to those functions, floating-leaf and emergent plant communities provide other valuable services such as erosions control and nutrient filtration. These communities also lessen the force of wind and waves before they reach the shoreline which serves to lessen erosion. Their root systems help stabilize bottom sediments and reduce sediment resuspension. Studies completed during this project indicate these nearshore plant populations are thriving in Long Lake, having expanded since a prior survey in 2014. On many lakes, larger watercraft and increased use has negatively impacted floating-leaf and emergent populations on many lakes. It is likely that compliance with the 200 ft slow-no-wake ordinance, as promoted by the LLPA-placed buoys has helped protect these shoreline habitats

Long Lake's submergent aquatic plant community is dominated by a low-growing species called muskgrasses. While resembling true aquatic plants, muskgrasses are stoneworts are actually large types of algae collectively called *charophytes*. Dominance of the aquatic plant community by charophytes is common in moderately hardwater lakes like Long Lake. Charophytes require lakes with good water clarity, and their large beds stabilize bottom sediments.

Long Lake also contains healthy populations of coontail, white-water crowfoot, sago pondweed, and native watermilfoil species (various-leaved and northern watermilfoil). These important native vegetation types provide variable habitat for the fish, insects, and other animals within Long Lake. Analysis of population trends indicates most aquatic plant populations have been stable over time. The primary exception is the native watermilfoils. These species were found at over 50% of littoral sampling locations in 2007 and have declined to just under 11% in 2024. Dense off-shore colonies of various-leaved watermilfoil were once a large impediment to navigation and recreation. It is unclear if this is response to watercraft traffic, zebra mussel populations, or some other natural factor. Long Lake was first documented to contain Eurasian watermilfoil (EWM) in 2002. EWM populations on many area lakes have increased to levels that greatly impact lake use, but have remained relatively low on Long Lake over time.

The largest change noticed in Long Lake was the population of curly-leaf pondweed (CLP). This non-native AIS has increased greatly in population and footprint within the lake, documented to occupy almost 100 acres of the lake in 2024 with over half of that acreage at densities that can impact use. While earlier efforts were directed to manage the CLP population within the lake, this strategy was abandoned when it became clear that it would be an unachievable goal.

As part of this project, many stakeholders have expressed the perception that the aquatic plant community is denser and more impactful than at any time in their experience. While such absolute statements are often exaggerated, the aquatic plant data largely support these observations. Long Lake now has an established CLP population within the lake and is likely to have high biomass of plants in the early part of the season. As an annual plant, each year the CLP population grows from turions deposited in previous years. Different environmental variables can trigger higher or lower turion sprouting in a given year. Some studies suggest that high amounts of snow cover on the ice can reduce CLP populations in the following year. Therefore, it may be possible that future years could have variable levels of CLP populations.

The LLPA has contracted mechanically harvesting operations in recent years to alleviate conditions caused by excessive aquatic plants. As an aspect of this project, the WDNR has requested a more precise plan to comply with regulatory guidelines of this technique. This project has invested a large amount of effort into designing a mechanical harvesting plan that assists lake users while having as low of an impact as possible.

Representatives from the Long Lake Haven Association at Chinatown favored a more aggressive approach using aquatic herbicides, especially in the Chinatown Harbor. The WDNR was clear that those activities would not be permitted at this time because 1) herbicides would impact fish habitat in this important area and surrounding WDNR designated Sensitive Areas and 2) mechanical harvesting, a viable alternative and lower-impact technique, should be sufficient to alleviate access constraints. Project planners also acknowledged concerns were raised by the local fishing club regarding the impact of the mechanical harvesting plan as a whole on the lake's fishery resource. The WDNR fisheries staff carefully considered these concerns and the project integrated parameters and conditions into the approved mechanical harvesting program to protect the fishery. This includes delayed start times until fish spawning has completed, avoidance of sensitive area of the lake, and a minimal size footprint of operations.

