

2025

WHITE LAKE

LIMNOLOGICAL EVALUATION

PREPARED FOR:
WHITE LAKE CITIZENS LEAGUE
OAKLAND COUNTY, MI

WHITE LAKE CITIZENS LEAGUE

Karen Pinagel, *President*

Larry D'Angelo, *Vice President*

Sarah Horn, *Secretary*

Chuck Neville, *Treasurer*

Joan Cooper, *Director*

Frank Dyson, *Director*

Mike Genter, *Director*

John Millington, *Director*

Paul Richard, *Director*

Andrea Schemanske, *Director*

Chris Wichers, *Director*



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INTRODUCTION

White Lake is located in White Lake Township, Oakland County, Michigan. The lake is 577 acres in surface area with a maximum depth of 32 feet and a mean (average) depth of 10.1 feet. White Lake has 8.7 miles of shoreline and an approximate volume of 6,016 acre-feet or 19 billion gallons. White Lake has a water retention time of 854 days, meaning it takes roughly 2.25 years for the lake to completely replace its water. In 2025, the White Lake Citizens League (WLCL) retained Progressive Companies for the purposes of studying water quality, assessing the current plant community, and providing recommendations for future management of White Lake. Current management is overseen by the WLCL with assistance from the licensed pesticide applicator to perform plant control work on the lake. This report includes information on the 2025 White Lake limnological study.



Figure 1. White Lake location map

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

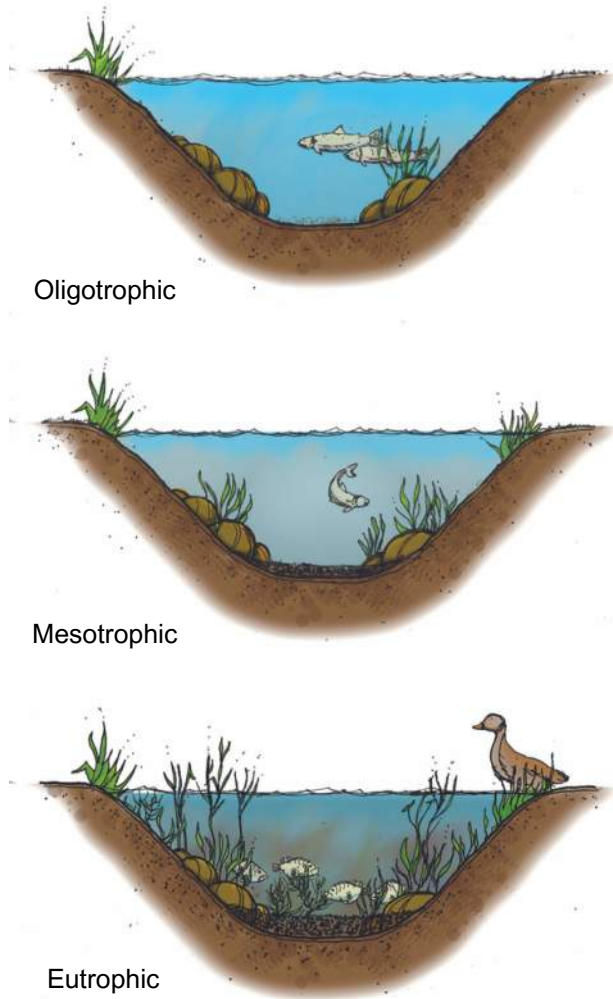


Figure 2. Lake classification.

PHOSPHORUS

Phosphorus is the nutrient that most often controls aquatic plant growth and the rate at which a lake ages and becomes more eutrophic. In the presence of oxygen, lake sediments act as a phosphorus trap, making it unavailable for aquatic plant and algae growth. If bottom-water oxygen is depleted, phosphorus will be released from the sediments and may be available to promote aquatic plant and algae growth. In some lakes, the internal release of phosphorus from the bottom sediments is the primary source of phosphorus loading.

By reducing the amount of phosphorus in a lake, it may be possible to limit the amount of aquatic plant and algae growth. In general, lakes with a phosphorus concentration greater than 20 µg/L (micrograms per liter, or parts per billion) are able to support abundant growth and are classified as nutrient-enriched or eutrophic.

CHLOROPHYLL-a

Chlorophyll-a is a pigment that imparts the green color to plants and algae. A rough estimate of the quantity of algae present in lake water can be made by measuring the amount of chlorophyll-a in the water column. A chlorophyll-a concentration greater than 6 µg/L is considered characteristic of a eutrophic condition.

SECCHI TRANSPARENCY

A Secchi disk is often used to estimate water clarity. The measurement is made by fastening a round, black and white, 8-inch disk to a calibrated line. The disk is lowered over the deepest point of the lake until it is no longer visible, and the depth is noted. The disk is then raised until it reappears. The average between these two depths is the Secchi transparency. Generally, it has been found that aquatic plants can grow at a depth of approximately twice the Secchi transparency measurement. In eutrophic lakes, water clarity is often reduced by algae growth in the water column, and Secchi disk readings of 7.5 feet or less are common.

Generally, as phosphorus inputs (both internal and external) to a lake increase, the amount of algae the lake can support will also increase. Thus, the lake will exhibit increased chlorophyll-a levels and decreased transparency. A summary of lake classification criteria is shown in Table 1.

TABLE 1 - LAKE CLASSIFICATION CRITERIA

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

* µg/L = micrograms per liter = parts per billion

pH and TOTAL ALKALINITY

pH is a measure of the amount of acid or base in the water. The pH scale ranges from 0 (acidic) to 14 (alkaline or basic) with neutrality at 7. The pH of most lakes in the Upper Midwest ranges from 6.5 to 9.0 (Michigan Department of Environmental Quality (MDEQ)* 2012; Table 2). In addition, according to the Michigan Department of Environment, Great Lakes, and Energy (EGLE 2021):

While there are natural variations in pH, many pH variations are due to human influences. Fossil fuel combustion products, especially automobile and coal-fired power plant emissions, contain nitrogen oxides and sulfur dioxide, which are converted to nitric acid and sulfuric acid in the atmosphere. When these acids combine with moisture in the atmosphere, they fall to earth as acid rain or acid snow. In some parts of the United States, especially the Northeast, acid rain has resulted in lakes and streams becoming acidic, resulting in conditions which are harmful to aquatic life. The problems associated with acid rain are lessened if limestone is present, since it is alkaline and neutralizes the acidity of the water.

Most aquatic plants and animals are adapted to a specific pH range, and natural populations may be harmed by water that is too acidic or alkaline. Immature stages of aquatic insects and young fish are extremely sensitive to pH values below 5. Even microorganisms which live in the bottom sediment and decompose organic debris cannot live in conditions which are too acidic. In very acidic waters, metals which are normally bound to organic matter and sediment are released into the water. Many of these metals can be toxic to fish and humans. Below a pH of about 4.5, fish are unable to survive. The Michigan Water Quality Standard (Part 4 of Act 451) states that pH shall be maintained within the range of 6.5 to 9.0 in all waters of the state.

Alkalinity, also known as acid-neutralizing capacity or ANC, is the measure of the pH-buffering capacity of water in that it is the quantitative capacity of water to neutralize an acid. pH and alkalinity are closely linked and are greatly impacted by the geology and soil types that underlie a lake and its watershed. According to MDEQ (2012):

Michigan’s dominant limestone geology in the Lower Peninsula and the eastern Upper Peninsula contributes to the vast majority of Michigan lakes being carbonate-bicarbonate dominant [which increases alkalinity and moderates pH] and lakes in the western Upper Peninsula having lower alkalinity and thus lesser buffering capacity.

The alkalinity of most lakes in the Upper Midwest is within the range of 23 to 148 milligrams per liter, or parts per million, as calcium carbonate (MDEQ 2012; Table 2).

TABLE 2 - pH AND ALKALINITY OF UPPER MIDWEST LAKES

Measurement	Low	Moderate	High
pH (in standard units)	Less than 6.5	6.5 to 9.0	Greater than 9.0
Total Alkalinity or ANC (in mg/L as CaCO ₃)*	Less than 23	23 to 148	Greater than 148

* MDEQ now the Michigan Department of Environment, Great Lakes, and Energy

* mg/L as CaCO₃ = milligrams per liter as calcium carbonate

CHLORIDE

Normally, chloride is a very minor component of freshwater systems and background concentrations are generally less than about 10 milligrams per liter (Wetzel 2001; Fuller and Taricska 2012, Figure 5). However, chloride pollution from sources such as road salting, industrial or municipal wastewater, water softeners, and septic systems can increase chloride levels in lakes. Increased chloride levels can reduce biological diversity and, because chloride increases the density of water, elevated chloride levels can prevent a lake from completely mixing during spring and fall. The U.S. Environmental Protection Agency's acute and chronic standards for protection of freshwater aquatic life are 860 and 230 milligrams per liter of chloride, respectively (USEPA 2021). EPA states that "[a]quatic life criteria for toxic chemicals are the highest concentration of specific pollutants or parameters in water that are not expected to pose a significant risk to the majority of species in a given environment or a narrative description of the desired conditions of a water body being 'free from' certain negative conditions."

