October

2024

BARTON LAKE

WATER QUALITY SUMMARY

PREPARED FOR:
BARTON LAKE ASSOCIATION &
THE SCHOOLCRAFT TOWNSHIP BOARD
KALAMAZOO COUNTY, MI

PROGRESSIVE
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ENVIRONMENTAL CONSULTANT

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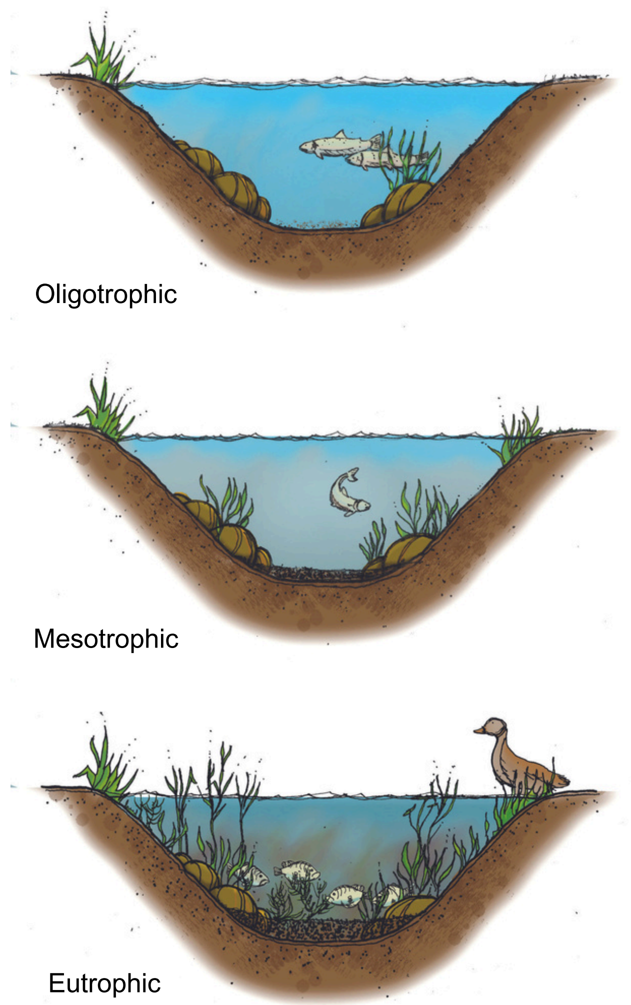
LAKE WATER QUALITY

Lake water quality is determined by a unique combination of processes that occur both within and outside of the lake. In order to make sound management decisions, it is necessary to have an understanding of the current physical, chemical, and biological condition of the lake, and the potential impact of drainage from the surrounding watershed.

Lakes are commonly classified as oligotrophic, mesotrophic, or eutrophic. Oligotrophic lakes are generally deep and clear with little aquatic plant growth. These lakes maintain sufficient dissolved oxygen in the cool, deep bottom waters during late summer to support cold-water fish such as trout and whitefish. By contrast, eutrophic lakes are generally shallow, turbid, and support abundant aquatic plant growth. In deep eutrophic lakes, the cool bottom waters usually contain little or no dissolved oxygen. Therefore, these lakes can only support warmwater fish such as bass and pike. Lakes that fall between these two extremes are called mesotrophic lakes.

