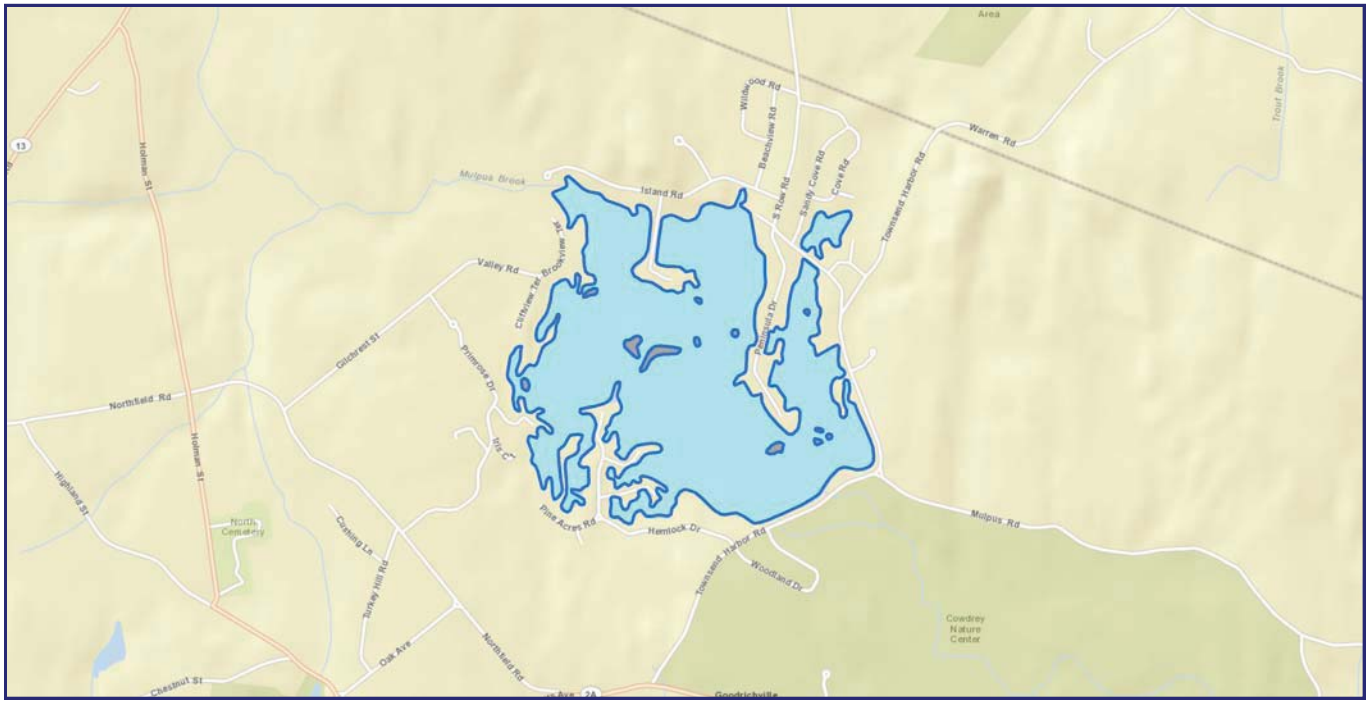
2012 Aquatic Weed Survey and Water Quality Analysis of Hickory Hills Lake



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Introduction

Please accept this as our Completion Report on the 2012 Aquatic Weed Survey and Water Quality Analysis of Hickory Hills Lake. As you know, Aquatic Control has been working with the Hickory Hills Landowners (HHL) for many years on a variety of lake management issues and has performed periodic vegetation surveys and water quality studies of the lake, most recently in 2010. The scope of this year's project was expanded to include a more detailed survey methodology and multiple water quality sample locations.

Around 2008, due to increased concern about nuisance vegetation and other issues, the HHL began taking a more active approach to lake management, primarily through the formation of the Lake Management Group (LMG). The purpose of the LMG is to investigate a variety of management topics and issues facing Hickory Hills Lake and provide detailed solutions to the Board of Directors. This has also included either directly implementing certain solutions or facilitating with Lake Management Contractors to perform work.

Historically, the management of Hickory Hills Lake was limited to periodic weed inspections by ACT and lake residents, mechanical weed harvesting of nuisance vegetation in high-use recreational areas and herbicide treatments of Little Hickory Lake in 2001 & 2006. More recently, a mechanical Hydro-Raking project was conducted in various public & private areas of the lake in 2011 and a number of activities were performed and are ongoing surrounding the discovery of non-native fanwort (*Cabomba caroliniana*) in July of 2011. It's our understanding that mechanical harvesting is no longer being conducted.

This project, including more detailed and quantitative assessment of the lake's aquatic vegetation along with testing of water quality, is envisioned to support the increased level of management activity at the lake and provide an on-going, standardized and repeatable method of monitoring the condition of the lake.

General Lake Characteristics

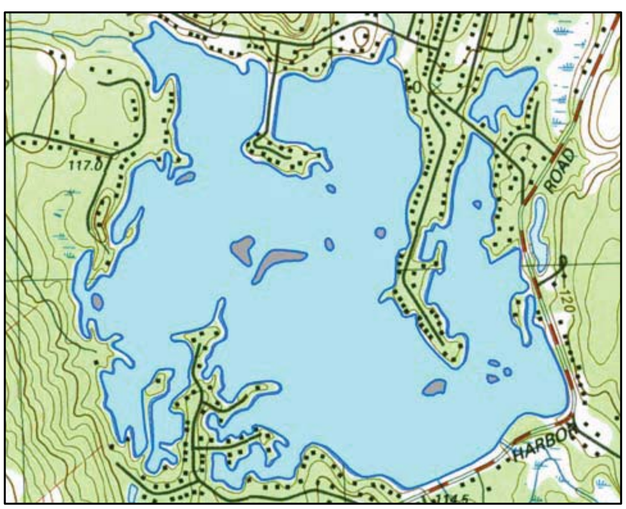


Figure 1 – Lake Map

Hickory Hills Lake (Figure 1 –left & Attachment A - Map 1) is an approximately 314-acre enhanced (impounded) waterbody with a maximum depth of 20 feet and an average depth of ~10.5 feet. It's largely irregular shoreline, encompassing over 9 linear miles, creates an abundance of shallow coves and backwater areas, capable of supporting abundant plant growth. Mulpus Brook is the primary source of surface water inflow to the lake. Sediment deposits have accumulated at this inlet area, forming an expansive, shallow "delta" with abundant emergent and floating vegetation. There are numerous other smaller inlets to the lake, which enter into various cove areas and comprise the remaining surface inflow to the lake.