5.0 AQUATIC PLANT IMPLEMENTATION PLAN SECTION

The *Long Lake Comprehensive Lake Management (CLM) Plan* was finalized and approved by the WDNR in March 2015. The Implementation Plan Section of the *Long Lake CLM Plan* (March 2015) includes the following management goals along with specific management actions developed to help reach those goals. The *Long Lake CLM Plan* (March 2015) can be found on the WDNR website located here:

<https://apps.dnr.wi.gov/lakes/grants/project.aspx?project=99027324>

2015 Long Lake Comprehensive Lake Management Plan

1. Increase LLPA's Capacity to Communicate with Lake Stakeholders and Facilitate Partnerships with Other Management Entities
 - Use education to promote lake protection and enjoyment through stakeholder education
 - Continue LLPA's involvement with other entities that have responsibilities in managing (management units) Long Lake
2. Maintain Current Water Quality Conditions
 - Monitor water quality through WDNR Citizens Lake Monitoring Network
3. Control Existing and Prevent Further Aquatic Invasive Species Infestations within Long Lake
 - Continue Spot Treatment Herbicide Control Strategy targeting CLP on Long Lake
 - Continue Targeting EWM/HWM on Long Lake with Spot Herbicide Treatments and Hand-Harvesting, as Appropriate
 - Continue Clean Boats Clean Waters watercraft inspections at Long Lake public access location
 - Reduce occurrence of purple loosestrife on Long Lake
 - Reduce occurrence of common reed (Phragmites) on Long Lake.
4. Improve Fishery Resource and Fishing by protecting and restoring the shoreland condition of Long Lake
 - Investigate restoring highly developed shoreland areas around Long Lake
 - Protect natural shoreland zones around Long Lake
 - Coordinate with WDNR, Boy Scout Camp, LLFC, and private landowners to expand coarse woody habitat in Long Lake
5. Maintain Navigability on Long Lake
 - Support responsible actions to gain reasonable navigational access to open water areas of Long Lake
 - Investigate conducting advanced studies to understand sedimentation within the lake

Figure 5.0-1. Long Lake management goals (numbered) and actions. Long Lake Comprehensive Management Plan (March 2015)

During an update to their *Aquatic Plant Management (APM) Plan* in 2019, the LLPA revisited Management Goals #3 and #5 from their *CLM Plan*. This *APM Plan* update established the following APM-related management goals (Figure 5.0-2). The LLPA will continue to follow the remaining goals outlined in the 2015 *CLM Plan*. The *Long Lake Aquatic Plant Management Plan* (July 2019) can be found on the WDNR website located here:

<https://apps.dnr.wi.gov/lakes/grants/project.aspx?project=115661305>

2019 Long Lake Aquatic Plant Management Plan (Update)

3. Manage Existing and Prevent Further Aquatic Invasive Species Infestations within Long Lake
 - Continue Clean Boats Clean Waters watercraft inspections at critical public access locations
 - Coordinate professional monitoring of AIS (approx. every 5 years)
 - Coordinate Periodic Quantitative Vegetation Monitoring (approx. every 5 years)
 - Coordinate Periodic Community Mapping (floating-leaf and emergent) Surveys (approx. every 10 years)

5. Manage Existing and Prevent Further Aquatic Invasive Species Infestations within Long Lake
 - Support responsible actions to gain reasonable navigational access to open water areas of Long Lake (mechanical harvesting plan)

Figure 5.0-2. Long Lake 2019 APM goals (numbered) and actions. From Long Lake Aquatic Plant Management Plan (July 2019)

2026 APM Plan Update

The objective of this APM Plan update is to revisit the aquatic plant-related goals and actions of the *2019 APM Plan* and adjust them appropriately based upon current best management practices (BMPs), the lessons learned during the years since the last plan was developed, and the information gathered during the Onterra studies completed to date. The LLPA will continue to follow the remaining goals outlined in the 2015 *CLM Plan* as it applies to general restoration and protection.

Within the following updated APM Plan, the LLPA has developed three APM goals. Goal #1 outlines the mechanical harvesting plan. This management goal is applicable to future permit applications, therefore the LLPA will be seeking official WDNR approval/acceptance of this management action. Goals #2 and #3 are useful for the LLPA to account for and plan future aquatic plant surveys and management plan updates, particularly as turnover in the LLPA board of directors occurs. While Goal #4 and Goal #5 are technically not related to aquatic plant management, the LLPA chose to include them within this Plan as a way of formalizing their lake management intentions within this document and providing guidance to the future LLPA board.

