Aqua Link, Inc.
Pond, Lake & Stream Management & Supplies

December 16, 2025

Lake Carey Welfare Association
PO Box 637
Tunkhannock, PA 18657

Re: Lake Carey
Aquatic Macrophyte Survey Final Report
ALI Project No. 1876-02

Dear Board Members:

Aqua Link was hired by the Lake Carey Welfare Association (hereinafter referred to as the Association) to perform an aquatic macrophyte (vascular plant) survey of Lake Carey amid the peak of the 2025 growing season. Located east of PA Route 29 in Lemon Township, Pennsylvania, Lake Carey has a surface area of approximately 244 acres.

The purpose of this aquatic plant survey was to document the different aquatic plant species (native and non-native) and their respective densities throughout the entire lake basin. Native aquatic plants are an integral component of balanced lake ecosystems and provide important aquatic habitats for numerous aquatic organisms including fish. In contrast, non-native, invasive aquatic plants can upset this delicate balance and outcompete native species, which are often less problematic. Once established, the control or eradication of non-native, invasive aquatic plants can be very expensive, therefore the early detection of non-native, invasive aquatic plants is an essential component of lake management plans.

Of particular interest in Lake Carey is the presence of a non-native, submerged plant species, known as Eurasian watermilfoil (*Myriophyllum spicatum*). This invasive aquatic plant can grow very densely and therefore have the potential for significantly affecting various lake uses along with crowding out native, more beneficial plant species. Eurasian watermilfoil was observed and recorded during the June 2025 survey at multiple sample sites, confirming the existence and spread of the invasive plant within Lake Carey. Surveying for this plant in subsequent years is strongly recommended and will further enable Aqua Link to determine the best management strategies moving forward.

This document represents the final report for the aquatic macrophyte survey, performed by Aqua Link on June 24th, 2025. Section 1 of this report discusses our study design, all methods used to collect field data, and how these data were analyzed. Section 2 represents the results of the aquatic plant survey and Section 3 provides a discussion of our conclusions and our recommendations to control nuisance, problematic aquatic vegetation and to further protect the lake in terms of water quality.

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1. Study Design, Field Methods & Data Analysis

Study Design & Field Methods

Aqua Link performed an aquatic macrophyte (aquatic plant) survey of Lake Carey on June 24th, 2025. The aquatic plant survey was performed by a 2-man field crew using a 14 ft Jon boat with a 9.9hp outboard motor equipped with a Lowrance water depth chart plotter (fathometer or water depth sounder).

For this study, aquatic vegetation (floating, leaved, and submerged) was sampled at 30 different locations throughout the lake along predetermined transects. The locations of all sampling points were recorded using a Garmin GPS unit (Montana 680t model). Following field data collection, all GPS coordinate data were downloaded and archived as a digital data file on our server.

At each lake sampling point, the aquatic plant community was observed and documented. Aquatic plants at the lake surface within reach of the boat were collected by hand for field identification. Next, submerged aquatic vegetation was sampled using an aquatic rake. The aquatic rake was lowered to the lake bottom and dragged a distance of approximately 1 meter (3.3 feet) on each side of the boat. Collected aquatic plants were sorted in the boat and identified. In addition, Aqua Link recorded the relative densities (low, medium, and high) of all aquatic plants that were collected at each of the sampling locations. Aqua Link also retained representative specimens of all vegetation collected during the macrophyte survey. All retained plant specimens were transported back to our laboratory. All identification of collected plant specimens were then verified by a second Aqua Link professional lake manager.

Data Analysis

Aqua Link developed an aquatic plant survey database for this project using Microsoft Excel. All aquatic plant data (e.g. plant identifications, relative densities and GPS locations) were entered into the database for analysis. The GPS data for all sampling locations were transferred into Google Earth mapping software in order to develop additional aquatic macrophyte coverage maps for this project.

2. Aquatic Macrophyte Survey Results

Aqua Link performed a macrophyte (aquatic plant) survey of Lake Carey on June 24th, 2025. The study design, methods, and data analysis for this aquatic macrophyte survey were previously discussed in Section 1. All field data collected as part of this survey are presented in Attachment A of this report.