The dam and outlet structure is located in the southeast corner of the lake and consists of ~100-foot concrete overflow spillway and nine 6-foot wide and 18" inch deep stoplog bays. There is also a low-level gate valve which allows for additional lowering of the lake's water level. The outlet of the lake continues eastward as Mulpus Brook, through a series of small ponds and wetlands before emptying into the Nashua River.

Methodology

The following assessment tasks were performed as part of this project,

Table 1 – Project Tasks

Task	Description
Aquatic Vegetation Assessment and Measurements of Water Depth	Pre-determined sample points were located at the vertexes of an 80-meter grid (See Attachment A - Map 2) and downloaded into a handheld Garmin GPS unit. At each point, water depth was measured with Lowrance sonar unit. Data was collected on species type, relative abundance and biomass. Vegetation was observed visually and with the aid of an underwater camera system. Plants were physically sampled with a throw-rake as necessary, except in areas of known fanwort growth.
Water Quality Sampling	Water quality samples were collected at three locations – one near the lake outlet, one from the Mulpus Brook inlet cove and one from Little Hickory Lake.
Field WQ Measurements	At each sample location, field measurement of temperature, dissolved oxygen and water clarity were performed. Samples were collected from each station for algal identification and enumeration. One sample was collected from the lake outlet station for zooplankton identification/enumeration.

Field work for this project was conducted on August 23rd & 24th. Water samples were analyzed by Microbac Laboratories of Worcester, MA. Phytoplankton (algae) samples were analyzed by ACT staff while the zooplankton samples were analyzed by Dr. Ken Wagner from Water Resource Services in Wilmington, MA.

Water Depth (Bathymetry) Results

Water depth data collected at each sample point was used to produce a contour map of the lake's bathymetry (See Attachment A - Map 3). The maximum water depth observed in the lake was 20-feet and the average was approximately 10.4-feet. As a benchmark, at the time of the survey, the water level was ~4-feet below the top of the concrete structure housing the low level outlet control.

The accuracy of the bathymetry map is based on the discrete number of data points and the precision of the measuring equipment and should not be considered an exact depiction of water depths in the lake or used for navigational purposes. It is however useful to visualize the bottom contours of the lake and to determine the size and extent of the littoral zone and other depth-related characteristics.

The following table shows the approximate surface area between each depth contour and the rough volume of water in each depth zone.

Table 2 – Lake Depth Areas & Volumes

Water Depth (feet)	Approximate Surface Area (acres)	% of total area	Approximate Volume (acre-ft)	% of total volume
0-3	32.4	10.2	909.4	28.1
3-6	44.4	14.0	817.9	25.3
6-9	55.7	17.5	679.7	21.0
9-12	72.4	22.8	442.2	13.7
12-15	57.6	18.1	247.3	7.6
15-18	37.3	11.7	110.9	3.4
18+	18.3	5.7	27.5	0.9
Totals	**318.1 acres**	**100%**	**3,234.9 acre-ft**	**100%**

Distribution of Aquatic Vegetation

The lake supports a diverse and abundant growth of native plants throughout the littoral area with the densest growth occurring in areas with water depths of 8-feet or less. Plant growth is present at lower density and biomass in water depths of 8 feet to 12 feet. In areas greater than 12-feet of water, the assemblage is dominated by stonewort (*Nitella sp*.), a form of "macro-algae" which provides beneficial, low-growing bottom cover and fish habitat.

The methodology used during this year's project allows for a more detailed and quantitative analysis of the lake's vegetation than past studies. At each data point, the relative bottom cover and biomass (height in the water column) was recorded for each plant species observed. Percent bottom cover is an estimate of the extent of growth per unit area for a certain species. It is determined from visual observations, not exact physical measurement and averages the variation in growth in the area surrounding the data point. While partially a subjective measurement, percent bottom cover is quantitative and with an experienced observer, the parameter is reasonably accurate and consistent across the data points.

While percent bottom cover gives a measurement of the proportion of lake bottom covered with plants, the parameter of biomass relates to the height and amount of growth in the in the water column. It is measured on a scale of 0-4 where,

Table 3 – Biomass Scale

Biomass Factor	Description
0	No Plants
1	Low-growing, bottom cover, usually less than a foot or two off the bottom depending on water depth. Likely not visible depending on water depth and clarity. Generally not problematic or a management concern.
2	Plants are clearly growing upwards through the water column, but most extend less than mid-way to the surface. May be visible from the surface depending on water depth and clarity. Likely not problematic or of management concern
3	Plant heights are reaching the upper half of the water column, but remain at least a foot or more beneath the surface. Clearly visible and may be problematic depending on species and location.
4	Plant growth is at or near the surface, may be topped out with emergent portions. Floating leaf plants like waterlilies are included in this factor. Plants are likely problematic in recreational or other high-use areas.

Overall, about 62.5% of the bottom in Hickory Hills Lake is covered with plant growth. If you do not include algae growth (filamentous or macro forms, i.e. stonewort), which occur mainly in the deeper areas, the percent bottom cover drops to ~40%. A majority of this growth is made up of submersed species and only about 3-4% of the plant cover in the lake is from floating leaf species, waterlilies and watershield. Map 4 shows the total percent plant cover (not including algae) at each data point.

Historically, bladderwort and tapegrass were noted as the two dominant species in the lake. The following table presents the species observed during the survey along with their lake-wide average percent cover and their percent occurrence (% of sample points where present).

Table 4 – List of Plant Species with Lake-wide % Cover and %Occurrence

Common Name	Scientific Name	Abbreviation	Lake-Wide Average % Cover	% occurrence
Bladderwort	Utricularia purpurea	U	15.6%	64.3%
Tapegrass	Vallinsneria Americana	V	8.2%	37.1%
Ribbonleaf pondweed	Potamogeton epihydrus	Pe	1.3%	15.2%
Watershield	Brasenia schreberi	B	2.4%	13.8%
Robbins pondweed	Potamogeton robbinsii	Pr	6.8%	50%
Stonewort	Nitella sp.	Ni	18.7%	52.4%
Thinleaf pondweed	Potamogeton pusilus	Pp	0.5%	8.6%
Slender spikerush	Eleocharis sp.	Eo	1.1%	6.7%
Mermaid Weed	Prospernica palustris	Mw	0.14%	1.4%
Largeleaf pondweed	Potamogeton amplifolius	Pa	1.5%	19%
Naiad	Najas sp.	Nj	0.48%	6.2%
White waterlily	Nypmphaea odorata	Ny	0.88%	6.7%
Yellow waterlily	Nuphar variegatum	Nu	0.09%	0.5%
Filamentous algae	Various	Fa	4.35%	11.9%
Submersed arrowhead	Saggitaria sp.	Sg	0.34%	3.3%
Quillwort	Isoetes sp.	Io	0.05%	0.5%
Coontail	Ceratophyllum demersum	Cd	0.02%	0.5%
Duckweed	Lemna minor	Lm	0.02%	0.5%
		Total	**62.5%**	

A number of maps are attached (Map 5a-r) showing the location and biomass of each observed species. Bladderwort continues to be the dominant plant in the lake, however aside from stonewort, Robbins pondweed is now the second most commonly occurring plant in the lake. Tapegrass is less common, but exhibits a higher growth density, coming in second in lake wide average percent cover when stonewort is excluded.

