

Town of Winchester Lakes

Vilas County, Wisconsin

Aquatic Plant Studies

Phase III

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1.0 INTRODUCTION

The Turtle Lake Chain is composed of Rock, North Turtle, and South Turtle Lakes which are hydrologically connected and are navigable by small watercraft to one another (Figure 1.0-1). From South Turtle Lake to North Turtle Lake watercraft can navigate under a small bridge and North Turtle to Rock Lakes through a 100-yard shallow channel (Photographs 1.0-1 and 1.0-2). The chain’s watershed is part of the greater Flambeau River Watershed and encompasses around 15,357 acres across portions of Vilas County, WI and Gogebic County, MI

Rock Lake is a 126-acre shallow lowland, brown-water, eutrophic drainage lake with a maximum depth of 20 feet and a mean depth of 9 feet. Its surficial watershed encompasses approximately 3,624 acres across portions of Vilas County, WI and Gogebic County, MI. Rock Lake is fed by upstream No Mans Lake via No Mans Creek, and the lake drains into downstream North Turtle Lake.

North Turtle Lake is a 368-acre deep lowland (two-story), brown-water, mesotrophic drainage lake with a maximum depth of 51 feet and a mean depth of 21 feet. Its surficial watershed encompasses approximately 12,901 acres across portions of Vilas County, WI and Gogebic County, MI. Primary tributaries flowing into North Turtle Lake include Rock Creek from the north and Rainbow Creek from the northeast. North Turtle Lake drains into the northern portion of South Turtle Lake and the Turtle River.

South Turtle Lake is a 488-acre deep lowland, brown-water, mesotrophic drainage lake with a maximum depth of 40 feet and a mean depth of 14 feet. Its surficial watershed encompasses approximately 15,357 acres across portions of Vilas County, WI and Gogebic County, MI. North Turtle Lake flows into South Turtle Lake from the north and the lake is drained by the Turtle River to the northeast.

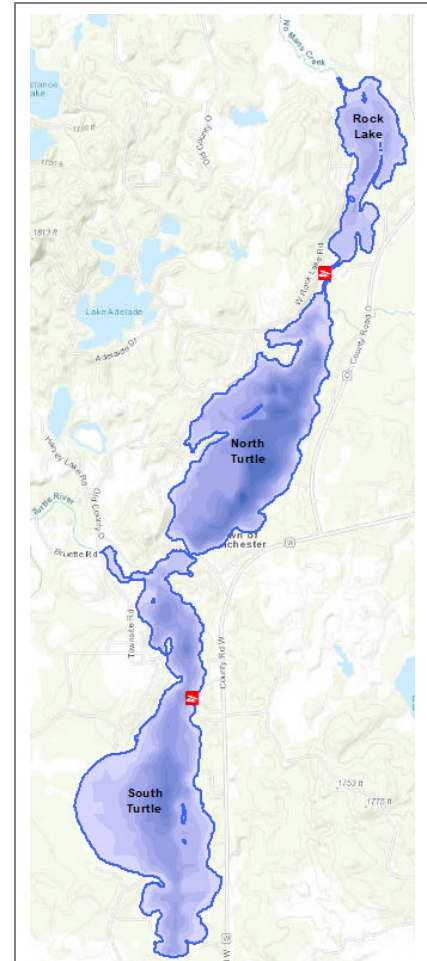


Figure 1.0-1 Turtle Chain, Vilas County, Wisconsin.



Photograph 1.0-1 Channel From Rock Lake to North Turtle Lake, Vilas County, Wisconsin.



Photograph 1.0-2 Bridge from North Turtle Lake to South Turtle Lake, Vilas County, Wisconsin.

The North Lakeland Discovery Center (NLDC) is a non-profit environmental education center located near Manitowish Waters, Wisconsin. The sponsor leads many activities including educational programs and presentations, citizen-based monitoring programs, aquatic invasive species outreach, shoreline restorations, environmental preservation projects and more. The sponsor and partners are heavily involved in the Northwoods Businesses for Clean Waters, July 4th Landing Blitz, Drain Campaign, Clean Boats Clean Waters, and Citizens Lake Monitoring Network, and AIS Statewide Snapshot Day. The sponsor has overseen AIS training/monitoring, education, and shoreland restoration during earlier projects in the Town of Winchester.

A project was initiated in 2015 to collect baseline data and assess the overall health of 12 lakes within the Town of Winchester. Ultimately, a town-wide Comprehensive Management Plan was completed in 2020. In recent years, the Town of Winchester, in partnership with NLDC, commenced a phased project to build upon the baseline dataset gathered in the Comprehensive Management Plan, through a series of environmental studies projects. The studies would replicate the aquatic plant surveys including the point-intercepts survey and community mapping surveys from each of the Town of Winchester lakes. This report is in association with Phase III of this project and is a deliverable under WDNR Grant # AEPP83525, AEPP87725 & AEPP85525. Lakes studied during Phase III included Rock Lake, North Turtle Lake, and South Turtle Lake.

As part of this project, each lake basin was monitored using WDNR-supported survey methods, including point-intercept surveys and floating-leaf and emergent community mapping surveys. Identical surveys conducted in 2017 and 2025 allow for direct comparisons among lake basins and provide valuable baseline information, although there are not enough years of data to determine long-term trends.

2.0 AQUATIC PLANTS

2.1 Primer on Aquatic Plant Data Analysis and 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.

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 North, South, and Rock Lakes in 2017 and 2025. 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 the following section.

Species List

The species list is simply a list of all of the aquatic plant species, both native and non-native, that have been located during the surveys completed in each lake. 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 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.

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 each lake to be compared to other lakes within the region and state.

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

Rock, North Turtle, and South Turtle Lakes fall within the Northern Lakes and Forests (NLF) *ecoregion* (Figure 2.1-1), 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.

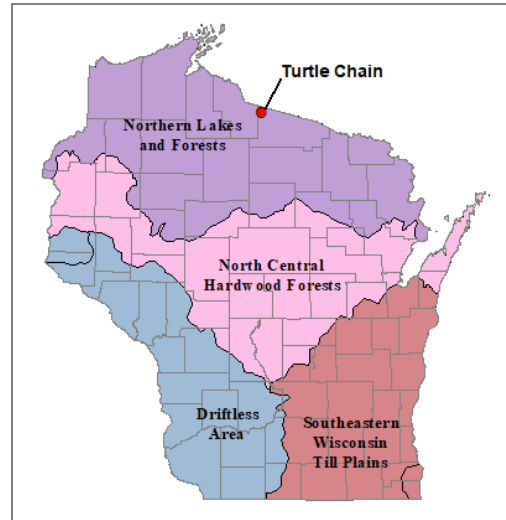


Figure 2.1-1. Location of the Turtle Chain within the ecoregions of Wisconsin. After (Nichols, 1999).

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 more resistant or resilient to invaders (Muthukrishnan, Davis, Jordan, & Forester, 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 the lakes are 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.

Floating-leaf and Emergent Plant Community Mapping Surveys

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. This 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. The emergent and floating-leaf aquatic plant communities in the Turtle Chain were mapped using a Trimble Global Positioning System (GPS) with sub-meter accuracy.

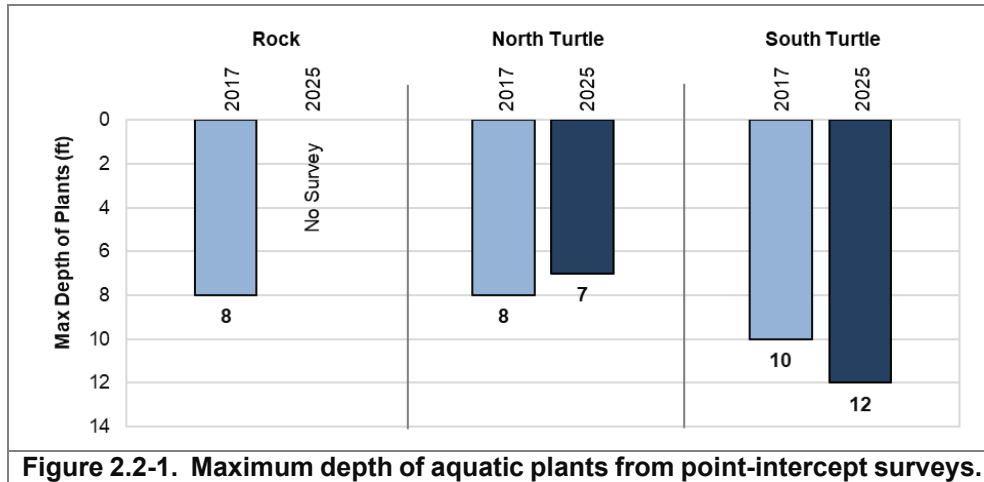
2.2 2025 Aquatic Plant Survey Results

The point-intercept survey provides a standardized way to gain quantitative information about a lake's aquatic plant population through visiting predetermined locations and using a rake sampler to identify all the plants at each location (Photograph 2.2-1). 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. The whole-lake point-intercept survey has been conducted on North and South Turtle Lakes and Rock Lake in 2017 and 2025. The sampling location spacing (resolution) and resulting total number of locations varied by lake and were created based upon guidance from the WDNR.



Photograph 2.2-1. Point-intercept survey on a WI lake.
Photo credit Onterra.

An important component of the point-intercept survey is defining the littoral zone, or the area at which aquatic plants can grow. When comparing each of the three lakes, South Turtle Lake usually has the deepest plant growth while Rock and North Turtle have shown to have shallower maximum depth of plant growth (Figure 2.2-1). Although these lakes are connected, the surveys show that each lake has different characteristics that make them unique. Subtle differences in water clarity at key points of the year may contribute to variation in max depth of plant growth between years for some lakes.



North Turtle Lake

In total, approximately 44 species have been recorded from North Turtle Lake from aquatic plant surveys, with 22 having a submergent growth form. In addition to the point intercept surveys, a community mapping survey has been completed on two occasions which captures several less common species often growing around the margins of the lake. Tables 2.2-1 and 2.2-2 are organized by growth form which separates out species based on whether they are emergent species, floating-leaf species, submergent species, 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. Examples of 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 the tables. Often these species are found growing on the shoreline or in shallow areas of the lake.

Table 2.2-1. Emergent and floating-leaf species located in North Turtle Lake in aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2017	2025
Emergent	<i>Carex sp. 1</i>	Sedge sp. 1	Native	N/A		I
	<i>Carex utriculata</i>	Common yellow lake sedge	Native	7		I
	<i>Decodon verticillatus</i>	Water-willow	Native	7		I I
	<i>Dulichium arundinaceum</i>	Three-way sedge	Native	9		I
	<i>Eleocharis palustris</i>	Creeping spikerush	Native	6		I I
	<i>Equisetum fluviatile</i>	Water horsetail	Native	7		I
	<i>Glyceria canadensis</i>	Rattlesnake grass	Native	7		I I
	<i>Iris pseudacorus</i>	Pale-yellow iris	Non-Native - Invasive	N/A		I
	<i>Iris versicolor</i>	Northern blue flag	Native	5		I
	<i>Pontederia cordata</i>	Pickelweed	Native	9		I I
	<i>Sagittaria latifolia</i>	Common arrowhead	Native	3		I I
	<i>Schoenoplectus acutus</i>	Hardstem bulrush	Native	5	X	X
	<i>Sparganium americanum</i>	American bur-reed	Native	8	X	I
	<i>Sparganium eurycarpum</i>	Common bur-reed	Native	5		I
	<i>Typha spp.</i>	Cattail spp.	Unknown (Sterile)	N/A		I
FL	<i>Brasenia schreberi</i>	Watershield	Native	7		I X
	<i>Nuphar variegata</i>	Spatterdock	Native	6	X	X
	<i>Nymphaea odorata</i>	White water lily	Native	6		I I
	<i>Sparganium fluctuans</i>	Floating-leaf bur-reed	Native	10		I 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

Table 2.2-2. Submergent, and submergent/emergent species located in North Turtle Lake during aquatic plant surveys.

Submergent	<i>Bidens beckii</i>	Water marigold	Native	8	X
	<i>Ceratophyllum demersum</i>	Coontail	Native	3	X
	<i>Chara spp.</i>	Muskgrasses	Native	7	X X
	<i>Elodea canadensis</i>	Common waterweed	Native	3	X
	<i>Isoetes spp.</i>	Quillwort spp.	Native	8	X X
	<i>Myriophyllum alterniflorum</i>	Alternate-flowered watermilfoil	Native	10	X
	<i>Myriophyllum sibiricum</i>	Northern watermilfoil	Native	7	X
	<i>Myriophyllum tenellum</i>	Dwarf watermilfoil	Native	10	X X
	<i>Najas flexilis</i>	Slender naiad	Native	6	X X
	<i>Nitella spp.</i>	Stoneworts	Native	7	X X
	<i>Potamogeton amplifolius</i>	Large-leaf pondweed	Native	7	X X
	<i>Potamogeton berchtoldii</i>	Slender pondweed	Native	7	X
	<i>Potamogeton epihydrus</i>	Ribbon-leaf pondweed	Native	8	I
	<i>Potamogeton gramineus</i>	Variable-leaf pondweed	Native	7	X X
	<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	Native	5	X X
	<i>Potamogeton robbinsii</i>	Fern-leaf pondweed	Native	8	X X
	<i>Potamogeton spirillus</i>	Spiral-fruited pondweed	Native	8	I
	<i>Potamogeton vaseyi</i>	Vasey's pondweed	Native - Special Concern	10	I
	<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	Native	6	X
	<i>Sagittaria sp. (rosette)</i>	Arrowhead sp. (rosette)	Native	N/A	I
<i>Utricularia vulgaris</i>	Common bladderwort	Native	7	I X	
<i>Vallisneria americana</i>	Wild celery	Native	6	X X	
S/E	<i>Sagittaria cuneata</i>	Arum-leaved arrowhead	Native	7	I
	<i>Sagittaria graminea</i>	Grass-leaved arrowhead	Native	9	I

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

Frequency of Occurrence

Figure 2.2-2 displays the littoral frequency of occurrence of aquatic plants located in the 2017 and 2025 point-intercept surveys along with an indication of which species showed statistically valid changes in occurrence between the surveys. The top four most common species found on the two surveys did not show statistically significant changes in their populations which include charophytes, wild celery, variable-leaf pondweed, and large-leaf pondweed. Slender naiad had a statistically significant increase in occurrence examined on the 2025 survey when compared to the 2017 survey. Common bladderwort, alternate-flowered watermilfoil, and bur-reed species all were not observed on the 2017 survey but were found on multiple sampling locations during the 2025 survey. This does not mean they were not present on the lake during 2017; they were likely present but at population levels low enough to not be detected on the survey. Similarly, water marigold was found on the 2017 survey and not on the 2025 survey which suggests that its population decreased and not that it wasn't present in the lake during the 2025 survey. The occurrences of all aquatic plant species encountered during each of the point-intercept surveys in North Turtle Lake are compiled within Appendix A.

