

Northeast Aquatic Research

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Lake Zoar Post- Herbicide Treatment Aquatic Plant Survey Results

Pre-treatment Survey: Survey conducted on July 16th, 2019

Post-treatment Survey: Survey conducted on September 23rd, 2019.

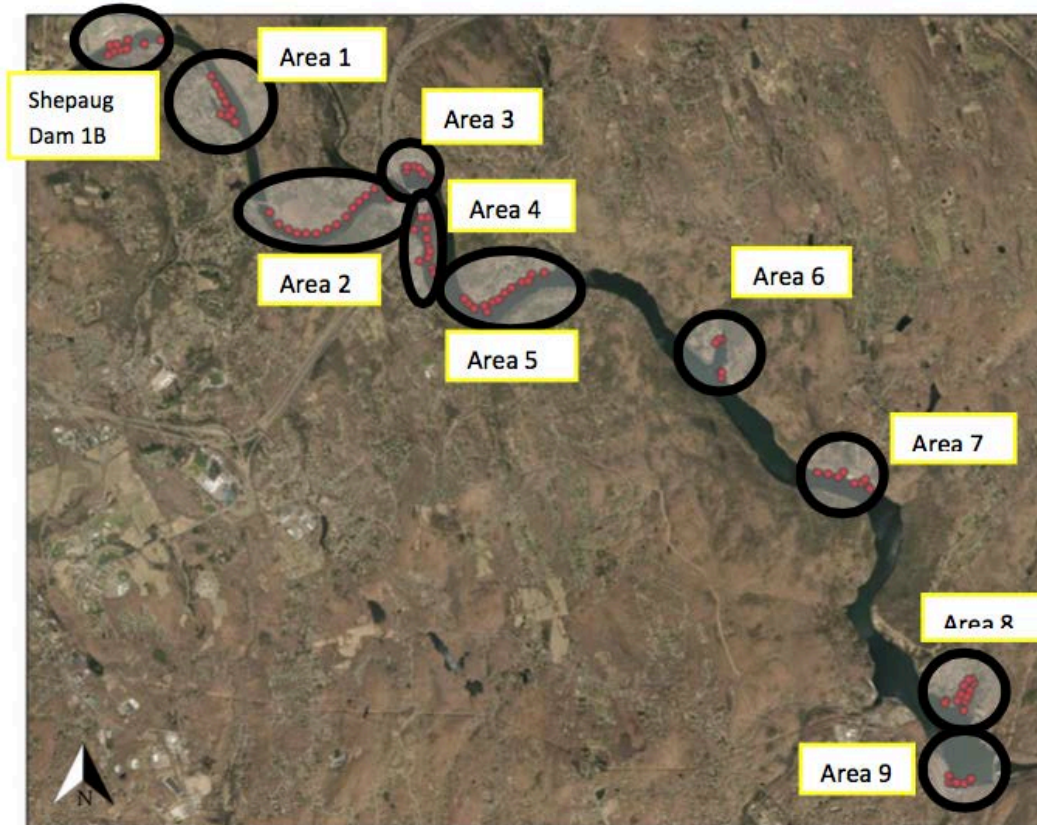
Treatment Dates: August 8th and 12th, 2019. Target plants: Eurasian milfoil, Curly-leaf pondweed.

All Treatment Areas (shown in Map 1):

Area	Size (acres)	Location - Description
1B	5.9	Narrow bands 100 feet wide opposite each other along the eastern and western shorelines.
1	10.0	Narrow band 100 feet wide along western side and within small cove about 1 mile below the Shepaug Dam.
2	5.7	Narrow band 70 feet wide along eastern shore about 2.5 miles below Shepaug Dam. Includes small bed on western side immediately above I84 Bridge.
3	8.2	Large bay on eastern side immediately below I84 Bridge, bounded to the west by large sandbar.
4	14.4	Large area that includes both sides of central sandbar and shallow waters on the western side.
5	11.2	Large shallow area offshore of DEEP boat launch and narrow band 75 wide along eastern shore.
6	5.0	Inner end of cove at Kettle town State Park.
7	2.4	Two small coves on eastern shore at Jackson Cove State Park.
8	8.4	Narrow band 50 feet wide and cove on eastern side about 2.5 miles above Stevenson Dam.
9	3.2	Small bay on western side about 1000 feet above Stevenson Dam.
Total	74.4	