Past surveys of the lake were not conducted with a quantitative approach, so previous observations of dominant species are more anecdotal in nature. Past surveys also did not account for the substantial but low biomass of stonewort, especially in deeper areas of the lake. Future surveys conducted with this year's protocol will allow for more descriptive observation of trends in aquatic vegetation.

Fanwort was not observed at any of the data points nor was it seen by ACT staff at any point during the two days of survey work. We understand the LMG is coordinating local volunteers to conduct regular, systematic inspections of the lake specifically for fanwort and has already identified a number of small, localized infestations outside of the boat ramp cove where it was first discovered in July of 2011. This increased frequency and level of effort specific to fanwort is vital to successfully contain and manage the infestation in Hickory Hills Lake.

A concern arose following the 2010 survey project when Mermaid weed was observed to have spread from its historical location and extent in Proctors Cove outwards toward the main lake. Although mermaid weed is a native plant species, it does tend towards more dense and higher biomass growth and thus has the potential to increase nuisance conditions in parts of the lake. Fortunately, no further spread of mermaid weed was observed during this year's survey.

In terms of Little Hickory, Point #'s 186, 187, 202 & 194 are located in that basin of the lake. Two additional points, #209 & 210 were also collected there. As distinct basin, Little Hickory exhibits dense plant growth similar to shallow coves in the main lake. The overall percent cover of plants in Little Hickory is about 80% and is dominated by bladderwort, tapegrass, largeleaf pondweed and floating leaf watershield and white waterlilies. While residents on the main lake can travel to areas of the lake where plant growth is less dense, the owners on Little Hickory do not have that option and thus the need for management of this area is more pronounced.

Water Quality Results

Figure 2 – Sampling Locations

On August 24th, samples were collected from three stations in the lake (see Figure 2 – Left) corresponding to the Mulpus Brook Cove, the main lake near the outlet and Little Hickory. The results of the laboratory analyses are provided in the table below followed by a brief description of the parameter and interpretation of the data.

Table 5 – Water Quality Results (ND = Non-Detect)

Parameter	Unit	Main Lake	Mulpus Brook Cove	Little Hickory
pH	S.U.	6.53	6.55	6.72
Alkalinity	mg CaCO3/ml	14.5	14.5	23.0
Turbidity	NTU	0.490	0.590	0.550
Conductivity	umhos/cm	117	118	200
Nitrate	mg/l	ND (<0.1)	ND (<0.1)	ND (<0.1)
Ammonia	mg/l	ND (<0.1)	ND (<0.1)	ND (<0.1)
Total Kjeldahl Nitrogen	mg/l	0.200	0.500	0.300
Total phosphorus	mg/l	ND (<0.01)	ND (<0.01)	0.130
Total Dissolved Phosphorus	mg/l	ND (<0.01)	ND (<0.01)	ND (<0.01)
Chlorophyll-A	mg/m^3	ND (<0.1)	ND (<0.1)	3.00
True Color	Pt-Co	10	10	10
Apparent Color	Pt-Co	10	15	10
E. Coli	CFU/100 ml	10	ND	ND

pH – The pH measurement scale is from 0 to 14, where zero is extremely acidic, 7 is neutral, and 14 is the most basic. A pH range of about 5.5 – 8.5 is desired for maintaining a healthy fishery. The results of this year's testing were all slightly acidic, but well within the desirable range and all three stations showed similar results. The lake's pH is dependent on a number of factors and often will fluctuate over the course of the summer. Alkalinity (see below) in the water may help to attenuate these fluctuations.

Total Alkalinity – Alkalinity is a measure of the buffering capacity of a waterbody against acid additions such as acid rain and pollution, which can be detrimental to wildlife populations. Total alkalinity measures the presence of carbonates, bicarbonates and hydroxides. Values below 20 mg/l are a signal that the lake may be susceptible to fluctuations in pH. The results of testing show the main lake and Mulpus Brook Cove were both slightly below this level, which is not uncommon for lakes in this region. Little Hickory was desirably above this threshold possibly due to it's more shallow and organic condition.

Turbidity – Turbidity is a measure of the light attenuation in the water and is related to the suspended and dissolved particles in the water. Generally, turbidity values will rise with higher solids in the water. Typically, turbidity values in lakes and pond rarely rises above 5 NTU. The turbidity results were all below 1 unit and show a desirably low level of solids.

Conductivity – Conductivity is a measure of the water's ability to conduct electricity and is related to the amount of dissolved minerals that are present. Most natural waters have conductivity readings between 50 and 500 umhos/cm and the results from Hickory Hills Lake were all within this typical range.

Nitrogen - Nitrogen is a vital nutrient in the pond environment for plant and algae growth. Nitrogen exists in water as various compounds, with relative amounts governed by such things as atmospheric influence, precipitation, biological activity and water chemistry. Total Kjeldal nitrogen (TKN) is a measure of the nitrogen contained in organic compounds, such as proteins and amino acids, and as ammonia. It is created from biological growth and decomposition. A concentration of 1.0 mg/l or below is considered desirable. All samples from this study were within this threshold.

Ammonia is a transitional product in the breakdown of organic nitrogen into nitrate. It is typically short-lived in the pond environment except under conditions of low dissolved oxygen. High levels of ammonia typically indicate a highly eutrophic pond with prolonged anaerobic (devoid of oxygen) conditions. All samples were tested below the detection limit of 0.1 mg/l.

Nitrate is another form of nitrogen in the water. Nitrate nitrogen is usually the most prevalent form of inorganic nitrogen in the water and results from such things as natural aerobic bacterial activity and fertilizer use. It is also the form that is most readily available for plant and algae growth. All samples showed non-detectable levels of nitrate (<0.1 mg/l)

Phosphorus - Phosphorus is generally considered to be the limiting nutrient for plant and algae growth, with total phosphorus concentrations of 0.03 mg/l or more being to sufficient to stimulate algae blooms or excessive plant growth. Total phosphorus analyses measure both particulate and dissolved phosphorus. Particulate phosphorus is generally not biologically available so dissolved phosphorus more readily supports plant and algae growth. All of the values obtained during this study were desirably low and except for total phosphorus in Little Hickory, were below the detectable level of 0.01 mg/l. Phosphorus values can change significantly over the course of a season and need to be tested more often to find a normal range for the lake. While rooted plant growth generally obtains most of its nutrients from the sediment, water column phosphorus has a more direct effect on algae growth.

