The Connecticut Agricultural Experiment Station

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The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

Pachaug Pond

Griswold, CT

Aquatic Vegetation Survey
Water Chemistry
Aquatic Plant Management Options

2019

Summer E. Stebbins

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The Connecticut Agricultural Experiment Station was founded in 1875. It is chartered by the General Assembly to make scientific inquiries and conduct experiments regarding plants and their pests, insects, soil and water, and to perform analyses for state agencies. Station laboratories are in New Haven and Windsor, and research farms in Hamden and Griswold.

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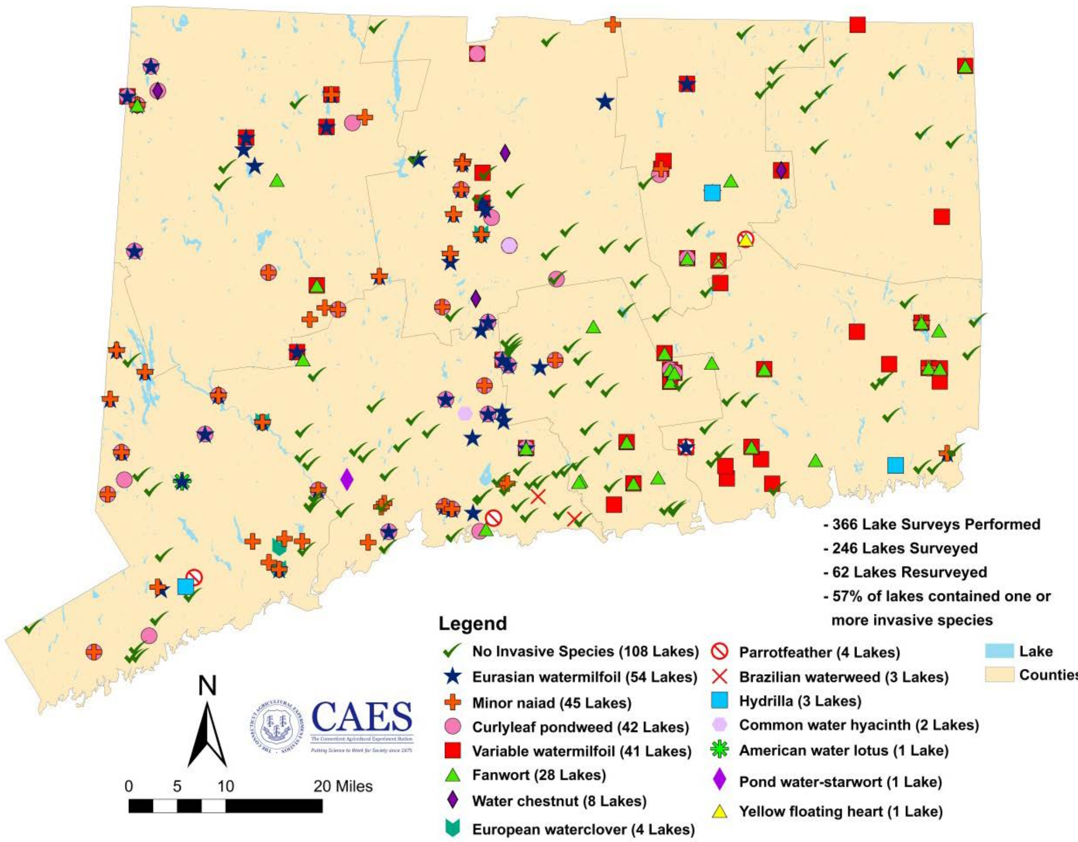

Figure 1. Locations of invasive aquatic plants found by CAES IAPP from 2004 to 2019.

Introduction:

Since 2004 the Connecticut Agricultural Experiment Station (CAES) Invasive Aquatic Plant Program (IAPP) has surveyed or resurveyed aquatic vegetation and monitored water chemistry in over 240 Connecticut lakes and ponds (Figure 1). Approximately 60% of the lakes and ponds contain invasive (non-native) plant species that are capable of causing rapid deterioration of aquatic ecosystems and recreation value. The presence of invasive species is related to water chemistry, public boat launches, and random events. The CAES IAPP information is stored on the website portal.ct.gov/caes-iapp where stakeholders can view digitized vegetation maps, detailed transect data, and temperature and dissolved oxygen profiles as well as water test results for clarity, pH, alkalinity, conductivity, and total phosphorus. This information allows citizens, government officials, and scientists to view past conditions, compare them with current conditions, and make educated management decisions.

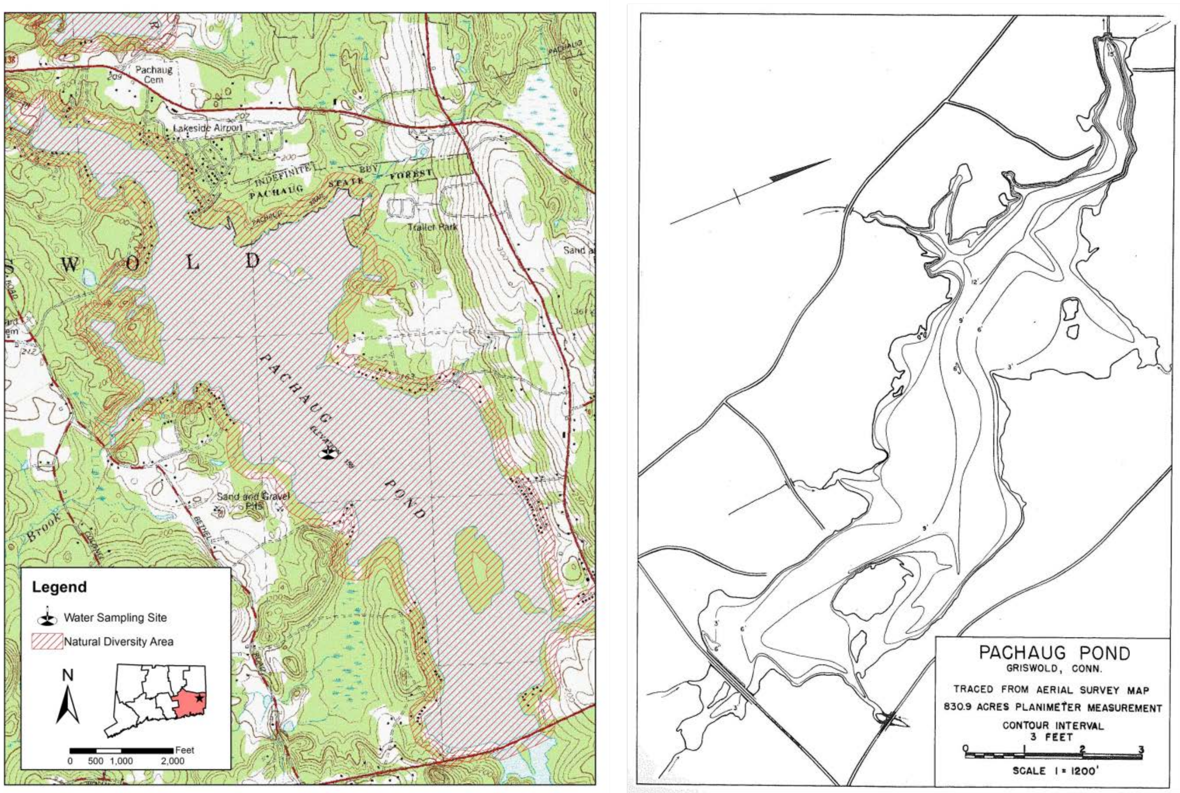

Figure 2. Topographic map of Pachaug Pond including location of state listed species (Natural Diversity Area) and CAES IAPP water sampling site (left) and bathymetry map circa 1959 (right).

This is the third CAES IAPP survey of Pachaug Pond for aquatic vegetation and water chemistry. Pachaug Pond is an 817-acre waterbody located in Griswold, CT. It has a maximum depth of approximately 16 feet and an average depth of about six feet. The shallow nature of the lake allows a large littoral zone that favors aquatic plant growth. State listed species are present throughout the entire lake (Figure 2, left) (CTDEEP, 2019). Protection of these species requires withholding details from the public without special request forms. Public access is via a state boat launch on the northern shore. There are no motor restrictions. Previous work on Pachaug Pond dates back to the 1950's when the State Board of Fisheries and Game (1959) described the lake as being shallow and fertile with abundant emergent and submergent vegetation (Figure 2, right; see appendix for full description). The specific plant species were not mentioned, but the bottom was described as being mud, swampy ooze, and sand. A dense algal bloom was observed that reduced the water clarity to two feet. Bass fishing was described as excellent with fish over five pounds common. The 1959 information mentioned frequent severe summer drawdowns that may have been

Figure 3. Water smartweed in the northwestern cove (left) and difficult to navigate patch of white water lily in the northeastern cove of the lake (right).

controlling aquatic vegetation. These drawdowns were stated as being due to utilization of the water for "industrial" purposes, which was likely power generation (personal communication). Apparently, drawdowns were lessening as of 1959, and aquatic vegetation was increasing. CAES studied Pachaug Pond in 1979 as part of a statewide investigation into changes in lake water chemistry (Frink and Norvell, 1984). In addition to detailed water chemistry, the study mentions Pachaug Pond as having moderately dense aquatic weeds in shallow areas and watermilfoil (species not identified) near the boat launch. Interestingly, pioneer infestations of invasive species might first be noticed at the boat launches if the plant arrived on a boat or trailer. The 1979 CAES water tests found a water clarity of 3.5 m (12 feet), an alkalinity of 15 mg/L $CaCO_3$ and a total phosphorus concentration of 16 μg/l at the surface and 13 μg/L at the bottom. These results suggest an oligo-mesotrophic condition where nutrients are not excessive.

Objectives:

- Perform a third survey of Pachaug Pond for aquatic vegetation and test water to quantify water chemistry.
- Compare with previous surveys and add vegetation maps and water chemistry information to the CAES IAPP website.
- Update aquatic plant management options.

Materials and Methods:

Aquatic Plant Surveys and Mapping:

We surveyed Pachaug Pond for aquatic vegetation on July 30-31 and August 1-2, 2019. The survey utilized methods established by CAES IAPP with the exception of fewer transects and less detail due to funding restrictions. Surveys were conducted from 16- and 18-foot motorized boats traveling over areas shallow enough to support aquatic plants. Plant species were recorded based on visual observation or collections with a long-handled rake or grapple. Lowrance® Hook 5 and HDS 5 sonar systems as well as ground truthing with occasional grapple tosses were used to determine vegetated areas in deep water. Quantitative information on plant abundance was obtained by resurveying 10 transects that were positioned perpendicular to the shoreline in 2017. Transect locations represented the variety of habitats occurring in the lake. Transects were located using a Trimble® R1 GNSS global positioning system with sub-meter accuracy. Sampling data points were taken along each transect at points 0, 5, 10, 20, 30, 40, 50, 60, 70, and 80 m from the shore. We measured depth with a rake handle, drop line, or digital depth finder and sediment type was estimated. Plant samples were obtained in shallow water with a rake and with a grapple in deeper water. Abundances of species present at each point were ranked on a scale of 1 – 5 (1 = very sparse, 2 = sparse, 3 = moderately abundant, 4 = abundant, 5 = extremely abundant). When field identifications of plants were questionable, we brought samples back to the lab for review using the taxonomy of Crow and Hellquist (2000*a*, 2000*b*). One specimen of each species collected in the lake was dried and mounted in the CAES IAPP aquatic plant herbarium. Digitized mounts can be viewed online (portal.ct.gov/caes-iapp). We post-processed the GPS data in Pathfinder® 5.85 (Trimble Navigation Limited, Sunnyvale, CA) and then imported it into ArcGIS® 10.6.1 (ESRI, Redlands, CA). Data were then overlaid onto USA National Agriculture Imagery Program (NAIP) natural color aerial imagery with 1 m resolution or higher from 2010-2017.

