Lake Shirley
2012 Aquatic Vegetation Survey

Project Report
September 18, 2012

Prepared For:

Lake Shirley
Improvement Corporation

Geosyntec consultants
engineers | scientists | innovators

SECTION 1: INTRODUCTION

Geosyntec Consultants (Geosyntec) was contracted by the Lake Shirley Improvement Corporation (LSIC) to conduct a comprehensive macrophyte (vascular aquatic plant) survey of Lake Shirley in Lunenburg, MA, during the summer of 2012. The purpose of the survey was to:

1. Provide an update on the composition and distribution Lake Shirley's macrophyte community, allowing the LSIC and the Conservation Commissions of Lunenburg and Shirley to track changes in the Lake's plant community in response to drawdown and other lake management techniques; and

2. Continue to track changes in the distribution and dominance of nuisance non-native plant species within the lake.

SECTION 2: AQUATIC VEGETATION SURVEY

2.1 Methodology

On September 6 and 7, 2012, Geosyntec conducted a macrophyte survey of Lake Shirley. Aquatic vegetation was sampled from a boat. Plant species were identified at 66 sampling locations (see Figure 3), based (with minor modifications) on the sampling stations established by Geosyntec's 2002-2011 vegetation surveys. Plants were identified by visual inspection and by using an aquatic vegetation grappling hook to sample submerged vegetation. At each station, the dominant plant(s) were recorded, as well as estimates of plant growth density and biomass. As categorized in Table 3, plant density is an estimate of aerial coverage when looking down to the lake bottom from the water surface. Biomass estimates the amount of plant matter within the water column. For example, a sampling station with dense growth of low-growing plants may have a high density estimate but a relatively low plant biomass estimate. A station with dense growth of a long, ropey plant like Eurasian milfoil, with stems reaching the water surface, would have both high plant density and high biomass estimates.

In addition to recording information from the 66 sampling stations, a running documentation of plant growth densities was estimated throughout the lakewide survey.

2.2 Vegetation Survey Results

2.2.1 Summary of 2002-2012 Vegetation Survey Results

To allow for comparison of changes in the Lake Shirley plant community over time, the following is a synopsis of the major findings of the vegetation surveys conducted by Geosyntec from 2002 through 2012, followed by a more detailed discussion of the 2012 survey results:

Year	Summary of Findings
2002	• Eurasian milfoil was the most well-distributed and dominant plant in the lake, present at 75% of sampling stations and dominant at 38% of all stations. • Variable milfoil was found at 60% of the stations and was dominant at 28% of stations. With the exception of the southwest portion of the lake, Variable milfoil was well distributed in all areas except the southwest portion of the lake. • Waterweed (*Elodea nuttallii*) was found at 52% of stations and was dominant at 28% of stations. • Fanwort was found at 50% of the stations and was dominant at 20% of stations. Fanwort was most abundant in the southern half of the Lake. • Only the deeper southern basin of the lake had a significant area with "sparse" (0-25% density) plant coverage. Plant densities elsewhere ranged from moderate (26-50%) to very dense (75-100%). • 27 macrophyte species observed, with a species richness index (average number of species per sampling station) of 4.27.