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A total of 30 individual points were sampled at Lake Carey on June 24th, 2025 (Figure 1). A total of six (6) different aquatic macrophyte species were recorded and identified during the survey (Table 1). The vegetation type for each identified specimen is also provided in Table 1. Macrophyte types were designated as either submerged aquatic vegetation (SAV), floating-leaved aquatic vegetation (FAV), or macro algae (MA). Refer to Attachment B for background information on the aquatic vegetation species that were collected on the field study date. It is to be noted that the plant and macro algae species recorded does not mean that they are the only aquatic species within Lake Carey, nor does it mean it is only present at these sample sites. For example, white water lily and spatterdock were observed in dense numbers in certain areas of the lake, but were not recorded in high densities due to the plant species not being present at the specific sample locations. Plants were only recorded if they were present at the sample point location.

Table 1. Aquatic Plants in Lake Carey in 2025

Common Name	*Scientific Name*	*Plant Type*
Eurasian watermilfoil	***Myriophyllum spicatum***	**SAV**
Claspingleaf pondweed	***Potamogeton perfoliatus***	**SAV**
Spatterdock	***Nuphar lutea***	**FAV**
White water lily	***Nymphaea odorata***	**FAV**
Coontail	***Ceratophyllum demersum***	**SAV**
Stonewort	***Nitella spp.***	**MA**

The most prevalent aquatic macrophytes in Lake Carey were Eurasian watermilfoil (*Myriophyllum spicatum*), followed by white water lily (*Nymphaea odorata*), and spatterdock (*Nuphar lutea*). Eurasian watermilfoil was found in five (5) of the 30 sampling locations, white water lily was found in four (4) of the 30 locations, and spatterdock was found in two (2) of the 30 locations. In total, 33% of all sample locations yielded at least one species of aquatic plant or algae. This distribution of aquatic vegetation is illustrated in Figures 1-4.

Eurasian watermilfoil was found in 17% of the sample locations on Lake Carey, and out of the six (6) sample sites where SAV was found, five (5) of them contained Eurasian watermilfoil (Figure 2 and 3). The results show few submerged plants were found at the sample locations, but where they were found, Eurasian watermilfoil was present at the majority of them. The densities of Eurasian watermilfoil found in the lake range from low to medium densities. Overall, SAV were found in 20% of the sample sites, which consisted of the invasive Eurasian watermilfoil,

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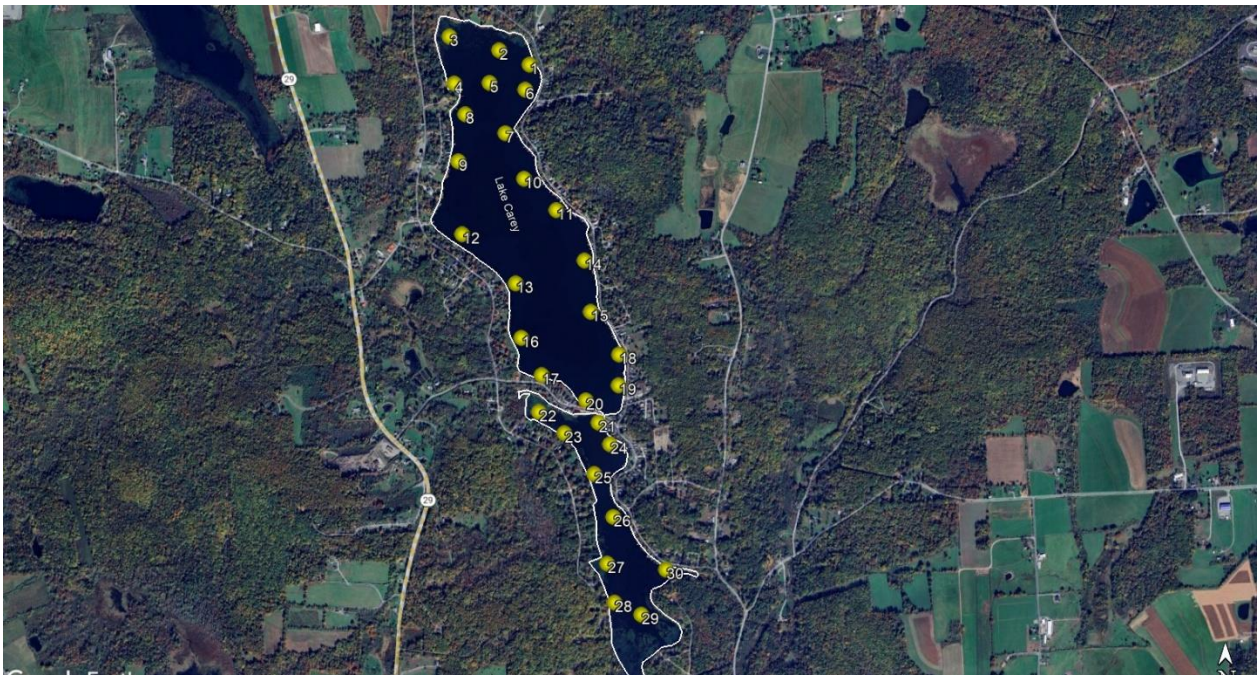