Table 1. Plants present in Pachaug Pond from 2017-2019. Present indicates the species presence in the lake while Frequency of Occurrence (FOQ) indicates presence of a species on transects.

Pachaug Pond							
Species (invasives in bold)		**2017**		**2018**		**2019**	
Common Name	**Scientific Name**	**Present**	**FOQ (%/point)**	**Present**	**FOQ (%/point)**	**Present**	**FOQ (%/point)**
Arrowhead	*Sagittaria* species	X	9	X	13	X	6
Brazilian watermeal	*Wolffia brasiliensis*	X	1				
Bur-reed	*Sparganium* species	X	12			X	4
Cattail	*Typha* species	X	0			X	0
Clasping-leaf pondweed	*Potamogeton perfoliatus*	X	2			X	1
Common bladderwort	*Utricularia macrorhiza*	X	8	X	54	X	1
Common duckweed	*Lemna minor*					X	0
Common reed	***Phragmites australis***	**X**	**1**	**X**	**2**	**X**	**0**
Coontail	*Ceratophyllum demersum*	X	17	X	17	X	16
Eelgrass	*Vallisneria americana*	X	65	X	59	X	53
Eurasian watermilfoil	***Myriophyllum spicatum***	**X**	**31**	**X**	**45**	**X**	**28**
Fanwort	***Cabomba caroliniana***	**X**	**48**	**X**	**42**	**X**	**42**
Floating bladderwort	*Utricularia radiata*	X	48			X	32
Floating-leaf pondweed	*Potamogeton natans*	X	3	X	1	X	0
Golden hedge-hyssop	*Gratiola aurea*	X	5	X	1		
Great duckweed	*Spirodela polyrhiza*			X	4	X	9
Humped bladderwort	*Utricularia gibba*	X	1	X	8	X	9
Large-leaf pondweed	*Potamogeton amplifolius*	X	9	X	19	X	8
Leafy pondweed	*Potamogeton foliosus*	X	1	X	3	X	1
Lesser bladderwort	*Utricularia minor*			X	1		
Little floating heart	*Nymphoides cordata*			X	9	X	10
Low watermilfoil	*Myriophyllum humile*	X	8	X	4		
Marsh primrose-willow	*Ludwigia palustris*	X	2	X	5	X	4
Minor naiad	***Najas minor***	**X**	**4**	**X**	**20**	**X**	**3**
Mudmat	*Glossostigma cleistanthum*	X	1	X	7	X	3
Pickerelweed	*Pontederia cordata*	X	12	X	22	X	13
Purple bladderwort	*Utricularia purpurea*	X	1	X	3	X	6
Quillwort	*Isoetes* species			X	3		
Ribbon-leaf pondweed	*Potamogeton epihydrus*	X	35	X	13	X	14
Robbins' pondweed	*Potamogeton robbinsii*	X	35	X	41	X	40
Slender naiad	*Najas flexilis*	X	11	X	19	X	18
Small-leaved pond-lily	*Nuphar microphylla*	X	0				
Snailseed pondweed	*Potamogeton bicupulatus*	X	10	X	13	X	7
Spikerush	*Eleocharis* species	X	8	X	11	X	14
Variable-leaf watermilfoil	***Myriophyllum heterophyllum***	**X**	**8**	**X**	**9**	**X**	**20**
Water smartweed	*Polygonum amphibium*	X	4	X	12	X	11
Watershield	*Brasenia schreberi*	X	31	X	30	X	32
Waterwort	*Elatine* species			X	7	X	1
Western waterweed	*Elodea nuttallii*			X	1	X	1
White water lily	*Nymphaea odorata*	X	18	X	22	X	26
Yellow water lily	*Nuphar variegata*	X	13	X	14	X	6
Total Species Richness	41	34	32	34	34	35	31
Total Native Species Richness	36	29	27	29	29	30	26
Total Invasive Species Richness	**5**	**5**	**5**	**5**	**5**	**5**	**4**

Water Analysis:

Water was analyzed from the deepest part of the lake. Water temperature and dissolved oxygen were measured 0.5 m beneath the surface and at 1 m intervals to the bottom. Water samples (250 mL) for pH, alkalinity, conductivity, and total phosphorus testing were obtained from 0.5 m beneath the surface and 0.5 m above the bottom. All samples were stored at 38°C until testing. A Fisher AR20® meter was used to determine pH and conductivity, and alkalinity (expressed as mg/l $CaCO_3$) was quantified by titration with 0.016 N H_2SO_4 to an end point of pH 4.5. We determined total phosphorus using the ascorbic acid method preceded by digestion with potassium persulfate (APHA, 1995). Phosphorus was quantified using a Milton Roy Spectronic 20D® spectrometer with a light path of 2 cm and a wavelength of 880 nm. Water was tested for temperature and dissolved oxygen using an YSI 58® meter. Water clarity was measured by lowering a six-inch diameter black and white Secchi disk into the water and determining to what depth it could be viewed.

Results and Discussion:

General Aquatic Plant Surveys and Transects:

We found five invasive and 30 native plant species in Pachaug Pond in 2019 (Table 1). Eurasian watermilfoil, fanwort, minor naiad, phragmites, and variable-leaf watermilfoil comprised the invasive species while the native species included a wide diversity of emergent and submergent macrophytes. Pachaug Pond contains among the greatest number of plant species found in any waterbody surveyed by CAES IAPP with only Gardner Lake (38 species) and Upper Moodus Reservoir (37 species) supporting more. Descriptions of the invasive species are in the appendix of this report while information on the native species can be found at the USDA "About PLANTS" website (https://plants.usda.gov/about_plants.html). Although monostands of invasive species were found in a few areas of the lake, areas covered by native species or invasive species mixed with native species were more common. Many of the shallow coves contained nuisance vegetation such as fanwort, water smartweed, and water lilies that reached the surface (Figure 3). Most of the lake, however, did not have problematic vegetation reaching the surface despite it being shallow enough to support luxuriant growth. In these areas, the bottom either did not support plant growth or was covered with native eelgrass and Robbins' pondweed. Reasons for this may include the brown water coloration that limits light, infertile substrate, and previous drawdowns.

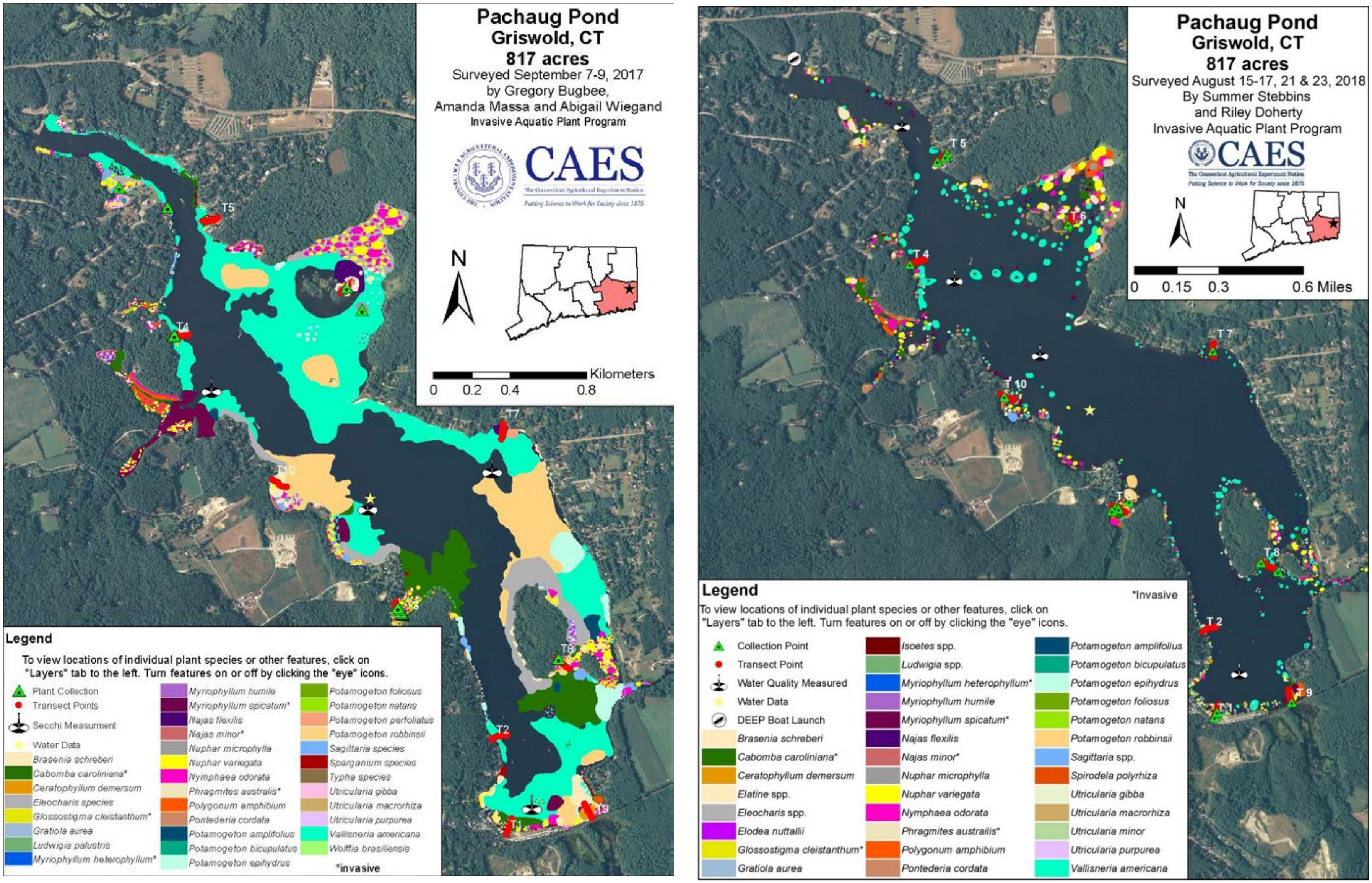

Figure 4. Aquatic plant survey of Pachaug Pond in 2017 (left) and 2018 (right).

