



September 3, 2018

Bare Hill Pond Watershed Management Committee
Bruce Leicher
Town of Harvard
99 Ann Lee Road
Harvard, MA 01451

Mr. Leicher,

Attached is the report for the water quality sampling and aquatic plant surveys conducted in 2018. As you are aware, we also collected an additional water quality and algae sample this year due to the spike in phosphorus concentrations recorded in July. Results of these analyses are provided in the attached report.

Please let me know if you have any questions or comments regarding this report. Thank you for the opportunity to assist with your continued assessment and management of Bare Hill Pond.

Sincerely,

A handwritten signature in black ink, reading "Wendy C. Gendron".

Wendy C. Gendron, CLM
Aquatic Ecologist



Report For:

Town of Harvard
Bare Hill Pond Watershed Management Committee
Harvard Massachusetts

Bare Hill Pond In-Lake Water Quality and Plant Surveys - 2018



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September 2018

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Introduction

Aquatic Restoration Consulting, LLC (ARC) performed in-lake water quality sampling and aquatic plant surveys within and surrounding Bare Hill Pond in 2018. The intent of these surveys were to document 2018 summer conditions and compare these data to previous years, identifying any trends.

The Bare Hill Pond Watershed Committee (Committee) has conducted winter water level drawdowns periodically since 2002. Early drawdowns were limited to the depth of the outlet (3.5 foot drawdown) but the installation of a pump system enables the Committee to increase the drawdown depth. Substantial reductions in plant cover and density were observed in association with initial extended water level drawdowns and remained consistent following subsequent drawdowns. A shift in species dominance from tall growing vegetative propagators (spread through fragmentation or by rhizomes) to low growing seed producers was observed. A history of drawdown depth and summary of conditions reported by the Committee is provided in Table 1.

Table 1. History of Bare Hill Pond Winter Drawdowns.

Winter Season	Water Level Reduction and Summary of Following Growing Season Observations
2002-03	1.5 Feet
2003-04	3.5' gravity drawdown
2004-05	3.5' gravity drawdown
2005-06	3.5' gravity drawdown - these first few created evidence of efficacy in drawdown zone and no evidence of substantial issues
2006-07	5' gravity and pump drawdown - some increase in efficacy
2007-08	5' gravity and pump drawdown - good freeze and improvement
2008-09	3.5' gravity drawdown - per request to see if a year off pumping would work - limited efficacy and rebound in plants
2009-10	6' gravity and pump drawdown - planning started for beach excavation and the storm water rain gardens
2010-11	6.5' gravity and pump drawdown - continued incremental efficacy and no harm detected
2011-12	7' gravity and pump drawdown - more efficacy and depth needed for the beach excavation project
2012-13	6' gravity and pump drawdown - backed off to see if efficacy could be maintained
2013-14	No drawdown - year off to see if lower frequency worked - phosphorous stable, some re-emergence in spots
2014-15	5.5' drawdown - heavy snowfall runoff - phosphorous increase and increased observance of invasives by residents in 5-8 foot zone but overall reduction in plant volume and at transect sites
2015-16	6.0' drawdown – very mild winter with an extended warm, dry and sunny growing season following
2016-17	5.75' drawdown – very mild winter, even warmer than previous year. Wet spring and summer; water level higher than past years
2017-18	6' drawdown; cold long winter with freezing temperatures into April. Period of hot humid weather leading to a pattern of extended wet weather. Water levels remained high throughout the summer.

The Committee, in consultation with ARC and the Town of Harvard Conservation Commission, decided not to perform a drawdown over the winter of 2013–2014. The purpose of the hiatus was to determine if taking a year off would result in discernible changes to the plant community and/or water quality. While the 2014 survey showed no substantial evidence in the observation points to suggest a drastic increase in plant growth, fanwort (*Cabomba caroliniana*) regained dominance in a portion of the drawdown zone. Observations outside the surveyed points by ARC and lake users made note of a general increase in plant growth. Watershield (*Brasenia schreberi*) was more prevalent in many areas outside the measurement points. Measurable changes in phosphorus concentrations were not observed in 2014.

Given the observed increase in plant abundance and concerns by residents that plant density will continue to increase in absence of a drawdown, the Conservation Commission permitted drawdowns in following years. This report summarizes data collected in 2018 and provides a comparison over several years, with an emphasis on the comparison within the last five years.

Influence of Weather

Ideal conditions for a winter water level drawdown to control rooted plants is a consistent cold winter (consecutive days below freezing) with little rain or snow. Snow insulates the ground preventing the hard freeze necessary to kill plant roots. Looking at the historic weather conditions recorded at Fitchburg Airport since 2009 during the Nov 15 through Mar 15 winter season, the winters of 2013-2014 and 2014-2015 had the lowest average minimum temperatures (18.0 and 17.2°F, respectively (Figure 1). The number of days when the low temperature fell below 30°F was 102 during 2013-2014, representing 84% of the days during the period of analysis; similarly, 92 days experienced low temperatures below 30°F in 2014-2015 representing 76% of the time (Figure 2). The next two winters were milder with average lows in mid 20 degrees with fewer days below 30°F. 2017-2018 was comparable to the cold years with 98 days with lows below 30°F (81% of the days) with an average low temperature of 19.5°F.

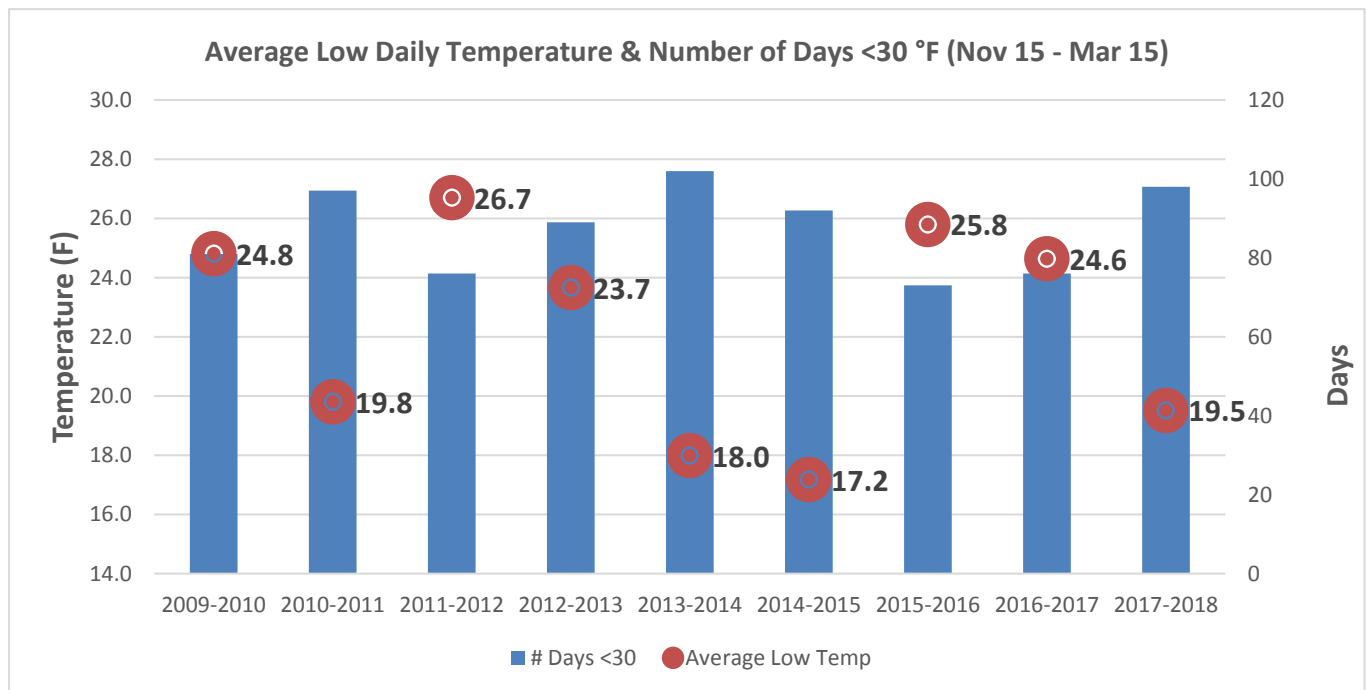


Figure 1. Average Low Air Temperature and Number of Days below 30°F during the Winter Season.

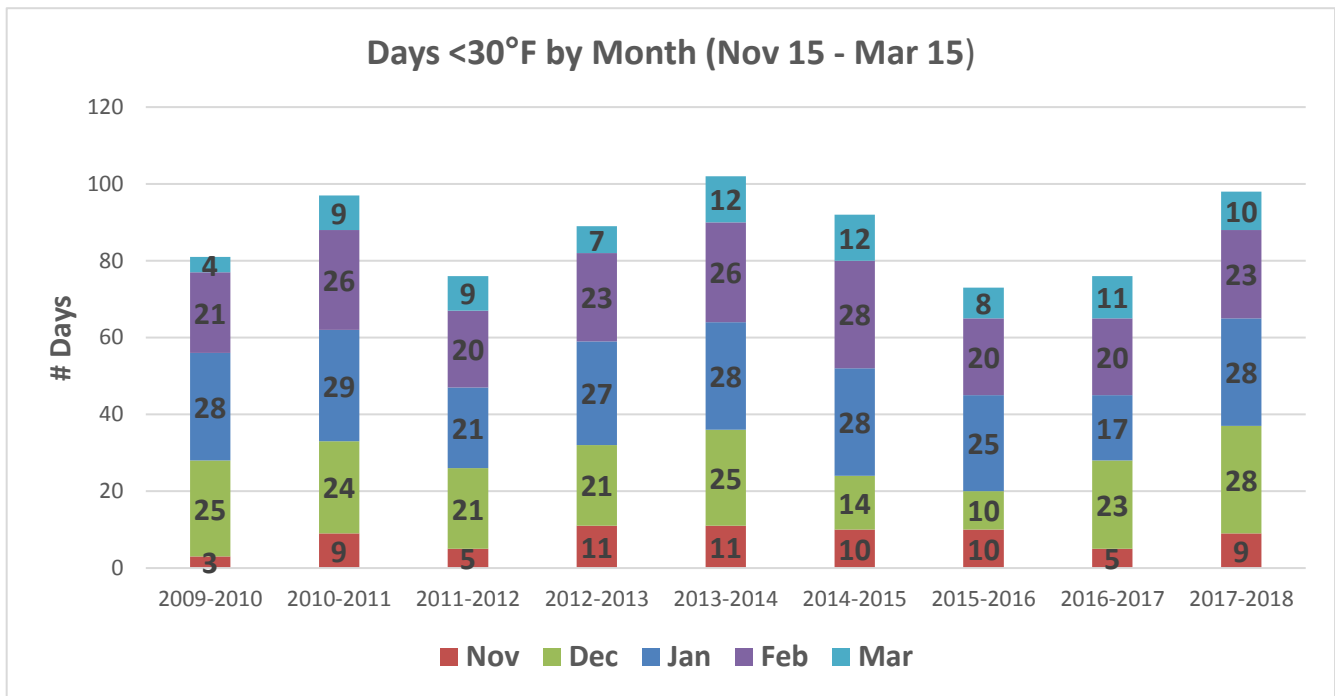


Figure 2. Number of Days with Air Temperatures below 30°F during the Winter Season.

In-Lake Sampling

In-lake sampling was conducted on May 24, June 20, and July 19, 2018. Supplemental sampling was conducted on August 2, 2018. ARC used the same sampling methods as prior surveys for data collection consistency (see prior reports for methodology). In-situ water depth profile measurements of temperature, dissolved oxygen (DO), and specific conductivity were recorded at two locations: shallow basin BHP-1 in the south basin and the deep hole in the north basin BHP-2 (pH data were not collected this year due to meter fouling). These data are presented in Table 2. Figure 3 provides a graphical representation of temperature and DO data for the deep station (BHP-2) in comparison with prior years.

The temperature and DO profiles suggest that the lake began to thermally stratify in May, was weakly stratified by June with a stronger stratification in July. Concentrations of DO in Bare Hill Pond are typically low (<5 milligrams-per-liter [mg/L]; the threshold desirable for fish) in waters greater than eighteen feet in May, but in May 2018 oxygen concentrations were below 5 mg/L at eight feet, much shallower than in prior years. Oxygen levels in June were also below normal. This suggests that there was substantial oxygen consumption in bottom waters with little to no mixing during May and June 2018. These early low oxygen conditions increase the potential for sediment phosphorus release. In July, oxygen profiles were within the typical range but there was a slight increase at 18-19 feet. This oxygen bump (Table 2, Figure 3) could be from algae in the hypolimnion (bottom water layer). We re-measured oxygen concentrations in this depth range a second time to ensure it wasn't a sampling error. A similar slight increase in oxygen was observed in the second profile capture.

Table 2. Bare Hill Pond Water Depth Profiles 2018.