It is important to note that while the occurrence of any given species may be statistically different between the two surveys in North Turtle Lake, there is not enough data to be able to identify if a

trend is occurring. Additional replications of this survey in the future may allow for a trend analysis.

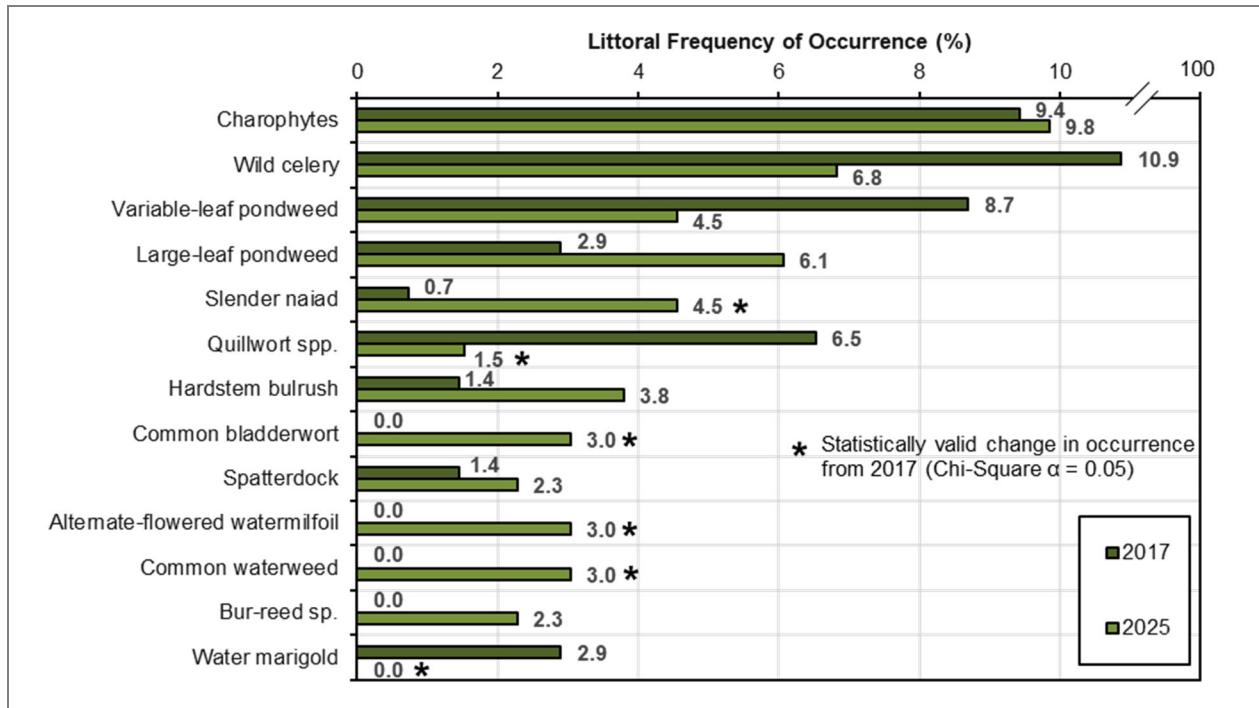


Figure 2.2-2. 2017 & 2025 Littoral Frequency of Occurrence of aquatic plant species in North Turtle Lake. Only species with an occurrence of 2% or greater in at least one survey is displayed. Asterisk indicates statistically valid change in occurrence between two surveys.

Charophytes were commonly encountered within North Turtle Lake in both the 2017 and 2025 surveys. Charophytes are a group of macro algae that consists of muskgrasses (*Chara* spp.) and stoneworts (*Nitella* spp.) and exhibit similar morphological characteristics which are sometimes difficult to tell apart in the field, so these species were lumped together in the analysis. Muskgrasses typically do better in systems with good water clarity and hard water. Their large beds help to stabilize bottom sediments. Studies have also shown that muskgrasses sequester phosphorous in the calcium carbonate incrustations which form on these plants, aiding in improving water quality by making the phosphorus unavailable to phytoplankton (Coops 2002).

Wild celery was another common species found in both years. It produces long, ribbon-like leaves which emerge from a basal rosette. Wild celery prefers to grow over harder substrates and is tolerant of low-light conditions. Its long leaves provide valuable structural habitat for the aquatic community while its network of roots and rhizomes help to stabilize bottom sediments. In mid- to late-summer, wild celery often produces abundant fruit which are important food sources for wildlife including migratory waterfowl.

Figure 2.2-3 displays littoral frequency of occurrence of all aquatic plants from 2017 and 2025 point-intercept surveys completed in North Turtle Lake. An increase of littoral sampling locations with vegetation in 2025 compared to 2017 was observed (23% and 34%, respectively). The increase of occurrence of plants observed in one area of the lake was along the central eastern shoreline where no plants were sampled in 2017 (Map 3). The plant species sampled in this area during the 2025 survey were mostly hardstem bullrush and large-leaf pondweed.

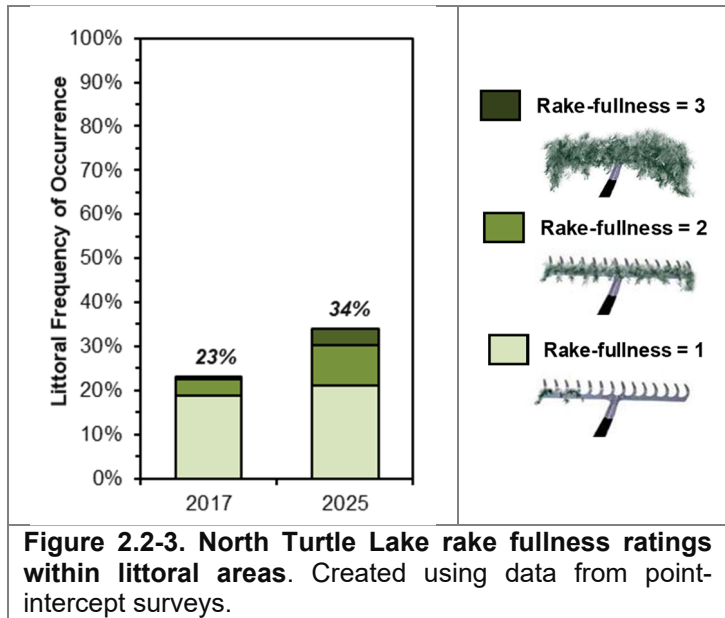


Figure 2.2-3. North Turtle Lake rake fullness ratings within littoral areas. Created using data from point-intercept surveys.

Floristic Quality Assessment

As discussed in the primer section, the calculations used for the Floristic Quality Index (FQI) for a lake’s aquatic plant community are based on the quantity and quality of aquatic plant species that were sampled on the rake during the point-intercept survey. North Turtle Lake’s native plant species richness value was 16 in 2017 and 20 in 2025. The average coefficient of conservatism value for all the species encountered each year also showed an increase in 2025 compared to 2017. Some species that were found in 2025 and not in 2017 that have a high coefficient of conservatism value are: floating-leaf bur-reed and alternate-flowered watermilfoil which both have coefficient of conservatism values of 10. The additional encounters with high-quality species contributed to the increased floristic quality value for 2025. As compared to other lakes within the same ecoregion, in 2025, the floristic quality value given to North Turtle Lake’s plant community was slightly above the ecoregion median value at 31.1 (Figure 2.2-4).

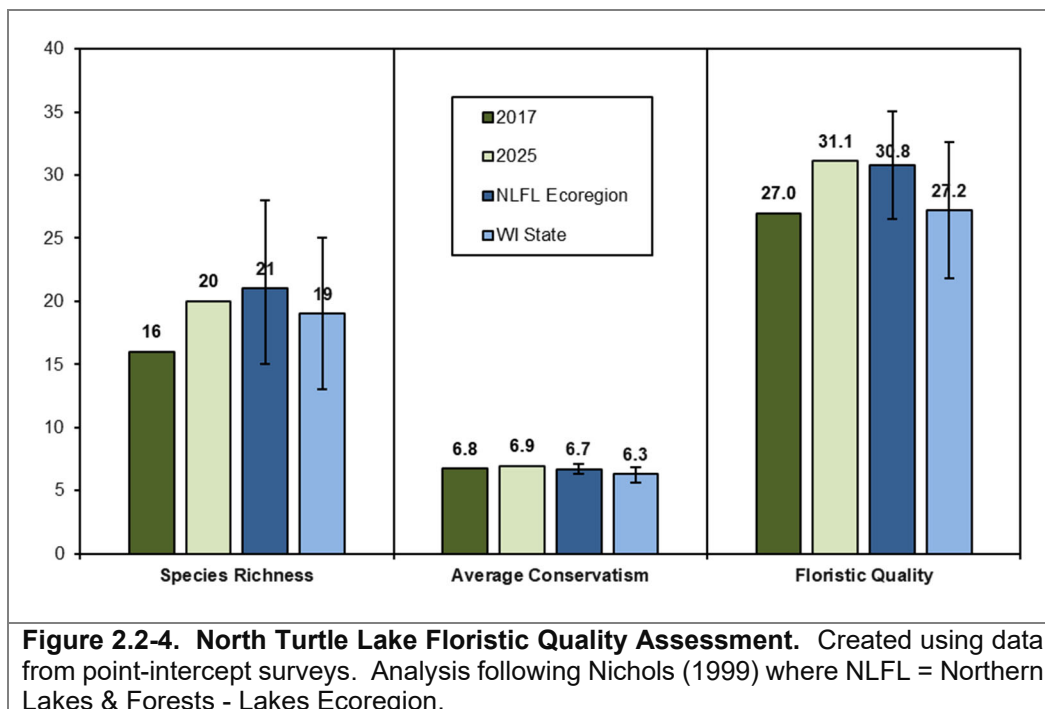


Figure 2.2-4. North Turtle Lake Floristic Quality Assessment. Created using data from point-intercept surveys. Analysis following Nichols (1999) where NLFL = Northern Lakes & Forests - Lakes Ecoregion.

Species Diversity

While a method for characterizing diversity values as fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how the North Turtle Lake’s diversity values rank. Using data collected by Onterra and WDNR Science Services, quartiles were calculated for 212 lakes within the NLFL Ecoregion in order to be able to compare the diversity between different lakes in the same region (Figure 2.2-5). Using the data collected from the whole-lake point-intercept surveys, the diversity of North Turtle Lake’s Simpson’s diversity index value had increased since the last survey with the 2025 value of 0.92 rising above the 75th percentile of other lakes in the NLFL Ecoregion. This means that if two plants were randomly sampled from the lake there is a 92% probability that the two individuals would be of a different species.

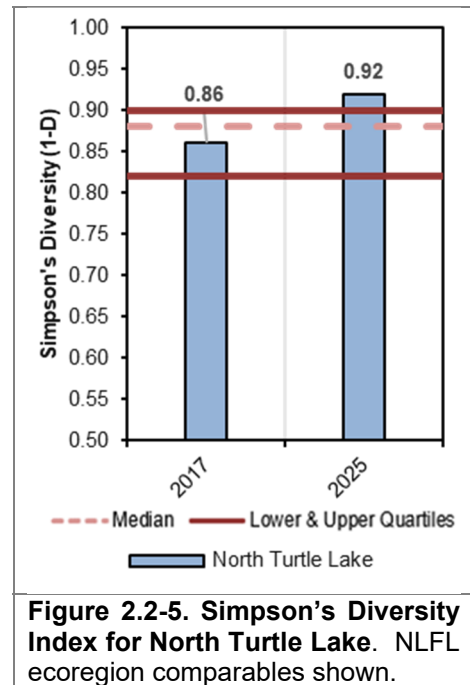


Figure 2.2-5. Simpson's Diversity Index for North Turtle Lake. NLFL ecoregion comparables shown.

One way to visualize the diversity of a lake’s plant community is to examine the relative frequency of occurrence of aquatic plant species. Relative frequency of occurrence is used to evaluate how often each plant species is encountered in relation to all the other species sampled. Figure 2.2-6 displays the relative frequency of occurrence of aquatic plant species from each of the point-intercept surveys in North Turtle Lake. These data indicate that

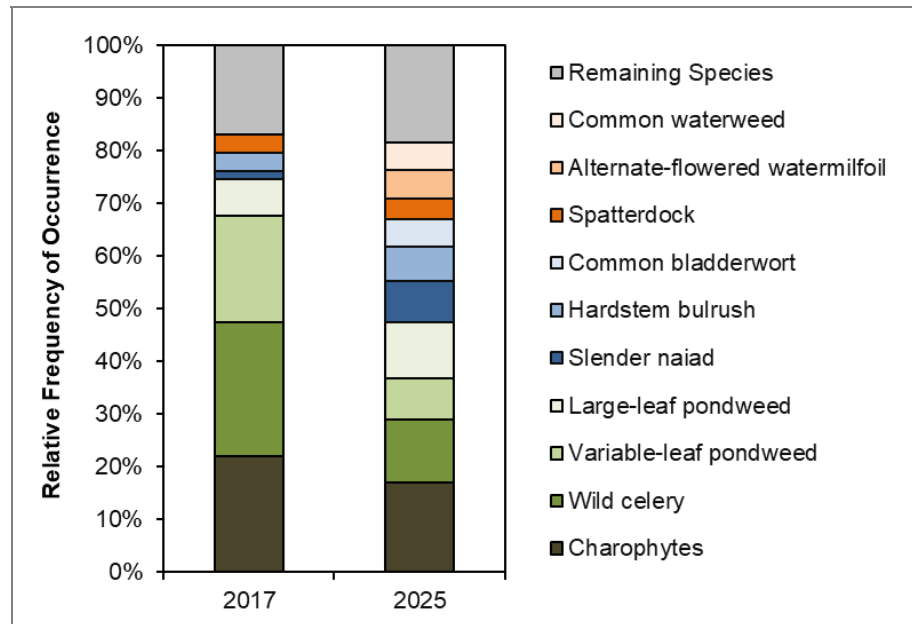


Figure 2.2-6. Relative frequency of occurrence of aquatic vegetation in North Turtle Lake. Created using data from 2017 and 2025 point-intercept surveys.

some species such as charophytes, wild celery and variable-leaf pondweed are comprised of a lower portion of the relative frequency in 2025 as compared to 2017, while slender naiad, hardstem bulrush, and common bladderwort have increased. Overall, the 2025 survey showed a more balanced plant composition than in 2017 when three species comprised nearly 70% of the relative frequency.