Chlorophyll-A – Chlorophyll-A is the green photosynthetic pigment found in the cells of all algae and can provide an indirect measure of algal density in the lake. As different algal species contain different amounts of chlorophyll and amounts can also change with light and weather conditions, it cannot provide a precise measurement of algal cell density but can be used to track changes and trends over the course of time. Eutrophic (biologically productive) waterbodies usually have chlorophyll concentrations between 10 and 500 mg/m^3. The two in-lake sample were non-detect for chlorophyll-a (< 0.1 mg/m^3) and Little Hickory showed a desirably low level of 3.0 mg/m^3.

True Color/Apparent Color - Apparent color is the color of the unfiltered water that is caused by suspended and dissolved matter. True color is the color of filtered water due to dissolved constituents only, like tannic and humic acid. Color results show a low level of color, due to primarily from dissolved material.

Bacteria - Coliform bacteria are naturally occurring in pond systems as well as resultant from human and animal inputs. *E. Coli is* specific to human and animal waste products. In general, acceptable values in "swimmable waters" for *E. Coli* bacteria are less than 230 organisms per 100 ml. All sample collected showed desirably low levels of bacteria.

Overall, the results show excellent water quality at all three stations with desirably low levels of phosphorus and nitrogen. The results obtained this year are comparable to past sampling results from the lake. There was little difference between the main lake station and the Mulpus Brook Cove while the Little Hickory sample showed slightly higher, but still desirable, levels of phosphorus and chlorophyll-a likely due to the prevalence of weed growth and reduced circulation.

For more a more detailed illustration of how this year's water quality compares to past studies, the following table shows a chronology of results from the main lake station.

Table 6 – Comparison of Historical WQ Results at the Main Lake Station

Parameter	Unit	Main Lake Station Result				
		2012	2010	2008	2006	2003
pH	S.U.	6.53	7.14	6.91	6.28	7.4
Alkalinity	mg CaCO3/ml	14.5	10.6	8.6	11	11
Turbidity	NTU	0.490	0.48	0.43	0.75	0.61
Conductivity	umhos/cm	117	NT	NT	NT	NT
Nitrate	mg/l	ND (<0.1)	<0.1	<0.1	0.12	0.22
Ammonia	mg/l	ND (<0.1)	<0.05	NT	NT	<0.2
Total Kjeldahl Nitrogen	mg/l	0.200	NT	NT	NT	NT
Total Phosphorus	mg/l	ND (<0.01)	<0.01	<0.02	0.007	0.013
Total Dissolved Phosphorus	mg/l	ND (<0.01)	NT	NT	NT	NT
Chlorophyll-A	mg/m^3	ND (<0.1)	NT	NT	NT	NT
True Color	Pt-Co	10	8	14	0	16
Apparent Color	Pt-Co	10	10	20	34	24
E. Coli	CFU/100 ml	10	NT	NT	NT	NT

Results for pH, alkalinity, turbidity and color show relatively stable levels over the sampling period with no discernable trends apparent. Results for nitrate and total phosphorus appear to have decreased over the sampling period which is desirable and shows improved water quality, although all the results are already within acceptable ranges. Other parameters were not consistently tested over the sampling period.

Temperature and dissolved oxygen measurements were taken at each sample location.

Table 7 – Temperature/Dissolved Oxygen Results

Depth (meters)	Main Lake		Mulpus Brook Cove		Little Hickory	
	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)	Temp (°C)	DO (mg/l)
Surface	26.2	7.66	26.2	7.80	26.5	8.52
1	26.1	7.94	25.5	8.42	24.8	6.96
2	25.8	7.39	25.3	7.79	24.5	6.49
3	25.7	6.99			24.3	3.5
4	25.6	6.22				
5	25.4	6.08				

In general, the water column at all three stations was well mixed and oxygenated with levels at or slightly below normal saturation levels. There was a noticeable drop in oxygen near the bottom of the Little Hickory station, but this is not uncommon due to the oxygen demand from decomposition processes in the sediment, especially in small waterbodies or isolated coves with more organic material and reduced circulation.

Water clarity was good at all stations, with Secchi disk transparency readings to the bottom of the lake – about 15-feet at the main lake station and 6-7 feet at the other two locations. Samples were collected for algae identification and enumeration, the results of which are presented below.

Table 8 – Phytoplankton Results

Station	Approximate Cell Count	Dominant Species
Main Lake	11,100 cells/ml	*Aphanocapsa* (blue-green) *Dictyosphaerium* (green)
Mulpus Brook Cove	17,908 cells/ml	*Microcystis* (blue-green) *Dictyosphaerium* (green)
Little Hickory	7,992 cells/ml	*Dictyosphaerium* (green) *Pediastrum* (green) *Botryoccus* (green) *Chlorella* (green)

All samples showed a relatively low density of microscopic algae which corresponds with the observations of good water clarity and low nutrient levels. Not surprisingly, algal density was slightly higher in the Mulpus Brook Cove but still well below what would be considered bloom conditions (> 50,000 cells/ml). Counts were lower in Little Hickory probably due to the abundance of plant growth which competes with algae for available nutrients and also acts as a "bio-filter".

On sample was collected from the main lake station for zooplankton identification and enumeration. Zooplankton are tiny animals that live throughout the water column and comprise an important component of the food. The zooplankton was sampled by vertical tow using a net with a mesh aperture of 80 micrometers through 30 meters of water, resulting in a concentrated sample representing 948 liters of lake water. Samples were examined at 40X to 100X magnification under brightfield optics to determine types present, richness, abundance through enumeration and size of the organisms present. The preserved samples were analyzed by Dr. Ken Wagner.

Overall, the sample showed a relatively low density and biomass of zooplankton. This is not unusual for lakes with low amounts of microscopic algae and is often the case later in the summer due to predation by fish. The sample was dominated by zooplankton in the Rotifera and Copepoda taxons. Additional sampling in the future and at different times of the year would be required to further assess zooplankton in Hickory Hills Lake. The zooplankton data sheet is included as Attachment D.

