Northeast Aquatic Research &

SOLITUDE LAKE MANAGEMENT

Coventry Lake
Hydrilla Management Program
2021 Treatment Report

Prepared for the Town of Coventry, CT

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Introduction

The 2021 season marks the sixth year of *Hydrilla verticillata* (Hydrilla) management in Coventry Lake. SOLitude Lake Management (SOLitude) has conducted annual herbicide treatments, while Northeast Aquatic Research (NEAR) has conducted aquatic plant surveys and associated monitoring.

Hydrilla was first discovered near the public boat ramp in 2015. In 2016 and 2017, the plants were treated with the herbicide Aquathol-K (endothall) and in 2017, specific patches were covered with benthic barriers as an attempt to halt growth and spread. Due to continued spread of Hydrilla in the lake, the management program switched to a whole-lake approach using the systemic herbicide Sonar One (fluridone) beginning in 2018. Fluridone has been used annually from 2018 through 2021 (4 years) with increasing success against invasive *Hydrilla* and invasive Eurasian milfoil (*Myriophyllum spicatum*).

The 2021 fluridone treatment was initiated on July 23rd by SOLitude Lake Management. Hydrilla is a late-season aquatic plant, which was the reasoning behind the mid-summer treatment start date. Booster treatments were administered on August 25th and September 28th. Herbicide concentration monitoring was conducted in order to ensure appropriate dosage throughout the treatment period.

NEAR conducted a thorough search for the Connecticut state-listed Threatened species *Potamogeton vaseyi* (Vasey's Pondweed) and *Lipocarpha micrantha* (Dwarf Bulrush) on June 21st, in locations where these species had been historically documented. The lake-wide pre-herbicide treatment survey was conducted on July 6th and 7th. The post-herbicide treatment survey was conducted on October 6th and 7th.

2021 Management Approach

The 2021 season was the fourth year of whole-lake fluridone treatment of Hydrilla in Coventry Lake. The goal behind whole-lake treatments has been to eliminate the risk of missing, and therefore not treating, patches of Hydrilla that may be present and/or regrowing in the lake undetected. Fluridone is known to be one of the most successful herbicides in long-term Hydrilla control and potential eradication. Fluridone concentrations were maintained in the lake for 90+ days.

SOLitude applied the first treatment of Fluridone on July 23rd, with a lake-wide dose of 4 ppb applied to the 178-acre littoral zone. A booster treatment was applied on August 25th, with a lake-wide dose of 2 ppb. A second booster treatment was applied on September 28th, again using a lake-wide dose of 2 ppb. The target littoral concentration of fluridone was 2-4ppb throughout a 90-day time period. At this low dosage, invasive Hydrilla and Eurasian milfoil can both be well-controlled, but many native species, like pondweeds (*Potamogeton sp.*) remain unharmed.

In the area where there was remaining Hydrilla found post-2020 fluridone treatments, SOLitude took care to maintain slightly higher dosages in those areas. One of the main concerns was a location near sampling station #1, where there is a stream that dilutes concentration (**Map 1**). To monitor fluridone concentrations, water samples were collected from the surface and 1-foot off the bottom from six different locations in the lake, as shown in **Map 1**. Samples were collected multiple times over the course of the project and results are displayed in **Table 1.**

Prior to each application, signs were posted around the shoreline of the lake warning of the temporary water use restrictions. Swimming was restricted either for the full day or until the afternoon on the days of treatment. Restrictions on certain types of irrigation were imposed for 30-days after each treatment.

Map 1. Coventry Lake 2021 Treatment Area.