Floating-leaf & Emergent Community Mapping

In 2025, Onterra ecologists replicated the emergent and floating-leaf aquatic plant community mapping survey in North Turtle Lake. The survey identified 10.8 acres of large communities around the margins of the lake. Occurrences of small communities were mapped with point-based methods and do not contribute to the acreage totals. The primary species that comprise these large communities include pickerelweed, hardstem bulrush, and bur-reed species (Map 1). The results indicate relatively similar extents of plant communities when comparing the 2025 survey to the 2017 survey (Figure 2.2-7). The 2017-2025 community comparison map indicates the extents of the 2017 communities compared to the 2025 colonies and allows for determination of where colonies expanded or contracted between the two surveys (Map 2).

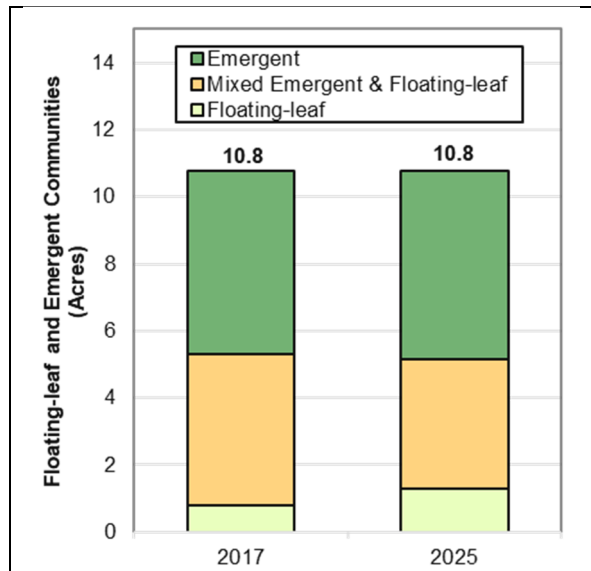


Figure 2.2-7. North Turtle Lake emergent and floating-leaf community acres.

South Turtle Lake

In total, approximately 45 species have been recorded from South Turtle Lake from aquatic plant surveys, with 22 having a submergent growth form (Tables 2.2-3 & 2.2-4). In addition to the point intercept surveys, a community mapping survey has been completed on two occasions which captures several less common species often growing around the margins of the lake. Tables 2.2-3 & 2.2-4 are organized by growth form which separates out species based on whether they are emergent species, floating-leaf species, submergent species, 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. Examples of 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 the tables. Often these species are found growing on the shoreline or in shallow areas of the lake.

Table 2.2-3. Emergent, floating-leaf, and floating-leaf/emergent species located in South Turtle Lake during aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2017	2025
Emergent	<i>Acorus americanus</i>	Sweetflag	Native	7	I	I
	<i>Calla palustris</i>	Water arum	Native	9		X
	<i>Carex comosa</i>	Bristly sedge	Native	5	I	I
	<i>Carex retrorsa</i>	Retorse sedge	Native	6	I	
	<i>Decodon verticillatus</i>	Water-willow	Native	7	I	I
	<i>Dulichium arundinaceum</i>	Three-way sedge	Native	9	I	I
	<i>Eleocharis palustris</i>	Creeping spikerush	Native	6	I	I
	<i>Equisetum fluviatile</i>	Water horsetail	Native	7	I	I
	<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>Pontederia cordata</i>	Pickernelweed	Native	9	I	I
	<i>Sagittaria latifolia</i>	Common arrowhead	Native	3	I	
	<i>Schoenoplectus acutus</i>	Hardstem bulrush	Native	5	X	X
	<i>Sparganium eurycarpum</i>	Common bur-reed	Native	5		I
	<i>Typha latifolia</i>	Broad-leaved cattail	Native	1		I
<i>Typha spp.</i>	Cattail spp.	Unknown (Sterile)	N/A			
FL	<i>Brasenia schreberi</i>	Watershield	Native	7	X	X
	<i>Nuphar variegata</i>	Spatterdock	Native	6	X	X
	<i>Nymphaea odorata</i>	White water lily	Native	6	X	X
	<i>Sparganium fluctuans</i>	Floating-leaf bur-reed	Native	10	X	
FL/E	<i>Sparganium sp.</i>	Bur-reed sp.	Native	N/A		I

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

Table 2.2-4. Submergent, and submergent/emergent species located in South Turtle Lake during aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2017	2025
Submergent	<i>Bidens beckii</i>	Water marigold	Native	8	X	X
	<i>Ceratophyllum demersum</i>	Coontail	Native	3	X	X
	<i>Ceratophyllum echinatum</i>	Spiny hornwort	Native	10	X	
	<i>Chara spp.</i>	Muskgrasses	Native	7	X	X
	<i>Elodea canadensis</i>	Common waterweed	Native	3	X	X
	<i>Elodea nuttallii</i>	Slender waterweed	Native	7	X	
	<i>Heteranthera dubia</i>	Water stargrass	Native	6	X	
	<i>Myriophyllum sibiricum</i>	Northern watermilfoil	Native	7	X	X
	<i>Najas flexilis</i>	Slender naiad	Native	6	X	X
	<i>Nitella spp.</i>	Stoneworts	Native	7	X	X
	<i>Potamogeton amplifolius</i>	Large-leaf pondweed	Native	7	X	X
	<i>Potamogeton gramineus</i>	Variable-leaf pondweed	Native	7	X	X
	<i>Potamogeton natans</i>	Floating-leaf pondweed	Native	5	I	
	<i>Potamogeton praelongus</i>	White-stem pondweed	Native	8	X	
	<i>Potamogeton pusillus</i>	Small pondweed	Native	7	X	X
	<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	Native	5	X	X
	<i>Potamogeton robbinsii</i>	Fern-leaf pondweed	Native	8	X	X
	<i>Potamogeton spirillus</i>	Spiral-fruited pondweed	Native	8	I	
	<i>Potamogeton vaseyi</i>	Vasey's pondweed	Native - Special Concern	10	I	X
	<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	Native	6	X	X
<i>Sagittaria sp. (rosette)</i>	Arrowhead sp. (rosette)	Native	N/A	I		
<i>Utricularia vulgaris</i>	Common bladderwort	Native	7	X		
S/E	<i>Eleocharis acicularis</i>	Needle spikerush	Native	5	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

Frequency of Occurrence

Figure 2.2-8 displays the littoral frequency of occurrence of aquatic plants located in the 2017 and 2025 point-intercept surveys along with an indication of which species showed statistically valid changes in occurrence between the surveys. Fern-leaf pondweed was the most frequently encountered native aquatic plant species in both surveys. Some species saw a statistically significant decline in occurrence between the two surveys including the combination of large-leaf and variable-leaf pondweed, small pondweed, northern watermilfoil, water marigold, and clasping-leaf pondweed. One species saw a statistically significant increase which was common waterweed. The occurrences of all aquatic plant species encountered during each of the point-intercept surveys in South Turtle Lake are compiled within Appendix A.

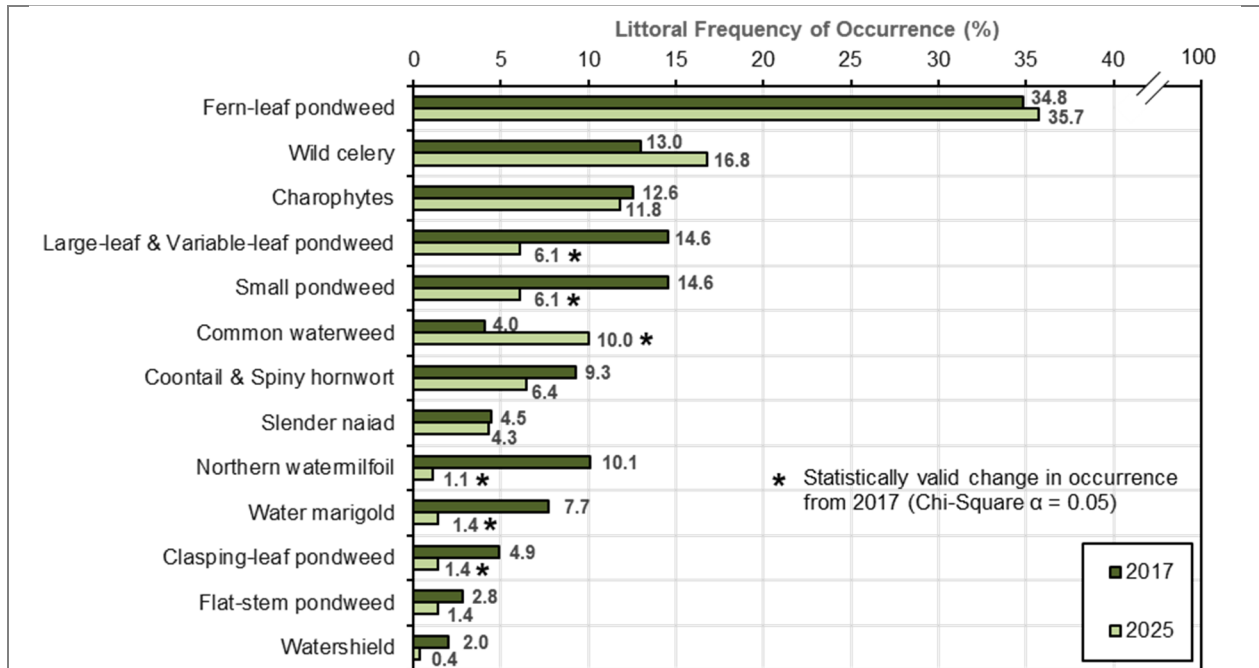


Figure 2.2-8. 2017 & 2025 Littoral Frequency of Occurrence of aquatic plant species in South Turtle Lake. Only species with an occurrence of 2% or greater in at least one survey is displayed. Asterisk indicates statistically valid change in occurrence between two surveys.

Fern-leaf pondweed has been the most prominent native species in South Turtle Lake overall between the 2017 and 2025 surveys (Figure 2.2-8). As its name suggests, the arrangement of leaves along the stem gives this plant a fern-like appearance. Fern-leaf pondweed typically develops large colonies over soft sediments which grow close to the lake bottom, and it is one of the deepest-growing vascular plants in Wisconsin. Large beds of fern-leaf pondweed provide excellent structural habitat for aquatic wildlife and help to prevent the suspension of the soft bottom sediments in which they grow. Fern-leaf pondweed is important to many ecosystems as it often provides evergreen-like vegetation even in the winter months.

Wild celery was another common species found in both years. It produces long, ribbon-like leaves which emerge from a basal rosette. Wild celery prefers to grow over harder substrates and is tolerant of low-light conditions. Its long leaves provide valuable structural habitat for the aquatic community while its network of roots and rhizomes help to stabilize bottom sediments. In mid- to late-summer, wild celery often produces abundant fruit which are important food sources for wildlife including migratory waterfowl.

Figure 2.2-9 displays littoral frequency of occurrence of all aquatic plants from both point-intercept surveys completed in South Turtle Lake. Vegetation was found at slightly less proportion of littoral sampling locations in 2025 compared to 2017 (61% and 56%, respectively). Map 6 shows TRF values across the entire lake and highlights a slight decrease in plant density across the lake. Map 6 also shows the plant distribution across the lake with most plants residing on the western side of the lake and very little vegetation in littoral areas of the eastern side of the lake.

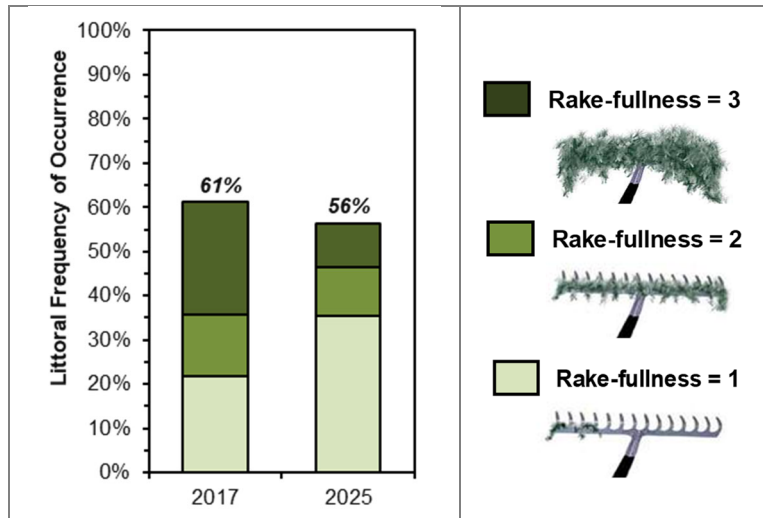


Figure 2.2-9. South Turtle Lake aquatic vegetation rake fullness ratings within littoral areas. Created using data from point-intercept surveys.

Floristic Quality Assessment

South Turtle Lake’s native plant species richness value was 26 in 2017 and 22 in 2025. Several species that were in low abundance in 2017 were not encountered in 2025. A very small reduction to those species populations could have created an undetectable level for those already sparse populations. The average conservatism value also dropped in 2025 when comparing the 2017 data. Both of these values dropping resulted in a lower floristic quality assessment value when comparing the two years. The 2025 floristic quality value of 30.5 is near the ecoregion median value.

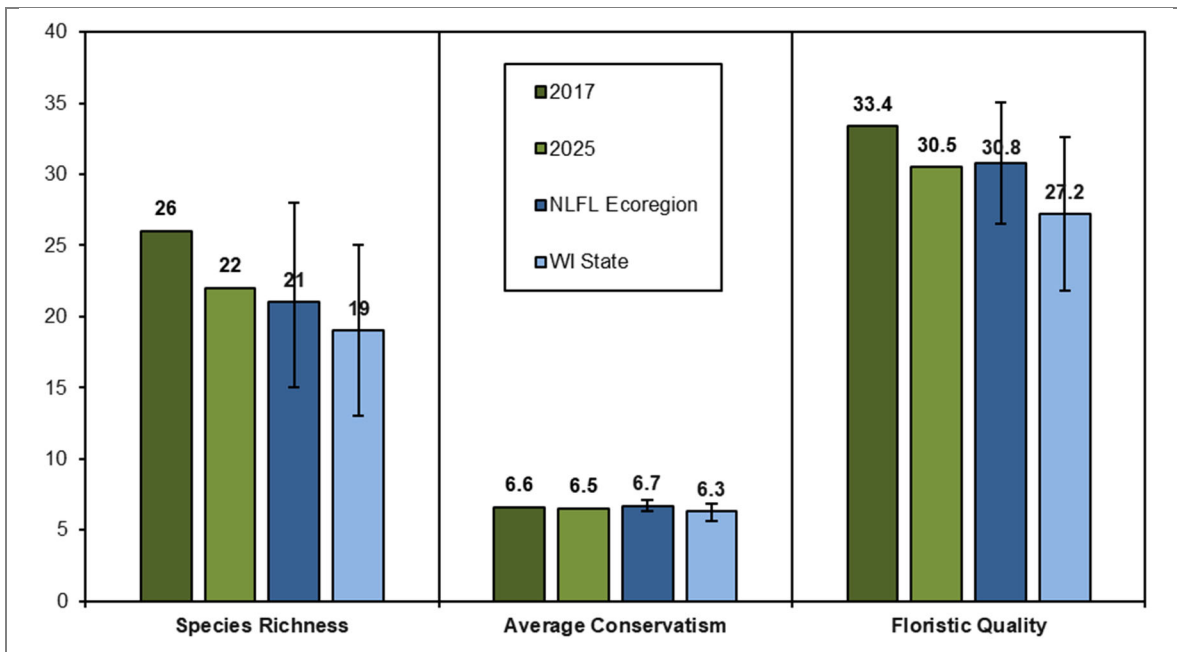


Figure 2.2-10. South Turtle Lake Floristic Quality Assessment. Created using data from point-intercept surveys. Analysis following Nichols (1999) where NLFL = Northern Lakes & Forests - Lakes Ecoregion.

