2022
Horseshoe Pond AIS Survey

Aquatic Invasive Species Surveys

Survey Team Report

ADIRONDACK RESEARCH

2022 Horseshoe Pond
Aquatic Invasive Species Survey

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Cover image: Horseshoe Pond, Town of Duane, Franklin County. Photo by 2022 survey team.

Executive Summary

The purpose of this effort was to perform a point intercept survey of in preparation for submitting a permit to the Adirondack Park Agency (APA) for management of Eurasian watermilfoil using the herbicide ProcellaCOR EC.

We surveyed 111 stations (sample points) with a total of 39 points within the three proposed treatment areas: a minimum of 12 points and a maximum of 15 points were surveyed at each of these areas. A total of 72 points were surveyed outside of the proposed treatment area. Our survey design and methodologies followed the APA requirements for permit submission.

Our team documented aquatic plant species occurrence, species cover class, overall plant cover class, and species richness at each of the 111 stations.

Eurasian watermilfoil was documented at a total of 65 of the 111 stations (58.56%); within the proposed treatment area it was recorded at 29 stations, and at 36 locations outside the proposed treatment area. Seventeen other native species were documented in this survey, one being a native milfoil species, Farwell's water-milfoil.

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Overview

We performed an aquatic invasive species (AIS) and native aquatic plant species survey for Horseshoe Pond, in Franklin County on August 8th-9th 2022. This survey was completed in preparation for The Horseshoe Pond - Deer River Flow Association applying to the Adirondack Park Agency for a permit to use the herbicide ProcellaCOR EC for the control of an aquatic pest (AQV). This survey was completed in accordance with all of the required parameters of the linked application requirements: https://www.dropbox.com/s/kn7c043b53k7wns/SIR-AquaticHerbicides.pdf?dl=0

The Horseshoe Pond - Deer River Flow Association is planning to apply for a permit to use ProcellaCOR EC in 2023 to manage Eurasian watermilfoil. We performed the surveys, and created maps and data tables of the survey results per the requirements of the permit.

For more information on our qualifications and services, our Qualifications Packet can be accessed via this link: https://www.dropbox.com/s/2jc37h56z4jkb6i/Lake%20Surveys.pdf?dl=0 You can also learn more about Adirondack Research at www.adkres.org.

Adirondack Research was able to complete the following tasks as part of this project:

- Survey 111 stations in the entirety of the 51-acre waterbody over two days with two crew members using a single company owned canoe.
- Survey, identify, and photograph all native plant species at point intercept survey stations within a survey design to meet Adirondack Park Agency requirements for applying for the use of the herbicide ProcellaCOR EC.
- Draft maps showing survey locations, overall plant abundance, species richness, and abundance for each of the 18 species recorded, in GIS.
- Create tables displaying: station number, GPS coordinates, depth, species richness, and abundance of the target species; abundance of each species at all stations; the total count of station numbers each species is found, including overall percentages; and susceptibility of each species to herbicide ProcellaCOR EC.
- Detailed descriptions of all eighteen species including information of the impacts of each species on their environment.
- Produced this report of the described survey effort.

Methods

Below is a description of the survey methods used while surveying your lake. We've included a brief description of the equipment used, our cleaning procedure for all of our equipment before accessing your lake, and a description of our survey techniques.

Equipment

Equipment used while completing the Aquatic Invasive Species (AIS) survey of the lake consisted of double-sided rakes for collecting plant samples from under the water, an iPad 4 mini for data collection. All data and observations were recorded using ESRI's Collector for ArcGIS application. Surveys were conducted via company canoe.

Cleaning

As our team is frequently moving from one water body to another, specific precautionary measures were taken to ensure that all equipment used was decontaminated and free of AIS. To ensure that all equipment was free of AIS, we thoroughly washed and decontaminated all of our equipment at one of the Adirondack AIS Prevention Program's free boat wash and decontamination stations. High pressure hot water was used at these sites to ensure that no AIS spread via equipment.

Monitoring Techniques

While out on the waterbody, we surveyed plants at survey stations, or sites, that were predetermined prior to performing the on-the-water survey. These survey stations were selected based on criteria outlined by the Adirondack Park Agency as requirements for applying for a permit application to perform management using the herbicide ProcellaCOR EC. Specifically, we established a sampling design based on the following APA requirements:

1. Perform survey at height of growing season
2. Establish point intercept survey points (stations/Sites) based on a grid size one acre or less.
3. Survey area must include the entire littoral zone (buffer zone) within 0.3 miles of the edge of the proposed treatment area.
4. Perform point intercept surveys at a minimum of 12 sites within the proposed treatment area and at least 24 sites outside of the proposed treatment area and within the 0.3 mile buffer zone.
5. Perform rake toss surveys at each site or sample point by throwing as many rake tosses as needed to find all plants at or near the sample point or site. This method is biased towards finding every plant species that may exist within the vicinity of a sampling location.
6. Record each species along with the following parameters (water depth, overall rake plant abundance, abundance of each species). Note that lake depth was determined from interpolating data from surrounding Eurasian milfoil beds to establish an approximate depth at each of the survey stations.

7. Additionally, photograph one example of each species identified during the survey.

The littoral zone typically encompasses the area from shoreline to a depth of about 15 feet. We utilized publicly available bathymetric maps of the proposed treatment areas as well as the surrounding area within 0.3 miles to determine the survey extent. We then evenly distributed roughly 24 survey points outside of the proposed treatment areas, for a total of 72 points across the entirety of the lake. We then shifted points to distribute our sampling locations across different habitat types, locations around shorelines, and to be within the water depths of the littoral zones based on maps and aerial imagery.

The team surveyed the area by navigating to each survey point, tossing the rake and by performing visual surveys where possible. All plants retrieved by rake toss or seen by visual inspection were identified to the best of our abilities (usually to the species level, but sometimes to genus). Both native and invasive plants found were identified using the "Maine Field Guide to Invasive Aquatic Plants and their common native look-alikes" by Lake Stewards of Maine.

Based upon how much plant material was observed on the rake toss, we assigned a percent cover for the entire rake and for each species on the rake. Plants that were observed visually and not collected on a rake toss were estimated based on their appearance from the water surface. Based on plant abundance, we used the following density classes:

Density Class	Class Description		Coverage Class (plant density)
T	Trace	1-2 stems	Less than 5%
S	Sparse	3-10 stems	5 - 25%
M	Moderate	Rakeful; no empty tines	26 - 50%
D	Dense	Rakeful; no visible tines	51 - 75%
HD	High Density	Difficult to bring on boat	76 - 100%

Table 1: Note we collect two density classes between 51-100% (51-75% and 75-100%) while some studies combine the two. Colors in the density class correspond to their relative abundance markers on maps (3 and 5-21).

Results

The team surveyed 111 sites in total over the course of two days in August 2022; detecting one invasive species (Eurasian watermilfoil) and 17 native species including one native milfoil (Farwell's watermilfoil). Table 2 provides a summary of all aquatic vegetation detected in Horseshoe Pond, in addition to their count and frequency of occurrence relative to the 111

points surveyed, invasive species are dictated in red. Full descriptions for each of these species, and impacts on their environment are attached in the appendix.

Table 2. Summary of Aquatic Vegetation Occurrences and Frequency – Horseshoe Pond 2022

Common Name	Scientific Name	# Stations	% Occurrence
Eurasian watermilfoil	*Myriophyllum spicatum*	65	58.56%
Stonewort	*Nitella sp.*	57	51.35%
Bladderwort	*Utricularia intermedia*	47	42.34%
Canadian water weed	*Elodea sp.*	42	37.84%
Muskgrass	*Chara sp.*	34	30.63%
Slender Naiad	*Najas sp.*	31	27.93%
White water lily	*Nymphaea odorata*	31	27.93%
Narrow-leaf bur-reed	*Sparganium angustifolium*	28	25.23%
Eelgrass	*Vallisneria americana*	25	22.52%
Watershield	*Brasenia schreberi*	24	21.62%
Spatterdock	*Nuphar advena*	23	20.72%
Ribbon leaf pondweed	*Potamogeton epihydrus*	10	9.01%
Big-leaved pondweed	*Potamogeton amplifolius*	6	5.41%
Grassy pondweed	*Potamogeton gramineus*	11	9.91%
Pickerelweed	*Pontederia cordata*	6	5.41%
Floating leaf pondweed	*Potamogeton natans*	5	4.50%
Robbins pondweed	*Potamogeton robbinsii*	1	0.90%
Farwell's watermilfoil	*Myriophyllum farwellii*	1	0.90%

A total of 447 individual plant records were logged amongst the 111 stations. Coverage class was recorded for each of these and are displayed in Table 4.

Species Distributions

Myriophyllum spicatum (Eurasian watermilfoil)

This plant was found at a total of 65 points resulting in 58.56% of occurrences, the highest of all species in Horseshoe Pond. It was found growing in all five stages of cover class, most commonly found at trace, (n=29, 45%) and sparse levels, (n=23, 35%). It was found at moderate, (n=6, 9%), dense, (n=5, 8%), and highly-dense levels, (n=2, 3%).

Brasenia schreberi (Watershield)

This plant was found at a total of 24 sample points resulting in 21.62% of occurrences. It was most commonly found growing at trace levels, (n=16, 67%), followed by sparse, (n=7, 29%), and moderate levels, (n=1, 4%).

Chara sp. (Muskgrass)

This plant was found at total of 34 sample points resulting in 37.84% of occurrences. It was found growing in five stages of cover class, most commonly appearing at trace levels, (n=18, 53%), followed by sparse, (n=10, 29%), moderate, (n=4, 12%), dense, (n= 1, 3%), and highly-dense, (n=1, 3%).

Elodea spp. (Canadian water weed)

This plant was found at a total of 42 sample points resulting in 37.84% of occurrences. It was most commonly found growing at trace levels, (n=25, 60%), followed by sparse, (n=16, 38%), and moderate levels, (n=1, 2%).

Myriophyllum farwellii (Farwell's watermilfoil)

This plant was found at 1 sample point resulting in 0.90% of occurrences. Its coverage at the station point was recorded as high-density, (n=1, 100%).

Najas flexilis (Naiad)

This plant was found at a total of 31 sample points resulting in 27.93% of occurrences. It was found growing in all five stages of cover class, most commonly appearing at sparse levels, (n=13, 43%), followed by trace levels, (n=6, 20%), moderate, (n=17%), dense, (n=3, 10%), and highly-dense, (n=3, 10%). *Note that coverage class was not recorded for one station point.*

Nitella sp. (Stonewort)

This plant was found at a total of 57 sample points resulting in 58.56% of occurrences across all five coverage classes. The majority of occurrences were found to have either trace levels of vegetation, (n=26, 46%) or sparse levels, (n=22, 39%). Followed by moderate levels, (n=6, 11%), dense (n=2, 4%), and then highly-dense, (n=1, 2%).

Nuphar lutea (Spatterdock)

This plant was found at a total of 23 sample points resulting in 20.72% of occurrences. It was found growing at an equal number of points for both trace, (n=8, 36%) and sparse levels, (n=8, 36%). Moderate and dense coverage were also equivalent at, (n=3, 14%) each. *Note that coverage class was not recorded for one station point.*

Nymphaea odorata (White water lily)

This plant was found at a total of 31 sample points resulting in 27.93% of occurrences. It was found growing in all five stages of cover class, most commonly appearing at trace levels, (n=11, 35%), followed by sparse growth, (n=8, 26%), dense, (n=5, 16%), highly-dense, (n=5, 16%), and moderate levels, (n=2, 6%).

Sparganium natans (Narrow-leaf bur-reed)

This plant was found at a total of 28 sample points resulting in 25.23% of occurrences. It was most commonly found growing at sparse levels, (n=15, 54%), followed by trace (n=11, 39%), and moderate levels (n=2, 7%).

Potamogeton amplifolius (Big-leaved pondweed)

This plant was found at a total of 6 sample points resulting in 5.41% of occurrences. It was found growing at an equal number of points for both trace, (n=3, 50%) and sparse levels, (n=3, 50%).

Pontederia cordata (Pickerelweed)

This plant was found at a total of 6 sample points resulting in 5.41% of occurrences. It was most commonly found growing at trace levels, (n=4, 80%), followed by sparse levels, (n=1, 20%). *Note that coverage class was not recorded for one station point.*

Potamogeton epihydrus (Ribbon leaf pondweed)

This plant was found at a total of 10 sample points resulting in 9.01% of occurrences. It was most commonly found growing at sparse levels, (n=6, 67%). Occurrences were recorded for high-density, dense, and moderate coverage all at one station each, (n=1, 11%). Note that coverage class was not recorded for one station point.

Potamogeton gramineus (Grassy pondweed)

This plant was found at a total of 11 sample points resulting in 9.91% of occurrences. It was most commonly found growing at sparse levels, (n=5, 50%), followed by trace levels, (n=2, 20%), dense, (n=2, 20%), and moderate, (n=1, 10%). *Note that coverage class was not recorded for one station point.*

Potamogeton natans (Floating-leaf pondweed)

This plant was found at a total of 5 sample points resulting in 4.50% of occurrences. It was recorded at 2 points with trace levels, (n=2, 40%), and found growing at sparse, moderate, and dense levels at one station point each, (n=1, 20%).

Potamogeton robbinsii (Robbin's pondweed)

This plant was found at 1 sample point resulting in 0.90% of occurrences. Its coverage at the station point was recorded as high-density, (n=1, 100%).