2003	• Eurasian milfoil was the most well-distributed and dominant plant in Lake Shirley, present at 75% of sampling stations and dominant at 21% of all stations. • Variable milfoil was found at 55% of the sampling stations and was dominant at 17% of stations, a slight decrease from 2002. • Although Fanwort was well distributed around the lake, this plant's dominance declined from 20% to 12% of all stations. • Invasive European Naiad is documented for the first time at two sampling stations. • A majority of the littoral zone had moderate plant growth, with 72% of the sampling stations this category. 11% of stations had sparse growth and 15% had either dense or very dense growth. • 21 macrophyte species observed, with a species richness index of 5.52.
2004	• Eurasian milfoil was the most well distributed plant in Lake Shirley, found at 77% of all stations. However, its relative dominance decreased to 14% of all stations. • Variable milfoil declined significantly in distribution and was not a dominant plant at any stations. • Fanwort continued to be well distributed and increased in dominance to 18% of stations. • Significant increase observed in the distribution (23%) and dominance (8%) of European Naiad. • A majority of the littoral zone had moderate plant growth, and 58% of sampling stations were in this category. 17% of stations had sparse growth and 26% had either dense or very dense growth. • 20 macrophyte species observed, with a species richness index of 5.18.
2005	• Eurasian milfoil was the most well-distributed and dominant plant in Lake Shirley. Eurasian milfoil was found at 92% of all stations and this plant increased in dominance (25% of all stations). • Fanwort declined significantly in overall abundance and dominance (9% of stations). • Modest increases in abundance and dominance for both Variable Milfoil and European Naiad. • A majority of the littoral zone had moderate plant growth (61% of the sampling stations). However, the sampling stations with sparse growth increased to 27%. A corresponding decrease in stations with either dense or very dense growth was also reported (13%). • 25 macrophyte species observed, with a species richness index of 6.36.
2006	• Macrophyte growth was diminished in many areas due to a severe algal bloom that affected Lake Shirley during summer 2006. It is also important to consider the cumulative effects on plant abundance related to the winter lake level drawdown conducted since 2003. • Eurasian milfoil continued to be the most well distributed and dominant plant in the lake, although its overall abundance and growth density declined since 2005. 18 out of 20 stations (90%) where Eurasian milfoil was a dominant plant were determined to have either sparse or moderate growth densities. • Overall plant density decreased notably in 2006. Sparse plant growth was reported at 45% of stations, moderate growth at 42%, and dense or very dense growth at 11%. • 27 macrophyte species observed. Species richness declined dramatically to 3.36, approximately half of its 2005 level.
2007	• During the post-herbicide treatment survey, most areas exhibited either no growth or extremely limited vegetation. • The most well distributed native plant on this survey date was Wild Celery (*Vallisneria americana*), which was observed at 12 out of the 20 survey areas. • Eurasian milfoil observed in trace amounts at only one survey area. European Naiad observed at six survey areas in the southwest section of the lake. Fanwort observed at three survey areas.
2008	• Invasive European Naiad has rapidly emerged as the most dominant plant in the lake. European Naiad was found at 44% of all sampling stations and was the dominant plant at 20% of all stations. • Eurasian milfoil declined significantly. It was present in small quantities at only 18% of sampling stations and was not dominant at any of the stations. • Fanwort was found at only 4 stations (6%) and was a dominant plant at only one station. • Variable milfoil was found in small quantities at only one of the sampling stations. • 24 macrophyte species observed, with a species richness index of 2.92.