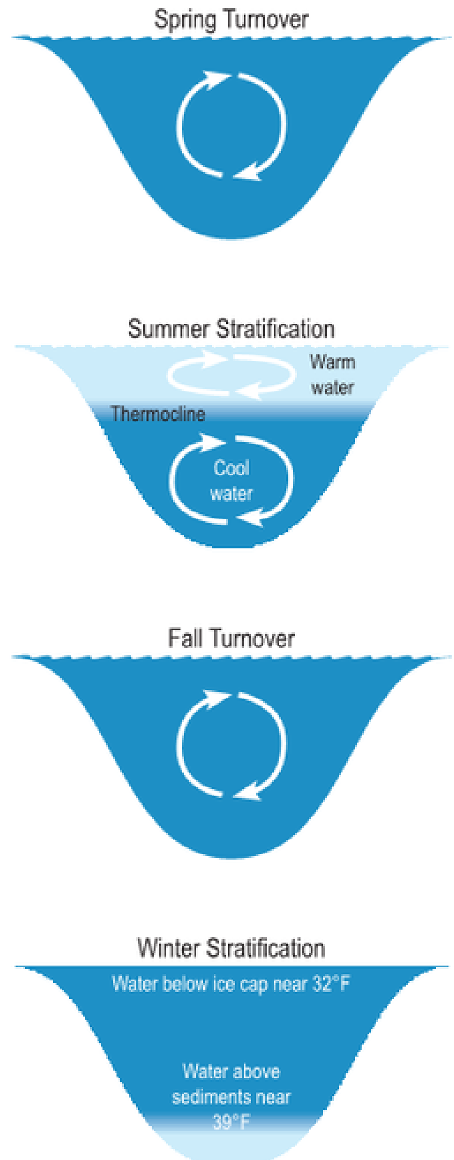
Under natural conditions, most lakes will ultimately evolve to a eutrophic state as they gradually fill with sediment and organic matter transported to the lake from the surrounding watershed. As the lake becomes shallower, the process accelerates. When aquatic plants become abundant, the lake slowly begins to fill in as sediment and decaying plant matter accumulate on the lake bottom. Eventually, terrestrial plants become established and the lake is transformed to a marshland. The aging process in lakes is called "eutrophication" and may take anywhere from a few hundred to several thousand years, generally depending on the size of the lake and its watershed. The natural lake aging process can be greatly accelerated if excessive amounts of sediment and nutrients (which stimulate aquatic plant growth) enter the lake from the surrounding watershed. Because these added inputs are usually associated with human activity, this accelerated lake aging process is often referred to as "cultural eutrophication." The problem of cultural eutrophication can be managed by identifying sources of sediment and nutrient loading (i.e., inputs) to the lake and developing strategies to halt or slow the inputs.



Lake classification.

TEMPERATURE

Temperature is important in determining the type of organisms which may live in a lake. For example, trout prefer temperatures below 68°F. Temperature also determines how water mixes in a lake. As the ice cover breaks up on a lake in the spring, the water temperature becomes uniform from the surface to the bottom. This period is referred to as "spring turnover" because water mixes throughout the entire water column. As the surface waters warm, they are underlain by a colder, more dense strata of water. This process is called thermal stratification. Once thermal stratification occurs, there is little mixing of the warm surface waters with the cooler bottom waters. The transition layer that separates these layers is referred to as the "thermocline." The thermocline is characterized as the zone where temperature drops rapidly with depth. As fall approaches, the warm surface waters begin to cool and become more dense. Eventually, the surface temperature drops to a point that allows the lake to undergo complete mixing. This period is referred to as "fall turnover." As the season progresses and ice begins to form on the lake, the lake may stratify again. However, during winter stratification, the surface waters (at or near 32°F) are underlain by slightly warmer water (about 39°F). This is sometimes referred to as "inverse stratification" and occurs because water is most dense at a temperature of about 39°F. As the lake ice melts in the spring, these stratification cycles are repeated.



Seasonal thermal stratification cycles.

DISSOLVED OXYGEN

An important factor influencing lake water quality is the quantity of dissolved oxygen in the water column. The major inputs of dissolved oxygen to lakes are the atmosphere and photosynthetic activity by aquatic plants. An oxygen level of about 5 mg/L (milligrams per liter, or parts per million) is required to support warmwater fish. In lakes deep enough to exhibit thermal stratification, oxygen levels are often reduced or depleted below the thermocline once the lake has stratified. This is because the oxygen has been consumed, in large part, by bacteria that use oxygen as they decompose organic matter (plant and animal remains) at the bottom of the lake. Bottom-water oxygen depletion is a common occurrence in eutrophic and some mesotrophic lakes. Thus, eutrophic and most mesotrophic lakes cannot support coldwater fish because the cool, deep water (that the fish require to live) does not contain sufficient oxygen.