BHP-1											
May 24, 2018				June 20, 2018				July 19, 2018			
Depth (ft)	Temp (C)	DO (mg/L)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	Spec. Cond (us/cm)
0	23.73	7.88	232	0	25.30	8.44	262	0	28.88	7.86	262
1	23.71	7.89	232	1	24.95	8.51	261	1	28.85	7.88	262
2	23.45	7.97	232	2	25.01	8.51	262	2	28.67	7.9	262
3	23.37	7.97	232	3	24.77	8.49	262	3	27.7	8.84	257
4	23.16	8.02	232	4	24.48	8.49	262	4	27.31	9.83	256
BHP-2											
Depth (ft)	Temp (C)	DO (mg/L)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	Spec. Cond (us/cm)
0	22.43	7.92	233	0	25.03	8.32	264	0	28.39	7.84	265
2	22.37	7.93	233	2	25.06	8.35	264	2	28.35	7.82	265
4	21.84	7.88	233	4	25.04	8.32	264	4	27.75	7.85	265
5	21.45	7.89	232	5	25.03	8.33	263	5	27.34	7.88	264
6	20.53	7.79	232	6	25.00	8.31	263	6	27.07	7.75	263
7	19.97	7.63	233	7				7	26.85	7.66	264
8	19.43	7.23	232	8	24.59	8.24	263	8	26.68	7.58	263
9	18.91	6.95	232	9	23.12	7.69	263	9	26.6	7.61	263
10	17.81	6.04	232	10	21.78	7.14	262	10	26.48	7.57	264
11	17.21	5.32	231	11	20.48	5.32	260	11	26.03	5.65	264
12	16.45	4.89	230	12	19.00	3.01	260	12	24.29	1.26	265
13	13.37	2.83	229	13	17.53	1.59	257	13	23.08	0.61	263
14	12.38	2.89	228	14	16.45	0.93	256	14	20.73	0.45	262
16	10.63	2.97	228	16	12.25	0.44	254	16	16.41	0.41	259
18	9.58	2.93	229	18	10.64	0.00	260	18	12.98	1.31	255
20	8.95	1.53	233	20	9.83	0.00	267	20	11.29	0.00	264
22	8.68	0.55	236	22	9.39	0.00	290	22	9.85	0.00	273

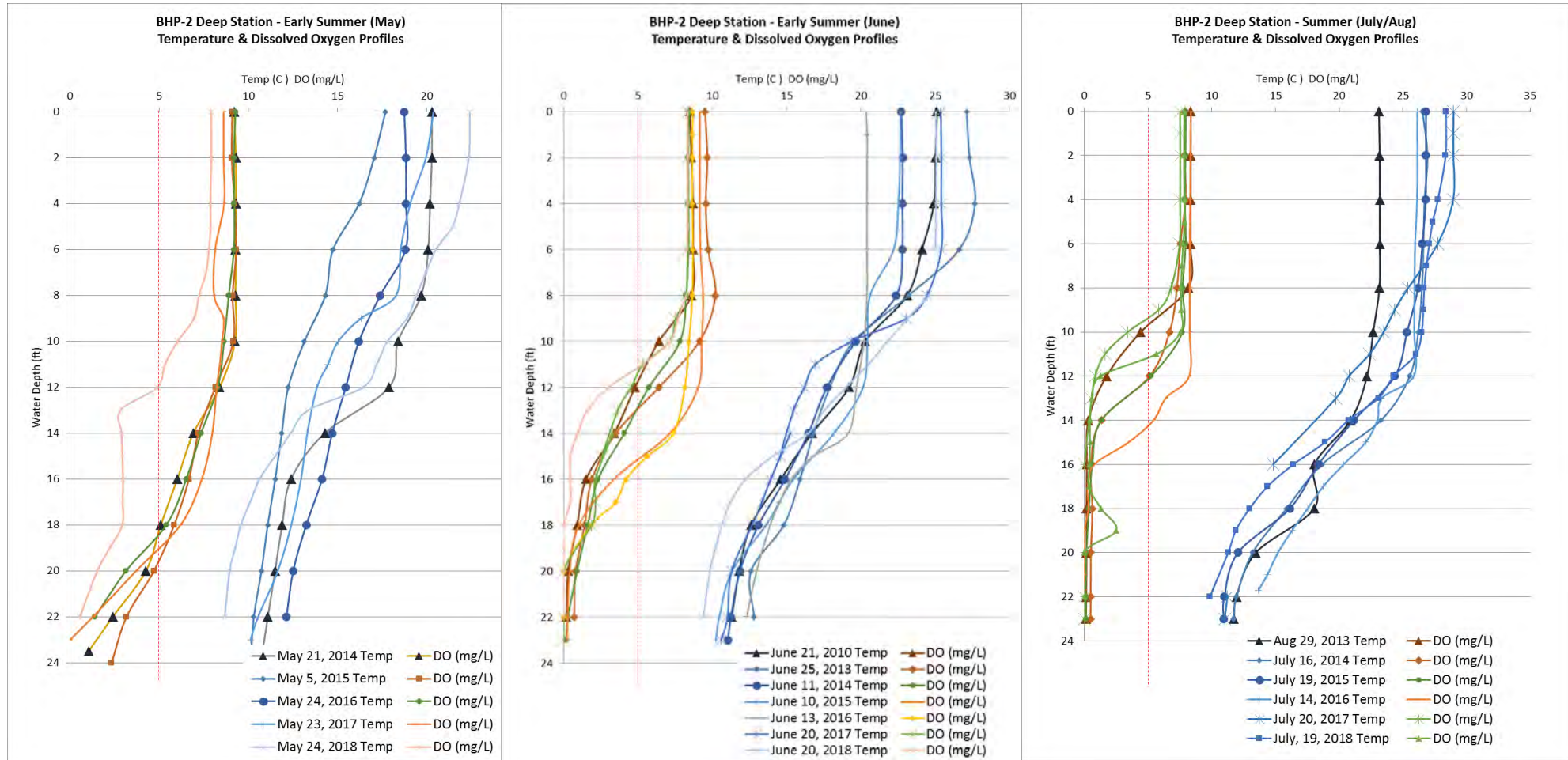


Figure 3. Temperature & Dissolved Oxygen Profiles at BHP-2 for 2010-2018

Figure 3 shows the decline of oxygen and comparison to prior years. Oxygen depletion starts above the thermocline. Much of the cold water fish refuge area is undesirable given the lack of oxygen. These data suggest that the lake has a substantial oxygen demand and is susceptible to iron-bound phosphorus release from the sediment. Phosphorus can accumulate in the hypolimnion under these conditions. Once the hypolimnetic phosphorus is mixed in the photic zone, algal blooms are more likely to occur.

Specific conductivity in 2018 was similar to prior years and above the desirable range (<200 us/cm); values above 200 us/cm can be indicative of elevated dissolved pollutants and high productivity. Values in June and July were slightly higher than in May. It is common to have increased conductivity near the water-sediment interface where suspended solids increase conductivity. Surface and mid depth values were comparable between the two stations.

Table 3 provides the results of phosphorus, total suspended solids and water clarity (measured by Secchi disk transparency) during 2018. 2018 phosphorus concentration comparison with prior years is illustrated graphically in Figure 4. Total phosphorus (TP) concentrations were above the Massachusetts Department of Environmental Protection (MassDEP) target concentration of 0.030 mg/L¹ in May, June and July. TP concentrations above this level increase the probability of algal blooms in Bare Hill Pond. TP concentrations in July were well above this threshold and were the highest recorded since 2015. When we sampled the hypolimnion in July, we noted a slight greenish color to the water. This, coupled with the high phosphorus concentrations raised a concern about algae productivity in the hypolimnion which would result in a bloom if mixed into the photic zone.

To better understand the color observation and uncharacteristic high TP concentration, we collected a water quality sample, plus a quality control duplicate on August 2, as well as a surface and hypolimnetic grab sample for algal analysis. Phosphorus concentrations were below the 0.030 mg/L threshold in August (using average of sample & duplicate), but the algal analysis showed a fair amount of Planktothrix. Planktothrix is a potential toxin-producing cyanobacterium (also known as blue-green algae). This bacterium is typically found in the hypolimnion near the thermocline. Its presence could explain the decrease in phosphorus in August (due to consumption) and the slight increase in oxygen observed in the temperature dissolved oxygen profile. It does have buoyancy control but will typically remain in deeper waters until late summer/fall. Planktothrix was not present in the epilimnetic (surface) sample. The epilimnetic sample contained several species of green algae. Overall algal density was not excessive (Appendix A).

Secchi disk transparency in 2018 ranged from 8.0 to 11.5 feet. Clarity was lowest in May, improved in June, declined in July and rebounded in August. All values were above the MassDEP State Water Quality Standard for swimming (4 feet; Figure 5).

¹ Bare Hill Pond Bare Hill Pond, Harvard, MA. TMDL Report MA81007-1999-001 July, 1999 Massachusetts Department of Environmental Protection https://www.harvard.ma.us/sites/harvardma/files/uploads/bhp_tmdl.pdf

Table 3. 2018 Bare Hill Pond In-lake Water Quality Data.

Station	Date	Time	TP (mg/L)	DP (mg/L)	TSS (mg/L)	Secchi (ft)	
2S	5/24/2018	18:00	0.049	0.015	<5	8	
2B	5/24/2018	18:05	0.043	0.011	<5		
1S	5/24/2018	18:35	0.059	0.043	<5	4.5	bottom
2S	6/20/2018	18:25	0.031	0.027	<5	11.5	
2B	6/20/2018	18:30	0.070	0.037	6		
1S	6/20/2018	18:55	0.039	0.032	<5	4.5	bottom
2S	7/19/2018	17:45	0.105	0.024	<5	9.5	
2B	7/19/2018	18:00	0.026	<0.020	13		
1S	7/19/2018	18:15	0.086	0.076	6	4.5	bottom
2S	8/2/2018	17:45	0.015	<0.010	5	10.5	
2SD	8/2/2018	17:45	0.033	<0.010			
2B	8/2/2018	17:55	0.023	<0.010	5		
1S	8/2/2018	18:05	0.029	<0.010	6	4.5	bottom

TSS = Total Suspended Solids

"Bottom" indicates the Secchi disk reached the pond bottom

SD – Surface quality control duplicate

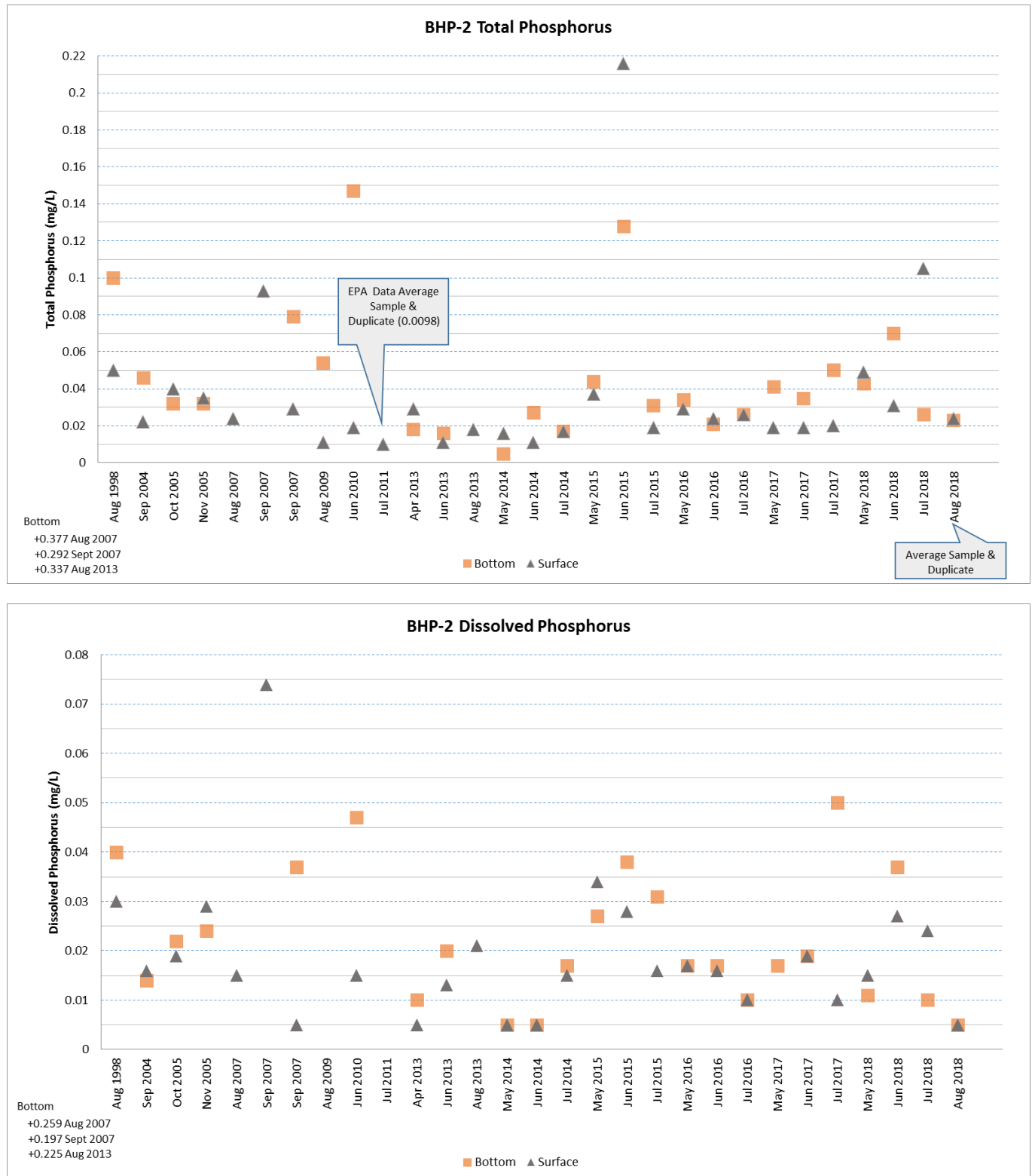


Figure 4. BHP-2 Total and Dissolved Phosphorus Concentrations.