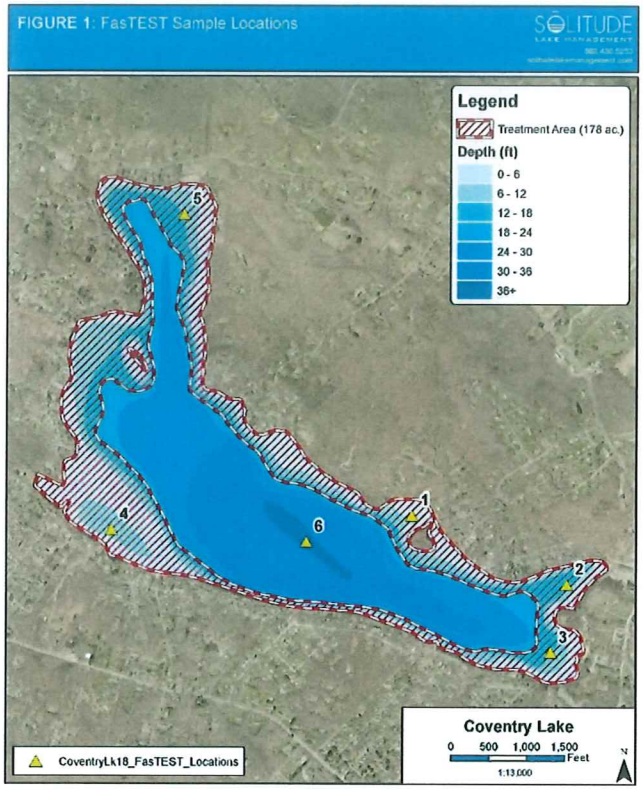


Table 1. 2021 FasTEST data (results in ppb).

	Station ("a" is surface sample, "b" is bottom sample)											
	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
Water Depth	8'		10'		12'		9'		12'		32'	
7/30/2021	3.1	2.9	2.6	2.8	2.5	2.5	2.9	3.1	2.9	2.6	2.6	2.3
8/11/2021	3.0	2.8	2.5	2.8	2.6	2.9	2.9	2.9	2.9	3.1	2.8	2.9
9/8/2021	3.4	3.3	3.7	2.7	4.2	3.7	3.6	3.9	4.4	3.7	3.7	3.5
10/5/2021	2.8	2.7	7.8	3.1	2.8	3.1	2.8	2.9	3.0	3.0	3.2	3.1

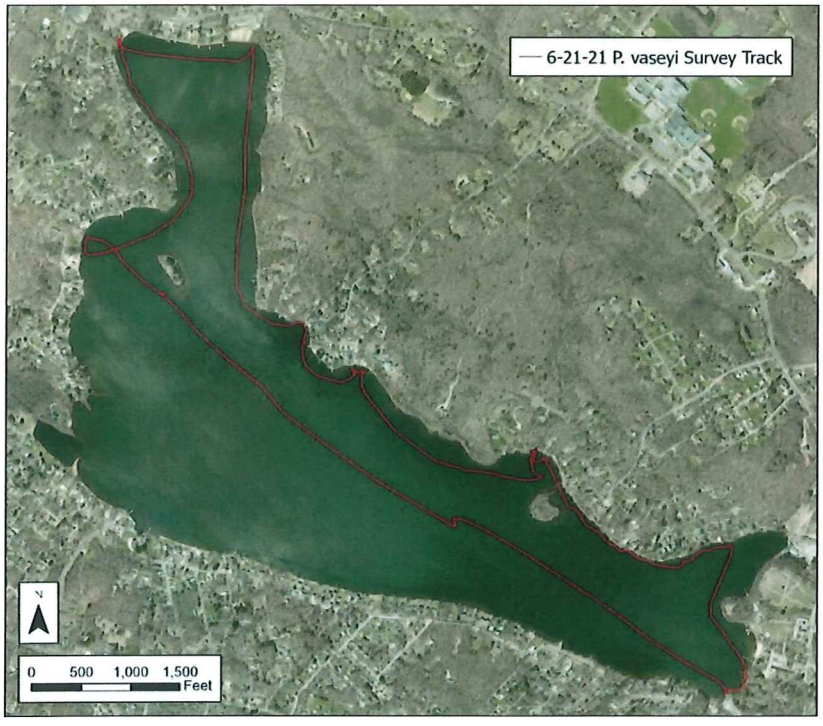
Fluridone was maintained at a desirable concentration for the 74 days of testing and concentrations were sufficient to provide continued impact after the final FasTEST sampling. Fluridone across the testing dates and stations ranged from a low of 2.3 ppb to a high of 7.8 ppb. The average fluridone concentration across all dates and stations was 3.14 ppb, which was higher than the prior two years. Due to the characteristics of this herbicide, concentrations were likely higher in the water at the lake bottom and in the sediment pore water, which comes in direct contact with the Hydrilla plants.

