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PAW PAW LAKE

ANNUAL REPORT

PREPARED FOR:
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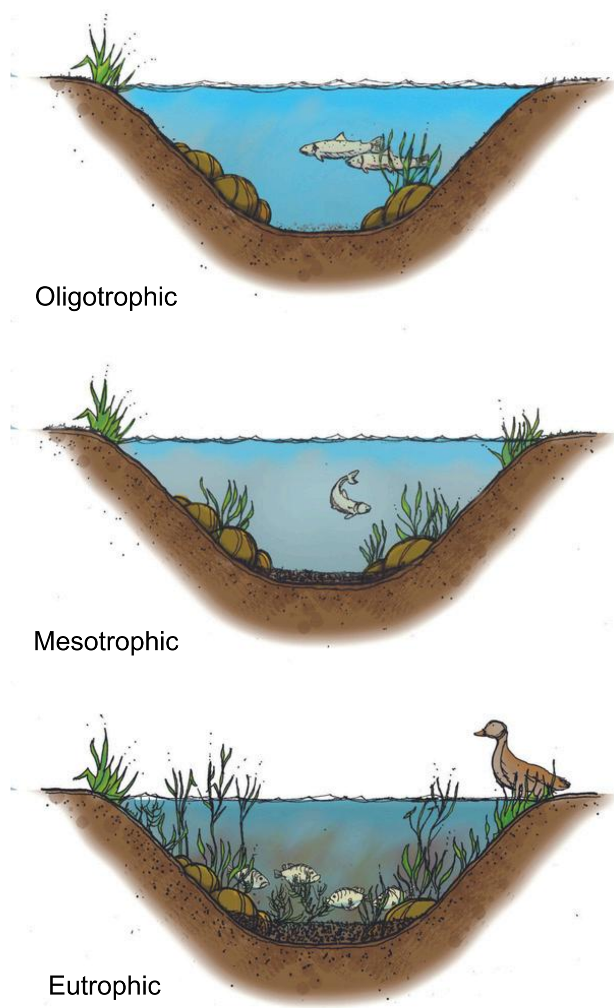
LAKE WATER QUALITY

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.



Lake classification.

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.

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.

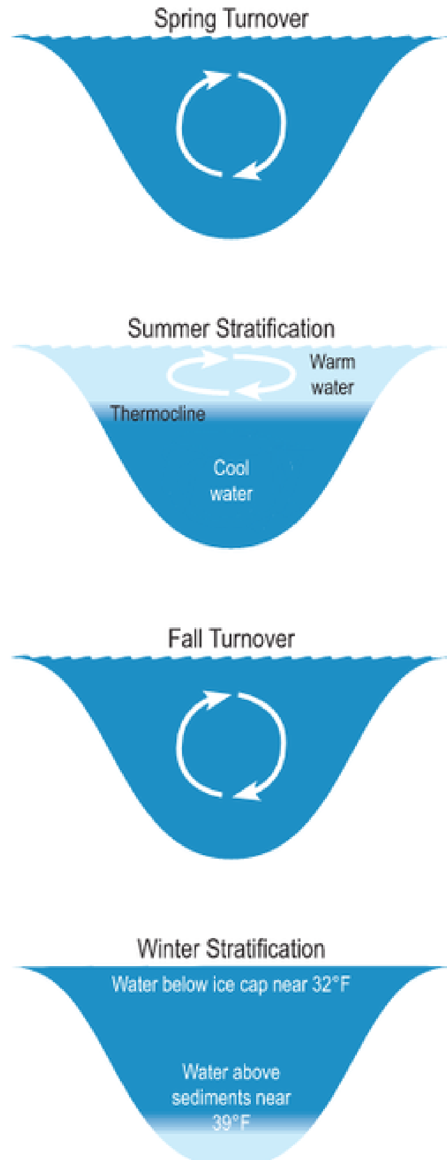
TABLE 1 - LAKE CLASSIFICATION CRITERIA

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

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.

SAMPLING RESULTS AND DISCUSSION

Sampling results are provided in Tables 2 and 3. In March of 2025, sampling was conducted during spring turnover when water temperatures were cool and dissolved oxygen concentrations were high. During the August sampling period, Paw Paw Lake was thermally stratified; the lake was warm and well-oxygenated at the surface, and was cool with low oxygen near the bottom. In 2025, total phosphorus concentrations were moderate to slightly elevated in the spring. The summer total phosphorus concentrations were moderate to high down to about 40 feet; below that depth, the phosphorus concentrations increased considerably. The elevated bottom-water phosphorus is likely due to internal release of phosphorus from the lake sediments. Secchi tranparency measurements were in the eutrophic range in both spring and summer while chlorophyll-*a* concentrations were high in the spring (eutrophic) and moderate (mesotrophic) in the summer. Based on historical and recent sampling results, Paw Paw Lake is classified as meso-eutrophic.