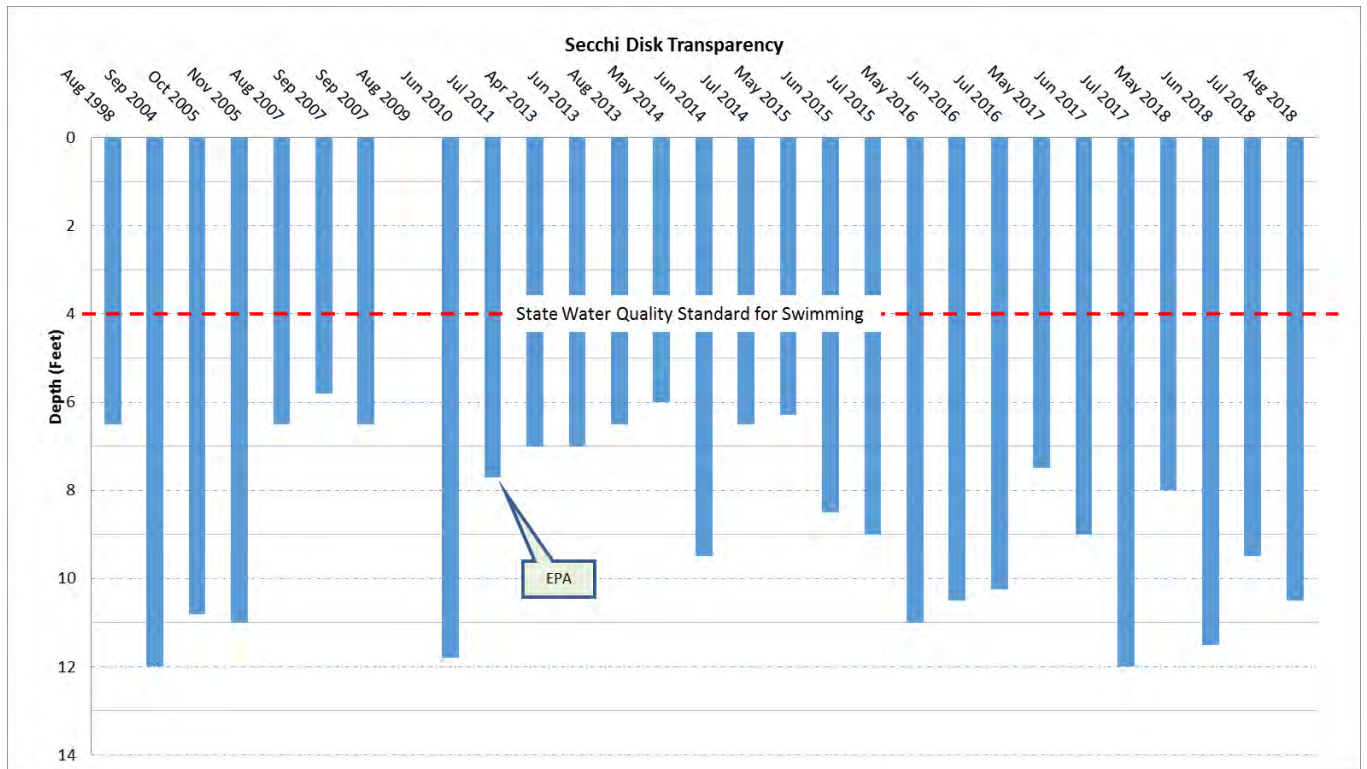


Figure 5. Bare Hill Pond (BHP-2) Secchi Disk Transparency.

In-lake Plant Survey

ARC conducted a plant survey on August 18, 2018. We used the same methods employed during the previous surveys conducted in 1998 through 2017. ARC mapped pond aquatic vegetation along the five transects (A through E) established in 1998. We also repeated the eight points added in 2016 (F through I). Each transect was divided into a series of observation points and were located using Global Positioning System (GPS). A total of 60 points were assessed during the survey.

The plant survey focused on macroscopic fully submerged (e.g., milfoil), floating-leaved (e.g., pond lily), and/or free floating plants (e.g., duckweed). At each transect point, we recorded the percent cover of all plants, the percent biovolume (as measured by the amount of the water column filled with plants) using a semi-quantitative (0-5) ranking system. A rank of 0 represented 0% cover/biovolume. A rank of 1 corresponded to 1 - 25% cover/biovolume; 2 = 26 - 50%; 3 = 51 - 75%; 4 = 76 - 99; and 5 = 100%. Species observed in each transect were identified and assigned a percent of composition of all species present. Water depth was also recorded at each transect point. These data are presented in Table 4 and Figures 6 and 7.

Table 5 provides a comparison between the last four surveys. The “IN” column in Table 5 represents the sample locations that were susceptible to the prior year’s drawdown (“in” the drawdown zone). One would expect to see changes in this column with variation of drawdown depth, provided the weather is ideal (exposed shoreline is subjected to freezing temperatures for a prolonged period without the insulating effect of snow cover). The “OUT” column represents data at sample locations where water depths are greater than the drawdown depth (“out” of the drawdown zone). No change related to the drawdown is expected in these cells. Ranks shaded green represent a change of two or more categories lower than the previous year and represent a desired outcome. Numbers shaded red indicate a two category change higher (an increase in plant cover or biovolume over the previous year). 2013 data do not have shaded values as 2013 was the starting point for this comparison. The prior year’s drawdown depth is shown in parentheses next to the year. The Committee did not conduct a drawdown in 2014 and therefore this value is zero.

Generally, a shift by two or more ranks (e.g. change from rank 1 to 3) is required before statistical significance is reportable. Data for 2018 were expected to be similar to 2017, with a possible slight reduction in plant growth given the colder temperatures and increased number of days with temperatures below 30°F. However, water temperatures in May were warmer than prior years and could have encouraged plant growth early. The survey data show very similar cover and biovolume conditions to 2017, with only one point showing a two point rank change; plant cover at A-4 decreased from a 4 to a 2 in 2018. This is likely attributable to a loss of watershield (*Brasenia schreberi*) and reduction of coontail (*Ceratophyllum demersum*), both native plants. These data suggest that there is no appreciable difference between the years in plant cover and density.

The general appearance of the pond showed similar plant growth conditions to 2017, with perhaps less watershield and more tapegrass (*Vallisneria americana*) based on anecdotal accounts. The watershield reduction was captured in the frequency of encounter data (also cover rank change and abundance at point A-4) and could represent a changed condition, although the percent difference is small (12 vs 14 points in 2018 vs 2017 respectively). The frequency of occurrence data did not capture an increase of tapegrass; tapegrass was observed at 18 points in 2018 vs 19 points in 2017. The greatest change, based on data collected at the sample points, was a decrease in variable milfoil (*Myriophyllum heterophyllum*). Milfoil was not encountered at nine of

the previous points, representing a 15% decrease in frequency at the 60 sample points. Two other changes representing a >5% change were an increase in waterlily (7 points representing 12% change) and decrease in filamentous algae encounters (5 points representing 8% frequency). Macro algae were again abundant in 2018 (observed at 43% of the points). Fanwort was the next most frequently encountered plant (42% of the points) and dominates the plant assemblage 56% of the time it is present. Select plant species frequency data are shown in Figure 8.

Table 4. 2018 Macrophyte Survey Data

				Species Composition (relative % biovolume)																											
Point	Water Depth (ft)	Cover	Bio-volume	Bs	Cc	Cd	Ec	FG	Iso	Macro	Mh	Mhum	Nf	Nm	No	Nv	Pa	Pc	Poly	Prob	Pspir	Pot	Sg	Spar	Usp	Va					
A-1	3.8	2	2					20							50				30												
A-2	3.7	2	2	60		20					5														15						
A-3	4.0	4	2	30									10	20		10									30						
A-4	4.0	4	2			5							20	5	60										10						
A-5	4.5	4	2	10	5					5			60												20						
A-6	4.9	5	1							80					20																
D-1	5.1	5	1	10	20		10		10						10					20	10				10						
D-2	5.0	5	1						10	30					30					20	10										
D-3	4.9	5	1	40						40	5														15						
D-4	4.7	5	1	60	10						10														20						
D-5	5.0	5	1	20						45						5							5		25						
D-6	5.0	5	1	30						50														10	10						
D-7	4.5	5	1	10						50																40					
D-8	5.3	5	1						10	90																					
D-9	6.1	5	1						10	80														10							
D-10	6.2	5	1						5	60												5	10	10		20					
D-11	6.1	5	1							90										10											
D-12	7.1	5	1		5						5									90											
D-13	8.4	5	1								10									90											
E-1	5.8	5	2		30					10										10						50					
E-2	5.8	5	1		5					50				5												40					
E-3	6.5	5	1							70				25							5										
E-4	7.4	5	3		70						30																				
E-5	8.6	5	3		45						10									45											
E-6	9.3	5	2		45						10									45											
E-7	9.8	5	2		20						40									40											
E-8	10.5	5	2		70						20									10											
F-1	5.9	1	1		30															30				40							
F-2	8.0	5	2		20						20									60											
G-1	4.8	3	2	5	95																										
G-2	8.3	4	3	10	80												10														
H-1	4.3	1	1					80																20							
H-2	8.6	4	2		50						30						20														
I-1	5.7	1	1												80					20											
I-2	9.7	4	1		60						40																				
Frequency of Occurrence				12	25	4	1	6	5	26	18	1	6	9	13	5	2	0	1	19	5	1	1	6	9	18					
Frequency Dominant				4	14	1	0	3	0	19	2	0	2	1	5	0	0	0	0	11	0	0	0	1	1	8					
% Time Dominated when Preser				33%	56%	25%	0%	50%	0%	73%	11%	0%	33%	11%	38%	0%	0%	0%	0%	58%	0%	0%	0%	0%	11%	44%					

Shaded cell indicates dominant species at observation point

Table 4. Key to Species Abbreviations

Genus species (common name)

Bs – <i>Brasenia schreberi</i> (watershield)	Nv – <i>Nuphar variegata</i> (yellow-flower waterlily)
Cc – <i>Cabomba caroliniana</i> (fanwort)	Pa - <i>Potamogeton amplifolius</i>
Cd - <i>Ceratophyllum demersum</i> (coontail)	Pc - <i>Potamogeton crispus</i>
Ec - <i>Elodea canadensis</i> (waterweed)	Prob – <i>Potamogeton robbinsii</i> (Robbins pondweed)
FG – filamentous algal mats	Pspir - <i>Potamogeton spirillus</i> (spiral pondweed)
Mh – <i>Myriophyllum heterophyllum</i> (variable-leaf milfoil)	Pot – <i>Potamogeton</i> spp. (pondweeds)
Ni.f – <i>Nitella flexilis</i> (stonewort)	Usp – <i>Utricularia</i> spp. (bladderwort)
Nm - <i>Najas minor</i> (brittle waternymph)	Va - <i>Vallisneria americana</i> (tapegrass)
No – <i>Nymphaea odorata</i> (white-flower waterlily)	

