



Report For:

Town of Harvard
Bare Hill Pond Watershed Management Committee
Harvard Massachusetts

Bare Hill Pond In-Lake Water Quality and Plant Surveys - 2017



Prepared by:
Aquatic Restoration Consulting, LLC
18 Sunset Drive
Ashburnham, MA 01430

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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 2017. The intent of these surveys was to document 2017 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

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 2017 and provides a comparison to data over several years, with emphasis on the comparison within the last four 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 2011-2012 and 2012-2013 had the lowest average temperatures (17.2 and 18.0°F, respectively; Figure 1). The number of days below 30°F were 76 (2011-2012) and 89 (2012-2013). The winter of 2013-2014 had the highest number of days below 30°F (102 days, highest number in December; Figure 2), but the average temperature was also higher (23.7°F).

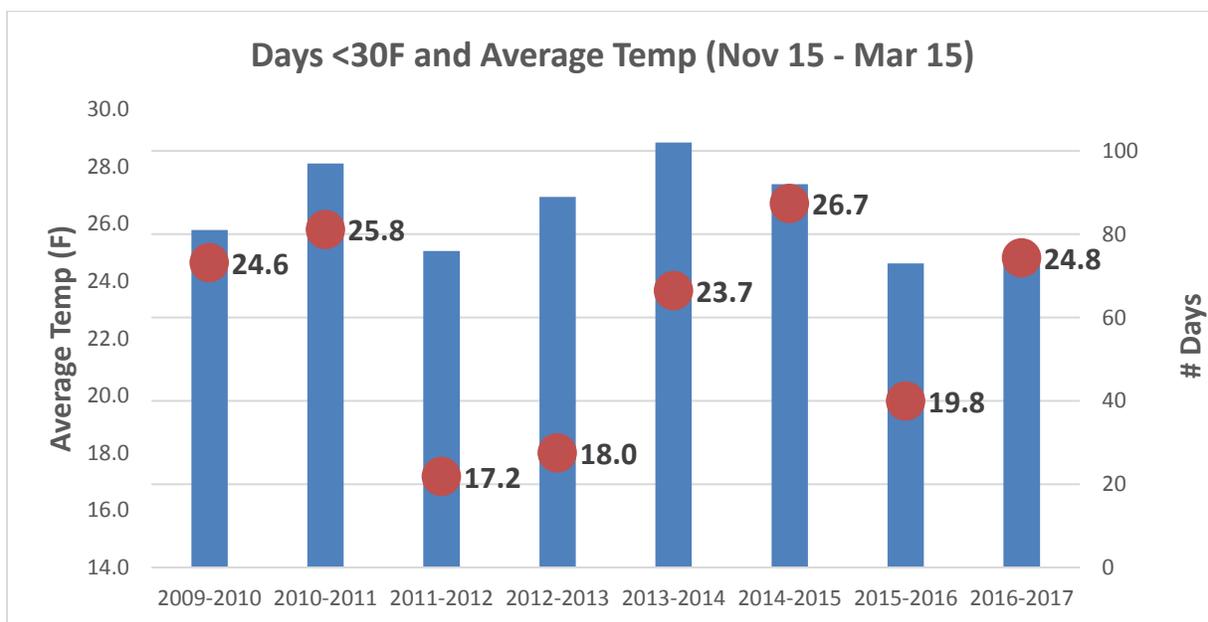


Figure 1. Air Temperature and Number of Days below 30°F during the Winter Season.

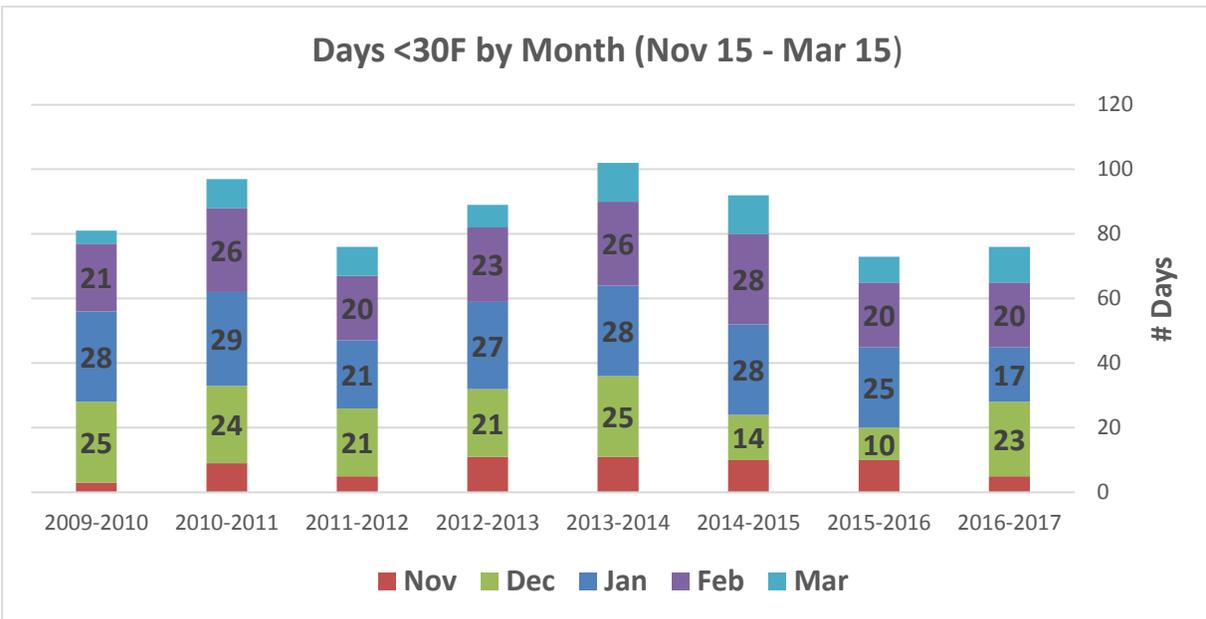


Figure 2. Number of Days with Air Temperatures below 30°F during the Winter Season.

In-Lake Sampling

Dry weather in-lake sampling was conducted on May 23, June 20, and July 20, 2017. 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), pH 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. 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 and was strongly stratified by June, with thermal stratification lessening in July. However, we experienced equipment problems so this data set is incomplete. Concentrations of DO in May were consistent throughout the water column until a depth of nineteen feet where concentrations dropped below the threshold desirable level for fish [5 - 6 milligrams-per-liter (mg/L)]. Concentrations in June were less than desirable below at 11 feet and even shallower in July, with concentrations <5 mg/L recorded at 10 feet. Oxygen depletion was second worse to only 2010 in June. DO concentrations were the worst in July since 2013 (there were no July data in 2010). 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.

Table 2. Bare Hill Pond Water Depth Profiles 2017.