Treatment Areas Details

Locations of Eurasian milfoil and Curly-leaf pondweed were mapped in each treatment area. The following maps each demonstrate the Eurasian milfoil coverage in hatched green, curly-leaf pondweed coverage in pink, and the treatment areas outlined in white. Treatment areas are combined into three zoomed maps of Lake Zoar. Map 1 includes treatment areas 1B, 1, & 2. Map 2 includes treatment areas 3, 4, 5, & 6. Map 3 includes treatment areas 7, 8, & 9.



Map 1 - Overview of All Sites

The treatment areas are circled and numbered. Red points depict survey waypoints.

Survey GPS Waypoint Results

For each survey in 2019, a series of GPS waypoints were used to document aquatic plant presence and coverage in the designated treatment areas.

Table 1 provides percent frequency and average density (% cover) numbers lake-wide, across all sites during the pre- and post-treatment surveys. Table 2 provides percent frequency and density numbers during the pre- and post-treatment surveys broken down by treatment area.

The percent frequency number indicates the percentage of total survey waypoints at which a given species was found within a treatment area. The average percent cover number represents the average density over all the locations at which the plant was found within a treatment area during the survey. Percent cover 0-19% is sparse, 20-49% is moderate, 50-79% is dense

coverage, and 80-100% is very dense plant growth. The overall percentage is a combination statistic that is calculated by multiplying the decimal percent frequency by the average percent cover to estimate the percent cover of each species over the whole survey area.

Several native aquatic plants were found growing at moderate to high density in many of the treatment areas including tapegrass (*Vallisneria americana*), thin-leafed pondweed (*Potamogeton pusillus*), clasping-leaf pondweed (*Potamogeton perfoliatus*), water star grass, river pondweed (*Potamogeton nodosus*), coontail (*Ceratophyllum demersum*) and Nuttall's elodea (*Elodea nuttallii*).

Looking at the percent frequency data in Table 1, you can see that there was a substantial decrease in invasive Eurasian milfoil (*Myriophyllum spicatum*), Curly-leaf pondweed (*Potamogeton crispus*), and Brittle naiad (*Najas minor*). There was also a subsequent increase in frequency of native species tape grass and coontail.

All areas were treated to control Eurasian milfoil and curly-leaf pondweed. Several areas also had low to moderate growth of the invasive Brittle naiad.

Curly-leaf pondweed decreased considerably between the pre- and post-treatment surveys, falling from 36 acres to 5.6 acres. However, curly-leaf naturally dies off by mid-summer, so it is likely that this decrease is not purely a result of the herbicide treatment.

During the post-treatment survey, milfoil was still found in all treatment areas, but decreased in both frequency and density. Overall, milfoil acreage decreased by approximately 10 acres between the pre- and post-treatment surveys, falling from 35.3 acres to 28.2 acres.

Most native aquatic plant species were also present at a lower frequency during the post-treatment survey.

Table 1. Aquatic plant presence (% occurrence) and density pre- and post-herbicide treatment.

Species Name	% Frequency		Density	
	Pre Avg	Post Avg	Pre Avg	Post Avg
Nothing Present	8.2	13	NA	NA
<i>Myriophyllum spicatum</i>	78.6	48.9	27	19.1
<i>Potamogeton crispus</i>	64.5	8.6	32.9	32.5
<i>Potamogeton nodosus</i>	9.7	6.6	14.4	45
<i>Zosterella dubia</i>	26.2	8.7	17	18.3
<i>Potamogeton pusillus</i>	59.2	23.9	39.2	17.1
<i>Vallisneria americana</i>	41.8	56.3	35.4	58.3
<i>Potamogeton perfoliatus</i>	2.9	2.2	30	30
<i>Chara sp.</i>	3.5	0	37.5	NA
<i>Nitella sp.</i>	1.5	0	5	NA
<i>Najas minor</i>	15	0.7	41.7	5
<i>Ceratophyllum demersum</i>	14.4	42.8	9.7	21.3
<i>Fontinalis sp.</i>	0.8	0	5	NA
<i>Filamentous algae</i>	10	13.2	28	40
<i>Najas flexilis</i>	8	0	16.7	NA
<i>Nymphaea odorata</i>	0	0.7	NA	15