TROPHIC STATE INDICATORS

Key parameters used to evaluate a lake's productivity or trophic state include total phosphorus, chlorophyll-*a*, and Secchi transparency.

Phosphorus is the nutrient that most often stimulates excessive growth of aquatic plants and causes premature lake aging. By measuring phosphorus levels, it is possible to gauge the overall health of a lake.

Chlorophyll-*a* is a pigment that imparts the green color to plants and algae. A rough estimate of the quantity of algae present in the water column can be made by measuring the amount of chlorophyll-a in the water column.

A Secchi disk is a round, black and white, 8-inch disk that is used to estimate water clarity. Generally, it has been found that plants can grow to a depth of about twice the Secchi disk transparency. This depth is referred to as the photic zone.

Generally, as phosphorus inputs to a lake increase, algae growth and chlorophyll-*a* increase and Secchi transparency decreases.

Secchi disk.

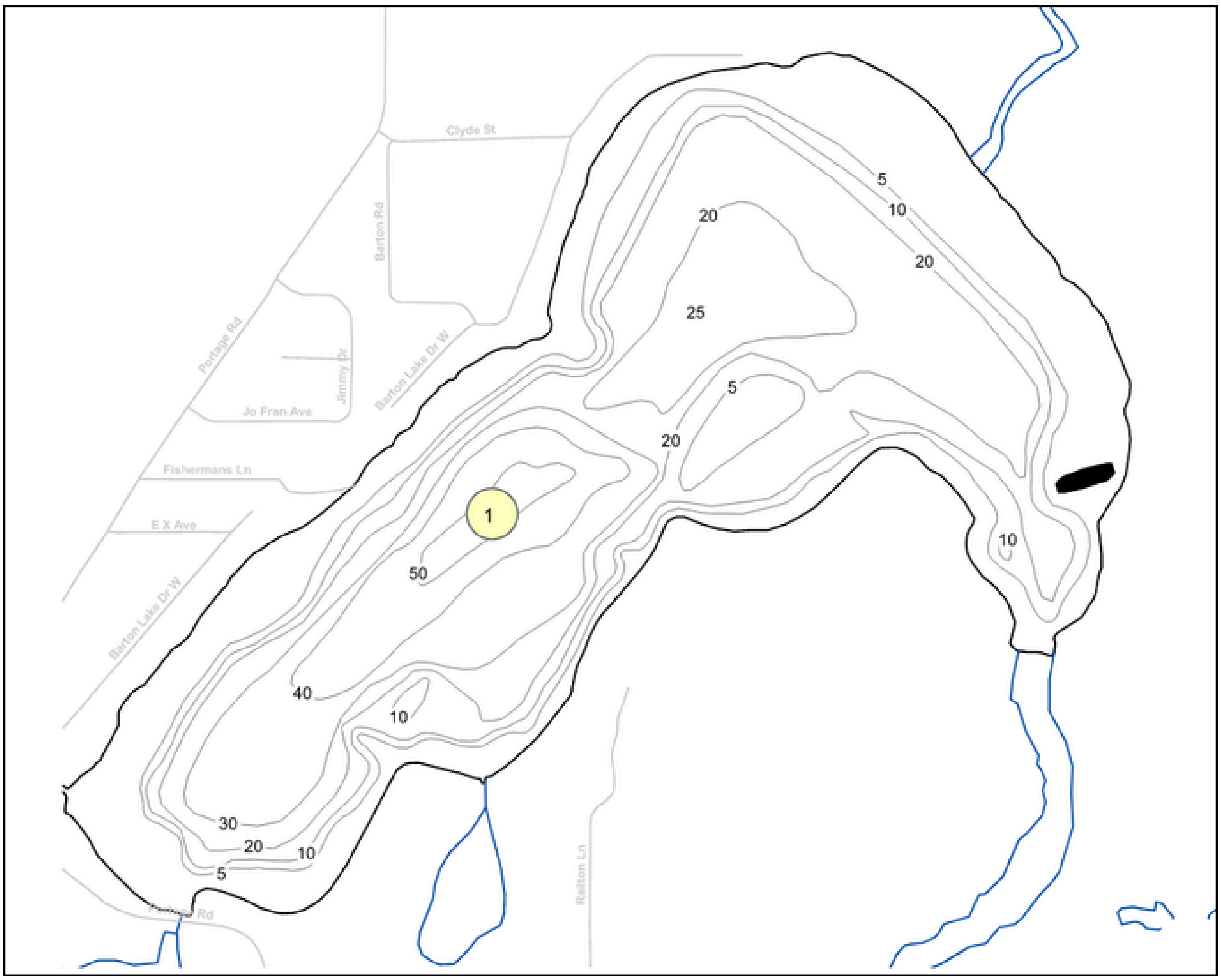
TABLE 1 - LAKE CLASSIFICATION CRITERIA

Lake Classification	Total Phosphorus (ug/L)*	Chlorophyll-*a* (ug/L)*	Secchi Transparency (feet)
Oligotrophic Mesotrophic Eutrophic	Less than 10 10 to 20 Greater than 20	Less than 2.2 2.2 to 6.0 Greater than 6.0	Greater than 15.0 7.5 to 15.0 Less than 7.5

* ug/L = micrograms per liter

SAMPLING RESULTS AND DISCUSSION