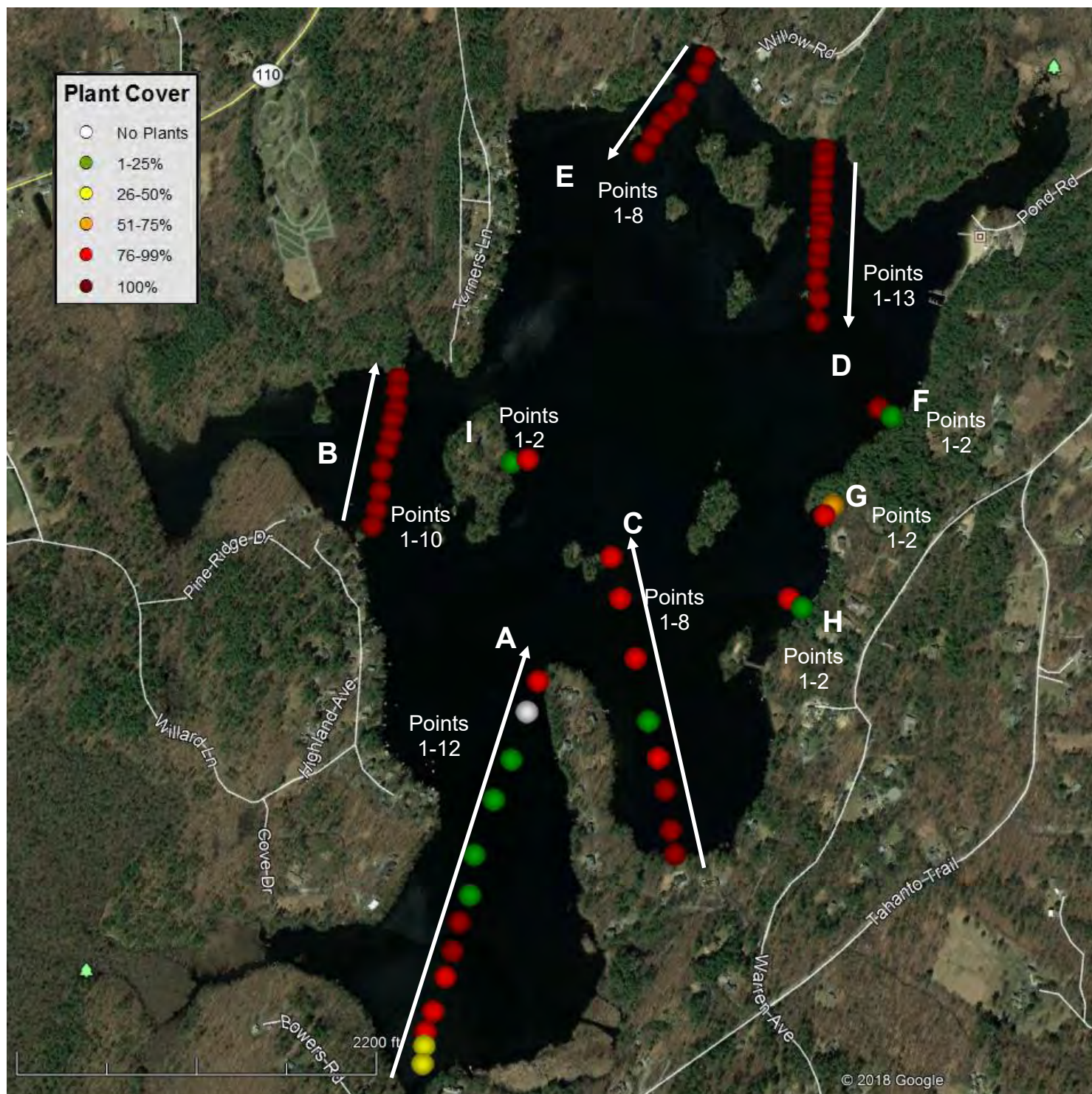


Figure 6. Bare Hill Pond 2018 Plant Cover

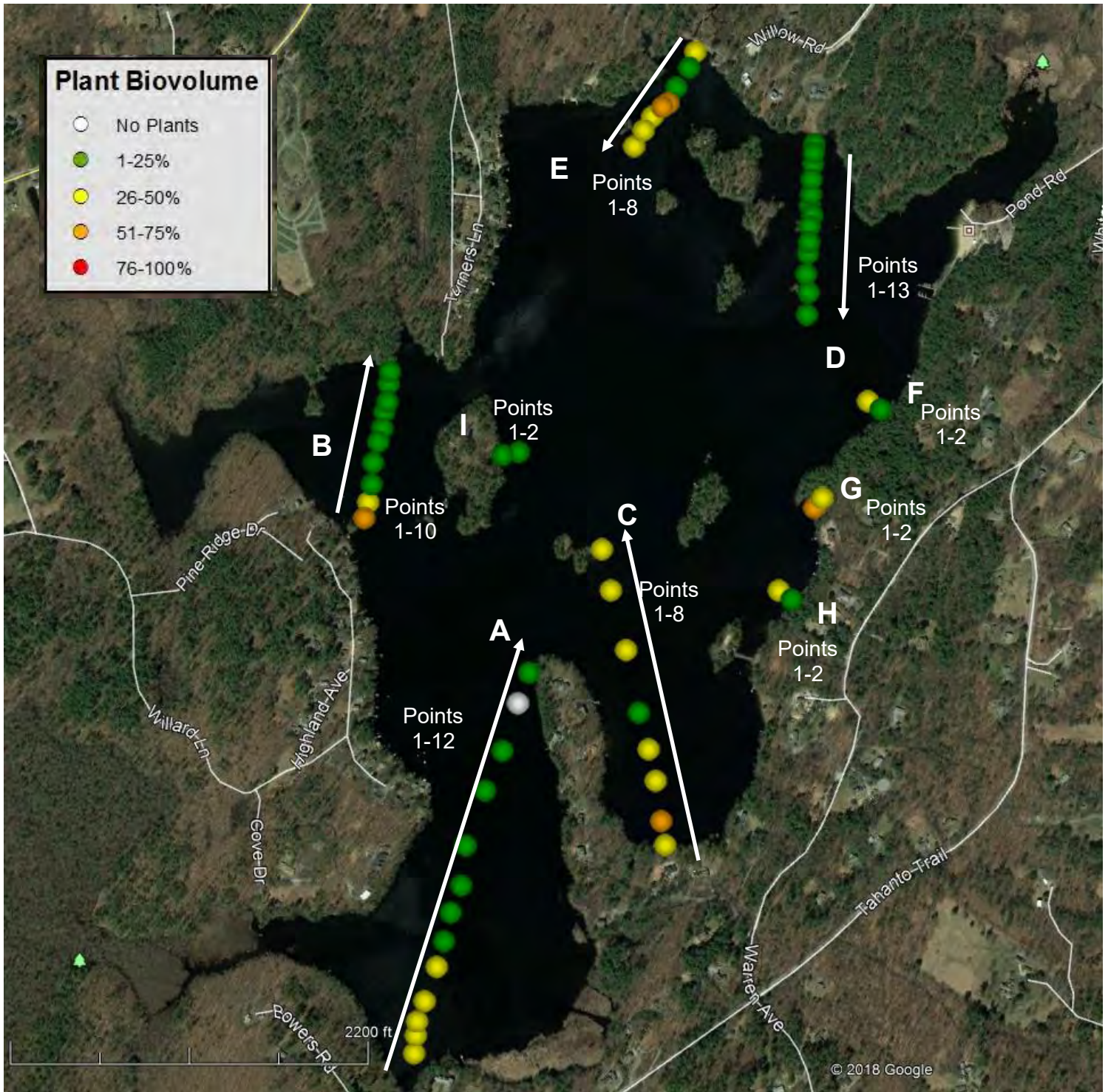


Figure 7. Bare Hill Pond 2018 Plant Biovolume

Table 5. Bare Hill Pond Cover and Biovolume Relative Change

		COVER												BIOVOLUME											
		2013 (6')		2014 (0')		2015 (5.5')		2016 (6')		2017 (5.75')		2018 (6')		2013 (6')		2014 (0')		2015 (5.5')		2016 (6')		2017 (5.75')		2018 (6')	
		Point	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN
Transect A	1	5		5		1		4		5		2		2		2		1		3		2		2	
	2	5		5		2		4		5		2		2		2		2		2		2		2	
	3	5		5		3		5		4		4		2		1		2		3		2		2	
	4	5		5		2		5		4		4		2		3		4		2		2		2	
	5	3		5		2		5		5		4		1		1		2		1		1		2	
	6	3		5		1		4		5		5		1		1		1		1		1		1	
	7	5		2		4		4		4		5		2		1		1		1		1		1	
	8	2		1			1	3		2			1	1		1		1		1				1	
	9		1		0		2		2		2		2			1			1			1		1	
	10		0		1		2		2		3		1			1			1			1		1	
	11		0		0		1		2		1			1					1			1		1	
	12		0		0		0		1		1			0					1			1		0	
	13		0		1		1		5			4							1			1		1	
Transect B	1	2		3		5		5		5		5		1		1		2		3		3		3	
	2	5		5		5		5		5		5		1		2		1		2		2		2	
	3	5		5		5		4		5		5		1		2		1		1		1		1	
	4	5		5		5		2		5		5		1		1		1		1		1		1	
	5	5		5		5		5		5		5		2		2		1		1		1		1	
	6	5		5		5		5		5		5		1		1		1		1		1		1	
	7	5		5		5		5		5		5		1		1		1		1		1		1	
	8	5		5		3		5		5		5		1		1		1		1		1		1	
	9	5		4		5		4		5		5		2		1		1		1		1		1	
	10	5		5		5		5		5		5		2		1		2		2		2		1	
Transect C	1	2				5		5			5		5		1		2		2			3		2	
	2		5		5		5		5		5		5		2		2		2		3		2		3
	3		4		5		5		5		5		5		1		2		3		3		2		2
	4		2		1		4		4		4		4		1		1		2		2		2		2
	5		0		0				1		1		1		0		0		1		1		1		1
	6		1		1		3		4		4		4		1		1		2		2		2		2
	7		1		1		1		4			3		1		1		1		2		2		2	
	8		2		3		4		4		4		4		2		1		3		2		2		2
Transect D	1	4		5		5		4		5		5		1		2		2		2		1		1	
	2	5		5		5		4		5		5		1		2		2		2		2		1	
	3	5		5		5		2		5		5		1		2		1		1		1		1	
	4	5		5		5		5		5		5		1		2		1		1		1		1	
	5	5		5		5		4		5		5		1		1		1		1		1		1	
	6	5		5		5		5		5		5		1		1		1		1		1		1	
	7	4		5		5		5		5		5		1		1		1		1		1		1	
	8	5		3		5		4		5		5		1		1		1		1		1		1	
	9	5		5			5	5		5			5	1		1		1		1		1			1
	10	5			3		5	5			5			1		1		1				1		1	
	11	5			3		5	4		5			5	1		1		1			1		1		1
	12		5		5		5	2			5			1		2		2		2		2		1	
	13		4		4		4		5			5			2		1		2		2		2		1
Transect E	1	5		3		5		5		4		5		1		2		1		1		1		2	
	2	2		5		5		5			5		5	1		1		1			1		1		1
	3		1		5		5	5			5		5	1		2		2			1			1	
	4		4		3		5		5		5		5	1		1		2		2		2		3	
	5		4		4		5		5		5		5	2		1		3		2		2		3	
	6		4		4		5		5		5		5	2		1		3		3		3		2	
	7		4		4		4		5		5		5	2		2		2		2		2		2	
	8		4		4		4		5		5		5	2		2		2		2		3		2	

Increase by 2 or more ranks from prior year

Decrease by 2 or more ranks from prior year

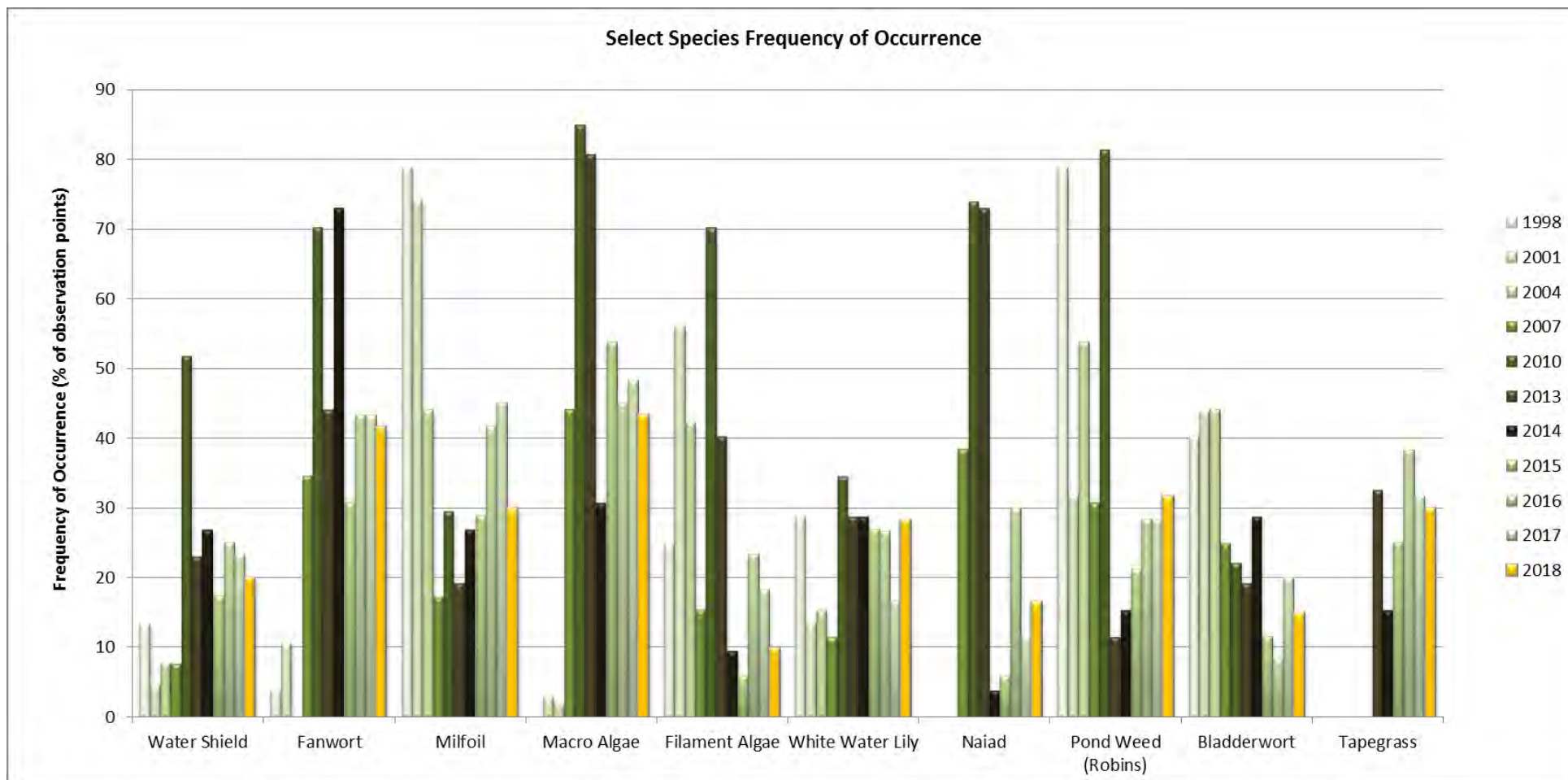


Figure 8. Bare Hill Pond Select Plant Species Frequency of Occurrence

Shoreline Iris Survey

In 2013 ARC marked the lateral extent of yellow iris (*Iris pseudacorus*) along Bare Hill Pond's shoreline. At the time, residents and the Conservation Commission were concerned that the drawdown was encouraging the growth and expansion of this non-native invasive species. Yellow iris is an invasive species that can outcompete native shoreline plants, reducing diversity and habitat value.

ARC repeated the presence/absence mapping of iris in June 2017 and 2018. The latitude and longitude of iris clusters were recorded using a handheld GPS unit when observed. This method was different than the mapping employed in 2013. In 2017 points were recorded to represent one to a cluster of plants, in 2013 iris presence was much greater and therefore the lateral distribution of the plant was reported. Not all plants were in bloom at the time of these surveys and could be confused with similar species. We observed the native iris species (blue flag iris) at multiple locations around of the pond in 2017 & 2018. It is possible that some of these points may represent native iris. A map of the two surveys (2017 & 2018) is provided in Figure 9. Abundance of iris in 2018 was similar to 2017 (found in 15 vs 18 locations in 2018 and 2017, respectively), although the distribution was somewhat different. This plant is can grow in up to 8 inches of water and can tolerate fluctuating water levels. Most of the iris observed were in waters less than 1' deep or on the bank.