2021 Aquatic Plant Survey Results

A survey in search of the state-listed Threatened species Vasey's Pondweed and Dwarf Bulrush was conducted on June 21st, focusing on areas where the plants were previously known to exist and in areas that had recognized adequate habitat for the two species. The survey track and locations with Vasey's Pondweed are shown in **Maps 2** and **3**.

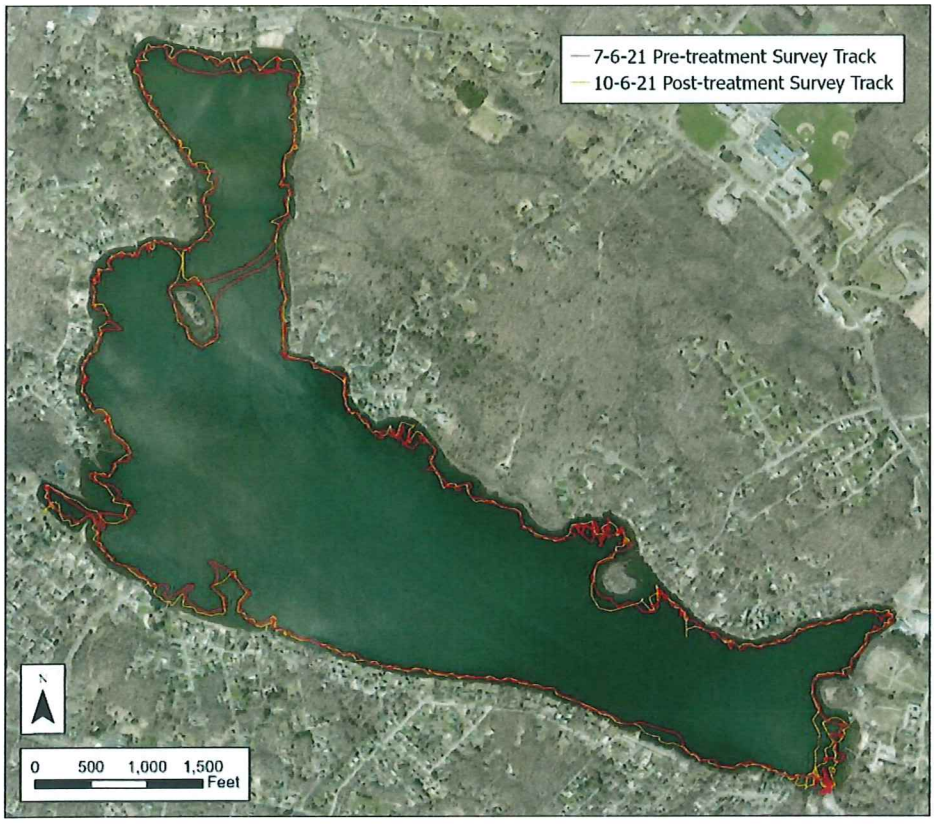
NEAR conducted a lake-wide pre-treatment aquatic plant survey on July 6th and 7th (**Map 4**). During this survey, waypoints from previous years of surveying were used, approximately 150 feet apart throughout the lake's littoral zone. Revisiting waypoints from previous years of surveying allows for statistical assessments in documenting species change over time and across the multi-year fluridone treatments. Additional new waypoints were made if new, state-listed, or invasive species were observed. All locations where Hydrilla had been found previously were extensively searched in 2021. A full-lake post-treatment survey was conducted on October 6th and 7th, utilizing the same survey methods as pre-treatment (**Map 4**). Small Hydrilla plants were found at the "Island Patch" during the underwater survey conducted on September 21st (**Map 5**), but Hydrilla was not found during the October post-treatment survey. The pre- and post-treatment surveys performed by boat employed a combination of visual assessments, hand-raking in shallow water, grappling rake tosses, and depth-soundings to view plants growing in deep water. Specific survey methods were consistent with those outlined in prior years.

Map 2. Survey track in search of statelisted species, June 21st, 2021.



Map 3. Locations of Potamogeton vaseyi; June 21st NDDB survey & July 6-7th pre-treatment survey.

Map 4. 2021 pre-treatment and post-treatment survey tracks (surveys dates indicate the first day of each survey).