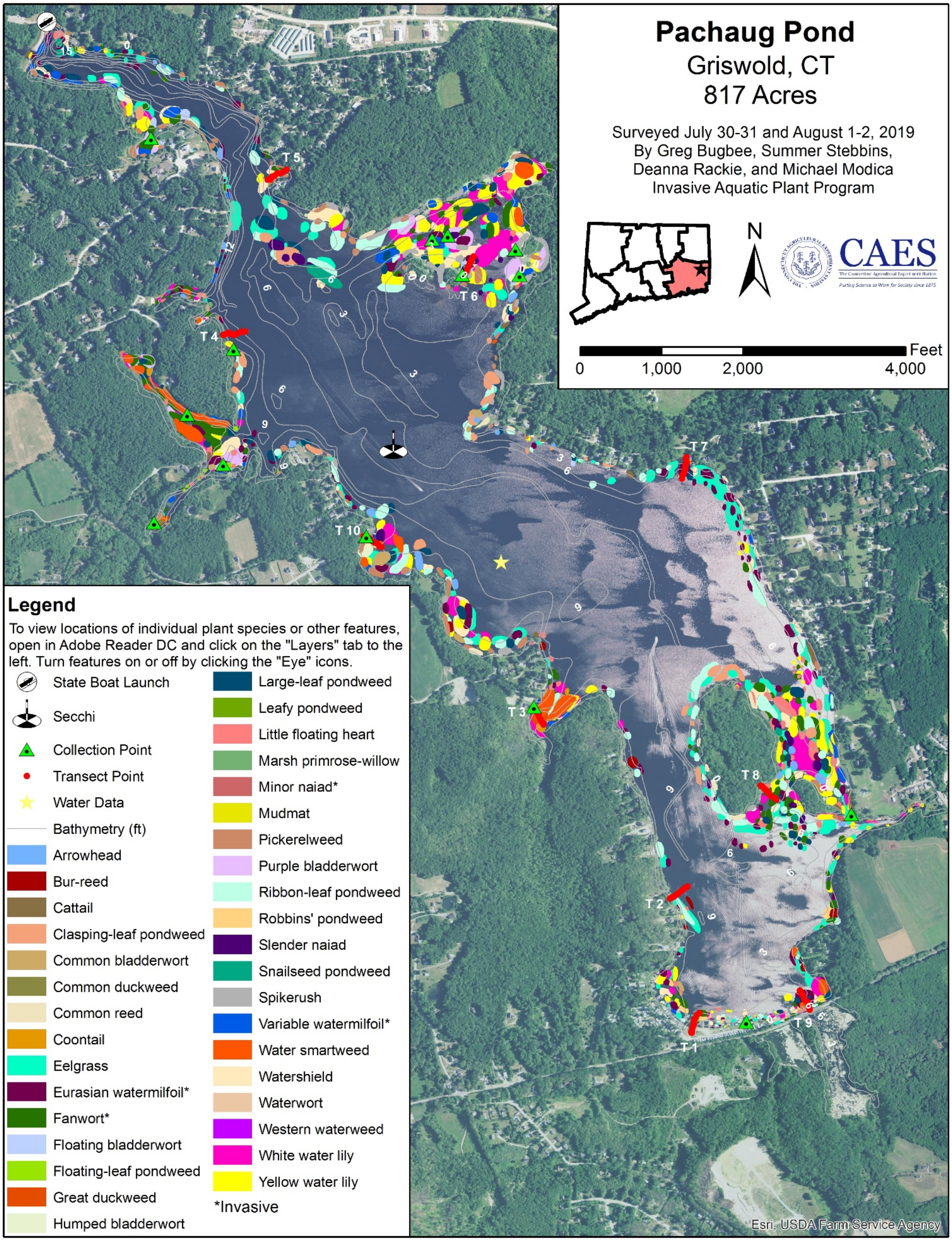

Figure 5. 2019 aquatic plant survey of Pachaug Pond.

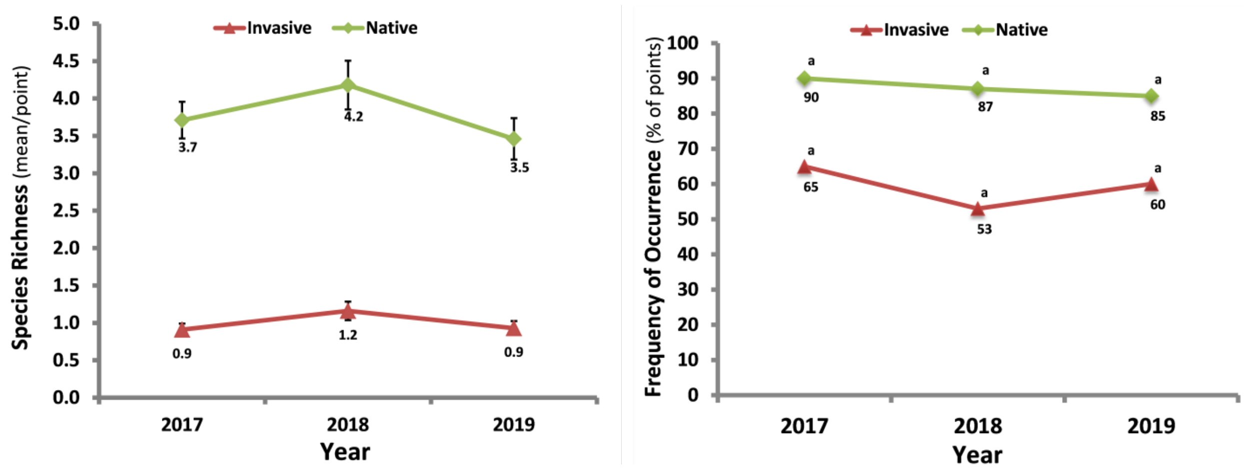

Figure 6. Species richness (left) and frequency of occurrence (right) of invasive and native plants in Pachaug Pond from 2017-2019.

Compared to 2018, vegetation appeared to slightly increase but remained less abundant than in 2017 (Figures 4, 5). Many coves had nuisance levels of emergent vegetation such as white and yellow water lily, water smartweed and watershield. Readers can consult the CAES IAPP website for the digitized survey maps where individual plant layers can be viewed separately (portal.ct.gov/caes-iapp). Occasionally areas only had low-lying algae, charaphyte, which was found using grapple tosses and sonar. Water smartweed, fanwort, and water lilies caused the most problems recreationally, creating patches dense enough to be nearly impassable by boat (Figure 3). Many of these areas also contained dense bladderworts; however, these plants were rarely a nuisance.

Comparisons of our frequency of occurrence (FOQ) data from 2017, 2018, and 2019, as taken from transects points, found little overall change in total invasive or native species (Figure 6). Individually, however, changes were evident (Table1). The FOQ of fanwort changed little (48%, 42%, 42%) while Eurasian watermilfoil (31%, 45%, 28%) and minor naiad were reduced (4%, 20%, 3%). Variable-leaf watermilfoil showed a substantial increase from previous years (8%, 9%, 20%). The most commonly found native plants in 2019 were eelgrass (53%), Robbins' pondweed (40%), floating bladderwort (32%), and watershield (32%). Overall species richness remained relatively unchanged for invasive species and native species alike (Figure 6).

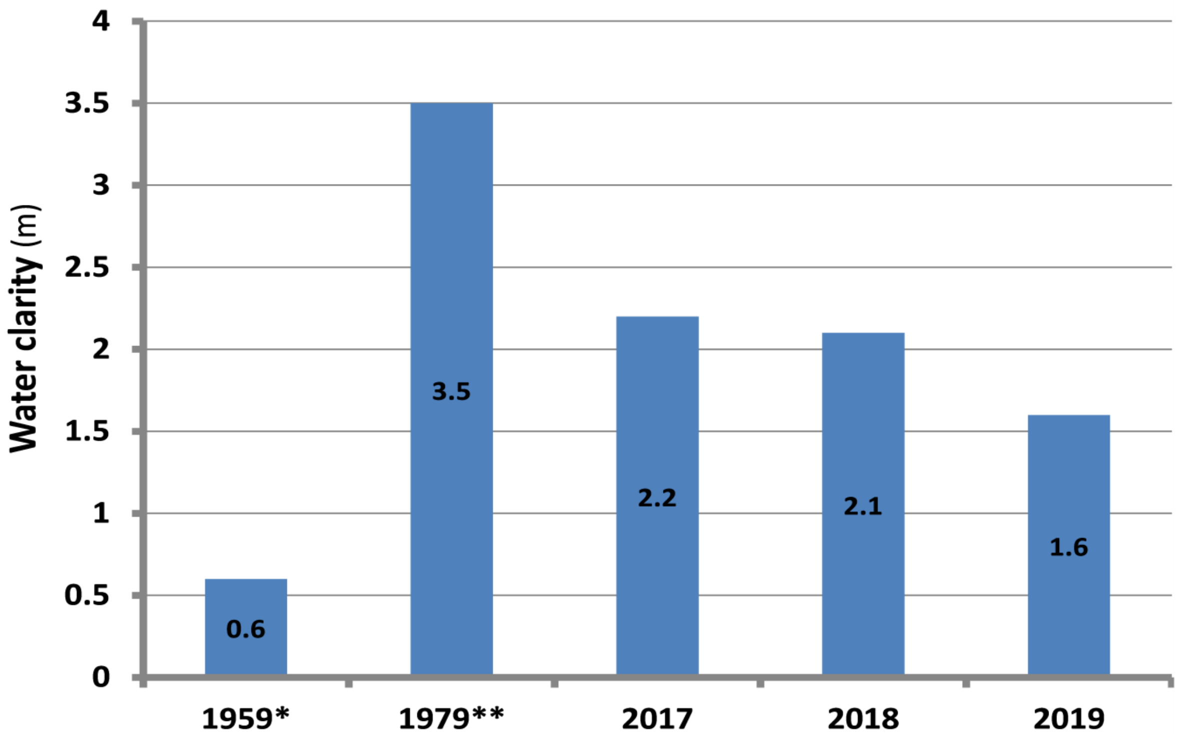

Figure 7. Water clarity in Pachaug Pond in 1959(*State Board of Fisheries and Game), 1979 (**CAES), 2017-2019 (CAES IAPP).

Water Chemistry:

Water clarity in Connecticut's lakes ranged from 0.3 - 10 m (1-33 feet) with an average of 2.3 m (7 feet) (CAES IAPP, 2019). Pachaug Pond had water clarity of 1.6 m (5 feet) in our 2019 survey, a little lower than the 2.2 m (7 feet) and 2.1 m (7 feet) recorded in 2017 and 2018 respectively (Figure 7). Measurements in 1979 found clarity to be 3.5 m (12 feet) (Frink and Norvell, 1984) while in the 1950's it was only 0.6 m (2 feet) (State Board of Fisheries and Game, 1959). The poor water clarity in the 1950's was attributed to an algal bloom. This could have been due to the reported industrial use of the water. Our 2019 observation was consistent with previous years with water clarity not reduced by algal blooms but rather the brown coloration caused by naturally occurring organic derivatives.