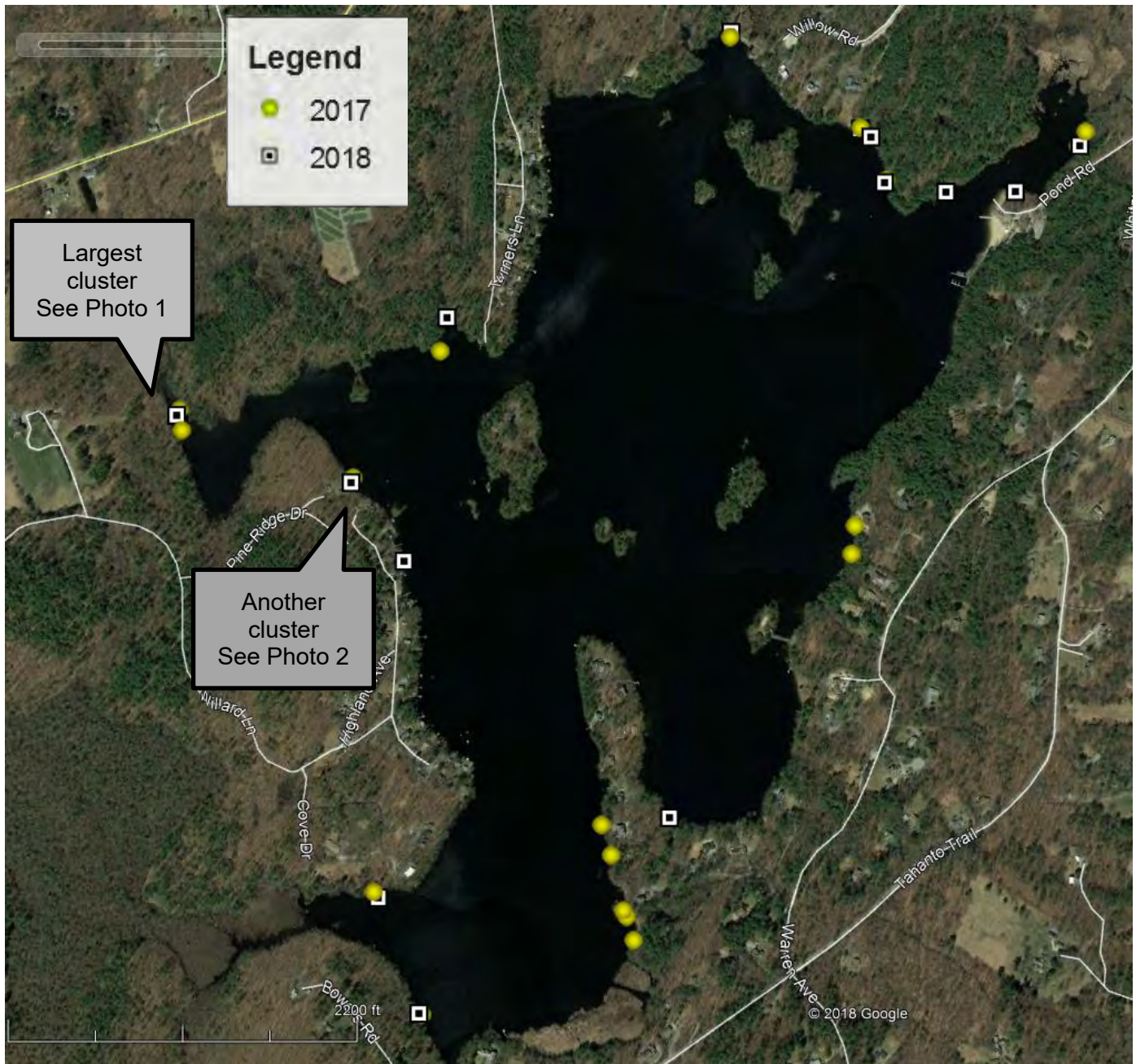


Figure 9. Iris Surveys 2017 and 2018



Photo 1 – yellow iris at northern tip of western cove



Photo 2 – Large cluster in front of home on west shore.

Wetland Plot Monitoring

Four pre-established wetland plots were surveyed on August 23, 2018. Two plots are located downstream of the dam and two plots are located north of the town beach. A wetland scientist recorded plants using the same methodology used by ENSR in 2001 (MassDEP Handbook: *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act*). Plot coordinate locations were established in 2016 and relocated using GPS for the 2018 survey. Plot locations were further verified by locating previous markings of pink surveyor's ribbons.

The 2018 survey observations indicated only slight changes in plant coverage and abundance and a few new species were documented within plots 1, 2, and 4, see attached plot forms in Appendix B. Generally, the plant coverage and abundance within each plot remained similar to that of previous years. Cat-tail (*Typha latifolia*) continued to be the dominate species in all four plots, a slight increase in estimated cover was observed in plot 1 while a slight decrease in abundance was observed in plot 2. Common reed (*Phragmites australis*) was again observed within the wetland north of the dam though abundance and density appeared to be somewhat reduced compared to the 2017 observations, see photos 9 and 10 of the attached photo log. The abundance and overall cover of purple loosestrife (*Lythrum salicaria*) appeared slightly reduced in Plot 2. Based on the 2018 survey plant communities within the two wetlands have remained consistent with only slight changes of abundance and estimated cover. The most significant change remains the introduction of common reed to the wetland located north of the dam first observed in 2017. Plot descriptions and photo log are attached.

Conclusion

Water quality data were not within the ideal range in 2018, but water clarity and plant abundance and composition remain largely unchanged. The region had significant rainfall following a warm start to the summer. This resulted in early warm water temperatures and depletion of oxygen. Elevated phosphorus concentrations were a concern as well as the greenish color of the hypolimnetic sample. This coupled with the observable increase in oxygen at the bottom were indicative of substantial growth of algae below the thermocline. The extra sampling event conducted in August and algal analysis proved to be worth the extra level of effort. We noted that phosphorus concentrations had decreased, likely used up by the algae that were present. This reduction in phosphorus availability may have kept the algal density at bay and therefore the risk of a summer bloom was reduced. The species of cyanobacteria (blue-green algae) present, however, is a known toxin producer and in excessive density could result in hazardous conditions leading to contact recreation warnings and beach closure.

There were no major differences observed in the plant community compared to 2017. A minor reduction of watershield and milfoil was recorded and was backed up by anecdotal accounts from lake users. Generally, plant dominance and frequency of encounters were similar. As in past years, thick patches of milfoil and fanwort were observed when traveling to and from the sample locations. Native pondweeds were also very abundant at and between observation locations.

Overall conditions within the wetland plots remain the same. The hand pulling of common reed in the wetland north of the dam last fall did retard the growth this year, but by mid-summer it was back. This plant has the capability to significantly reduce the diversity of this wetland. But for now, plant diversity in the sampling plots remain high. The water level was up in both the wetland and lake this year.

I do not have any significant concerns with repeated winter water level drawdowns. The initial shift in plant diversity away from fanwort and milfoil dominance has been maintained within the drawdown zone, with some variability year to year (although these plants remain problematic in deeper areas). The plant community is diverse within the drawdown zone. The Committee reports a strong wildlife community based on frog calls and frequent wildlife observations. Phosphorus values were elevated this year, likely attributable to internal recycling of nutrients from the sediment under the low oxygen conditions and the uncharacteristically wet July-August. As with past years, dissolved oxygen remains low and accumulation of phosphorus within the hypolimnion remains a threat, but this is not related to winter water level drawdown. There is no evidence of significant ecological harm associated with the drawdown based on data collected as part of this investigation and the work performed by the Committee.

Appendix A – Algae Results

Sample Identification	Bare Hill Pond surface						
Sample Date	8/2/2018						
Additional Client or Location Information	WC Gendron, ARC, pond in Harvard, MA						
Algal Contents	* = common	** = abundant	*** = dominant				
Blue-Greens							
Coccoid forms							
N-fixing filamentous forms	Dolichospermum						
Other filamentous forms							
Greens							
Flagellated forms	Chlamydomonas						
Chlorococcaleans	Oocystis	Chlorella	Schroederia	Sphaerocystis	Elakatothrix		
Filamentous forms							
Desmids							
Diatoms							
Centric planktonic forms							
Pennate forms without raphe							
Pennate forms with raphe							
Goldens							
Flagellated forms							
Filamentous forms							
Other forms							
Other Flagellates							
Dinoflagellates							
Cryptomonads							
Euglenoids	Trachelomonas						
Other Algae							
Non-Algal Contents							
Zooplankton							
Organic detritus							
Inorganic material							
Other particulates							
Indications from Sample							
Nutrient enrichment	Possible but not strongly evident						
N:P ratio	Moderate						
pH	Low to moderate						
Organic contamination	Possible but not strongly evident						
Taste and odor	Unlikely						
Toxicity	One possible toxin producer present but not abundant						
Other implications	No dominant taxon, algae not excessive						

Sample Identification	Bare Hill Pond deep						
Sample Date	8/2/2018						
Additional Client or Location Information	WC Gendron, ARC, pond in Harvard, MA						
Algal Contents	* = common	** = abundant	*** = dominant				
Blue-Greens							
Coccoid forms							
N-fixing filamentous forms							
Other filamentous forms	Planktothrix*	Spirulina					
Greens							
Flagellated forms							
Chlorococcaleans	Scenedesmus	Ankistrodesmus					
Filamentous forms							
Desmids							
Diatoms							
Centric planktonic forms							
Pennate forms without raphe							
Pennate forms with raphe							
Goldens							
Flagellated forms							
Filamentous forms							
Other forms							
Other Flagellates							
Dinoflagellates							
Cryptomonads	Cryptomonas						
Euglenoids	Trachelomonas*	Euglena	Phacus				
Other Algae							
Non-Algal Contents							
Zooplankton							
Organic detritus							
Inorganic material							
Other particulates							
Indications from Sample							
Nutrient enrichment	Probable						
N:P ratio	Moderate						
pH	Moderate						
Organic contamination	Possible but not strongly evident						
Taste and odor	Possible						
Toxicity	Possible						
Other implications	Algae are not excessive, but substantial amount of Trachelomonas indicates organic content and Planktothrix is a potential toxin producing cyanobacterium that grows near the thermocline and can eventually come to the surface.						

Appendix B – Wetland Plot Vegetation Sheets & Photo Log

2018 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. N/A
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Sunny, mid 80s°F
 Date: August 23, 2018
 Plot Size: 30-ft radius, Plot 1
 Observers: Julia Stearns
 Photographs: Yes (Log Photos 1 and 2)

General Description of the Vegetation Sample Station: Plot 1

Vegetation sample Plot 1 is located in the scrub-shrub wetland community approximately 100 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. Plot 1, established in 2013, was located using coordinates surveyed with a GPS in 2016. During the 2018 survey flooded conditions were observed and approximately 18 to 26 inches of water was recorded throughout the area. The seasonal stream channel observed in previous years was obscured by the high water though variations of water depths within the plot indicated the channel was still present. Old windfalls were also present within the plot. The overall plant coverage increased from 80 percent, observed in previous years, to approximately 85-90 percent. Plant diversity continues and only minor changes of estimated cover for some species were observed. The fringe flood plain forest, located to the east of the plot, has not changed in terms of species and cover estimates. A few new species were observed within the plot's herbaceous layer, see table below. Estimated cover of cat-tail (*Typha latifolia*) increased slightly while Speckled alder (*Alnus incana*) and Black chokeberry (*Aronia melanocarpa*) were not observed this year, most likely due to difficulty identifying the exact plot location during the 2017 survey since these species are present within the wetland. The sample plot was photographed during the survey, see Photos 1 and 2 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	26-50%
	White Pine (<i>Pinus strobes</i>)	1	6-15%
	White Oak (<i>Quercus alba</i>)	1	1-5%
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	1	16-25%
	Arrowwood (<i>Viburnum dentatum</i>)	2	6-15%
	Multiflora Rose (<i>Rosa multiflora</i>)	2	6-15%
	Swamp Rose (<i>Rosa palustris</i>)	1	1-5%
	Meadow Sweet (<i>Spiraea alba</i>)	1	1-5%
	Silky dogwood (<i>Cornus amomum</i>)	2	6-15%
	*Maleberry (<i>Lyonia ligustrina</i>)	1	1-5%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	4	26-50%
	Wool-grass (<i>Scirpus cyperinus</i>)	2	6-15%
	Purple loosestrife (<i>Lythrum salicaria</i>)	2	6-15%
	Royal fern (<i>Osmunda regalis</i>)	1	1-5%

	Species Name	Abundance	Estimated Cover
	False nettle (<i>Boehmeria cylindrica</i>)	2	6-15%
	Upright Sedge (<i>Carex stricta</i>)	3	6-15%
	Sensitive fern (<i>Onoclea sensibilis</i>)	1	1-5%
	Jewelweed (<i>Impatiens capensis</i>)	2	6-15%
	Pickeralweed (<i>Pontederia cordata</i>)	1	1-5%
	Water Parsnip (<i>Sium suave</i>)	2	1-5%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Marsh St. John's Wort (<i>Triadenum fraseri</i>)	1	1-5%
	Common duckweed (<i>Lemna minor</i>)	2	5-16%
	*Bedstraw (<i>Galium</i> sp.)	1	1-5%
	*Arrow Arum (<i>Peltandra virginica</i>)	1	1-5%
	*Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
	*Monkeyflower (<i>Mimulus ringens</i>)	1	1-5%
	*Marsh fern (<i>Thelypteris thelypteroides</i>)	1	1-5%
Vine	Wild Grape (<i>Vitis</i> sp.)	1	1-5%

*New species

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was covered with 18-26" of free standing water.

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
Location: Harvard, Massachusetts
Transect No. N/A
Community Type: Scrub-Shrub Wetland
Soil Type: Muck and sands and gravel

Weather: Sunny, low 80s°F
Date: August 13, 2017
Plot Size: 30-ft radius, Plot 1
Observers: Julia Stearns
Photographs: Yes (Log Photos 1 and 2)

General Description of the Vegetation Sample Station: Plot 1

Vegetation sample plot 1 is located in the scrub-shrub wetland community approximately 100 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. Plot 1, established in 2013, was marked in the field with pink surveyors ribbon and staked with an orange colored rebar. The rebar was not relocated this year and although the general location was identified a new shrub, silky dogwood (*Cornus amomum*), was observed at the fringes of the shrub layer of the plot and the abundance of sweet pepperbush (*Clethra alnifolia*) was slightly reduced, see table below. As described on the 2013 and 2016 data forms, a small seasonal stream enters the plot from the east and flows west, however the stream was not visible during the 2017 survey due to flooded conditions. In addition, two windfalls, identified in 2013 and 2016, were also not prominent in 2017 due to the flooded conditions. A fringe flood plain forest is located to the east of the plot small portions of which fall into the tree layer of the sample plot. The estimated plant cover in Plot 1 is over 80 percent. The sample plot was photographed during the survey, see Photos 1 and 2 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	26-50%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
	White Oak (<i>Quercus alba</i>)	1	1-5%
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	3	16-25%
	Arrowwood (<i>Viburnum dentatum</i>)	2	6-15%
	Black Chokeberry (<i>Aronia melanocarpa</i>)	3	26-50%
	Multiflora Rose (<i>Rosa multiflora</i>)	2	6-15%
	Swamp Rose (<i>Rosa palustris</i>)	1	1-5%
	Speckled Alder (<i>Alnus incana</i>)	1	1-5%
	Meadow Sweet (<i>Spiraea alba</i>)	1	1-5%
	Silky dogwood (<i>Cornus amomum</i>)	1	1-5%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	4	16-25%
	Wool-grass (<i>Scirpus cyperinus</i>)	2	6-15%
	Purple loosestrife (<i>Lythrum salicaria</i>)	2	6-15%
	Royal fern (<i>Osmunda regalis</i>)	2	6-15%
	False nettle (<i>Boehmeria cylindrica</i>)	2	6-15%
	Upright Sedge (<i>Carex stricta</i>)	3	6-15%

	Sensitive fern (<i>Onoclea sensibilis</i>)	1	1-5%
	Jewelweed (<i>Impatiens capensis</i>)	1	1-5%
	Pickeralweed (<i>Pontederia cordata</i>)	1	1-5%
	Water Parsnip (<i>Sium suave</i>)	2	1-5%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Marsh St. John's Wort (<i>Triadenum fraseri</i>)	1	1-5%
	Common duckweed (<i>Lemna minor</i>)	4	76-95%
Vine	Wild Grape (<i>Vitis</i> sp.)	3	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was covered with 18-26" of free standing water.