BHP-1														
May 23, 2017					June 20, 2017					July 20, 2017				
Depth (ft)	Temp (C)	DO (mg/L)	pH (SU)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	pH (SU)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	pH (SU)	Spec. Cond (us/cm)
0	20.48	8.38	7.43	231	0	23.19	8.44	7.52	230	0				
1	20.48	8.38	7.38	236	1	24.74	8.30	7.52	231	1				
2	20.40	8.42	7.34	236	2	24.76	8.32	7.88	230	2				
3	20.31	8.48	7.32	237	3	24.75	8.33	8.16	231	3				
4	20.02	8.87	7.31	237	4	23.91	8.50	8.40	232	4				
5	19.71	9.02	7.29	236	5	23.86	8.42	8.38	232	5				
Missing data due to low battery														
BHP-2														
Depth (ft)	Temp (C)	DO (mg/L)	pH (SU)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	pH (SU)	Spec. Cond (us/cm)	Depth (ft)	Temp (C)	DO (mg/L)	pH (SU)	Spec. Cond (us/cm)
0	20.39	8.61	7.87	237	0	25.37	8.37	7.79	235	0	28.98	7.51	7.99	240
2	19.97	8.61	7.77	237	2	25.41	8.32	7.73	235	2	28.97	7.53	7.99	240
4	19.09	8.64	7.68	237	4	25.40	8.36	7.71	235	4	28.95	7.52	7.98	240
6	18.55	8.14	7.54	236	6	25.40	8.34	7.70	235	6	27.74	7.48	7.90	239
8	18.29	8.08	7.43	234	8	24.43	8.21	7.59	235	8	25.42	6.81	7.56	237
9	16.32	8.61	7.36	236	9	23.04	7.53	7.30	235	9	24.36	5.82	7.22	237
10	15.05	8.52	7.31	235	10	19.39	7.12	7.07	232	10	23.49	3.41	6.92	236
11	14.47	8.40	7.28	235	11	16.93	5.35	6.93	230	11	22.38	1.62	6.74	236
12	13.86	8.22	7.24	235	12	16.19	4.53	6.85	232	12	20.78	0.85	6.67	236
14	13.31	7.98	7.21	234	14	15.24	3.30	6.77	233	14				
16	12.96	7.39	7.15	232	16	13.92	2.12	6.71	237	16	14.83	0.00	6.64	239
18	12.41	6.20	7.03	234	18	12.68	1.87	6.70	239	18				
20	11.66	3.71	6.93	240	20	11.29	0.00	6.78	251	20				
22	10.55	1.29	6.82	247	22	11.02	0.00	6.97	262	22	11.23	0.00	7.08	298
23	10.12	0.00	6.80	248	23	10.59	0.00	7.07	277	23	11.02	0.00	7.43	
Missing data due to low battery														

Note: Although the HACH Sonde was completely charged the night before sampling in July, the battery died.

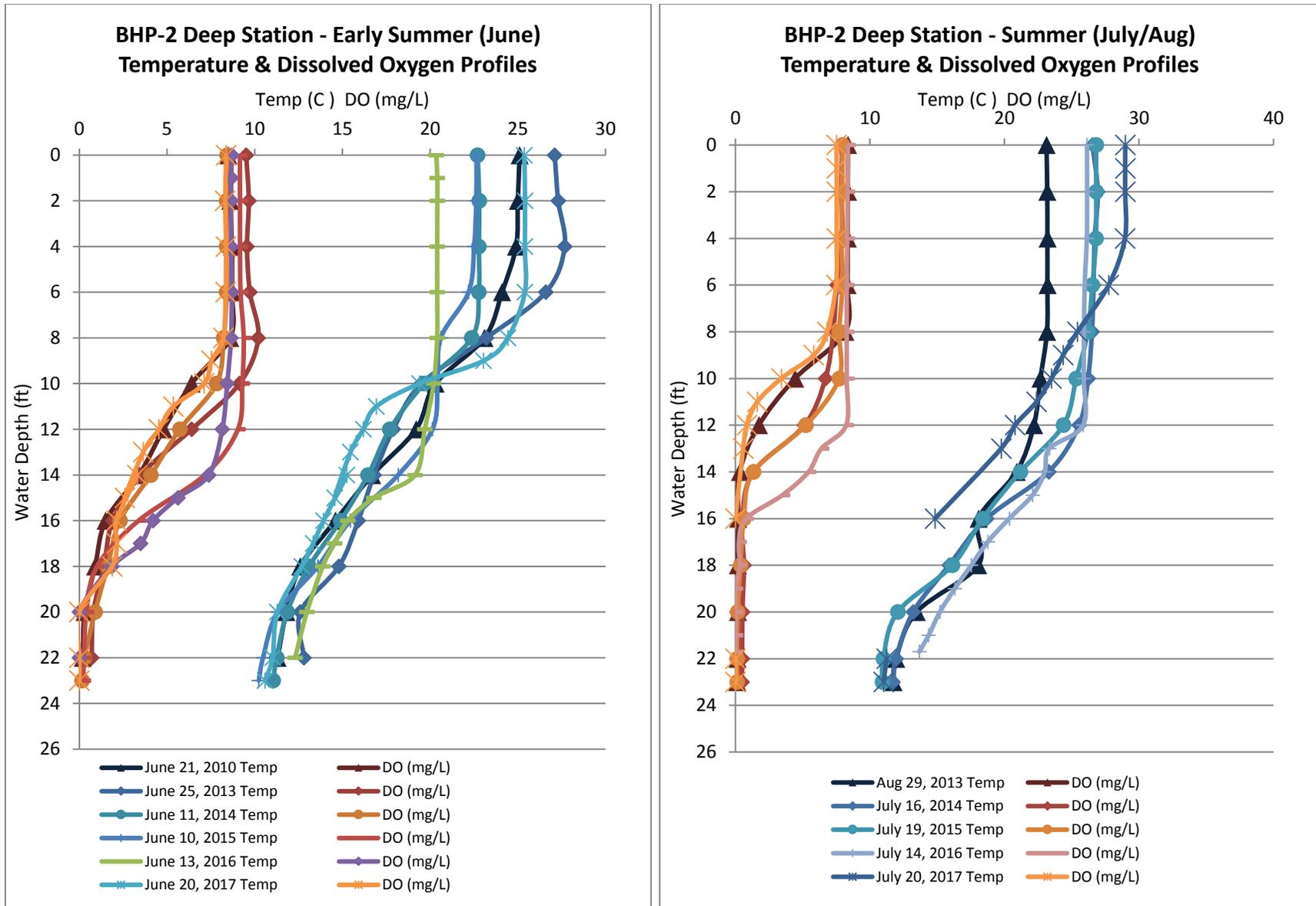


Figure 3. Temperature & Dissolved Oxygen Profiles at BHP-2 for 2010-2017

Generally, surface pH levels are neutral to slightly basic and become more acidic with water depth. The southern basin had a higher basic condition in June 2017 (pH ranging from 7.5 to 8.4 SU) when compared to May. Increased photosynthetic activity could have caused a temporary increase in pH; when plants and algae use carbon dioxide from the water column during photosynthesis, this reduces water acidity. Specific conductivity in 2017 increased gradually with depth and time and was above the desirable range (<200 us/cm); values above 200 us/cm can be indicative of elevated dissolved pollutants and high productivity. 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 2017. 2017 phosphorus concentration comparison with prior years is illustrated graphically in Figure 4. The surface total phosphorus (TP) concentrations in 2017 were relatively consistent throughout the summer, but bottom concentrations increased over time. This is typical of a highly stratified lake with low DO in the hypolimnion and ample stores of phosphorus in sediments. Surface phosphorus concentrations were lower in 2017 than in 2016 (average 0.019 vs 0.026 mg/L). It should be noted that the laboratory reported high phosphorus concentrations for the surface sample at BHP-2S in May. ARC requested the lab reanalyze for total phosphorus; dissolved phosphorus was beyond the hold time and could not be accurately reassessed. The initial run reported a TP value of 0.082 mg/L and the revised value was 0.016 mg/L. The lesser value was more consistent with the results in June and July. Dissolved phosphorus values were generally low with the exception of the bottom sample in July.