Figure 1. Aquatic Plant Sampling Locations at Lake Carey

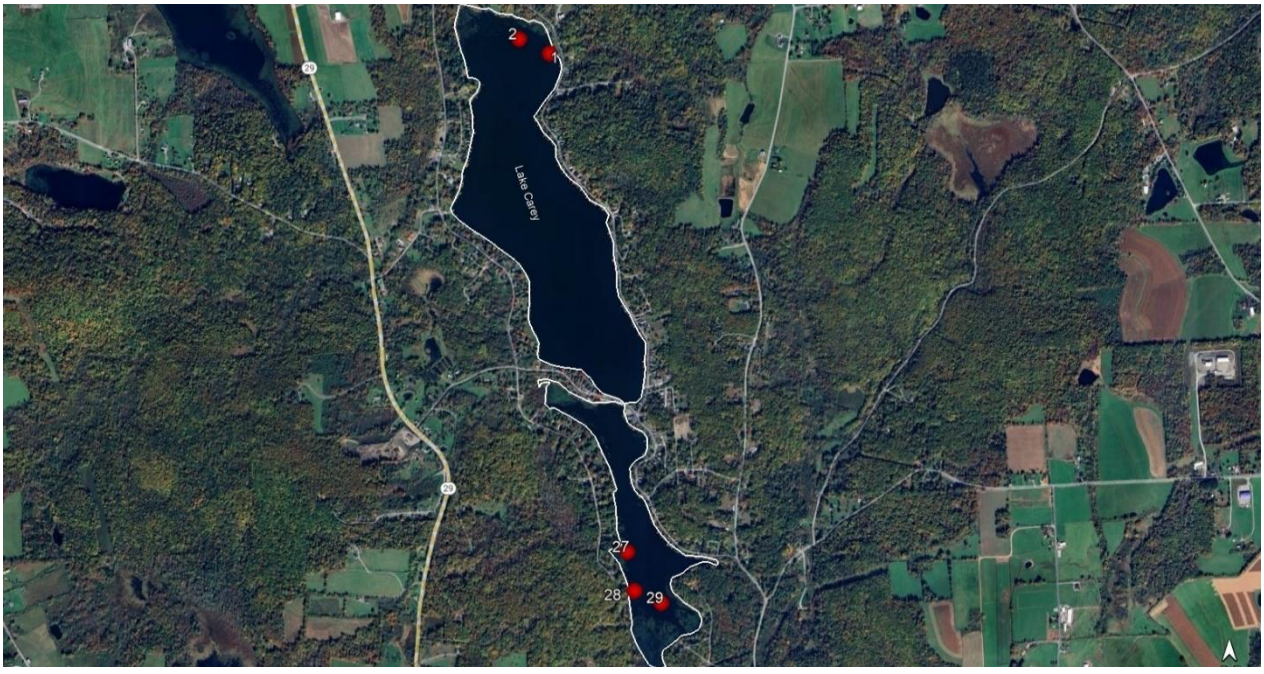


Figure 2. Eurasian Watermilfoil Distribution at Lake Carey

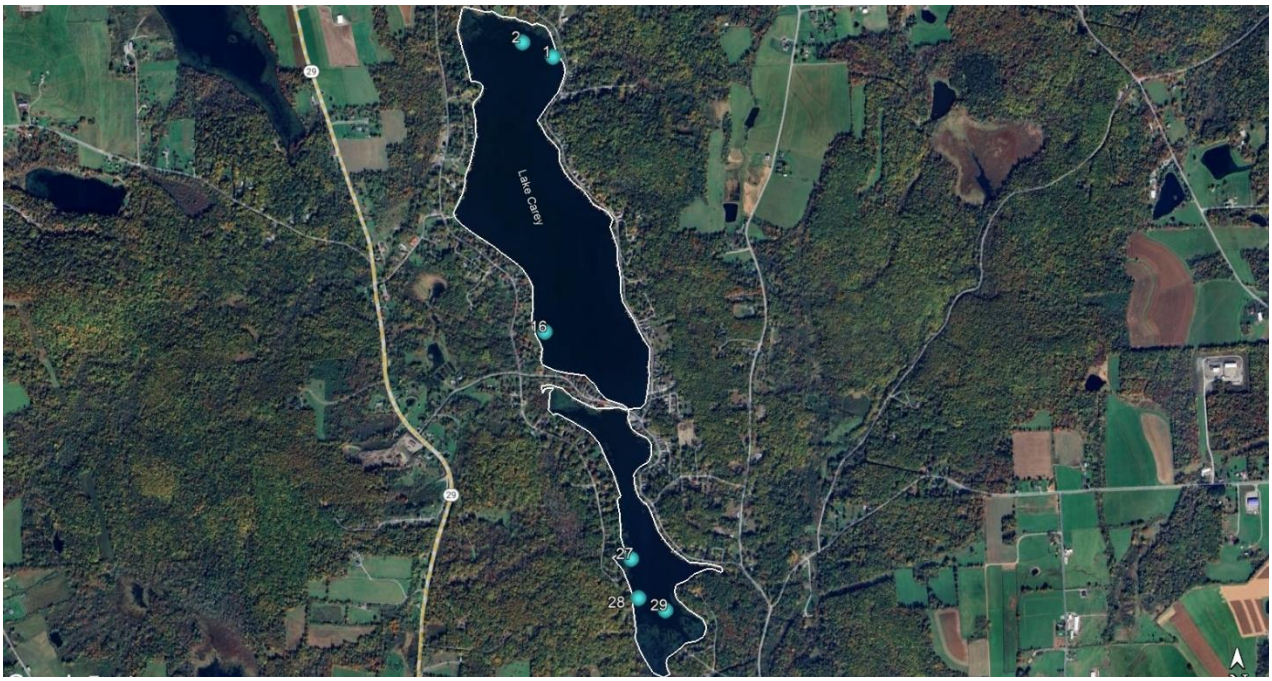


Figure 3. SAV Distribution at Lake Carey

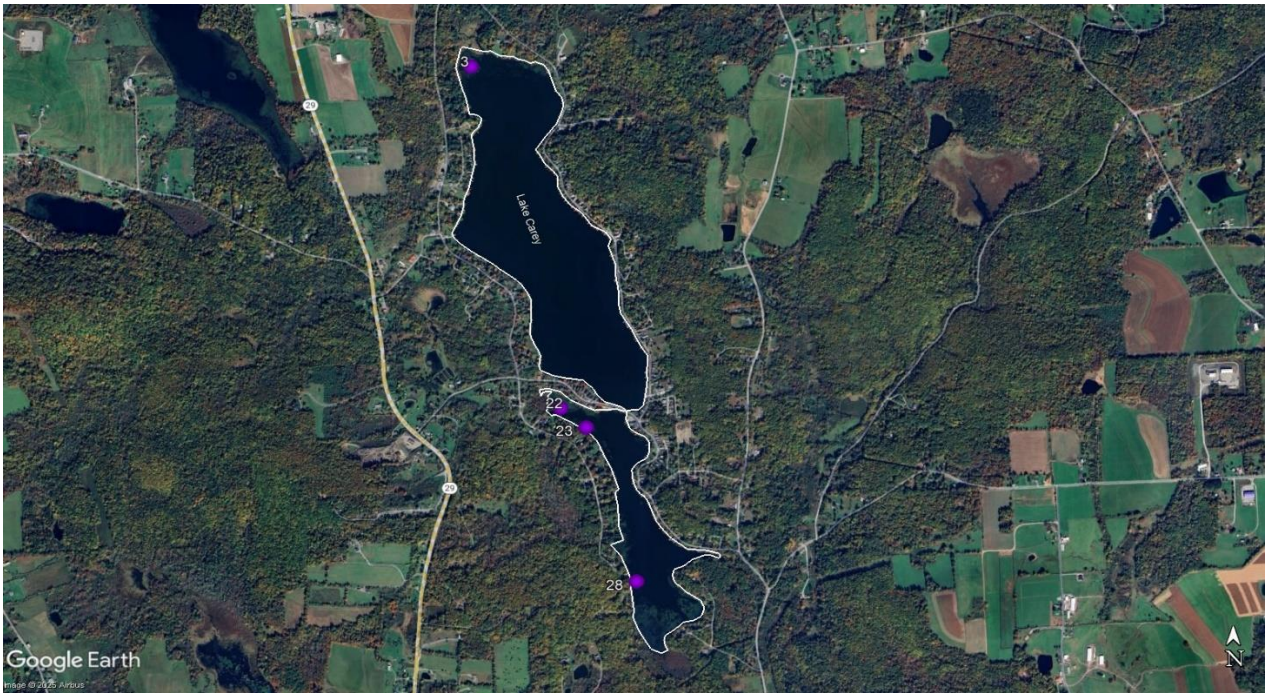


Figure 4. FAV Distribution at Lake Carey

claspingleaf pondweed, and coontail. Both claspingleaf pondweed and coontail are native, submerged plant species that can be very beneficial to the aquatic ecosystem. However, claspingleaf pondweed and coontail were each recorded at being present at only one (1) of the 30 total sample locations and in low densities.

Floating-leaved aquatic vegetation (FAV), was found in 13% of sampling locations on Lake Carey (Figure 4). The FAV recorded consisted of white water lily and spatterdock. White water lily was found in low to medium densities while spatterdock was found in low densities. All of the FAV recorded during the survey are native, beneficial plants to the lake ecosystem. They provide habitat for fish and other aquatic species to use for cover, spawning, or forage locations. Wildlife such as ducks, herons, and turtles will also use FAV for a number of uses as well as fisherman who will target areas around the floating plants due to the cover they provide for game fish. However, FAV in dense amounts can also become nuisance plants. When these floating plants grow too densely together, they can limit access to the water for both people and wildlife. Monitoring and maintaining FAV can help provide a more balanced ecosystem within a lake that is beneficial for fish and other wildlife, as well as for human use.

3. Conclusions & Recommendations