Utricularia intermedia (Bladderwort)

This plant was found at a total of 47 sample points resulting in 42.34% of occurrences. It was found growing at trace, (n=20, 45%) and sparse amounts, (n=21, 48%) at almost an equal number of sites in this waterbody. It was additionally found in moderate amounts, (n=2, 5%) and densely (n=1, 2%). *Note that coverage class was not recorded for three station points.*

Vallisneria americana (Eelgrass)

This plant was found at a total of 25 points resulting in 22.52% of occurrences. It occurred most commonly at both trace, (n=12, 48%) and sparse levels, (n=11, 44%). It was additionally found growing moderately in coverage, (n=2, 8%).

Eurasian watermilfoil distribution

Of the 65 stations Eurasian watermilfoil, 28 were recorded in the proposed treatment area, and 37 were located outside the proposed treatment area. Of the 28 points recorded in the treatment area the majority of points, (n=13, 46%) were recorded at sparse densities. Followed then by dense coverage, (n=5, 18%), equivalent recordings for trace and moderate coverage, (n=4, 14%), and highly-dense coverage, (n=2, 7%). Of the 37 stations outside of the treatment area the majority of points, (n=25, 68%) were recorded at trace densities, followed by sparse, (n=10, 27%), and moderate coverage (n=2, 5%). Dense or highly-dense coverage was not found at any of the points outside the treatment area. Table 3 displays the station number and respective GPS coordinates that Eurasian watermilfoil was recorded, along with its abundance and the total species richness at that point. Tables are ordered from lowest to highest density, separated by the five coverage classes.

Table 3. Eurasian Watermilfoil Presence – Horseshoe Pond 2022

Station #	x	y	Abundance of Target Species	Depth (ft.)	Total Species Richness
11	-74.2905	44.6717	less than 5%	4	6
13	-74.2892	44.6715	less than 5%	4	7
15	-74.2907	44.6714	less than 5%	6	6
16	-74.2912	44.6714	less than 5%	3	6
18	-74.2921	44.6709	less than 5%	4	4
19	-74.2928	44.6707	less than 5%	5	7
23	-74.2882	44.6617	less than 5%	5	6
25	-74.2892	44.6622	less than 5%	5	8
27	-74.2899	44.6629	less than 5%	2	7
29	-74.2906	44.6634	less than 5%	2	3
34	-74.2916	44.6643	less than 5%	4	9
53	-74.2930	44.6676	less than 5%	2	5
56	-74.2920	44.6676	less than 5%	2	5
57	-74.2920	44.6674	less than 5%	1	4
58	-74.2921	44.6683	less than 5%	2	4
59	-74.2924	44.6686	less than 5%	6	4
61	-74.2924	44.6690	less than 5%	7	3
69	-74.2905	44.6710	less than 5%	6	2
76	-74.2886	44.6691	less than 5%	3	8
87	-74.2907	44.6688	less than 5%	9	4
88	-74.2911	44.6688	less than 5%	4	4
89	-74.2913	44.6690	less than 5%	2	4
92	-74.2894	44.6686	less than 5%	1	5
93	-74.2897	44.6686	less than 5%	9	2
95	-74.2904	44.6686	less than 5%	10	3
97	-74.2911	44.6686	less than 5%	3	3
103	-74.2897	44.6684	less than 5%	9	2
110	-74.2894	44.6678	less than 5%	6	4
111	-74.2897	44.6679	less than 5%	3	3

Table 3 continued

Station #	x	y	Abundance of Target Species	Depth (ft.)	Total Species Richness
10	-74.2908	44.6717	5% - 25%	3	8
14	-74.2904	44.6714	5% - 25%	7	8
30	-74.2906	44.6636	5% - 25%	5	5
31	-74.2909	44.6638	5% - 25%	4	6
32	-74.2909	44.6641	5% - 25%	4	7
35	-74.2913	44.6648	5% - 25%	5	6
36	-74.2916	44.6648	5% - 25%	6	5
40	-74.2920	44.6657	5% - 25%	5	2
41	-74.2923	44.6660	5% - 25%	5	5
43	-74.2923	44.6662	5% - 25%	5	5
46	-74.2923	44.6667	5% - 25%	5	3
63	-74.2925	44.6695	5% - 25%	7	4
66	-74.2924	44.6698	5% - 25%	6	6
70	-74.2894	44.6710	5% - 25%	8	3
71	-74.2885	44.6710	5% - 25%	8	5
75	-74.2888	44.6696	5% - 25%	8	8
77	-74.2894	44.6696	5% - 25%	7	3
85	-74.2897	44.6688	5% - 25%	7	3
98	-74.2911	44.6684	5% - 25%	5	4
99	-74.2911	44.6681	5% - 25%	2	5
100	-74.2907	44.6680	5% - 25%	2	2
104	-74.2894	44.6681	5% - 25%	10	2
109	-74.2890	44.6677	5% - 25%	3	4
17	-74.2915	44.6712	26% - 50%	6	4
45	-74.2923	44.6664	26% - 50%	5	6
96	-74.2907	44.6686	26% - 50%	9	3
105	-74.2887	44.6682	26% - 50%	7	4
106	-74.2880	44.6679	26% - 50%	8	4
107	-74.2877	44.6675	26% - 50%	7	3
37	-74.2916	44.6650	51% - 75%	5	3
67	-74.2925	44.6705	51% - 75%	7	3
73	-74.2875	44.6703	51% - 75%	2	4
101	-74.2907	44.6684	51% - 75%	10	2
108	-74.2884	44.6677	51% - 75%	10	3
38	-74.2920	44.6652	76% - 100%	5	3
39	-74.2920	44.6655	76% - 100%	5	3

Table 4. Abundance of Species by Site

Station #	Depth (ft.)	Eurasian watermilfoil	Big-leaved pondweed	Bladderwort	Eelgrass	Canadian waterweed	Floating leaf pondweed	Grassy pondweed	Muskgrass	Slender Naiad	Narrow-leaf bur-reed	Stonewort	Pickerelweed	Ribbon leaf pondweed	Robbin's pondweed	Spatterdock	Watershield	White water lily	Species Richness	Overall Abundance
1	3			T		T	M				S					T			5	26-50%
2	4					T		0	S		T		S			M			6	26-50%
3	6					T			S		M		0					T	5	26-50%
4	5					T	T		S		S		T			T	T		7	Less than 5%
5	3			0					S		T					S		T	5	Less than 5%
6	4								T		T					T		T	4	Less than 5%
7	3			T		T	D				S								4	51-75%
8	4						S		T		S								3	5-25%
9	6			T		T					S	T			T	0			6	5-25%
10	3	S		S		S		M			S	S				D	T		8	51-75%
11	4	T		0		S					T	S				D			6	51-75%
12	3			S		S		S				M	T						5	26-50%
13	4	T	S			S			T		S	S				D			7	51-75%
14	7	S		S	T	T					T	T					T		8	5-25%
15	6	T		S	T	T						S						S	6	5-25%
16	3	T		S		T		S				M						S	6	26-50%
17	6	M		T		S						S							4	26-50%
18	4	T			T	T					S								4	5-25%
19	5	T	S			T					S	T				T	T		7	5-25%
20	2			M	S							T		S			T	HD	6	76-100%
21	4			M	T													HD	3	76-100%
22	4			S										D			T	D	4	51-75%
23	5	T		T				S						S			S	D	6	51-75%
24	2			S	S									D			T	D	6	51-75%
25	5	T		S	T	S					T			S			T	HD	8	76-100%
26	4			D										S				HD	3	76-100%
27	2	T		0	T	T						D		S				D	7	51-75%
28	4			T	S			S						T				M	5	26-50%
29	2	T								D								T	3	51-75%
30	5	S		T	S							S						S	5	5-25%
31	4	S		S	S					T		S						D	6	51-75%
32	4	S		T						T	T	M					T	M	7	26-50%
33	4			S						M								S	3	26-50%
34	4	T		S		S		D		S		S				S	S	S	9	51-75%
35	5	S		T		S					T	T					S		6	5-25%
36	6	S			S	S										T	T		5	5-25%
37	5	D				S					S								3	51-75%
38	5	HD									S						S		3	76-100%
39	5	HD									S					S			3	76-100%
40	5	S				T													2	5-25%
41	5	S								S		S				S		S	5	5-25%
42	3									0		M						S	3	26-50%
43	5	S			S	S						T					S		5	5-25%
44	3				S					D		T					S	T	5	51-75%
45	5	M			S	S						S				T	T		6	26-50%

Table 4 continued

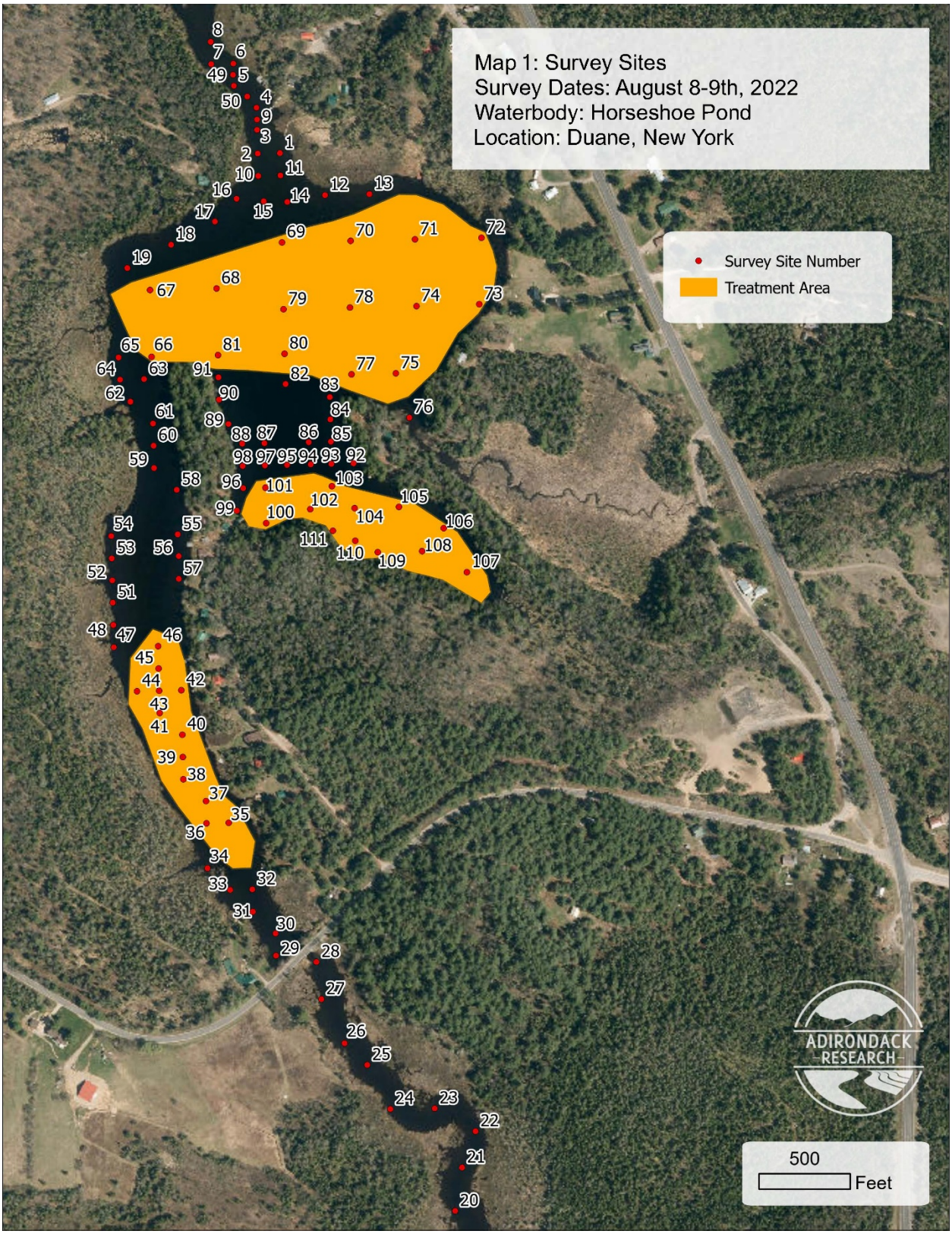
Station #	Depth (ft.)	Eurasian watermilfoil	Big-leaved pondweed	Bladderwort	Eelgrass	Canadian waterweed	Floating leaf pondweed	Grassy pondweed	Muskgrass	Slender Naiad	Narrow-leaf bur-reed	Stonewort	Pickerelweed	Ribbon leaf pondweed	Robbin's pondweed	Spatterdock	Watershield	White water lily	Species Richness	Overall Abundance
46	5	S						S				T							3	5-25%
47	2									S	T					S	T		4	5-25%
48	1			S	T					S						M			4	26-50%
49	5					T	T		T										4	Less than 5%
50	5			T		T					S					S			4	5-25%
51	2			S	T	T												S	4	5-25%
52	2			S	M											S	M		4	26-50%
53	2	T		S		T				S								HD	5	76-100%
54	3									HD	T	S					T		4	76-100%
55	4				T			D											2	51-75%
56	2	T		S	T					S		S							5	5-25%
57	1	T		S		T							T						4	5-25%
58	2	T				S					S	S							4	5-25%
59	6	T				S				S		S							4	5-25%
60	6											T							1	Less than 5%
61	7	T			S							M							3	26-50%
62	5									HD									1	76-100%
63	7	S			S							S						T	4	5-25%
64	5					T				HD		S						T	4	76-100%
65	5					T				D	T	T				M			5	51-75%
66	6	S		T	T	S				T		T							6	5-25%
67	7	D		T													T		3	51-75%
68	9											T							1	Less than 5%
69	6	T							HD										2	76-100%
70	8	S				M			S										3	26-50%
71	8	S		T		T			T			T							5	5-25%
72	4			T	M	T													3	26-50%
73	2	D		T								T					S		4	51-75%
74	8				T							T							2	Less than 5%
75	8	S		T				T	S	M	M						T	T	8	26-50%
76	3	T		T				T	T	M		S	T			T			8	26-50%
77	7	S							S		S								3	5-25%
78	7																		1	Less than 5%
79	7											HD							1	76-100%
80	9																		1	Less than 5%
81	7								T	S		S							3	5-25%
82	9																		1	Less than 5%
83	3								M			S							2	26-50%
84	3									S		T							2	5-25%
85	7	S							S	T									3	5-25%
86	10											T							1	Less than 5%
87	9	T				T			T			T							4	Less than 5%
88	4	T							T	S		T							4	5-25%
89	2	T							S	M		T							4	26-50%
90	2			T					M	T						T			4	26-50%
91	5									S		T							2	5-25%