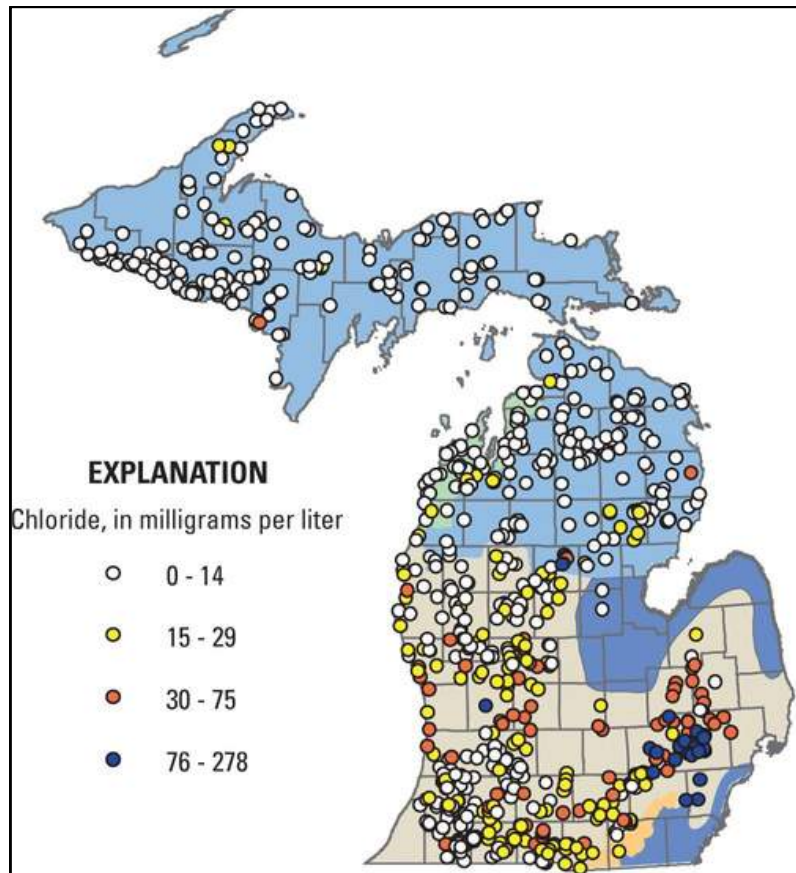


Figure 3. Lake chloride levels (2001–10) in USEPA ecoregions. Fuller and Taricska 2012.

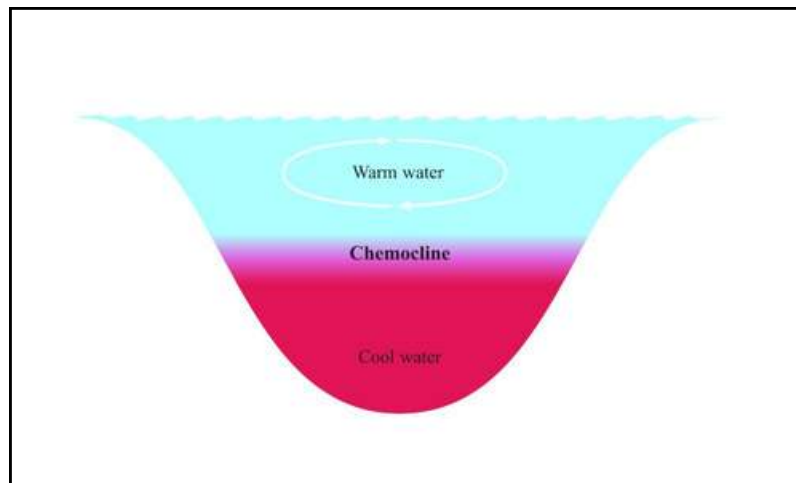


Figure 4. High chloride inputs can result in a chemocline, preventing lake mixing.

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.

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.

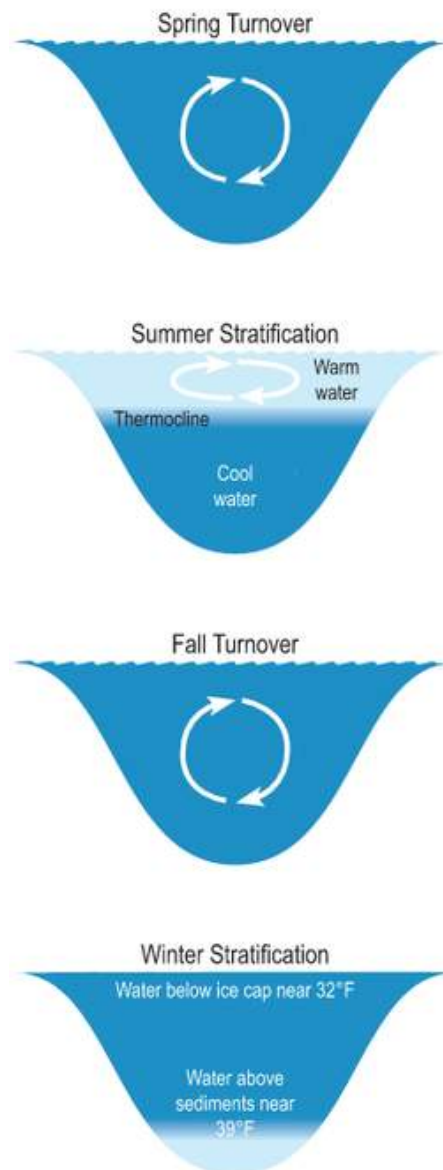


Figure 5. Seasonal thermal stratification cycles.

SAMPLING METHODS

Water quality sampling was conducted in the summer of 2025 at the two deep basins within White Lake. Temperature and dissolved oxygen were measured using a YSI ProSolo ODO/T probe. Samples were collected at five foot depth intervals with a Van Dorn bottle to be analyzed for pH, total alkalinity, total phosphorus, and chloride. pH was measured in the field using a Hach Pocket Pro pH meter. Total alkalinity samples were placed on ice and transported to Progressive Companies and for analysis. Total phosphorus and chloride samples were placed on ice and transported to Summit Laboratories* for analysis. Total alkalinity was titrated at Progressive Companies using Standard Methods procedure 2320 B. Total phosphorus and chloride were analyzed at Summit Laboratory using Standard Methods procedures 4500-PE and 4500-Cl, respectively. In addition to the depth-interval samples at each deep basin, Secchi transparency was measured and composite chlorophyll-a samples were collected from the surface to a depth equal to twice the Secchi transparency. Chlorophyll-a samples were analyzed by Prein and Newhof Laboratories* using Standard Methods procedure 10200 H.

SAMPLING RESULTS AND DISCUSSION

Sampling results are provided in Tables 2 and 3. In August 2025, White Lake was mixed; having uniform temperature and dissolved oxygen throughout the water column. Based on the lake's depth and historical data, White Lake is polymictic. This means that the lake stratifies and de-stratifies periodically throughout the summer. In 2025, total phosphorus concentrations were low. Sediment phosphorus release occurred in 2018 during a period of stratification (Appendix A). However, it is not apparent to be a significant loading source in the lake. pH, total alkalinity and chloride were all within the moderate range for Upper Midwest lakes. Chloride levels have decreased since sampling conducted in 2018 (Appendix A), and are still well below the EPA's acute and chronic standards for freshwater life. Oxygen depletion occurred in a very small area of the lake at the bottom waters of sample site 1 in 2025. This is likely due to oxygen consumption during the breakdown of organics within the lake. The lake supports a warm water fishery, where species such as bass and panfish will thrive within the lake. Since there are no areas of cool oxygenated water during the summer months, cool water species such as pike and walleye cannot thrive within the lake. While pike have been known to occupy warm-water fisheries within the mid-west, they typically will have stunted growth and may require stocking over time to sustain populations. Based upon the 2025 sampling, White Lake remains mesotrophic with improved overall phosphorus concentrations compared to 2018 and lower chloride levels than those observed in 2018. Transparency (water clarity) showed a significant decrease since the summer of 2018. However, this may be related to suspended sediments likely caused by boating activities and not an increase in algae growth (chlorophyll-a concentrations remained low).