Table 2. Pre- and post-treatment % occurrence and average density by treatment area.

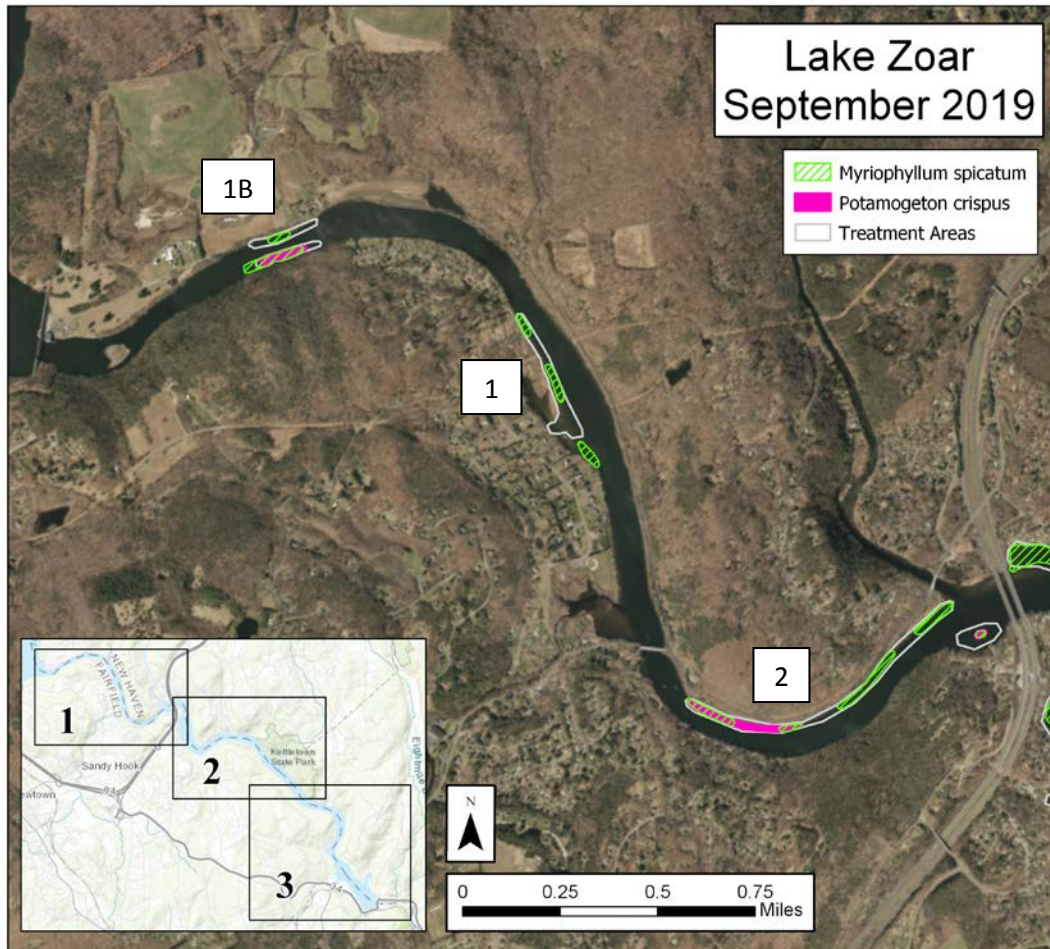
Pre-treatment % Occurrence										
Species	1B	1	2	3	4	5	6	7	8	9
Nothing Present						8.3	16.7	16.7	40	
Myriophyllum spicatum	100	93.3	92.3	66.7	90	66.7	66.7	83.3	40	87.5
Potamogeton crispus	60	93.3	100	100	100	75	33.3	33.3		50
Potamogeton nodosus	40	13.3	30.8							12.5
Zosterella dubia	60	20	30.8	83.3	50	8.3			10	
Potamogeton pusillus	20	80	76.9	66.7	80	91.7	66.7	50	10	50
Valisneria americana	40	46.7	84.6	66.7	30	66.7	16.7	16.7		50
Potamogeton perfoliatus		13.3	7.7			8.3				
Chara sp.		20	15.4							
Nitella sp.		6.7				8.3				
Najas minor			15.4				50	16.7	30	37.5
Ceratophyllum demersum			7.7	16.7	40	25			30	25
Fontinalis sp.			7.7							
Filamentous algae				16.7			83.3			
Najas flexilis				50	30					
Nymphaea odorata										