2009	• Invasive European Naiad continues to be the most dominant plant in the lake, found at 44% of all sampling stations and dominant at 15% of all stations. • Fanwort was found at 10 stations (15%) and was a dominant plant at only one station. • Eurasian milfoil continued to decline. It was present in small quantities at only two sampling stations. Variable milfoil was found in small quantities at only one of the sampling stations. • 22 macrophyte species observed, with a species richness of 2.83. Only 4 species were dominant at more than 1 sampling station.
2010	• Structured macroalgae (Musk Grass) has emerged as the dominant macrophyte in the lake, found at 56% of sampling stations and dominant at 36% of stations. Musk Grass was particularly dominant throughout much of the northern basin of the lake, where it formed a low-growing canopy along the lake bottom. • Native Wild Celery continues to be the most well distributed plant in Lake Shirley, found at 64% of the sampling stations. This plant was also dominant at 7 stations (11%), second only to Musk Grass. • Invasive European Naiad has declined since the 2009 survey. This plant was present at 29% of the sampling stations but was not a dominant plant at any station. In 2008 and 2009, European Naiad was the most dominant plant in the lake. • Invasive Fanwort, Eurasian milfoil and Variable milfoil were generally observed in low quantities, similar to what was observed in 2009. • Overall plant growth density and biomass was similar to 2009, following several years of steady decline in plant abundance. • 24 macrophyte species observed, with a species richness index of 2.88 (similar to 2009).
2011	• Invasive European Naiad rebounded from a significant decline in 2010 to become the dominant plant in Lake Shirley. Prior to its decline in 2010, European Naiad had been the most dominant plant in the lake in 2008-2009. Its abundance in 2011 (observed at 70% of stations, dominant at 23%) was significantly higher than its previous reported peak in 2009. • Invasive Fanwort had a modest increase in abundance, observed at 18 stations (27%) and dominant at 3 stations. Fanwort is still well below its 2005 level, when it was present at 62% of all stations and dominant at 6 stations. • Invasive Eurasian Milfoil and Variable Milfoil were observed in low quantities, similar to what was observed in 2009-2010. • Native Wild Celery continues to be the most well distributed plant in Lake Shirley, found at 73% of the sampling stations. This plant was also dominant at 20% of the stations, second only to European Naiad. • The 2011 plant density index and biomass index were both slightly higher but similar to those reported in 2009 and 2010. . • 19 macrophyte species were observed, representing a modest decline from recent years. The 2011 species richness index was 2.92, similar to 2008-2010.
2012	• The overall growth density and biomass of aquatic plants in Lake Shirley increased for the third consecutive year, with both being at the highest levels observed since 2006. The most significant observation was the lakewide increase in the distribution and growth density of invasive European Naiad. • Wild Celery was the second most abundant species observed. This beneficial native plant can cause nuisance conditions for boating in some areas. This plant has spiral flower stalks that extend to the water surface and are prone to becoming wrapped around boat propellers. • Invasive Fanwort had a modest decline in overall abundance, observed at 12 stations (27%) and dominant at 2 stations. However, Fanwort appeared to be more abundant and widespread than in recent years within the cove near sampling station #36. • Invasive Eurasian Milfoil and Variable Milfoil were observed in low quantities, similar to what was observed in 2009-2011. • Six species were observed at 20% or more of the sampling stations, compared to five species in 2010 and 2011. Four of these species were native and two were non-native (European Naiad, Fanwort). • 20 macrophyte species were observed. The species richness index (average # of species per sampling location) was 3.32, the highest level observed since 2006.

2.2.2 2012 Vegetation Survey Results

A listing of plant species present at each of the sixty-six sampling stations is provided in Table 3, including information on vegetation density, plant biomass, and dominant plants at each station. A summary of the major findings of the 2012 vegetation survey is as follows:

General Notes

- As shown in Figure 1, the overall growth density and biomass of aquatic plants in Lake Shirley increased for the third consecutive year, with both being at the highest levels observed since 2006. The most significant observation with regard to plant abundance was the lakewide increase in the distribution and growth density of invasive European Naiad.

- Most of the sampling stations (43 stations, 65%) were characterized by sparse plant growth ranging from 0-25% density. However, the number of stations with either moderate (26-50% density) or dense (51-75% density) plant growth increased to 21 stations from 13 stations in 2011.

- The number of sampling stations dominated by non-native, invasive species has increased significantly over the past few years. In 2010, only 2 stations (3%) were dominated by non-native species, followed by 18 stations (27%) in 2011 and 28 stations (42%) in 2012. This increase is primarily due to the increased abundance of European Naiad.

- 20 species (see Table 3) of macrophytes were documented in Lake Shirley during the 2012 survey. This result is similar to recent years (i.e. 24 species in 2010 and 19 species in 2011).

- Six species were observed at 20% or more of the sampling stations, compared to five species in 2010 and 2011. Four of these species were native and two were non-native (European Naiad, Fanwort).

European Naiad

Fanwort

Eurasian milfoil

Variable milfoil

Invasive/Non-native Species

- **European Naiad** (*Najas minor*) has continued to be the most dominant and widely dispersed plant in Lake Shirley. Its abundance in 2012 (observed at 82% of stations, dominant at 39%) increased significantly in many parts of the lake. The number of sampling stations dominated by this plant increased by 73% from 15 stations in 2011 to 26 stations in 2012.

- **Fanwort** (*Cabomba caroliniana*) had a modest decline in overall abundance, observed at 12 stations (27%) and dominant at 2 stations. However, Fanwort appeared to be more abundant and widespread than in recent years within the cove where sampling station #36 is located.