Vasey's pondweed (*P. vaseyi*) typically begins to die off by mid-July, and is completely senesced by late summer, so the plant was not present during the post-treatment survey in October. Dwarf Bulrush (*Lipocarpha micrantha)* is a flowering sedge that grows in shoreline habitat. This species was last documented in Coventry Lake in 2017. The area of the lake with a historical record of *L. micrantha* was searched by Dr. Knoecklein, but the species was not found. However, many shoreline sedges were observed throughout the survey and there appeared to be no negative herbicide impacts to shoreline emergent species. Hydrilla was not found in Coventry Lake during the pre-treatment survey. It is possible that a few, small plants were present, but they were too small and/or sparse to detect by boat-survey methods at the time of the survey.

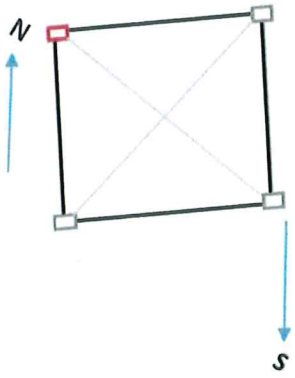
In addition to the surveys conducted from a boat, underwater inspections were done on September 21st, two months after the initial herbicide treatment. Six sites that had Hydrilla documented in previous years were inspected via underwater survey techniques (**Map 5**). Sites were swum in an underwater transect pattern, searching for visible Hydrilla growth. A considerable number of small Hydrilla plants were found in the area that had been previously covered with benthic barriers, just offshore of the peninsula. This area had been previously referred to as the "Island Patch" in past reports (**Map 5,** red location). The Hydrilla plants found on September 21st were approximately 3-5 inches tall and scattered in 10 to 12 feet of water. Observed Hydrilla plant density at this area was approximately 1 small plant every 2-3ft. The plants were brittle and visibly discolored, exhibiting the whiteish and purplish discoloring that is characteristic of fluridone herbicide chlorosis (**Images 1-2**).

Map 5. 2021 underwater survey locations of September 21st, 2021.
Hydrilla present only in the area of the red "island" location in mostly 10-12ft of water. Approximate 9/21/21 underwater survey areas are outlined.

Image 1 & 2 Fluridone impacted Hydrilla from deep-water "Island patch" 2021

Attempts were made to begin tuber sampling on this date at the "Island Patch" location, yet the extremely rocky and boulder-filled area in which the Hydrilla sprouts grew, made tuber sampling challenging and infeasible at this location. During the time of this underwater inspection, many other native plant species were observed underwater, including *Zosterella dubia* and *Potamogeton perfoliatus,* typically up to 10ft deep. Despite extensive underwater searching, no Hydrilla was seen growing at the other locations, including in the shallow waters of the western island cove, where small Hydrilla plants had been seen at the end of the 2020 season near the mouth of a small stream. The Solitude treatment applicator made mention of Hydrilla being found in the northwestern shallows of the cove that runs along Route 31 (Main Street), but NEAR was not able to locate this presence during the October post-treatment survey.

On October 14th, a second underwater diving survey was conducted to search for Hydrilla tubers in the area that had the largest historical Hydrilla bed, off the boat-ramp in 8-12ft of water. The starting location of the large historical Hydrilla bed (41.765800, -72.310069) was used to set up a gridded underwater ~10mx10m quadrat like shown below. Cinderblocks mark each corner of the ~100m² sampling area and have been left in place for semi-permanent monitoring. The first cinderblock (red) is laid at 41.765872, -72.310011. The large sampling area was set up oriented North-South, mostly in line with the boat ramp dock, but after adjusting the distance between the corners, the grid ended up tilted about 13 degrees west. On a clear day the two southern blocks should be visible in roughly 8ft of water and should be easy to locate. The southeastern block is roughly 20m north of the end of the boat ramp dock. Ten ~6" diameter cores of ~10" deep were sampled within the grid. The sediment samples were brought to the surface and sifted through a mesh screen over the side of the boat, to search for Hydrilla tubers. None of the samples had Hydrilla tubers. At this point it was determined that many more samples would be required for adequate tuber density monitoring of this site, and that it would be easier and less labor intensive to devise a way to take cores from a boat instead of on SCUBA.