Our June 2025 aquatic macrophyte survey yielded six (6) different aquatic plants that were recorded throughout Lake Carey. Of these plants, three (3) are classified as submerged aquatic vegetation (SAV), two (2) are classified as floating-leaved aquatic vegetation (SAV), and one (1) macro algae (MA). Based on these findings, the aquatic macrophyte community in Lake Carey has somewhat limited diversity with low to moderate plant densities. Of all aquatic plants and macro algae identified, only one species is non-native to Pennsylvania, that being the invasive, submerged aquatic plant known as Eurasian watermilfoil. Although only one invasive species was found within the lake, the native submerged species that were recorded, were found in low densities and only located at two different sample sites. The scarcity of native submerged plants along with the presence of a prolific, invasive species can have negative effects on the lake biodiversity and overall health of the waterbody.

Eurasian watermilfoil being a highly invasive aquatic plant, can spread by way of fragmentation, allowing the species to spread rapidly through a waterbody without relying on seed dispersal. Watercraft, water flow, wildlife, and wind are some of the factors that can contribute to the spread of Eurasian watermilfoil, which allows the plant to inhabit anywhere within a waterbody where conditions are right. Being an extremely adaptable species, Eurasian watermilfoil can grow anywhere within a lake when the substrate is adequate and there is enough of both sunlight and nutrients. Eurasian watermilfoil has been known to grow in depths of up to 20ft, making lake shorelines and the overall littoral zone of a waterbody susceptible to plant growth. When Eurasian watermilfoil becomes too dense, it can form large, thick mats that are almost impenetrable to both