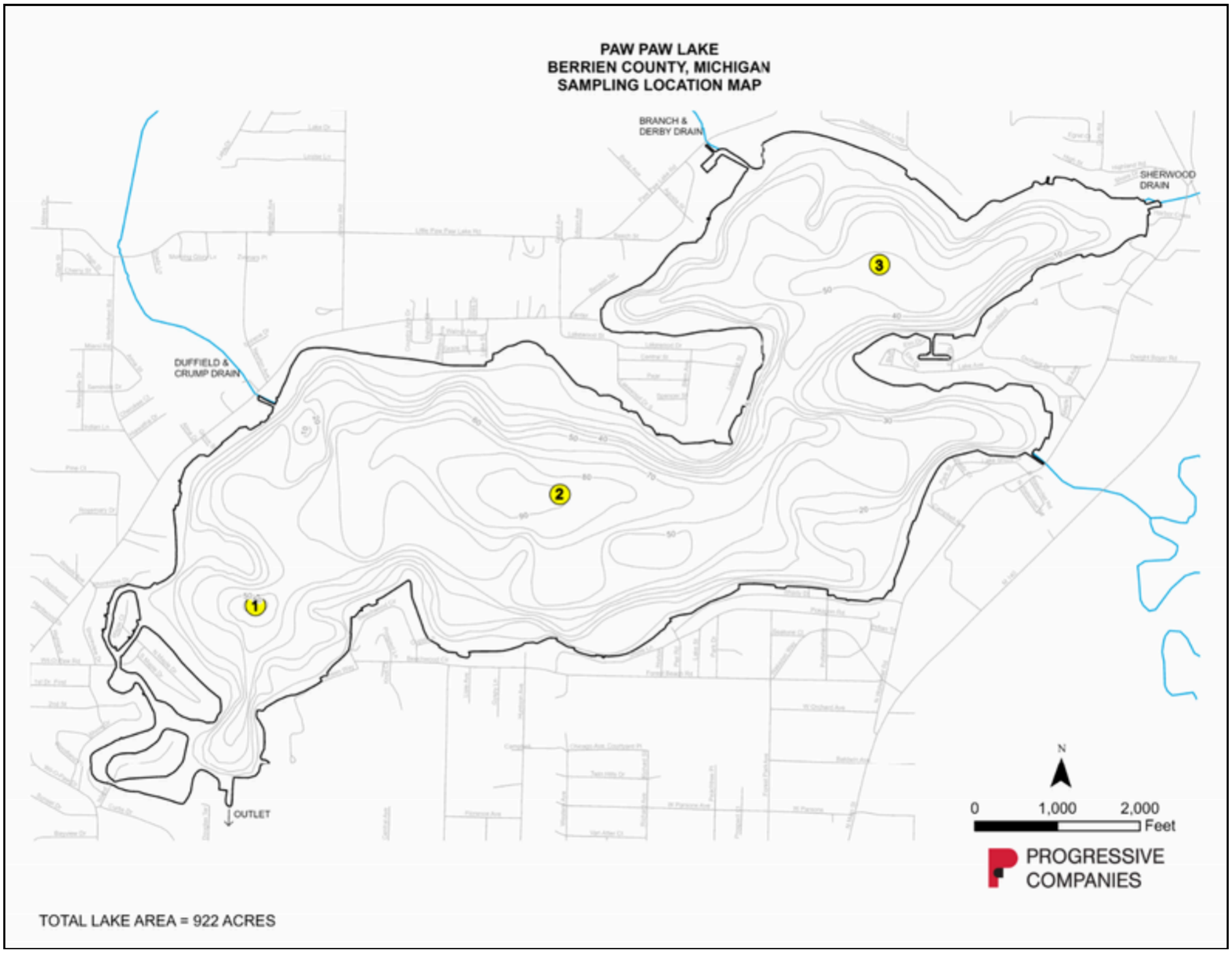


TABLE 2 - PAW PAW LAKE 2025 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (F)	Dissolved Oxygen (mg/L)*	Total Phosphorus (µg/L)*
14-Apr-25	1	1	47	14.4	25
14-Apr-25	1	10	47	14.1	24
14-Apr-25	1	20	46	13.3	16
14-Apr-25	1	30	45	13.1	17
14-Apr-25	1	40	45	13.2	12
14-Apr-25	1	50	45	12.5	10
14-Apr-25	1	58	45	12.4	14
14-Apr-25	2	1	47	13.4	16
14-Apr-25	2	10	46	13.4	11
14-Apr-25	2	20	46	12.9	19
14-Apr-25	2	30	45	12.5	16
14-Apr-25	2	40	45	12.5	17
14-Apr-25	2	50	45	12.6	22
14-Apr-25	2	60	44	12.5	17
14-Apr-25	2	70	44	12.3	15
14-Apr-25	2	80	44	12.0	28
14-Apr-25	2	89	44	11.7	18
14-Apr-25	3	1	48	13.4	24
14-Apr-25	3	10	48	13.4	11
14-Apr-25	3	20	46	12.5	17
14-Apr-25	3	30	45	11.7	20
14-Apr-25	3	40	45	10.9	17
14-Apr-25	3	52	45	9.9	28

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