- **Eurasian milfoil** (*Myriophyllum spicatum*) continues to be present in the lake in trace amounts. This plant was present in small quantities at only 6 stations in 2012 and 4 stations in 2011. In 2005, Eurasian milfoil was the most dominant plant in Lake Shirley.

- As observed in 2008-2011, **Variable milfoil** (*Myriophyllum heterophyllum*) was found in small quantities at only one sampling station. This plant was observed in the cove adjacent to the Bald Eagle nesting location at the western end of the lake.

Native Species

A summary of the native plant species most commonly observed during the 2012 vegetation survey is provided below.

- **Wild Celery** (*Vallisneria americana*) was present at 42 stations (64%) and dominant at 11 stations (17%), second only in distribution and dominance to European Naiad. All parts of Wild Celery are important food items for many species of waterbirds, and this plant is particularly important as a food source for some duck species during winter migration. Although the strap-like submerged leaves of this plant are typically around 3-feet in length, the cord-like pistillate (female) flower stalks can be much longer and extend to the water surface. These flower stalks, which retract into the water in a spiral form following pollination/fertilization, can create a nuisance for boaters by becoming tightly wrapped around propellers.

- **Bushy Pondweed** (*Najas flexilis*) was present at 24 stations (36%) and dominant at 4 stations (6%), a significant increase compared to 2011 when it was found at 14 stations but was not a dominant plant. Bushy Pondweed was the third most well distributed plant in the lake.

- **Stonewort** (Nitella spp.) is a structured macroalgae that has increased significantly in abundance since 2011, particularly in the lake's northern basin where it was common as a low-growing mat near the lake bottom. In 2012, stonewort was observed at 20 stations and was a dominant plant at 8 stations. In 2011, stonewort was observed at only one station. Stonewort can play an important role in maintaining water clarity in lakes. By sequestering nutrients at the sediment-water interface (at the lake's bottom), this plant helps to prevent nutrients from fueling potential algal blooms at the surface. The increased abundance of stonewort in 2012 may help to explain Lake Shirley's relatively good water clarity at the time of the vegetation survey.

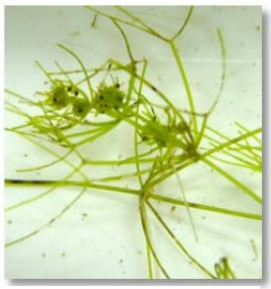
- **Thin-leaf Pondweed** (*Potamogeton pusillus*) was not a dominant plant at any sampling station in 2012, but did increase its distribution significantly from 5 stations in 2011 to 20 stations in 2012. Like many native *Potamogeton* species, the seeds and vegetation of this plant provide cover and food for aquatic animals.

- **Grassy Pondweed** *(Potamogeton gramineus)* was present at 10 stations (15%) and dominant at 3 stations (5%), similar to the 2011 survey results. The seeds, tubers, and vegetation of this plant provide important food and cover for aquatic animals and waterfowl.

Data summary tables, a vegetation density map, and a species tally sheet from the 2012 vegetation survey are provided on the following pages.

Wild Celery

Bushy Pondweed



Stonewort

Thin-leaf Pondweed

Grassy Pondweed

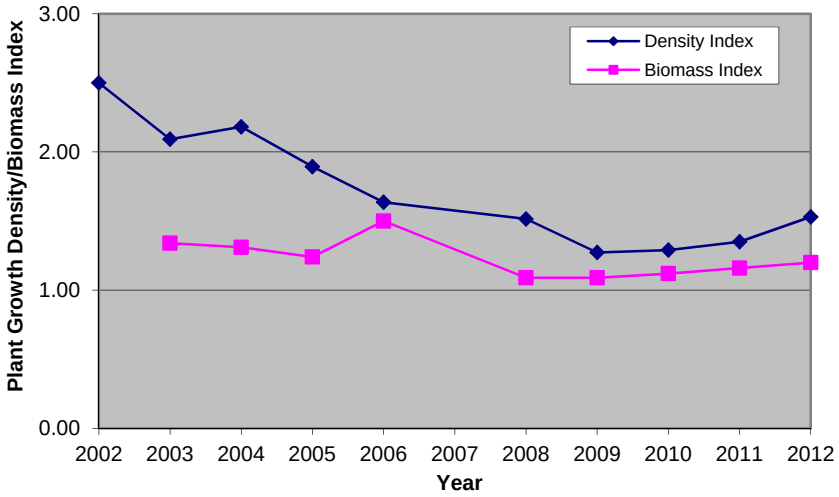
Table 1: Plant Growth Density Estimates, 2002-2012