fish and wildlife as well as interfere with human recreational use. Due to this concern of invasive plant infestations, it is important to continue to monitor and manage Eurasian watermilfoil in order to prevent the continued growth and spread of the species.

The native aquatic plants that could pose a concern are the floating aquatic plants, white water lily and spatterdock. Although both plant species are native and provide many benefits to aquatic ecosystems, they can become a nuisance when densities are high. When floating-leaved aquatic vegetation becomes too dense in areas, especially species like spatterdock and white water lily, they can limit the growth of other native species and block sunlight penetration to submerged aquatic plants. The large root masses known as tubers, can collect sediment and silt flowing into the lake causing sediment buildup in these areas, which in turn can decrease water depth. The shallowing of these areas limit access for people as well as fish and can even create bogs or islands, further decreasing water depth and ultimately shrinking the surface area of the waterbody.

Based upon the above, Aqua Link offers the following recommendations to the Association to improve and protect the water quality and aquatic habitats of Lake Carey:

1. Aquatic macrophyte surveys should be performed annually or at least on some routine basis. The purpose of these surveys is to continually monitor the lake for the introduction and spread of non-native plants in the lake (e.g. Eurasian watermilfoil) and the invasion of other non-native aquatic plants. These surveys can also be used to assess the need and/or effectiveness of aquatic herbicide treatments on both target and nontarget plant species.