Now that the semi-permanent underwater sampling grid has been placed, it is possible to mark each corner with temporary surface buoys for any future Hydrilla surveying and/or tuber monitoring efforts.

Although there were no Hydrilla plants or tubers found at the previously extensive boat-ramp patch, the presence of small Hydrilla plants in the Island Patch (41.76987, -72.31654) indicates that there are still some remaining tubers present in the rocky sediments. It's possible that this area had a higher tuber density because it had been previously covered by benthic barriers in 2018-2019, which may have limited the effects of the initial fluridone treatment at this location. The benthic barriers were all removed in spring 2020 and have now been treated for two consecutive years without the influence of the barriers. Hydrilla was not found during the post-treatment survey.

Additional Aquatic Plant Species

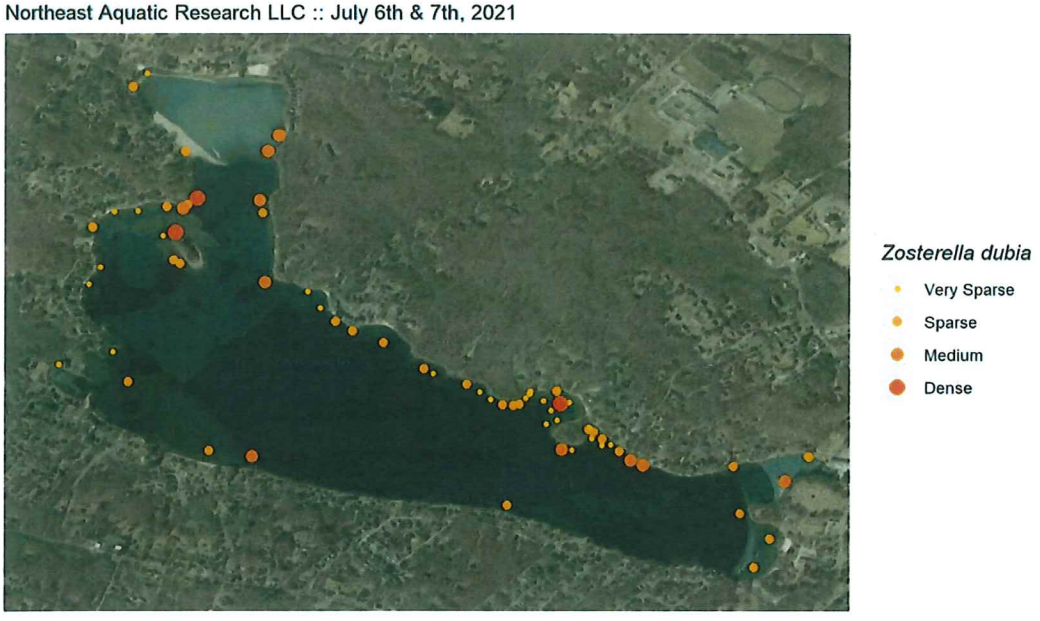
The species frequency and density results from the 2021 pre-treatment and post-treatment surveys are listed in **Table 2.** 'Percent Frequency' documents the overall frequency as a percentage of the total number of survey waypoints. When a species was found at a waypoint, the density of the species within that area (as seen from the surface, on the grappling rake, and/or on the depth sounder) was recorded. The average density for each species is based on the average of all density estimates across all the locations where the species was found. A value of "NA" for average density indicates the species was not found. During the pre-treatment survey, *Potamogeton perfoliatus* (Clasping-leaf pondweed), *Zosterella dubia* (Yellow star grass), *Potamogeton amplifolius* (Large-leaf pondweed), and *Nitella* sp. (Musk grass) were the dominant species in the lake, meaning these species were present at greater than 20% frequency (**Map 6, Map 7, Map 8, Map 9**). During the post-treatment survey, *Zosterella dubia, Potamogeton perfoliatus*, and *Nitella* were dominant (**Maps 10-12**). As in 2020, no invasive *Myriophyllum spicatum* (Eurasian milfoil) was found, which had previously been one of the dominant species in the lake prior to fluridone treatments.

Table 2. 2021 pre-treatment (July 6th & 7th) and post-treatment (October 6th) survey vegetation data.