Density Rating	# of stations (% of stations)									
	2002 (64 stations)	2003 (65 stations)	2004 (66 stations)	2005 (66 stations)	2006 (66 stations)	2008 (66 stations)	2009 (66 stations)	2010 (66 stations)	2011 (66 stations)	2012 (66 stations)
1: Sparse 0-25%	9 (14%)	7 (11%)	11 (17%)	18 (27%)	30 (45%)	39 (59%)	52 (79%)	51 (77%)	51 (77%)	43 (65%)
2: Moderate 26-50%	23 (36%)	47 (72%)	38 (58%)	40 (61%)	28 (42%)	22 (33%)	11 (17%)	11 (17%)	9 (14%)	13 (20%)
3: Dense 51-75%	23 (36%)	9 (15%)	11 (17%)	5 (8%)	6 (9%)	3 (5%)	2 (3%)	4 (6%)	4 (6%)	8 (12%)
4: Very Dense 76-100%	9 (14%)	2 (3%)	6 (9%)	3 (5%)	1 (2%)	2 (3%)	1 (2%)	0 (0%)	2 (3%)	2 (3%)
Density Index*	**2.50**	**2.09**	**2.18**	**1.89**	**1.64**	**1.52**	**1.27**	**1.29**	**1.35**	**1.53**

Table 2: Plant Biomass Estimates, 2003-2012

Biomass Rating	# of stations (% of stations)								
	2003 (65 stations)	2004 (66 stations)	2005 (66 stations)	2006 (66 stations)	2008 (66 stations)	2009 (66 stations)	2010 (66 stations)	2011 (66 stations)	2012 (66 stations)
1: Scattered plant growth; or primarily at lake bottom	45 (69%)	53 (80%)	51 (77%)	39 (59%)	60 (91%)	61 (92%)	60 (91%)	58 (88%)	54 (82%)
2: Less abundant growth, or in less than half of water column	19 (29%)	8 (12%)	14 (21%)	22 (33%)	6 (9%)	4 (6%)	4 (6%)	5 (8%)	11 (17%)
3: Substantial growth through majority of water column	1 (2%)	4 (6%)	1 (2%)	4 (6%)	0 (0%)	1 (2%)	2 (3%)	3 (5%)	1 (2%)
4: Abundant growth throughout water column to surface	0 (0%)	1 (2%)	0 (0%)	1 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Biomass Index*	**1.34**	**1.31**	**1.24**	**1.50**	**1.09**	**1.09**	**1.12**	**1.16**	**1.20**

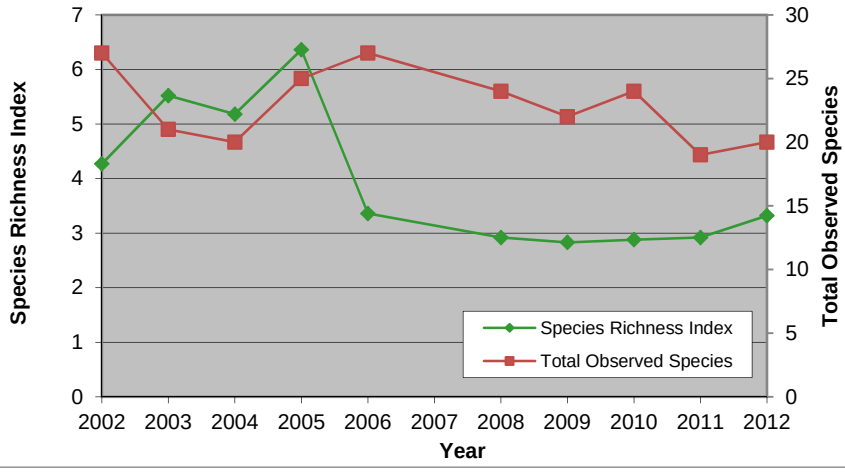
Figure 1: Lake Shirley Plant Growth Density and Biomass Index, 2002-2012



Density Index and **Biomass Index** are weighted averages of the density ratings and biomass ratings for each of the vegetation survey years listed in Table 1 and 2. For each year, the numeric rating (1 to 4) is multiplied by the number of survey stations with that rating. The sum of these values is divided by the total number of sampling stations, resulting in the index value.