Sampling results are provided in Tables 2 and 3. In March of 2024, sampling was conducted during spring turnover when water temperatures were cool and dissolved oxygen concentrations were high. During the August 2024 sampling period, Barton Lake was thermally stratified; the lake was warm and well-oxygenated at the surface, and was cool with low oxygen near the bottom. In 2024, total phosphorus concentrations were low during the spring and generally moderate throughout the summer, with the notable exception of the two deepest samples, which exhibited elevated levels. The elevated bottom-water phosphorus is likely due to internal release of phosphorus from the lake sediments.



Barton Lake Sampling Location Map.

TABLE 2 - BARTON LAKE 2024 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (F)	Dissolved Oxygen (mg/L)*	Total Phosphorus (ug/L)*
11-Mar-24	1	1	44	11.8	<10
11-Mar-24	1	10	44	11.8	<10
11-Mar-24	1	20	44	11.7	<10
11-Mar-24	1	30	44	11.7	<10
11-Mar-24	1	40	43	11.6	<10
11-Mar-24	1	44	43	11.6	<10
20-Aug-24	1	1	74	6.6	27
20-Aug-24	1	10	74	6.6	29
20-Aug-24	1	20	72	4.4	45
20-Aug-24	1	30	57	0.2	27
20-Aug-24	1	40	52	0.2	90
20-Aug-24	1	45	52	0.4	104

TABLE 3 - BARTON LAKE 2024 SURFACE WATER QUALITY DATA

Date	Station	Secchi Transparency (feet)	Chlorophyll-*a* (ug/L)*
11-Mar-24	1	8	1
20-Aug-24	1	7	1

* mg/L = milligrams per liter = parts per million
* ug/L = micrograms per liter = parts per billion