2016 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Overcast, 82°F
 Date: August 18, 2016
 Plot Size: 30-ft radius, Plot 1
 Observers: Julia Stearns
 Photographs: Yes (Log Photos 1 and 2)

General Description of the Vegetation Sample Station: Plot 1

Vegetation sample Plot 1 is located in the scrub-shrub wetland community approximately 100 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. The established Plot 1 from 2013 was marked in the field with pink surveyors ribbon and staked with an orange colored rebar and relocated during this survey. As described on the 2013 data form the plot includes a fringe of flood plain forest along its eastern border and a small seasonal stream enters from the east and flows west. The windfall, identified in 2013, is still noticeable along the western portion of the plot. An additional windfall was observed just east of center in the plot. The estimated plant cover in Plot 1 is over 90 percent. The sample plot was photographed during the survey, see Photos 1 and 2 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	26-50%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
	White Oak (<i>Quercus alba</i>)	1	1-5%
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	4	26-50%
	Arrowwood (<i>Viburnum dentatum</i>)	2	6-15%
	Black Chokeberry (<i>Aronia melanocarpa</i>)	3	26-50%
	Multiflora Rose (<i>Rosa multiflora</i>)	2	6-15%
	Swamp Rose (<i>Rosa palustris</i>)	1	1-5%
	Speckled Alder (<i>Alnus incana</i>)	1	1-5%
	Meadow Sweet (<i>Spiraea alba</i>)	1	1-5%
Herbaceous:	Cattail (<i>Typha latifolia</i>)	4	16-25%
	Wool-grass (<i>Scirpus cyperinus</i>)	2	6-15%
	Purple loosestrife (<i>Lythrum salicaria</i>)	2	6-15%
	Royal fern (<i>Osmunda regalis</i>)	2	6-15%
	False nettle (<i>Boehmeria cylindrica</i>)	2	6-15%
	Upright Sedge (<i>Carex stricta</i>)	3	6-15%
	Sensitive fern (<i>Onoclea sensibilis</i>)	1	1-5%
	Jewelweed (<i>Impatiens capensis</i>)	1	1-5%
	Pickeralweed (<i>Pontederia cordata</i>)	1	1-5%

	Water Parsnip (<i>Sium suave</i>)	2	1-5%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
Vine	Wild Grape (<i>Vitis</i> sp.)	3	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was saturated with free standing water recorded within 1 inch of the soil surface and areas of 6-12" of standing water.

2013 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
Location: Harvard, Massachusetts
Transect No. One
Community Type: Scrub-Shrub Wetland
Soil Type: Muck and sands and gravel

Weather: Overcast, 75°F
Date: August 29, 2013
Plot Size: 30-ft radius, Plot 1
Observers: Julia Stearns
Photographs: Yes (Log Photos 1 and 2)

General Description of the Vegetation Sample Station: Plot 1

Vegetation sample Plot 1 is located in the scrub-shrub wetland community approximately 100 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. Efforts were made to relocate the original plot established in 2001, however the plot and wooden stake were not found during the 2013 visit. It is believed the general area of the original Plot 1 was located based on identifiable descriptions and data collected during the 2001 survey. The general location of Plot 1 was located based on identifiable descriptions and data collected during the 2001 survey. The newly established Plot 1 was marked in the field with pink surveyors ribbon and staked with an orange colored rebar. A fringe of flood plain forest occurs along the eastern edge of the sample plot. A small seasonal stream enters the plot from the east and flows west and a windfall is situated along the western portion of the plot. The estimated plant cover in Plot 1 is over 80 percent. The sample plot was photographed during the survey, see Photos 1 and 2 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	26-50%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
	White Oak (<i>Quercus alba</i>)	1	1-5%
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	4	26-50%
	Arrowwood (<i>Viburnum dentatum</i>)	2	6-15%
	Black Chokeberry (<i>Aronia melanocarpa</i>)	3	26-50%
	Multiflora Rose (<i>Rosa multiflora</i>)	2	6-15%
	Swamp Rose (<i>Rosa palustris</i>)	1	1-5%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	5	16-25%
	Wool-grass (<i>Scirpus cyperinus</i>)	3	16-25%
	Purple loosestrife (<i>Lythrum salicaria</i>)	3	6-15%
	Royal fern (<i>Osmunda regalis</i>)	2	6-15%
	False nettle (<i>Boehmeria cylindrica</i>)	2	6-15%
	Slender-leaved goldenrod (<i>Solidago tenuifolia</i>)	2	6-15%
	Sensitive fern (<i>Onoclea sensibilis</i>)	3	6-15%
	Jewelweed (<i>Impatiens capensis</i>)	3	6-15%
	Upright Sedge (<i>Carex stricta</i>)	3	6-15%
	Arrow Arrum (<i>Peltandra virginica</i>)	1	1-5%
	Water Parsnip (<i>Sium suave</i>)	2	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was saturated with free standing water recorded within 1 inch of the soil surface.

2001 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Cloudy, Lt. Wind, 55-60 ° F
 Date: November 14, 2001
 Plot Size: 30-ft. radius, Plot 1
 Observers: Don Schall
 Photographs: Yes (Figure 1)

General Description of the Vegetation Sample Station:

Vegetation sample plot is located in the scrub-shrub wetland community approximately 100 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. A narrow fringe of flood plain forest occurs along the edge of the sample plot. The estimated plant cover in the sample plot is over 60 percent. The sample plot was photographed during the survey performed on November 14, 2001.

Species List with Estimated Cover and Abundance Rankings for Dominants
 Cover Estimates: 1 - 5%; 6-15%; 16-25%; 25-50%; 51-75%; 76-95%; and 96-100%
 Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	5	16-25%
	White Pine (<i>Pinus strobus</i>)	4	6-15%
	Black Gum (<i>Nyssa sylvatica</i>)	3	6-15%
Saplings:	Red Maple (<i>Acer rubrum</i>)	4	Included in Tree Cover
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	5	51-75%
	HB Blueberry (<i>Vaccinium corymbosum</i>)	4	6-15%
	Arrowwood (<i>Viburnum dentatum</i>)	4	6-15%
	Swamp Azalea (<i>Rhododendron viscosum</i>)	3	6-15%
	Black Chokeberry (<i>Aronia melanocarpa</i>)	3	1-5%
Vines:	Wild Grape (<i>Vitis</i> sp.)	3	1-5%
Herbaceous:			
	Wool-grass (<i>Scirpus cyperinus</i>)	4	6-15%
	Soft Rush (<i>Juncus effusus</i>)	4	6-15%
	Cinnamon Fern (<i>Osmunda cinnamomea</i>)	4	6-15%

Sample plot is subject to spring floods and backwater flooding due to a beaver dam at the culvert under Route 110. Dam material was recently removed from the culvert. Standing deadwood is present in the scrub-shrub wetland due to past flooding. A windfall red maple occurs in the sample plot. Soil consists of approximately 3 inches of black muck over sands and gravel. Soil was saturated with free water recorded 8 inches below the soil surface. Signs of past flooding were evident at the base of standing trees and exposed boulders.

2018 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. N/A
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands

Weather: Sunny, mid 80s°F
 Date: August 23, 2018
 Plot Size: 30-ft radius, Plot 2
 Observers: Julia Stearns
 Photographs: Yes (Photos 3 and 4)

General Description of the Vegetation Sample Station: Plot 2

Vegetation sample plot 2 is located in the scrub-shrub wetland community located approximately 500 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. The plot was located using GPS coordinates collected during the 2016 survey. The plot includes a fringe of flood plain forest along its eastern border that has not changed in species or abundance. Similar to previous surveyed years the plant cover estimate remains over 90 percent. During the 2018 survey slight variations in vegetative species and abundance were observed and four additional species were documented, Beggar tick (*Bidens connate*), Smartweed (*Polygonum* sp.), Jewelweed (*Impatiens capensis*), and Arrow arum (*Peltandra virginica*). Reductions in abundance of Cat-tail (*Typha latifolia*), Purple loosestrife (*Lythrum salicaria*), and False nettle (*Boehmeria cylindrica*) were also observed while Royal fern (*Osmunda regalis*) increased in abundance and estimated cover. Sensitive fern (*Onoclea sensibilis*) was not observed during this survey. Species abundance and cover remained similar to that of the 2017 survey. The sample plot was photographed during the survey and photos are provided in the Photograph Log (photos 3 and 4).

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	16-25%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
	Black Oak (<i>Quercus velutina</i>)	1	1-5%
Shrubs:	Maleberry (<i>Lyonia ligustrina</i>)	3	16-25%
	Black Alder (<i>Ilex verticillata</i>)	2	1-5%
	Swamp Rose (<i>Rosa palustris</i>)	4	16-25%
	Meadowsweet (<i>Spiraea latifolia</i>)	2	6-15%
	Silky dogwoos (<i>Cornus amomum</i>)	2	6-15%
	Buttonbush (<i>Cephalanthus occidentalis</i>)	1	1-5%
	Glossy Buckthorn (<i>Frangula alnus</i>)	1	1-5%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	4	51-75%
	Upright Sedge (<i>Carex stricta</i>)	5	51-75%
	Purple loosestrife (<i>Lythrum salicaria</i>)	3	16-25%
	Wool-grass (<i>Scirpus cyperinus</i>)	4	16-25%
	Marsh Fern (<i>Thelypteris palustris</i>)	3	6-15%
	Sedge (<i>Carex</i> sp.)	3	6-15%

	Species Name	Abundance	Estimated Cover
	Pickeralweed (<i>Pontederia cordata</i>)	1	1-5%
	*Beggar Ticks (<i>Bidens connate</i>)	1	1-5%
	Marsh St. Johnswort (<i>Triadenum virginicum</i>)	1	1-5%
	Soft-stemmed Bulrush (<i>Scirpus validus</i>)	1	1-5%
	Water Hemlock (<i>Ciduta maculata</i>)	1	1-5%
	Royal Fern (<i>Osmunda regalis</i>)	4	26-50%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Water Willow (<i>Decodon verticillatus</i>)	1	1-5%
	Lurid Sedge (<i>Carex lurida</i>)	1	1-5%
	Bluejoint grass (<i>Calamagrostis</i>)	1	1-5%
	False Nettle (<i>Boehmeria cylindrical</i>)	1	1-5%
	Bedstraw (<i>Galium</i> sp.)	1	1-5%
	*Smartweed (<i>Polygonum</i> sp.)	1	1-5%
	*Jewelweed (<i>Impatiens capensis</i>)	1	1-5%
	*Arrow Arum (<i>Peltandra virginica</i>)	2	1-5%

*New species

Soil consists of approximately 8 inches of black muck over sand and gravel. Approximately 8-24" of standing water was observed amongst the vegetation.

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. N/A
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands

Weather: Sunny, low 80°F
 Date: August 13, 2017
 Plot Size: 30-ft radius, Plot 2
 Observers: Julia Stearns
 Photographs: Yes (Photos 3 and 4)

General Description of the Vegetation Sample Station: Plot 2

Vegetation sample plot 2 is located in the scrub-shrub wetland community approximately 500 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. The orange colored rebar installed during the 2013 survey was not relocated during the 2017 survey; however the location description was followed and the general area was believed to have been found. The wetland area and plot was flooded during the observations. As previously described, a fringe of flood plain forest occurs along the eastern edge of the sample plot. Similar to previous observation years estimated plant cover was over 90 percent. Three additional species were observed in the herbaceous layer and noted during the 2017 survey and one species, Royal Fern (*Osmunda regalis*), increased in abundance. In general observed species abundance was similar to the 2016 survey. The sample plot was photographed during the survey and photos are provided in the Photograph Log (photos 3 and 4).

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	16-25%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
	Black Oak (<i>Quercus velutina</i>)	1	1-5%
Shrubs:	Maleberry (<i>Lyonia ligustrina</i>)	3	16-25%
	Black Alder (<i>Ilex verticillata</i>)	2	1-5%
	Swamp Rose (<i>Rosa palustris</i>)	4	16-25%
	Meadowsweet (<i>Spiraea latifolia</i>)	2	6-15%
	Silky dogwoos (<i>Cornus amomum</i>)	2	6-15%
	Buttonbush (<i>Cephalanthus occidentalis</i>)	1	1-5%
	Glossy Buckthorn (<i>Frangula alnus</i>)	1	1-5%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	5	51-75%
	Upright Sedge (<i>Carex stricta</i>)	5	51-75%
	Purple loosestrife (<i>Lythrum salicaria</i>)	4	26-50%
	Wool-grass (<i>Scirpus cyperinus</i>)	4	16-25%
	Marsh Fern (<i>Thelypteris palustris</i>)	3	6-15%
	Sedge (<i>Carex</i> sp.)	3	6-15%
	Pickereelweed (<i>Pontederia cordata</i>)	2	1-5%
	Water Parsnip (<i>Sium suave</i>)	2	1-5%

	Marsh St. Johnswort (<i>Triadenum virginicum</i>)	1	1-5%
	Soft-stemmed Bulrush (<i>Scirpus validus</i>)	1	1-5%
	Water Hemlock (<i>Ciduta maculata</i>)	1	1-5%
	Royal Fern (<i>Osmunda regalis</i>)	3	6-15%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Water Willow (<i>Decodon verticillatus</i>)	1	1-5%
	Lurid Sedge (<i>Carex lurida</i>)	1	1-5%
	Water Purslane (<i>Ludwigia palustris</i>)	1	1-5%
	Bluejoint grass (<i>Calamagrostis</i>)	1	1-5%
	False Nettle (<i>Boehmeria cylindrical</i>)	3	6-15
	Bedstraw (<i>Galium</i> sp.)	1	1-5%
	Sensitive fern (<i>Onoclea sensibilis</i>)	1	1-5%

Soil consists of approximately 8 inches of black muck over sand and gravel. Approximately 12-24" of standing water was observed amongst the vegetation.