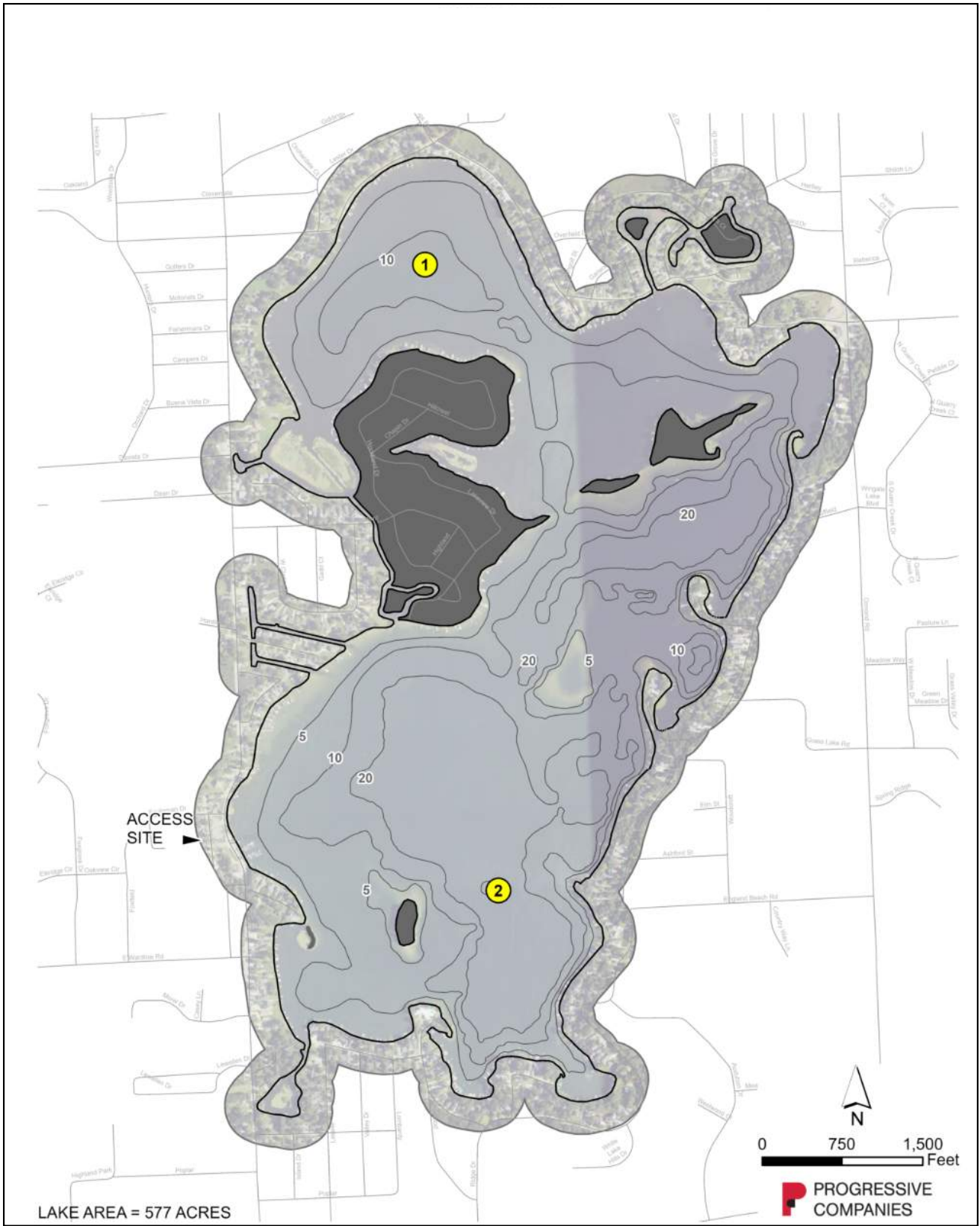


Figure 6. White Lake sampling location map

TABLE 3 - WHITE LAKE 2025 DEEP BASIN WATER QUALITY DATA

Date	Site	Depth (feet)	Temp (F)	Dissolved Oxygen (mg/L)*	Total Phosphorus (µg/L)*	pH (S.U.)*	Total Alkalinity (mg/L CaCO3)*	Chloride (mg/L)*
26-Aug-25	1	1	72	9.5	11	8.32	135	71
26-Aug-25	1	5	72	9.5	<10	8.35	141	76
26-Aug-25	1	10	72	9.3	14	8.38	139	72
26-Aug-25	1	15	71	0.5	14	8.34	140	72
26-Aug-25	2	1	73	8.0	12	8.14	136	74
26-Aug-25	2	5	73	7.9	<10	8.12	135	73
26-Aug-25	2	10	73	7.9	x	8.14	135	x
26-Aug-25	2	15	73	8.0	11	8.14	134	70
26-Aug-25	2	20	73	7.9	<10	8.18	140	71
26-Aug-25	2	24	73	8.0	10	8.25	132	71

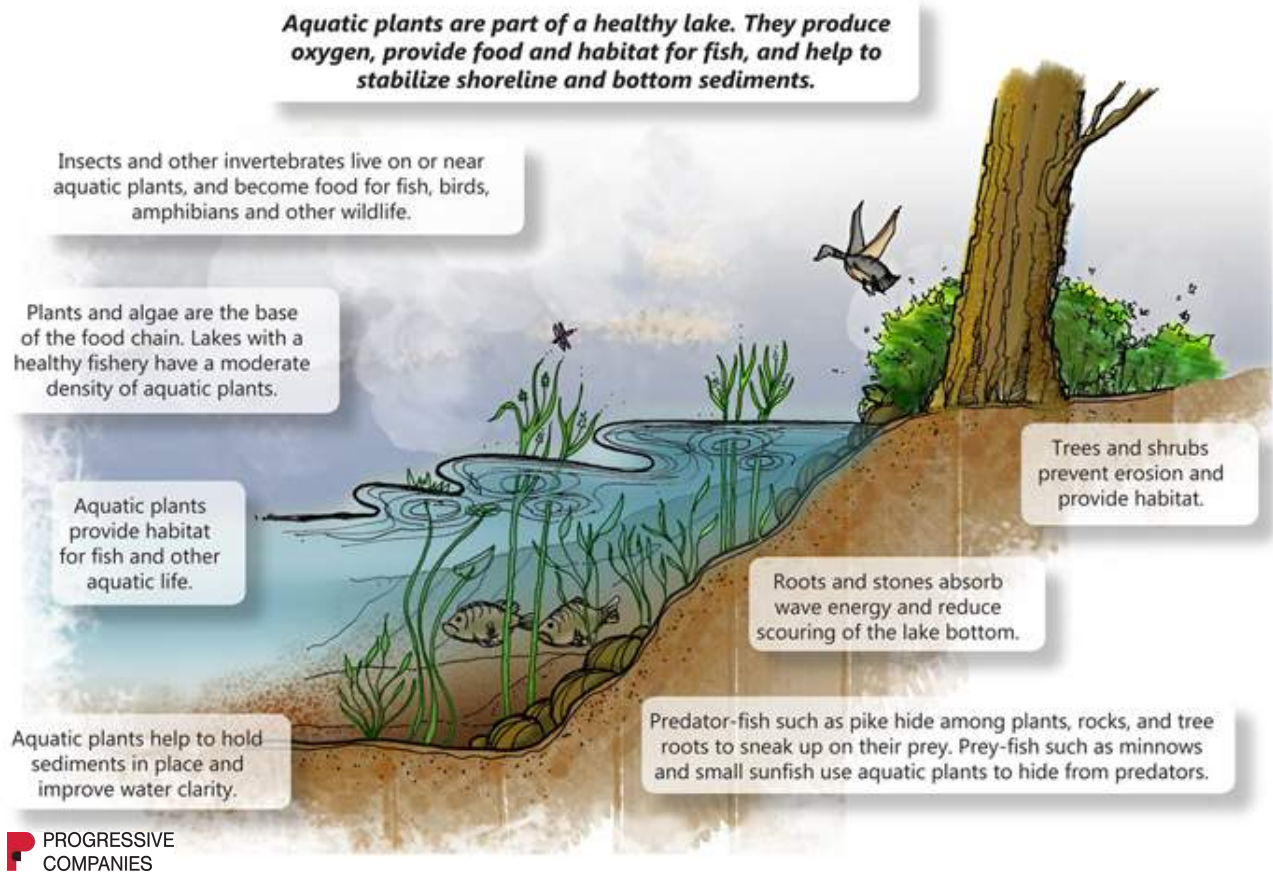
TABLE 4 - WHITE LAKE 2025 SURFACE WATER QUALITY DATA

Date	Station	Secchi Transparency (feet)	Chlorophyll-a (µg/L)*
26-Aug-25	1	4.5	2
26-Aug-25	2	7.0	1

* mg/L = milligrams per liter = parts per million
 * µg/L = micrograms per liter = parts per billion
 x = water sample lost during transport

PLANT COMMUNITY ASSESSMENT

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 on the lake's ecosystem. It is important to maintain an active plant control program to reduce the establishment and spread of invasive species within White Lake.



Aquatic nuisance plant control programs typically rely on the use of aquatic herbicides. In Michigan, the application of these herbicides require a permit issued by the Department of Environment, Great Lakes, and Energy (EGLE). Licensed pesticide applicators are authorized to carry out treatments across waterbodies under a lake wide issued permit. To ensure that aquatic plant management is conducted in an environmentally responsible and cost-effective manner, it is often advantageous for communities to engage professional lake management consultants. These consultants can provide oversight, develop comprehensive management strategies, and coordinate treatment plans tailored to the specific needs of the lake.

PLANT INVENTORY SURVEYS

Detailed vegetation survey of White Lake were conducted on June 23 and September 9 to evaluate the type and abundance of all plants in the lake. The tables below list each plant species observed during each survey as well as inventory results from 2018 and the relative abundance of each. At the time of the June 23 survey, 14 submersed species, one free-floating species, three floating-leaved species, and four emergent species were found in the lake. On September 9, nine submersed species, one free-floating species, two floating-leaved species, and five emergent species were found in the lake. White Lake maintains a good diversity of beneficial native plant species.

TABLE 5 - WHITE LAKE JUNE 23, 2025 PLANT INVENTORY DATA

Common Name	Scientific Name	Group	2025 Percentage of sites where present
Eurasian milfoil	<i>Myriophyllum spicatum</i>	Submersed	30
Thin-leaf pondweed	<i>Potamogeton</i> sp.	Submersed	25
Richardson's pondweed	<i>Potamogeton richardsonii</i>	Submersed	17
<i>Chara</i>	<i>Chara</i> sp.	Submersed	15
Whitestem pondweed	<i>Potamogeton praelongus</i>	Submersed	13
Illinois pondweed	<i>Potamogeton illinoensis</i>	Submersed	11
Starry stonewort	<i>Nitellopsis obtusa</i>	Submersed	8
Wild celery	<i>Vallisneria americana</i>	Submersed	6
Large-leaf pondweed	<i>Potamogeton amplifolius</i>	Submersed	3
Sago pondweed	<i>Stuckenia pectinata</i>	Submersed	2
Curly-leaf pondweed	<i>Potamogeton crispus</i>	Submersed	2
Variable pondweed	<i>Potamogeton gramineus</i>	Submersed	2
Flat-stem pondweed	<i>Potamogeton zosteriformis</i>	Submersed	2
Coontail	<i>Ceratophyllum demersum</i>	Submersed	2
Watermeal	<i>Wolffia punctata</i>	Free-floating	3
White waterlily	<i>Nymphaea odorata</i>	Floating-leaved	15
Yellow waterlily	<i>Nuphar</i> sp.	Floating-leaved	6
Water shield	<i>Brasenia schreberi</i>	Floating-leaved	1
Cattail	<i>Typha</i> sp.	Emergent	3
Buttonbush	<i>Cephalanthus occidentalis</i>	Emergent	2
Flowering rush	<i>Butomus umbellatus</i>	Emergent	1
Lake sedge	<i>Carex lacustris</i>	Emergent	1