Secchi disk transparency in 2017 ranged from 7.5 to 12.0 feet. Clarity was lowest in May. Surface water in May contained colloidal material that appeared green and may have been algae, but the sample was not analyzed under a microscope to confirm. Clarity increased with time. This is an opposite trend that occurred in 2016 where clarity decreased over the summer. 2017 was a wet year and perhaps the increased flushing improved conditions. Clarity was the greatest reported since 2004 (Figure 5).

Table 3. 2017 Bare Hill Pond In-lake Water Quality Data.

Station	Date	Time	TP (mg/L)	DP (mg/L)	TSS (mg/L)	Secchi (ft)	
2S	5/23/2017	17:40	0.082*	0.075	<5	7.5	
REANALYZED			0.016				
2B	5/23/2017	17:50	0.041	0.017	6		
1S	5/23/2017	18:10	0.031	0.015	<5	5	bottom
2S	6/20/2017	17:40	0.019	0.019	<5	9	
2B	6/20/2017	17:50	0.035	0.019	10		
1S	6/20/2017	18:10	0.022	<0.010	5	4.5	bottom
2S	7/20/2017	17:20	0.02	<0.010	5	12	
2B	7/20/2017	17:15	0.05	0.050	16		
1S	7/20/2017	17:45	0.019	<0.010	<5	5.0	bottom

TSS = Total Suspended Solids

"Bottom" indicates the Secchi disk reached the pond bottom

* Value higher than expected - reanalyzed

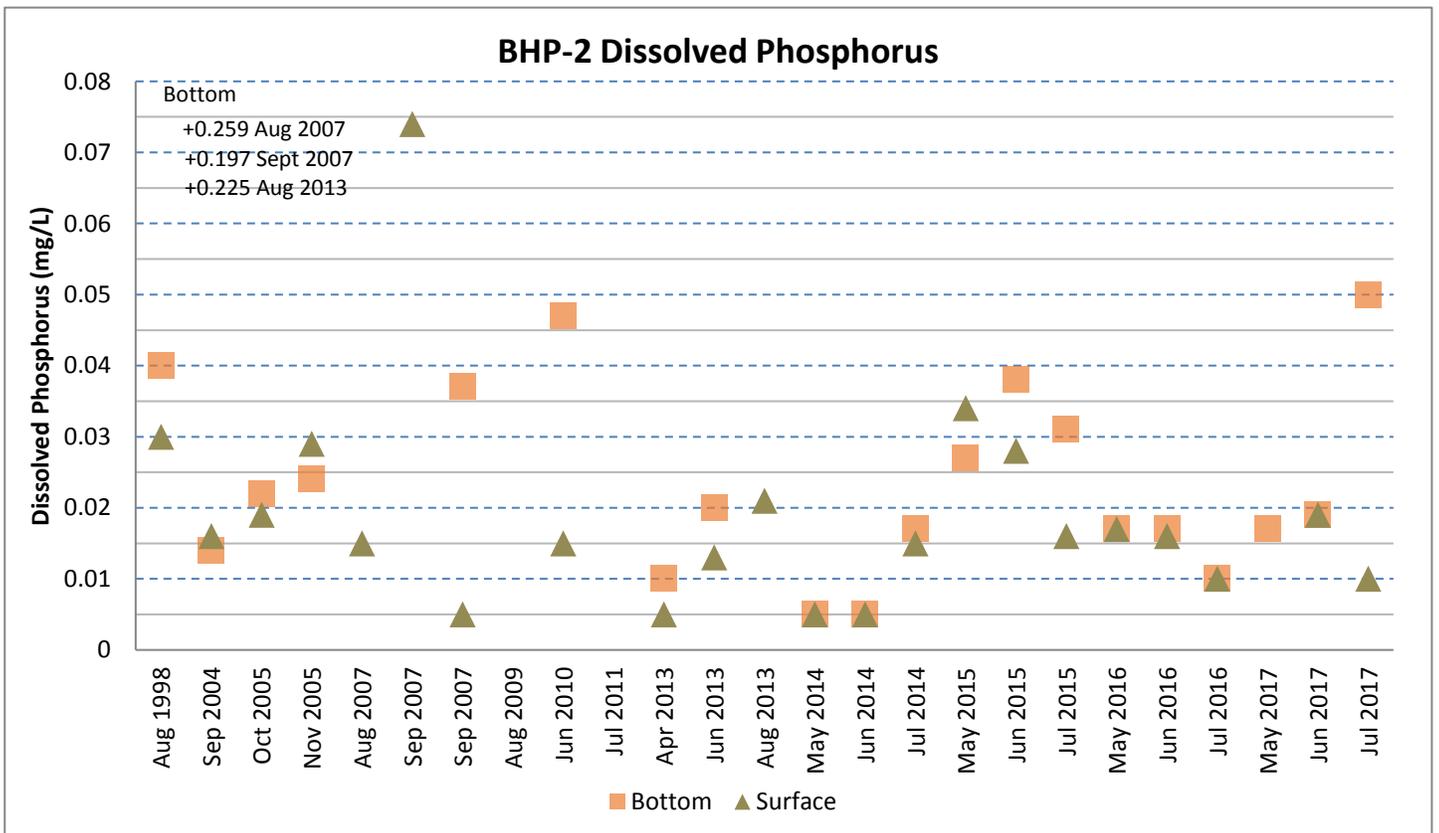
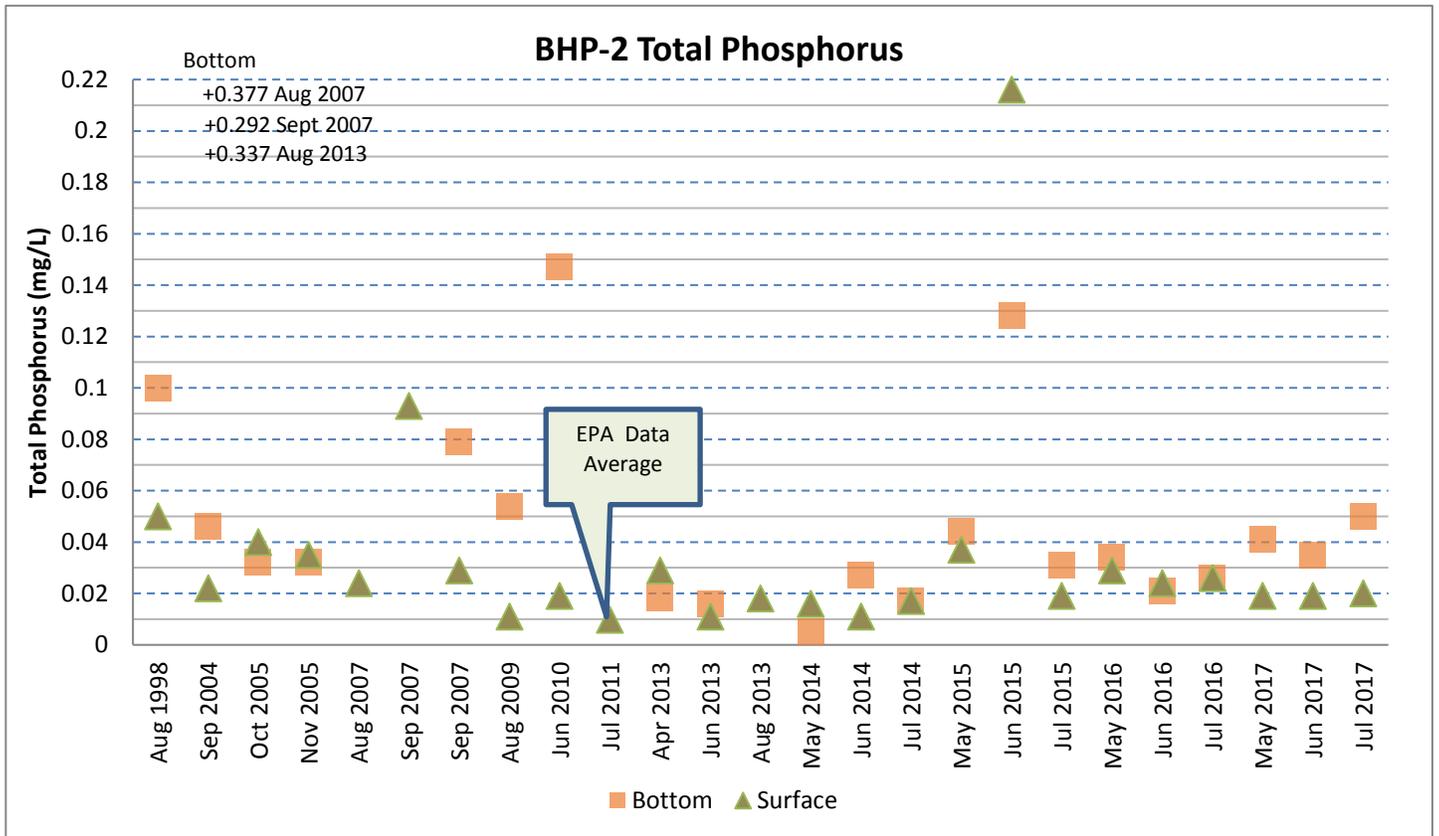