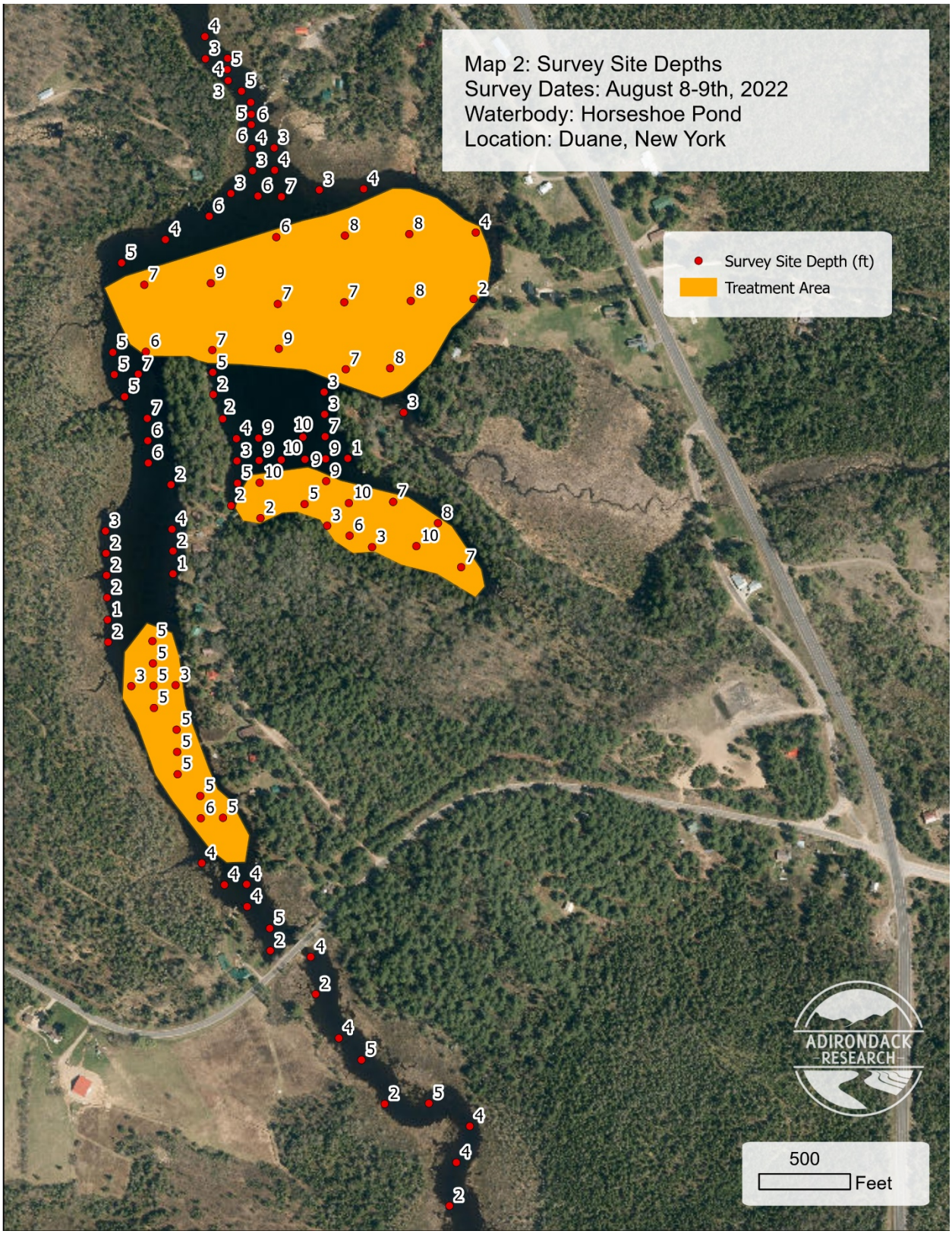
Table 4 continued

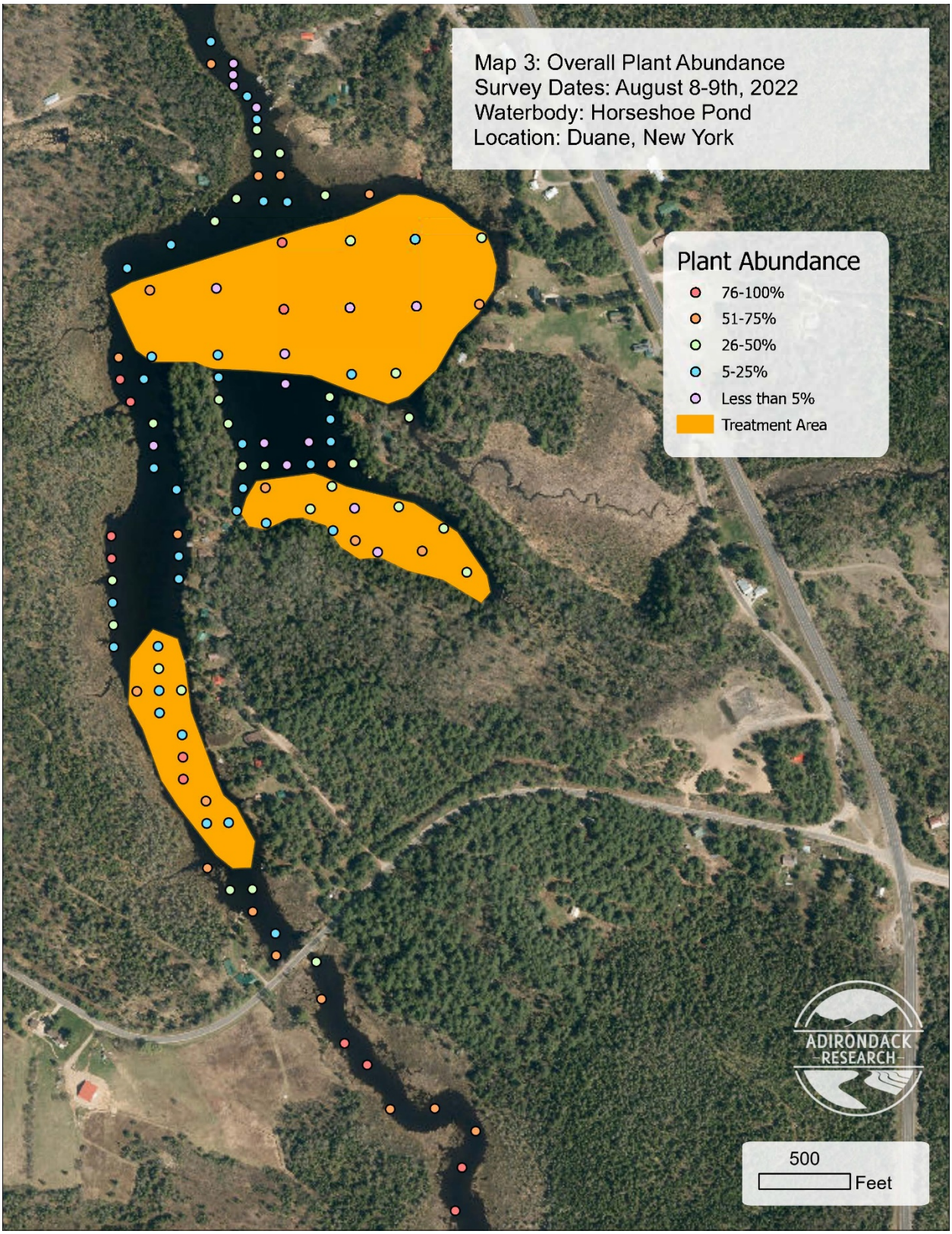
Station #	Depth (ft.)	Eurasian watermilfoil	Big-leaved pondweed	Bladderwort	Eelgrass	Canadian waterweed	Floating leaf pondweed	Grassy pondweed	Muskgrass	Slender Naiad	Narrow-leaf bur-reed	Stonewort	Pickerelweed	Ribbon leaf pondweed	Robbin's pondweed	Spatterdock	Watershield	White water lily	Species Richness	Overall Abundance
92	1	T							T	M		T						T	5	26-50%
93	9	T										D							2	51-75%
94	9			S		T						S							3	5-25%
95	10	T							T			T							3	Less than 5%
96	9	M		S								S							3	26-50%
97	3	T	S						M										3	26-50%
98	5	S							T	S								T	4	5-25%
99	2	S	T	S					T			T							5	5-25%
100	2	S								T									2	5-25%
101	10	D							T										2	51-75%
102	5								M	S									2	26-50%
103	9	T										M							2	26-50%
104	10	S							T										2	Less than 5%
105	7	M				S			T			T							4	26-50%
106	8	M	T			T										S			4	26-50%
107	7	M	T						T										3	26-50%
108	10	D		T								S							3	51-75%
109	3	S		S					T			T							4	Less than 5%
110	6	T		T					D									T	4	51-75%
111	3	T							S								T		3	5-25%