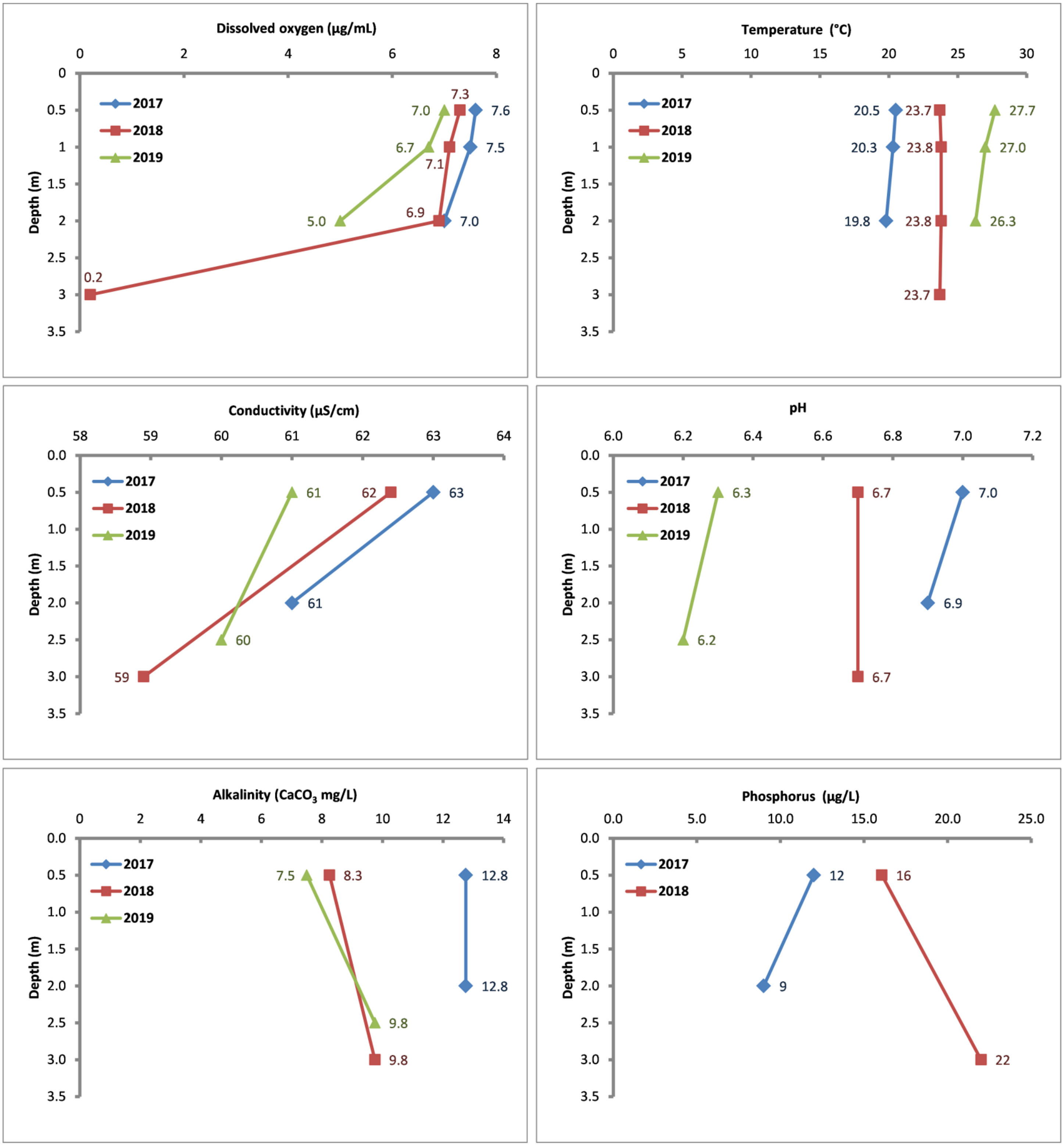

Figure 8. Water chemistry in Pachaug Pond from 2017-2019.

The shallow nature of Pachaug Pond resulted in little stratification across all years (Figure 8). Only minor changes in the tested water parameters occurred with depth. Dissolved oxygen concentrations were high throughout the water column, and the pH was near neutral (6.2 – 7.0). The alkalinity of 7.5 - 13 mg/L $CaCO_3$ was low for Connecticut lakes which range from near 0 to >170 (CAES IAPP, 2019). Low alkalinity waterbodies are more prone to pH change due to outside influences such as watershed activities and acid rain. Conductivity is an indicator of dissolved ions that come from natural and man-made sources (mineral weathering, organic matter decomposition, fertilizers, septic systems, road salts, etc.). Connecticut waterbodies have conductivities that range from 50 -250 µS/cm. Pachaug Pond's conductivity of near 61 µS/cm ranks it among the lowest.

A key parameter used to categorize a lake's trophic state is the concentration of phosphorus (P) in the water column. High levels of P can lead to nuisance or toxic algal blooms (Frink and Norvell 1984, Wetzel 2001). Rooted macrophytes are considered to be less dependent on P from the water column as they obtain a majority of their nutrients from the hydrosoil (Bristow and Whitcombe, 1971). Lakes with P levels from 0 - 10 µg/L are considered nutrient-poor or oligotrophic. When P concentrations reach 15 - 25 µg/L, lakes are classified as moderately fertile or mesotrophic and when P reaches 30 - 50 µg/L they are considered fertile or eutrophic (Frink and Norvell, 1984). Lakes with P concentrations >50 µg/L are categorized as extremely fertile or hypereutrophic. Pachaug Pond's P concentration in 2018 was 16 µg/L at surface and 22 µg/L near the bottom, which classifies the lake as mesotrophic. The 2019 P test had not yet been performed at the time of this writing. Analysis of the water in by CAES 1979 (Frink and Norvell, 1984) found similar P concentrations of 16 µg/L at surface and 13 µg/L near the bottom.

CAES IAPP has found that the occurrence of invasive plants in lakes can be attributed to specific water chemistries (June-Wells et al. 2013). For instance, lakes with higher alkalinities and conductivities are more likely to support Eurasian watermilfoil, minor naiad, and curlyleaf pondweed (*Potamogeton crispus*) while lakes with lower values support fanwort and variable-leaf watermilfoil. Invasive zebra mussels (*Dreissena polymorpha*) are becoming a problem in several lakes in western Connecticut and have similar water chemistry preferences.

Aquatic Vegetation Management Options:

Figure 9. New harvesting machine technology.

Managing nuisance aquatic vegetation in Pachaug Pond will be challenging because the lake has extensive areas of desirable native vegetation and state listed species may need protection. In addition, large numbers of residents utilize the lake for recreational activities, particularly fishing, boating, and swimming. Options include water level drawdown, harvesting, herbicides, biological controls, and bottom barriers (Cooke et al., 2005). Dredging may also be employed but is usually impractical for large lakes like Pachaug.

Water level drawdown can be an effective and economical means of controlling nuisance vegetation in large shallow lakes like Pachaug Pond. Fortunately, the lake has a dam with an outlet suitable for the technique, and it has already been employed with some possible success. Proposed dam repairs will likely cause long-term drawdowns occurring in lakes such as Bashan Lake, Moodus Reservoir and Lake Beseck. Because the lake usually remains low during the growing season, significant changes can occur in the plant community with wetland plants proliferating in the former sediment and aquatic plants inhabiting areas that were formerly too deep. Often these plants are invasive such as phragmites, milfoil, and fanwort or nuisance native species such as cattails and water lilies.

Current interest in mechanical harvesting could result in this being a viable option; however, knowledge of the pros and cons is recommended prior to making large purchases of the necessary machinery. Major benefits of mechanical harvesting include quick results, the ability to target

Figure 10. CAES IAPP testing of short-term benthic barriers in Lake Beseck.

areas and avoid damage to species needing protection, avoidance of aquatic herbicides, and removal of nutrients contained in the harvested vegetation. Drawbacks include the initial expense of the harvesting machine, maintenance costs, rapid regrowth, the need for follow-up work, and costs for vegetation removal and disposal. New mechanical harvesting machines are now available that offer promise for removal of the root system, but this varies by plant species and sediment type (Figure 9).

Herbicides can be effective in controlling unwanted aquatic vegetation. Aquatic herbicide use requires permits from CTDEEP. Specifics on the use of aquatic herbicides in Connecticut are found in the CTDEEP publication entitled "Nuisance Aquatic Vegetation Management: A Guidebook" (CTDEP, 2005). In 2018, CAES IAPP tested a new herbicide called ProcellaCOR to control variable-leaf watermilfoil in Bashan Lake with excellent results.

Although efforts are underway to find biological controls for nuisance aquatic vegetation, breakthroughs have been limited. Plant eating fish called grass carp (*Ctenopharyngodon idella*) can effectively reduce the populations of certain aquatic weeds. The introduction of grass carp into Connecticut lakes requires approval by CTDEEP. In Connecticut, only sterile (triploid) grass carp are permitted. Introducing grass carp in Pachaug Pond could cause damage to non-target plants necessary to maintain the current fishery. CAES has worked with officials from the United States

Department of Agriculture to find new plant pathogens and insects that control nuisance aquatic plants with little success.

Benthic barriers or "bottom blankets" are effective at eliminating nuisance vegetation in small areas such as swim zones, around docks, and pioneer infestations. CAES IAPP has tested short-term placement (<30 days) of the barriers in Lake Quonnipaug, Bashan Lake, and Lake Beseck (Figure 10). Season long control for Eurasian watermilfoil and fanwort was achieved. Although labor intensive, benthic barriers may be able to be moved from place to place during a season for effective control.

Conclusions:

Compared to 2018, Pachaug Pond had a similar aquatic plant abundance and frequency. Thirty-five species of plants were found in 2019 with five being invasive. Many of the shallow coves contained nuisance vegetation such as fanwort, water smartweed, and water lilies that reached the surface. Most of the lake, however, did not have problematic vegetation reaching the surface even though it was shallow enough to support it. In these areas, the bottom either did not support plant growth or was covered with non-nuisance eelgrass and Robbins' pondweed. Reasons for this may include brown coloration to the water that limits light, infertile substrate, and previous drawdowns. Our water tests found Pachaug Pond to be relatively low in alkalinity with minimal stratification. Water clarity was limited by the water's brown coloration. The most promising aquatic plant management option is continuation of the winter drawdown, although harvesting could play a major role if recent interest results in the procurement of the proper equipment and utilization. Proposed dam repairs will likely result in a long-term drawdown with considerable change in the plant community.

Acknowledgments:

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Appendix

Narrative from State Board of Fisheries and Game Lake and Pond Survey Unit – 1959

Pachaug Pond

Pachaug Pond is a large, artificial impoundment located in New London County in the township of Griswold. This shallow, fertile pond was formed by impounding the Pachaug River. It has a surface area of 830.9 acres, a maximum depth of 18 feet and an average depth of 6.1 feet. Much of the well-wooded shoreline is in the Pachaug State Forest. Submerged and emergent vegetation is abundant, particularly in the shoal areas and shallow areas. The pond bottom is of mud, swampy ooze and sand. A dense algal bloom reduces transparency to two feet. The waters of this pond are not thermally stratified.