Figure 4. BHP-2 Total and Dissolved Phosphorus Concentrations.

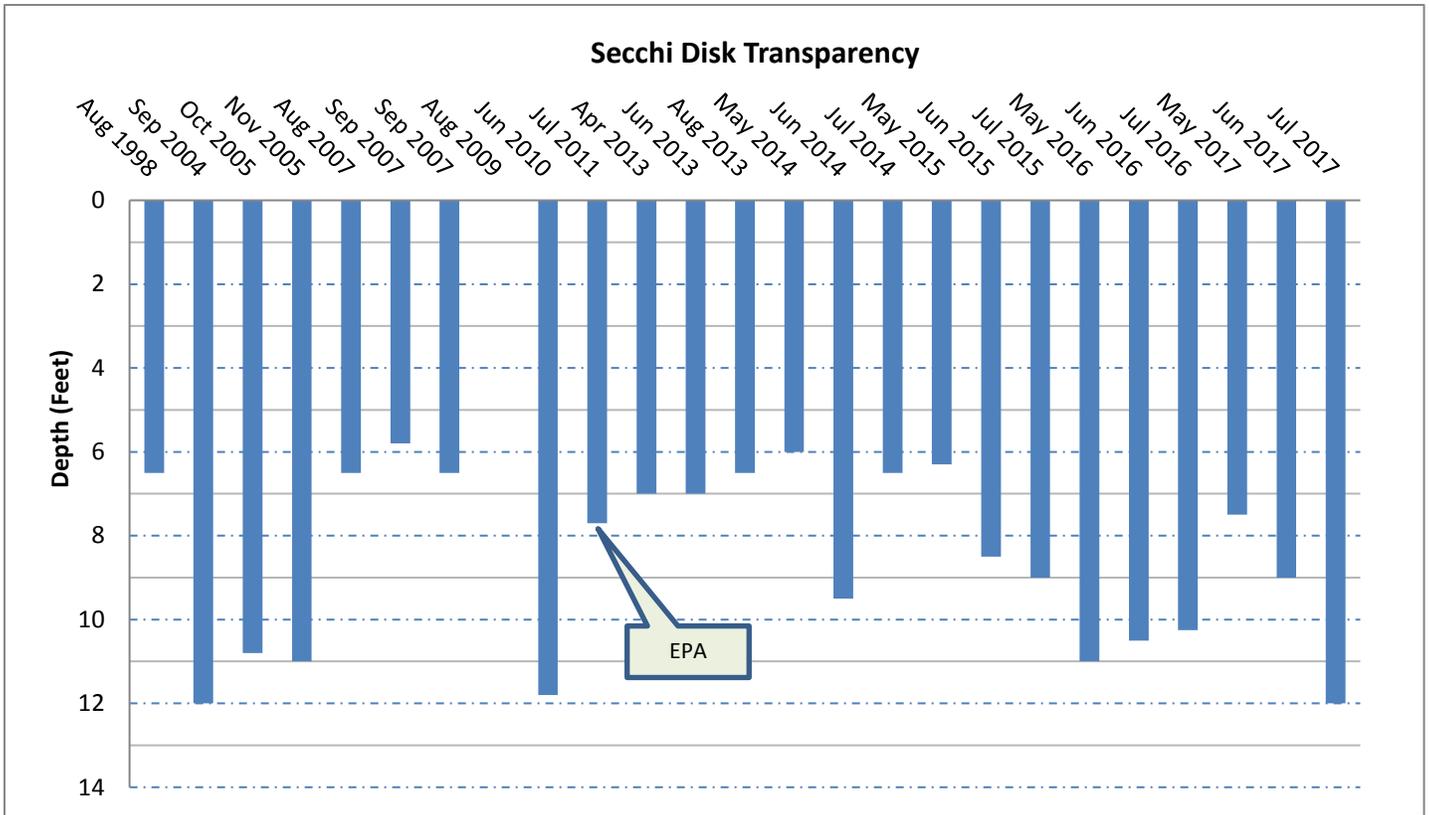


Figure 5. Bare Hill Pond (BHP-2) Secchi Disk Transparency.

In-lake Plant Survey

ARC conducted a plant survey on August 19, 2017. We used the same methods employed during the previous surveys conducted in 1998 through 2016. 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. Plant cover data recorded in Transect B & D showed the largest change of all observation locations in 2017. Cover increased at three locations, two of which are within the drawdown zone. Within Transect B (point 4), the composition of plants were the same in 2016, watershield (*Brasenia schreberi*) and tapegrass (*Vallisneria Americana*), both native plants. One or both increased the two dimensional coverage. With Transect D, point 12 there was a shift from grassy arrowhead or duck potato (*Sagittaria graminea*) to Robbins pondweed (*Potamogeton robbinsii*), again both native species. Robbins pondweed grows in much denser clusters than duck potato. Point 3 in Transect D suggested more growth of watershield in 2017 than in 2016.