Within the following management actions, the LLPA Board of Directors is listed as the facilitator for all management actions. The Board of Directors will be responsible for deciding whether the formation of sub-committees and/or directors is needed to carry out the various management actions.

Management Goal 1: Maintain Navigability on Long Lake

Management Action:	Increase recreational use through planned and permitted mechanical harvesting activities – Mechanical Harvesting Plan
Timeframe:	Continuation of Current Effort
Facilitator:	LLPA Board of Directors
Description:	<p>The WDNR oversees the management of aquatic plants on inland lakes. The manual cutting and raking of native aquatic plant species within a 30-foot-wide area containing a pier, boat lift, or swim raft is exempt from a state permit provided that the cut plants are removed from the lake (and wild rice is not being removed). However, the use of mechanized or mechanical devices in all instances requires a WDNR permit.</p> <p>The LLPA understands the importance of aquatic vegetation within Long Lake. However, nuisance aquatic plant conditions exist in certain parts of the lake, caused largely by a combination of submersed aquatic invasive species (primarily curly-leaf pondweed) and disturbance-tolerant native vegetation. Photograph 5.0-1 shows the nuisance plants from the Chinatown harbor in June 2024. Curly-leaf pondweed and white-water crowfoot are the main rooted aquatic plants in this area, with filamentous algae and duckweed caught on the surface-matted plants. Representatives from the Long Lake Haven Association at Chinatown correctly state that these plants are extremely difficult if not impossible to navigate through, and are impacting lake access for their members.</p> <div data-bbox="423 1087 1414 1780" style="text-align: center;"> </div> <p>Photograph 5.0-1. Surface-matted aquatic plants in Chinatown harbor. Photo credit Onterra, June 3, 2024.</p>

Management of nuisance aquatic plants has occurred on Long through contracted mechanical harvesting since 2016. The LLPA reviewed its historic mechanical harvesting strategy as a part of this project, constructing a revised strategy to meet the current needs of LLPA riparians and lake users. Map 11 outlines the updated strategy, summarized by the following bullet points:

Design Parameters

- Navigation Path (30-ft wide) – this lane removes a swath of plants just lakeward from the pier-face (i.e. end of docks) to allow easier access to deeper water. Modifications were made to the Chinatown area to address high traffic access needs (Figure 5.0-3).
- Riparian Spoke (10-ft wide) - These lanes connect docks to common use access lanes. Riparians can opt in to this program, paying the LLPA a set fee for this service. The maximum number of riparians enrolled in this program has been 70, which equates to slightly less than one acre in total.



Figure 5.0-3. Mechanical harvesting plan for Chinatown. 30-ft wide navigation path shown in purple.

Implementation

- No harvesting shall occur before June 1 to avoid impacting valuable fish spawning habitat.
- The WDNR is not likely to permit riparian spokes during early June due to fisheries concerns. Harvesting operations shall not disturb spawning or nesting fish.
- Harvesting shall be done in a manner to minimize accidental capture of fish. Any game fish accidentally captured shall be released immediately. Attempts should be made to release all other fish and aquatic species.
- Harvesting locations are limited to areas on the permit map. The contracted mechanical harvester shall have an onboard GPS unit loaded with the spatial data reflecting the mechanical harvesting lanes to ensure compliance.
- Submerged plants are the target for this permit and removal of floating-leaf (e.g. water lilies) species needs to be minimized because of their ecological value and niche occupation.
- Aquatic plants that are cut must be removed from the water.