TABLE 2 - CONTINUED

Date	Station	Sample Depth (feet)	Temperature (F)	Dissolved Oxygen (mg/L)*	Total Phosphorus (µg/L)*
26-Aug-25	1	1	75	7.0	15
26-Aug-25	1	10	74	6.7	13
26-Aug-25	1	20	74	6.4	<10
26-Aug-25	1	30	58	0.1	17
26-Aug-25	1	40	53	0.1	60
26-Aug-25	1	50	51	0.2	148
26-Aug-25	1	56	51	0.2	146
26-Aug-25	2	1	75	8.2	10
26-Aug-25	2	10	75	7.8	25
26-Aug-25	2	20	74	6.6	<10
26-Aug-25	2	30	62	0.1	16
26-Aug-25	2	40	52	0.1	46
26-Aug-25	2	50	50	0.1	170
26-Aug-25	2	60	49	0.1	185
26-Aug-25	2	70	49	0.1	232
26-Aug-25	2	80	48	0.1	273
26-Aug-25	2	87	49	0.1	293
26-Aug-25	3	1	76	8.1	18
26-Aug-25	3	10	75	7.1	16
26-Aug-25	3	20	75	4.8	10
26-Aug-25	3	30	56	0.1	58
26-Aug-25	3	40	51	0.1	352
26-Aug-25	3	50	50	0.2	355

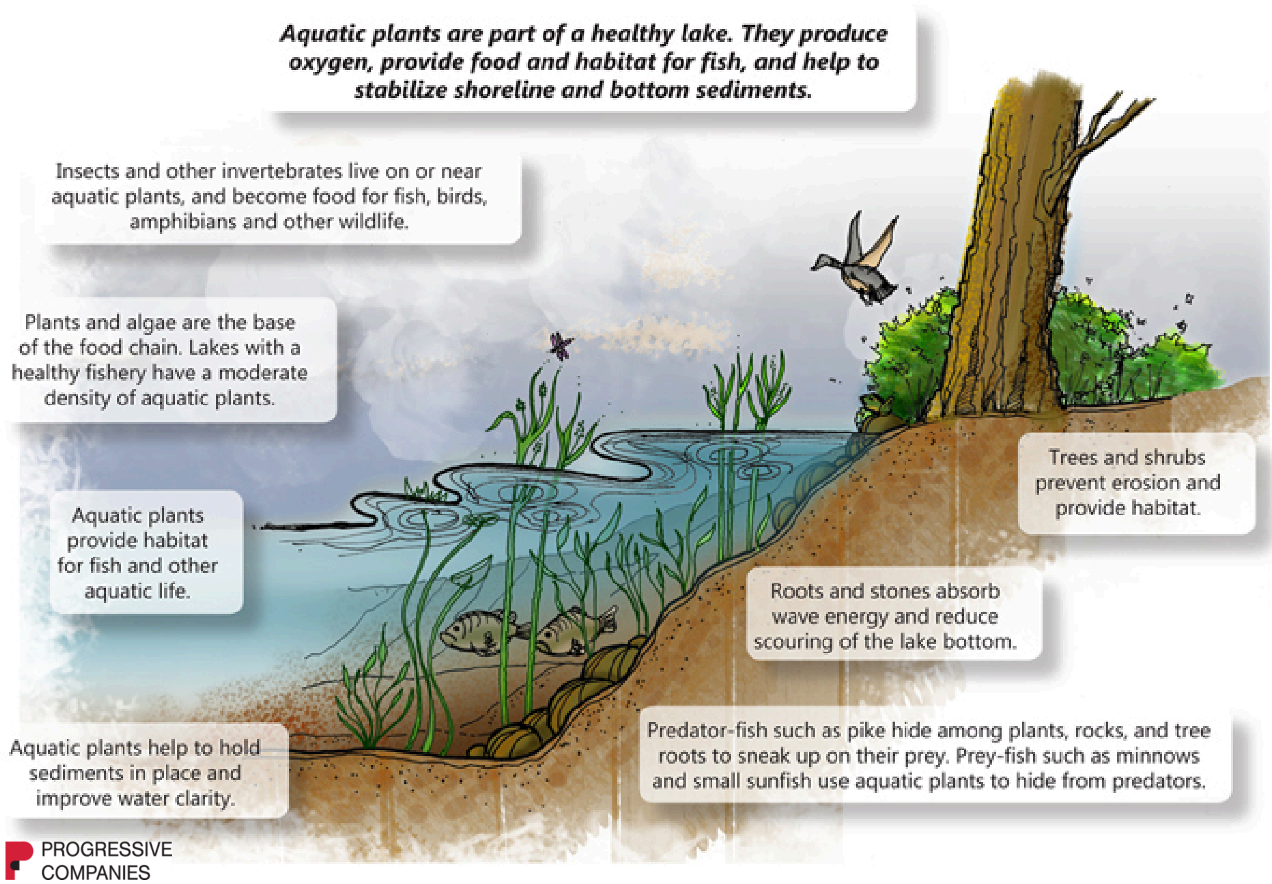
TABLE 3 - PAW PAW LAKE 2025 SURFACE WATER QUALITY DATA