Species Diversity

The Simpson’s Diversity Index value from South Turtle Lake is compared to data collected by Onterra and the WDNR Science Services on lakes within the Northern Lakes and Forests ecoregion and on lakes throughout Wisconsin (Figure 2.2-11). 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 South Turtle Lake’s diversity values rank. South Turtle Lake’s Simpson’s Diversity Index value was 0.90 in 2017, compared to 0.84 in 2025. The 2025 value falls below the median value for the ecoregion. This means that if two plants were randomly sampled from the lake there is a 84% probability that the two individuals would be of a different species.

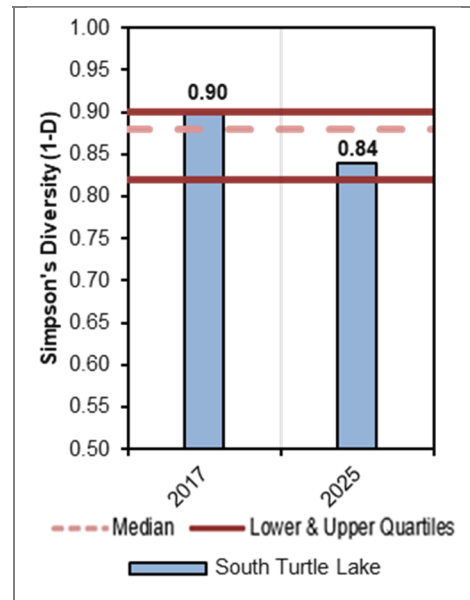


Figure 2.2-11. South Turtle Lake Simpson's Diversity Index. Created using data from point-intercept surveys.

One way to visualize the diversity of a lake’s plant community is to examine the relative frequency of occurrence of aquatic plant species. Relative frequency of occurrence is used to evaluate how often each plant species is encountered in relation to all the other species found. Figure 2.2-12 displays the relative frequency of occurrence of aquatic plant species from each of the point-intercept surveys in South Turtle Lake. These data indicate that some species such as fern-leaf

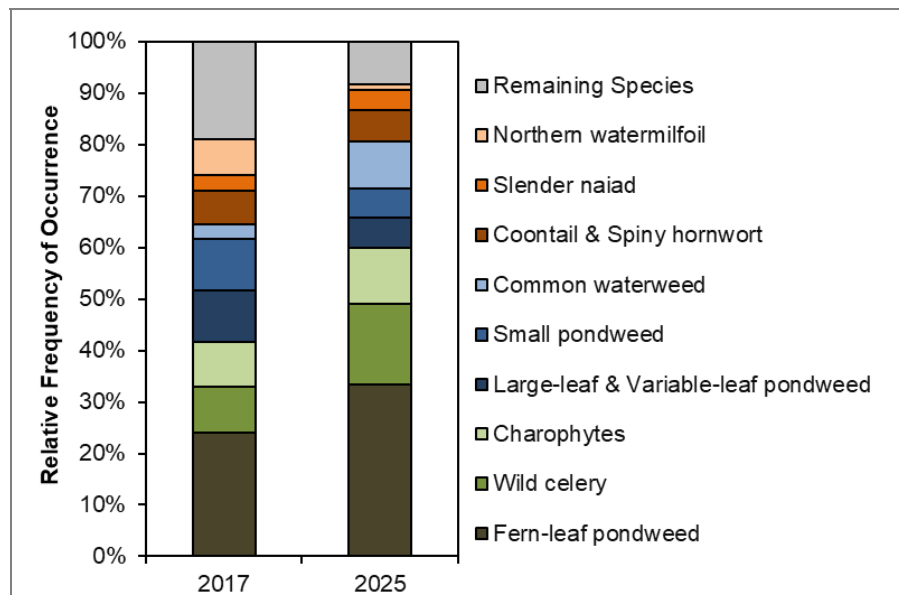


Figure 2.2-12. Relative frequency of occurrence of aquatic vegetation in South Turtle Lake. Created using data from 2017 and 2025 point-intercept surveys.

pondweed, wild celery and charophytes are comprised of a higher portion of the relative frequency in 2025 as compared to 2017, while small pondweed and the combination of large-leaf & variable-leaf pondweed have decreased. Overall, the aquatic plant composition in 2025 showed that three species comprised nearly 60% of the plant population compared to the same three species comprising 40% of the plant population in 2017.

Floating-leaf & Emergent Community Mapping

In 2025, Onterra ecologists replicated the emergent and floating-leaf aquatic plant community mapping survey in South Turtle Lake. South Turtle Lake’s emergent and floating-leaf aquatic plant community was delineated in 2017 and covered 23.4 acres of the lake. In 2025, 24.4 acres of these plant communities covered the lake. This shows a one acre increase and that these plant communities have remained relatively similar (Figure 2.2-13). The primary species that comprise these communities include floating-leaf bur-reed, white water lily, hardstem bulrush, and pickerelweed. (Map 4). The 2017-2025 community comparison map indicates the extents of the 2017 communities compared to the 2025 colonies and allows for determination of where colonies expanded or contracted between the two surveys (Map 5).

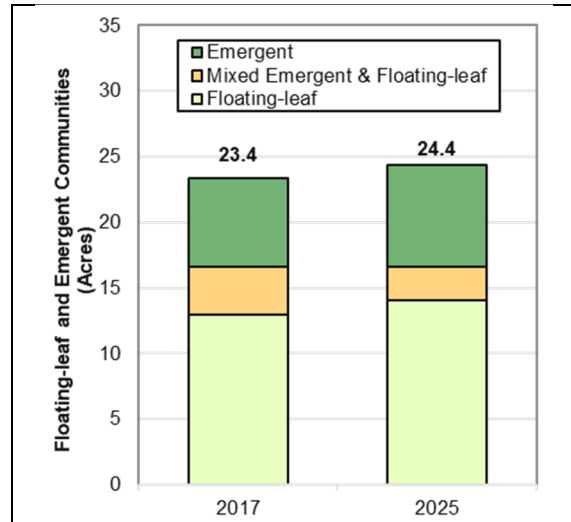


Figure 2.2-13. South Turtle Lake emergent and floating-leaf community acres.

Sweetflag (*Acorus calamus*), a non-native – naturalized emergent species, was observed in multiple locations in shallow water (approximately 1 foot) in South Turtle Lake. It is believed that this species was transported by native Americans west as a food source brought by the Europeans as European development was occurring in the eastern united states.

Rock Lake

A point-intercept survey was conducted by NLDC on Rock Lake in 2025. Analysis of those data can be found in separate reporting issued by NLDC.

Floating-leaf & Emergent Community Mapping

In 2025, Onterra ecologists also replicated the emergent and floating-leaf aquatic plant community mapping survey in Rock Lake (Map 7). Figure 2.2-14 illustrates that these communities have increased in areal coverage since they were first mapped by Onterra in 2017. When taking a closer look at the comparison of these two surveys, it can be observed that colonies that were not present on the 2017 survey had developed in areas on the eastern shoreline along with some expansions of existing colonies around the lake. In Rock Lake, these communities are primarily comprised of white water lily (*Nymphaea odorata*), floating-leaf bur-reed (*Sparganium fluctuans*), and hardstem bulrush (*Schoenoplectus acutus*). The 2017-2025 community comparison map indicates the extents of the 2017 communities compared to the 2025 colonies and allows for determination of where colonies expanded or contracted between the two surveys (Map 8).

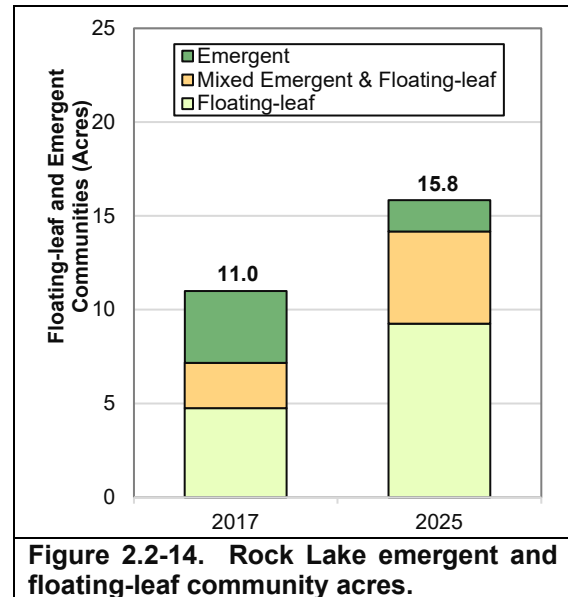
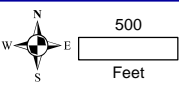
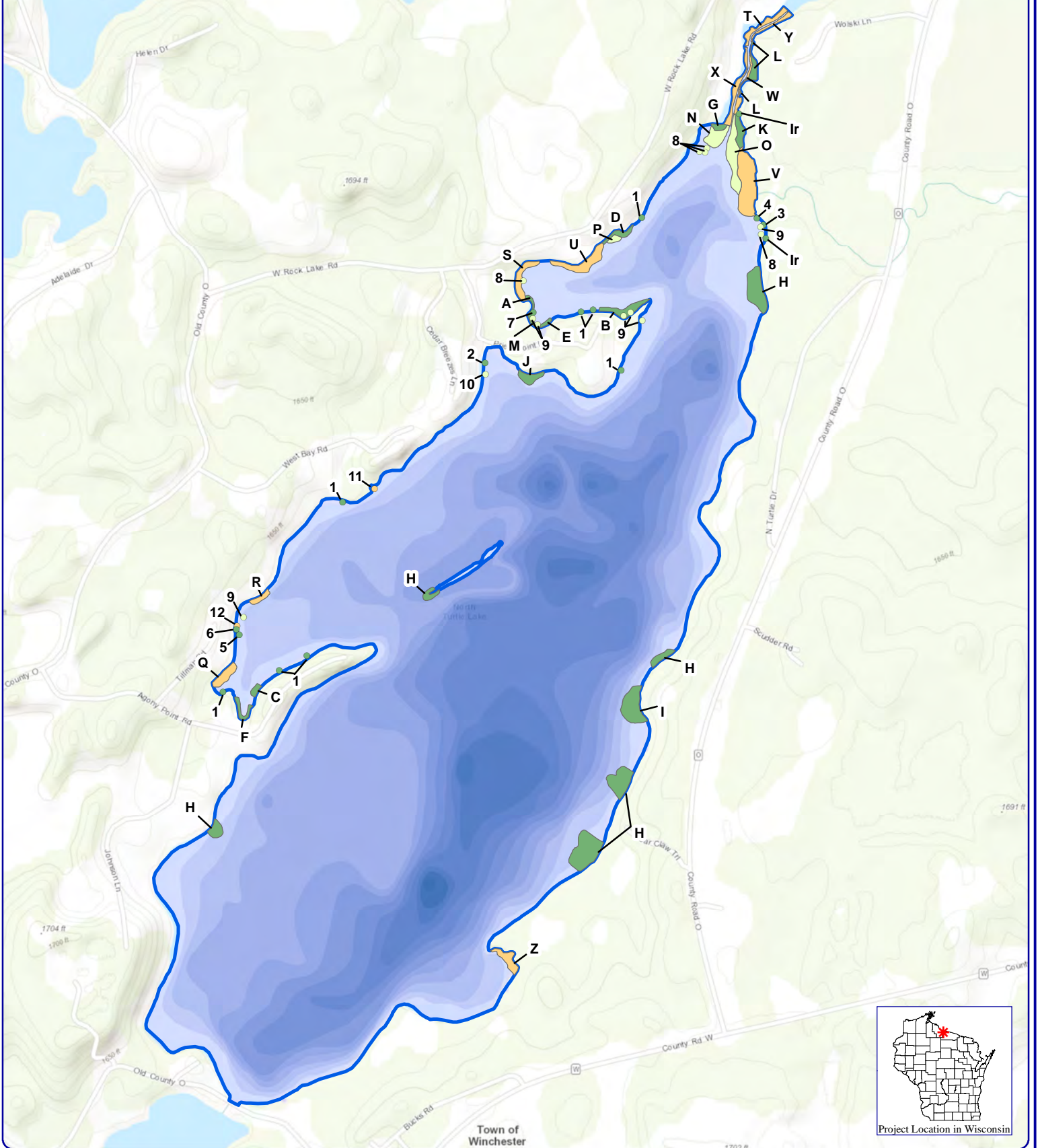


Figure 2.2-14. Rock Lake emergent and floating-leaf community acres.