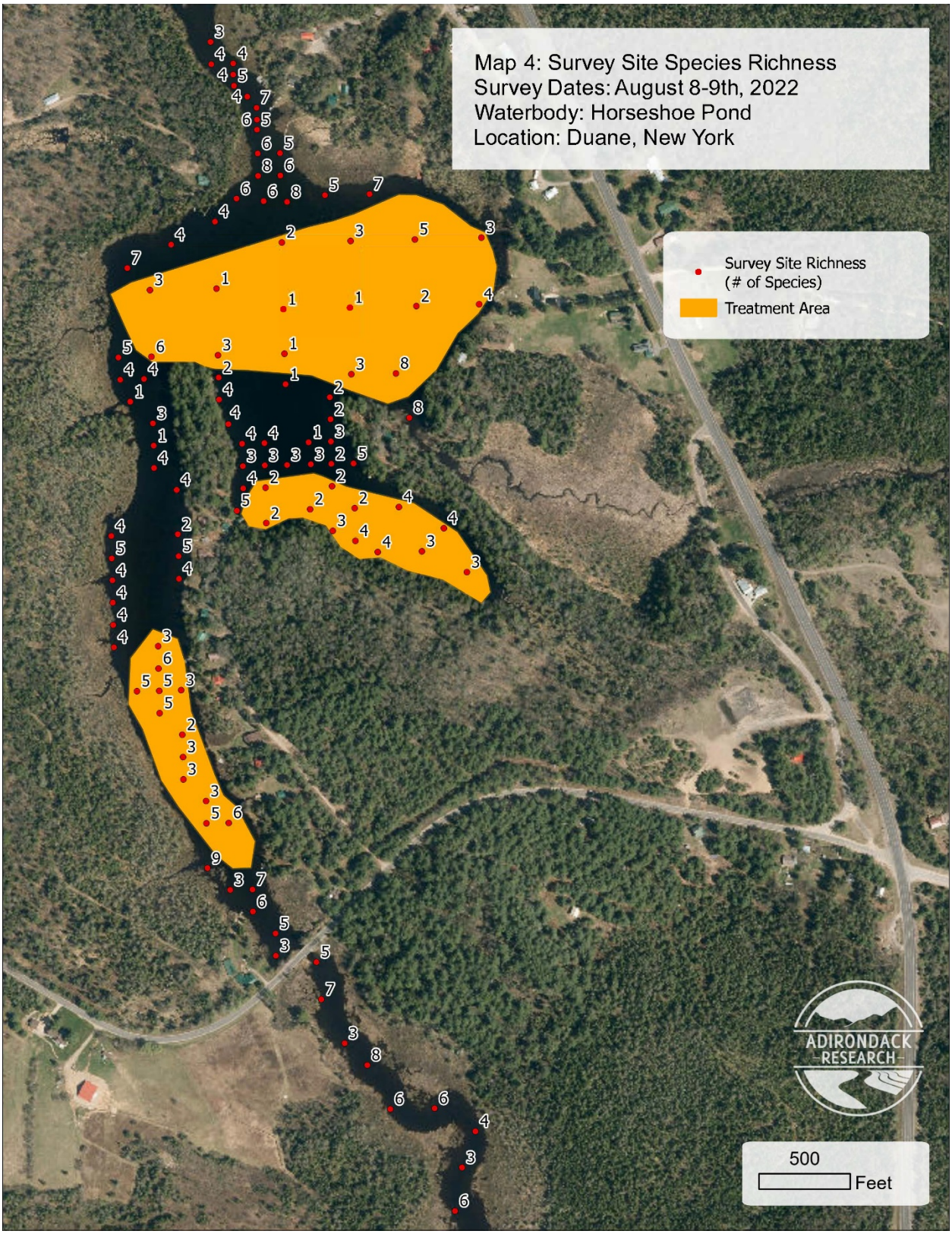
Maps

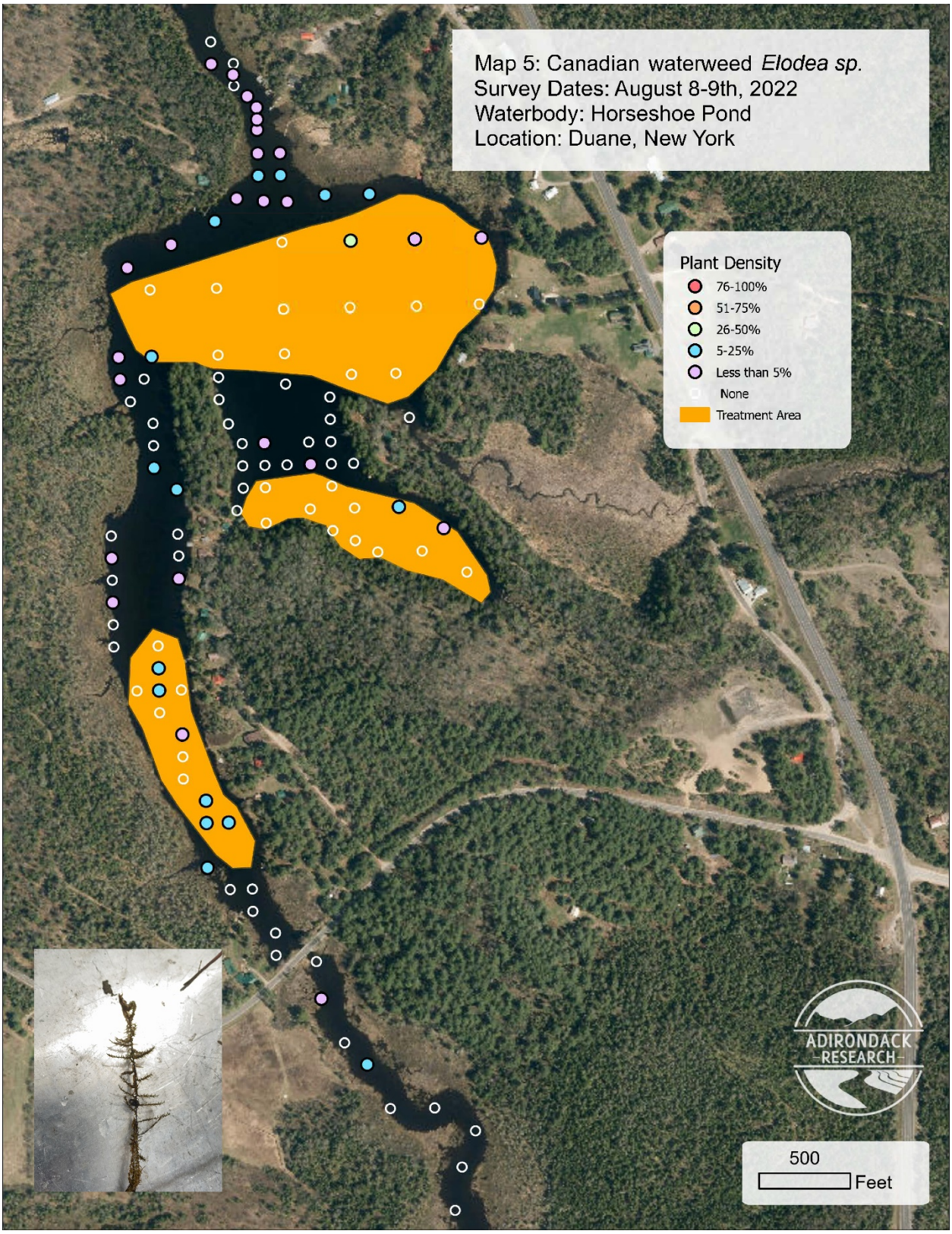
Maps 5-21 display the plant abundance for each species across all survey points. Map 1 marks the numbered station points, Map 2 displays depth at each station point, Map 3 displays overall plant abundance, and Map 4 displays species richness per site.

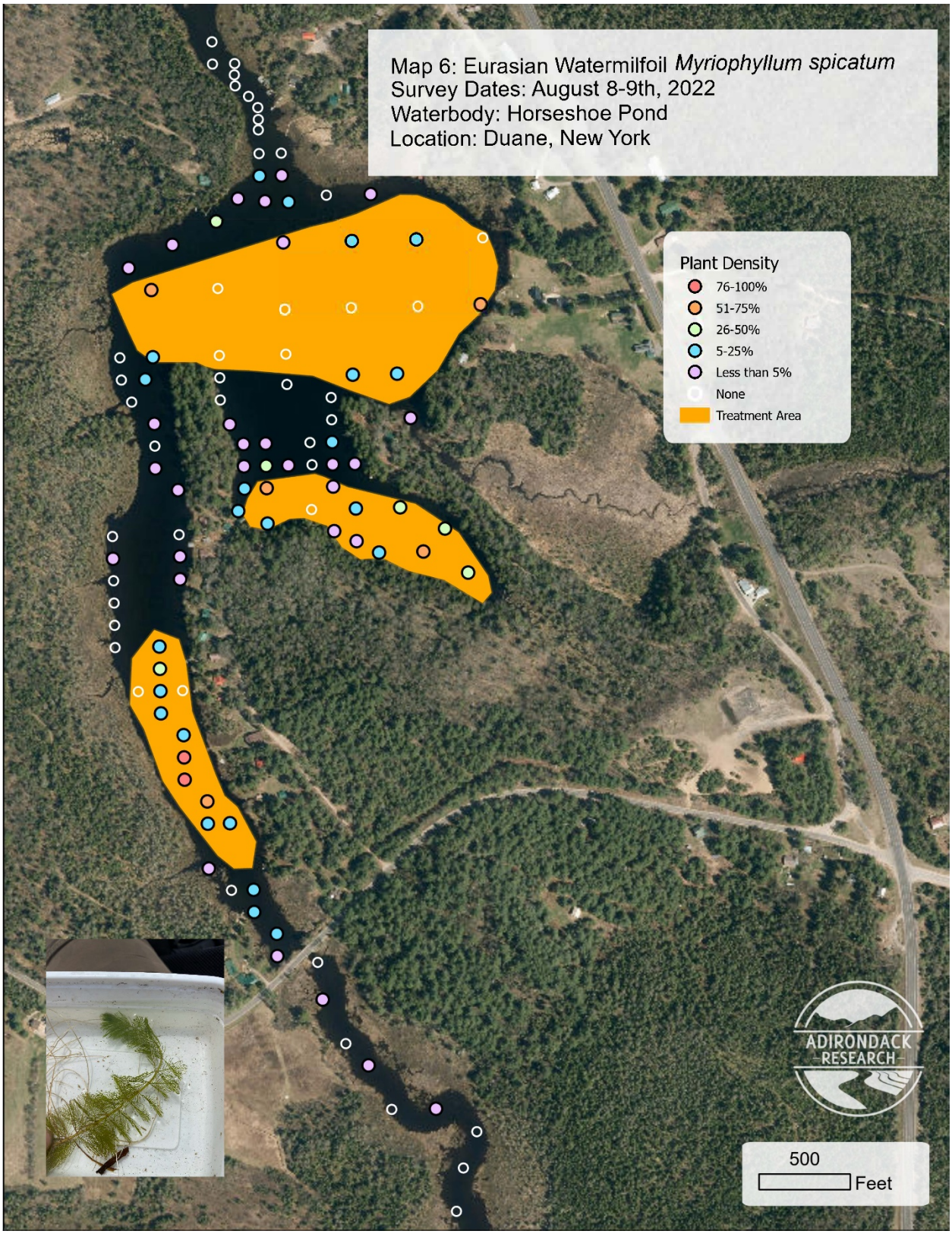

Map 1: Survey Sites
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Survey Site Number
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 2: Survey Site Depths
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Survey Site Depth (ft)
Treatment Area
ADIRONDACK RESEARCH
500
Feet

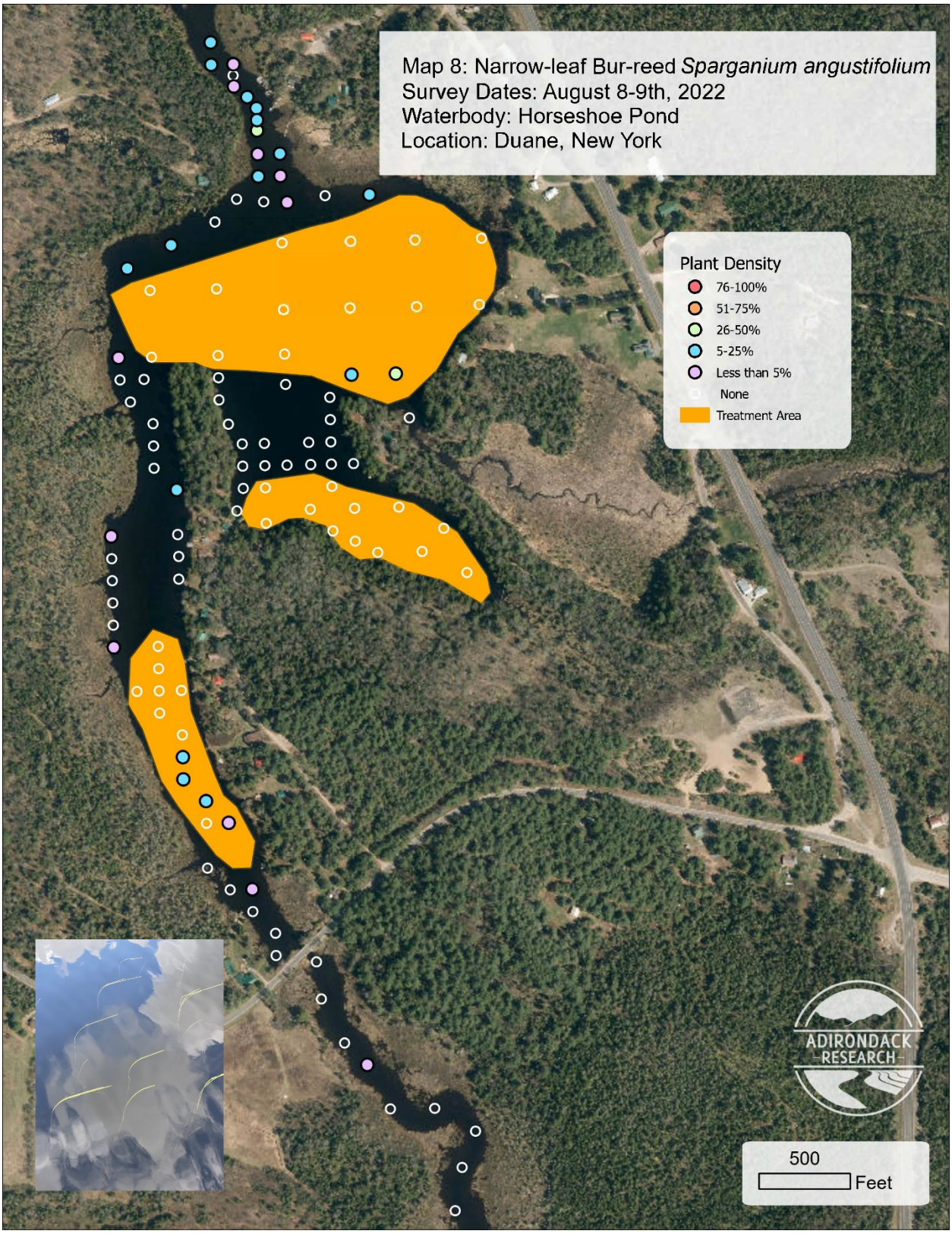

Map 3: Overall Plant Abundance
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Abundance
76-100%
51-75%
26-50%
5-25%
Less than 5%
Treatment Area
ADIRONDACK RESEARCH
500
Feet

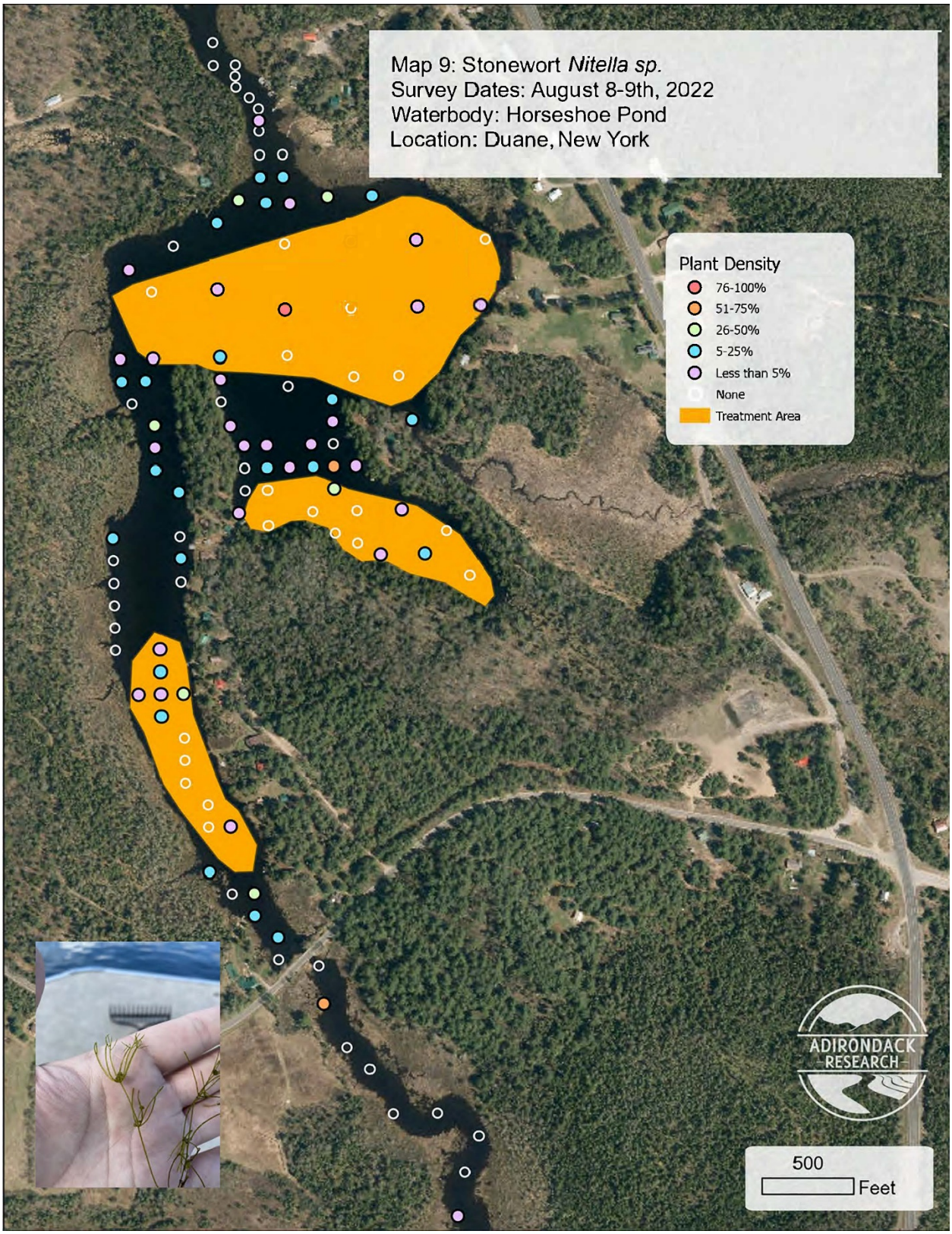

Map 4: Survey Site Species Richness
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Survey Site Richness
(# of Species)
Treatment Area
ADIRONDACK
RESEARCH
500
Feet