Exotic invasive species

PLANT INVENTORY SURVEYS

TABLE 6 - WHITE LAKE LATE SUMMER 2025 PLANT INVENTORY DATA

Common Name	Scientific Name	Group	2025 Percentage of sites where present	2018 Percentage of sites where present
Richardson's pondweed	<i>Potamogeton richardsonii</i>	Submersed	33	46
Whitestem pondweed	<i>Potamogeton praelongus</i>	Submersed	32	0
Wild celery	<i>Vallisneria americana</i>	Submersed	25	42
Eurasian milfoil	<i>Myriophyllum spicatum</i>	Submersed	8	36
Starry stonewort	<i>Nitellopsis obtusa</i>	Submersed	5	34
Bladderwort	<i>Utricularia vulgaris</i>	Submersed	1	15
Illinois pondweed	<i>Potamogeton illinoensis</i>	Submersed	1	5
Large-leaf pondweed	<i>Potamogeton amplifolius</i>	Submersed	1	3
Coontail	<i>Ceratophyllum demersum</i>	Submersed	1	11
Duckweed	<i>Lemna minor</i>	Free-floating	2	1
White waterlily	<i>Nymphaea odorata</i>	Floating-leaved	15	63
Yellow waterlily	<i>Nuphar</i> sp.	Floating-leaved	2	11
Cattail	<i>Typha</i> sp.	Emergent	3	5
Buttonbush	<i>Cephalanthus occidentalis</i>	Emergent	1	10
Purple loosestrife	<i>Lythrum salicaria</i>	Emergent	1	11
Iris	<i>Iris</i> sp.	Emergent	1	4
Phragmites	<i>Phragmites australis</i>	Emergent	1	0

Exotic invasive species

A reduction in Eurasian milfoil growth was observed between the June 2025 and September 2025 surveys of the lake, likely attributable to the treatments conducted in June. Treatment reports indicate that broad spectrum contact herbicides were used to control the invasive milfoil. A decline in several beneficial native aquatic species was also observed, suggesting that the contact herbicides had negative impacts to the native vegetation. Wild celery (*Vallisneria americana*) exhibited significant expansion over the same period. As a late-season species, wild celery is capable of rapidly colonizing areas left vacant by earlier vegetation loss. Some southern U.S. states have identified an exotic species of *Vallisneria* as well as a hybrid strain. Both of these strains of wild celery have shown invasive traits. Progressive Companies collected wild celery samples from several Michigan lakes in late 2024. Results indicate that so far, *Vallisneria americana* is currently the only strain found in Michigan. A fact sheet on wild celery can be found in Appendix B.

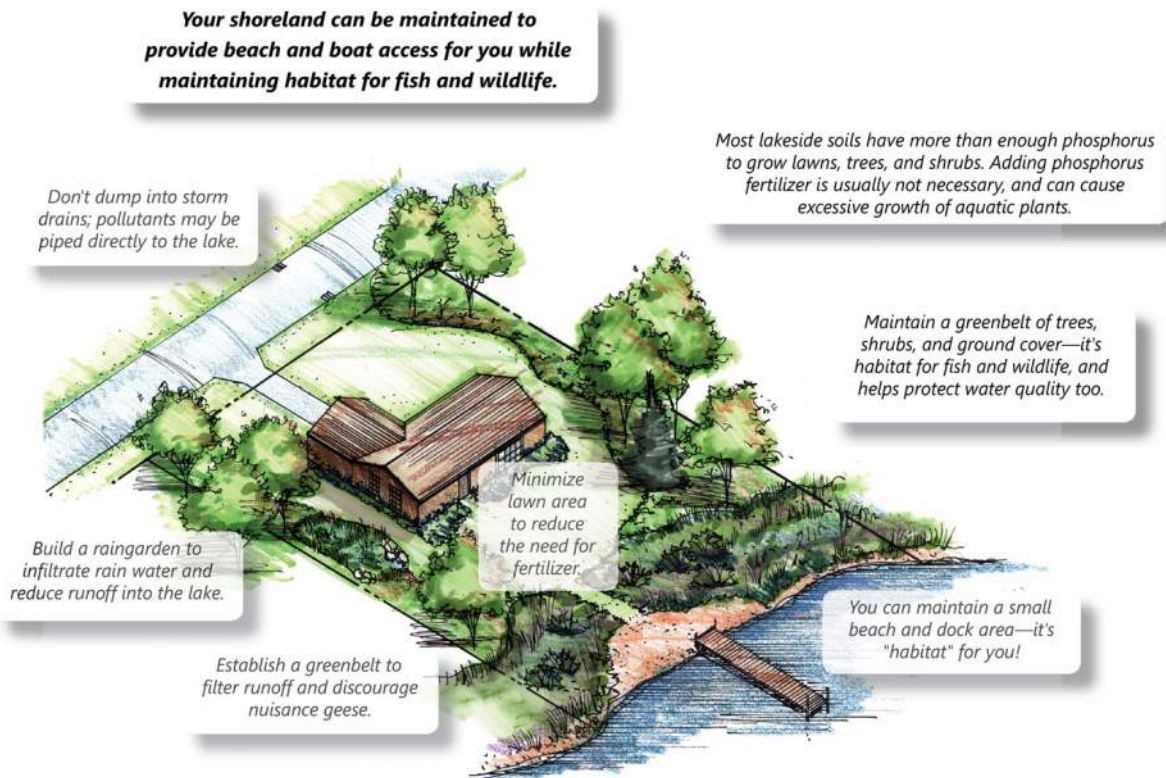
In general, the native aquatic plant community has declined in distribution around the lake since 2018. This could be a result of heavy contact herbicide use to control the invasive plant community, which over time, can negatively impact the native community. Late season Eurasian milfoil and starry stonewort growth has significantly decreased since 2018, a distribution map can be found in Appendix A.

HYDROLOGIC ASSESSMENT

Hydrologic soil groups are used to estimate infiltration and runoff potential. There are four categories outlined by the United States Department of Agriculture: Group A; high infiltration and low runoff potential, Group B; moderate infiltration and runoff potential, Group C; slow infiltration and high runoff potential, and Group D: very slow infiltration and very high runoff potential.

An assessment of major catch basins and stormwater inlets surrounding White Lake was conducted. Field investigations identified five primary sites of interest. Hydrologic soil data were analyzed across the watershed to evaluate runoff potential for White Lake (map located in Appendix A). Of the five identified sites, two are located within Group A hydrologic areas, two within Group B/D hydrologic areas, and one within an urbanized area where hydrologic data are unavailable.

Sites within Group A hydrologic areas present minimal concern due to their high infiltration capacity and low runoff potential. Conversely, the two sites situated in Group B/D hydrologic areas exhibit moderate to high runoff potential and may warrant further evaluation for potential stormwater management improvements. The remaining site, located in an urbanized drainage area discharging to a hardened boat launch at the south end of the lake, demonstrates very limited infiltration capacity. Runoff from this area has a high potential to transport pollutants including chlorides, nutrients, and sediment into White Lake. Direct runoff from residential frontage can also contribute to nutrient loading within White Lake. Residents should utilize shoreline best management practices to reduce negative contributions to the lake.



WAKE BOAT IMPACTS

A wake boat is a recreational powerboat that is used for the purpose of creating large wakes to enhance the sports of wakeboarding and wake surfing. In recent years, these boats have gained popularity on inland lakes. Their usage has resulted in unintended negative consequences to some lake ecosystems in Michigan. Boats used for wake surfing create larger waves than other recreational watercraft as they typically fill ballast tanks with water to weigh them down, displacing immense amounts of water to create a large wake. Many of these boats are also outfitted with hydraulic trim tabs that increase the steepness of the wake.

The operation of wake boats in shallow water and near shore areas has significant impacts on the lake bottom and shoreline habitat. When a wake boat is operating at wake surfing speed, approximately ten miles per hour, the boat's stern is angled down, pointing the propeller towards the lake bottom. When operating in waters shallower than 15 feet, the turbulence from the propellers can disrupt the lake bottom, resuspending sediments, uprooting aquatic plants, and displacing valuable habitat. This resuspension of sediment reduces water clarity and introduces phosphorus into the water column, increasing the chance for algae blooms. White Lake has extensive shallow areas, and is therefore at increased risk for ecosystem degradation.

The Michigan DNR has published recommendations for safe and environmentally friendly wake boat operation based on their literature review published in 2023. "The [Fisheries] Division recommends that wake boats operating in wake-surfing or wake-boarding mode do so in water that is at least 15 feet deep (MDNR 2023)." The Division also recommends "Boats operating in wake-surfing mode or wake-boarding mode, during which boat speed, wave shapers, and/or ballast are used to increase wave height, are recommended to operate at least 500 feet from docks or the shoreline, regardless of water depth (MDNR 2023)." These recommendations are not rule or law, but are meant to educate wake boat owners on how to most responsibly operate wake boats to care for Michigan's inland lakes.

A recent study conducted by the University of Minnesota - St. Anthony Falls Research Laboratory found that sediment resuspension can occur in water depths up to 20 feet. Using this data further recommendation can be made to only operate in water depths greater than 20 feet and a minimum of 700 feet from any shoreline.

A map provided in Appendix A displays a 500-foot buffer from the shoreline and areas shallower than 15 feet and 20 feet in White Lake. Based on the results of these studies, it is recommended that wake surfing operation should be limited to the delineated areas on White Lake, to avoid negative ecological impacts.

RECOMMENDATIONS

Aquatic vegetation management on White Lake should continue to improve lake quality and maintain ecosystem stability. The use of systemic herbicides is advised for the targeted control of Eurasian milfoil, as these products offer extended, selective control while minimizing adverse impacts on native plant species. Preservation of native aquatic vegetation should remain a priority throughout the growing season, with active management limited to areas where plant growth significantly interferes with navigation or recreational use. In addition, implementing a small-scale, late-season mechanical harvest may help reduce biomass accumulation at the end of the season, thereby slowing the development of organic muck and contributing to improved sediment and nutrient management over time. Consistent vegetation control efforts should be maintained to prevent the resurgence of invasive species and to support the overall ecological health and water quality of the lake.