Management Recommendations

With a few exceptions, the assemblage of aquatic weeds in Hickory Hills Lake has remained relatively stable over the years. The most notable differences this year were an increase in the population of native Robbins pondweed, some reduction in extent of tapegrass, documentation of sparse weed growth in deeper areas of the lake and, of course, the new infestation of fanwort.

Aquatic plants are an important component of the lake's ecosystem, providing valuable fish and wildlife habitat. Generally, the literature suggests a 20-40% cover of aquatic vegetation is ideal for warm water fisheries like Hickory Hills Lake. Excluding stonewort, which is a low-growing, beneficial bottom cover, the lake exhibits about a 40% cover of aquatic plants, which is on the upper of the ideal range. Non-native species are not considered suitable habitat and are generally considered a threat to the ecosystem. With the exception of fanwort, all other species observed in the lake were native.

Non-native species should be actively managed in order to limit their population and spread in the lake and minimize adverse effects on native flora and fauna. It may also be necessary to manage native species, when they are present in recreational/ high-use areas of the lake or are expanding beyond a desirable level.

The most common plant in the lake, bladderwort, is a NATIVE species, but can become a nuisance under certain conditions. We understand residents have expressed concern about the abundant growth of bladderwort and its impact on recreation in the lake. Bladderwort has been present in the lake for quite some time and probably varies in abundance from year to year based on numerous environmental factors such as water clarity, water temperature, water level and other climatic patterns and conditions.

Bladderwort is sometimes referred to as "aquatic tumbleweed" because it's only loosely anchored to the bottom and very often forms floating "rafts" that can move around the lake. Bladderwort propagates from year to year primarily by dropping Winter Buds (or turions). It can also spread vegetatively by tubers or fragments and by seed, although these are not the primary means of reproduction. We would not recommend managing bladderwort (or other native plants) lake-wide, however nuisance growth in priority areas could be managed as needed.

With the presence of fanwort, as well as localized areas of nuisance, native plant growth, there are a number of in-lake management techniques that may be appropriate for Hickory Hills Lake. In addition to implementing vegetation control methods, a management plan should also include an appropriate level of monitoring to regularly document the lake's condition, guide/evaluate the program and identify any changes or new infestations of non-native species.

Drawdown

It is our understanding that the lake is currently drawn down (lowered) 18-inches in the winter for shoreline maintenance. The Association may want to consider looking into a deeper drawdown for nuisance weed control. While drawdown is not likely to be a solution for fanwort due to its depth of growth, increasing the depth of drawdown could provide an improved degree of nuisance plant control along the higher use, shoreline areas of the lake.

Given the bathymetry of Hickory Hills Lake, increasing the drawdown from 1.5-feet to 3.0-feet will marginally expand the zone of control along the shoreline and still will not expose any large areas except for parts of the Mulpus Brook inlet area and the cove area behind the "marina" on the western side of the lake. According to Table 2, a three-foot drawdown would expose ~32.4 acres of the lake bottom and retain ~72% of the lake water volume. Due to ice scour, plant control may extend an additional 6-12 inches below the actual lowered level of the lake. A six foot drawdown would expose significantly more area – 24.2% but only leave ~46% of the total lake water volume.

A three-foot drawdown is unlikely to have any adverse impacts to the lake environment, but a six-foot drawdown would require more assessment including a review of potential impacts on shallow wells, adjacent wetlands and other concerns, the ability to lower the lake using the current outlet structure would need to be conducted prior to moving forward with this technique. All drawdowns require filing an NOI with the Conservation Commission. Drawdowns over 3-feet require enhanced review and coordination with the Department of Fish & Game.

Mechanical Harvesting

Mechanical harvesting was used at Hickory Hills Lake in the past to reduce problematic plant growth along developed areas of the lake, but has not been used for the last couple years due to equipment problems and the discovery of fanwort. Harvesting is still an appropriate strategy for native plant like bladderwort as long as the target areas are thoroughly examined for fanwort growth. Since fanwort spreads by fragmentation, harvesting in areas of fanwort is strongly discouraged. If the HHL still owns a harvester, this can be a cost-effective approach to manage areas of dense growth which may be impeding access or recreation.

Aside from not harvesting in areas of fanwort, the decision on where in the lake to harvest should be prioritized based on periodic observations of the occurrence of dense, nuisance levels of native plant growth and their proximity (and potential adverse effects) on recreation use. In general, areas of native plant growth that are not impacting uses, such as along undeveloped shorelines and in isolated coves should be left unmanaged for habitat preservation.

Herbicide Treatment

Several USEPA / State registered herbicides are available for control of the plants present in Hickory Hills Lake. Herbicide selection would be based on the target plants and configuration/size of the treatment area. Herbicide treatment does not pose a significant risk to humans or fish/wildlife when conducted by licensed applicators in accordance with the product label. Treatment costs generally range from $300-$800 or more per acre depending on the herbicide used and the layout/extent of the treatment area.

We do not recommend or believe it's desirable to embark on widespread vegetation control using herbicides at Hickory Hills Lake. Rather, herbicide treatment is presented as one option for managing localized areas of nuisance growth and as a tool in the ongoing battle against fanwort. As an example, the HHL has contracted with ACT to treat Little Hickory Lake with Sonar (fluridone) twice in the past and is planning to treat again in 2013. The following table describes the active ingredients available for use in aquatic systems.

Table 9 – Aquatic Herbicide Matrix

Active Ingredient	Trade Names	Plants Controlled	Irrigation Restriction Label
Copper (algaecides & herbicides)	Copper sulfate; K-Tea; Cutrine Plus; Captain; Komeen, Nautique	Algae – filamentous & microscopic; curlyleaf pondweed other submersed	None
Sodium Carbonate Peroxyhydrate	Phycomycin; GreenClean	Algae – filamentous & microscopic	None
Diquat	Reward	Milfoil & other submersed plants; duckweed & watermeal	3-5 days

Endothall	Aquathol K (herbicide); Hydrothol 191 (algaecide)	Pondweeds and algae	7-14 days
Fluridone	Sonar & generics	Watermeal, duckweed, milfoil, fanwort and other submersed plants	30-day min (often 60-90 days with multiple applications
Glyphosate	Rodeo & generics	Cattails, phragmites, purple loosestrife, waterlilies, etc.	None
2,4-D	Navigate	Milfoil, water chestnut, waterlilies	~ 30 days. If known uses are present, residue testing is required
Triclopyr	Renovate 3; Renovate OTF	Milfoil, purple loosestrife	180 days or required residue testing
Products Pending MA Department of Agricultural Resources (DAR) Registration			
Imazapyr	Habitat	Phragmites and mose emergent vegetation/lilies	Up to 120 days; requires residue testing
Imazamox	Clearcast	Pondweed, milfoil, hydrilla	Residue testing required
Flumioxazin	Clipper	Fanwort, milfoil, other submersed and floating plants (watermeal)	~5-days
Penoxsulam	Galleon	Hydrilla, milfoil, watermeal	Residue testing required
Bispyribac-sodium	Tradewind	Milfoil; hydrilla; some floating and emergent weeds	Extended; requires residue testing
Carfentrazone	Stingray	Floating & Emergent plants	Up to 14 days

Specifically for fanwort, Sonar (fluridone) and Clipper (flumioxazin) are the only two herbicides shown to provide effective control. Sonar has been used extensively for many years to provide systemic ("root-killing") control of fanwort under various treatment conditions. Typically treatments are conducted with both liquid and slow-release pellet formulations to provide the needed target concentration and exposure time (typically at least 60-days).