Post-treatment % Occurrence										
Species	1B	1	2	3	4	5	6	7	8	9
Nothing Present	20	14.3			33.3		25		37.5	
Myriophyllum spicatum	80	35.7	69.2	100	44.4	36.4	25	40	25	33.3
Potamogeton crispus	40		46.2							
Potamogeton nodosus	20	14.3	15.4							16.7
Zosterella dubia	20	7.1	23.1	20						16.7
Potamogeton pusillus	20		53.8	20	22.2	18.2	25	80		
Valisneria americana	60	92.9	92.3	100	22.2	63.6	25	40		66.7
Potamogeton perfoliatus		7.1	15.4							
Chara sp.										
Nitella sp.										
Najas minor		7.1								
Ceratophyllum demersum		42.9	76.9	60	33.3	36.4	75	20	50	33.3
Fontinalis sp.										
Filamentous algae				60		27.3	25	20		
Najas flexilis										
Nymphaea odorata		7.1								

Pre-treatment Average Density										
Species	1B	1	2	3	4	5	6	7	8	9
Myriophyllum spicatum	44	61.8	29.2	10	26.7	16.9	7.5	25	20	29.3
Potamogeton crispus	31.7	44.6	57.7	53.3	34	34.4	12.5	10		17.5
Potamogeton nodosus	10	10	32.5							5
Zosterella dubia	20	6.7	16.3	52	9	10			5	
Potamogeton pusillus	10	11.7	24.5	12.5	34.4	67.3	75	41.7	40	75
Valisneria americana	7.5	32.1	28.2	32.5	46.7	41.3	50	30		50
Potamogeton perfoliatus		20	50			20				
Chara sp.		45	30							
Nitella sp.		5				5				
Najas minor			5				46.7	100	20	36.7
Ceratophyllum demersum			10	10	8.8	10			11.7	7.5
Fontinalis sp.			5							
Filamentous algae				20			36			
Najas flexilis				16.7	16.7					
Nymphaea odorata										

Post-treatment Average Density										
Species	1B	1	2	3	4	5	6	7	8	9
Myriophyllum spicatum	35	8	12.5	8.2	30	5	22.5	10	40	20
Potamogeton crispus	45		20							
Potamogeton nodosus	60	30	20							70
Zosterella dubia	40	10		5						
Potamogeton pusillus	30		22.5	10	5	10		25		
Valisneria americana	53.33	82	62.5	40		80		25		65
Potamogeton perfoliatus			30							
Chara sp.										
Nitella sp.										
Najas minor		5								
Ceratophyllum demersum		11.67	10	10	20	23.33	11.25	60	15	30
Fontinalis sp.										
Filamentous algae				40				40		
Najas flexilis										
Nymphaea odorata		15								

Post-treatment Area Descriptions



Map 2 – Zoom 1: Treatment Areas 1B, 1, and 2

Treatment Area 1B

Both Eurasian milfoil and curly-leaf pondweed were not significantly impacted by the herbicide. Milfoil remained present throughout most of the treatment area post-treatment, and the density of the plant beds decreased only slightly. Curly-leaf coverage decreased somewhat, but the beds that remained were slightly denser than pre-treatment.