2016 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands

Weather: Overcast, 82°F
 Date: August 18, 2016
 Plot Size: 30-ft radius, Plot 2
 Observers: Julia Stearns
 Photographs: Yes (Photos 3 and 4)

General Description of the Vegetation Sample Station: Plot 2

Vegetation sample Plot 2 is located in the scrub-shrub wetland community approximately 500 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. The orange colored rebar installed during the 2013 survey was relocated during the 2016 survey. A fringe of flood plain forest occurs along the eastern edge of the sample plot. The 2016 estimated plant cover was over 90 percent as was observed in 2013. Although new species were identified and noted during the 2016 survey overall species abundance was very similar to 2013. The sample plot was photographed during the survey and photos are provided in the Photograph Log (photos 3 and 4).

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	16-25%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
	Black Oak (<i>Quercus velutina</i>)	1	1-5%
Shrubs:	Maleberry (<i>Lyonia ligustrina</i>)	3	16-25%
	Black Alder (<i>Ilex verticillata</i>)	2	1-5%
	Swamp Rose (<i>Rosa palustris</i>)	4	16-25%
	Meadowsweet (<i>Spiraea latifolia</i>)	2	6-15%
	Silky dogwoos (<i>Cornus amomum</i>)	2	6-15%
	Buttonbush (<i>Cephalanthus occidentalis</i>)	1	1-5%
	Glossy Buckthorn (<i>Frangula alnus</i>)	1	1-5%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	5	51-75%
	Upright Sedge (<i>Carex stricta</i>)	5	51-75%
	Purple loosestrife (<i>Lythrum salicaria</i>)	4	26-50%
	Wool-grass (<i>Scirpus cyperinus</i>)	4	16-25%
	Marsh Fern (<i>Thelypteris palustris</i>)	3	6-15%
	Sedge (<i>Carex</i> sp.)	3	6-15%
	Pickrelweed (<i>Pontederia cordata</i>)	2	1-5%
	Water Parsnip (<i>Sium suave</i>)	2	1-5%
	Marsh St. Johnswort (<i>Triadenum virginicum</i>)	1	1-5%
	Soft-stemmed Bulrush (<i>Scirpus validus</i>)	1	1-5%
	Water Hemlock (<i>Ciduta maculata</i>)	1	1-5%

	Royal Fern (<i>Osmunda regalis</i>)	1	1-5%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Water Willow (<i>Decodon verticillatus</i>)	1	1-5%
	Lurid Sedge (<i>Carex lurida</i>)	1	1-5%
	Water Purslane (<i>Ludwigia palustris</i>)	2	1-5%
	Bluejoint grass (<i>Calamagrostis</i>)	3	1-5%

Soil consists of approximately 8 inches of black muck over sand and gravel. Approximately 12-18" of standing water was observed amongst the vegetation.

2013 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands

Weather: Overcast, 75°F
 Date: August 29, 2013
 Plot Size: 30-ft radius, Plot 2
 Observers: Julia Stearns
 Photographs: Yes (Photos 3 and 4)

General Description of the Vegetation Sample Station: Plot 2

Vegetation sample Plot 2 is located in the scrub-shrub wetland community approximately 500 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. Efforts were made to relocate the original plot established in 2001, however the plot and wooden stake were not found during the 2013 visit. The general location of Plot 2 was located based on identifiable descriptions and data collected during the 2001 survey. Plot 2 was marked in the field with pink surveyors ribbon and staked with an orange colored rebar. A fringe of flood plain forest occurs along the eastern edge of the sample plot. The 2013 estimated plant cover was over 90 percent. The sample plot was photographed during the survey and photos are provided in the Photograph Log (photos 3 and 4).

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	3	16-25%
	White Pine (<i>Pinus strobes</i>)	2	6-15%
Shrubs:	Maleberry (<i>Lyonia ligustrina</i>)	3	16-25%
	Black Alder (<i>Ilex verticillata</i>)	2	1-5%
	Swamp Rose (<i>Rosa palustris</i>)	3	16-25%
	Meadowsweet (<i>Spiraea latifolia</i>)	3	16-25%
Herbaceous:	Cat-tail (<i>Typha latifolia</i>)	5	51-75%
	Upright Sedge (<i>Carex stricta</i>)	5	51-75%
	Wool-grass (<i>Scirpus cyperinus</i>)	5	26-50%
	Purple loosestrife (<i>Lythrum salicaria</i>)	4	26-50%
	Rice cutgrass (<i>Leersia oryzoides</i>)	3	6-15%
	Water Purslane (<i>Ludwigia palustris</i>)	2	1-5%
	Marsh Fern (<i>Thelypteris palustris</i>)	3	6-15%
	Sedge (<i>Carex</i> sp.)	3	6-15%
	Arrow Arrum (<i>Peltandra virginica</i>)	2	1-5%
	Water Parsnip (<i>Sium suave</i>)	2	1-5%

Soil consists of approximately 8 inches of black muck over sand and gravel. Soil was saturated to the soil surface and small areas of surface were observed amongst the vegetation.

2001 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Cloudy, Lt. Wind, 55-60 ° F
 Date: November 14, 2001
 Plot Size: 30-ft. radius, Plot 2
 Observers: Don Schall
 Photographs: Yes (Figure 2)

General Description of the Vegetation Sample Station:

Vegetation sample plot is located in the scrub-shrub wetland community approximately 500 ft. north of the dam at the northern end of the pond. Access to the sample plot is from the service road to the dam off Willow Road. A narrow fringe of flood plain forest occurs along the edge of the sample plot. The estimated plant cover in the sample plot is over 60 percent. The sample plot was photographed during the survey performed on November 14, 2001.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 - 5%; 6-15%; 16-25%; 25-50%; 51-75%; 76-95%; and 96-100%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	5	16-25%
	White Pine (<i>Pinus strobus</i>)	4	6-15%
Saplings:	Absent		
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	5	16-25%
	HB Blueberry (<i>Vaccinium corymbosum</i>)	4	16-25%
	Black Alder (<i>Ilex verticillata</i>)	4	6-15%
	Swamp rose (<i>Rosa palustris</i>)	3	1-5%
Vines:	Absent		
Herbaceous:		5	16-25%
	Wool-gGrass (<i>Scirpus cyperinus</i>)		
	Tussock Sedge (<i>Carex stricta</i>)	5	26-50%
	Sedge (<i>Carex</i> sp.)	3	6-15%
	Purple Loosestrife (<i>Lythrum salicaria</i>)	3	1-5%
	Canada Bluejoint Grass (<i>Calamagrostis canadensis</i>)	4	1-5%
	Burreed (<i>Sparganium</i> sp.)	4	6-15%
	Water Purslane (<i>Ludwigia palustris</i>)	3	1-5%

Sample plot is subject to spring floods and backwater flooding due to a beaver dam at the culvert under Route 110. Standing deadwood is present in the scrub-shrub wetland due to past flooding. Soil consists of approximately 8 inches of black muck over sands and gravel. Soil was saturated with free water recorded 2 inches below the soil surface.

2018 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond

Location: Harvard, Massachusetts

Transect No. N/A

Community Type: Scrub-Shrub Wetland

Soil Type: Muck and sands and gravel

Weather: Sunny, mid 80s°F

Date: August 23, 2018

Plot Size: 30-ft radius, Plot 3

Observers: Julia Stearns

Photographs: Yes (Log Photos 5 and 6)

General Description of the Vegetation Sample Station: Plot 3

Vegetation sample Plot 3 is located in the scrub-shrub wetland community approximately 1,000 ft. north of town beach parking lot. Access to the sample plot is from the bike trail along Pond Road and approximately 300 ft. to the northwest. This plot, established in 2016, was marked in the field with pink surveyors ribbon tied to a stand of Speckled Alder at the plot's eastern perimeter. The plot center was located approximately 30 feet west of this survey ribbon. The plot was also located approximately 100 ft. northwest of plot 4. A narrow fringe of scrub-shrub wetland occurs along the eastern border of the plot which was unchanged in terms of abundance and estimated cover. The estimated plant cover remained at over 85 percent and only a minor change to Wild grape (*Vitis* sp.) abundance was observed. The occurrence of Purple loosestrife (*Lythrum salicaria*) remained rare. The sample plot was photographed during the survey, see Photos 5 and 6 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16-25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees	Absent		
Shrubs:	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	6-15%
	Speckled Alder (<i>Alnus incana</i>)	1	6-15%
Herbaceous:	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	5	96-100%
	Upright Sedge (<i>Carex stricta</i>)	1	1-5%
	Smartweed (<i>Polygonum</i> sp.)	1	1-5%
	Arrow-leaved Tearthumb (<i>Polygonum sagittatum</i>)	1	1-5%
	Purple loosestrife (<i>Lythrum salicaria</i>)	1	1-5%
	Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
Vine	Wild Grape (<i>Vitis</i> sp.)	1	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Approximately 12-24" of free standing water was observed covering the plot.

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. N/A
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Overcast, low 80°F
 Date: August 13, 2017
 Plot Size: 30-ft radius, Plot 3
 Observers: Julia Stearns
 Photographs: Yes (Log Photos 5 and 6)

General Description of the Vegetation Sample Station: Plot 3

Vegetation sample plot 3 is located in the scrub-shrub wetland community approximately 1000 ft. north of town beach parking lot. Access to the sample plot is from the bike trail along Pond Road and approximately 300 ft. to the northwest. This plot, established in 2016, and was marked in the field with pink surveyors ribbon tied to a stand of Speckled Alder at the plot's eastern perimeter. The plot center was located approximately 30 feet west of this survey ribbon. The plot is also located approximately 100 ft. northwest of plot 4. A narrow fringe of scrub-shrub wetland occurs to the east. The estimated plant cover remained over 85 percent, similar to what was observed in 2016, with slight changes to abundance and cover of specific species. A decrease of upright sedge (**Carex stricta**), smartweed (*Polygonum* sp.), arrow-leaved tearthumb (*Polygonum sagittatum*), and wild grape (*Vitis* sp.) were observed in 2017. Purple loosestrife (*Lythrum salicaria*) abundance did not change but remained generally the same. The sample plot was photographed during the survey, see Photos 5 and 6 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16-25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees	Absent		
Shrubs:	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	6-15%
	Speckled Alder (<i>Alnus incana</i>)	1	6-15%
Herbaceous:	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	5	96-100%
	Upright Sedge (<i>Carex stricta</i>)	1	1-5%
	Smartweed (<i>Polygonum</i> sp.)	1	1-5%
	Arrow-leaved Tearthumb (<i>Polygonum sagittatum</i>)	1	1-5%
	Purple loosestrife (<i>Lythrum salicaria</i>)	1	1-5%
	Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
Vine	Wild Grape (<i>Vitis</i> sp.)	2	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Approximately 8-18" of free standing water was observed covering the plot.

2016 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Overcast, 82°F
 Date: August 18, 2016
 Plot Size: 30-ft radius, Plot 3
 Observers: Julia Stearns
 Photographs: Yes (Log Photos 5 and 6)

General Description of the Vegetation Sample Station: Plot 3

Vegetation sample Plot 3 is a new plot located in the scrub-shrub/emergent wetland community approximately 1000 ft. north of town beach parking lot. Access to the sample plot is from the bike trail along Pond Road and approximately 300 ft. to the northwest. This newly established Plot was marked in the field with pink surveyors ribbon tied to a stand of Speckled Alder at the plot's eastern perimeter; the plot center was located approximately 30 feet west of this survey ribbon. The Plot is also located approximately 100 ft. northwest of Plot 4. A narrow fringe of scrub-shrub wetland occurs to the east of the sample plot. The estimated plant cover in Plot 3 is over 85 percent. The sample plot was photographed during the survey, see Photos 5 and 6 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees	Absent		
Shrubs:	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	6-15%
	Speckled Alder (<i>Alnus incana</i>)	1	6-15%
Herbaceous:	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	5	96-100%%
	Upright Sedge (<i>Carex stricta</i>)	3	26-50%
	Smartweed (<i>Polygonum</i> sp.)	2	6-1-5%
	Arrow-leaved Tearthumb (<i>Polygonum sagittatum</i>)	2	6-15%
	Purple loosestrife (<i>Lythrum salicaria</i>)	1	1-5%
	Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
Vine	Wild Grape (<i>Vitis</i> sp.)	3	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was saturated to the soil surface, areas of deep pooled water.

2018 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
Location: Harvard, Massachusetts
Transect No. N/A
Community Type: Scrub-Shrub Wetland
Soil Type: Muck and sands and gravel

Weather: Sunny, mid 80s°F
Date: August 23, 2018
Plot Size: 30-ft radius, Plot 4
Observers: Julia Stearns
Photographs: Yes (Log Photos 7 and 8)

General Description of the Vegetation Sample Station: Plot 4

Vegetation sample plot 4 is located in the scrub-shrub/emergent wetland community approximately 900 ft. north of town beach parking lot. Access to the sample plot is from the bike trail along Pond Road and approximately 200 ft. to the northwest. Plot 4 is marked in the field with pink and blue surveyors ribbon tied to a Red maple (*Acer rubrum*) sapling located in the center of the plot. The plot includes a narrow fringe of scrub-shrub and forested wetland along its eastern border. The estimated plant cover in the plot was over 85 percent, similar to what has been observed during past surveys. Four new species were observed within the plot, Jewelweed (*Impatiens capensis*), Arrowleaf tearthumb (*Polygonum sagittatum*), Sensitive fern (*Onoclea sensibilis*), and Monkeyflower (*Mimulus ringens*). An increase of Wool-grass (*Scirpus cyperinus*) and Arrow arum (*Peltandra virginica*) was also observed while Meadow sweet (*Spiraea alba*) was absent. The sample plot was photographed during the survey, see Photos 7 and 8 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	2	16-25%
	White Pine (<i>Pinus strobes</i>)	1	1-5%
	Red Oak (<i>Quercus rubra</i>)	1	1-5%
	Black Oak (<i>Quercus velutina</i>)	1	1-5%
Sapling	Red maple (<i>Acer rubrum</i>)	1	1-5%
Shrubs:	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	16-25%
	Speckled Alder (<i>Alnus incana</i>)	3	16-25%
	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	16-25%
Herbaceous:	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	4	51-75%%
	Purple loosestrife (<i>Lythrum salicaria</i>)	4	51-75%
	Marsh St. Johnswort (<i>Triadenum virginicum</i>)	3	16-25%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Wool-grass (<i>Scirpus cyperinus</i>)	4	51.75%
	Arrow Arum (<i>Peltandra virginica</i>)	3	16-14%
	Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
	Upright Sedge (<i>Carex stricta</i>)	3	26-50%
	Smartweed (<i>Polygonum</i> sp.)	1	1-5%

	Species Name	Abundance	Estimated Cover
	Lurid sedge (<i>Carex lurida</i>)	1	1-5%
	*Jewelweed (<i>Impatiens capensis</i>)	1	1-5%
	*Arrowleaf Tearthumb (<i>Polygonum sagittatum</i>)	1	1-5%
	*Sensitive fern (<i>Onoclea sensibilis</i>)	1	1-5%
	*Monkeyflower (<i>Mimulus ringens</i>)	1	1-5%

*New species

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was saturated and 8-14" of free standing water was observed.