There were only minor changes in the overall biovolume from 2016 to 2017. All category changes were less than two. And those that differed had a lower biovolume rank in 2017 (i.e., less plant biomass) with the exception of one point Transect E point 8. The invasive species fanwort (*Cabomba caroliniana*) dominated this point in both 2016 and 2017. Variable-leaf milfoil (*Myriophyllum heterophyllum*) was also observed at this location both years. This point is outside the drawdown zone. These data suggest that there is no appreciable difference between the years in plant cover and density. However, outside the points, there were multiple locations where milfoil and fanwort reached the surface. Watershield coverage also appeared greater in 2017, but only one point suggested this increase.

Table 4. 2017 Macrophyte Survey Data

Point	Water Depth (ft)	Cover	Bio-vol	Bs	Cc	Cd	Ec	FG	Macro Algae	Mh	M. hum	Nm	No	Nv	Pa	Pc	P. rob	P. spir	Pot	Sg	U. sp	Va
A-1	3.0	5	2		10	30		40		15											5	
A-2	3.5	5	2	80									20									
A-3	3.5	4	2	40					5			5	5	30							15	
A-4	4.0	4	4	25		40		5					30									
A-5	4.1	5	1	10	5				80												5	
A-6	4.2	5	1						85			5							5		5	
A-7	5.0	4	1		5				75			10						10				
A-8	5.5	2	1						100													
A-9	6.5	2	1			70		25													5	
A-10	10.0	3	1		10			60		30												
A-11	11.5	1	1					100														
A-12	13.0	1	1					100														
A-13	5.8	4	1							5										25		70
B-1	3.0	5	3	30				10	5	10	10									10	5	20
B-2	4.0	5	2	10				10		20			30									30
B-3	4.7	5	1						70				10									20
B-4	4.7	5	1						90													10
B-5	4.7	5	1						70				20									10
B-6	4.8	5	1						80				10									10
B-7	4.8	5	1						70													30
B-8	4.9	5	1	20					25	10				25								20
B-9	4.9	5	1	25					40			10										25
B-10	4.7	5	2						40			30										30
C-1	6.2	5	3		30					10							25	25	10			
C-2	8.0	5	2							10					40		50					

Point	Water Depth (ft)	Cover	Bio-vol	Bs	Cc	Cd	Ec	FG	Macro Algae	Mh	M. hum	Nm	No	Nv	Pa	Pc	P. rob	P. spir	Pot	Sg	U. sp	Va
C-3	8.8	5	2							10					40		50					
C-4	10.6	4	2		70												30					
C-5	12.5	1	1		100																	
C-6	12.5	4	2		100																	
C-7	12.5	3	2		80					20												
C-8	7.0	4	2		10					50					5			5				30
D-1	3.5	5	1		10			10	10			10	10							10	25	15
D-2	4.1	5	2	10			5		10	15			30	5							25	
D-3	4.7	5	1	40	5		5			5							5				35	5
D-4	4.3	5	1	20				5	60								5		5	5		
D-5	4.5	5	1	40					40	5											15	
D-6	4.7	5	1	50					30												20	
D-7	4.5	5	1	20					80													
D-8	3.9	5	1						80	5										15		
D-9	5.5	5	1						90	5	5											
D-10	5.8	5	1						100													
D-11	5.7	5	1						100													
D-12	7.0	5	2							5					15		80					
D-13	9.0	5	2		5					15							80					
E-1	5.2	4	1						65													35
E-2	6.0	5	1		10				40	10												40
E-3	6.3	5	1		5				75			10					10					
E-4	7.4	5	2		15				10	15					10		50					
E-5	8.0	5	2		45			10									45					
E-6	8.7	5	3		45					10							45					
E-7	9.5	5	2		30				10	30							30					
E-8	10.2	5	3		75					20							5					

Point	Water Depth (ft)	Cover	Bio-vol	Bs	Cc	Cd	Ec	FG	Macro Algae	Mh	M. hum	Nm	No	Nv	Pa	Pc	P. rob	P. spir	Pot	Sg	U. sp	Va
F-1	4.0	1	1		40																	60
F-2	7.5	5	2		10					25					15		50					
G-1	3.1	2	1		60												5			10	5	20
G-2	8.5	5	2		40					30					20		10					
H-1	3.9	1	1																	100		
H-2	8.0	4	2		20					50					30							
I-1	4.8	1	1																			100
I-2	10.5	4	2		70					30												
Frequency of Occurrence				14	26	3	2	11	29	27	2	7	9	3	8	0	17	3	3	7	12	19
Frequency Dominant				6	12	2	0	4	22	3	0	0	2	1	0	0	9	0	0	1	1	5
% Time Dominated when Present				43	46	67	0	36	76	11	0	0	22	33	0	0	53	0	0	14	8	26

Shaded cell indicates dominant species at observation point

Genus species (common name)

Bs – *Brasenia schreberi* (watershield)

Cc – *Cabomba caroliniana* (fanwort)

Cd - *Ceratophyllum demersum* (coontail)

Ec - *Elodea canadensis* (waterweed)

FG – filamentous algal mats

Mh – *Myriophyllum heterophyllum* (variable-leaf milfoil)

Ni.f – *Nitella flexilis* (stonewort)

Nm - *Najas minor* (brittle waternymph)

No – *Nymphaea odorata* (white-flower waterlily)

Nv – *Nuphar variegata* (yellow-flower waterlily)

Pa - *Potamogeton amplifolius*

Pc - *Potamogeton crispus*

Prob – *Potamogeton robbinsii* (Robbins pondweed)

Pspir - *Potamogeton spirillus* (spiral pondweed)

Pot – *Potamogeton* spp. (pondweeds)

Usp – *Utricularia* spp. (bladderwort)

Va - *Vallisneria americana* (tapegrass)