These indices allow for a comparison of relative changes in plant growth density and biomass over time.

Figure 2: Lake Shirley Species Richness Index and Total Observed Species, 2002-2012



Species Richness Index and **Total Observed Species** are measures of biological diversity within the Lake Shirley aquatic plant community. The species richness index is calculated by averaging the number of plant species observed at each sampling station for each vegetation survey. Total observed species is the number of all species observed throughout the lake during a specific survey.

For the period of 2002-2012, species richness peaked in 2005 at an average of 6.36 species per station. Species richness declined dramatically between 2005 and 2006, was stable from 2008 through 2011, and increased slightly in 2012.

Table 3: Aquatic Vegetation Survey Tally Sheet

Geosyntec consultants

Location: Lake Shirley (Lunenburg, MA)

Date: September 6-7, 2012 **Surveyed by:** Bob Hartzel

[•] species present at monitoring station [**•**] species dominant at monitoring station

Plant Species	# stations present	# stations dominant	% stations present	% stations dominant	Monitoring Locations																																	
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24A	25	26	27	28	29	30	31	32	33
European Naiad (*Najas minor*) *	54	26	82%	39%	**•**	**•**	**•**	•	•	**•**	•		•	**•**	•	•	•	**•**	**•**	•				•	**•**	**•**	**•**	•		**•**		**•**	•	**•**	**•**	•	•	
Wild Celery (*Vallisneria americana*)	42	11	64%	17%		•	•	**•**	**•**	•	**•**			•	•	•	•	**•**	•					•	•		•			•			**•**		**•**	•	**•**	
Bushy Pondweed (*Najas flexilis*)	24	4	36%	6%	•	•	•		•								**•**		•	•					**•**	**•**				•		•		•			•	
Stonewort (*Nitella sp.*)	20	8	30%	12%				**•**	**•**	•		**•**					**•**								•		•	**•**	**•**		**•**			•	•			
Thin-leaf Pondweed (*Potamogeton pusillus*)	20	0	30%	0%	•	•	•		•	•			•		•			•	•														•	•				
Fanwort (*Cabomba caroliniana*) *	13	2	20%	3%				•	•						•	•		•				**•**																
Grassy pondweed (*Potamogeton gramineus*)	10	3	15%	5%											**•**	**•**		•			•														•			
Yellow Water Lily (*Nuphar variegatum*)	6	1	9%	2%										•																					•	**•**		
Eurasian Milfoil (*Myriophyllum spicatum*) *	6	0	9%	0%													•	•		•																		
Small Waterwort (*Elatine minima*)	4	0	6%	0%									•			•																			•			
Ribbonleaf Pondweed (*Potamogeton epihydrus*)	3	1	5%	2%																																		
Eastern Purple Bladderwort (*Utricularia purpurea*)	3	0	5%	0%											•	•						•																
Coontail (*Ceratophyllum demersum*)	3	0	5%	0%																		•																
Claspingleaf Pondweed (*Potamogeton perfoliatus*)	3	0	5%	0%																																		
Arrowhead (*Sagittaria latifolia*)	3	0	5%	0%																																•		
White Water Lily (*Nymphaea odorata*)	2	0	3%	0%											•																					•		
Robbin's Pondweed (*Potamogeton robbinsii*)	1	1	2%	2%																		**•**																
Variable Milfoil (*Myriophyllum heterophyllum*) *	1	0	2%	0%																		•																
Common Bladderwort (*Utricularia vulgaris*)	1	0	2%	0%																		•																
Little Floating Bladderwort (*Utricularia radiata*)	1	0	2%	0%																																		
# of Species Observed					3	4	4	4	6	4	2	1	3	3	7	6	5	6	4	3	1	6	0	2	4	2	3	2	1	3	1	2	3	4	6	5	3	0
Plant Density Rating					1	2	1	2	2	2	1	2	1	1	2	1	2	3	2	1	1	4	0	1	2	4	1	1	1	1	1	1	2	1	1	1	1	0
Plant Biomass Rating					1	1	1	2	2	2	1	1	1	1	1	1	1	2	1	1	1	3	0	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0