	<ul style="list-style-type: none"> • “Floaters” consisting of dislodged or free-floating plants may be targeted outside of areas on harvest map so long they are outside of the pier head, and the harvester is set to its shallowest cutting setting. • The current harvester would avoid shallow water (>3 feet deep) harvesting to minimize sediment disturbance. • Reports summarizing harvesting activities shall be given to the WDNR by November 30, each harvesting season. The harvest report should include a breakdown by geographic area, summarizing the amount of effort, quantity of plants removed, proportions of plant species removed, and fish/amphibian bycatch amounts. <p>The LLPA seeks multi-year mechanical harvesting permits, which are available to applicants that have APM Plans that have been updated in the last 5 years. Fluctuations in curly-leaf pondweed and native plant populations are likely. It is anticipated that some years would require extensive mechanical harvesting, other years many not require as much. The LLPA typically performs two cuttings per year, once in early-June and again in early-July. If nuisance conditions persist throughout the summer, a third mechanical harvesting event in August may occur.</p>
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Management Action:	Facilitate riparian actions to minimize nuisance aquatic plants through manual removal methods
Timeframe:	Continuation of Current Effort
Facilitator:	LLPA Board of Directors
Description:	<p>The mechanical harvesting action discussed above aims to restore navigation and access to deeper water parts of the system. While a component of the mechanical harvesting plan includes riparian access spokes, this action may not meet riparian expectations for recreation. In practice, the mechanical harvester needs to stay lakeward from the end of docks (i.e. pier-face). Conducting mechanical harvesting outside of the predefined lanes or in waters shallower than 3 feet deep would be a violation of the LLPA’s harvesting permit.</p> <p>The LLPA encourages riparian owners to manage aquatic plants within their recreational footprint if desired. Each riparian owner can legally remove aquatic vegetation in a 30-foot wide area of one’s frontage directly adjacent to one’s pier without a permit. This access lane can extend perpendicularly into the lake as far as desired. A few exceptions apply, including if the area is a designated Sensitive Area, the desire area is greater than the 30 feet wide, or if a mechanical assistance mechanism, like a mechanical cutter or diver-assisted suction harvesting equipment is being used. Simply wading into the lake and removing aquatic plants with a non-mechanical device (e.g. rake or v-cutter) within this footprint is legal so long as all the dislodged or cut aquatic plants are removed from the lake. Riparians can hire contractors to remove plants in this manner without a permit so long as they stay in the designated 30-ft wide corridor and</p>

use non-mechanical removal methods. The following links provide additional information on legal manual removal of aquatic plants by riparians:

https://dnr.wisconsin.gov/sites/default/files/topic/Lakes/plants/RiparianOwnerExemption_NoPermitNeeded.pdf

https://dnr.wisconsin.gov/sites/default/files/topic/Lakes/plants/RiparianOwnerExemption_PermitNeeded.pdf

If aquatic plant impediments do not fit the criteria exempt from WDNR permitting, the impacted property owner or community group may seek a contractor to remove plants with a diver-assisted suction harvest equipment or other similar permissible equipment. These efforts will require a WDNR permit currently under NR109 (under updated NR107 if rule revision passes), which will require a specific map of where the operations will be occurring, the aquatic plant species to be harvested, and the disposal plan for removed vegetation.

Several Long Lake property owners have purchased commercially available mixing props, often referred to as aqua thrusters. Mixing props are used to reduce algal surface mats from accumulating. The WDNR does not advocate for mixing props, but allows their use without a permit if the prop direction is parallel to the water surface and does not impact the sediment. If aqua thruster use results in movement of silt from the lake bottom, it is in violation with the law unless a Chapter 30 permit is granted. More information on mixing props can be found here under “mixing prop or other mixing devices:”

<https://dnr.wisconsin.gov/topic/Waterways/construction/mechanizedAPM.html>

Management Goal 2: Ensure the LLPA maintains current and operational management plans