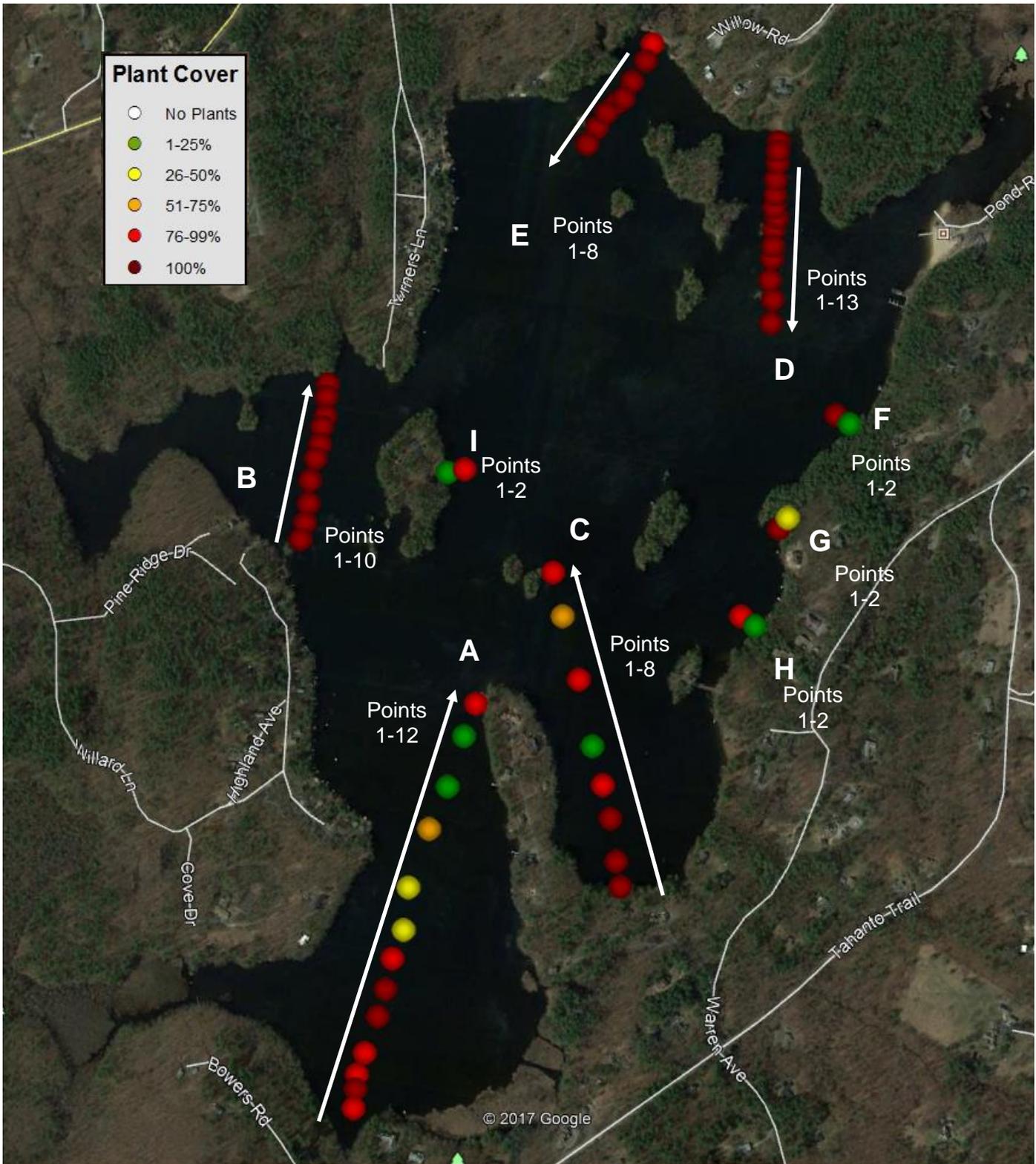


Figure 6. Bare Hill Pond 2017 Plant Cover

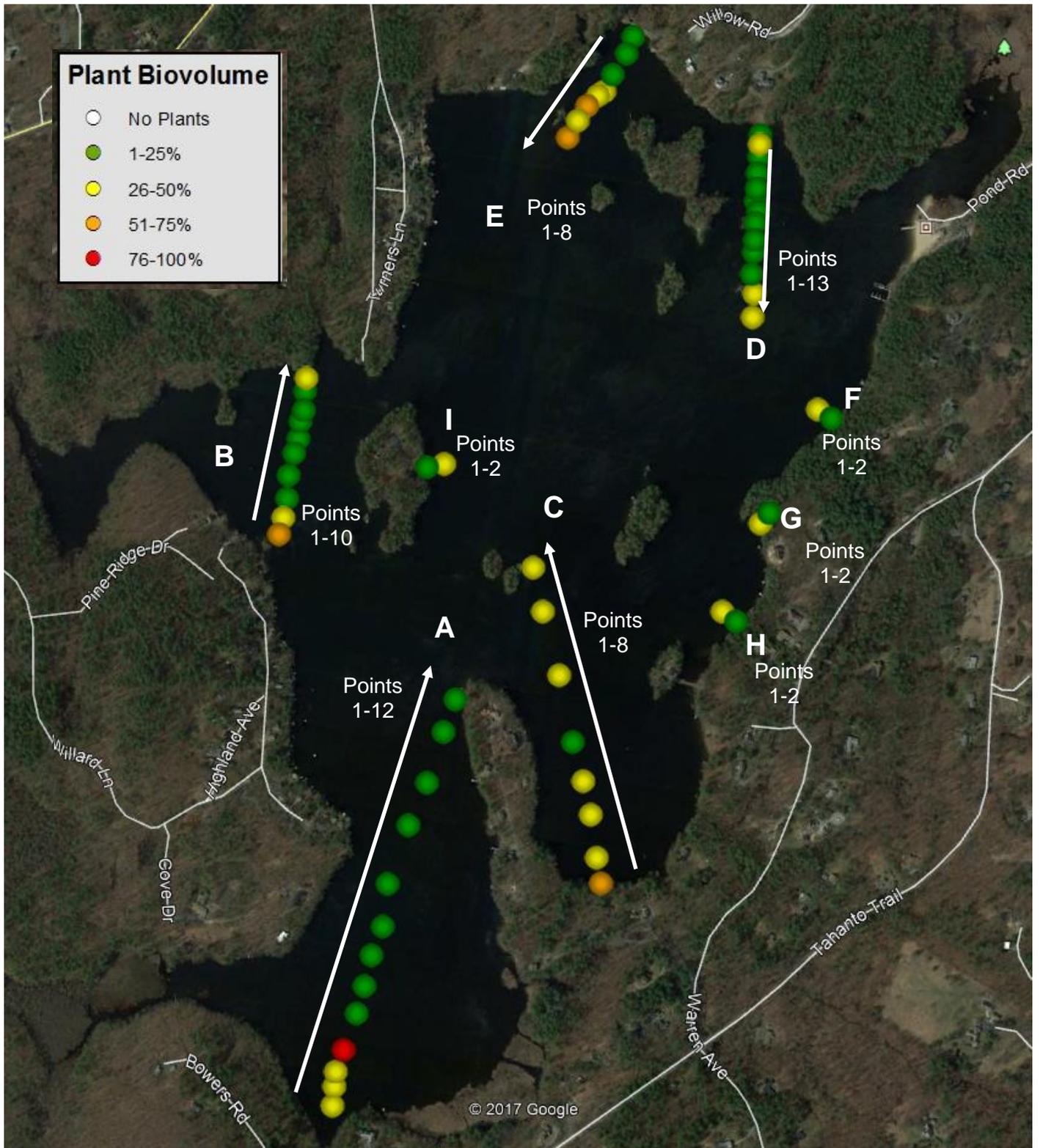


Figure 7. Bare Hill Pond 2017 Plant Biovolume

Table 5. Bare Hill Pond Cover and Biovolume Relative Change

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

Increase by 2 or more ranks from prior year

Decrease by 2 or more ranks from prior year

The general appearance of the pond showed similar plant growth conditions to 2016, with perhaps more watershield. While it wasn't encountered more frequently, its coverage was greater as indicated by point D-3. These conditions are supported by the cover and biovolume ranks shown in Table 5 and the plant species frequency data shown in Figure 8. While 2017 was similar to 2016, 2016 had more frequent observations of certain plants than in 2015 suggesting an increase in plant growth: watershield, fanwort, milfoil (*Myriophyllum heterophyllum*) and pondweeds (*Potamogeton* spp.). Figure 8 illustrates the most frequently encountered species data since 2010. Macro algae were abundant again in 2017 (observed at just under 50% of the points). This non-vascular plant is low growing and forms a carpet on the bottom. Plant dominance has shifted from fanwort and milfoil to macro algae and naiads (*Najas* spp.) in past drawdown years, but recent data do not indicate any major shifts.