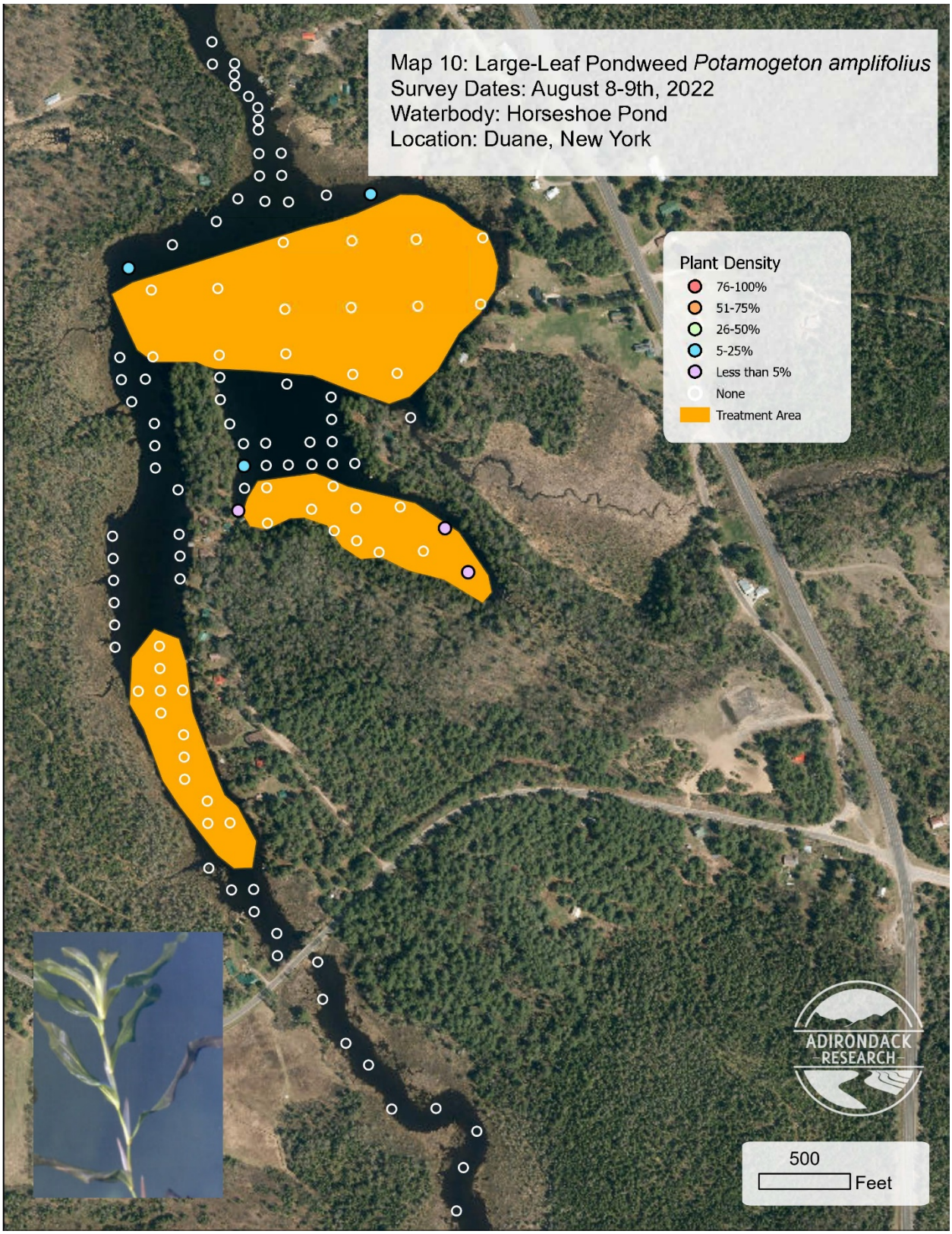

Map 5: Canadian waterweed *Elodea sp.*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 6: Eurasian Watermilfoil *Myriophyllum spicatum*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

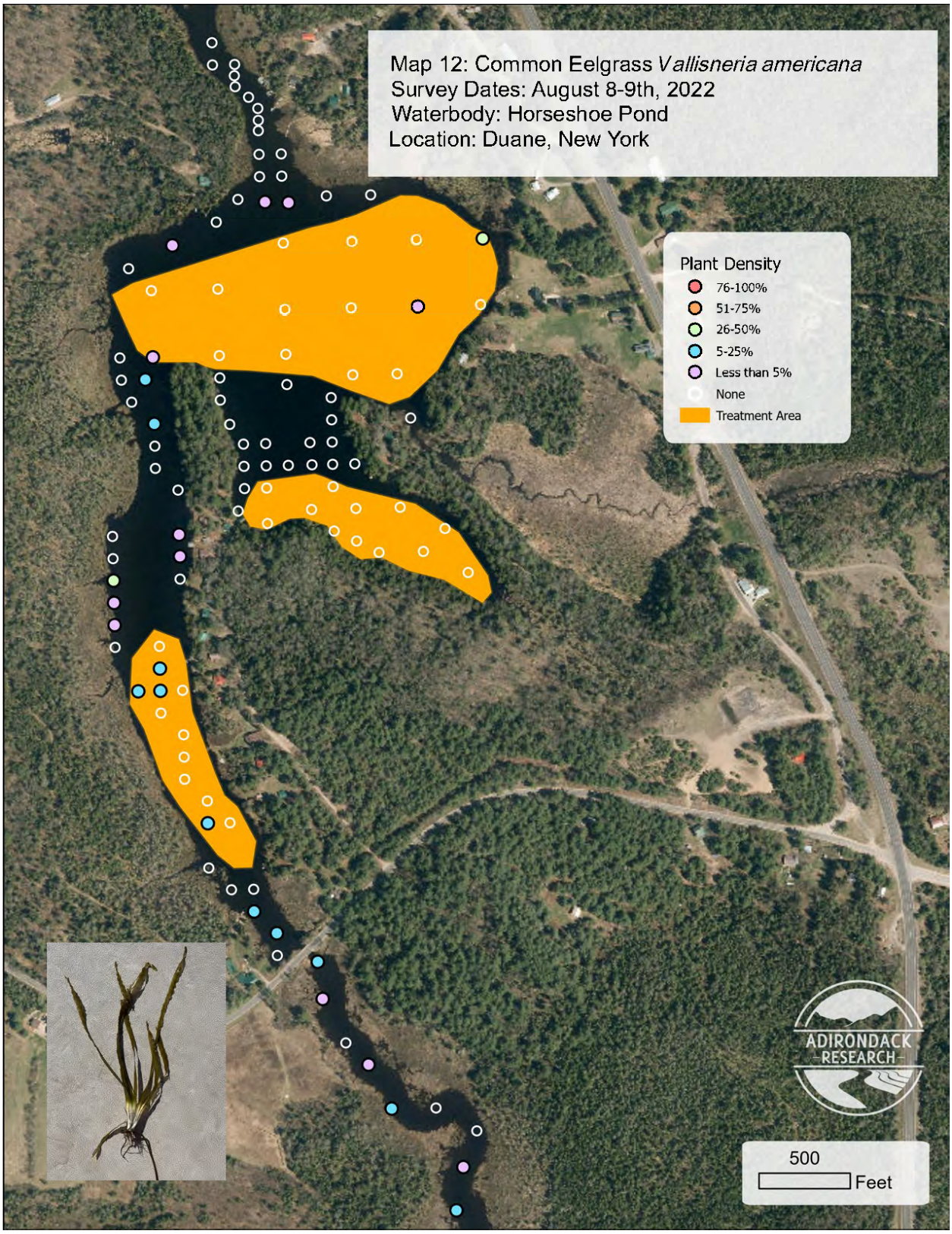

Map 7: Floating-Leaf Pondweed *Potamogeton natans*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

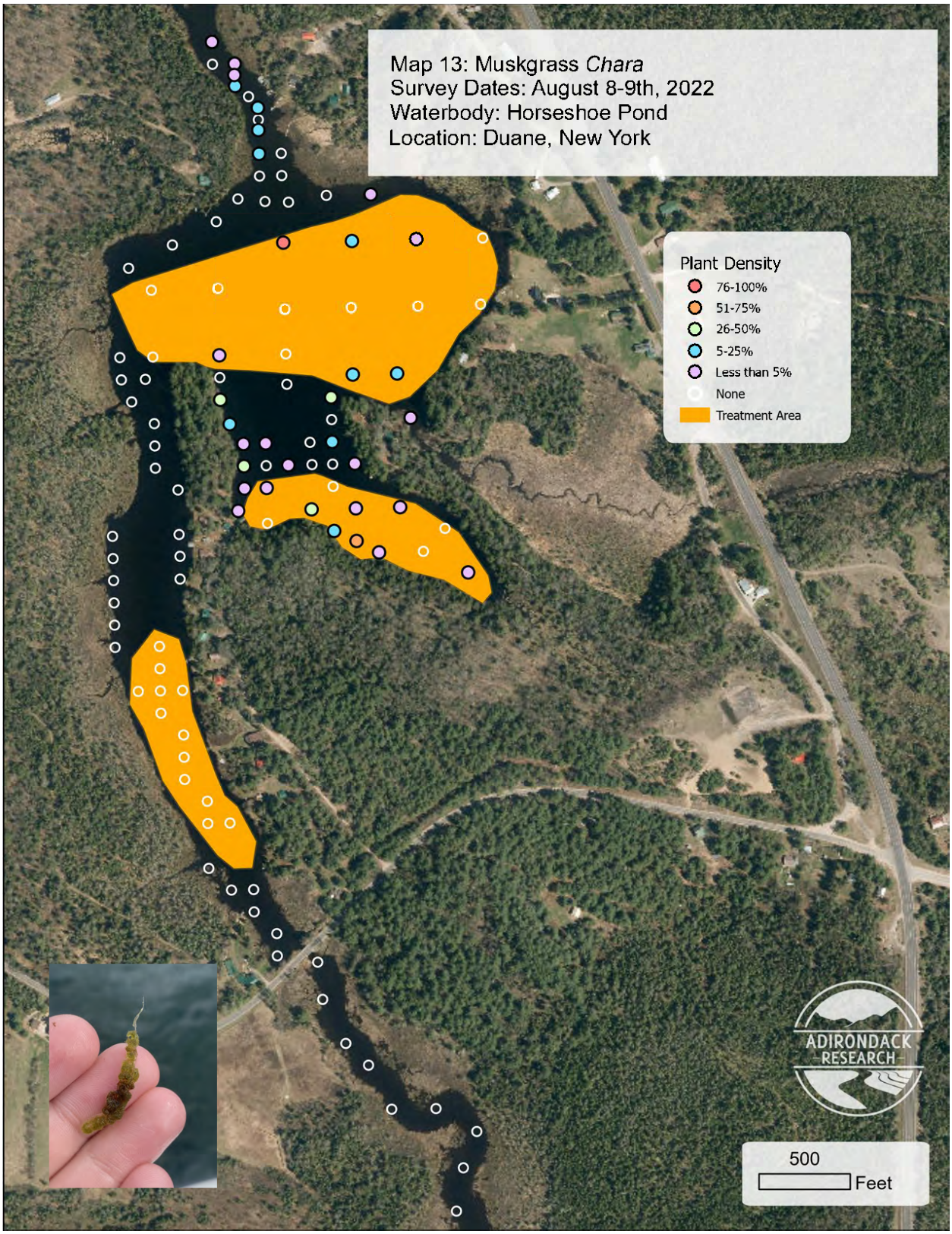

Map 8: Narrow-leaf Bur-reed *Sparganium angustifolium*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