Note: Species within lettered and numbered communities can be found in the table on the subsequent page



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 Lake Management Planning
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Sources
 Basemap: ESRI
 Hydro: WDNR
 Aquatic Plant Survey: Onterra, 2025
 Orthophotography: NAIP, 2025
 Map date: October 30, 2025 - LLC

Legend

Survey Results: (July 29, 31, 2025 & September 16, 2025)

- | Small Plant Communities | Large Plant Communities |
|--|--|
| ● Emergent | ■ Emergent |
| ● Floating-leaf | ■ Floating-leaf |
| ● Mixed Floating-leaf & Emergent | ■ Mixed Floating-leaf & Emergent |

Map 1
 North Turtle Lake
 Vilas County, Wisconsin
2025 Floating-Leaf & Emergent Plant Communities

North Turtle Lake 2025 Emergent & Floating-Leaf Plant Species
 Corresponding Community Polygons and Points are displayed on North Turtle Lake- Map 1

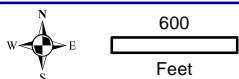
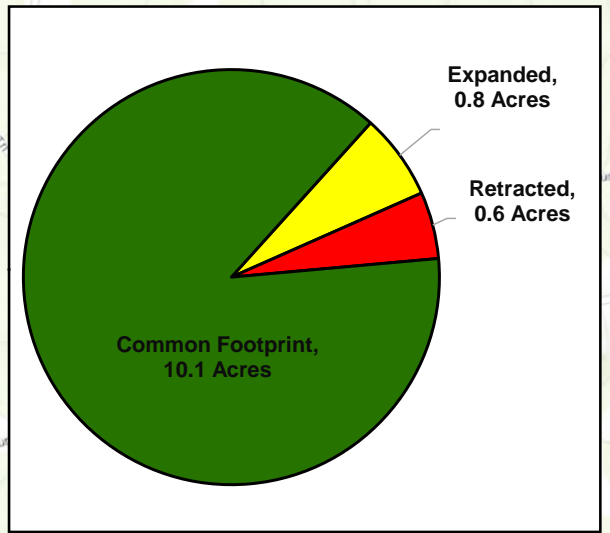
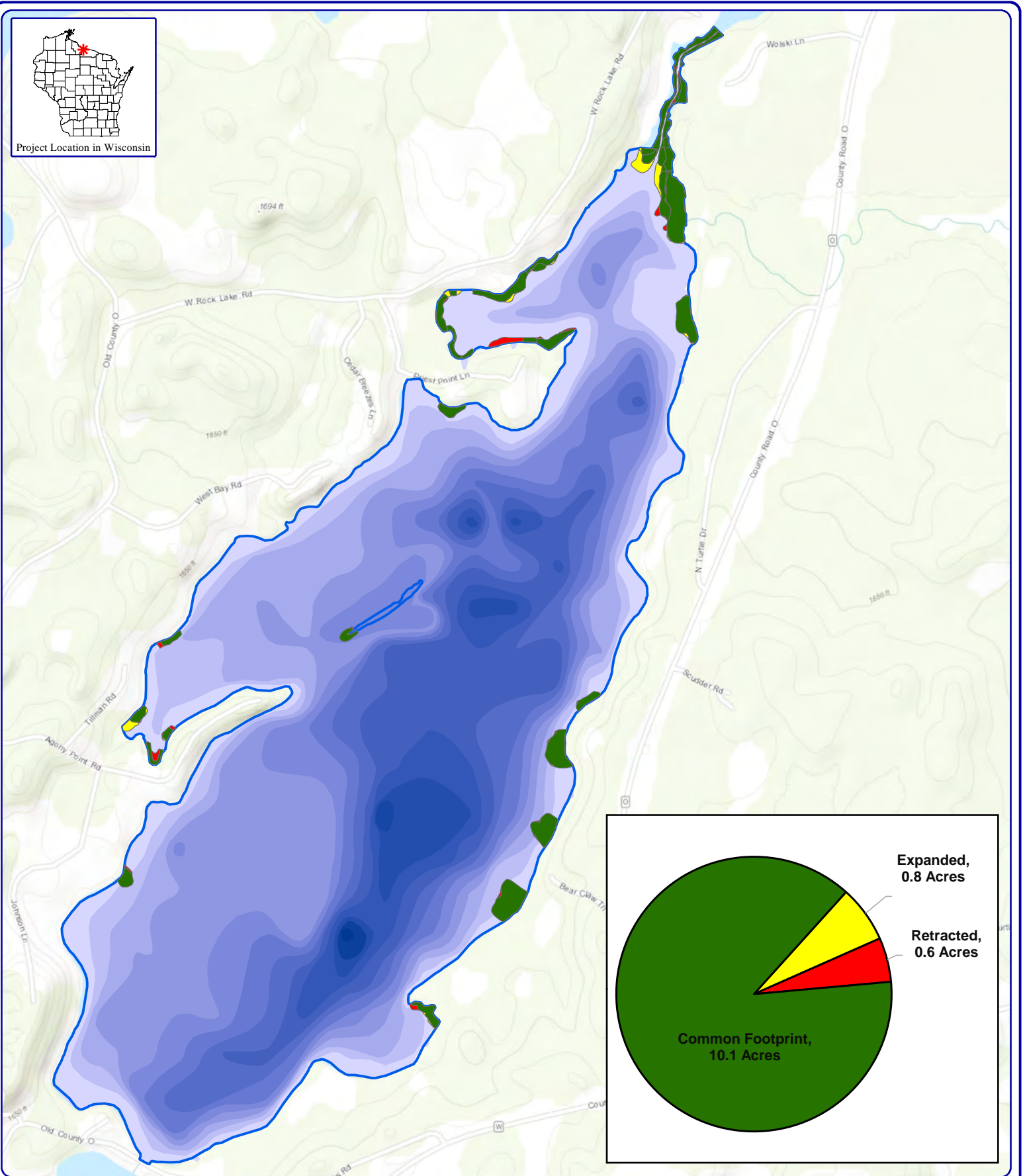
Large Plant Community (Polygons)										
Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Species 9	Acres
A	Bur-reed sp. (sterile)	Pickerelweed								1.30
B	Bur-reed sp. (sterile)	Misc. Wetland Species	Grass sp. (sterile)	Pickerelweed						1.04
C	Bur-reed sp. (sterile)									0.77
D	Bur-reed sp. (sterile)	Pickerelweed	Grass sp. (sterile)							0.77
E	Bur-reed sp. (sterile)	Pickerelweed								0.77
F	Bur-reed sp. (sterile)	Pickerelweed	Common arrowhead							0.64
G	Creeping spikerush									0.58
H	Hardstem bulrush									2.12
I	Hardstem bulrush	Creeping spikerush								0.28
J	Hardstem bulrush	Creeping spikerush								0.26
K	Pickerelweed	Hardstem bulrush	Bur-reed sp. (sterile)	Water-willow						0.25
L	Sedge sp. (sterile)	Misc. Wetland Species								0.60
M	Water-willow	Bur-reed sp. (sterile)								0.17
Floating-leaf	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Species 9	Acres
N	Floating-leaf bur-reed	White water lily								0.15
O	Floating-leaf bur-reed	White water lily	Spatterdock							0.15
P	Spatterdock									0.14
Floating-leaf & Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Species 9	Acres
Q	Bur-reed sp. (sterile)	Pickerelweed	Spatterdock	White water lily	Grass sp. (sterile)	Sedge sp. (sterile)				0.14
R	Bur-reed sp. (sterile)	Spatterdock	Creeping spikerush	Pickerelweed						0.14
S	Bur-reed sp. (sterile)	Water-willow	Spatterdock	Floating-leaf bur-reed						0.10
T	Grass sp. (sterile)	Bur-reed sp. (sterile)	Pickerelweed	Misc. Wetland Species	Water-willow	Floating-leaf bur-reed	White water lily			0.10
U	Pickerelweed	Grass sp. (sterile)	Spatterdock	Bur-reed sp. (sterile)	Misc. Wetland Species	Floating-leaf bur-reed				0.09
V	Pickerelweed	Spatterdock	American bur-reed	Floating-leaf bur-reed	White water lily					0.09
W	Pickerelweed	Spatterdock	Floating-leaf bur-reed	White water lily	Water-willow	Watershield	Arrowhead sp. (sterile)	Cattail sp.		0.06
X	Pickerelweed	Water-willow	Misc. Wetland Species	Cattail sp.	White water lily	Bur-reed sp. (sterile)	Grass sp. (sterile)	Spatterdock	Creeping spikerush	0.06
Y	Sedge sp. (sterile)	Pickerelweed	Floating-leaf bur-reed	Water horsetail	Bur-reed sp. (sterile)	Cattail sp.	Misc. Wetland Species	Water-willow		0.01
Z	Spatterdock	American bur-reed	Bur-reed sp. (sterile)	Cattail sp.	Grass sp. (sterile)	Common arrowhead				0.00

Small Plant Community (Points)				
Emergent	Species 1	Species 2	Species 3	Species 4
1	Bur-reed sp. (sterile)			
2	Bur-reed sp. (sterile)	Pickerelweed	Common arrowhead	
3	Bur-reed sp. (sterile)	Pickerelweed	Common arrowhead	Cattail sp.
4	Common arrowhead			
5	Creeping spikerush			
6	Pickerelweed			
7	Spatterdock			
lr	Iris sp.			
Floating-leaf	Species 1	Species 2	Species 3	Species 4
8	Floating-leaf bur-reed			
9	Spatterdock			
10	White water lily			
Floating-leaf & Emergent	Species 1	Species 2	Species 3	Species 4
11	Bur-reed sp. (sterile)	Spatterdock		
12	Bur-reed sp. (sterile)	Spatterdock	Sedge sp. (sterile)	

Species are listed in order of dominance within the community. Bolded species were the most abundant in the community while not bolded species were simply present; Scientific names can be found in the species list in Table 3.1.1-1






Project Location in Wisconsin



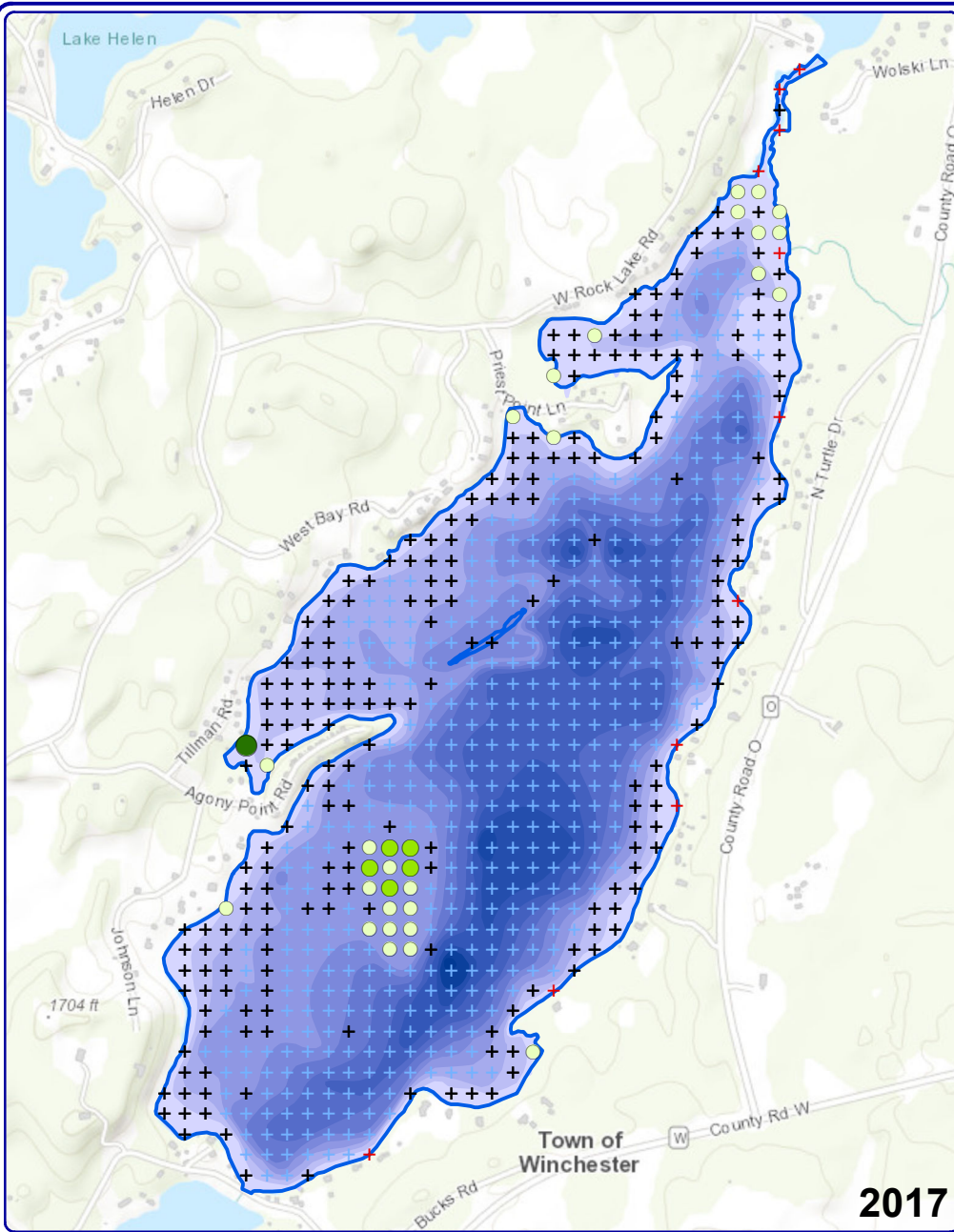
Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Aquatic Plants Surveys: Onterra, 2017, 2025
Bathymetry: Onterra
Basemap: ESRI
Map date: December 20, 2025 - RMF

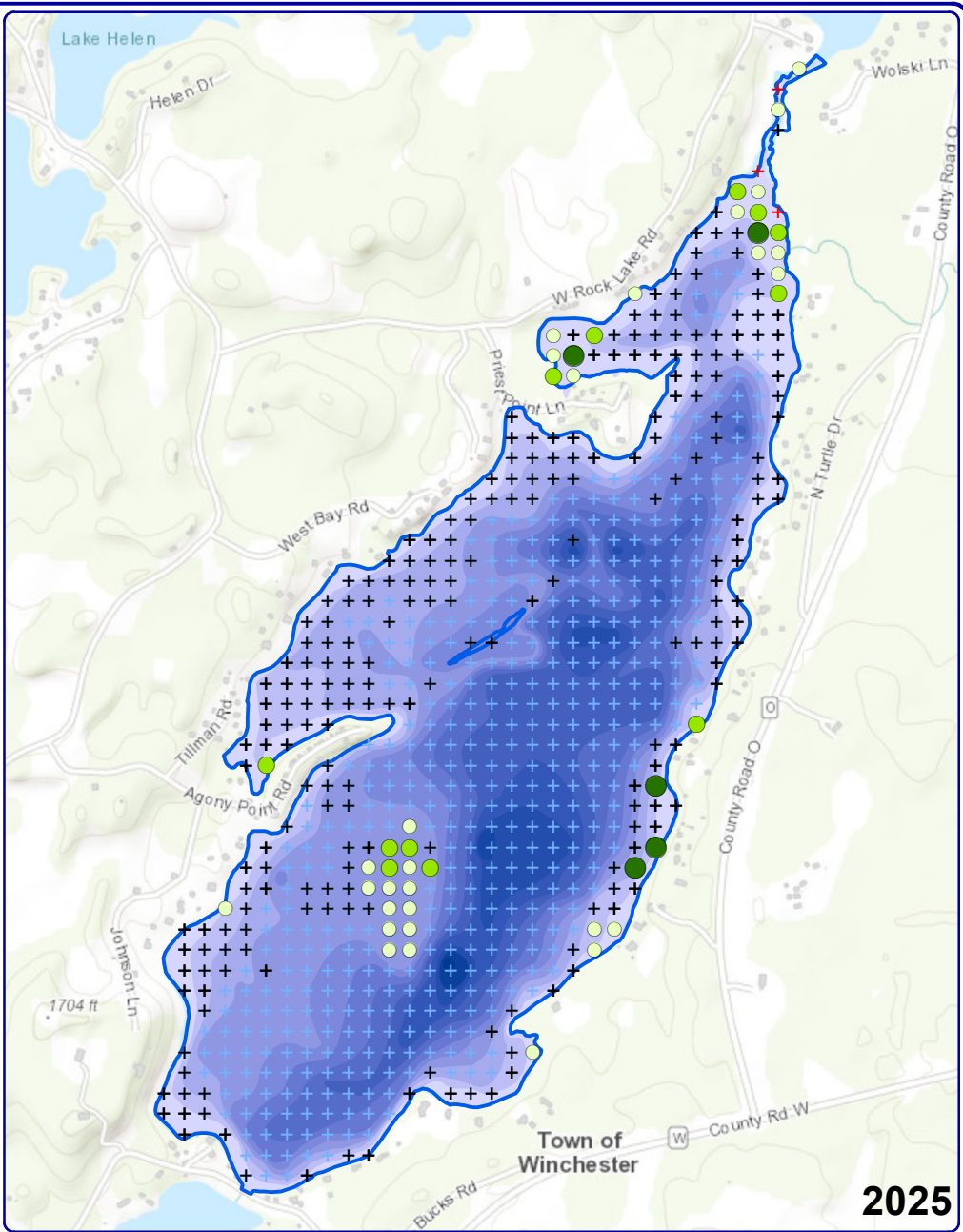
Legend
Large Plant Communities

-  Common Footprint
-  Expanded
-  Retracted

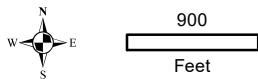
Map 2
North Turtle Lake
Vilas County, Wisconsin
**2017-2025 Aquatic
Plant Communities
Comparison**