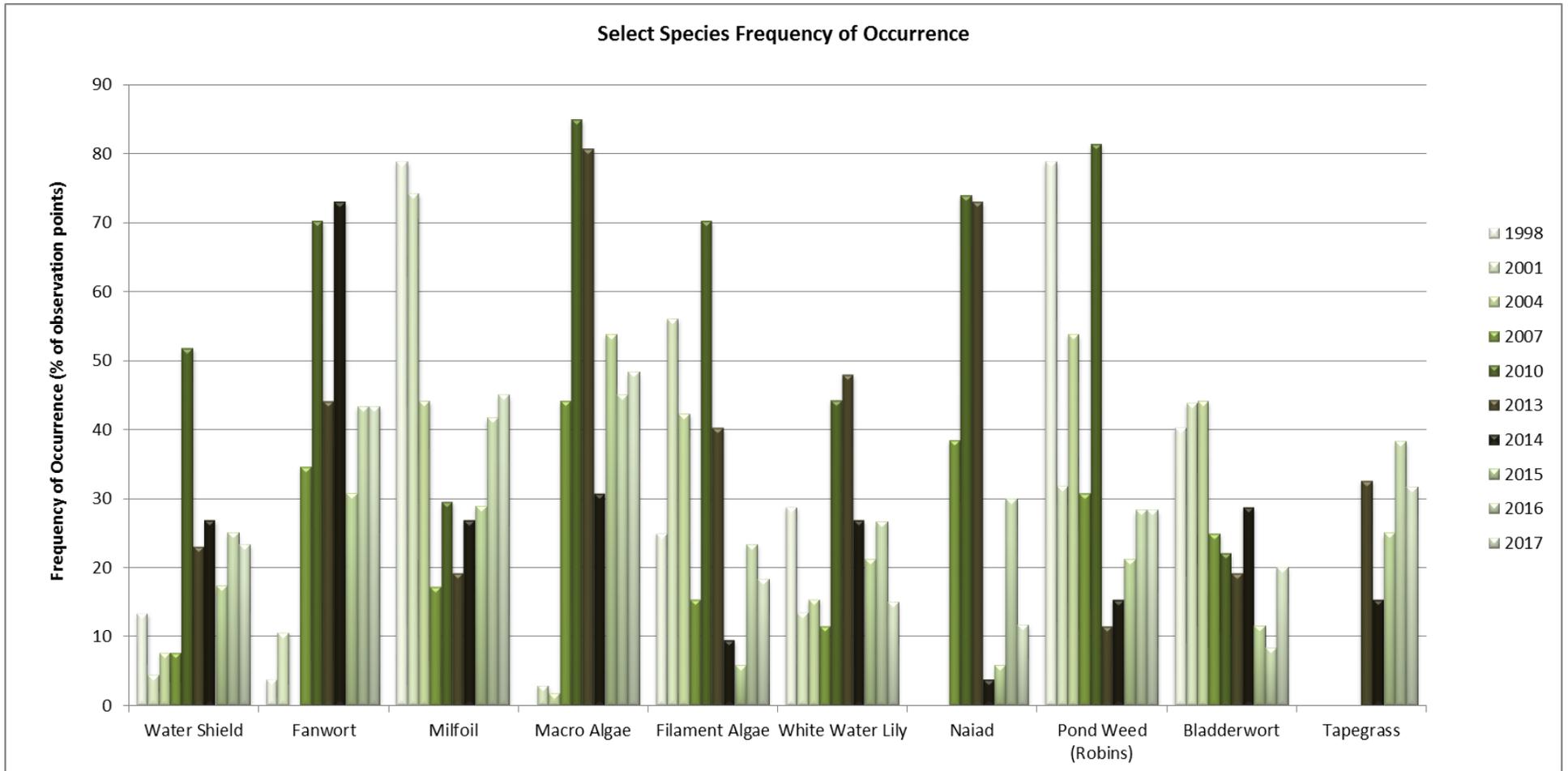


Figure 8. Bare Hill Pond Select Plant Species Frequency of Occurrence

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. The latitude and longitude was 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. We observed the native species (blue flag iris) in the north eastern portion of the pond in 2017. It is possible that some of these points may represent native iris. A map of the two surveys is provided in Figure 10. Iris was much less abundant in 2017. Most of the iris observed were in waters less than 1' deep or on the bank.