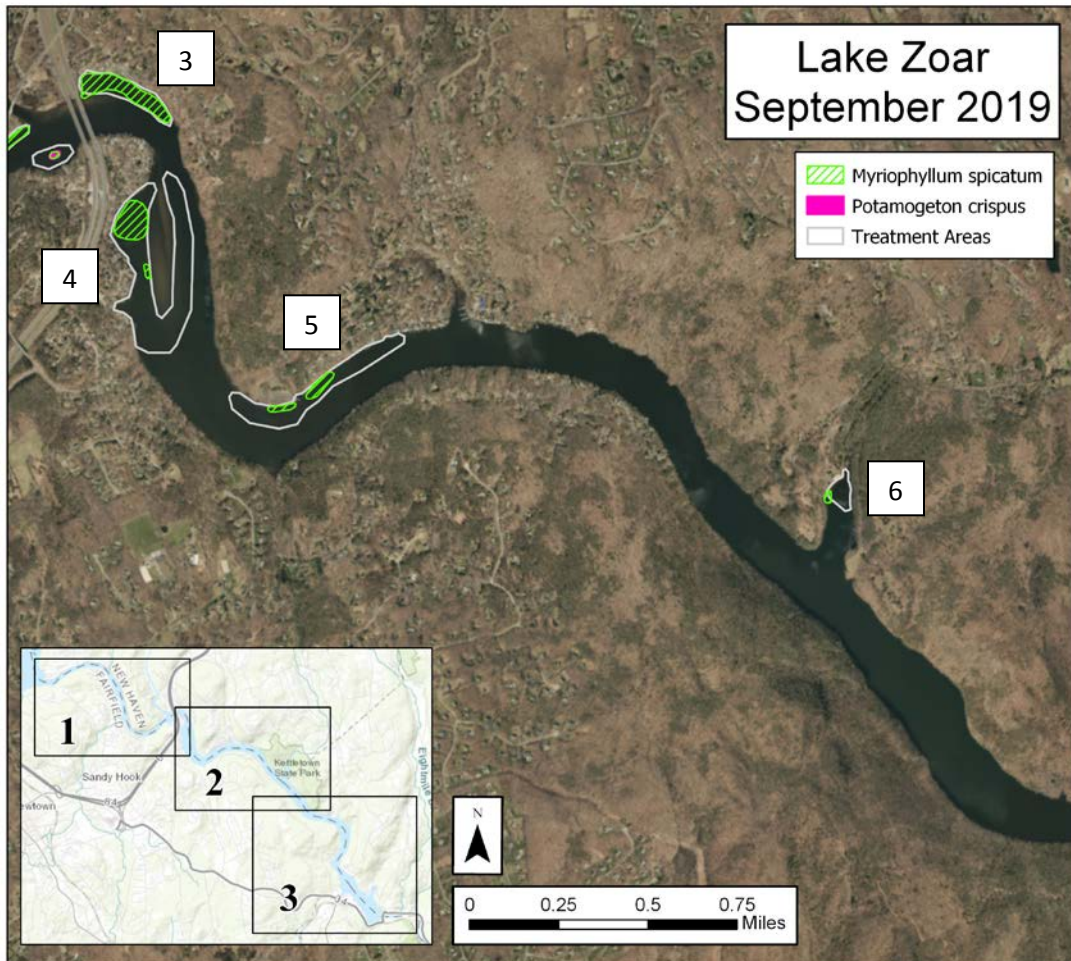
Treatment Area 1

Pre-treatment, both milfoil and curly-leaf pondweed filled nearly all of Area 1, and both were found at moderate to high density. Following the herbicide treatment, milfoil was found at approximately 35% of waypoints, and was very sparse where found. Brittle naiad was found at one waypoint at very low density post-treatment. Curly-leaf was not found in this area post-treatment.