2. Existing stands of Eurasian watermilfoil (EWM) should be treated using a selected aquatic herbicide. For the best results, EWM should be treated prior to seeding in order to control the spread of this non-native invasive aquatic plant. If Eurasian watermilfoil populations are properly identified and treated, the plant can be better controlled through density reductions and possible eradication of infested areas.

3. Nuisance stands of aquatic vegetation (submerged and floating leaved) impacting lakeside property owners should be properly controlled using selected aquatic herbicides. These products should be applied by a company with licensed aquatic applicators. All aquatic pesticides treatments can only be performed after obtaining a state approved permit.

4. Encroaching stands of floating leaved aquatic vegetation in the shallow northern and southern sections of the lake should be responsibly controlled using selected aquatic herbicides. As noted in No. 3, these aquatic treatments

must be performed by a certified aquatic applicator with a valid state approved permit application.

5. Native stands of aquatic vegetation not identified in Nos. 2, 3 and 4 should not be controlled and allowed to thrive. These aquatic plants are very beneficial to the entire aquatic ecosystem including the lake's fishery.

6. Bioaugmentation targeting accumulated organic sediments in the northern and southern sections of the lake should be implemented. MicroLife Muck Out is a formulation of concentrated bacteria designed specifically to facilitate the breakdown of organic muck on the lake bottom. Applying this product will slow down and reduce the accumulation of organic muck caused from plant and algae decomposition.

7. Any floating bogs should be physically removed or treated with MicroLife Clear Max and aquatic herbicides. These bogs typically consist of organic muck, water lily roots (rhizomes), and some smaller, rooted aquatic vegetation. Floating bogs can form naturally or sometimes as a by-product after herbicide treatments of floating-leaved plants. Once formed, exposed mud on the surface of these bogs can start growing terrestrial grasses. If these bogs are not physically removed, aquatic herbicides can be sprayed on any live plant material and MicroLife Clear Max can be applied to and surrounding the mud bogs to facilitate the breakdown of the associated organic material.

8. Lake water quality monitoring should continue annually. This is important to assess if water quality is improving or degrading when various lake best management practices are implemented such as, aquatic plant management, bioaugmentation, and lake aeration.

Many of the above recommendations will require a high level of technical expertise and, therefore, likely require the professional services of a qualified environmental consultant. Aqua Link is an environmental consulting firm, specializing in lake management and restoration, and is uniquely qualified to assist the Association in implementing all of the recommendations offered in this report. In addition, the implementation of some of the recommendations may be eligible for state and federal funding. Aqua Link is highly experienced and knowledgeable in various grant programs and preparing grant applications in order to obtain state and federal funding. Over the past 28 years, Aqua Link has assisted agencies, organizations, and associations in securing funds for their projects.

If you have any questions or need assistance in implementing any of the recommendations offered in this report, please call me. Thank you for allowing Aqua Link to assist you in properly managing your lake.

Sincerely,

Edward W. Molesky, Jr., CLM
President
Aqua Link, Inc.
Hydro Logic Products
NALMS Certified Lake Manager

EWM:kam
Attachments A & B

ATTACHMENT A

Aquatic Plant Survey Field Data

Lake Carey **Macrophyte Survey** **Prepared by Aqua Link, Inc.**

ALI Customer No. 1876-02

6/24/2025

Plant ID and Density (Low, Medium, or High)

Plant Common Names

WayPoint	Latitude	Longitude	Eurasian Watermilfoil	Claspingleaf Pondweed	Spatterdock	White Water Lily	Coontail	Stonewort
1	41.602367°	-75.928186°	Low	Low				
2	41.602945°	-75.929822°	Low					
3	41.603495°	-75.932495°			Low	Low		
4	41.601606°	-75.932231°						
5	41.601633°	-75.930340°						
6	41.601358°	-75.928412°						
7	41.599608°	-75.929485°						
8	41.600371°	-75.931645°						
9	41.598478°	-75.932016°						
10	41.597777°	-75.928480°						
11	41.596515°	-75.926743°						
12	41.595547°	-75.931812°						
13	41.593571°	-75.928926°						
14	41.594489°	-75.925227°						
15	41.592425°	-75.924891°						
16	41.591380°	-75.928624°					Low	
17	41.589881°	-75.927528°						Low
18	41.590707°	-75.923367°						
19	41.589472°	-75.923393°						
20	41.588869°	-75.925154°						
21	41.587969°	-75.924479°						
22	41.588399°	-75.927680°			Low	Low		
23	41.587549°	-75.926309°				Low		
24	41.587101°	-75.923851°						
25	41.585910°	-75.924702°						
26	41.584181°	-75.923677°						
27	41.582305°	-75.924004°	Medium					
28	41.580738°	-75.923612°	Medium			Medium		
29	41.580249°	-75.922172°	Low					
30	41.582060°	-75.920842°						
Count			5	1	2	4	1	1