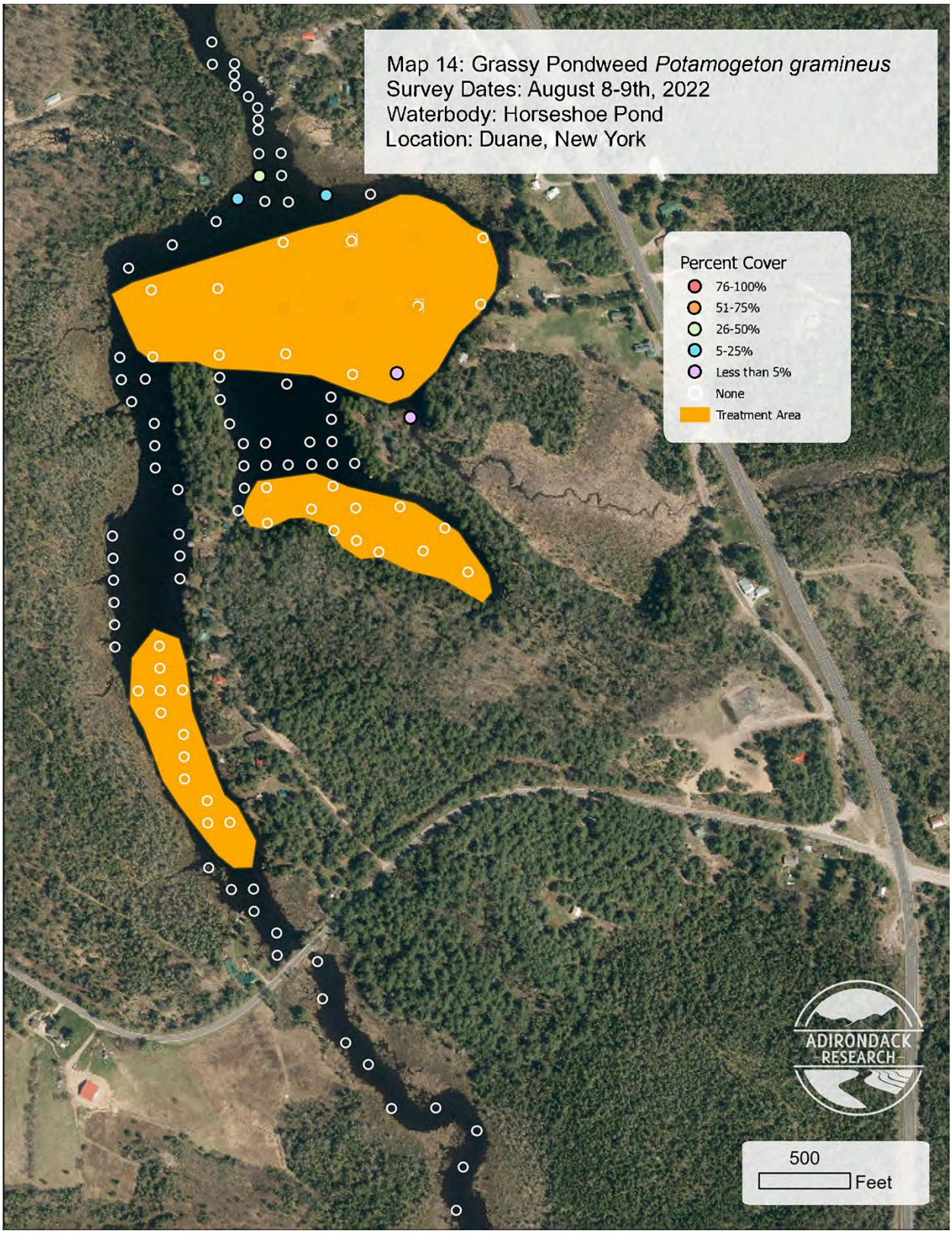

Map 9: Stonewort *Nitella sp.*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

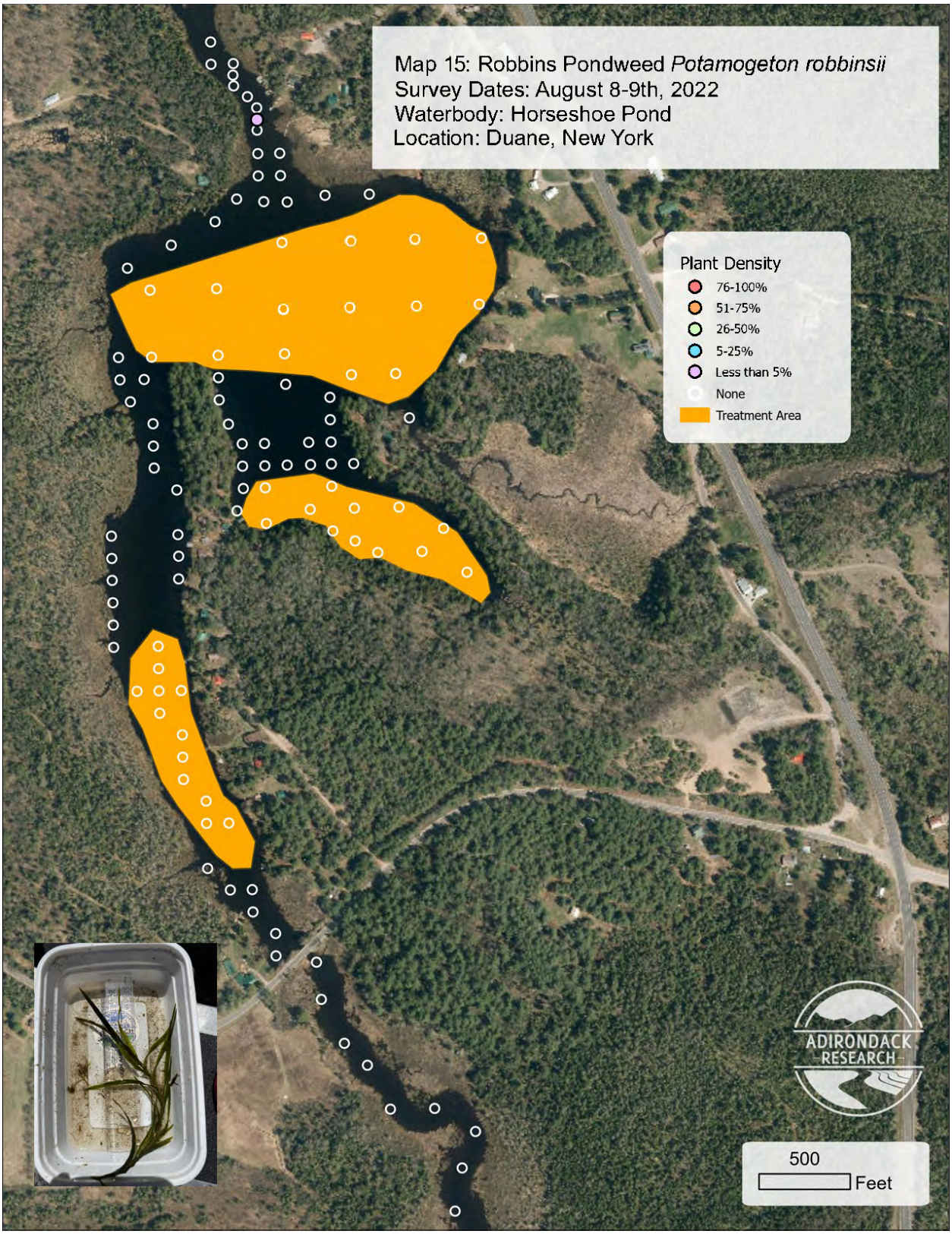

Map 10: Large-Leaf Pondweed *Potamogeton amplifolius*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

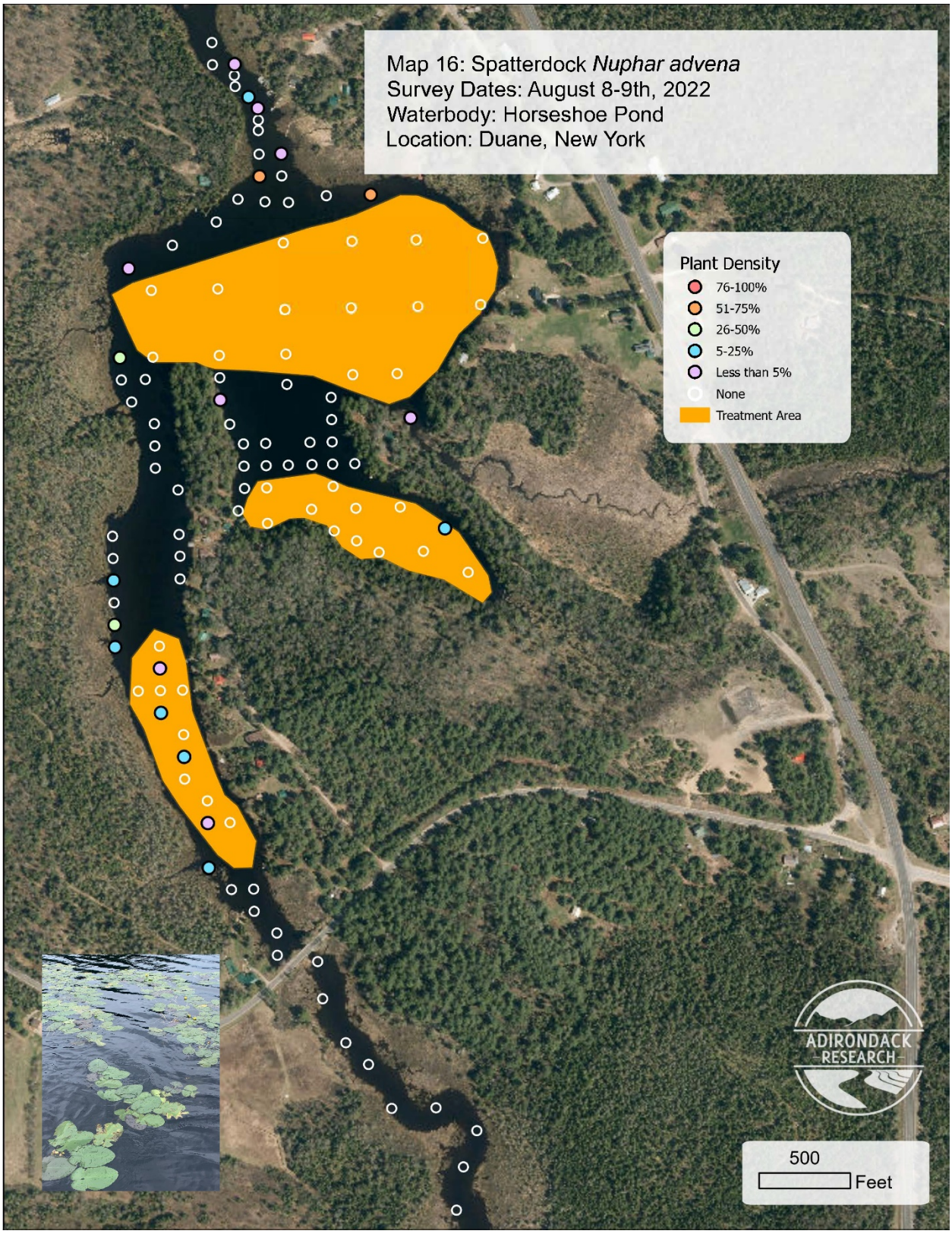

Map 11: Common Bladderwort *Utricularia intermedia*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 12: Common Eelgrass *Vallisneria americana*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