Management Action:	Periodically update lake management plan
Timeframe:	Continuation of current effort; periodic
Facilitator:	
Description:	<p>The LLPA will impose that all board and committee members should review and be familiar with the current <i>Aquatic Plant Management Plan</i> and reference the Implementation Plan Section (5.0) while fulfilling their duties as leaders in the LLPA.</p> <p>The term <i>Best Management Practice (BMP)</i> is often used in environmental management fields to represent the management option that is currently supported by that latest science and policy. When used in an action plan, the term can be thought of as a placeholder with anticipation of having an evolving definition over time.</p> <p>Historically, lake groups would update Comprehensive Lake Management (CLM) Plan at roughly 8-10 year increments. A CLM Plan would focus on numerous aspects of lake management, including water quality, watershed, shoreland, and aquatic plants. Especially after the adoption of NR193 in 2020 (Surface Water Grant program), having an approved Aquatic Plant Management (APM) Plan completed within the last five years is a requirement of certain grants and permitted activities. APM Plans have a narrow focus compared to CLM plans, largely constructed to address aquatic plant-related aspects of a waterbody.</p> <p>Typically during every-other 5-year APM Plan update, lake groups also choose to address additional aspects more commonly included with a CLM Plan, such as an investigation of water quality parameters.</p> <p>A component of an updated APM Plan would include a solicitation of stakeholder perceptions and perspectives, such as a stakeholder survey. During the next Plan update, the LLPA could consider a replicate defined population survey, as was conducted as part of this project, or a more open survey to solicit a wider audience of lake users.</p> <p>APM Plans typically take 1.5-2 years to complete, with the first year consisting of field data collection followed by meetings and planning activities. The WDNR Surface Water Grant program allows funding potential for planning projects, currently with application deadlines occurring September 15 (preapplication) and November 15 (final) of the preceding year. More information on the WDNR Surface Water Grant program is available at:</p> <p style="text-align: center;">https://dnr.wisconsin.gov/aid/SurfaceWater.html</p>

	<p><u>Aquatic Plant Management Plan</u></p> <p>Embedded within a CLMP is a plan to manage and monitor aquatic plants. This aspect is referred to as an <i>Aquatic Plant Management (APM) Plan</i>. BMPs for aquatic plant management change rapidly, as new information about effectiveness, non-target impacts, and risk assessment emerges. To be eligible to apply for grants that provide cost share for AIS control and monitoring, “a current plan has a completion date of no more than 5 years prior to submittal of the recommendation for approval. A [whole-lake] point-intercept survey of the aquatic plant community conducted within 5 years of the year an applicant applies for a grant is required.” The WDNR is currently working to revise the aquatic plant management codes (NR107 & NR109) with similar APM Plan requirements.</p> <p>While not required, the LLPA will strive to include a water quality monitoring component within every-other APM Plan update. Since the 2026 APM Plan does not contain a water quality investigation, the 2031 APM Plan will consider including this component. For Long Lake, this is particularly important as the impacts of zebra mussels continue to manifest on the water quality of the system.</p>
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Management Goal 3: Monitor Aquatic Vegetation on Long Lake

Management Action:	Conduct periodic point-intercept aquatic plant surveys
Timeframe:	Periodic: at least once every 5 years, Timing: during July-August
Facilitator:	LLPA Board of Directors
Description:	<p>The point-intercept method as described Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010 (Hauxwell et al. 2010) have been conducted on Long Lake in 2007, 2010, and 2013 by the WDNR, and 2018 and 2024 by Onterra. This survey provides quantitative population estimates for all aquatic plant species within a lake and is designed to allow comparisons with past surveys in Long Lake as well as comparisons to other waterbodies throughout the state.</p> <p>At each point-intercept location within the <i>littoral zone</i>, information regarding the depth, substrate type (soft sediment, sand, or rock), and the plant species sampled along with their relative abundance (rake fullness) on the sampling rake is recorded.</p> <p>The LLPA will ensure whole-lake point-intercept surveys are conducted at least once every five years to maintain eligibility for WDNR multi-year mechanical harvesting permits.</p>

<u>Management Action:</u>	Consider conducting periodic community mapping (floating-leaf and emergent) surveys
Timeframe:	Elective: every 10 years or when prompted
Facilitator:	LLPA Board of Directors
Description:	<p>A key component of any aquatic plant community assessment is the delineation of the emergent and floating-leaf aquatic plant communities within each lake as these plants are often underrepresented during the point-intercept survey. The emergent and floating-leaf community mapping survey (often referred to as <i>community mapping survey</i>) creates a snapshot of these important communities within each lake as they existed during the survey and is valuable in the development of the management plan and in comparison with future surveys.</p> <p>This survey would delineate the margins of floating-leaf (e.g., water lilies) and emergent (e.g., cattails, bulrushes) plant species using GPS technology (preferably sub-meter accuracy) as well as document the primary species present within each community. This survey was conducted on Long Lake in 2014 and repeated in 2024.</p> <p>The LLPA will consider conducting this survey at roughly 10 year intervals to understand if these populations are expanding or contracting over time, and to avoid during development of mechanical harvesting strategies. The survey would also track the occurrences of non-native emergent species, such as purple loosestrife.</p>

