



Northeast Aquatic Research



74 Higgins Highway
Mansfield Center, CT 06250
www.northeastaquaticresearch.net

March 9, 2023

TO: Crystal Pond Association

ATTN: Tom Hawkins

FROM: Hannah Moore

CC: George Knoecklein, PhD, Principal Limnologist

Re: Crystal Pond 2022 Water Quality and Aquatic Plant Results

Discussion of 2022 Water Quality Results

Water Clarity

Water clarity ranged from 4m to 6m for most of the summer, with the worst clarity occurring in June and then again in September. The best clarity of the season occurred in May, when clarity was recorded below 7 meters on all but one sampling date. Clarity also improved at the end of the season. Overall, water clarity in 2022 was relatively good.

Temperature and Dissolved Oxygen

The water column was fully mixed in May but was stratified by early-mid June. The lake remained stratified until the end of September, at which point it returned to a fully mixed state. The water at the bottom of the deep spot was anoxic (dissolved oxygen <1 mg/L) from July through mid-September, reaching a maximum height of 7 meters (as measured down from the surface), or approximately 1.5 meters of anoxic water) from late August into early September (see appendix for isopleths of water temperature and dissolved oxygen).

Nutrients

Total phosphorus and total nitrogen concentrations were generally good in May and June but were elevated in the bottom water from July through September, in line with the period of anoxia and internal nutrient loading.

TP at the top and middle of the water column ranged from 7ppb to 18ppb, with the highest values occurring in late August. TP in the bottom water increased steadily between May and October, reaching a maximum concentration of 75ppb in October.

TN at the top and middle of the water column ranged from 183ppb to 292ppb. Again, the highest values were recorded in August. TN in the bottom water reached a maximum concentration of 735ppb in August.

Ammonia at the top and middle of the water column was low in most samples. Ammonia in the bottom water reached a maximum concentration of 71ppb in August.

Inlet Nutrients

Inlet samples were collected from the five primary inlets (Inlets 1, 4, 7, 8, and 9) on May 30th, June 24th, August 26th, and October 16th. A sixth inlet, Lake Drive Culvert, was sampled on August 26th. All six inlets had very elevated nutrient concentrations on most sampling dates. There were five samples that had over 100ppb phosphorus and an additional 4 samples that had phosphorus values between ~50 and 100ppb. Nitrogen was also exceedingly high in several samples, with concentrations over 1,000ppb.

At this time, the Crystal Pond Association needs to focus efforts on tracking down the source(s) of these nutrients and controlling them. The lake cannot continue to receive this quantity of phosphorus and nitrogen and remain in good condition for long.

Phytoplankton

One phytoplankton (algae) sample was collected from Crystal Pond on July 11th. This sample was dominated by cyanobacteria, of the genera *Microcystis* and *Dolichospermum*, which are toxin-producing and can form blooms. However, the numbers were low, containing a total of 2,915 cells/mL of cyanobacteria. The World Health Organization (WHO) “take action” number for toxic cyanobacteria is 100,000 cells/mL. The combination of these residual cyanobacteria in the lake and the increased level of phosphorus in bottom water suggests that cyanobacteria cell numbers will increase in the future.

Aquatic Plants

NEAR conducted an aquatic plant survey of Crystal Pond on September 15th. During this survey, a total of 22 aquatic plant species were identified. Two species, *Potamogeton robbinsii* and *Potamogeton amplifolius*, were dominant, meaning they were present at greater than 20% frequency. The Connecticut State-listed species *Bidens beckii* was also fairly abundant, present at 18% of survey waypoints, mainly at the northern end of the pond. No invasive plant species were found in the pond.

Recommendations

Conduct a thorough examination of the drainage basin to understand why the inlets have such high phosphorus concentrations. Continue collecting samples for nutrient analysis from as many inlets as can be found and as frequently as possible. Storm water samples should also be collected from the inlets as frequently as possible.