Since Sonar herbicide requires a long contact time with the target plants, it can be challenging to use effectively in smaller treatment areas and areas subject to high dilution (near inlets, small sections of shoreline, etc). It is best suited for larger areas or isolated cove areas with little or no water exchange. Sonar can be fairly broad-spectrum (affecting a wide variety of plant species) at high doses, however many plants, such as fanwort, can be controlled at lower dose ranges. Although Sonar is somewhat more expensive than Clipper herbicide, its systemic properties make it the preferred option when suitable treatment conditions can be maintained.

Clipper is pending registration in Massachusetts (expected by Spring 2013), but has been shown to provide excellent, seasonal control of fanwort in other New England lakes. There is also some indication that treatment with Clipper provides a reduction in the extent of infestation after multiple years of use. Clipper is still fairly costly compared to other contact herbicides, but is generally less expensive than Sonar in most situations. Clipper is a broad-spectrum herbicide and affects a wide range of plant species, but because it's a contact herbicide, significant re-growth is usually seen in the year after treatment. From recent experience, however, fanwort is highly susceptible to Clipper herbicide and some cumulative reductions in the extent of infestation is observed after multiple years of treatment. Clipper works very quickly and only requires a contact time measured in hours, making a viable alternative to Sonar herbicide in otherwise challenging situations.

For control of bladderwort, the herbicide of choice would likely be Reward (diquat) herbicide. Sonar herbicide does provide marginal control of bladderwort, but higher doses are required and control in subsequent years is often limited. Reward herbicide works fairly well on bladderwort, is economical to use, can be used on a smaller partial lake basis and provide seasonal control of bladderwort.

We understand that the LMG has implemented its own multi-faceted fanwort management program, including, among other tasks, volunteer plant surveying and suction harvesting. As always, we'd welcome the opportunity to work with you as needed on planning and implementing this work, including discussions on the appropriateness of herbicide treatment.

Hydro-Raking

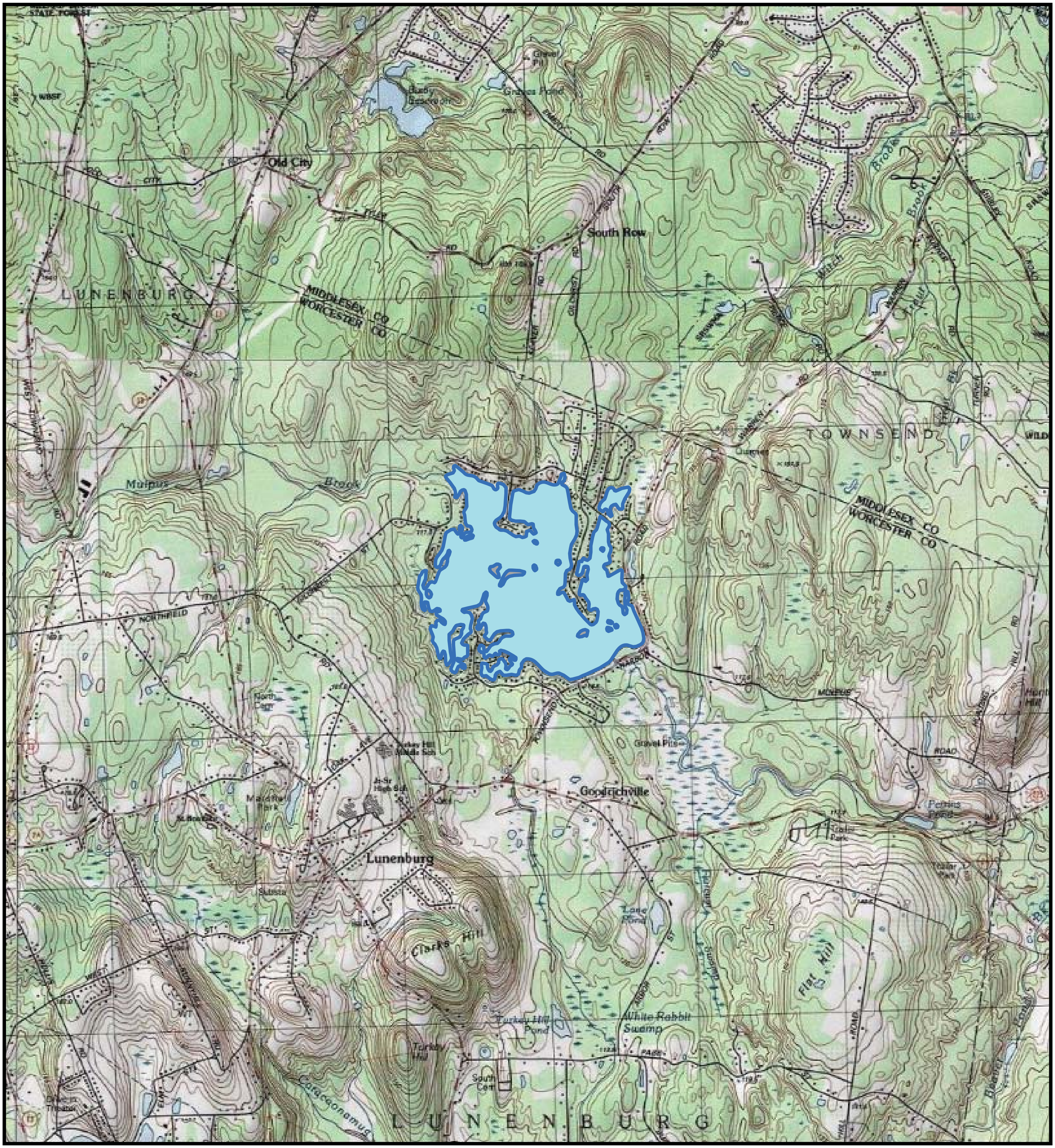
In areas of dense waterlily growth, some hydro-raking may be useful to open up lanes for resident access and fishing. Hydro-raking is also useful for individual residents to clear their waterfronts of weed and debris that may have collected. The Hydro-Rake is essentially a floating backhoe with hydraulically powered paddle-wheels. It is contracted on an hourly basis for $195/hour with a lump sum mobilization charge of $1,000-$1,500. Since the Hydro-Rake has no on-board storage, raked material must be deposited along the shoreline, preferably within 100-200 feet of the work area. After drying, the material will need to be loaded and disposed of at an approved upland location. We understand an extensive hydro-raking project was conducted by another contractor in 2011. We'd be interested in discussing how that project was conducted and perceived by the LMG. When properly performed with appropriate planning and safeguards, Hydro-Raking can be a very effective management technique.