Treatment Area 2

Milfoil and curly-leaf were both present throughout this area at a moderate to high density during the pre-treatment survey. Following the herbicide treatment, milfoil coverage reduced somewhat, although it was still present at approximately 70% of waypoints. However, the

density of this species decreased from 30% to 13% between the pre- and post-treatment surveys. Curly-leaf presence decreased by approximately 50% between pre- and post-treatment, and the density of the remaining beds decreased as well. Brittle naiad was found at two waypoints at very low density pre-treatment and was not found in the area post-treatment.



Map 3 – Zoom 2: Treatment Areas 3, 4, 5, and 6

Treatment Area 3

Pre-treatment, milfoil sparsely covered approximately two thirds of this treatment area. Post-treatment, milfoil coverage had increased, completely filling the treatment area, although density remained low. Curly-leaf was present at approximately 50% average density at all survey waypoints pre-treatment. During the September survey, curly-leaf was not found in this treatment area.

Treatment Area 4

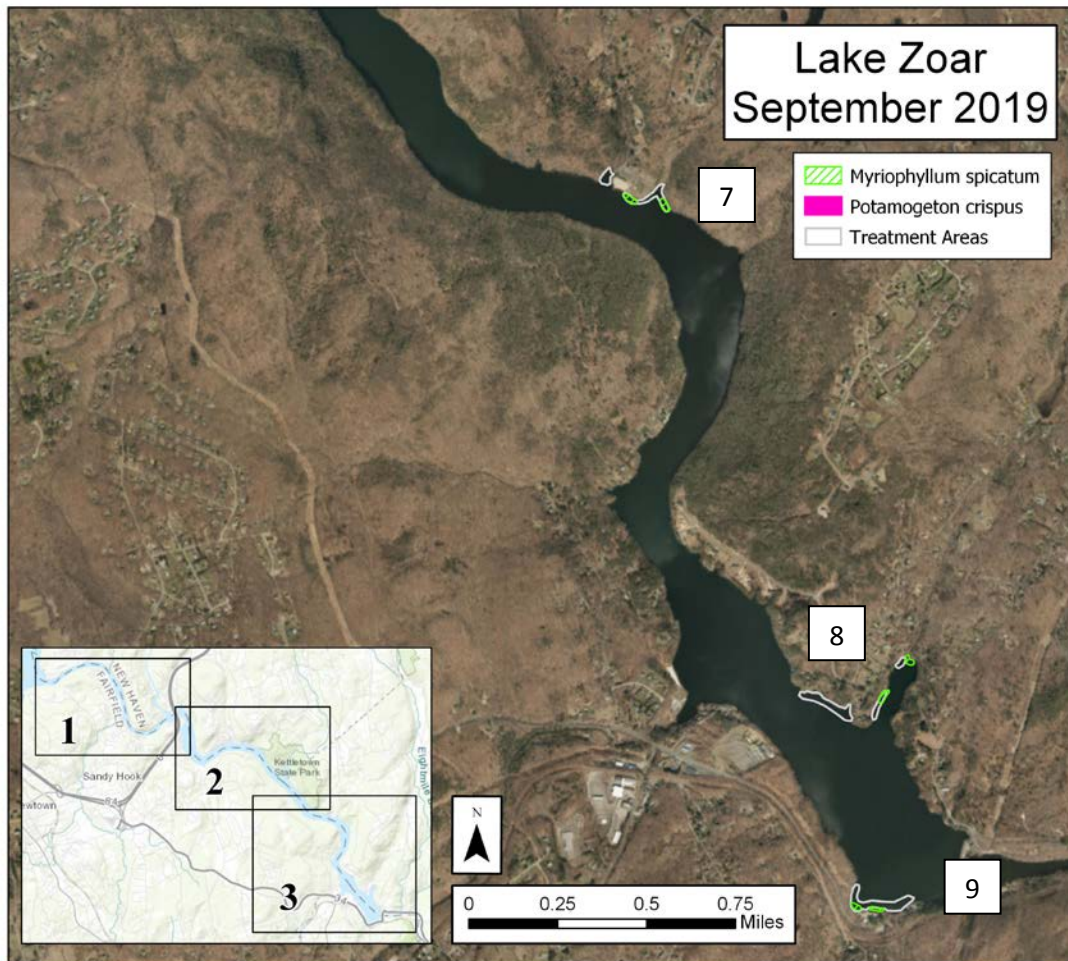
Both milfoil and curly-leaf pondweed filled this treatment area during the July survey, present at low to moderate density. Post-treatment, milfoil had decreased to slightly less than half of the area. Post-treatment, no curly-leaf was found in the area and one third of the waypoints lacked any plant growth at all. The sand bar was found to have several emergent pickerel-weed plants scattered along the northern, shallower section.