Residents should utilize and implement shoreland best management practices where possible, to reduce nutrient loading within White Lake (Appendix B). Residents who operate wake surfing boats, should follow recommendations set by the DNR and University of Minnesota and only operate in areas delineated in the wake boat operation map (Appendix A).

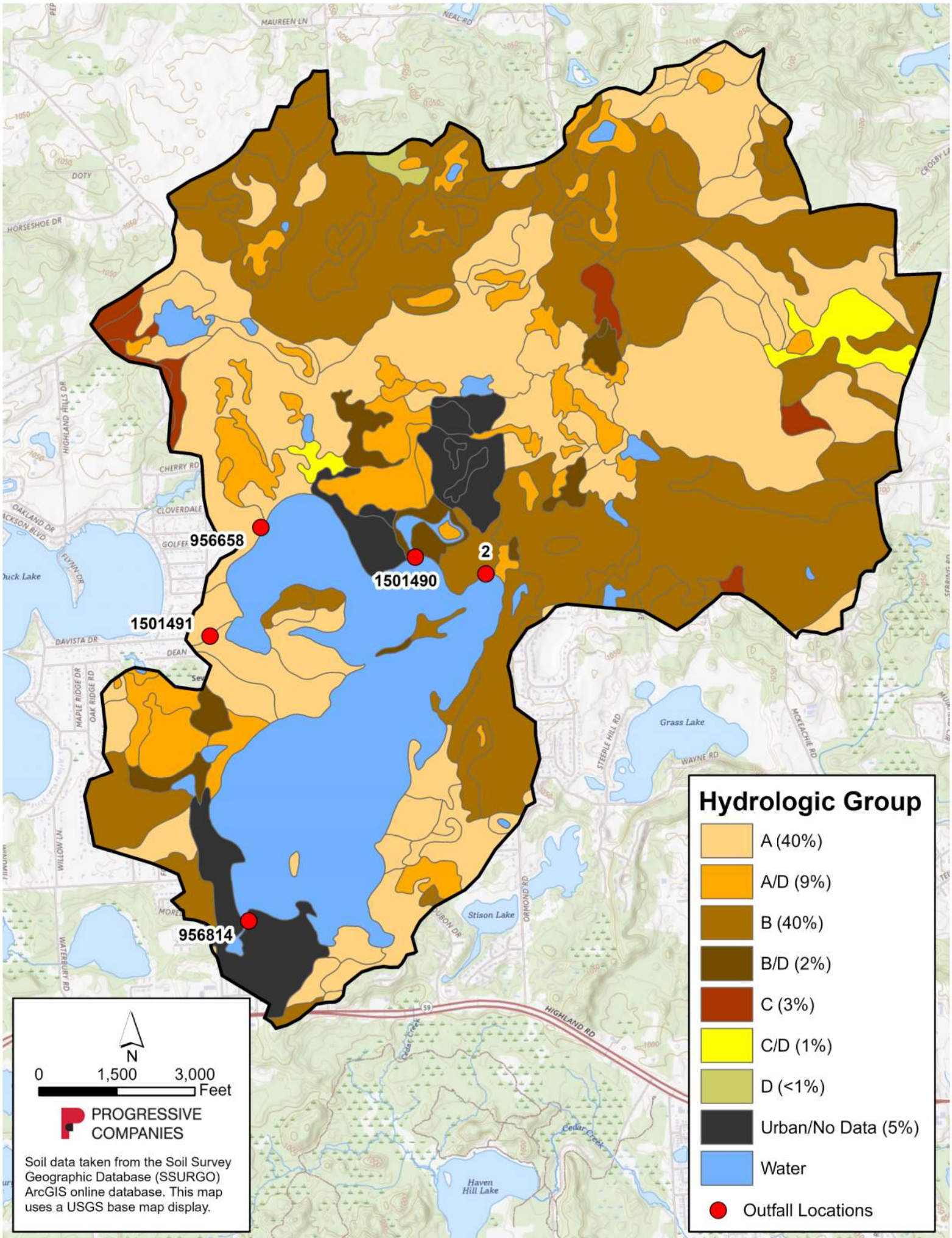
Finally, it is strongly recommended that a qualified environmental consultant be engaged to oversee plant control and lake improvement activities. Professional oversight will help ensure that management practices are conducted in an environmentally responsible and cost-effective manner.

TABLE 7 - WHITE LAKE 2026 PROPOSED MANAGEMENT ACTIVITIES

Proposed Management Activity	Projected Cost
Lake Management Oversight <ul style="list-style-type: none"> • Aquatic plant surveys + monitoring • Contractor coordination • Treatment and harvesting recommendations • Information and education 	\$12,900
Aquatic Herbicide Applications <ul style="list-style-type: none"> • Permitting + applications from licensed pesticide applicators 	\$60,000
Mechanical Harvesting (~ 20 acres)* <ul style="list-style-type: none"> • Plant cutting and removal/disposal 	\$15,000
Total	\$87,900


APPENDIX A

Maps and Historical Data



Hydrologic Group

- A (40%)
- A/D (9%)
- B (40%)
- B/D (2%)
- C (3%)
- C/D (1%)
- D (<1%)
- Urban/No Data (5%)
- Water
- Outfall Locations



0 1,500 3,000
Feet

PROGRESSIVE COMPANIES

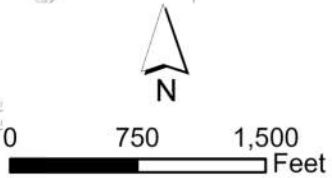
Soil data taken from the Soil Survey Geographic Database (SSURGO) ArcGIS online database. This map uses a USGS base map display.

WHITE LAKE OAKLAND COUNTY, MICHIGAN ECOLOGICALLY SAFE WAKE BOAT USE RECOMMENDATION MAP



Legend

- DNR recommended wake boat operation areas (Over 500' from shore and at least 15' deep)
- University of Minnesota - St. Anthony Falls Laboratory recommended wake boat operation areas (Over 500' from shore and at least 20' deep)