Shoreline development is very light and there are only a few cottages present. Boats are available for rental at a livery at the southern end of the pond. There is a state-owned right-of-way present, but this is poorly developed and is unuseable.

Pachaug Pond has been stocked with smallmouth bass and yellow perch.

Largemouth bass are common in abundance and exhibit excellent growth. Yellow perch are common in abundance. This species grows at a rate equal to the state average. Bluegill sunfish are abundant and grow at a rate well above the state average. Chain pickerel are scarce and exhibit an above-average growth rate. Calico bass are common in abundance. The growth rate of this species is equal to the state average. Bullheads are common in abundance and golden shiners are abundant.

This pond has the reputation of producing excellent bass fishing. Bass over five pounds are relatively common. Fishing for panfish such as perch, bluegill sunfish, calico bass and bullheads should be excellent.

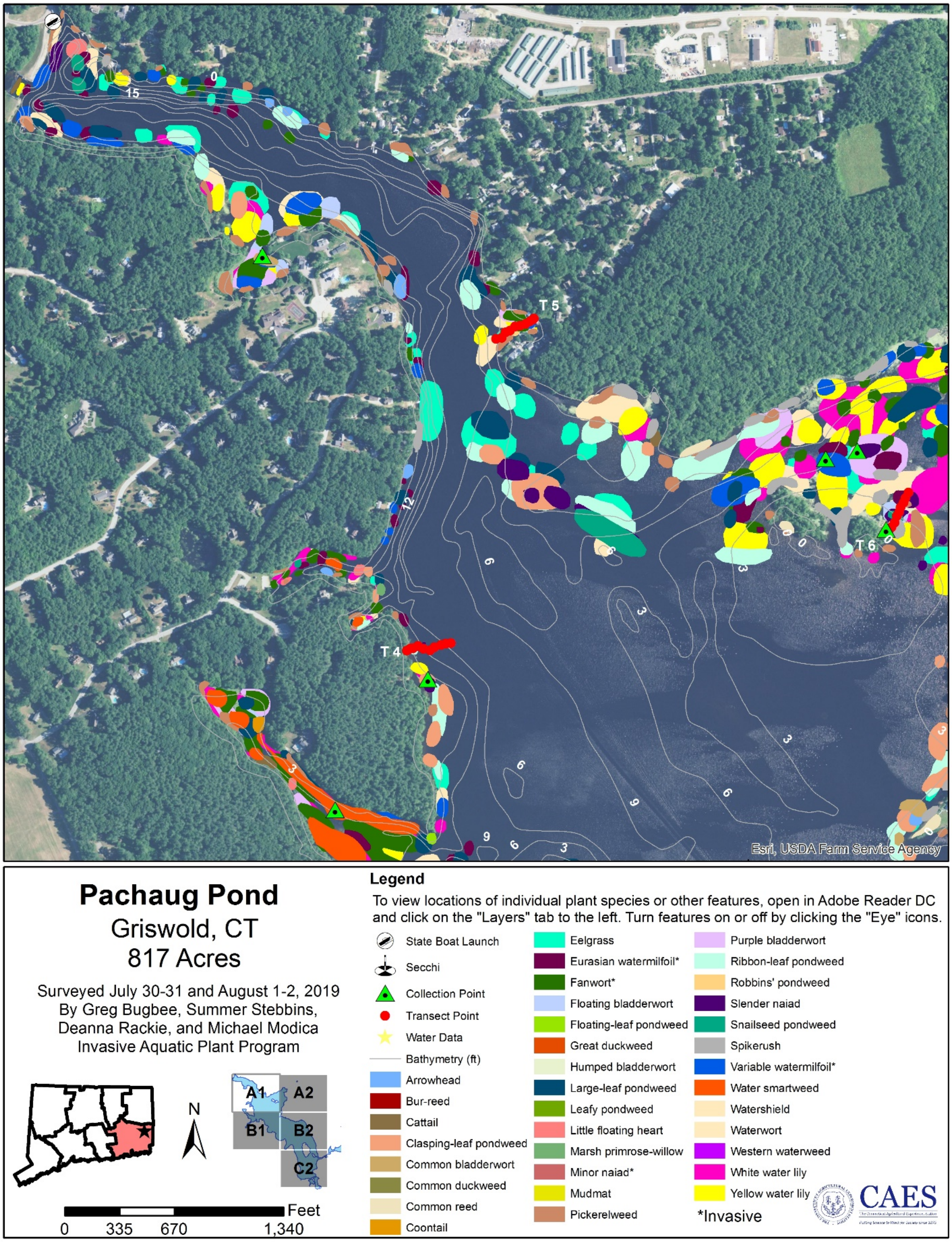
In the past, this body of water was subject to severe drawdown during late June, July and August. This drawdown took place after the game species had reproduced and did not destroy their nests or young. As a result of the drawdown, the game fish and panfish were crowded into a smaller area and the panfish were more readily available to the game fish as forage. The resultant increase in predation aided in controlling the numbers of panfish and helped to keep these fish within the limits of the food supply and, at the same time, helped to provide numerous fast-growing game fish. The drawdown process also helped to control aquatic vegetation and this resulted in considerable open water relatively free from water weeds. For the past several years, the water has not been used for industrial purposes and, as a result, the water level has remained fairly stable. Aquatic vegetation is becoming more abundant and the amount of open water more restricted. This increase in the abundance of "water weeds" may provide excessive escape cover for panfish and can well result in stunted populations of yellow perch and bluegill sunfish.

The drawdown and exposure of considerable areas of the pond bottom also allowed smartweed and other semi-terrestrial plants to grow on the exposed shoals. These terrestrial plants furnished excellent food for waterfowl and attracted large numbers of ducks during the fall shooting season.

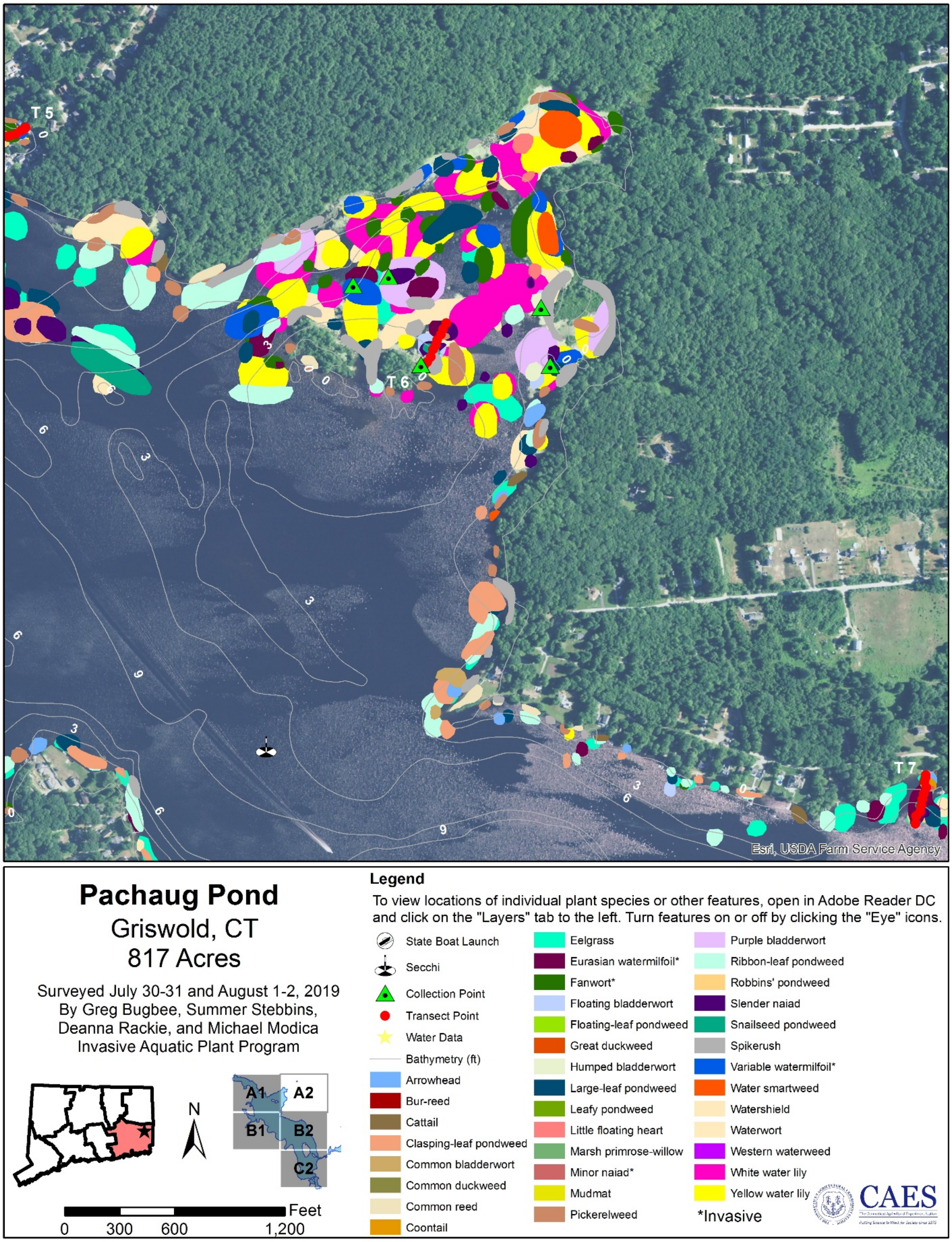
It is recommended that a control structure be installed in the dam so that the pond can be lowered three to four feet every summer. Such a drawdown should be started in June and the reduced water level should be held until the end of August.

No special regulations are recommended at this time.