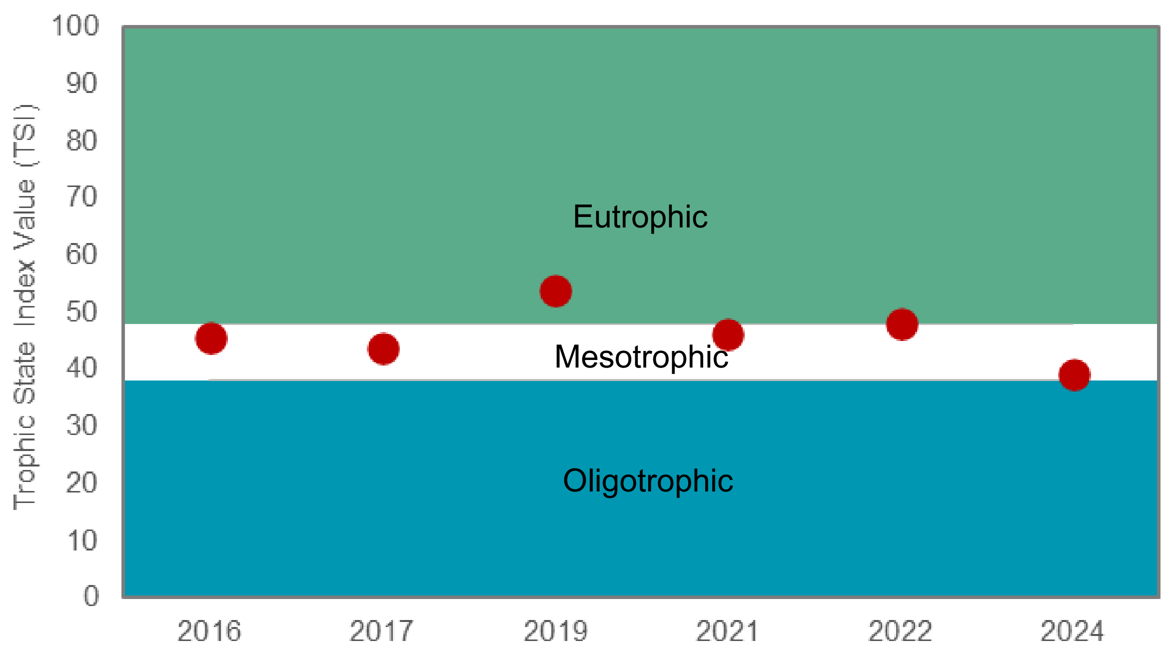
BARTON LAKE TROPHIC STATE

Carlson's Trophic State Index (TSI) was developed from mathematical relationships that allowed phosphorus, chlorophyll-*a*, and Secchi transparency readings to be converted to a numerical scale from 0 to 100, with increasing numbers indicating more productive lakes. Table 4 shows how the TSI can be used to rate the trophic state of Michigan lakes.

TABLE 4 - TSI INDEX FOR MICHIGAN

Trophic State	TSI Value
Oligotrophic Mesotrophic Eutrophic	Less than 38 38 to 48 Greater than 48

The average TSI values for Barton Lake based on spring phosphorus and summer chlorophyll-*a* and Secchi transparency data collected in 2016, 2017, 2019, 2021, 2022, 2024 are shown in the graph below.



Based on water quality data collected from 2016 to 2024, Barton Lake is mesotrophic. Average phosphorus concentrations, chlorophyll-*a* values and clarity in Barton Lake fall below the eutrophic threshold.

Spring sampling was not conducted in 2020 due to pandemic restrictions, therefore, TSI could not be calculated. Monitoring was also not conducted in 2018 and 2023 as funds were diverted to pay for public hearing costs.