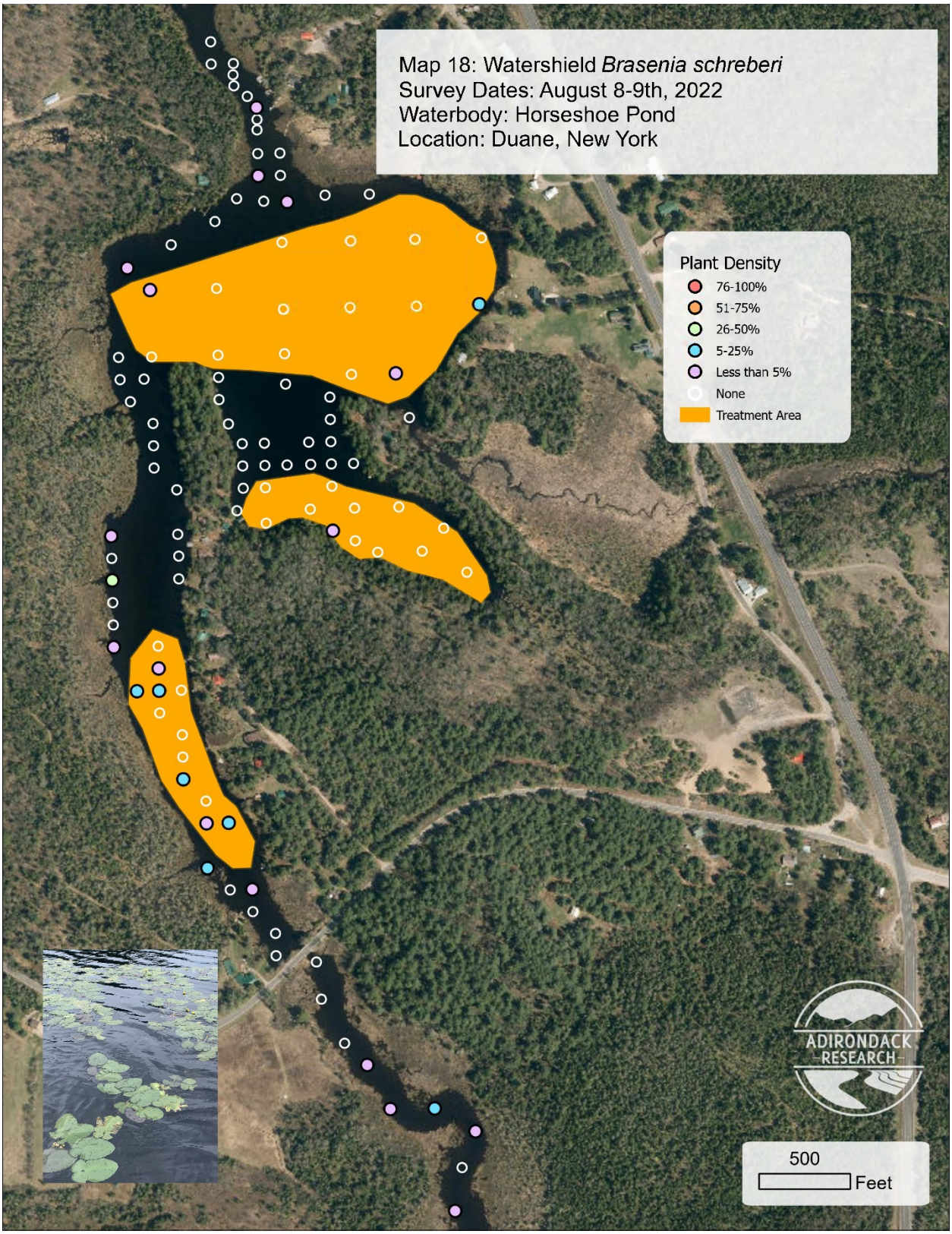

Map 13: Muskgrass *Chara*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

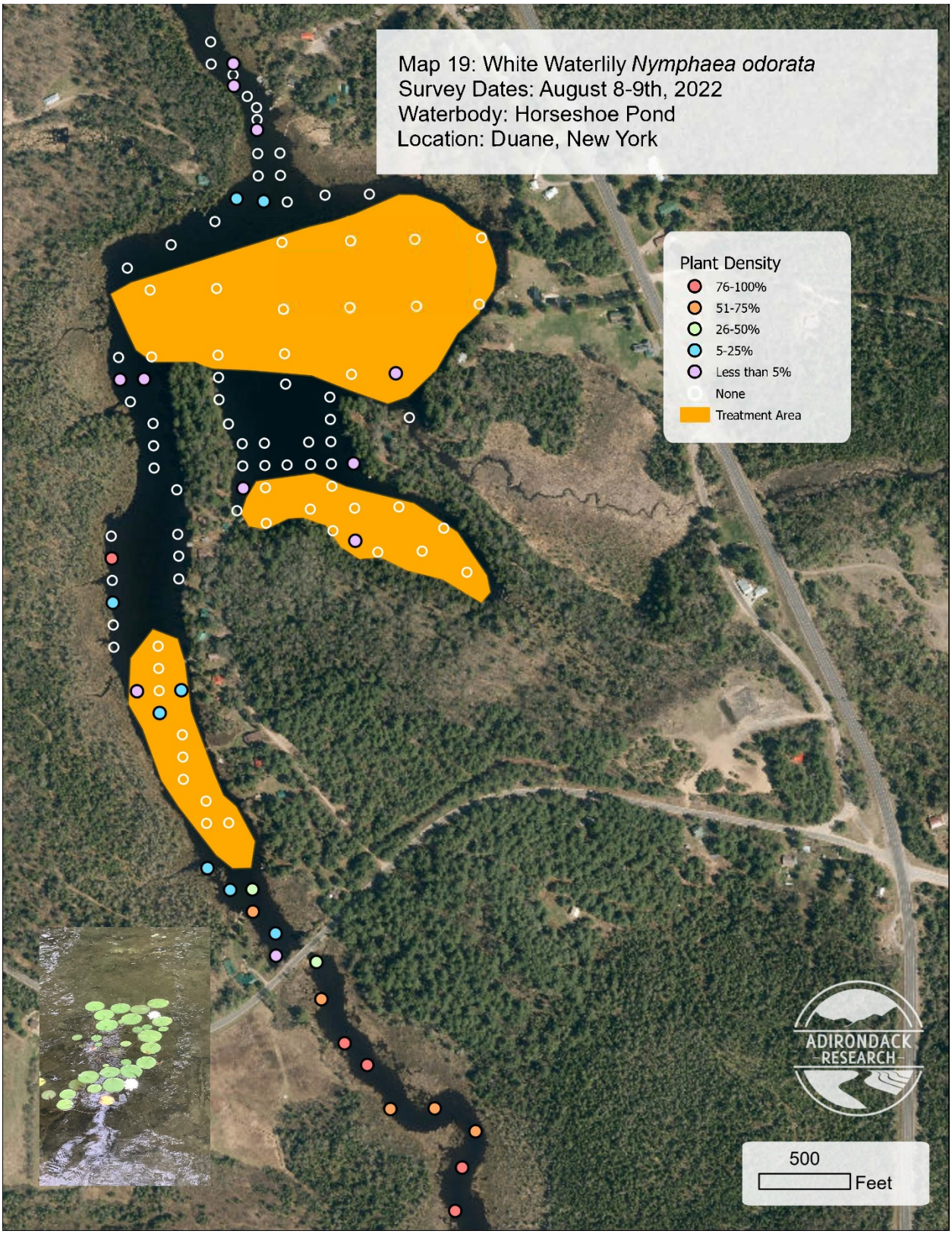

Map 14: Grassy Pondweed *Potamogeton gramineus*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Percent Cover
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

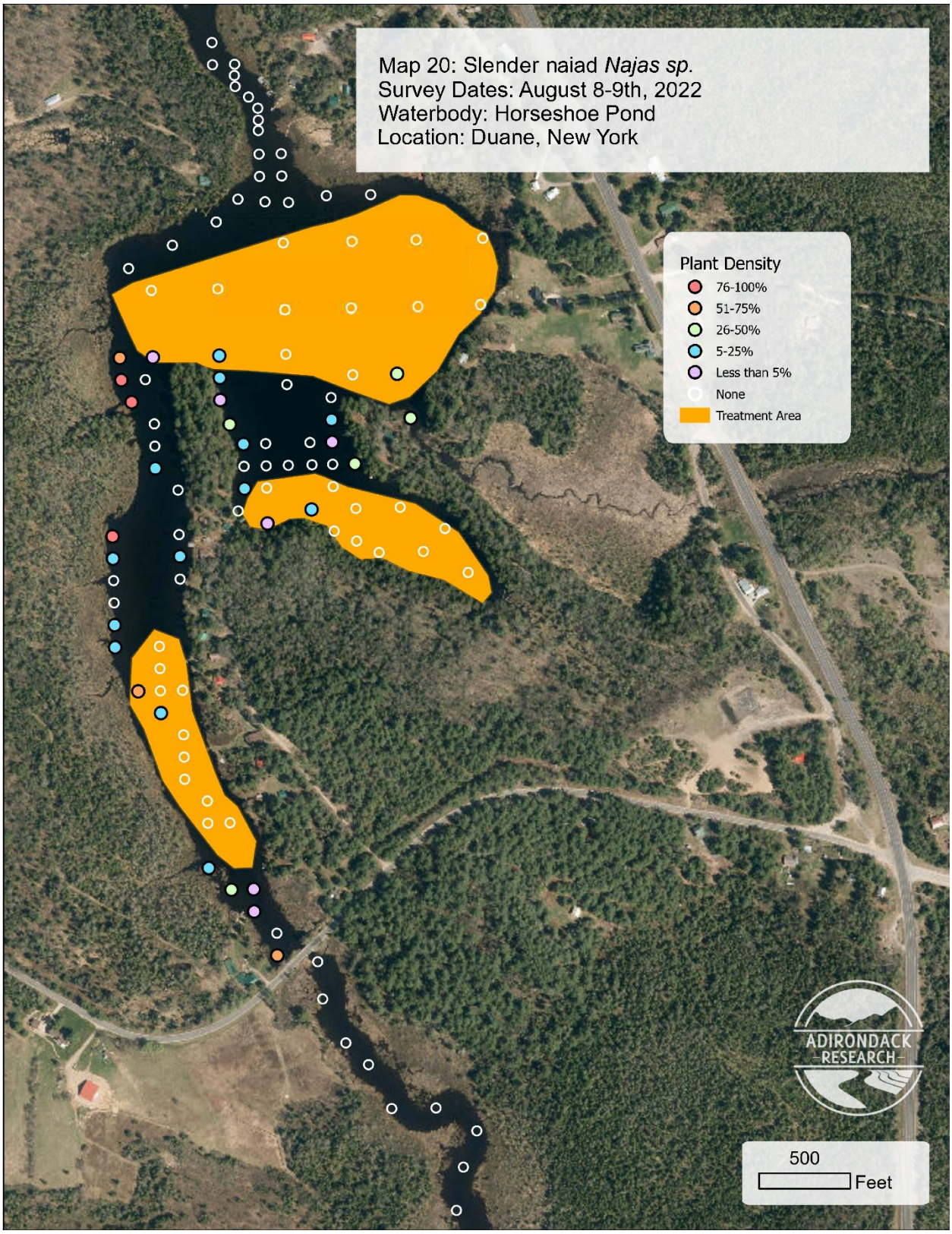

Map 15: Robbins Pondweed *Potamogeton robbinsii*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

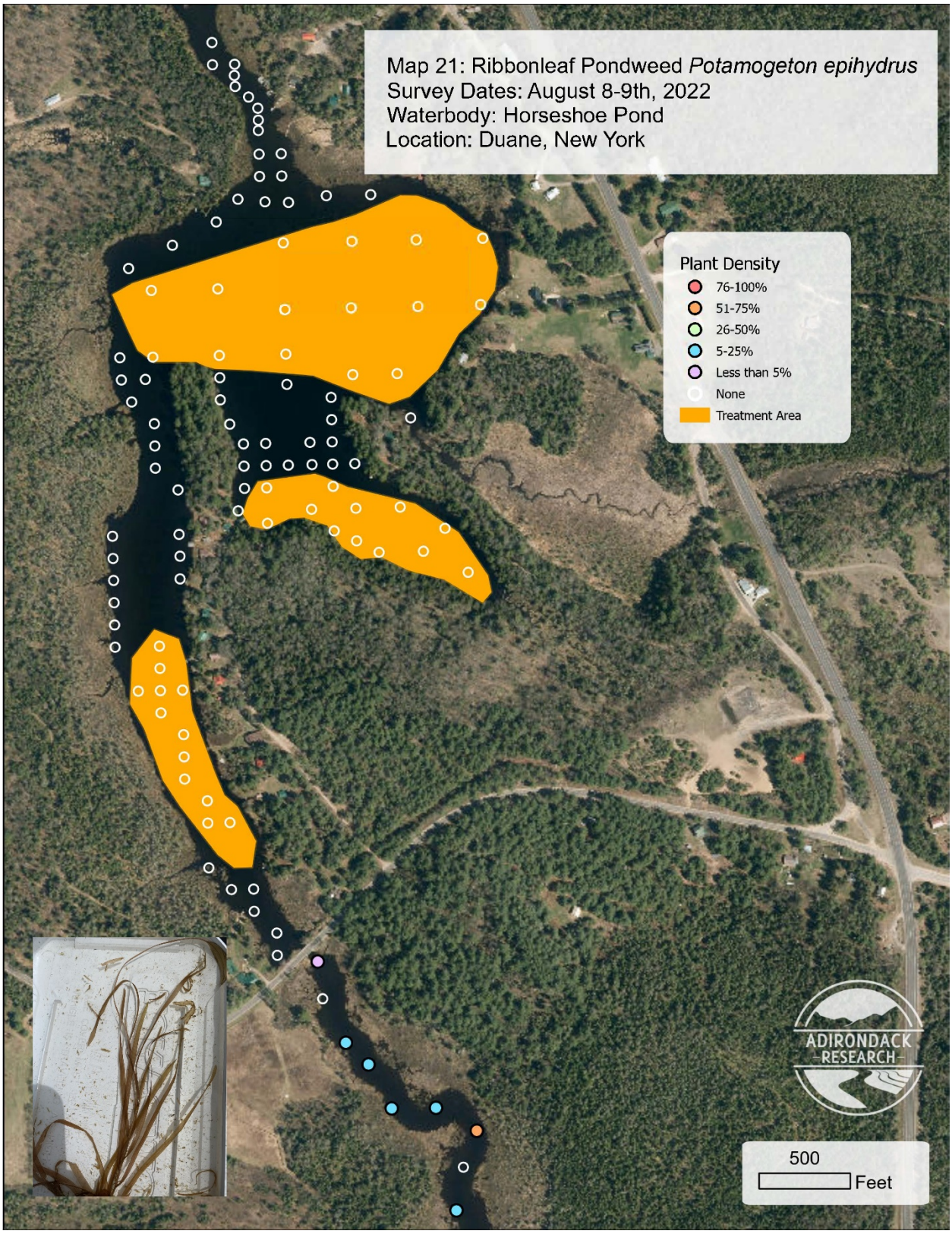

Map 16: Spatterdock *Nuphar advena*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 17: Variable-Leaf Pondweed *Potamogeton gramineus*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 18: Watershield *Brasenia schreberi*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 19: White Waterlily *Nymphaea odorata*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet


Map 20: Slender naiad *Najas sp.*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK
RESEARCH
500
Feet


Map 21: Ribbonleaf Pondweed *Potamogeton epihydrus*
Survey Dates: August 8-9th, 2022
Waterbody: Horseshoe Pond
Location: Duane, New York
Plant Density
76-100%
51-75%
26-50%
5-25%
Less than 5%
None
Treatment Area
ADIRONDACK RESEARCH
500
Feet