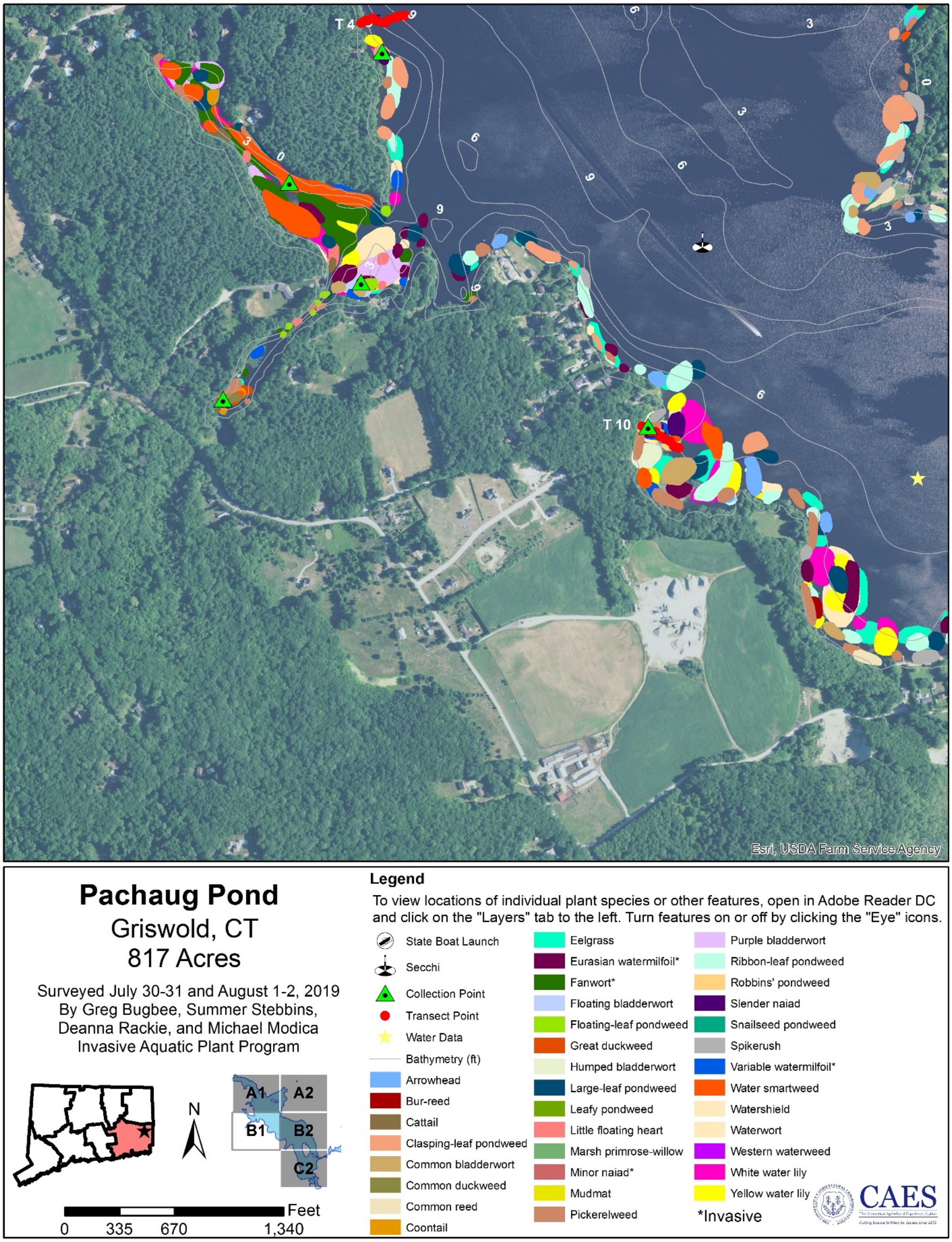
Aquatic Plant Survey Maps by Section



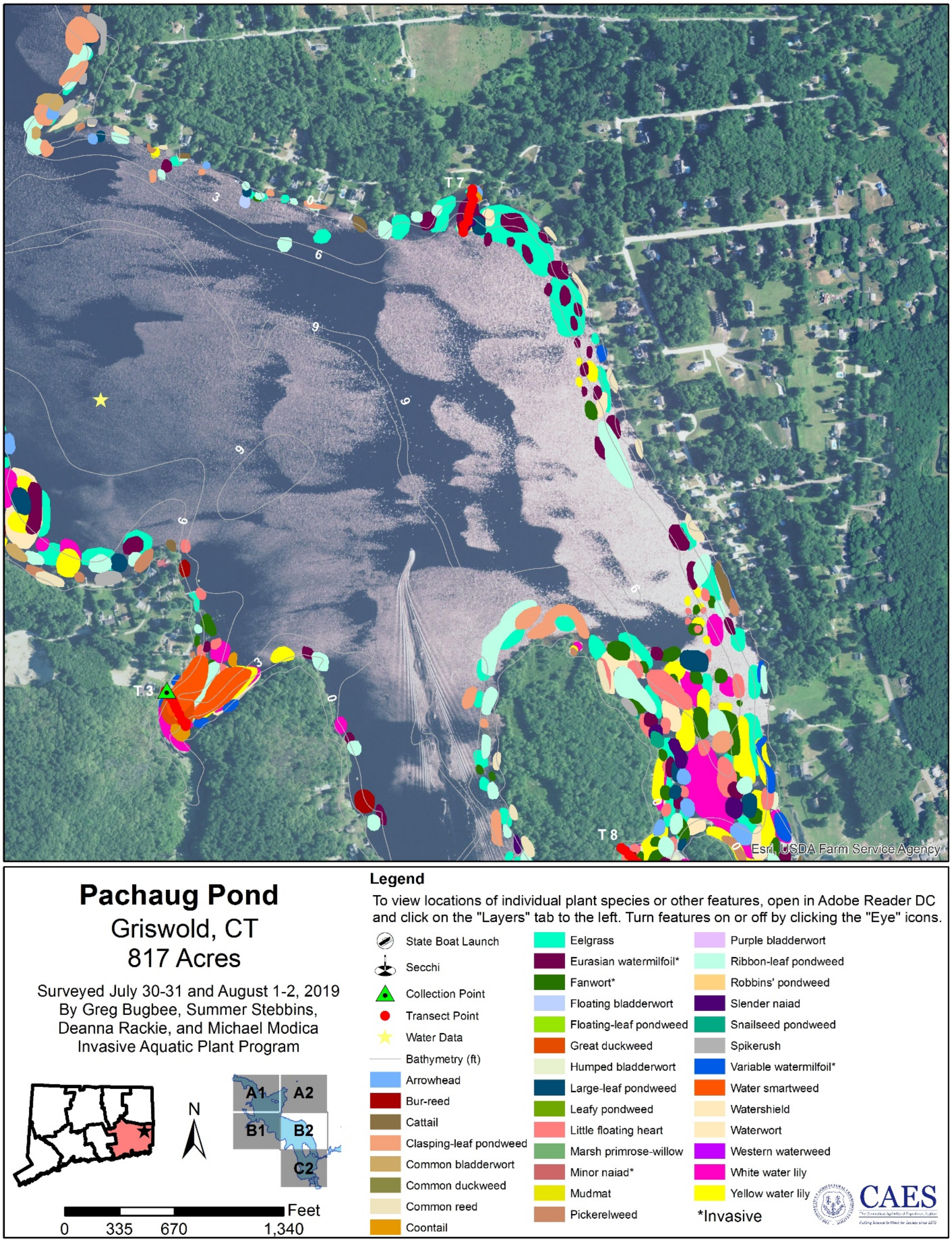
Section A1: 2019 survey of Pachaug Pond.



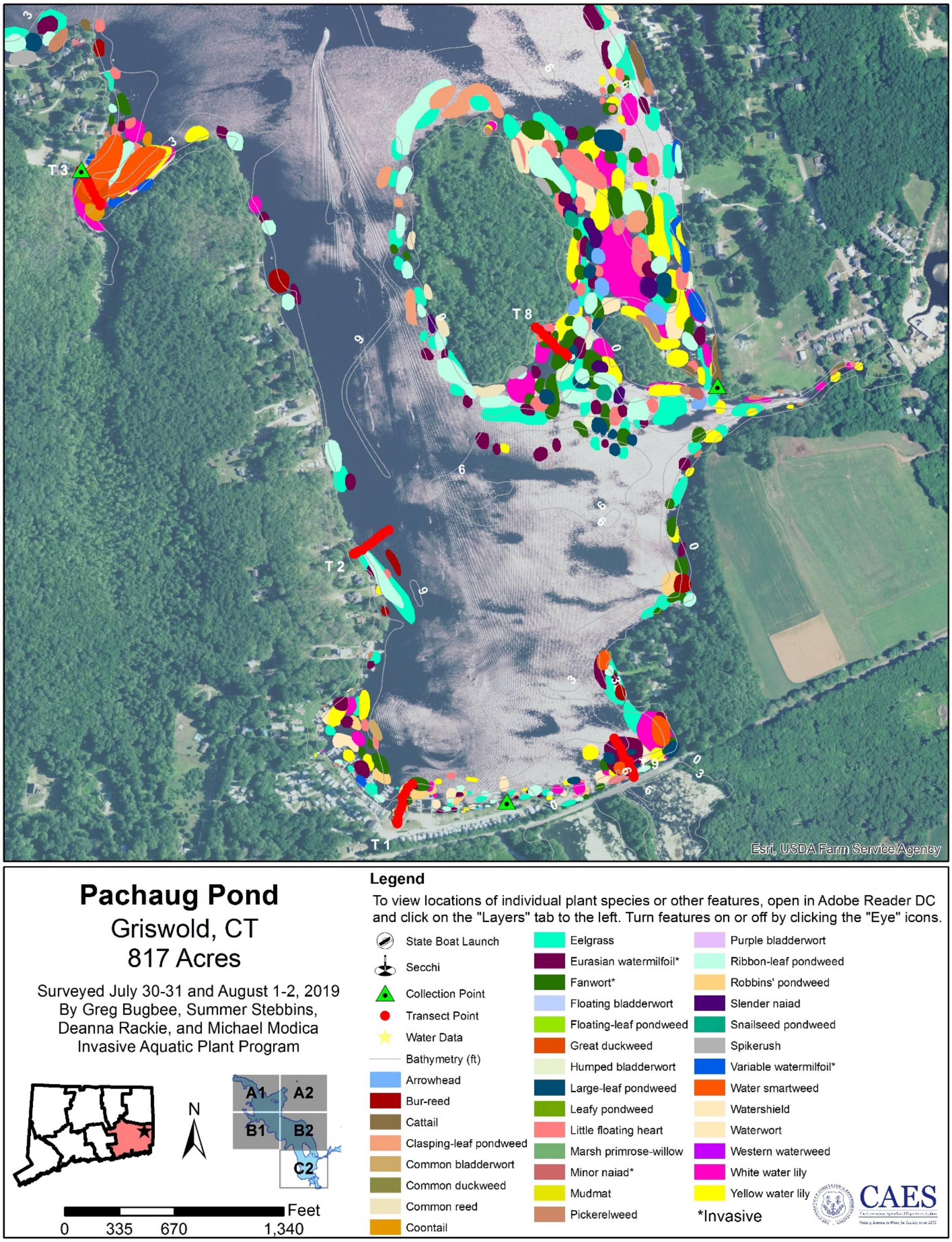
Section A2: 2019 survey of Pachaug Pond.



Section B1: 2019 survey of Pachaug Pond.



Section B2: 2019 survey of Pachaug Pond.



Section C2: 2019 survey of Pachaug Pond.