Plant Species	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	62A	63	64
European Naiad (*Najas minor*) *	•	**•**	•	**•**	•		**•**	**•**	**•**	•	**•**	**•**		**•**	•	•		•	•	•	**•**	•			•	**•**	•	•	**•**	**•**	•	•
Wild Celery (*Vallisneria americana*)	**•**	•		**•**	•		•	•	•	•	•	•		•	•	•	**•**	•	•	•	•	•		•	•		**•**					
Bushy Pondweed (*Najas flexilis*)							•		•	•		•					•				•			**•**		•		•	•		•	
Stonewort (*Nitella sp.*)	•			•												•	•							•	**•**			•			•	
Thin-leaf Pondweed (*Potamogeton pusillus*)									•			•		•		•	•	•								•	•					•
Fanwort (*Cabomba caroliniana*) *			**•**	•			•			•	•	•									•											
Grassy pondweed (*Potamogeton gramineus*)							•	•			•							**•**			•											
Yellow Water Lily (*Nuphar variegatum*)	•									•				•																		
Eurasian Milfoil (*Myriophyllum spicatum*) *							•			•	•																					
Small Waterwort (*Elatine minima*)							•																									
Ribbonleaf Pondweed (*Potamogeton epihydrus*)				•						**•**											•											
Eastern Purple Bladderwort (*Utricularia purpurea*)																																
Coontail (*Ceratophyllum demersum*)								•									•															
Claspingleaf Pondweed (*Potamogeton perfoliatus*)			•	•			•																									
Arrowhead (*Sagittaria latifolia*)								•		•																						
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Variable Milfoil (*Myriophyllum heterophyllum*) *																																
Common Bladderwort (*Utricularia vulgaris*)																																
Little Floating Bladderwort (*Utricularia radiata*)	•																															
# of Species Observed	5	2	3	6	2	0	8	5	4	8	5	5	0	4	2	4	4	4	2	2	6	2	0	3	3	3	3	3	2	1	3	2
Plant Density Rating	3	1	2	2	1	0	3	1	1	3	3	3	0	1	1	1	2	1	1	1	3	1	0	3	1	1	1	1	1	1	1	1
Plant Biomass Rating	2	1	1	1	1	0	2	1	1	2	2	2	0	1	1	1	1	1	1	1	2	1	0	1	1	1	1	1	1	1	1	1

*** Non-native, invasive plant**

Key to Density and Biomass Ratings		
Rating	Density (% cover)	Biomass
0	Absent: 0%	Plants absent
1	Sparse: 1-25%	Scattered plant growth; or primarily at lake bottom
2	Moderate: 26-50%	Less abundant growth, or in less than half of water column
3	Dense: 51-75%	Substantial growth through majority of water column
4	Very Dense: 76-100%	Abundant growth throughout water column to surface

N

45 51 44 47 48 50 46 49 52 64 62A 63 53 62 55 43 54 61 57 56 42 59 41 60 58 5 7 39 3 40 12 13 14 11 38 8 1 9 10 36 16 15 35 37 17 34 33 19 29 27 24a 20 18 32 25 24 28 30 23 31 21 22

Legend

- Vegetation Stations

Vegetation Density

- Sparse: 0-25%
- Moderate: 26-50%
- Dense: 51-75%
- Very Dense: 76-100%

Notes

2005 aerial image from MassGIS

500 0 500 1,000 Feet

Lake Shirley Vegetation Density
Survey Date: September 6-7, 2012

Geosyntec consultants

ACTON, MASSACHUSETTS | 17-SEP-2012

Figure 3

Q:\GISProjects\BW0101-Lake Shirley\Projects\VegetationDensity2012.mxd