Continue volunteer monitoring in 2023. Collect water samples from the deep spot (Station 1) once per month. Water clarity and profile data may be collected more frequently, if volunteers have the ability to do so. Due to the presence of bloom-forming cyanobacteria in 2022, we recommend collecting monthly phytoplankton samples in 2023.

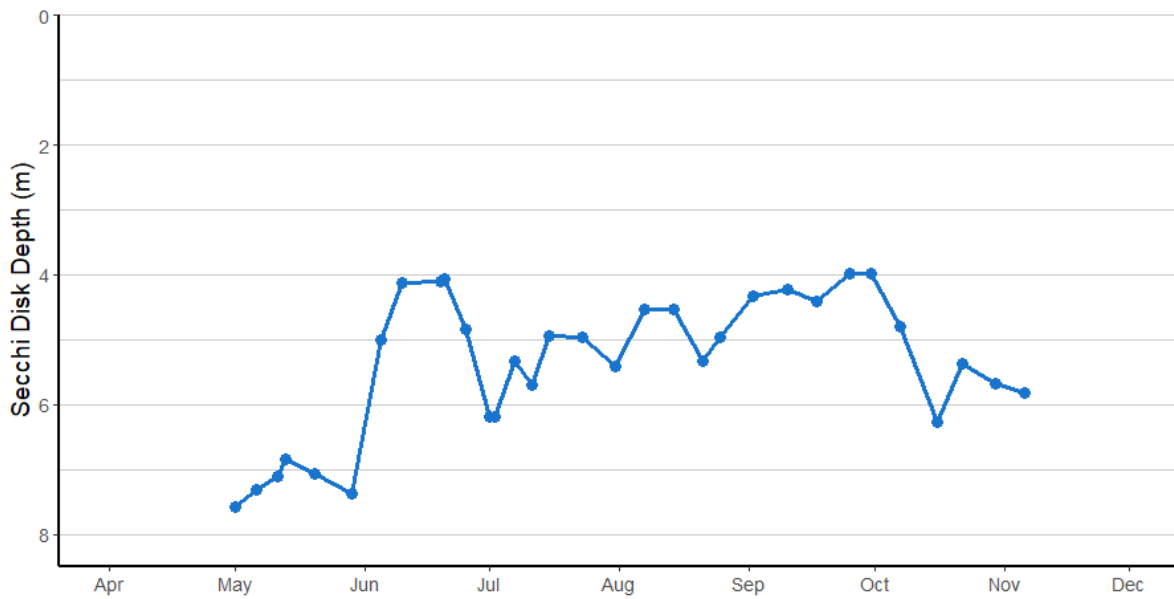
Conduct a full-lake aquatic plant survey in late summer 2023 to assess the plant community and search for invasive species.

If residents feel plants are a nuisance in certain small areas (such as around docks or recreational areas), those can be prioritized for hand-removal management.