DATE: _____

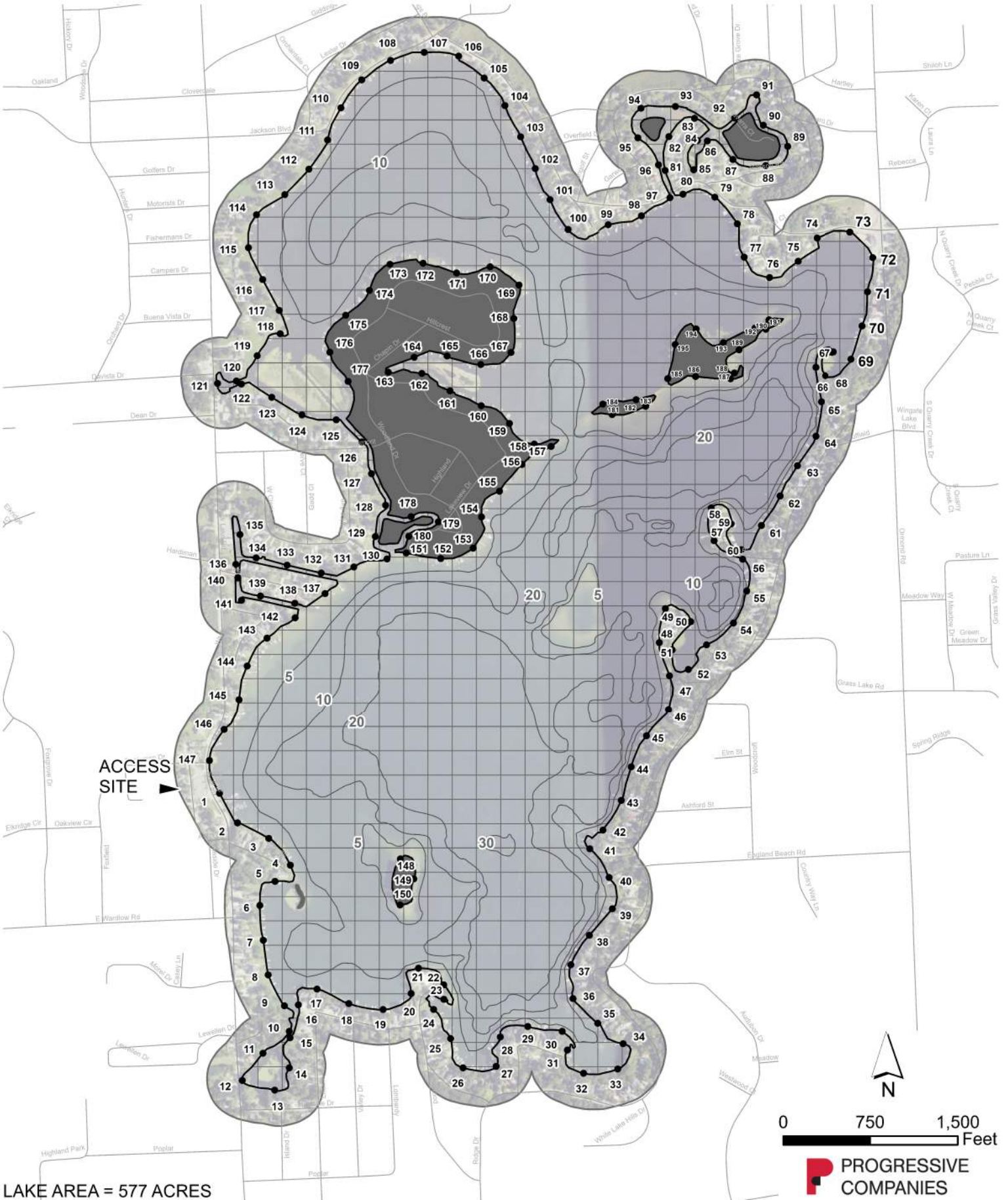
CREW: _____

WEATHER: _____

NOTES: _____

WHITE LAKE OAKLAND COUNTY, MICHIGAN AQUATIC PLANT SURVEY MAP

☐ = 1 ACRE



LAKE AREA = 577 ACRES

PROGRESSIVE COMPANIES

TABLE 4
WHITE LAKE DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L) ¹	Total Phosphorus (µg/L) ²	Total Suspended Solids (mg/L) ¹	Chloride (mg/L) ¹	pH (S.U.) ³	Total Alkalinity (mg/L as CaCO ₃) ⁴
16-May-18	1	1	66	---	<5	4	101	8.7	132
16-May-18	1	5	65	10.8	<5	4	102	8.7	128
16-May-18	1	10	62	10.6	<5	4	102	8.7	127
16-May-18	1	15	60	10.2	<5	4	104	8.7	130
16-May-18	2	1	64	9.1	<5	4	100	8.6	127
16-May-18	2	5	64	10.2	<5	4	99	8.6	128
16-May-18	2	10	63	9.6	<5	4	99	8.6	125
16-May-18	2	15	60	9.7	<5	4	100	8.5	129
16-May-18	2	20	60	9.6	<5	4	99	8.5	127
16-May-18	2	25	58	9.9	<5	4	100	8.5	128
16-May-18	2	30	56	9.8	<5	4	101	8.5	123
09-Aug-18	1	1	80	9.2	<5	6	100	8.6	130
09-Aug-18	1	5	80	8.3	14	6	100	8.7	140
09-Aug-18	1	10	80	7.4	9	6	101	8.6	138
09-Aug-18	1	15	76	1.7	98	11	106	8.1	167
09-Aug-18	2	1	79	9.2	5	7	99	8.8	125
09-Aug-18	2	5	79	8.5	12	7	99	8.8	136
09-Aug-18	2	10	79	8.5	12	17	99	8.8	132
09-Aug-18	2	15	79	7.9	16	10	100	8.6	136
09-Aug-18	2	20	76	3.0	27	7	96	8.1	137
09-Aug-18	2	25	70	2.4	34	12	97	7.8	145

1 mg/L = milligrams per liter = parts per million.

2 µg/L = micrograms per liter = parts per billion.

3 S.U. = standard units

4 mg/L CaCO₃ = milligrams per liter as calcium carbonate.

TABLE 5
WHITE LAKE PHOSPHORUS AND NITROGEN DATA

Date	Station	Sample Depth (feet)	Total Phosphorus ($\mu\text{g/L}$) ¹	Nitrate Nitrogen (mg/L) ²	Nitrite Nitrogen (mg/L) ²	Total Kjeldahl Nitrogen (mg/L) ²	Nitrogen to Phosphorus Ratio
16-May-18	1	1	<5	<0.1	<0.1	1.6	352
16-May-18	1	5	<5	<0.1	<0.1		
16-May-18	1	10	<5	<0.1	<0.1	1.1	264
16-May-18	1	15	<5	<0.1	<0.1	1.1	260
16-May-18	2	1	<5	0.1	<0.1	1.0	241
16-May-18	2	5	<5	0.1	<0.1	1.1	260
16-May-18	2	10	<5	0.1	<0.1	0.3	108
16-May-18	2	15	<5	0.1	<0.1	0.3	100
16-May-18	2	20	<5	0.1	<0.1	<0.1	65
16-May-18	2	25	<5	0.1	<0.1	<0.1	66
16-May-18	2	30	<5	0.1	<0.1	<0.1	64

TABLE 6
WHITE LAKE SURFACE WATER QUALITY DATA

Date	Sample Location	Secchi Transparency (feet)	Chlorophyll-a ($\mu\text{g/L}$) ¹
16-May-18	1	11	1
16-May-18	2	27	1
09-Aug-18	1	9	1
09-Aug-18	2	14	3

During the May sampling, White Lake was cool and well-oxygenated from the surface to the bottom (Table 4). Thermal stratification was observed at both deep basins with relatively warm waters near the surface underlain by cooler waters near the lake bottom. During the August sampling period, low dissolved oxygen levels were measured at the bottom of both deep basin sites. These data indicate that White Lake can sustain cool- and warm-water fish such as bass, pike and walleye, however, the lake lacks a refuge for cold-water fish such as trout.

Phosphorus levels in White Lake were generally low except in August when phosphorus levels were considerably higher at the bottom of each deep basin (Table 4). The elevated phosphorus levels were likely the result of phosphorus release from the deep-water lake sediments as oxygen was depleted from the bottom water during late summer. Although deep-water phosphorus levels are high, the volume of water containing high-phosphorus is small. Thus, it does not appear that internal phosphorus loading is significant in White Lake.

¹ $\mu\text{g/L}$ = micrograms per liter = parts per billion.

² mg/L = milligrams per liter = parts per million.

APPENDIX B
Fact Sheets and Guides

SHORELAND MANAGEMENT A GUIDE FOR WHITE LAKE

Created by Progressive Companies - Water Resources Group

Natural shoreland areas around lakes help to reduce pollution runoff and provide valuable fish and wildlife habitat. These areas protect the environment and contribute to the natural beauty of a lake. Because of their many benefits, several states, including Minnesota, Wisconsin, Vermont, Maine, and New Hampshire, have put shoreland protection rules in place. Around the country, lake communities are finding that bringing back natural shorelines is good for everyone: it leads to cleaner water, healthier fish populations, and a better experience for people who live near or visit the lake.



Protecting the natural features along the shoreline is an important step toward improving the health of White Lake. Rather than installing seawalls or other hard structures, consider planting native vegetation and keeping a buffer zone between your lawn and the water. This helps slow down runoff and reduce the amount of pollution reaching the lake. One of the main drivers of excessive plant and algae growth in White Lake is phosphorus. Lawn fertilizers are a common source. In fact, Michigan law bans the use of fertilizers containing phosphorus unless a soil test shows it's needed or you're starting a new lawn. Chloride is another pollutant that can affect water quality. High levels can harm fish, insects, and amphibians that live in or near the water. Chloride often comes from road salt and water softener discharge. By following good shoreline management practices, you can help limit the amount of phosphorus and chloride that ends up in White Lake.

Your shoreland can be maintained to provide beach and boat access for you while maintaining habitat for fish and wildlife.

Don't dump into storm drains; pollutants may be piped directly to the lake.

Most lakeside soils have more than enough phosphorus to grow lawns, trees, and shrubs. Adding phosphorus fertilizer is usually not necessary, and can cause excessive growth of aquatic plants.

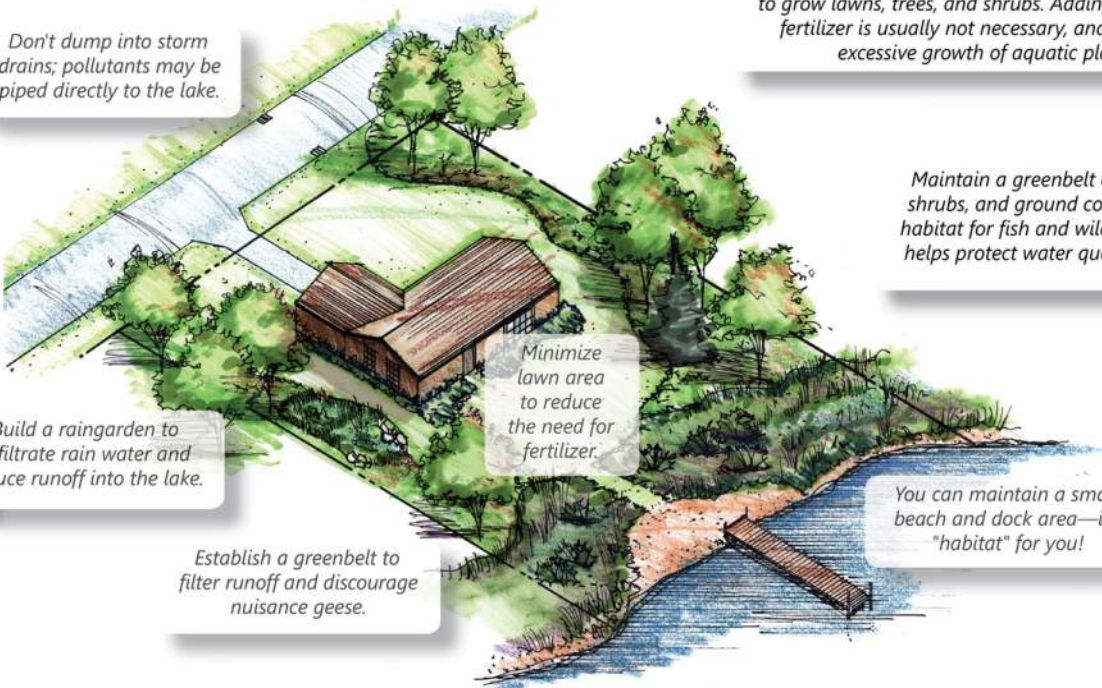
Build a raingarden to infiltrate rain water and reduce runoff into the lake.

Minimize lawn area to reduce the need for fertilizer.

Maintain a greenbelt of trees, shrubs, and ground cover—it's habitat for fish and wildlife, and helps protect water quality too.

Establish a greenbelt to filter runoff and discourage nuisance geese.

You can maintain a small beach and dock area—it's "habitat" for you!