Date	Station	Secchi Transparency (feet)	Chlorophyll-*a* (µg/L)*
14-Apr-25	1	6	16
14-Apr-25	2	5	19
14-Apr-25	3	5	16
26-Aug-25	1	5	4
26-Aug-25	2	5	4
26-Aug-25	3	5	4

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

PLANT CONTROL PROGRAM SUMMARY

A nuisance aquatic plant control program has been ongoing on Paw Paw 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 Paw Paw Lake in 2025.

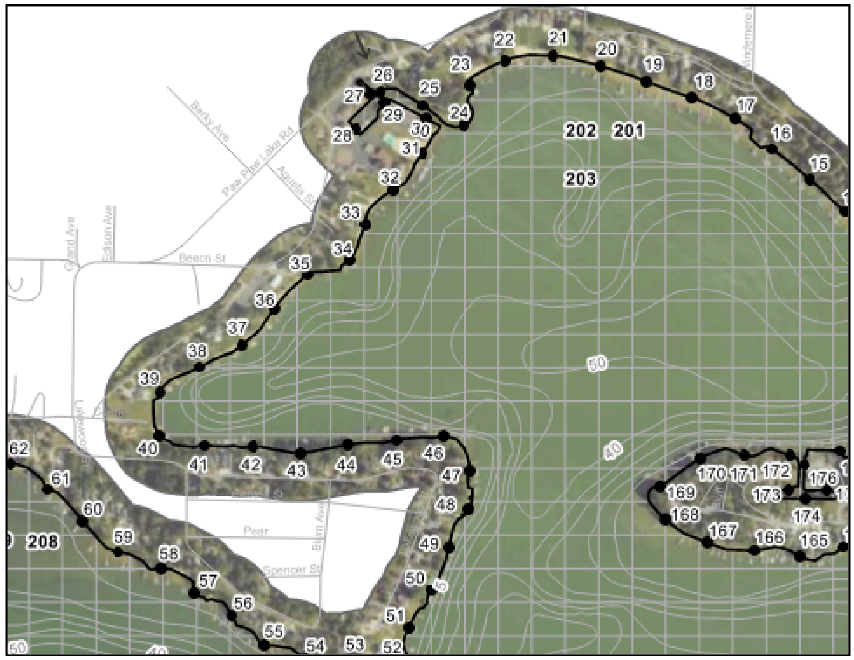


Aquatic plants are an important component of lakes. They produce oxygen during photosynthesis, provide food, habitat and cover for fish, and help stabilize shoreline and bottom sediments. There are four main aquatic plant groups: submersed, floating-leaved, free-floating, and emergent. Each plant group 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 Paw Paw Lake. Plant control efforts in 2025 consisted of four aquatic plant surveys and four aquatic 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 contractor. 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



Curly-leaf pondweed
Potamogeton crispus

Primary plants targeted for control in Paw Paw Lake include Eurasian milfoil, curly-leaf pondweed, 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 2025 are summarized in Table 4.