2017



2025



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 Lake Management Planning
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 www.onterra-eco.com

Sources:
 Hydro and Roads: WDNR
 Bathymetry: WDNR, digitized by Onterra
 Aquatic Plant Survey: Onterra, 2017 & 2025
 Map Date: December 31, 2025 - RMF

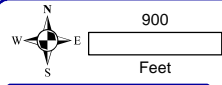
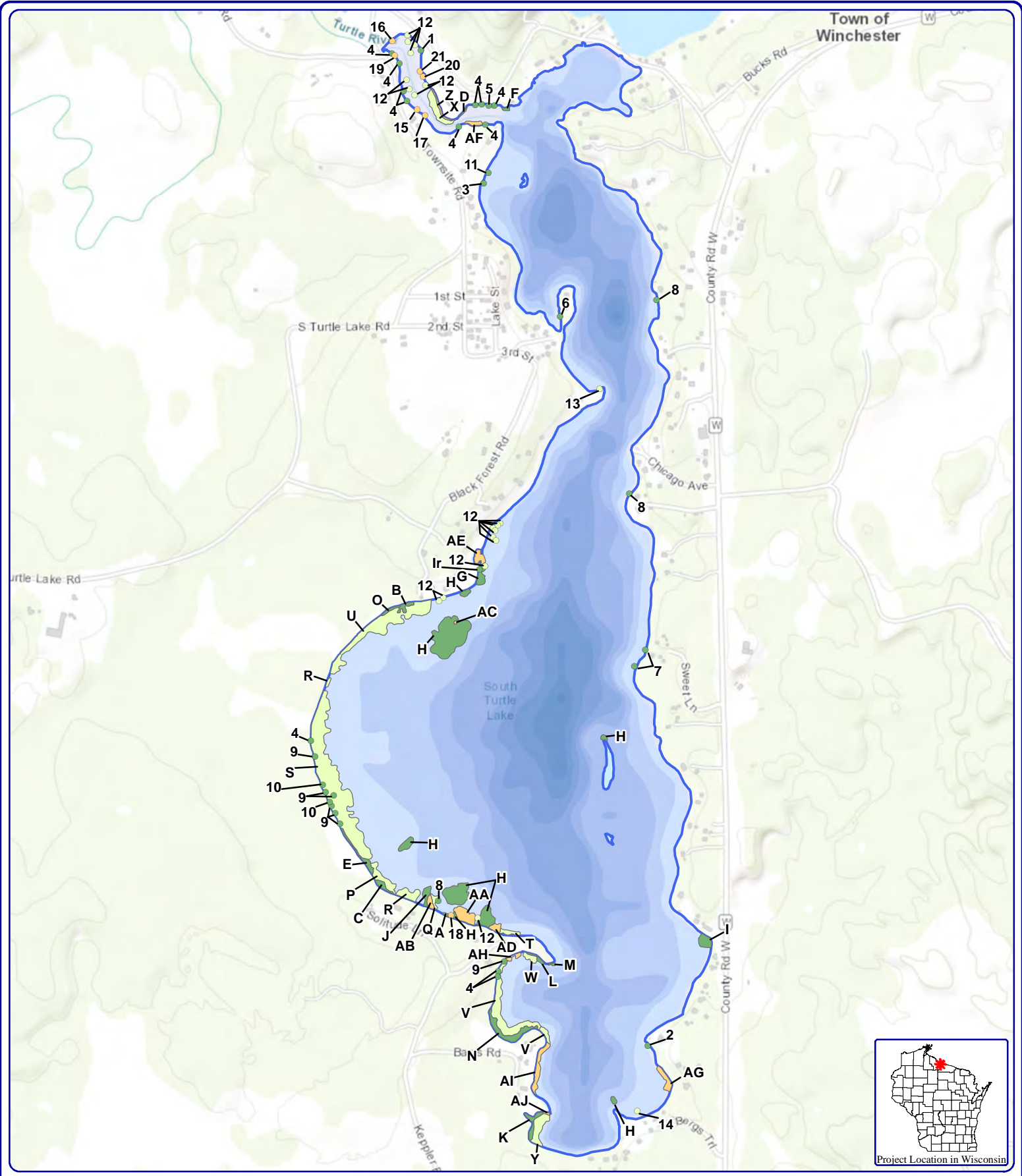


Project Location in Wisconsin

Legend

- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3
- + No Vegetation
- + Non-Navigable
- + Deep - No Vegetation

Map 3
 North Turtle
 Vilas County, Wisconsin
PI Survey:
Aquatic Vegetation
Distribution Compare



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 www.onterra-eco.com

Sources
 Basemap: ESRI
 Hydro & Bathymetry: WDNR, Digitized by Onterra
 Aquatic Plant Survey: Onterra, 2025
 Map date: October 29, 2025 - RMF

Legend
 Survey Results: (July 31, 2025)

Small Plant Communities	Large Plant Communities
● Emergent	■ Emergent
■ Floating-leaf	■ Floating-leaf
■ Mixed Floating-leaf & Emergent	■ Mixed Floating-leaf & Emergent

Map 4
 South Turtle Lake
 Vilas County, Wisconsin
**2025 Floating-Leaf
 & Emergent Plant
 Communities**

South Turtle 2025 Emergent & Floating-Leaf Plant Species
 Corresponding Community Polygons and Points are displayed on South Turtle Lake - Map 1

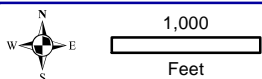
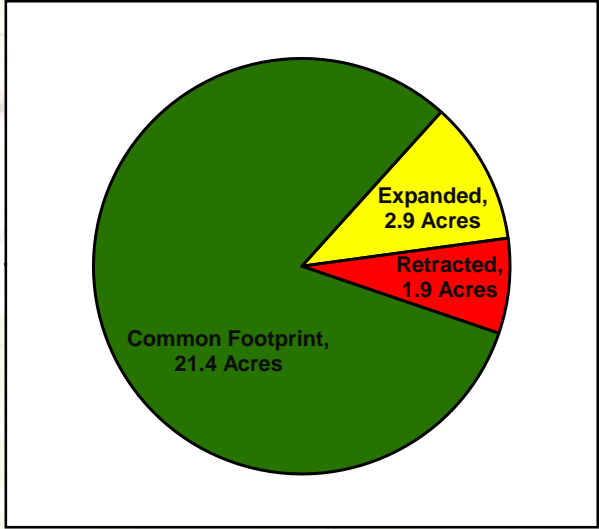
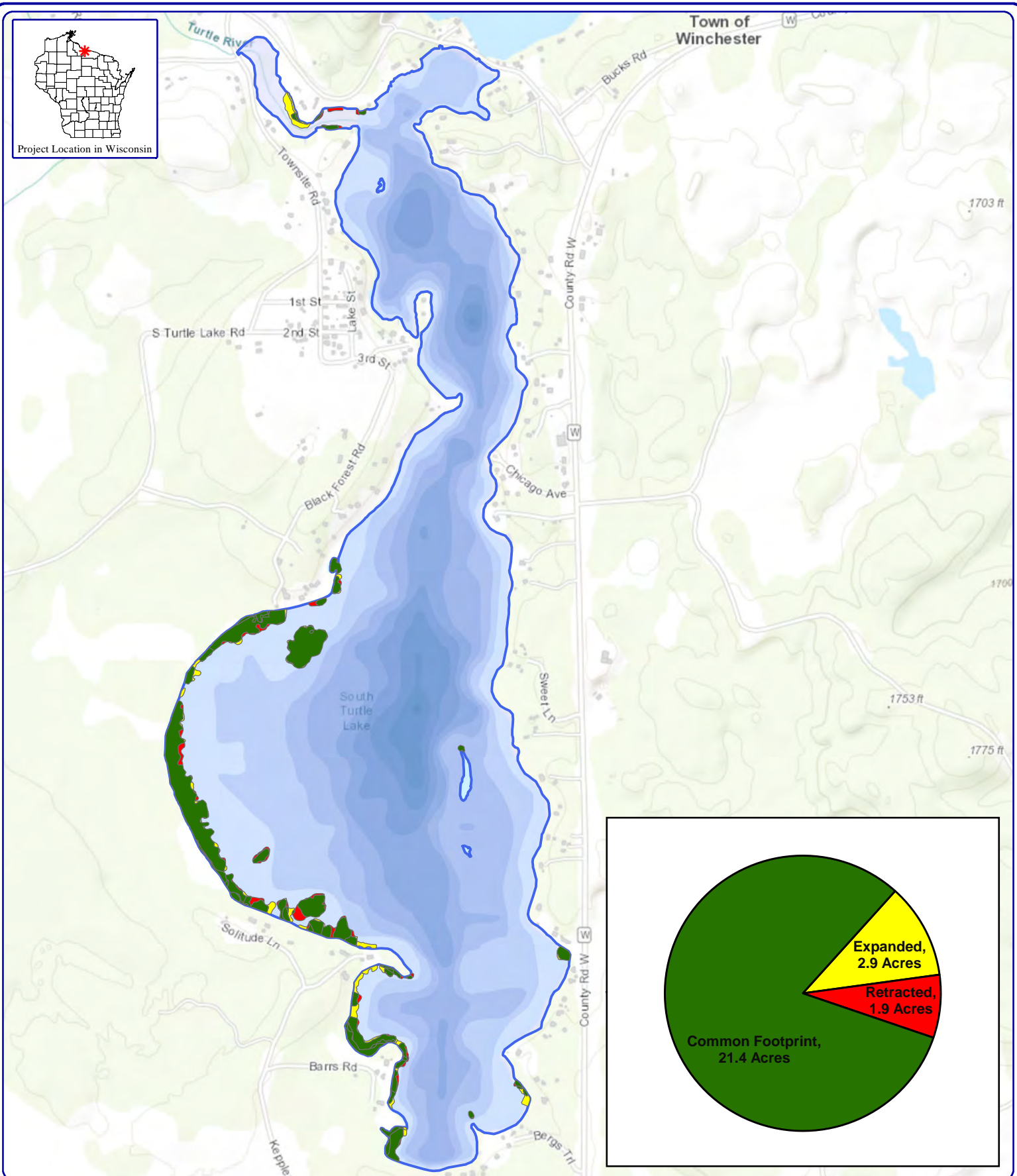
Large Plant Community (Polygons)									
Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Acres
A	American bur-reed								0.05
B	American bur-reed	Pickerelweed	Common arrowhead						0.18
C	American bur-reed	Spatterdock	White water lily						0.17
D	Bristly sedge	Bur-reed sp. (sterile)							0.04
E	Bur-reed sp. (sterile)	Broad-leaved cattail	Pickerelweed						0.29
F	Creeping spikerush								0.06
G	Creeping spikerush	Pickerelweed							0.29
H	Hardstem bulrush								4.94
I	Hardstem bulrush	Broad-leaved cattail							0.33
J	Hardstem bulrush	Pickerelweed							0.24
K	Misc. Wetland Species	Bur-reed sp. (sterile)	Sweetflag	Bristly sedge	Common arrowhead	Water horsetail			0.29
L	Pickerelweed	Broad-leaved cattail	Bur-reed sp. (sterile)	Water horsetail	Three-way sedge	Common arrowhead			0.11
M	Pickerelweed	Sweetflag	Three-way sedge	Bur-reed sp. (sterile)	Sedge sp. (sterile)				0.03
N	Pickerelweed	Water horsetail	Cattail sp.	Three-way sedge	Bur-reed sp. (sterile)				0.69
O	Water willow								0.09
Floating-leaf	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Acres
P	Hardstem bulrush	Broad-leaved cattail							0.57
Q	Hardstem bulrush	Pickerelweed							0.16
R	Misc. Wetland Species	Bur-reed sp. (sterile)	Sweetflag	Bristly sedge	Common arrowhead	Water horsetail			0.53
S	Pickerelweed	Broad-leaved cattail	Bur-reed sp. (sterile)	Water horsetail	Three-way sedge	Common arrowhead			6.47
T	Pickerelweed	Sweetflag	Three-way sedge	Bur-reed sp. (sterile)	Sedge sp. (sterile)				0.18
U	Pickerelweed	Water horsetail	Cattail sp.	Three-way sedge	Bur-reed sp. (sterile)				2.80
V	Water willow								1.87
W	Floating-leaf bur-reed	Spatterdock	White water lily						0.19
X	Floating-leaf bur-reed	Watershield	White water lily						0.62
Y	Floating-leaf bur-reed	White water lily	Spatterdock						0.69
Floating-leaf & Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Acres
Z	Bur-reed sp. (sterile)	White water lily	Bristly sedge	Watershield	Sweetflag				0.13
AA	Hardstem bulrush	Spatterdock	Floating-leaf bur-reed	Watershield					0.60
AB	Hardstem bulrush	Watershield							0.16
AC	Hardstem bulrush	White water lily							0.02
AD	Hardstem bulrush	White water lily	Pickerelweed	Spatterdock					0.18
AE	Pickerelweed	White water lily	Hardstem bulrush	Bur-reed sp. (sterile)	Floating-leaf bur-reed				0.27
AF	White water lily	Bur-reed sp. (sterile)	Sweetflag						0.14
AG	White water lily	Bur-reed sp. (sterile)	Watershield	Floating-leaf bur-reed	Pickerelweed	Water horsetail	Bristly sedge	Common arrowhead	0.32
AH	White water lily	Cattail sp.	Bur-reed sp. (sterile)						0.12
AI	White water lily	Spatterdock	Bur-reed sp. (sterile)	Spatterdock	Common arrowhead	Watershield	Bristly sedge		0.52
AJ	White water lily	Water horsetail	Bur-reed sp. (sterile)	Common arrowhead	Bristly sedge	Sweetflag			0.03