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
Location: Harvard, Massachusetts
Transect No. N/A
Community Type: Scrub-Shrub Wetland
Soil Type: Muck and sands and gravel

Weather: Sunny, low 80s°F
Date: August 13, 2017
Plot Size: 30-ft radius, Plot 4
Observers: Julia Stearns
Photographs: Yes (Log Photos 7 and 8)

General Description of the Vegetation Sample Station: Plot 4

Vegetation sample plot 4 is located in the scrub-shrub/emergent wetland community approximately 900 ft. north of town beach parking lot. Access to the plot is from the bike trail along Pond Road and approximately 200 ft. to the northwest. The 2016 reestablished plot 4 was marked in the field with pink and blue surveyors ribbon tied to a Red Maple sapling in the center of the plot and easily relocated in 2017. A narrow fringe of scrub-shrub and forested wetland occurs to the eastern fringe of the sample plot. The estimated plant cover in plot 4 was over 85 percent, similarly observed in 2016. A few changes in specie observations in 2017 included the addition of small patch of lurid sedge (*Carex lurida*) while water hemlock (*Ciduta maculate*) and three way sedge (*Dulichium arundinaceum*) were not observed. The sample plot was photographed during the survey, see Photos 7 and 8 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	2	16-25%
	White Pine (<i>Pinus strobes</i>)	1	1-5%
	Red Oak (<i>Quercus rubra</i>)	1	1-5%
	Black Oak (<i>Quercus velutina</i>)	1	1-5%
Sapling	Red Maple (<i>Acer rubrum</i>)	1	1-5%
Shrubs:	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	16-25%
	Speckled Alder (<i>Alnus incana</i>)	3	16-25%
	Meadow Sweet (<i>Spiraea alba</i>)	1	1-5%
	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	16-25%
Herbaceous:	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	4	51-75%%
	Purple loosestrife (<i>Lythrum salicaria</i>)	4	51-75%
	Marsh St. Johnswort (<i>Triadenum virginicum</i>)	3	16-25%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Wool-grass (<i>Scirpus cyperinus</i>)	1	1-5%
	Arrow Arrum (<i>Peltandra virginica</i>)	1	1-5%
	Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
	Upright Sedge (<i>Carex stricta</i>)	3	26-50%
	Smartweed (<i>Polygonum</i> sp.)	1	1-5%
	Lurid sedge (<i>Carex lurida</i>)	1	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was saturated and 6-12" of free standing water was observed.

2016 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. One
 Community Type: Scrub-Shrub Wetland
 Soil Type: Muck and sands and gravel

Weather: Overcast, 82°F
 Date: August 18, 2016
 Plot Size: 30-ft radius, Plot 4
 Observers: Julia Stearns
 Photographs: Yes (Log Photos 7 and 8)

General Description of the Vegetation Sample Station: Plot 4

Vegetation sample Plot 4 is located in the scrub-shrub/emergent wetland community approximately 900 ft. north of town beach parking lot. Access to the sample plot is from the bike trail along Pond Road and approximately 200 ft. to the northwest. Efforts were made to relocate the original plot established in 2001, however the plot and wooden stake were not found during the 2016 visit. It is believed the general area of the original Plot 4 was located based on identifiable descriptions and data collected during the 2001 survey. The newly established Plot 4 was marked in the field with pink and blue surveyors ribbon tied to a Red Maple sapling in the center of the plot. The trail to the plot was also marked with pink surveyors tape for future relocation and surveys. A narrow fringe of scrub-shrub and forested wetland occurs to the east of the sample plot. The estimated plant cover in Plot 4 is over 80 percent. The sample plot was photographed during the survey, see Photos 7 and 8 of the attached Photographic Log.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 – 5%; 6-15%; 16—25%; 26-50%; 51-75%; 76-95%

Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Red Maple (<i>Acer rubrum</i>)	2	16-25%
	White Pine (<i>Pinus strobes</i>)	1	1-5%
	Red Oak (<i>Quercus rubra</i>)	1	1-5%
	Black Oak (<i>Quercus velutina</i>)	1	1-5%
Sapling	Red Maple (<i>Acer rubrum</i>)	1	1-5%
Shrubs:	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	16-25%
	Speckled Alder (<i>Alnus incana</i>)	3	16-25%
	Meadow Sweet (<i>Spiraea alba</i>)	1	1-5%
	Buttonbush (<i>Cephalanthus occidentalis</i>)	2	16-25%
Herbaceous:	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	5	76-95%%
	Purple loosestrife (<i>Lythrum salicaria</i>)	4	51-75%
	Marsh St. Johnswort (<i>Triadenum virginicum</i>)	3	16-25%
	Water Hemlock (<i>Ciduta maculate</i>)	1	1-5%
	Bittersweet Nightshade (<i>Solanum dulcamara</i>)	1	1-5%
	Wool-grass (<i>Scirpus cyperinus</i>)	1	1-5%
	Arrow Arrum (<i>Peltandra virginica</i>)	1	1-5%

	Arrowhead (<i>Sagittaria</i> sp.)	1	1-5%
	Upright Sedge (<i>Carex stricta</i>)	3	26-50%
	Smartweed (<i>Polygonum</i> sp.)	1	1-5%
	Three-way Sedge (<i>Dulichium arundinaceum</i>)	1	1-5%

Soil consists of approximately 3-4 inches of black muck over sand and gravel. Soil was saturated to the soil surface with shallow areas of pooled water.

2001 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. Two
 Community Type: Emergent Wetland
 Soil Type: Muck over sands and gravel

Weather: Cloudy, Lt. Wind, 55-60 ° F
 Date: November 14, 2001
 Plot Size: 30-ft. radius, Plot 3
 Observers: Don Schall
 Photographs: Yes (Figure 3)

General Description of the Vegetation Sample Station:

Vegetation sample plot is located in emergent wetland community approximately 400 ft. north of the town beach parking lot. Access to the sample plot is from the bike trail along Pond Road. A narrow fringe of scrub-shrub wetland occurs along the upper edge of the pond at the sample plot. The estimated plant cover in the sample plot is over 75 percent. The sample plot was photographed during the survey performed on November 14, 2001.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 - 5%; 6-15%; 16-25%; 25-50%; 51-75%; 76-95%; and 96-100%
 Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Absent		
Saplings:	Absent		
Shrubs:	Sweet Pepperbush (<i>Clethra alnifolia</i>)	4	6-15%
	HB Blueberry (<i>Vaccinium corymbosum</i>)	4	6-15%
	Swamp Azalea (<i>Rhododendron viscosum</i>)	3	1-5%
	Gray Birch (<i>Betula populifolia</i>)	3	1-5%
Vines:	Absent		
Herbaceous:			
	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	5	76-95%
	Sedge (<i>Carex</i> sp.)	3	6-15%
	Purple Loosestrife (<i>Lythrum salicaria</i>)	3	1-5%
	Blueflag (<i>Iris versicolor</i>)	3	1-5%
	Water Purslane (<i>Ludwigia palustris</i>)	3	1-5%
	Royal Fern (<i>Osmunda regalis</i>)	3	1-5%

Sample plot is subject to extended periods of exposure due to water drawdown in the fall. Water level is managed to control nuisance aquatic vegetation in Bare Hill Pond. A narrow fringe of scrub-shrub wetland exists along the upper edge of the sample plot. Soil consists of over 16 inches of black muck over sands and gravel. Soil was saturated to the soil surface.

2001 Field Report: Vegetation Sampling Sheet

Site Name: Bare Hill Pond
 Location: Harvard, Massachusetts
 Transect No. Two
 Community Type: Emergent Wetland
 Soil Type: Muck over sands and gravel

Weather: Cloudy, Lt. Wind, 55-60 ° F
 Date: November 14, 2001
 Plot Size: 30-ft. radius, Plot 4
 Observers: Don Schall
 Photographs: Yes (Figure 4)

General Description of the Vegetation Sample Station:

Vegetation sample plot is located in emergent wetland community approximately 900 ft. north of the town beach parking lot. Access to the sample plot is from the bike trail along Pond Road. A narrow fringe of scrub-shrub wetland occurs to the east of the sample plot. The estimated plant cover in the sample plot is over 75 percent. The sample plot was photographed during the survey performed on November 14, 2001.

Species List with Estimated Cover and Abundance Rankings for Dominants

Cover Estimates: 1 - 5%; 6-15%; 16-25%; 25-50%; 51-75%; 76-95%; and 96-100%
 Frequency of Occurrence Scale: 5 = Abundant; 4 = Frequent; 3 = Occasional; 2 = Infrequent; and 1 = Rare

	Species Name	Abundance	Estimated Cover
Trees:	Absent		
Saplings:	Absent		
Shrubs:	Absent		
Vines:	Absent		
Herbaceous:			
	Cat-tail (<i>Typha latifolia</i> and <i>T. angustifolia</i>)	5	26-50%
	Canada Bluejoint Grass (<i>Calamagrostis canadensis</i>)	5	26-50%
	Purple Loosestrife (<i>Lythrum salicaria</i>)	5	16-25%
	Wool-grass (<i>Scirpus cyperinus</i>)	4	6-15%

Sample plot is subject to extended periods of exposure due to water drawdown in the fall. Water level is managed to control nuisance aquatic vegetation in Bare Hill Pond. A narrow fringe of scrub-shrub wetland exists just to the east of the sample plot. Soil consists of over 16 inches of black muck over sands and gravel. Soil was saturated to the soil surface.

PHOTOGRAPHIC LOG

Client Name: Town of Harvard		Site Location: Bare Hill Pond Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 1	Date: 8/23/2018		
Direction Photo View: East			
Description: Plot 1: located approximately 100 ft. north of the dam.			

Photo No. 2	Date: 8/23/2018		
Direction Photo View: North			
Description: Plot 1: close up view of plot.			

PHOTOGRAPHIC LOG

Client Name: Town of Harvard, MA		Site Location: Bare Hill Pond, Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 3	Date: 8/23/2018		
Direction Photo View: North			
Description: Plot 2: located 500 feet north of the dam and marked with pink survey ribbon visible in center of photograph.			

Photo No. 4	Date: 8/23/2018	
Direction Photo View: West		
Description: Plot 2: Fringe forest in background is not part of the sample plot.		

PHOTOGRAPHIC LOG

Client Name: Town of Harvard, MA		Site Location: Bare Hill Pond, Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 5	Date: 8/23/2018		
Direction Photo View: West			
Description: Plot 3: dominant cattail in plot.			

Photo No. 6	Date: 8/23/2018	
Direction Photo View: East		
Description: Plot 3: close-up view of plot.		

PHOTOGRAPHIC LOG

Client Name: Town of Harvard, MA		Site Location: Bare Hill Pond, Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 7	Date: 8/23/2018		
Direction Photo View: North			
Description: Plot 4: Purple loosestrife, wool-grass, and button bush apparent in photo.			

Photo No. 8	Date: 8/23/2018	
Direction Photo View: South		
Description: Plot 4: center of plot marked with blue and pink ribbon.		

PHOTOGRAPHIC LOG


Client Name: Town of Harvard		Site Location: Bare Hill Pond Willow Road, Harvard, MA		Project Bare Hill Pond
Photo No. 9	Date: 8/23/2018			
Direction Photo View: Northeast				
Description: View of wetland north of dam.				

Photo No. 10	Date: 8/23/2018			
Direction Photo View: Northwest				
Description: View of wetland north of dam.				

PHOTOGRAPHIC LOG

Client Name: Town of Harvard		Site Location: Bare Hill Pond Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 1	Date: 8/13/2017		
Direction Photo View: North			
Description: Plot 1: approximately 100 ft. north of the dam.			

Photo No. 2	Date: 8/13/2017		
Direction Photo View: West			
Description: Plot 1: close up view of plot.			

PHOTOGRAPHIC LOG

Client Name:

Town of Harvard, MA

Site Location:

Bare Hill Pond, Willow Road, Harvard, MA

Project

Bare Hill Pond

Photo No.
3

Date:
8/13/2017

Direction Photo View:
East

Description:

Plot 2: remarked with pink survey ribbon visible in center of photograph. Fringe forested wetland to the south and east of the plot.



Photo No.
4

Date:
8/13/2017

Direction Photo View:
West

Description:

Plot 2: close up view of plot.



PHOTOGRAPHIC LOG

Client Name: Town of Harvard, MA		Site Location: Bare Hill Pond, Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 5	Date: 8/13/2017		
Direction Photo View: West			
Description: Plot 3: dominant cattail in plot.			

Photo No. 6	Date: 8/13/2017	
Direction Photo View: East		
Description: Plot 3: east side of plot view of shrub layer.		

PHOTOGRAPHIC LOG

Client Name: Town of Harvard, MA		Site Location: Bare Hill Pond, Willow Road, Harvard, MA	Project Bare Hill Pond
Photo No. 7	Date: 8/13/2017		
Direction Photo View: North			
Description: Plot 4: marked with pink and orange survey ribbon.			

Photo No. 8	Date: 8/13/2017	
Direction Photo View:		
Description: Plot 4: close up of plot.		