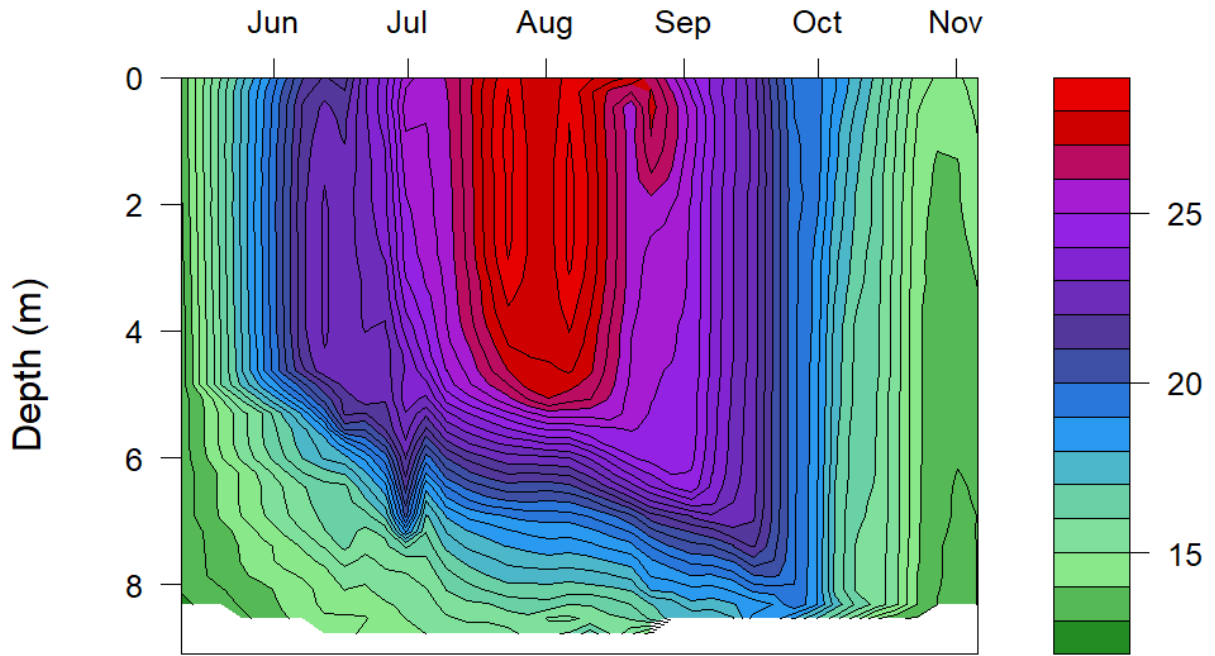
Thank you for your tireless efforts to monitor and manage Crystal Pond.

Sincerely,
Hannah Moore
Northeast Aquatic Research, LLC

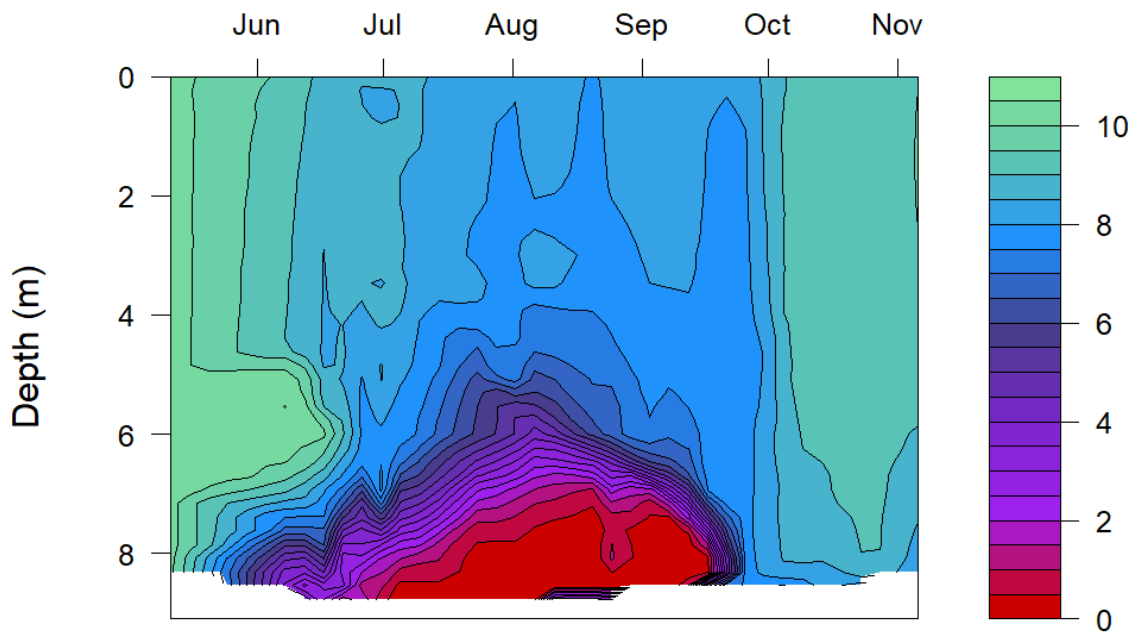
Secchi disk depths (m) in Crystal Pond in 2022.