Small Plant Community (Points)				
Emergent	Species 1	Species 2	Species 3	Species 4
1	Bristly sedge	Bur-reed sp. (sterile)		
2	Broad-leaved cattail			
3	Broad-leaved cattail	Bur-reed sp. (sterile)	Sweetflag	
4	Bur-reed sp. (sterile)			
5	Bur-reed sp. (sterile)	Common arrowhead		
6	Bur-reed sp. (sterile)	Water horsetail	Bristly sedge	
7	Creeping spikerush			
8	Hardstem bulrush			
9	Pickerelweed			
10	Pickerelweed	Bur-reed sp. (sterile)		
11	Sweetflag			
1r	Iris sp. (sterile)			
Floating-leaf	Species 1	Species 2	Species 3	Species 4
12	White water lily			
13	White water lily	Spatterdock		
14	White water lily	Watershield		
Floating-leaf & Emergent	Species 1	Species 2	Species 3	Species 4
15	Bur-reed sp. (sterile)	Pickerelweed	Broad-leaved cattail	White water lily
16	Bur-reed sp. (sterile)	Bristly sedge	White water lily	
17	Bur-reed sp. (sterile)	White water lily	Bristly sedge	
18	Spatterdock	Hardstem bulrush	Pickerelweed	American bur-reed
19	White water lily	Spatterdock	Bur-reed sp. (sterile)	
20	White water lily	Bristly sedge	Bur-reed sp. (sterile)	
21	White water lily	Bur-reed sp. (sterile)		

Species are listed in order of dominance within the community. Bolded species were the most abundant in the community while not bolded species were simply present. Scientific names can be found in the species list in Table 3.1.2-1



Project Location in Wisconsin



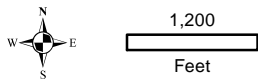
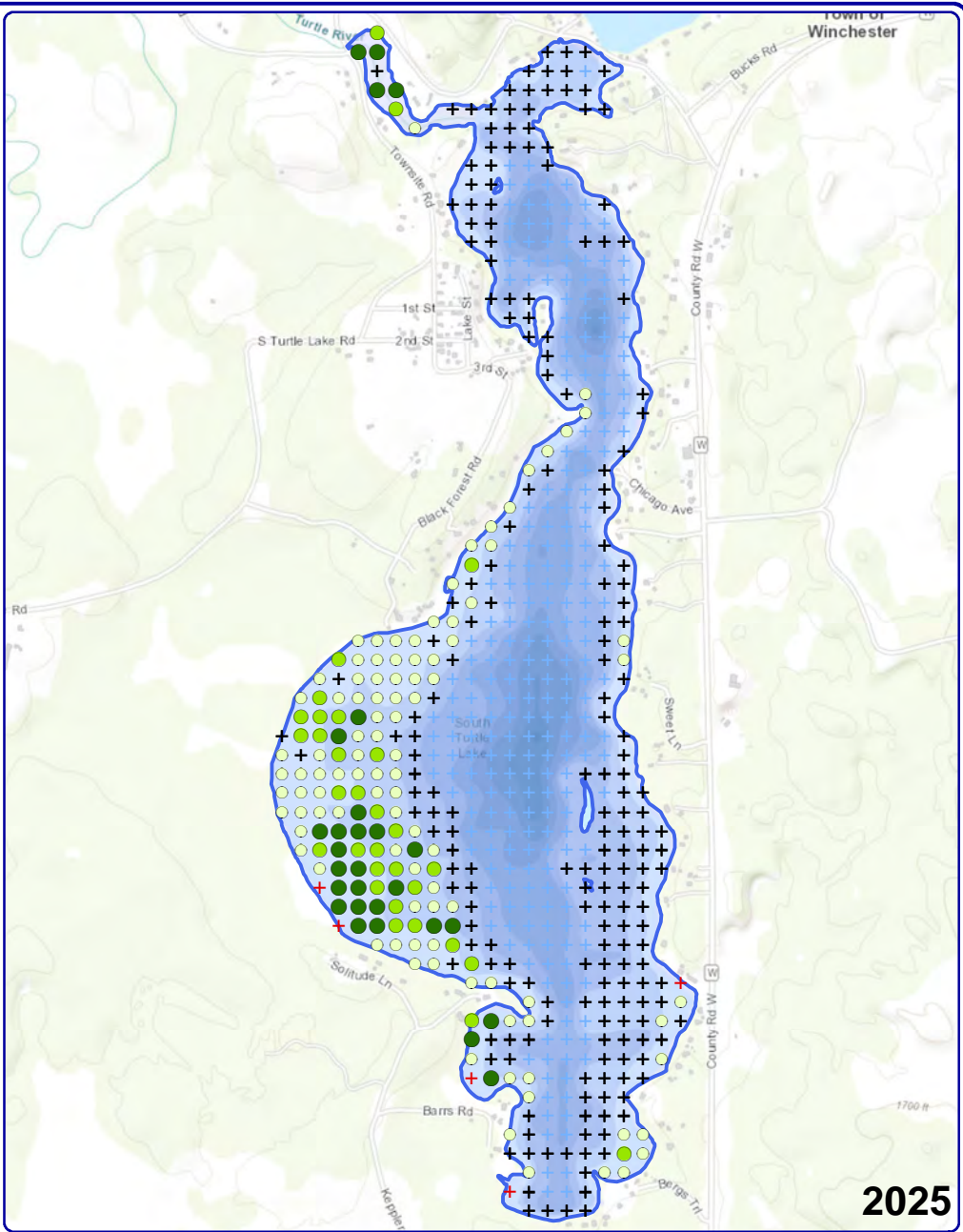
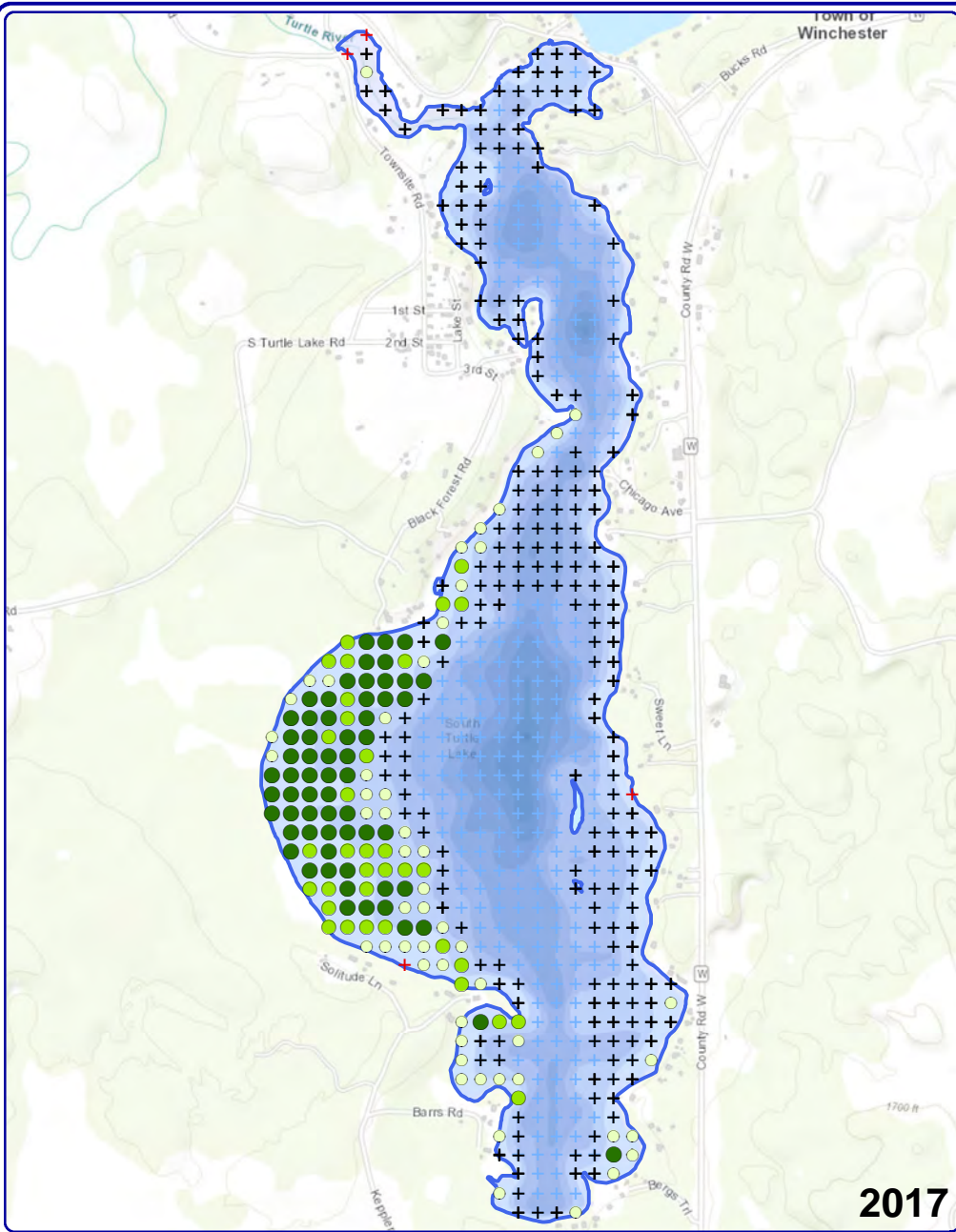
Onterra LLC
 Lake Management Planning
 815 Prosper Road
 De Pere, WI 54115
 920.338.8860
 www.onterra-eco.com

Sources:
 Hydro: WDNR
 Aquatic Plants Surveys: Onterra, 2017, 2025
 Bathymetry: Onterra
 Basemap: ESRI
Map date: December 20, 2025 - RMF

Legend
Large Plant Communities

- Common Footprint
- Expanded
- Retracted

Map 5
South Turtle Lake
 Vilas County, Wisconsin
2017-2025 Aquatic
Plant Communities
Comparison



Onterra LLC
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 De Pere, WI 54115
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 www.onterra-eco.com

Sources:
 Hydro and Roads: WDNR
 Bathymetry: WDNR, digitized by Onterra
 Aquatic Plant Survey: Onterra, 2017 & 2025
 Map Date: December 31, 2025 - RMF



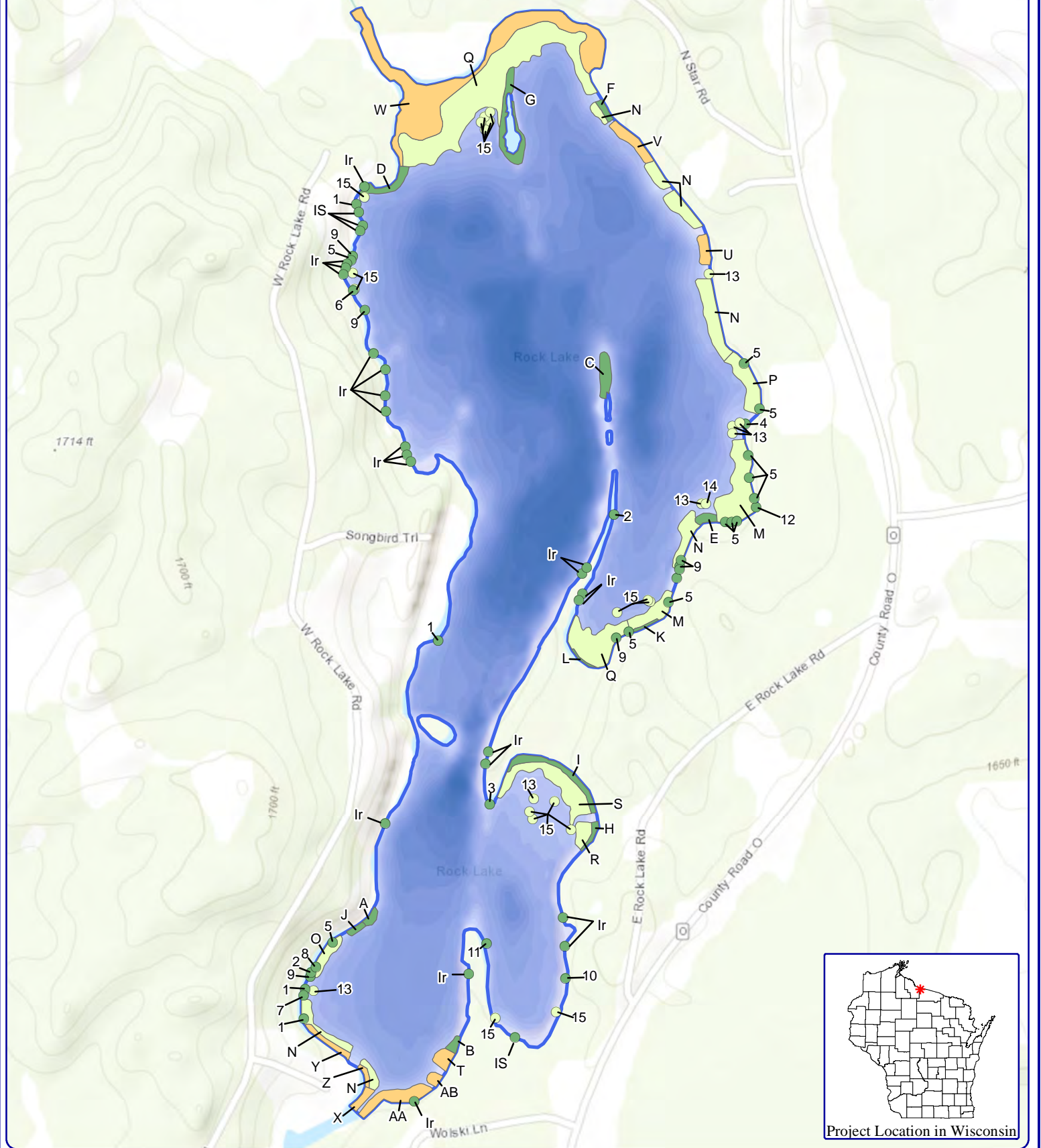
Project Location in Wisconsin

Legend

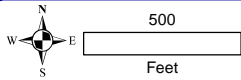
- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3
- + No Vegetation
- + Non-Navigable
- + Deep - No Vegetation

Map 6
South Turtle Lake
 Vilas County, Wisconsin
PI Survey:
Aquatic Vegetation
Distribution Compare

Note: Species within lettered and numbered communities can be found in the table on the subsequent page



Project Location in Wisconsin



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Sources
 Basemap: ESRI
 Hydro: WDNR
 Aquatic Plant Survey: Onterra, 2025
 Orthophotography: NAIP, 2022
 Map date: November 7, 2025 - LLC

Legend

Survey Results: (September 16, 2025)