Key to Plant Species

Common Name	Scientific Name	Common Name	Scientific Name
Eurasian Watermilfoil	*Myriophyllum spicatum*	White Water Lily	*Nymphaea odorata*
Claspingleaf Pondweed	*Potamogeton perfoliatus*	Coontail	*Ceratophyllum demersum*
Spatterdock	*Nuphar lutea*	Stonewort	*Nitella spp.*

ATTACHMENT B

Aquatic Plant Descriptions & Pictures

Eurasian Watermilfoil

Myriophyllum spicatum

This plant is **invasive** in Pennsylvania and should be eradicated if possible.

This plant can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description -Eurasian watermilfoil has gray-greenish, featherlike leaves in whorls of three to five around the stem. Leaves generally have twelve or more pairs of leaflets. This exotic plant usually has a dark, reddish appearance with very long multibranched stems. Plants may reach 10ft or more and can form dense colonies. Reddish flowers develop on leafless spikes with very short leaves surrounding them. The flowers may rise above the water surface a few inches. The plant can reproduce through seeds or fragmentation. It grows in a variety of conditions and can quickly grow to intolerable levels in a pond. It is one of the most aggressive invasive plants in the United States and often out-competes and replaces native pond plants. Native milfoil species look similar but usually have more delicate leaf structures. Eurasian watermilfoil was accidentally introduced into North America from Europe. It most likely reached eastern North America through the aquarium trade, when people released the contents of their aquariums into local waterways.

Value - Eurasian watermilfoil is of limited benefit. It frequently becomes so thick that it interferes with other plants' growth and with habitat use by larger fish. It is not a favored food by waterfowl or other wildlife. It attracts invertebrates and serves as a food source for fish but to a lesser extent than most other submerged plants. Native milfoil species do not tend to grow as densely and are frequently found with bladderwort in acidic, stained water.

Common look-alike – Northern watermilfoil, bladderwort

Coontail

Ceratophyllum demersum

Alternate name -hornwort

Description - The dark olive-green leaves of coontail are whorled around the stem. Each leaflet is forked with toothed edges. The leaflets are more densely crowded around the tip of the stem, giving the appearance of a raccoon tail. The purplish green flowers form where the leaf attaches to the stem and remain submerged. The plant may be anchored to the bottom or, more likely, free-floating beneath the surface. Coontail prefers ponds with hard water, although one species can be found more commonly in softer, acidic waters. Coontail can tolerate low light conditions in deep water. Plants have been described as having a very coarse or "plastic" feeling. Coontail spreads by seeds and by fragmentation.

Value - Coontail foliage is a favorite of many species of waterfowl and muskrats in Pennsylvania. It is also home to many invertebrates such as snails, crustaceans, and insect larvae, thus providing a great source of food for fish. Coontail inhibits the growth of blue-green algae on its stems by secreting sulfur-based toxins.

Claspingleaf Pondweed

Potamogeton perfoliatus

Description – Claspingleaf pondweed is a submerged, rooted, flowering aquatic plant that grows in alkaline, brackish, and freshwater lakes, streams and estuaries. Substrate conditions are often low in organic content forming a firm muddy bottom or sand-based sediment in slow moving waters. Plants are found throughout the Northeast and tend to be darker green colored in shallow waters and are a paler green in deeper water.

Value – Provides habitat for fish species, invertebrates, and other aquatic wildlife along with being an important food source for waterfowl.

Common look-alike – Largeleaf pondweed, curlyleaf pondweed

Stonewort

Nitella sp.

Description – Stonewort is classified as a macro algae, meaning it is a non-microscopic algae that can be seen with the naked eye. It has smooth stems and branches, lacking encrustation. Branches are arranged in whorls around the main stem. It is most common in soft water, especially in the Northeastern region of Pennsylvania. Stonewort is usually considered beneficial to the aquatic ecosystem.