Crystal Pond 2022 Water Temperature Isoleth



Crystal Pond 2022 Dissolved Oxygen Isoleth



2022 Nutrient Results

Total Phosphorus (TP) ppb (µg/L)

	May-1	May-11	Jun-20	Jul-11	Aug-21	Oct-16
Top	10	9	7	9	18	10
Middle	8	10	7	12	17	8
Bottom	9	9	19	25	66	75

Total Nitrogen (TN) ppb

	May-1	May-11	Jun-20	Jul-11	Aug-21	Oct-16
Top	193	200	232	229	292	217
Middle	207	183	263	243	274	277
Bottom	221	176	361	259	735	526

Ammonia Nitrogen (NH₃) ppb *ND = Below Detection Limit, NA = Not Available*

	May-1	May-11	Jun-20	Jul-11	Aug-21	Oct-16
Top	<i>ND</i>	<i>ND</i>	<i>ND</i>	3	8	<i>ND</i>
Middle	9	<i>ND</i>	4	6	8	<i>NA</i>
Bottom	22	<i>ND</i>	26	<i>ND</i>	71	33

Total Phosphorus Inlet Sample Results

	Inlet 1	Inlet 4	Inlet 7	Inlet 8	Inlet 9	Lake Drive
May-30	5	33	263	13	24	<i>NA</i>
Jun-24	29	35	42	44	12	<i>NA</i>
Aug-26	75	97	168	57	130	181
Oct-16	157	27	25	16	49	<i>NA</i>

Total Nitrogen Inlet Sample Results

	Inlet 1	Inlet 4	Inlet 7	Inlet 8	Inlet 9	Lake Drive
May-30	157	391	1,408	293	438	<i>NA</i>
Jun-24	397	414	852	417	257	<i>NA</i>
Aug-26	1,541	1,069	1,490	821	1,041	1,229
Oct-16	916	307	466	356	607	<i>NA</i>

July 11th Phytoplankton Counts

Group	Genus	Count
Cyanobacteria	<i>Dolichospermum</i>	437
	<i>Microcystis</i>	2,478
Greens	<i>Chlamydomonas</i>	292
	<i>Staurastrum</i>	73
Diatoms	<i>Tabellaria</i>	219
Dinoflagellates	<i>Ceratium</i>	437

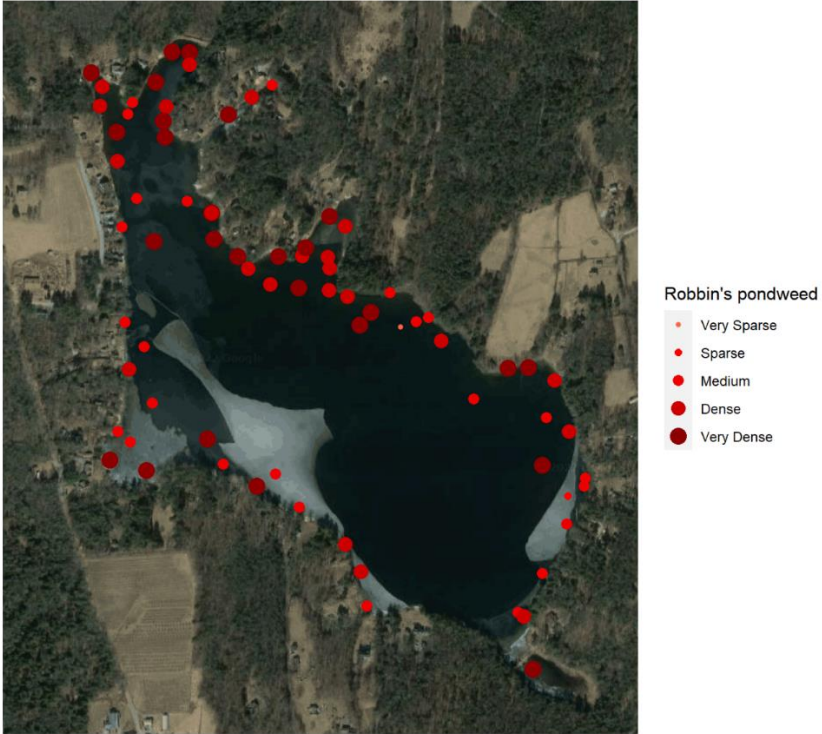
List of aquatic plant species documented during the September 15th, 2022 full-lake survey of Crystal Pond. Connecticut state-listed species is highlighted in blue.