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PLANT CONTROL SUMMARY

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ENVIRONMENTAL CONSULTANT

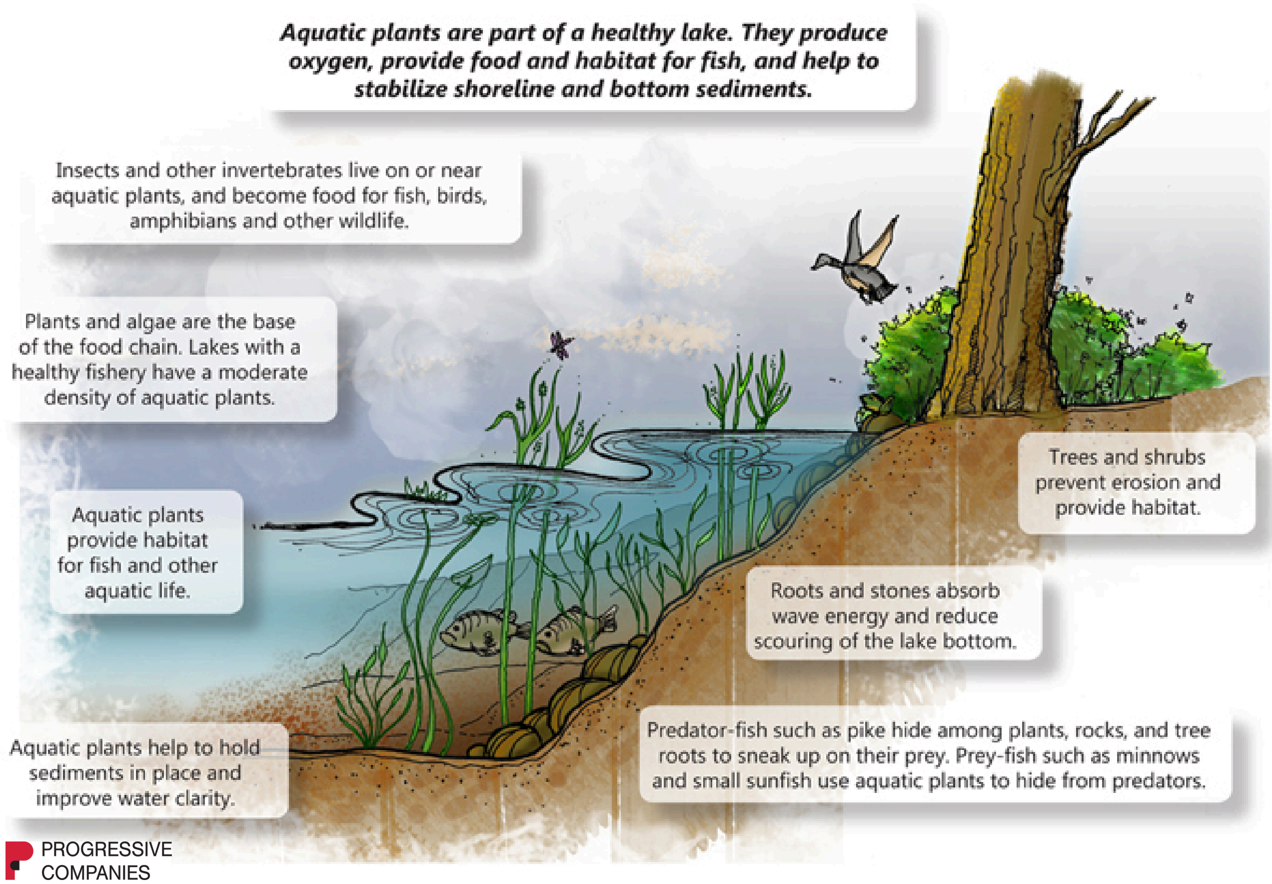
Progressive Companies

AQUATIC HERBICIDE APPLICATOR

PLM Lake & Lake Management Corp.

PROGRAM SUMMARY

A nuisance aquatic plant control program has been ongoing on Barton Lake for many years. The primary objective of the program is to prevent the spread of invasive aquatic plants while preserving beneficial native plant species. This report contains an overview of plant control activities conducted on Barton Lake in 2024.