Invasive Plant Descriptions

Cabomba caroliniana

Common names:
Fanwort
Carolina fanwort

Origin:
Southeast United States
South America

Key features:
Plants are submersed

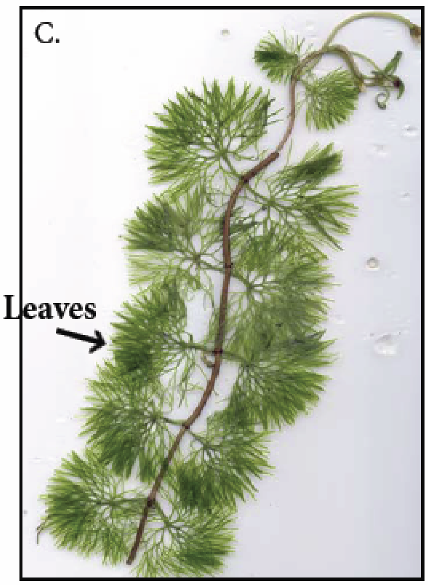
Stems: Can be 6 feet (2 m) long

Leaves: Dissected, opposite leaves 0.8-2 inches (2-5 cm) are fan-like and made up of forked leaflets attached to the stem by a petiole. Floating leaves 0.2-0.8 inches (6-20 mm) wide are oblong and produced on flower shoots

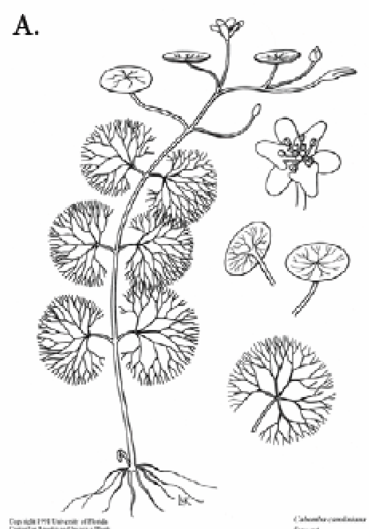
Flowers: Small, solitary flowers are usually white to pinkish

Fruits/Seeds: Flask shaped

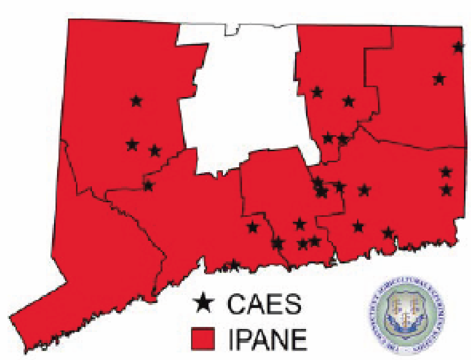
Reproduction: Seed and fragmentation



Easily confused species:
Watermilfoils: *Myriophyllum* spp.
White water crowfoot: *Ranunculus longirostris*
Water marigold: *Megalodonta beckii*



A. Copyright 1991 Univ. of Florida, Center for Aquatic and Invasive Plants
B. Copyright 2002 Univ. of Florida, Photo by A. Murray
C. Photo by A. Smagula



Myriophyllum heterophyllum

Common names:
Variable-leaf watermilfoil
Variable watermilfoil
Two-leaf watermilfoil

Origin:
Southern United States

Key features:
Plants are submersed

Stems: Dark brown stems extend to the water's surface and spread to form large mats

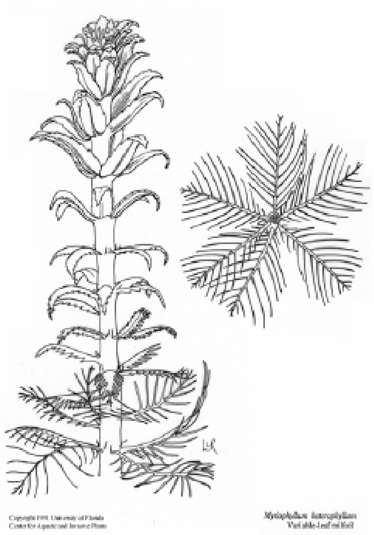
Leaves: Triangular with ≤ 11 pairs of leaflets. Leaves are dissected and whorled (4-6 leaves/whorl) resulting in a feathery appearance with leaf whorls < 1 inch apart giving it a ropy appearance

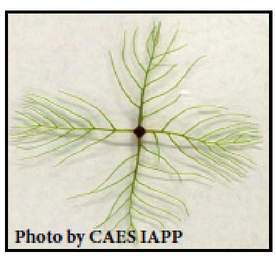
Flowers: Inflorescence spike 2-14 inches (5-35 cm) long extend beyond the water's surface with flowers in whorls of four with reddish petals

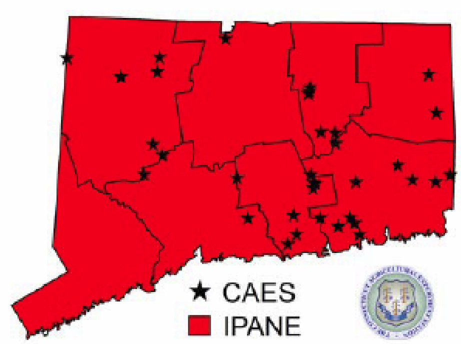
Fruits/Seeds: Fruits are almost round, with a rough surface

Reproduction: Fragmentation and seeds

Easily confused species:
Eurasian watermilfoil: *Myriophyllum spicatum*
Low watermilfoil: *Myriophyllum humile*







Myriophyllum spicatum

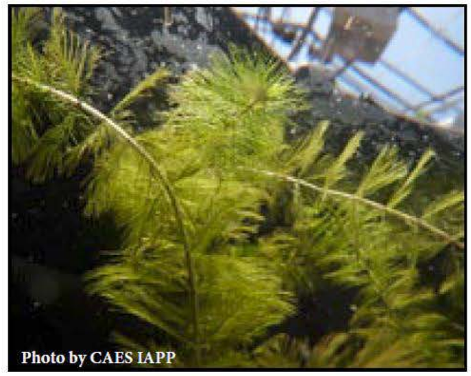


Photo by CAES IAPP

Common name:
Eurasian watermilfoil

Origin:
Europe and Asia

Key features:
Plants are submersed

Stems: Stem diameter below the inflorescence is greater with reddish stem tips

Leaves: Leaves are rectangular with ≥ 12 pairs of leaflets per leaf and are dissected giving a feathery appearance, arranged in a whorl, whorls are 1 inch (2.5 cm) apart

Flowers: Small pinkish male flowers that occur on reddish spikes, female flowers lack petals and sepals and have 4 lobed pistil

Fruits/Seeds: Fruit are round 0.08-0.12 inches (2-3 mm) and contain 4 seeds

Reproduction: Fragmentation and seeds

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Easily confused species:
Variable-leaf watermilfoil: *Myriophyllum heterophyllum*
Low watermilfoil: *Myriophyllum humile*
Northern watermilfoil: *Myriophyllum sibiricum*
Whorled watermilfoil: *Myriophyllum verticillatum*

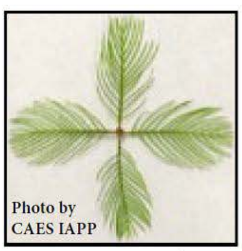


Photo by CAES IAPP

Photo by CAES IAPP

Photo by CAES IAPP

Najas minor


Photo by CAES IAPP

Common names:
Minor naiad
Brittle waternymph
Spiny leaf naiad
Eutrophic waternymph

Origin:
Europe

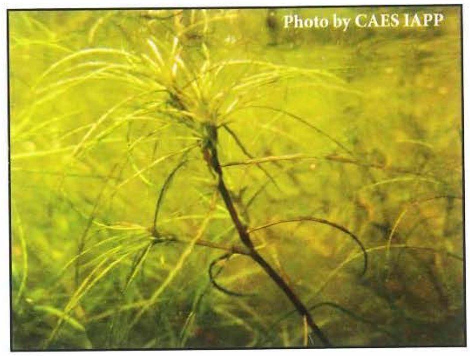


Photo by CAES IAPP

Key features:
Plants are submersed

Stems: Branched stems can grow up to 4-8 inches (10-20 cm) long

Leaves: Opposite and lance shaped on branched stems with easily visible toothed leaf edges and leaves appear curled under, basal lobes of leaf are also serrated, 0.01-0.02 inches (0.3-0.5 mm)

Flowers: Monoecious (male and female flowers on same plant)

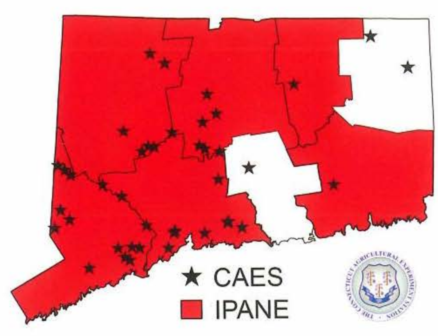
Fruits/Seeds: Fruits are purple-tinged and seeds measure 0.03-0.06 inches (1.5-3 mm)

Reproduction: Seeds and fragmentation


Photos by CAES IAPP

Easily confused species:
Other naiads (native): *Najas* spp.