	Scientific Name	% Frequency	Avg. Density
<i>Robbins pondweed</i>	<i>Potamogeton robbinsii</i>	70	65
<i>Large-leaf pondweed</i>	<i>Potamogeton amplifolius</i>	50	38
<i>Water marigold</i>	<i>Bidens beckii</i>	18	40
<i>Grassy pondweed</i>	<i>Potamogeton gramineus</i>	14	31
<i>Tape grass</i>	<i>Vallisneria americana</i>	9	42
<i>Arrowhead0-submersed</i>	<i>Sagittaria graminea</i>	6	38
<i>Narrow-leaf pondweed</i>	<i>Potamogeton pusillus</i>	4	25
<i>Coontail</i>	<i>Ceratophyllum demersum</i>	3	12
<i>Duckweed, Watermeal</i>	<i>Lemna sp/Wolffia sp</i>	2	10
<i>Purple bladderwort</i>	<i>Utricularia purpurea</i>	2	8
<i>Water shield</i>	<i>Brasenia schreberi</i>	1	50
<i>Spike rush submersed</i>	<i>Eleocharis acicularis</i>	1	5
<i>Aquatic moss</i>	<i>Fontinalis sp</i>	1	30
<i>Mudmat</i>	<i>Glossostigma sp</i>	1	10
<i>Cyanobacteria mat</i>	<i>Lyngbya wollei</i>	1	5
<i>Muskgrass</i>	<i>Nitella sp</i>	1	10
<i>Yellow waterlily</i>	<i>Nuphar variegata</i>	1	70
<i>White waterlily</i>	<i>Nymphaea odorata</i>	1	20
<i>Red-leaf pondweed</i>	<i>Potamogeton epihydrus</i>	1	10
<i>Bladderwort</i>	<i>Utricularia geminiscapa</i>	1	30
<i>Bladder wort</i>	<i>Utricularia gibba</i>	1	10
<i>Bladderwort</i>	<i>Utricularia macrorhiza</i>	1	5

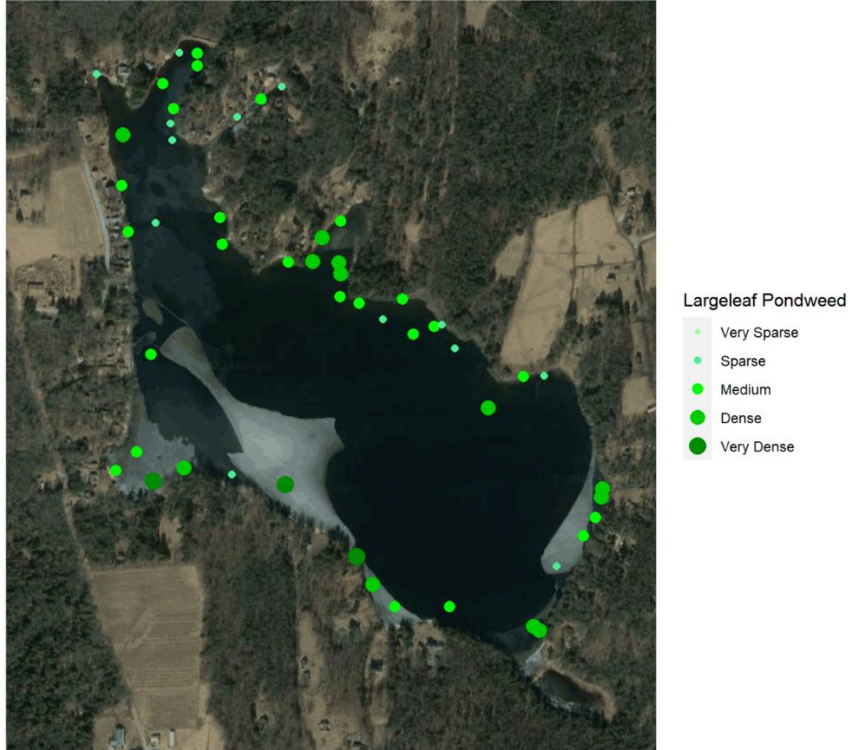
Crystal Pond 9-15-22 Survey Points
Northeast Aquatic Research, LLC