Plant Descriptions & ProcellaCOR Sensitivity

[1]Table 5. ProcellaCOR sensitivity

Common Name	Scientific Name	ProcellaCOR Sensitivity	Source
Big-leaved pondweed	*Potamogeton amplifolius*	LOW	1
Bladderwort	*Utricularia intermedia*	LOW	1
Canadian water weed	*Elodea sp.*	LOW	1
Eelgrass	*Vallisneria americana*	LOW	1
Eurasian watermilfoil	*Myriophyllum spicatum*	HIGH	1
Farwell's watermilfoil	*Myriophyllum farwellii*	HIGH	1
Floating leaf pondweed	*Potamogeton natans*	LOW	1
Grassy pondweed	*Potamogeton gramineus*	LOW	1
Muskgrass	*Chara sp.*	LOW	2
Slender Naiad	*Najas sp.*	LOW	1
Narrow-leaf bur-reed	*Sparganium angustifolium*	N/A	
Pickerelweed	*Pontederia cordata*	LOW-MODERATE	1
Ribbon leaf pondweed	*Potamogeton epihydrus*	LOW	1
Robbins pondweed	*Potamogeton robbinsii*	LOW	1
Spatterdock	*Nuphar advena*	LOW-MODERATE	1
Stonewort	*Nitella sp.*	LOW	2
Watershield	*Brasenia schreberi*	MODERATE-HIGH	1
White water lily	*Nymphaea odorata*	MODERATE	1

Table 5. ProcellaCOR sensitivity for all species detected in Horseshoe Pond

Myriophyllum spicatum (Eurasian watermilfoil)

Originating in Europe and Asia, *Myriophyllum spicatum* (Eurasian watermilfoil) is a rapidly spreading invasive milfoil species. It's ability to grow in cool water and at low light conditions, in addition to reproducing by fragmentation and fruit production; allows it to quickly overtake waterbodies and choke out native species. It has feather-like leaves, arranged in whorls of 4 to 5 along the stem, and each leaf has a central axis with 12 to 21 leaflet pairs. It has relatively large spaces between each whorl, sometime greater than ½ inch. These leaves are attached to thin stems that can normally grow 3 to 10 feet but have been reported as long as 33 feet in length. The stem is typically light brown in color and the tips are occasionally red or pink in color. These stems branch off repetitively at the water's surface forming large, floating mats of vegetation that block light to native species and imped water traffic. It is extremely sensitive to

[1]**Source 1:** Heilman, M. (2019). "Selective Control of Invasive Watermilfoils with ProcellaCOR® Aquatic Herbicide and Response of Native Aquatic Plants." SePRO. https://lgpc.ny.gov/system/files/documents/2022/03/technical-summary-procellacor-selective-control-of-invasive-watermilfoils-plus-appendix-28jan2019.pdf
Source 2: Vermont Department of Environmental Conservation (2022), "ProcellaCOR EC Aquatic Macrophyte Species Frequency of Occurrence Pre-and Post-Treatment Statistical Analysis." https://dec.vermont.gov/sites/dec/files/wsm/lakes/ANC/docs/Procellacor%20Aquatic%20Macrophyte%20Species%20Frequency%20of%20Occurrence%20Pre-and%20Post-Treatment%20Statistical%20Analysis%204-12-22.pdf

ProcellaCOR treatment, completely wiping out exposed plant beds and resulting in severe browning to the extent the plant is no longer recognizable.

Myriophyllum farwellii (Farwell's watermilfoil)

Is a native milfoil that grows completely submerged in water, preferring silty bottoms, often in less than 4 feet of water. Its stems are slender, commonly growing 12 to 28 inches in length, and can vary in color from reddish-purple to a reddish-green. Leaves are very delicate growing 1 to 3 cm long, arranged variously, with some being opposite of each other on the stem and some whorled in 3s or 4s. Its leaves have 5 to 8 pairs of thread-like divisions containing small black glands at the leaflet axil. Rather than producing a terminal flower, it produces flowers from these axils of the leaves. Unlike *Myriophyllum spicatum* (Eurasian watermilfoil), this native milfoil's stem does not branch out very much at the water's surface, still allowing for natural light to pass through to the waterbodies bottom. Its foliage provides shade, shelter, and foraging opportunities for fish and invertebrates, while waterfowl utilize its fruit as food source. It is sensitive to ProcellaCOR treatment, wiping out exposed plant beds and resulting in browning.

Nitella sp. (Stonewort)

Are branched multicellular algae, that may grow several feet long and resemble larger plants. Commonly light-green to bright-green in color with forked, bushy branches 1/16 to 1/8 inches in diameter, and does not flower. *Nitella sp.* (Stonewort) grows entirely below the water surface, usually in deeper zones, to depths of 30 feet. The plant provides food for waterfowl and cover for fish and also supports insects and other small aquatic animals, which provide substance for trout, bluegills, small mouth bass, and largemouth bass. Stonewort has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Utricularia intermedia (Bladderwort)

Is a carnivorous free-floating, non-rooted plant that can reach 2-3 meters in length with submerged stems, bladders, and overwintering buds. Stems are slender, 1/16 inches think or smaller with small, crowded, linear leaves forked 3-7 times. Dark bladders cover the stems and are responsible for capturing prey, opening like a valve to trap microorganisms then using enzymes to slowly digest prey and absorb needed nutrients. Prey can consist of aquatic insect larvae, water mites, nematodes, gastropods, small tadpoles, crustaceans, diatoms, and other aquatic microorganisms. *Utricularia intermedia* (Bladderwort) produces 1-4 bright yellow 1/3 inch snap-dragon-like blooms with a slender green stalk. Its stems provide food and cover for many fish species. Bladderworts have been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Elodea sp. (Canadian water weed)

Grows entirely underwater, except for a small white flower that blooms during the summer. Leafy shoots between 8 inches and 3.5 feet long are elongated, with slender, unbranched roots, and branched stems. Leaves are dark green, oval-shaped and arranged in clusters of 3-4. *Elodea sp.* (Canadian water weed) is an excellent oxygen producer and provides a habitat for many small aquatic animals, which fish and wildlife eat. However, dense growth of this plant can create a nuisance, and its closed, compact structure is not ideal fish habitat. Canadian water weed has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Chara sp. (Muskgrass)

A grey-green multi-cellular algae with a crisp, gritty texture caused by calcium deposits on its surface. It has cylindrical, whorled branches with 6 to 16 branchlets around each node, but no true leaves. Existing completely under the water's surface height can range from just under an inch to 6.5 feet. It is commonly mistaken for regular vascular plants because they form stemlike, leaflike, and rootlike structures. Growing both in shallow and deep water, *Chara sp*. (Muskgrass) is consumed by many species of ducks and provides habitat or shelter for invertebrates and small fish. Muskgrass has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Najas flexilis (Slender Naiad)

Is an annual submersed rooted or floating plant with slender, branching stems and fibrous roots. Growth is usually compact and relatively bushy; the highly branched stems can grow up to 4 feet in length and fragment easily. Leaves are commonly 1 mm wide and 0.5 to 3.5 cm long, and are typically stiff, curled and pointed, and have spines along the margins that are visible to the naked eye. Tiny flowers appear in the axil of the plant with separate male and female flowers on the same plant. *Najas flexilis* (Slender Naiad) can form dense surface mats of vegetation that inhibit growth of native plant species and reduce the water quality of habitat utilized by aquatic fauna. Naiad's have been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Nymphaea odorata (White water lily)

Roots in relatively shallow, silty bottoms up to 5 feet deep and produces a familiar round floating leaf 6 to 12 inches in diameter. Flowers have twenty to thirty white tapering petals. They also have forty or more bright yellow stamens in the center and a whorl of four green to purplish sepals at the base. The flowers, which are three to five inches wide, are fragrant and emerge in early Summer. *Nymphaea odorata* (White water lily) provide shad and protection for largemouth bass and sunfish. Seeds are eaten by waterfowl and leaves, stems, and flowers provide food for beavers and muskrats. White water lily has been found to have a moderate

sensitivity to ProcellaCOR treatment. Initial symptoms, including a reduction in biomass and browning of leaves can be seen almost imminently to 2 weeks. However, this plant will tend to make a strong to full recovery over-time.

Sparganium natans (Narrow-leaf bur-reed)

Often found in less than 2 feet of water, with a height ranging from 1 to 3 feet, it has thin, flexible, linear, grass-like leaves which float on the water's surface. The leaf length can range from 200-2500 mm. It is most commonly recognizable by round flower heads in a spike-like arrangement at the top of the stem, with separate male and female flower heads on the same plant. *Sparganium natans* (Narrow-leaf bur-reed) has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Brasenia schreberi (Watershield)

A floating-leaf aquatic plant, resembling miniature water lily leaves; with 2–5-inch oval, bright green leaves and red to purple bottoms. Its stems are attached to a rooted rhizome, anchoring into the ground and providing a source of nutrients. Purple flowers bloom in late summer to early fall for a two-day period on short 1-inch stocks. It is most commonly found in clear, soft water, up to depths of 10 feet. *Brasenia schreberi* (Watershield) provides shade and cover for panfish, largemouth bass, northern pike, and is eaten by waterfowl. This plant has been found to have a moderate to high sensitivity to ProcellaCOR treatment. Notable reductions in density and coverage of this plant can be observed after treatment, along with severe discoloration. Effects from ProcellaCOR with be dependent of the proximity of watershield to treatment areas.

Nuphar lutea (Spatterdock)

Recognizable by its 8-to-16-inch heart shaped, grass-green colored floating "lily-like" leaves; Nuphar lutea (Spatterdock) exists in shallow waters with muck or silt bottoms. Its flowers rise several inches above the water to form a yellow ball with inward curving petals. The underside of its leaves and stem are coated in a clear gelatinous slime. The underwater roots contain starch and are edible and fruits are eaten by waterfowl, beavers, and muskrats. The floating leaves additionally provide shade and cover for fish. Notable reductions in density and coverage of this plant can be observed after treatment, along with discoloration. Effects from ProcellaCOR with be dependent of the proximity of watershield to treatment areas.

Potamogeton gramineus (Grassy pondweed)

Often found in less than 3 feet of water, it grows from a creeping rhizome that anchors in wet substrate, producing thin, cylindrical, heavily branching stems. Leaf appearance is variable depending on depth. Floating leaves are rounded at the base and can be rounded or pointed at the tip about 1½ inches long, and up to 2cm wide, while submersed leaves are narrowly elliptic and almost always pointed at the tip. This species hybridizes frequently, but can be recognized by its flower, a dense cylindrical spike with 5-10 whorls of flowers that just reaches above the surface of the water. *Potamogeton gramineus* (Grassy pondweed) has been found to have a

relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Potamogeton amplifolius (Big-leaved pondweed)

Recognizable by its wide, often reddish, strongly arching, ruffled, submerged leaves, with flowers and fruits that rise above the water from the axils of these leaves. Submersed leaves are thin, widest above around the middle, 2 to 8 inches long, and up to 2¾ inches wide. Commonly found in deeper waters, it can grow between 6 inches to 4 feet in height. It is sensitive to increased turbidity and has difficulty recovering from top-cutting. Its broad leaves provide abundant shade and shelter for fish, while its nutlets provide an excellent food source for waterfowl. *Potamogeton amplifolius* (Big-leaved pondweed) has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Potamogeton epihydrus (Ribbon leaf pondweed)

Can be distinguished by its two types of leaves. The submersed leaves are narrow and ribbon-like, thin and transparent, that can reach up to two meters long, and alternate along the stem. Its floating leaves are broad and elliptical and supported by a stalk. Found in shallow, quiet waters of soft water lakes and ponds, it can grow between 4 inches to 3 feet in height, most commonly in mucky substrates. Fruiting stalks are located on the top of these stems, which provide nutritious seeds for waterfowl. *Potamogeton epihydrus* (Ribbon leaf pondweed) has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Pontederia cordata (Pickerelweed)

Pickerelweed is a perennial emergent that can reach three to four feet in height. It is easily recognizable by its bright purple to blue flowers spiking up 6 inches from the water. Deep green, heart shaped leaves, 1 to 6 inches in width and 2 to 10 inches in length, emerge at the ends of stems that are fibrously rooted in soil commonly, no more than 3 feet deep. Fish and small mammals use the foliage for cover, while waterfowl consume its seeds, and deer and muskrats consume its vegetation. *Pontederia cordata* (Pickerelweed) has been found to have a low to moderate sensitivity to ProcellaCOR treatment. It is more common to suffer effects such as discoloration and slight loss of biomass density after treatment. However, it will still generally tend to make a full recovery in time.

Potamogeton natans (Floating-leaf pondweed)

Growing from 2 to 4 feet tall, *Potamogeton natans* (Floating-leaf pondweed) have long, pale, bent leaf stalks that connect to green, heart-elliptical shaped, 1 to 2 inch wide, 1.5 to over 4 inch long, floating leaves. It can tolerate a variety of sediment types and water chemistries, commonly growing in waters no deeper than 8 feet. Its leaves provide shade and hunting opportunities for fish. *Potamogeton natans* (Floating-leaf pondweed) has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

Vallisneria americana (Eelgrass)

A submerged, flowering seagrass that thrives in soft, sandy sediment in shallow bays and inlets. It is a grass like plant with dark-green, narrow, ribbon shaped leaves with rounded tips, that grow 20 to 50 cm in length. These leaves shoot from rhizomes binding the plant to the sediment. *Vallisneria americana* (Eelgrass) form dense underwater meadows, that support a diversity of flora and fauna, and act as a nursery to fish and shellfish. Additionally, it adds structure to silty sands that would otherwise shift and erode. Eelgrass has been found to have a relatively low sensitivity to ProcellaCOR treatment, resulting in little to no response observed on the plants health after treatment.

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