- | Small Plant Communities | Large Plant Communities |
|---|--|
| ● Emergent | ■ Emergent |
| ● Floating-leaf | ■ Floating-leaf |
| ● Mixed Floating-leaf & Emergent (None) | ■ Mixed Floating-leaf & Emergent |

Map 7
 Rock Lake
 Vilas County, Wisconsin
2025 Aquatic Plant Communities

Rock Lake 2025 Emergent & Floating-Leaf Plant Species
 Corresponding Community Polygons and Points are displayed on Rock Lake - Map 1

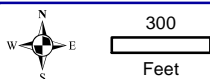
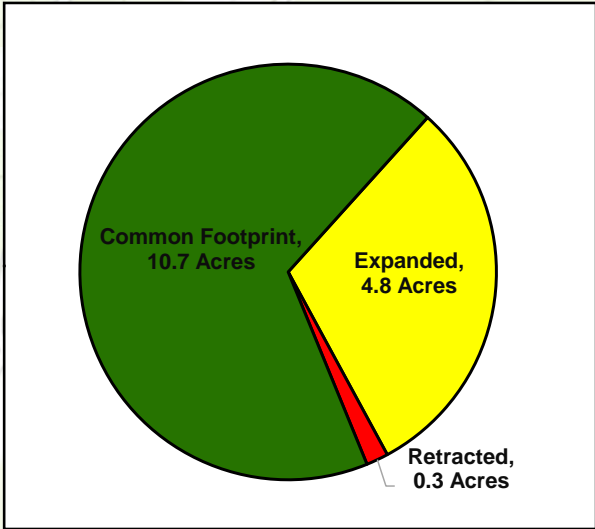
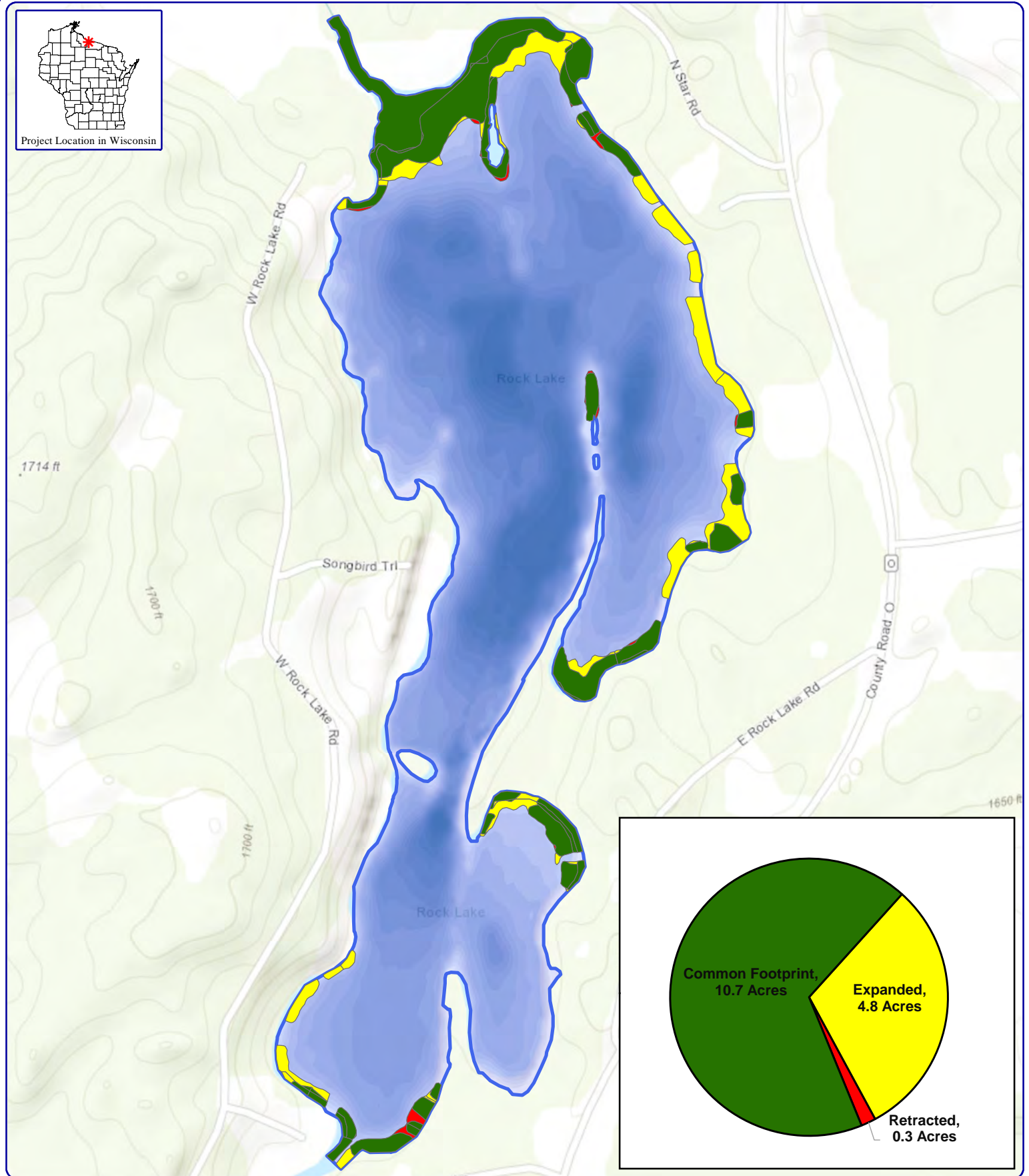
Large Plant Community (Polygons)									
Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Acres
A	Bur-reed sp. (sterile)								0.07
B	Common bur-reed	Pickerelweed							0.07
C	Creeping spikerush								0.24
D	Hardstem bulrush								0.21
E	Hardstem bulrush	Creeping spikerush							0.09
F	Hardstem bulrush	Pickerelweed							0.07
G	Hardstem bulrush	Pickerelweed	Bur-reed sp. (sterile)						0.41
H	Pickerelweed	Water smartweed	Bur-reed sp. (sterile)	Sedge sp. (sterile)					0.07
I	Pickerelweed	Water-willow	Sedge sp. (sterile)	Bur-reed sp. (sterile)	Common arrowhead				0.32
J	Sedge sp. (Sterile)								0.06
K	Sedge sp. (Sterile)	Pickerelweed							0.03
L	Water-willow	Pickerelweed							0.03
Floating-leaf	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Acres
M	Floating-leaf bur-reed	White water lily	Spatterdock	Watershield					1.36
N	Floating-leaf bur-reed	White water lily							1.83
O	Floating-leaf bur-reed	White water lily	Spatterdock						0.23
P	White water lily	Floating-leaf bur-reed							0.47
Q	White water lily	Floating-leaf bur-reed	Spatterdock	Watershield					4.36
R	White water lily	Spatterdock	Floating-leaf bur-reed						0.18
S	White water lily	Spatterdock	Floating-leaf bur-reed						0.82
Floating-leaf & Emergent	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7	Species 8	Acres
T	Floating-leaf bur-reed	White water lily	Pickerelweed	Creeping spikerush					0.15
U	Floating-leaf bur-reed	White water lily	Pickerelweed						0.16
V	Hardstem bulrush	Floating-leaf bur-reed	White water lily	Sedge sp. (sterile)	Cattail sp.				0.27
W	Hardstem bulrush	Pickerelweed	Water-willow	Bur-reed sp. (sterile)	White water lily	Floating-leaf bur-reed	Sedge sp. (sterile)	Cattail sp.	3.16
X	Pickerelweed	Sedge sp. (sterile)	Cattail sp.	White water lily	Floating-leaf bur-reed	Bur-reed sp. (sterile)	Water horsetail	Grass sp. (sterile)	0.11
Z	Water horsetail	Pickerelweed	Floating-leaf bur-reed	White water lily	Bur-reed sp. (sterile)	Sedge sp. (sterile)			0.56
AA	Water horsetail	Sedge sp. (sterile)	Bur-reed sp. (sterile)	Pickerelweed	White water lily	Spatterdock	Floating-leaf bur-reed	Cattail sp.	0.43
AB	Water horsetail	Sedge sp. (sterile)	Floating-leaf bur-reed	Pickerelweed	White water lily	Common arrowhead			0.08

Small Plant Community (Points)			
Emergent	Species 1	Species 2	Species 3
1	Bur-reed sp. (sterile)		
2	Cattail sp.		
3	Creeping spikerush	Sedge sp. (sterile)	
4	Hardstem bulrush	Pickerelweed	Creeping spikerush
5	Pickerelweed		
6	Pickerelweed	Sedge sp. (sterile)	
7	Pickerelweed	Bur-reed sp. (sterile)	
8	Pickerelweed	Sedge sp. (sterile)	
9	Sedge sp. (sterile)		
10	Sedge sp. (sterile)	Creeping spikerush	
11	Spatterdock		
12	Water-willow	Pickerelweed	
1r	Iris sp. (sterile)		
Floating-leaf	Species 1	Species 2	Species 3
13	Floating-leaf bur-reed		
14	Floating-leaf bur-reed	White water lily	
15	White water lily		

Species are listed in order of dominance within the community. Bolded species were the most abundant in the community while not bolded species were simply present. Scientific names can be found in the species list in Table 3.2-1.



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Sources:
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Bathymetry: Onterra
Basemap: ESRI
Map date: December 20, 2025 - RMF

Legend
Large Plant Communities

- Common Footprint
- Expanded
- Retracted

Map 8
Rock Lake
Vilas County, Wisconsin
**2017-2025 Aquatic
Plant Communities
Comparison**

A

APPENDIX A

Aquatic Plant Data

North Turtle Lake 2017 & 2025 Point-Intercept Surveys - Littoral Frequency of Occurrence

Scientific Name	Common Name	LFOO (%)		2017-2025	
		2017	2025	% Change	Direction
<i>Chara spp.</i>	Muskgrasses	8.7	9.1	4.5	▲
<i>Vallisneria americana</i>	Wild celery	10.9	6.8	-37.3	▼
<i>Potamogeton gramineus</i>	Variable-leaf pondweed	8.7	4.5	-47.7	▼
<i>Potamogeton amplifolius</i>	Large-leaf pondweed	2.9	6.1	109.1	▲
<i>Najas flexilis</i>	Slender naiad	0.7	4.5	527.3	▲
<i>Isoetes spp.</i>	Quillwort spp.	6.5	1.5	-76.8	▼
<i>Schoenoplectus acutus</i>	Hardstem bulrush	1.4	3.8	161.4	▲
<i>Utricularia vulgaris</i>	Common bladderwort	0.0	3.0		▲
<i>Nuphar variegata</i>	Spatterdock	1.4	2.3	56.8	▲
<i>Myriophyllum alterniflorum</i>	Alternate-flowered watermilfoil	0.0	3.0		▲
<i>Elodea canadensis</i>	Common waterweed	0.0	3.0		▲
<i>Sparganium sp.</i>	Bur-reed sp.	0.0	2.3		▲
<i>Potamogeton robbinsii</i>	Fern-leaf pondweed	0.7	1.5	109.1	▲
<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	0.7	1.5	109.1	▲
<i>Sparganium fluctuans</i>	Floating-leaf bur-reed	0.0	1.5		▲
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	0.0	1.5		▲
<i>Nitella spp.</i>	Stoneworts	1.4	0.8	-47.7	▼
<i>Bidens beckii</i>	Water marigold	2.9	0.0	-100.0	▼
<i>Myriophyllum tenellum</i>	Dwarf watermilfoil	0.7	0.8	4.5	▲
<i>Potamogeton berchtoldii</i>	Slender pondweed	0.0	0.8		▲
<i>Brasenia schreberi</i>	Watershield	0.0	0.8		▲
<i>Sparganium americanum</i>	American bur-reed	0.7	0.0	-100.0	▼
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	0.7	0.0	-100.0	▼
<i>Ceratophyllum demersum</i>	Coontail	0.7	0.0	-100.0	▼

South Turtle Lake 2017 & 2025 Point-Intercept Surveys - Littoral Frequency of Occurrence

Scientific Name	Common Name	LFOO (%)		2017-2025	
		2017	2025	% Change	Direction
<i>Potamogeton robbinsii</i>	Fern-leaf pondweed	34.8	35.7	2.6	▲
<i>Vallisneria americana</i>	Wild celery	13.0	16.8	29.6	▲
<i>Potamogeton pusillus</i>	Small pondweed	14.6	6.1	-58.3	▼
<i>Elodea canadensis</i>	Common waterweed	4.0	10.0	147.0	▲
<i>Chara spp.</i>	Muskgrasses	8.5	7.9	-7.6	▼
<i>Ceratophyllum demersum</i>	Coontail	8.9	6.4	-27.8	▼
<i>Potamogeton amplifolius</i>	Large-leaf pondweed	9.3	3.6	-61.6	▼
<i>Najas flexilis</i>	Slender naiad	4.5	4.3	-3.8	▼
<i>Nitella spp.</i>	Stoneworts	4.0	3.9	-3.0	▼
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	10.1	1.1	-89.4	▼
<i>Potamogeton gramineus</i>	Variable-leaf pondweed	5.7	2.5	-55.9	▼
<i>Bidens beckii</i>	Water marigold	7.7	1.4	-81.4	▼
<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	4.9	1.4	-70.6	▼
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	2.8	1.4	-49.6	▼
<i>Eleocharis acicularis</i>	Needle spikerush	1.2	1.4	17.6	▲
<i>Schoenoplectus acutus</i>	Hardstem bulrush	1.2	1.1	-11.8	▼
<i>Brasenia schreberi</i>	Watershield	2.0	0.4	-82.4	▼
<i>Sparganium fluctuans</i>	Floating-leaf bur-reed	1.6	0.0	-100.0	▼
<i>Nuphar variegata</i>	Spatterdock	0.8	0.4	-55.9	▼
<i>Elodea nuttallii</i>	Slender waterweed	1.6	0.0	-100.0	▼
<i>Utricularia vulgaris</i>	Common bladderwort	1.2	0.0	-100.0	▼
<i>Nymphaea odorata</i>	White water lily	0.4	0.4	-11.8	▼
<i>Potamogeton vaseyi</i>	Vasey's pondweed	0.0	0.4		▲
<i>Potamogeton praelongus</i>	White-stem pondweed	0.8	0.0	-100.0	▼
<i>Isoetes spp.</i>	Quillwort spp.	0.0	0.4		▲
<i>Heteranthera dubia</i>	Water stargrass	0.8	0.0	-100.0	▼
<i>Calla palustris</i>	Water arum	0.0	0.4		▲
<i>Fissidens spp. & Fontinalis spp.</i>	Aquatic Moss	0.4	0.0	-100.0	▼
<i>Ceratophyllum echinatum</i>	Spiny hornwort	0.4	0.0	-100.0	▼

Data Compiled by Onterra