How Shoreline Property Owners Can Help Protect White Lake:

Reduce Nutrient Pollution


- Skip phosphorus-based fertilizers. Many lawns already have enough phosphorus, so extra amounts often end up in the lake. If you hire a lawn care service, ask them to use phosphorus-free products.
- Use less fertilizer overall. Follow label instructions, and when possible, use even less.
- Water wisely. Overwatering can wash fertilizers and soil into the lake.
- Don't feed ducks or geese. Their droppings are rich in nutrients that can fuel algae growth.
- Avoid burning yard waste near the shore. Nutrients are concentrated in the ash, which can easily wash into the lake.
- Keep leaves, grass clippings, and other yard waste out of the lake. As plant material breaks down, it releases nutrients into the water, which can fuel the growth of aquatic plants and algae.
- Let native plants grow near the shoreline. Skip mowing right to the water's edge. Instead, allow a buffer of natural vegetation to grow. It helps filter runoff and can also keep nuisance geese away.
 - ► More info: shoreline.msu.edu
- Slow down stormwater runoff. Rain gardens can soak up water from roofs and driveways, reducing runoff into the lake.
 - ► Learn more: raingardennetwork.com

Limit Chloride Pollution

- Check your water hardness. If it's already low, you may not need a softener at all.
- Soften only where needed. Skip softening water for outdoor taps or cold drinking water.
- Adjust your settings. If you're going through more than one bag of salt per month, your system might need fine-tuning.
- Consider upgrading. Newer, demand-initiated softeners use less salt and only regenerate when needed.
- Extend the cycle time. If you have a timer-based unit, set it to regenerate less often if possible.
- Watch where it drains. Avoid discharging softener backwash onto lawns or near the lake. If possible, redirect it to a dry well or connect to the sewer system.
- ► Learn more: <https://dnr.mo.gov/water/how-water/pollutants-sources/chloride>



A reliable resource for
information on Michigan's
inland lakes.

 michiganlakeinfo
michiganlakeinfo.com



WILD CELERY FACT SHEET

Created by Progressive Companies / Water Resources Group

Vallisneria americana, commonly known as wild celery or eelgrass, is a submerged aquatic plant native to North America. It plays an important role in freshwater ecosystems, providing food for migratory waterfowl and habitat for fish and invertebrates, stabilizing sediment, and improving water quality. However, its rapid growth and expansive coverage can raise concerns for navigation and recreational activities in affected water bodies.

Wild celery can form dense mats that may obstruct waterways, making navigation challenging for boaters. These thick patches can reduce visibility and maneuverability, posing risks for boaters who may not be able to detect shallow areas or obstacles. In addition, *Vallisneria* is shallow-rooted and can be easily dislodged, allowing it to float and accumulate along shorelines.

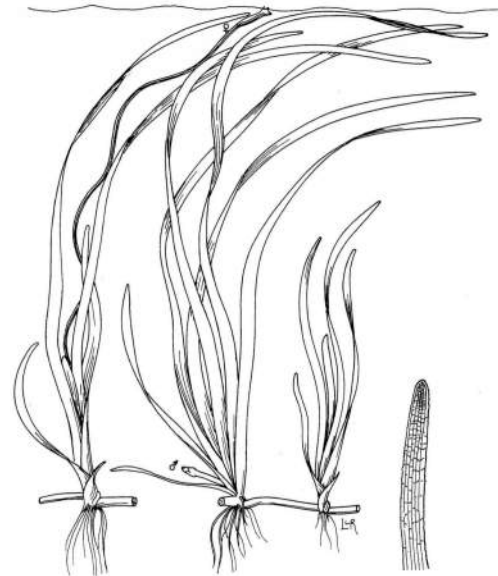
While most aquatic plants can be effectively controlled with herbicides, treating wild celery is often less successful, as treatment typically only suppresses growth rather than eliminating the plant entirely. Further, wild celery has a robust rhizome system that allows it to regenerate even after herbicide application, making season-long control challenging.

The most common method employed to manage its growth is the application of chelated copper, a form of copper complexed with organic compounds, which enhances its efficacy and reduces toxicity to non-target organisms. Chelated copper acts as an herbicide by disrupting the photosynthetic process in aquatic plants. The effectiveness of chelated copper is highly dependent on application timing and concentration. Optimal results are typically observed when applied in late spring or early summer when *Vallisneria* is actively growing. Even so, the remaining plant mass and relatively quick regrowth present continuous management challenges.

The Michigan Department of Environment, Great Lakes, & Energy (EGLE) requires a permit be obtained prior to applying herbicides to lakes in Michigan. The permits specify approved herbicides, dosage, use restrictions, and areas of the lake where treatments are allowed. For wild celery, only two treatments in the same area are permitted per year.

Another option for controlling wild celery is mechanical harvesting, which involves the physical cutting and removal of the plant. This method is particularly suitable for large sections of the lake ranging from two to eight feet in depth that exhibit dense growth, especially in areas away from developed shorelines where herbicide treatment is not permitted. In most cases, harvesting does not require a permit. Still, there are limitations to this method such as cost, non-selective plant removal, uncaputured plant fragments, and the need to transport plant material for disposal.

While wild celery does offer ecological benefits, its dense growth can interfere with recreation and navigation. Both chemical and mechanical management strategies have their place, though each comes with limitations that require careful consideration. Boaters navigating through areas with heavy vegetation should trim up their motors to prevent damage and reduce the risk of becoming stuck. If you have concerns about wild celery or other aquatic vegetation in your lake, it's best to speak with your lake management consultant to determine the most appropriate and environmentally responsible course of action.



AQUATIC HERBICIDES FACT SHEET

Created by Progressive Companies / Water Resources Group

Prevention is the first defense in exotic species control. However, once an exotic plant has colonized a lake, a rapid response should be taken to control its spread. One such response is the use of aquatic herbicides.

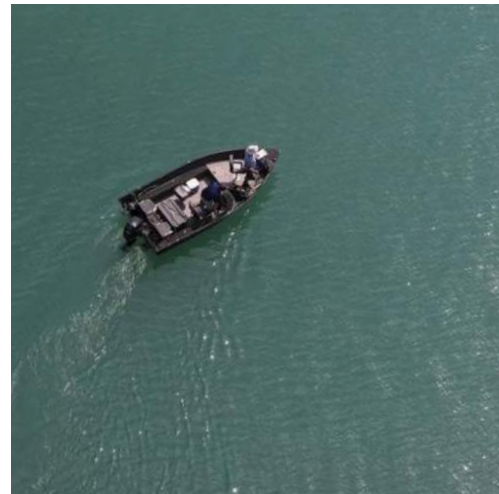
In Michigan, a permit is required from the Michigan Department of Environment, Great Lakes, and Energy (EGLE) to apply herbicides to lakes. The permit lists the herbicides that are approved for use, respective dose rates, use restrictions, and indicates specific areas of the lake where treatments are allowed. EGLE aquatic herbicide permitting information can be found at <https://www.michigan.gov/egle/about/organization/water-resources/aquatic-nuisance-control>.

Prior to being applied to Michigan's inland lakes, herbicides must be registered and approved by the Environmental Protection Agency (EPA). There are currently over 300 herbicides registered with the EPA. Of those, only about a dozen are approved for use in the aquatic environment. In addition to Michigan's permitting system, there are federal regulations that require herbicide applicators to acquire a pesticide general permit and to prepare and submit a pesticide discharge management plan. Herbicide applicators must also obtain a pesticide applicator certification through the Michigan Department of Agriculture and Rural Development (MDARD) prior to applying aquatic herbicides.

There are two basic types of herbicides: systemic and contact. Systemic herbicides are taken up by the plant and translocated to the root system killing the plant entirely. With systemic herbicides, it may take several weeks for the impacts to the treated plants to become apparent. Contact herbicides act quickly, impacting plants within a week after treatment, but only affect the portion of the plant that comes into contact with the herbicide, leaving the roots intact and viable. This allows the plants to reestablish more quickly, allowing them to potentially grow to nuisance levels again later in the season.



Eurasian milfoil (*Myriophyllum spicatum*).



Aquatic plant survey.

Unlike systemic herbicides that are selective in controlling invasive plants like Eurasian milfoil, contact herbicides can impact a broad spectrum of plant species, but timing and rate of application can be used to minimize non-target impacts. Deciding which herbicide to use in a particular situation will depend on the plant(s) being targeted, potential impacts to non-target species, cost, use restrictions, and other factors. In general, herbicide treatments should target nuisance exotic species such as Eurasian milfoil and starry stonewort and have minimal impacts on most native plant species.

If applied properly, herbicides have no direct impacts on fish or other aquatic animals. Herbicides approved for aquatic application disrupt a variety of plant-specific processes including cell growth, DNA synthesis, photosynthesis, and enzyme production. In general, lakes with a variety and moderate density of plants often support healthy fisheries. Targeting invasive exotic plants with herbicides aids in the preservation of valuable, native plants that provide habitat and cover for fish and other aquatic organisms.

The best approach or combination of approaches to control aquatic plants in a particular lake depends on local conditions and the expectations of lake residents. Once an exotic plant has been introduced in a lake, a complete eradication is unlikely and a sustained effort is often required to ensure control. Ask your lake management consultant about the best way to manage the aquatic plants in your lake.



Systemic herbicide.



Starry stonewort (*Nitellopsis obtusa*).

A reliable resource for information on Michigan's inland lakes.




MECHANICAL HARVESTING FACT SHEET

Created by Progressive Companies / Water Resources Group

Mechanical harvesting (i.e., plant cutting and removal) and herbicide application are methods commonly used to control nuisance aquatic plant growth in Michigan's inland lakes. In some situations, mechanical harvesting is the best solution to reduce nuisance aquatic plant growth. When aquatic plants are treated with herbicides, they die, sink to the bottom, and decompose, creating an ideal environment for future plant growth. During decomposition, bacteria consume dissolved oxygen reserves which can lead to oxygen depletion, putting stress on the aquatic organisms within a treatment area. When plants are harvested, the biomass is removed from the lake along with the nutrients contained within the plant tissues. This prevents the re-assimilation of these nutrients back into the lake and also reduces the risk for oxygen depletion. For more information about nutrient dynamics in lakes, please visit: <https://www.michiganlakeinfo.com/trophic-state>

In most cases, harvesting does not require a permit. This allows for the physical removal of plants to take place in areas of the lake not permitted for herbicide treatments. However, mechanical harvesters have limitations on where they can successfully operate. Most mechanical harvesters require at least two feet of water to operate efficiently. Also, liability and maneuverability can limit operation in the immediate proximity of moored boats, docks, and boat hoists.