<u>Management Action:</u>	Conduct periodic professional EWM mapping surveys
Timeframe:	Elective: every 5 years or when prompted Timing: during latter part of growing season
Facilitator:	LLPA Board of Directors
Description:	<p>As the name implies, the late season EWM Mapping Survey is a professionally contracted survey completed towards the end of the growing season when EWM is at its anticipated peak growth stage, allowing for a true assessment of the amount and density of EWM within the lake. For Long Lake, this survey would likely take place in mid-August to the end of September, depending on the growing conditions of the particular year. This survey would include a complete meander survey of the system's littoral zone by professional ecologists and mapping using GPS technology (sub-meter accuracy is preferred).</p> <p>The LLPA has monitored the EWM population through periodic late-season EWM mapping surveys. The EWM population has remained relatively low in Long Lake, after first being detected in 2002. Unless prompted by a specific rationale, such as a large and noticeable increase in the EWM population, the LLPA will consider implementing this survey every 5 years during APM Plan updates.</p>

Management Action:	Conduct periodic professional CLP mapping surveys
Timeframe:	Elective: every 5 years or when prompted Timing: during early part of growing season
Facilitator:	LLPA Board of Directors
Description:	<p>As discussed in the Non-Native Aquatic Plant Section (3.3), CLP was first “officially” recorded from Long in 2007. The LLPA initiated herbicide management of the CLP population in 2007 and continued until 2018. While the directed treatments were moderately effective where conducted, the CLP population continued to expand beyond what could be financially targeted on an annual basis. Since the CLP population had progressed past an early-infestation stage and was now considered an established population within the lake, the WDNR indicated future herbicide permits would not be supported. The LLPA created an updated APM Plan (finalized in 2019) that discontinued CLP herbicide management and shifted to mechanical harvesting to mitigate nuisance plant conditions.</p> <p>Undoubtedly, a robust and widespread base of turions is present in the sediments of Long Lake. These turions are viable in the sediments for 10 years or more after being deposited, with inconsistent sprouting levels occurring each season based upon unknown environmental conditions. In some years there will be a higher amount of CLP sprouting and therefore a higher CLP population.</p> <p>The LLPA would give consideration to periodically monitoring the CLP population within Long Lake, particularly during APM Planning projects. That being said, the population has likely reached a maximum capacity, and documenting population swings may be more of an academic exercise than having practical importance on driving management decisions.</p>

Management Goal 4: Discourage Resident Canada Goose Populations

Management Action:	Decrease Canada goose populations
Timeframe:	Continuation of current effort.
Facilitator:	LLPA Board of Directors
Description:	<p>Canada geese prefer to linger upon open lawns near waterbodies because of the lack of cover for potential predators. The presence of geese on a lake resident's beach may not be an issue; however, the feces the geese leave are unsightly and pose a health risk. Geese feces may become a source of fecal coliforms.</p> <p>Green space around the lake allows riparians to use the nearshore areas for recreation. There is also a substantial amount of green space at the Long Lake State Park where Canada geese congregate, with access to nearby sanitary settling ponds where goose nesting occurs.</p> <p>Vegetated and wooded natural shorelines are the best way to discourage geese from coming on to properties. As the primary line of defense, WDNR and other state/federal agencies encourage lake organizations to install natural vegetation buffers. Starting in 2014, a program was enacted by the WDNR and UW-Extension to promote riparian landowners to implement relatively straightforward shoreland restoration activities. This program, now called the Healthy Lake and Rivers Grant program, provides education, guidance, and grant funding to promote installation of best management practices aimed to protect and restore lakes and rivers in Wisconsin. The cost share allows \$1,000 per practice, up to \$25,000 per annual grant application. More details and resources for the program can be found at:</p> <p style="text-align: center;">https://healthylakeswi.com</p> <p>In some instance, resident Canada geese populations can reach large numbers even if substantial shoreland buffers are installed. In these instances, there are a few action steps that can be taken to manage or reduce Canada goose population.</p> <p>The US Fish and Wildlife Services (USFWS) has a program where nest sites can be registered and egg addling can occur. Addling is the process of applying an oil to the egg to terminate embryo development but leave the egg intact so the goose does not lay additional eggs. The LLPA would need to hire a professional with the proper permits and certification to conduct this work. In extreme scenarios, the USFWS and US Department of Agriculture Wildlife Services may consider euthanizing a portion of the resident Canada goose population during their molting stage. In 2021, fifty-five geese were removed from Long Lake as a part of this program. More information can be found here:</p> <p style="text-align: center;">https://dnr.wisconsin.gov/topic/WildlifeHabitat/damage</p> <p style="text-align: center;">https://apps.fws.gov/rcgr/</p>