Treatment Area 5

During the July survey, milfoil covered two thirds of the treatment area at a low density. Curly-leaf covered approximately the same area as milfoil, although it was slightly denser. Post-treatment, milfoil had decreased in coverage by about half, and was very sparse in the areas where found. No curly-leaf was found in this area post-treatment.

Treatment Area 6

Pre-treatment, a large, although sparse patch of milfoil was present in the center of the cove, and a small patch was found at the entrance to the cove. Post-treatment, the inner cove patch had reduced in size and the patch at the cove entrance had disappeared. One small, low-density patch of curly-leaf was present in the inner cove pre-treatment. Brittle naiad was present at 50% of waypoints at moderate density during the pre-treatment survey, but was not found in the area post-treatment. No curly-leaf was found in Area 6 post-treatment.



Map 4 – Zoom 3: Treatment Areas 7, 8, and 9

Treatment Area 7

Pre-treatment, milfoil was present throughout the treatment area at varying density. Small, low-density patches of curly-leaf were present in the two coves of Area 7 pre-treatment. In September, milfoil had decreased to two small patches, and no curly-leaf was found in the area.

One small but high-density patch of brittle naiad was present in the area pre-treatment, but was not found in the area during the post-treatment survey.

Treatment Area 8

Milfoil was present at 40% frequency and 20% average density pre-treatment. It was growing in a narrow band along the cove's western shoreline to the far end of the cove. Post-treatment, milfoil had reduced to 25% frequency, although it had become denser in the patches that remained. A narrow band of brittle naiad was growing along the shoreline at the end of the cove during the pre-treatment survey but was not present in September. No curly-leaf was found in Area 8 during either of the surveys. Post-treatment, a considerable portion of this treatment area lacked any aquatic plant presence. The only aquatic plant other than milfoil found in the area post-treatment was the native species coontail.

Treatment Area 9

Pre-treatment, Eurasian milfoil was growing at low to moderate density at all but one waypoint in this treatment area. Post-treatment, milfoil coverage had decreased to one third of the waypoints, and density had decreased somewhat as well. Pre-treatment, curly-leaf was present at 50% frequency and a low density, and brittle naiad was present at 38% frequency and moderate density. No curly-leaf or brittle naiad was found in this area post-treatment.

Additional Comments:

Comparison of the pre-treatment and post-treatment survey data suggests that the treatment reduced, but did not eliminate, milfoil in nearly all treatment areas. Milfoil frequency in the treatment areas reduced by 15% to 57%. Treatment Area 3 is the only area in which milfoil frequency increased between the pre- and post-treatment surveys. In addition to a reduction in frequency, the density of milfoil within plant beds reduced in most treatment areas.

In past years, the northernmost sites, Treatment Areas 1B and 1, have been more difficult to control with targeted herbicide treatments likely due to increased water flow at these sites. It appears that the treatment did reduce milfoil in both of these sites in 2019, although Treatment Area 1 saw only a moderate decrease in milfoil frequency and density.

Curly-leaf pondweed was found only in Treatment Areas 1B and 2. However, as discussed in the Survey Results, this nearly complete eradication is likely due to the natural early die-off of this species.

Brittle naiad was found in five of the ten treatment areas during the pre-treatment survey. Post-treatment, this species was found only in Area 1, at a single waypoint.