Though harvesting is an effective tool for many lakes, this plant control method does have limitations. First, this approach is somewhat expensive due to the cost of the equipment and the time it takes to perform the task. Second, the harvester is unable to selectively remove plants. Most plant material in the path of the harvester will be removed, however, not all plant material will be harvested as aquatic plants may bend, move, or float away from the harvester during operation. Finally, the biomass removed from a lake must be disposed of somewhere. Farmers will often accept the plant material for use as mulch or fertilizer, but transport to the disposal site may add time and costs to the project.

There are some situations where harvesting may be detrimental to a lake ecosystem. Non-native milfoil species should be avoided when harvesting as they reproduce and spread through fragmentation. As there are herbicides that specifically target non-native milfoil species, it is recommended to use those selective herbicides for control. Both herbicide application and mechanical harvesting should be considered when approaching starry stonewort management. If mechanical harvesting is the selected mode of control, care should be taken by the harvesting contractor as starry stonewort can also spread through fragmentation.



Vegetation removal.



Mechanical harvester in operation.



THE ROLE OF PHOSPHORUS IN LAKE ECOLOGY

FACT SHEET

Created by Progressive Companies / Water Resources Group

Lakes can be classified into three broad categories based on their productivity or ability to support plant and animal life. The three basic lake classifications are “oligotrophic,” “mesotrophic,” and “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 warm water fish such as bass and pike. Lakes that fall between these two extremes are called mesotrophic lakes.

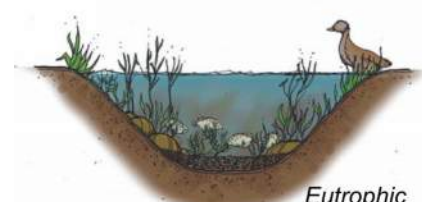
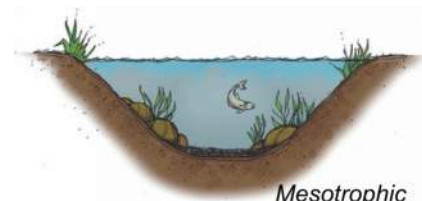
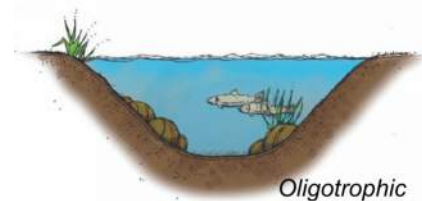
Lakes that receive large inputs of nutrients are susceptible to excessive plant and algae growth and an acceleration of the natural progression from an oligotrophic state to a eutrophic one. This process is called eutrophication. Phosphorus, the nutrient that most often drives aquatic plant and algae growth, can be introduced to a lake from both internal and external sources.

External phosphorus loading refers to the amount of phosphorus entering a lake from its watershed or directly from the atmosphere. Watershed inputs include phosphorus tied to organic material in surface water runoff, groundwater movement into the lake (often tied to septic seepage), or from a point source such as a river or stream flowing directly into a lake. Phosphorus that enters a lake from external sources is available for use by plants and algae and eventually ends up in the lake’s sediments, where, in the presence of oxygen, is bound to sediment particles. However, if a lake is mesotrophic or eutrophic, anoxic (oxygen-free) conditions often exist in water deeper than around 20-25 feet as a lake thermally stratifies (warm water near the surface overlays deeper, cooler water) in the late spring and summer. These anoxic conditions allow for the release of phosphorus from sediment particles, making it available again for use by plants and algae. This type of phosphorus loading that occurs within a lake where sediment-bound phosphorus is recycled back into the water column is called internal loading.

Lakes that experience internal loading often exhibit algae blooms during the summer and into the fall as some of the phosphorus from deeper water can leak into the warm upper waters of a lake through diffusion or mixing. One way to limit internal phosphorus loading is to make the available phosphorus inactive again by applying an aluminum or lanthanum-based salt to the lake. This binds the dissolved phosphorus into fine, solid particles that eventually sink to the deeper portions of the lake and are unavailable for algal growth.



Filamentous algae bloom.



Trophic states.

Phosphorus inactivation can provide long term control of nuisance algae due to the reduction of available nutrients that drive algal growth.¹ An added benefit to these treatments occurs when the precipitated solid material is sufficient enough to create a chemically impermeable barrier above the sediments that effectively inhibits future release of phosphorus – even under anoxic conditions. The duration of effectiveness can vary depending on the characteristics of the lake but generally lasts several years, in some cases, even decades.²

Typical management of algae involves the use of algicides which break down the structure of algal cells and are only effective for a very short duration (usually a few days). If favorable growth conditions persist in a lake, algae growth will follow. Additionally, some copper-based algicides do not break down completely and can build up in the sediments after repeated usage.

When evaluating whether a lake is a good candidate for nutrient inactivation, a thorough study of the lake’s water chemistry and sediment characteristics should be undertaken by a qualified scientist to ensure that the treatments will be effective given the high potential cost of this management strategy. Current technology favors the use of either aluminum sulfate (Alum) or lanthanum carbonate³ (Phoslock⁴ or EutroSORB G⁵) as the most effective phosphorus inactivation treatments available and permitted for use in Michigan. Alum is commonly used to treat wastewater and drinking water and, over the last half-century, there have been hundreds of lake alum treatments. Alum treatments require special application equipment and can be quite costly. Although comparable in cost, application of currently available lanthanum-based products are more easily applied to lake waters than alum. Both treatments require a Rule 97 Certification of Approval from the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

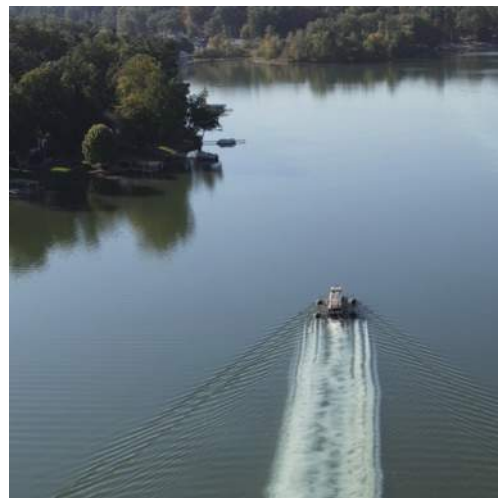
When evaluating the best tool for nutrient inactivation, several factors will need to be assessed including a lake’s physical, chemical, and hydrologic characteristics. These evaluations can best be conducted by an unbiased third-party consultant having no financial ties to either of these nutrient inactivation tools.

References:

- 1 Cooke, G.D., E.B. Welch, S.A. Peterson, S.A. Nichols. 2005. Restoration and Management of Lakes and Reservoirs, Third Edition. Taylor & Francis.
- 2 Progressive AE. 2023. Byram Lake Water Quality Report.
- 3 Zhang, S., et al. 2022. Adsorption of Phosphorus by Surface Precipitation on Lanthanum Carbonate Through In Situ Anion Substitution Reactions. Frontiers in Environmental Science Volume 10.
- 4 Phoslock is a trademark of PET Water Solutions, Victoria, Australia
- 5 EutroSORB G is a trademark of SePRO Corp., Carmel, IN



Sediment core sample.



Alum application.



FERTILIZERS & WATER QUALITY FACT SHEET

Created by Progressive Companies / Water Resources Group

Phosphorus is the nutrient that most often stimulates excessive growth of aquatic plants and algae, leading to a variety of problems in aquatic ecosystems. The nutrient enrichment of waterbodies is called eutrophication. Elevated phosphorus levels accelerate the eutrophication process, leading to the premature aging of Michigan's inland lakes.

To reduce this problem, many Great Lakes states including Michigan, Minnesota, and Wisconsin now restrict the use of lawn fertilizers that contain phosphorus. Michigan's law (PA 299 of 2010) allows phosphorus use only when establishing a new lawn or when a soil test shows the soil is low in phosphorus. The law also limits fertilizer use near surface waters and prohibits applications on frozen or saturated ground. Agricultural fertilizers remain exempt from this law entirely. On golf courses, fertilizers containing phosphorus are permitted for use if a staff member has completed a state-required training course.

Other states have similar regulations. In 2002, Minnesota was the first to adopt a statewide phosphorus fertilizer law. Studies conducted in Minnesota found that phosphorus-free fertilizers were easily obtainable, that many homeowners supported the change, the law did not increase consumer costs, and that overall phosphorus use declined. Further, local governments in several states have added their own ordinances on top of state rules.

Recent research has looked closely at how fertilizer limits influence water quality. Studies indicate that limiting phosphorus fertilizer use can reduce nutrient pollution and gradually improve water clarity in lakes. Improvements tend to be more notable when fertilizer use is limited during seasons when turfgrass is not actively growing, because unused fertilizer is more likely to wash off the land during those periods.

Reducing fertilizer use is only one piece of the solution. Soil erosion, animal waste, and previous over-application of fertilizer can also contribute to elevated phosphorus levels in lakes. Nonetheless, fertilizer laws are one practical way to reduce the flow of nutrients from lawns into nearby streams and lakes.

Property owners can support efforts to limit nutrient inputs by choosing phosphorus-free fertilizers unless a soil test indicates a deficiency. Keeping fertilizer off of impervious surfaces like sidewalks and driveways, avoiding application before heavy rain, and maintaining sufficiently vegetated buffers near the water's edge all help reduce runoff. Although it often takes years to measure conclusive changes in lake conditions, limiting unnecessary phosphorus use is key to protecting water quality over the long term.



Insufficient buffer strip along the water's edge.



Algae bloom exacerbated by excess nutrients.