Photo by CAES IAPP



Transect Data

Appendix Pachaug Pond Transect Data (1 of 2)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Brasch	CabCar	CerDem	ElaSpp	EleSpp	EloNut	GloCle	JunPel	LudSpp	MyrHet	MyrSpi	NajFle	NajMin	NupVar	NymOdo	NymCor	PolAmp	PonCor	PotAmp	PotBic	PotEpi	PotFol	PotPer	PotRob	SagSpp	SpaSpp	SpiPol	UtrGib	UtrMac	UtrPur	UtrRad	ValAme
1	1	0.5	Greg Bugbee	41.54862	-71.90047	8/2/2019	0.3	Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0
1	2	5	Greg Bugbee	41.54865	-71.90048	8/2/2019	1.1	Silt	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	3
1	3	10	Greg Bugbee	41.54869	-71.90045	8/2/2019	1.2	Silt	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	3
1	4	20	Greg Bugbee	41.54880	-71.90043	8/2/2019	1.3	Sand	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
1	5	30	Greg Bugbee	41.54888	-71.90037	8/2/2019	1.5	Sand	0	2	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
1	6	40	Greg Bugbee	41.54895	-71.90035	8/2/2019	1.5	Sand	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
1	7	50	Greg Bugbee	41.54905	-71.90035	8/2/2019	1.6	Gravel	0	2	0	0	0	0	0	0	0	0	3	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
1	8	60	Greg Bugbee	41.54913	-71.90028	8/2/2019	1.8	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0
1	9	70	Greg Bugbee	41.54922	-71.90022	8/2/2019	1.8	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
1	10	80	Greg Bugbee	41.54928	-71.90012	8/2/2019	1.8	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
2	1	0.5	Greg Bugbee	41.55316	-71.90138	8/2/2019	0.1	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	5	Greg Bugbee	41.55317	-71.90133	8/2/2019	0.5	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3	10	Greg Bugbee	41.55320	-71.90128	8/2/2019	1.3	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2	4	20	Greg Bugbee	41.55323	-71.90118	8/2/2019	1.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2	5	30	Greg Bugbee	41.55329	-71.90107	8/2/2019	2.0	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	6	40	Greg Bugbee	41.55334	-71.90097	8/2/2019	2.3	Organic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	7	50	Greg Bugbee	41.55341	-71.90086	8/2/2019	2.6	Organic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	8	60	Greg Bugbee	41.55346	-71.90078	8/2/2019	2.5	Organic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	9	70	Greg Bugbee	41.55351	-71.90069	8/2/2019	2.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	10	80	Greg Bugbee	41.55355	-71.90059	8/2/2019	2.6	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	0.5	Greg Bugbee	41.55965	-71.90742	8/1/2019	0.2	Sand	2	2	2	0	2	2	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0	0	0	0	0	0	2	0	0	0	3	0
3	2	5	Greg Bugbee	41.55960	-71.90738	8/1/2019	0.2	Sand	3	3	2	0	2	0	0	2	0	0	0	0	0	0	3	2	0	2	0	0	0	0	0	0	0	2	2	0	0	0	2	0
3	3	10	Greg Bugbee	41.55956	-71.90734	8/1/2019	1.0	Muck	3	2	2	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
3	4	20	Greg Bugbee	41.55948	-71.90726	8/1/2019	1.2	Muck	2	2	2	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	3	0	0	2	1	0	0	2	0
3	5	30	Greg Bugbee	41.55941	-71.90722	8/1/2019	1.8	Muck	0	3	3	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	3	0	0	2	0	0	0	2	0
3	6	40	Greg Bugbee	41.55934	-71.90718	8/1/2019	1.8	Muck	0	3	3	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	3	0	0	2	0	0	0	2	0
3	7	50	Greg Bugbee	41.55925	-71.90712	8/1/2019	1.8	Muck	2	3	3	0	0	0	0	0	0	0	2	0	0	0	2	0	2	0	1	0	0	0	0	3	0	0	2	0	0	0	2	0
3	8	60	Greg Bugbee	41.55915	-71.90706	8/1/2019	1.3	Organic	2	3	2	0	0	0	0	0	0	2	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0
3	9	70	Greg Bugbee	41.55911	-71.90697	8/1/2019	1.3	Organic	2	3	2	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0
3	10	80	Greg Bugbee	41.55906	-71.90698	8/1/2019	0.2	Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0
4	1	0.5	Greg Bugbee	41.57230	-71.92118	8/1/2019	0.2	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2	5	Greg Bugbee	41.57233	-71.92110	8/1/2019	0.5	Sand	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
4	3	10	Greg Bugbee	41.57234	-71.92104	8/1/2019	0.9	Sand	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
4	4	20	Greg Bugbee	41.57238	-71.92093	8/1/2019	1.1	Sand	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	5	30	Greg Bugbee	41.57233	-71.92081	8/1/2019	1.6	Silt	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	6	40	Greg Bugbee	41.57230	-71.92066	8/1/2019	2.1	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	7	50	Greg Bugbee	41.57235	-71.92056	8/1/2019	3.0	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	8	60	Greg Bugbee	41.57239	-71.92041	8/1/2019	3.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	9	70	Greg Bugbee	41.57241	-71.92031	8/1/2019	3.6	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	10	80	Greg Bugbee	41.57242	-71.92019	8/1/2019	3.6	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	0.5	Michael Modica	41.57786	-71.91826	8/1/2019	0.2	Muck	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	0	0	0	0	0	0	0	0	0	2
5	2	5	Michael Modica	41.57784	-71.91829	8/1/2019	0.3	Muck	2	3	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
5	3	10	Michael Modica	41.57782	-71.91835	8/1/2019	0.6	Muck	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0
5	4	20	Michael Modica	41.57777	-71.91845	8/1/2019	0.7	Muck	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	3
5	5	30	Summer Stebbins	41.57774	-71.91857	8/1/2019	0.7	Muck	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
5	6	40	Summer Stebbins	41.57773	-71.91868	8/1/2019	0.7	Muck	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	4	3
5	7	50	Summer Stebbins	41.57766	-71.91880	8/1/2019	0.8	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	3
5	8	60	Summer Stebbins	41.57763	-71.91890	8/1/2019	0.7	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
5	9	70	Summer Stebbins	41.57754	-71.91898	8/1/2019	0.5	Muck	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
5	10	80	Summer Stebbins	41.57753	-71.91911	8/1/2019	0.5	Sand	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	3

Appendix Pachaug Pond Transect Data (2 of 2)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Brasch	CabCar	CerDem	ElaSpp	EleSpp	EloNut	GloCle	JunPel	LudSpp	MyrHet	MyrSpi	NajFle	NajMin	NupVar	NymOdo	NymCor	PolAmp	PonCor	PotAmp	PotBic	PotEpi	PotFol	PotPer	PotRob	SagSpp	SpaSpp	SpiPol	UtrGib	UtrMac	UtrPur	UtrRad	ValAme
6	1	0.5	Summer Stebbins	41.57424	-71.91040	8/1/2019	0.1	Muck	3	0	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	2
6	2	5	Summer Stebbins	41.57426	-71.91035	8/1/2019	0.2	Muck	4	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0
6	3	10	Summer Stebbins	41.57429	-71.91030	8/1/2019	0.2	Muck	4	0	0	0	2	0	0	0	0	0	0	3	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	2	0	2	0	3
6	4	20	Summer Stebbins	41.57437	-71.91023	8/1/2019	0.3	Muck	4	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	3
6	5	30	Summer Stebbins	41.57448	-71.91018	8/1/2019	0.3	Muck	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	2	2
6	6	40	Summer Stebbins	41.57454	-71.91013	8/1/2019	0.3	Muck	4	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	3
6	7	50	Summer Stebbins	41.57463	-71.91009	8/1/2019	0.3	Gravel	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0
6	8	60	Summer Stebbins	41.57471	-71.91002	8/1/2019	0.3	Muck	4	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2	2
6	9	70	Summer Stebbins	41.57478	-71.90998	8/1/2019	0.3	Muck	4	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
6	10	80	Summer Stebbins	41.57487	-71.90991	8/1/2019	0.3	Muck	3	1	0	0	0	0	0	0	0	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
7	1	0.5	Greg Bugbee	41.56804	-71.90044	8/2/2019	0.2	Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2
7	2	5	Greg Bugbee	41.56800	-71.90045	8/2/2019	0.5	Sand	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
7	3	10	Greg Bugbee	41.56795	-71.90047	8/2/2019	0.2	Sand	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4
7	4	20	Greg Bugbee	41.56785	-71.90043	8/2/2019	1.0	Sand	0	2	2	0	0	0	0	0	0	2	2	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4
7	5	30	Greg Bugbee	41.56776	-71.90049	8/2/2019	1.2	Gravel	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
7	6	40	Greg Bugbee	41.56768	-71.90052	8/2/2019	1.5	Sand	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2
7	7	50	Greg Bugbee	41.56758	-71.90054	8/2/2019	1.5	Gravel	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	2	0
7	8	60	Greg Bugbee	41.56749	-71.90056	8/2/2019	1.6	Gravel	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	2
7	9	70	Greg Bugbee	41.56743	-71.90065	8/2/2019	1.6	Gravel	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
7	10	80	Greg Bugbee	41.56731	-71.90066	8/2/2019	1.6	Silt	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2
8	1	0.5	Greg Bugbee	41.55694	-71.89726	8/2/2019	0.1	Sand	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	3	0	0	1	0	0	0	2
8	2	5	Greg Bugbee	41.55691	-71.89722	8/2/2019	0.4	Sand	2	0	0	0	2	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	2	0	0	4	3	0	0	1	0	0	0	2
8	3	10	Greg Bugbee	41.55689	-71.89717	8/2/2019	0.8	Sand	2	0	0	0	2	0	0	0	1	2	0	0	0	0	0	3	0	0	0	0	3	0	0	4	2	0	0	1	0	0	0	2
8	4	20	Greg Bugbee	41.55681	-71.89708	8/2/2019	1.0	Sand	2	2	2	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	2	0	2	0	2	0	0	0	2
8	5	30	Greg Bugbee	41.55674	-71.89699	8/2/2019	1.2	Silt	2	2	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2
8	6	40	Greg Bugbee	41.55669	-71.89690	8/2/2019	1.2	Silt	0	4	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
8	7	50	Greg Bugbee	41.55662	-71.89685	8/2/2019	1.2	Silt	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
8	8	60	Greg Bugbee	41.55656	-71.89677	8/2/2019	1.4	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	9	70	Greg Bugbee	41.55651	-71.89661	8/2/2019	1.5	Silt	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8	10	80	Greg Bugbee	41.55645	-71.89656	8/2/2019	1.5	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	2	2
9	1	0.5	Greg Bugbee	41.54936	-71.89516	8/2/2019	0.2	Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	2	5	Greg Bugbee	41.54943	-71.89518	8/2/2019	1.2	Gravel	0	3	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	3
9	3	10	Greg Bugbee	41.54947	-71.89519	8/2/2019	1.3	Organic	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	4	0	0	0	0	0	0	0	2
9	4	20	Greg Bugbee	41.54954	-71.89526	8/2/2019	1.8	Silt	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	2	0	0	0	0	4	0	0	0	0	0	0	0	2
9	5	30	Greg Bugbee	41.54963	-71.89527	8/2/2019	1.3	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2
9	6	40	Greg Bugbee	41.54969	-71.89538	8/2/2019	1.9	Silt	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
9	7	50	Greg Bugbee	41.54977	-71.89542	8/2/2019	1.9	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0
9	8	60	Greg Bugbee	41.54985	-71.89546	8/2/2019	1.4	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
9	9	70	Greg Bugbee	41.54993	-71.89554	8/2/2019	1.9	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
9	10	80	Greg Bugbee	41.55001	-71.89559	8/2/2019	1.4	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
10	1	0.5	Greg Bugbee	41.56547	-71.91497	8/1/2019	0.2	Sand	2	0	0	0	3	0	0	0	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	2	5	Greg Bugbee	41.56546	-71.91494	8/1/2019	0.2	Sand	3	2	0	0	3	0	0	0	1	2	0	2	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	2	0
10	3	10	Greg Bugbee	41.56545	-71.91487	8/1/2019	1.0	Silt	3	2	0	0	2	0	0	0	1	2	0	3	0	0	2	2	0	1	0	2	0	0	0	0	0	0	0	0	0	2	2	0
10	4	20	Greg Bugbee	41.56538	-71.91478	8/1/2019	1.1	Silt	2	0	0	0	0	0	0	0	0	2	0	3	0	2	2	2	0	1	0	2	3	0	0	0	0	0	0	0	0	0	2	0
10	5	30	Greg Bugbee	41.56538	-71.91467	8/1/2019	1.1	Silt	3	0	0	0	2	0	0	0	0	2	0	3	0	2	2	2	0	1	0	2	0	2	0	0	0	2	0	0	0	0	0	2
10	6	40	Greg Bugbee	41.56530	-71.91457	8/1/2019	1.2	Silt	2	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	2
10	7	50	Greg Bugbee	41.56526	-71.91446	8/1/2019	1.3	Muck	2	0	0	0	0	0	0	0	0	2	2	0	0	2	2	2	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	2
10	8	60	Greg Bugbee	41.56522	-71.91436	8/1/2019	1.3	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2
10	9	70	Greg Bugbee	41.56513	-71.91427	8/1/2019	1.3	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
10	10	80	Greg Bugbee	41.56511	-71.91416	8/1/2019	1.5	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0