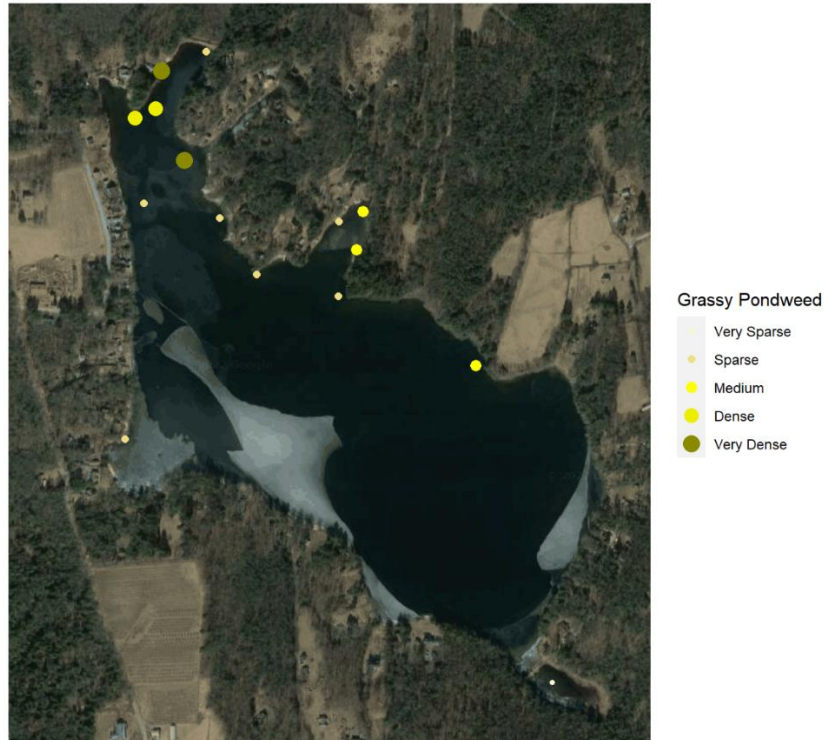
Crystal Pond September 15th, 2022: Robbin's pondweed (*Potamogeton robbinsii*)
Northeast Aquatic Research, LLC