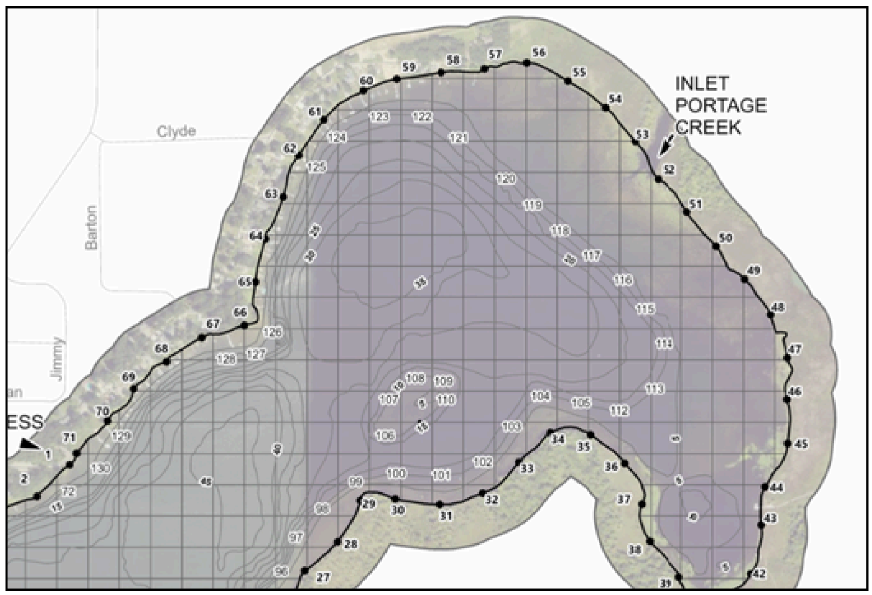


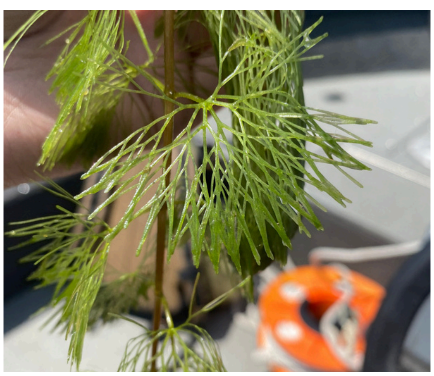
Aquatic plants are an important component of lakes. They produce oxygen during photosynthesis, provide food, habitat and cover for fish, and help stabilize shoreline and bottom sediments. There are four main aquatic plant groups: submersed, floating-leaved, free-floating, and emergent. Each plant group provides important ecological functions. Maintaining a diversity of native aquatic plants is important to sustaining a healthy fishery and a healthy lake. Invasive aquatic plant species have negative impacts to the lake's ecosystem. It is important to maintain an active plant control program to reduce the introduction and spread of invasive species within Barton Lake. Plant control efforts in 2024 consisted of four herbicide treatments.

PLANT CONTROL

Plant control activities are coordinated under the direction of an environmental consultant, Progressive Companies. Scientists from Progressive conduct GPS-guided surveys of the lake to identify problem areas, and georeferenced plant control maps are provided to the plant control contractors. GPS reference points are established along the shoreline and drop-off areas of the lake. These waypoints are used to accurately identify the location of invasive and nuisance plant growth areas.