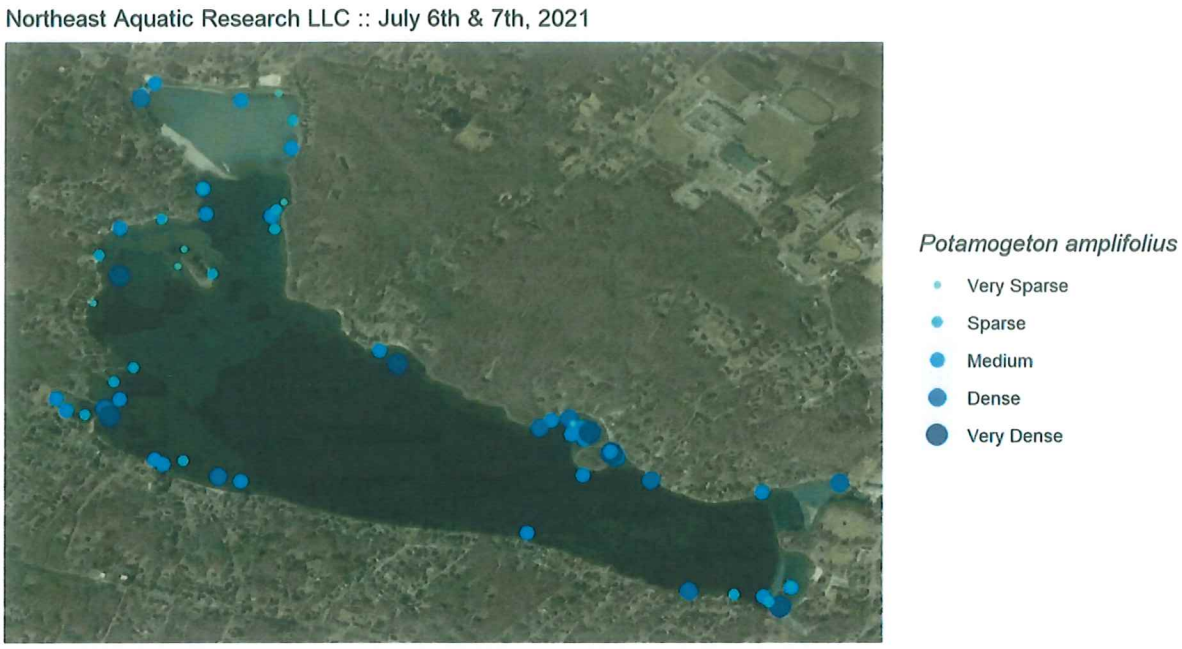
Scientific Name	% Frequency		Average Density	
	Pre	Post	Pre	Post
Ceratophyllum demersum	9	11	25	10
Eleocharis acicularis	< 1	1	15	10
Elodea canadensis	4	6	33	32
Elodea nuttallii	4	1	24	10
Filamentous algae	1	5	25	46
Fontinalis	0	1	NA	10
Najas flexilis	< 1	0	5	NA
Nitella	22	20	12	37
Potamogeton amplifolius	34	17	32	38
Potamogeton berchtoldii	1	1	40	12.5
Potamogeton bicupulatus	0	<1	NA	20
Potamogeton perfoliatus	47	33	47	31
Potamogeton pusillus	3	0	26	NA
Potamogeton vaseyi	4	0	11	NA
Sagittaria graminea	1	0	8	NA
Vallisneria americana	1	0	28	NA
Zosterella dubia	36	46	14	18

Map 6. Pre-treatment survey locations and densities of Potamogeton perfoliatus, July 6th & 7th, 2021.

Map 7. Pre-treatment survey locations and densities of Zosterella dubia, July 6th & 7th, 2021.