Management Goal 5: Ensure proper water flow within the Watercress Creek inlet

Management Action:	Work with appropriate agencies and landowners to facilitate maximum water flow in the Watercress Creek between Tittle Lake and State Highway 67
Timeframe:	Continuation of current effort.
Facilitator:	LLPA Board of Directors
Description:	<p>Watercress Creek is the primary inlet to Long Lake, entering through Tittle Lake. Watercress Creek is considered a Class II trout stream, indicating it supports a good population of trout with, at minimum, a one-year-old, self-sustaining population, but requires stocking to maintain a quality fishery due to limited natural reproduction.</p> <p>The LLPA has periodically organized volunteers to clean out natural debris within the Watercress Creek, facilitating navigability and stream flow. It is asserted that when functioning incorrectly, a delta forms at the mouth of the Watercress Creek in Tittle Lake (Figure 5.0-4).</p> <p>The LLPA believes that a constriction in the culvert under the driveway to the Boy Scouts of America camp on Long Lake is greatly reducing natural flow of this inlet. This culvert has shifted and sunk from its original design, and has become partially occluded with emergent vegetation and debris. The LLPA would like to work with the landowner and appropriate state agencies to restore this culvert to function as designed.</p>

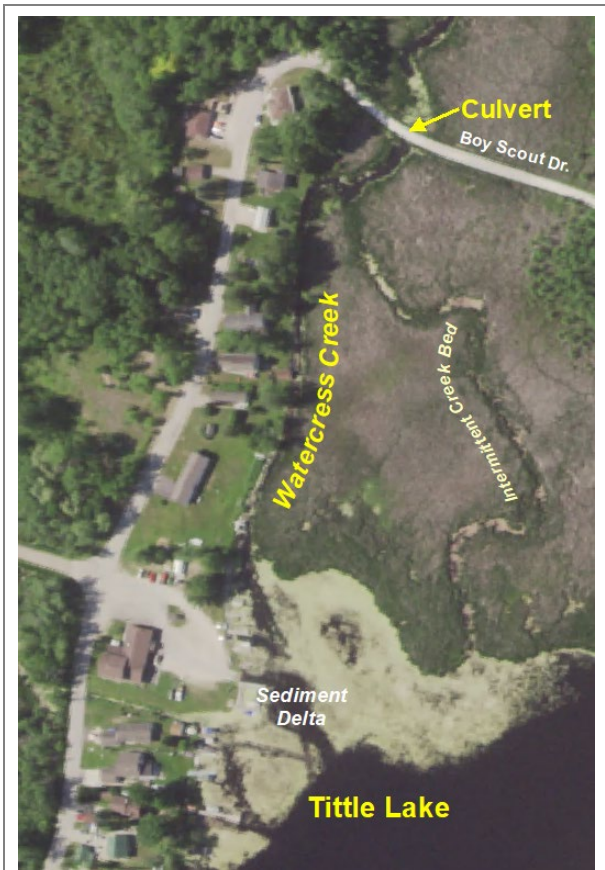


Figure 5.0-4. Watercress Creek Inlet.

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