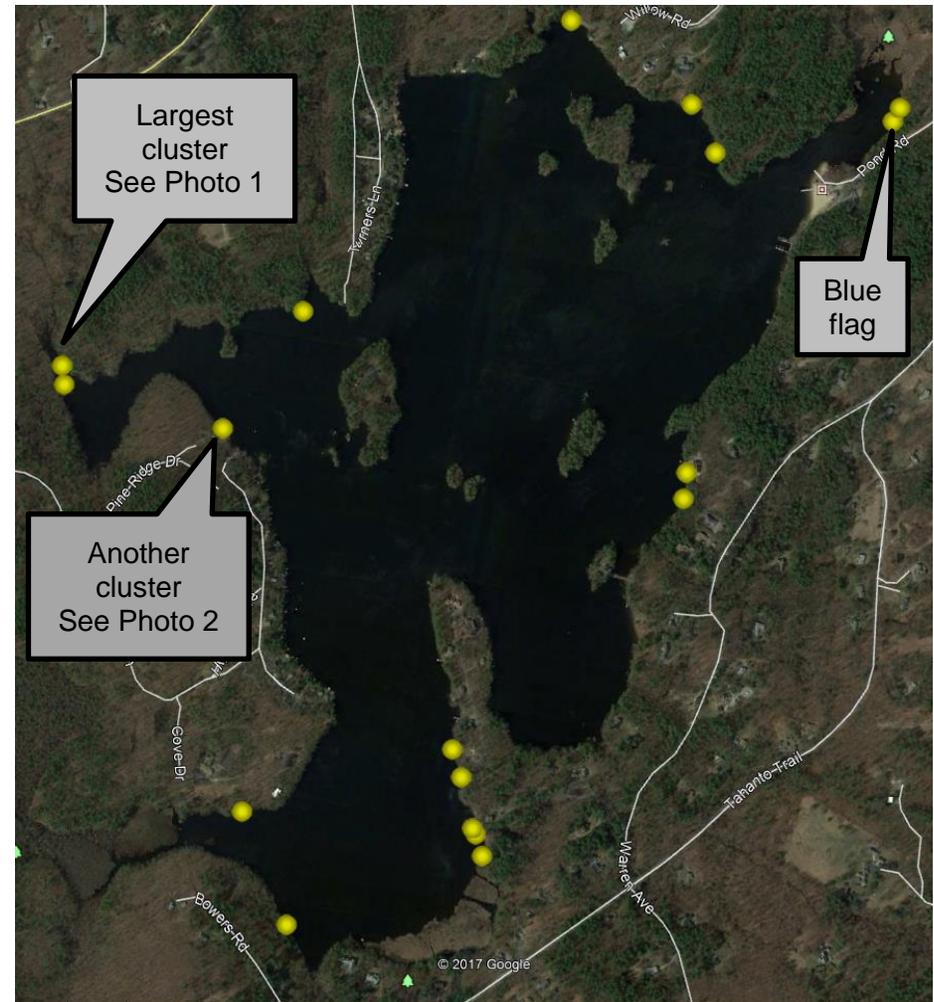


Figure 9. Iris Surveys 2013 (left) and 2017 (right),

Photo 1 – yellow iris at northern tip of western cove



Photo 2 – Large cluster in front of home on west shore. Iris is the darker, taller form. Shorter brighter green plant in foreground is bur-reed (*Sparganium*)



Wetland Plot Monitoring

Four pre-established wetland plots were surveyed on August 13, 2017. 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 (MADEP Handbook: *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act*). Plots 1 and 2 were generally located in close proximity to the 2016 plot locations and plots 3 and 4 were relocated in the same location as the 2016 survey. Water level within all plots was much higher than in 2013.

Although slight changes were observed, general vegetation diversity in the sample plots remained similar to those documented in previous years with only slight changes in species abundance and the addition of a few new species. Cattail (*Typha latifolia*) continued to be the dominant species in all four plots, with a slight decrease in abundance for Plot 4; cattail abundance remained similar in the other three plots compared to the 2016 survey. The most significant change noted this year was the presence of common reed (*Phragmites australis*). Common reed was observed in the wetland just north of the dam. It is visible to the north from the crest of the dam (photos 9 and 10 in the photo log provided in Appendix A). Common reed is not represented on the attached Vegetation Sampling sheets since it did not fall within the monitoring plot. However, this species is an aggressive non-native plant that poses a significant risk to habitat quality (diversity and wildlife value) of the wetland.

Conclusion

Water quality data suggest lake conditions in 2017 differed from 2016. Last year was a very dry summer with limited flushing. This year we've experienced more precipitation and as a result water levels within the pond are higher. This increased flushing has likely helped keep phosphorus low (surface phosphorus was lower in 2017). However, thermal stratification was the strongest observed in recent years. This suggests a higher resistance to lake mixing, and more extreme oxygen loss in the hypolimnion. Low DO conditions were again observed above the thermocline. There was an increase in phosphorus concentrations in the hypolimnion over time which is characteristic of internal loading (release of phosphorus from sediments under anoxic conditions). If concentrations are mixed into the upper layers, the likelihood of an algal bloom increases.

There were no major differences observed in the plant community compared to 2016. Some minor increases of cover, but plant dominance and frequency of encounters was similar. As in past years, thick patches of milfoil and fanwort were observed when traveling to and from the sample locations. Watershield also appeared dense outside the sample points and data suggests a slight increase in cover at one observation location (D-3). Plants in water depths up to 8-10 feet were observed topping out at the surface. Native pondweeds were also very abundant at and between observation locations.

Overall conditions within the wetland plots remain the same with the exception of the introduction of common reed in the wetland north of the dam. This is a significant concern. Common reed can spread rapidly by seed and rhizomes, sending out long runners to colonize new areas. It forms dense monocultures out-competing native plants and provides limited habitat value. Once established, it is very difficult to eradicate. Management and control techniques include herbicides, burning, cutting/mowing and mechanical removal (hydrorake or other root removal). For this relatively small stand, it is recommended that the plants are treated with an herbicide followed by plant removal (and roots if possible). A spot treatment, injections or hand wiping technique is recommended to limit impact to surrounding vegetation. It is essential that the

Committee implement a rapid response plan to remove this plant before spreads causing irreparable harm to this diverse wetland. The likelihood of successful eradication is greatly diminished the longer it remains unaddressed.

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 have stabilized and the pond has seen some of the best clarity in recent 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.

Appendix A – Wetland Plot Vegetation Sheets & Photo Log

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond	Weather: Sunny, low 80°F
Location: Harvard, Massachusetts	Date: August 13, 2017
Transect No. N/A	Plot Size: 30-ft radius, Plot 1
Community Type: Scrub-Shrub Wetland	Observers: Julia Stearns
Soil Type: Muck and sands and gravel	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>Oncoclea sensibilis</i>)	1	1-5%
	Jewelweed (<i>Impatiens capensis</i>)	1	1-5%
	Pickerelweed (<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	Weather: Cloudy, Lt. Wind, 55-60 ° F
Location: Harvard, Massachusetts	Date: November 14, 2001
Transect No. One	Plot Size: 30-ft. radius, Plot 1
Community Type: Scrub-Shrub Wetland	Observers: Don Schall
Soil Type: Muck and sands and gravel	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 sp.</i>)	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.

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%
	Pickerelweed (<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 Nightshage (<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%
	Pickeralweed (<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.

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond	Weather: Overcast, low 80°F
Location: Harvard, Massachusetts	Date: August 13, 2017
Transect No. N/A	Plot Size: 30-ft radius, Plot 3
Community Type: Scrub-Shrub Wetland	Observers: Julia Stearns
Soil Type: Muck and sands and gravel	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 (Carex stricta)	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.

2017 FIELD REPORT: VEGETATION SAMPLING SHEET

Site Name: Bare Hill Pond	Weather: Sunny, low 80s°F
Location: Harvard, Massachusetts	Date: August 13, 2017
Transect No. N/A	Plot Size: 30-ft radius, Plot 4
Community Type: Scrub-Shrub Wetland	Observers: Julia Stearns
Soil Type: Muck and sands and gravel	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	Weather: Cloudy, Lt. Wind, 55-60 ° F
Location: Harvard, Massachusetts	Date: November 14, 2001
Transect No. Two	Plot Size: 30-ft. radius, Plot 3
Community Type: Emergent Wetland	Observers: Don Schall
Soil Type: Muck over sands and gravel	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	Weather: Cloudy, Lt. Wind, 55-60 ° F
Location: Harvard, Massachusetts	Date: November 14, 2001
Transect No. Two	Plot Size: 30-ft. radius, Plot 4
Community Type: Emergent Wetland	Observers: Don Schall
Soil Type: Muck over sands and gravel	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: 8/13/2017		
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.		

PHOTOGRAPHIC LOG

Client Name: Town of Harvard		Site Location: Bare Hill Pond Willow Road, Harvard, MA	Project: Bare Hill Pond
Photo No. 9	Date: 8/13/2017		
Direction Photo View: Northeast			
Description: Common reed (<i>Phragmites australis</i>) located approximately 50-100 ft. north of the dam.			

Photo No. 10	Date: 8/13/2017		
Direction Photo View: Northwest			
Description: Common reed (<i>Phragmites australis</i>) located approximately 50-100 ft. north of the dam.			