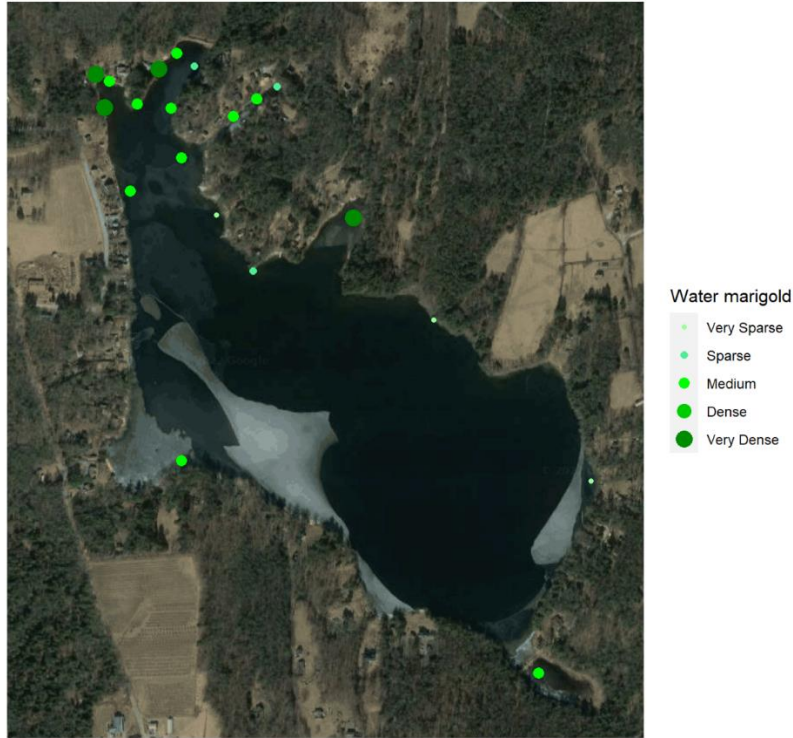
Crystal Pond September 15th, 2022: Largeleaf Pondweed (*Potamogeton amplifolius*)
Northeast Aquatic Research, LLC



Crystal Pond September 15th, 2022: Grassy Pondweed (*Potamogeton gramineus*)
Northeast Aquatic Research, LLC



Crystal Pond September 15th, 2022: Water marigold (*Bidens beckii*)
 Northeast Aquatic Research, LLC



Aquatic Plant Surveys Comparisons

Dominant aquatic plant species in Crystal Pond. Connecticut state-listed species is highlighted in blue.

Scientific Name	Common Name	Percent Occurrence											
		2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
<i>Potamogeton robbinsii</i>	Robbin's pondweed	70	77	83	63	53	54	77	52	31	27	42	57
<i>Bidens beckii</i>	Water marigold	18	25	15	11	29	27	35	23	30	26	19	40
<i>Potamogeton gramineus</i>	Grassy pondweed	14	2	22	21	19	31	35	15	20	21	44	23
<i>Potamogeton amplifolius</i>	Largeleaf pondweed	50	45	47	44	34	49	33	52	43	16	19	28
<i>Vallisneria americana</i>	Tapegrass	9	14	13	15	11	11	14	10	6	5	7	6

List of NEAR Surveyors 2014-2022.

Date	Surveyors
8/5/2014	George Knoecklein, Hillary Kenyon, Sabina Perkins
7/31/2015	George Knoecklein, Hillary Kenyon, Sabina Perkins
9/15/2016	George Knoecklein, Hannah Moore
9/11/2017	Hillary Kenyon, Hannah Moore, Kendra Kilson
8/20/2018	George Knoecklein, Madeline Kollegger
8/27/2019	Hillary Kenyon, Ryan Mayer
9/8/2020	Hillary Kenyon, Kendra Kilson
8/30/2021	Hannah Moore, Emma Sloan
9/15/2022	George Knoecklein, Emma Sloan

Connecticut DEEP Trophic Categories and Ranges of Indicator Parameters.

Category	T. Phosphorus (ppb)	T. Nitrogen (ppb)	Secchi Depth (m)	Chlorophyll <i>a</i> (ppb)
Oligotrophic	0 -- 10	2 -- 200	6 +	0 -- 2
Oligo-mesotrophic	10 -- 15	200 -- 300	4 -- 6	2 -- 5
Mesotrophic	15 -- 25	300 -- 500	3 -- 4	5 -- 10
Meso-eutrophic	25 -- 30	500 -- 600	2 -- 3	10 -- 15
Eutrophic	30 -- 50	600 -- 1000	1 -- 2	15 -- 30
Highly Eutrophic	50 +	1000 +	0 -- 1	30 +

Map of Inlet Locations.