Eurasian milfoil
Myriophyllum spicatum

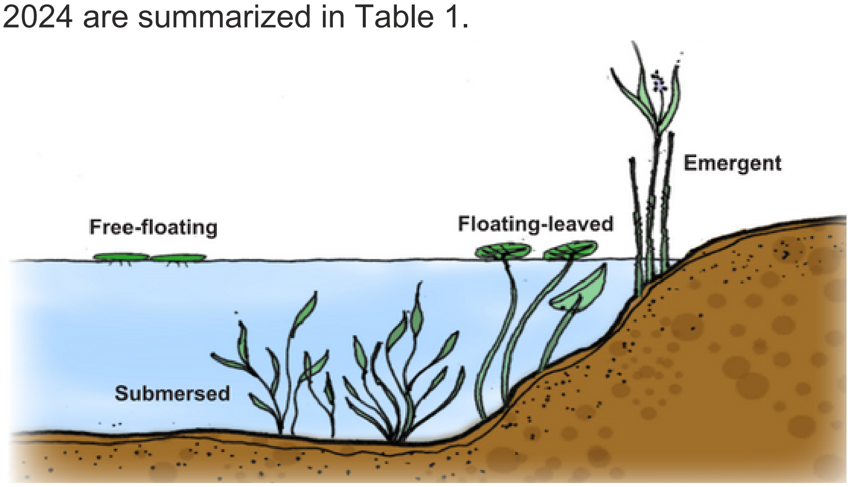




Carolina Fanwort
Cabomba caroliniana

Primary plants targeted for control in Barton Lake include Eurasian milfoil, *Cabomba*, and starry stonewort. These plants are non-native (exotic) species that tend to be highly invasive and have the potential to spread quickly if left unchecked. Plant control activities conducted on the lake in 2024 are summarized in Table 1.

Starry stonewort
Nitellopsis obtusa



PLANT CONTROL

TABLE 1. BARTON LAKE 2024 PLANT CONTROL ACTIVITIES

Date	Plants Targeted	Acreage
May 15	curly-leaf pondweed, algae	14.75
June 6	curly-leaf pondweed, E. milfoil, nuisance natives	18.00
July 8	nuisance natives, *Cabomba*, starry stonewort	15.50
August 27	E. milfoil, *Cabomba*, starry stonewort	5.75
Total		**54.00**

In 2024, a total of 54 acres of Barton Lake was treated with aquatic herbicides. Eurasian milfoil was treated with the systemic herbicide, ProcellaCOR, for season-long control. Curly-leaf pondweed treatment occurred using contact herbicides. Starry stonewort was treated with copper based algaecide in July and August. Contact herbicides were used to control *Cabomba* later in the season.

In the 2025 season, the objective will be to focus on the early growth of *Cabomba* in an effort to reduce its population, along with continue control of non-native milfoil, starry stonewort, and nuisance growth of native plants, where appropriate.

PLANT INVENTORY SURVEY

In addition to the surveys of the lake to identify invasive plant locations, a detailed vegetation survey of Barton Lake was conducted on August 20 to evaluate the type and abundance of all plants in the lake. The table below lists each plant species observed during the survey and the relative abundance of each. At the time of the survey, 12 submersed species, two floating-leaved species, and six emergent species were found in the lake. Barton Lake maintains a moderate diversity of beneficial, native plant species.

TABLE 2. BARTON LAKE 2024 PLANT INVENTORY DATA

Common Name	Scientific Name	Group	Percentage of sites where present in 2024	Percentage of sites where present in 2023
Wild celery	*Vallisneria americana*	Submersed	56	68
Starry stonewort	*Nitellopsis obtusa*	Submersed	25	63
Thin-leaf pondweed	*Potamogeton* sp.	Submersed	24	4
Illinois pondweed	*Potamogeton illinoensis*	Submersed	17	6
Chara	*Chara* sp.	Submersed	15	10
Variable pondweed	*Potamogeton gramineus*	Submersed	8	25
Carolina fanwort	*Cabomba caroliniana*	Submersed	8	28
Slender naiad	*Najas flexilis*	Submersed	7	27
Coontail	*Ceratophyllum demersum*	Submersed	7	13
Flat-stem pondweed	*Potamogeton zosteriformis*	Submersed	6	1
Eurasian milfoil	*Myriophyllum spicatum*	Submersed	4	4
Bladderwort	*Utricularia vulgaris*	Submersed	3	17
White waterlily	*Nymphaea odorata*	Floating-leaved	34	63
Yellow waterlily	*Nuphar* sp.	Floating-leaved	4	7
Cattail	*Typha* sp.	Emergent	44	51
Purple loosestrife	*Lythrum salicaria*	Emergent	37	54
Arrowhead	*Sagittaria latifolia*	Emergent	8	13
Phragmites	*Phragmites australis*	Emergent	7	13
Bulrush	*Schoenoplectus* sp.	Emergent	3	3
Swamp loosestrife	*Decodon verticillatus*	Emergent	1	0

Exotic Invasive Species