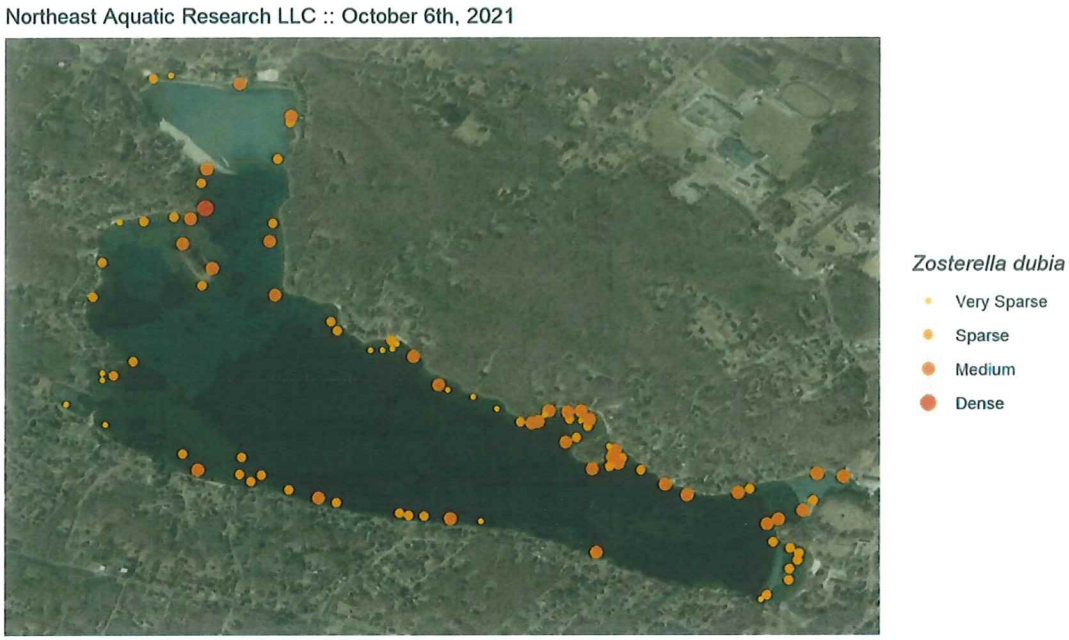


Map 8. Pre-treatment survey locations and densities of Potamogeton amplifolius, July 6th & 7th, 2021.



Map 9. Pre-treatment survey locations and densities of Nitella sp., July 6th & 7th, 2021

Map 10. Post-treatment survey locations and densities of Zosterella dubia, October 6th, 2021.



Map 11. Post-treatment locations and densities of Potamogeton perfoliatus, October 6th, 2021.

Map 12. Post-treatment survey locations and densities of Nitella sp., October 6th, 2021

Discussion & Recommendations

One important thing to note is that the 2021 fluridone water column sampling results indicated a consistently higher dosage of fluridone in the water column than in previous years treatments. The mean FasTEST fluridone concentrations across all sites and monitoring dates was 3.14 ppb in 2021. The 2020, 2019, and 2018 mean measured FasTEST concentrations from the same monitoring locations were 2.47, 2.16, and 1.80 ppb, respectively. It is well-known that Hydrilla tubers may last in the sediments for upwards of 6 to 7 years[1] (Nawrocki, 2016). For that reason, it makes most sense to continue the full-lake fluridone treatments for another two years, with the goal of nearly completely eradicating sediment tuber banks in the lake. It is possible that some tubers may survive after that time, but management from North Carolina reservoirs indicates upwards of 99% of tuber density reduction is possible over 5-6 years, and that 93% reduction was observed after three years of treatment (Nawrocki, 2016). It is unrealistic to continue annual fluridone treatments for many more years and the best course of action appears to be to potentially treat pop-up locations of Hydrilla with a contact herbicide, as needed for a period of two years beginning in 2024. Re-evaluation will be needed as conditions change, but it is plausible that fluridone treatments will be necessary every three years, in order to keep any remaining Hydrilla from reestablishing a tuber bank[2]. If small pop-up patches of Hydrilla occur between future scheduled treatments, the Town can use the benthic barrier material that they have on hand to rapidly cover a patch and prevent fragmentation/spread, while additional measures are organized as needed.

[1] Nawrocki, J.J., R.J. Richarson, and S.T. Hoyle, 2016. *Monoecious hydrilla tuber dynamics following various management regimes on four North Carolina reservoirs*. Journal of Aquatic Plant Management, 54(12-19).

[2] Report of the Science Advisory Panel for the California Department of Food and Agriculture (CDFA) Hydrilla Eradication Program, 2009. Clear Lake, CA. <https://www.cdfa.ca.gov/plant/IPC/hydrilla/pdfs/hydrilla2009_trpreport.pdf>