Starry stonewort
Nitellopsis obtusa

In Michigan, an Aquatic Nuisance Control (ANC) permit must be acquired from the Department of Environment, Great Lakes, and Energy (EGLE) before herbicides are applied to inland lakes. The permit lists the herbicides that are approved for use, maximum dose rates, use restrictions, and indicates specific areas of the lake where herbicides may be applied. Permit requirements are designed to protect public health and the environment. The contracted herbicide applicator on Paw Paw Lake, PLM Lake & Land Management Corp., holds the ANC permit for the lake.

TABLE 4 - PAW PAW LAKE 2025 PLANT CONTROL ACTIVITIES

Date	Plants Targeted	Acreage
May 27	E. milfoil, curly-leaf	68.50
June 26	E. milfoil	88.00
August 4	E. milfoil, starry stonewort	28.00
August 19	nuisance natives	1.25
Total		**185.75**

In 2025, 185.75 acres of Paw Paw Lake were treated with aquatic herbicides throughout the season. Eurasian milfoil was treated with a combination of systemic and contact herbicides. Curly-leaf pondweed was treated in May using contact herbicides which provided control of the invasive plant. Starry stonewort was treated with a contact herbicide in a few small areas.

Due to unsatisfactory milfoil control results on Paw Paw Lake in recent years, 22 milfoil samples were collected from various locations around the lake for genetic analysis. All 22 samples were identified as the Eurasian milfoil strain E_MISGP_734, a common strain known to be susceptible to both fluridone and 2,4-D treatments. This particular strain has not been laboratory tested with other herbicides, so no additional data are available on its susceptibility to other treatment options. Fluridone is typically applied as a whole-lake treatment. Because Paw Paw Lake is relatively deep and large, maintaining effective fluridone concentrations throughout the water column would be challenging and costly, making it a less practical option. The use of 2,4-D will be considered for targeted spot-treatments; however, its use is subject to additional permit restrictions limiting the areas of the lake in which its application is allowed.

The systemic herbicides triclopyr and florpyrauxifen-benzyl have demonstrated efficacy against most Eurasian milfoil strains. Both products are effective at selectively targeting milfoil while minimizing impacts on native aquatic plants. These herbicides are planned for use in 2026, with application rates and treatment areas carefully selected to achieve effective control of the milfoil population in Paw Paw Lake.

PLANT INVENTORY SURVEY

In addition to the surveys of the lake to identify invasive plant locations, a detailed vegetation survey of Paw Paw Lake was conducted on August 26 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, 13 submersed species, one free-floating species, three floating-leaved species, and eight emergent species were found in the lake. Paw Paw Lake maintains a good diversity of beneficial native plant species.

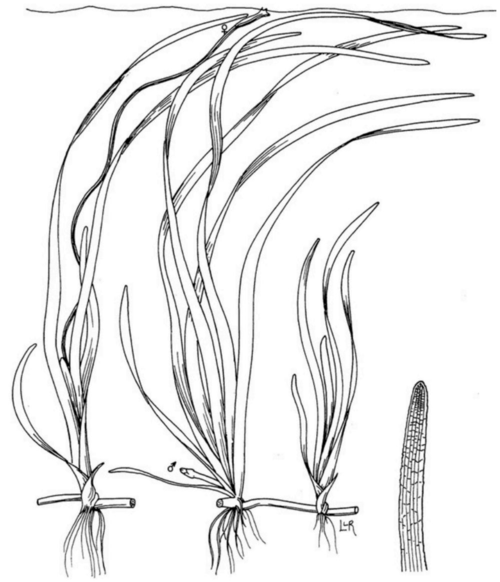
TABLE 5 - PAW PAW LAKE 2025 PLANT INVENTORY DATA