Value – Waterfowl feed on Stonewort. It is also home to microscopic algae and invertebrates that are eaten by small fish. It is also a great source of habitat for fish.

Common look-alike – Muskgrass (*Chara)*

Spatterdock

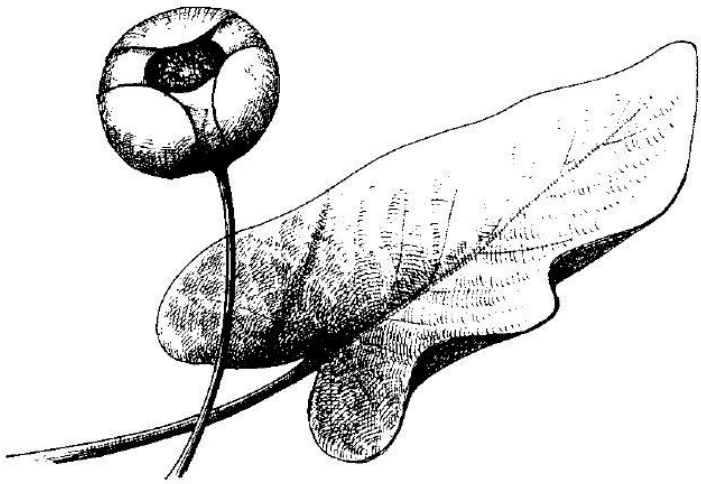
Nuphar lutea

Alternate names—yellow water lily, cow lily, bullhead pond lily

Description—Spatterdock is common to Pennsylvania ponds, especially acidic, soft-water ponds in northern regions. It has large, 12-inch leaves that are round to heart shaped, with a distinct midrib. Most leaves extend above the water. Flowers are large and yellowish outside and reddish inside. Spatterdock tolerates fluctuating water levels and reproduces by rootstocks and seeds.

Value—Spatterdock is an excellent plant from a wildlife and fisheries perspective. It supports a high density of fish and insect life below the water surface, providing good food and cover for fish. Large bass can often be found cruising through spatterdock looking for small fish and insects. Spatterdock is also a food source for many animals and plants.

Common look-alike—water lily



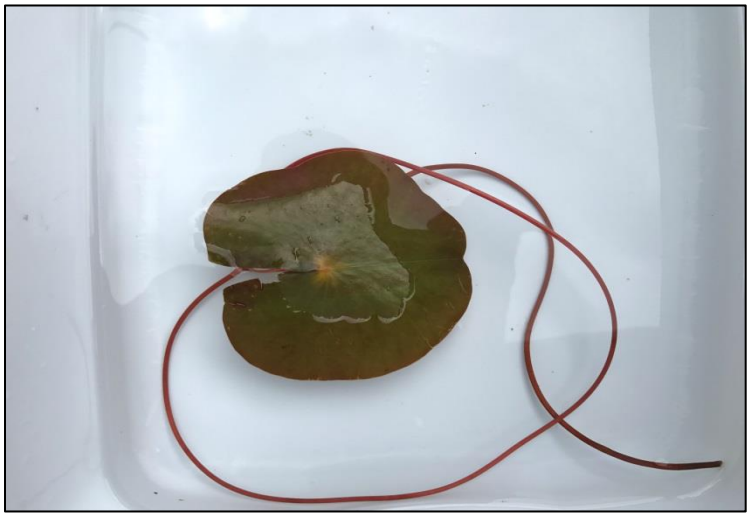
White Water Lily

Nymphaea spp.

Alternate name - fragrant water lily

Description -Floating round leaves grow up to 12 inches across, are split to the stem in a V shape at the center, and are often purple underneath. Flowers of native water lilies are large, showy, and white, and have a sweet smell. Water lilies bearing other colored flowers are nonnative, tropical plants often sold for backyard water gardens. Flowers remain open from morning until shortly after midday. Commonly planted as an ornamental, this plant reproduces by rootstocks and seeds. It prefers to grow in slow moving water less than six feet deep.

Value - This plant's beautiful appearance and its flowers make it a commonly used item in aquascapes. In addition, water lily creates excellent habitat for fish as it attracts small and large fish and their prey (insects, frogs, etc.). Despite this benefit, however, water lily's tangled stems make fishing very difficult. Waterfowl eat parts of the plant, as do a variety of wildlife, including deer. Water lily is also a favorite of honeybees.



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