Common Name	Scientific Name	Group	Percentage of sites where present
Wild celery	*Vallisneria americana*	Submersed	63
Eurasian milfoil	*Myriophyllum spicatum*	Submersed	41
Coontail	*Ceratophyllum demersum*	Submersed	39
Chara	*Chara* sp.	Submersed	25
Thin-leaf pondweed	*Potamogeton* sp.	Submersed	17
Large-leaf pondweed	*Potamogeton amplifolius*	Submersed	13
Water stargrass	*Heteranthera dubia*	Submersed	7
Starry stonewort	*Nitellopsis obtusa*	Submersed	5
Flat-stem pondweed	*Potamogeton zosteriformis*	Submersed	5
Slender naiad	*Najas flexilis*	Submersed	4
Leafy pondweed	*Potamogeton foliosus*	Submersed	1
Variable pondweed	*Potamogeton gramineus*	Submersed	1
Variable-leaf milfoil	*Myriophyllum heterophyllum*	Submersed	1
Duckweed	*Lemna minor*	Free-floating	2
Yellow waterlily	*Nuphar* sp.	Floating-leaved	13
White waterlily	*Nymphaea odorata*	Floating-leaved	9
Floating-leaf pondweed	*Potamogeton natans*	Floating-leaved	1
Arrowhead	*Sagittaria latifolia*	Emergent	7
Purple loosestrife	*Lythrum salicaria*	Emergent	5
Lake sedge	*Carex lacustris*	Emergent	2
Bulrush	*Schoenoplectus* sp.	Emergent	2
Pickerelweed	*Pontederia cordata*	Emergent	1
Swamp loosestrife	*Decodon verticillatus*	Emergent	1
Cattail	*Typha* sp.	Emergent	1
Phragmites	*Phragmites australis*	Emergent	1

Exotic invasive species

PLANT SPOTLIGHT: WILD CELERY

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 widespread coverage have raised concerns about navigation and recreational use in Paw Paw Lake and other regional lakes, as it forms dense mats and accumulates along shorelines when fragmented by boat traffic.



Wild celery is difficult to control with herbicides, as treatments typically suppress rather than eliminate it. Its robust rhizome system allows for rapid regrowth, making season-long control challenging. The most common treatment is chelated copper, a copper compound bound to organic molecules that improve its uptake and reduce toxicity to non-target species. It disrupts photosynthesis and is most effective when applied in late spring or early summer during active growth. However, regrowth and residual plant mass continue to pose 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.

While wild celery does offer ecological benefits, its dense growth can interfere with recreation and navigation. Boaters navigating through areas with dense vegetation should trim up their motors to prevent damage and reduce the risk of becoming stuck. Shoreline property owners are encouraged to manually rake areas of dense wild celery growth along their frontage if its presence is adversely affecting navigational and/or recreational pursuits.

BOATING THROUGH AND AROUND AQUATIC PLANTS

Boating on inland lakes with abundant aquatic vegetation presents unique challenges. Vegetation plays an essential role in Paw Paw lake's ecology, supporting wildlife and improving water quality. Areas of dense vegetation present obstacles for boaters, especially when it binds up propellers or impedes navigation. By following a few simple strategies, boaters can enjoy their time on the water while avoiding damage to both their vessel and the lake ecosystem.

One of the most common issues when boating through aquatic vegetation is the buildup of plants on the motor propeller, which can affect performance and cause engine strain. To avoid this, it's helpful to trim outboard motors up when driving through particularly dense vegetation. This raises the propeller out of the thickest areas of plant growth and reduces the risk of obstruction. If you do end up with vegetation wrapped around the propeller, it's important to remove the debris promptly to prevent engine damage. This can be accomplished by putting the boat in reverse until the accumulated plants come off, briefly lifting the propeller out of the water while in drive, or shutting off the motor and manually removing plant material. Keeping a cutting tool handy on board can make the process quick and safe.

On lakes with significant aquatic plant growth, it's best to choose areas with less dense vegetation for your route. Typically, plants grow closer to the shore, so navigating near the middle of the lake or in deeper water can help you avoid thick patches.

Some species of aquatic plants and algae, especially non-native ones, can be highly destructive to lake ecosystems. Invasive species such as Eurasian milfoil and starry stonewort can spread rapidly, often choking out native species and disrupting local wildlife. Boat propellers can inadvertently fragment these plants, allowing them to spread to new areas of the lake. To help prevent this, boaters should try to avoid traveling through dense beds of aquatic plants. If you do need to pass through such areas, proceed slowly with the motor trimmed up to minimize plant fragmentation. After boating in areas with dense vegetation, be sure to inspect your boat and motor for any remaining plant fragments. Removing plants from your boat, trailer, and gear can prevent the spread of invasive species to other bodies of water.