Hydro-Raking provides a more intensive (and time consuming) removal process and as such is usually not suitable for managing larger areas of submersed plant growth. As with mechanical harvesting, the decision on where in the lake to hydro-rake should be prioritized based on the occurrence of dense, nuisance levels of native plant growth and their proximity (and potential adverse effects) on recreation use. Typically, beach areas (both common-use and along private residential shorefront) are the types of locations where hydro-raking will be a suitable technique.

Other control methods would either not be cost-effective or applicable at Hickory Hills Lake. There are no biological control agents (i.e. grass carp, insects) currently permitted for general use in Massachusetts. No known insects target the species found in the lake and effectiveness and impacts of grass carp in large multi-use waterbodies is too uncertain and generally not recommend even in states where they are legal. Aeration is sometimes effective against algal blooms, but provides no control over vascular plants. Bottom weed barriers are effective for small swim or dock areas applications Covering larger areas is cost prohibitive (>$40,000 just for material) and may have negative impacts to macro-invertebrates and fish.

One final recommendation would be to repeat this monitoring project on an annual basis and at a similar scale. Monitoring is an important part of Lake Management for early detection of invasive/exotic species that can quickly overrun a lake. As always, we're happy to continue being involved in the on-going discussion about monitoring and implementation of management techniques at Hickory Hills Lake.

Attachment A – Maps



Hickory Hills Lake

Lunenburg, MA

Locus Map

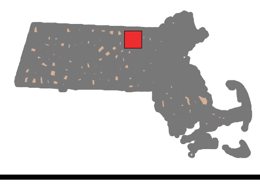
MAP	SURVEY DATE:	MAP DATE:
1	8/23 & 8/24/12	12/2012

Legend:

N

0 1,0002,000 4,000 6,000 8,000 Feet

AQUATIC CONTROL TECHNOLOGY, INC.
11 JOHN ROAD
SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
FAX: (508) 865-1220
WEB: WWW.AQUATICCONTROLTECH.COM



Hickory Hills Lake

Lunenburg, MA

Survey Points

MAP	SURVEY DATE:	MAP DATE:
2	8/23 & 8/24/12	8/23/12

Legend:

N

0 225 450 900 1,350 1,800 Feet

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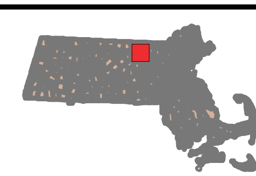

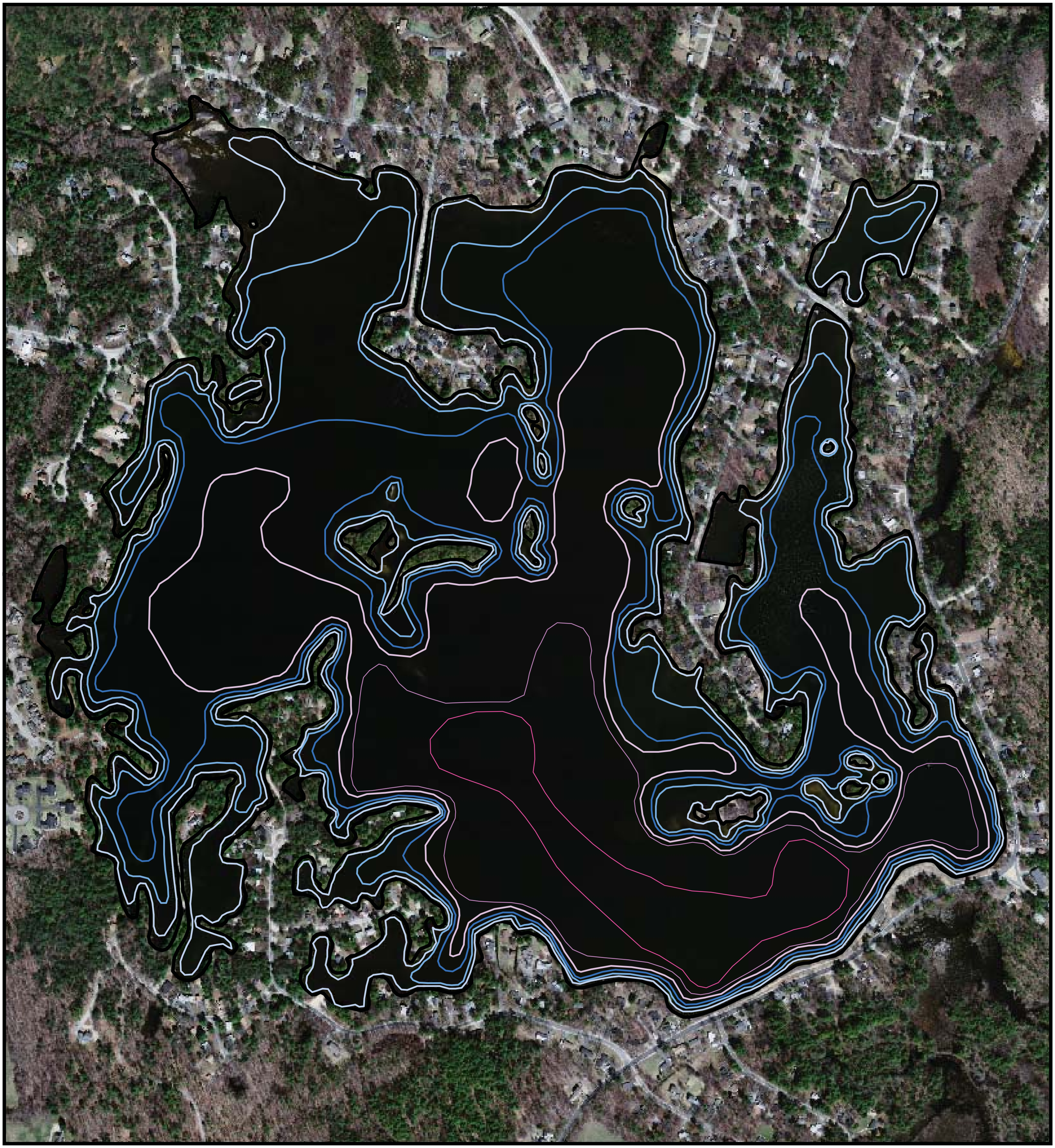

Hickory Hills Lake

Lunenburg, MA

Bathymetry Map

MAP	SURVEY DATE:	MAP DATE:
3	8/23 & 8/24/12	8/23/12

Legend:

Water Depth (ft)

- 3
- 6
- 9
- 12
- 15
- 18

Contour Interval : 3-feet

0 237.5 475 950 1,425 1,900 Feet

N

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SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
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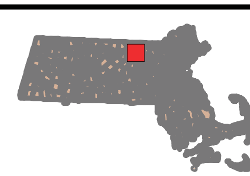
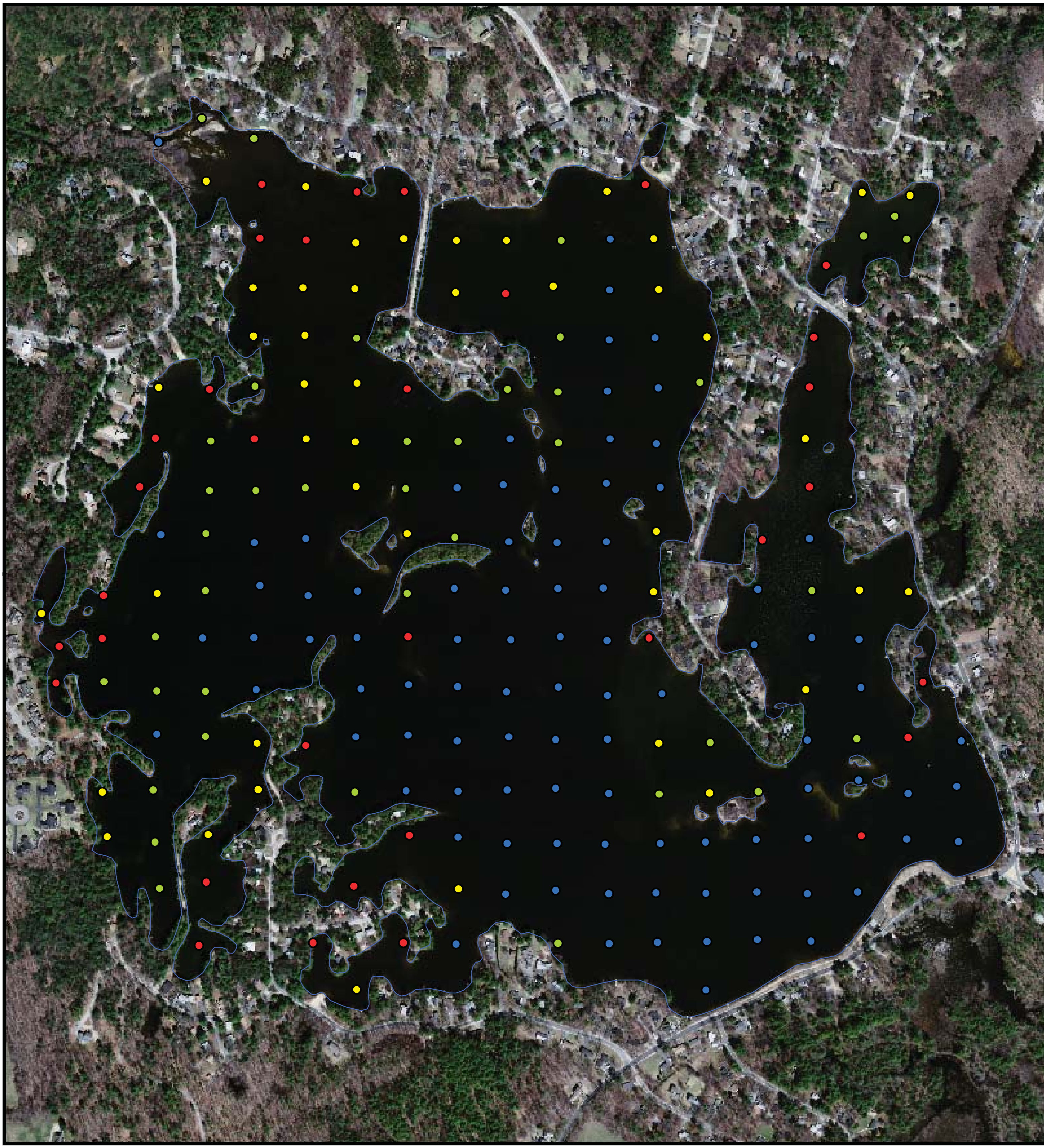
WEB: WWW.AQUATICCONTROLTECH.COM





Hickory Hills Lake

Lunenburg, MA

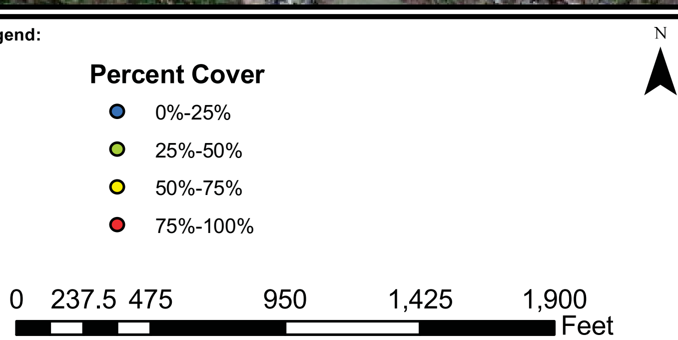
Total Percent Plant Cover

MAP	SURVEY DATE:	MAP DATE:
4	8/23 & 8/24/12	8/23/12

Legend:

Percent Cover

- 0%-25%
- 25%-50%
- 50%-75%
- 75%-100%



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PHONE: (508) 865-1000
FAX: (508) 865-1220
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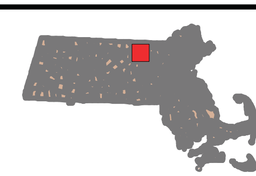
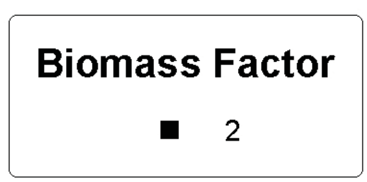


Map 5a

Locations and Biomass of Submersed arrowhead

Map 5b

Locations and Biomass of Coontail

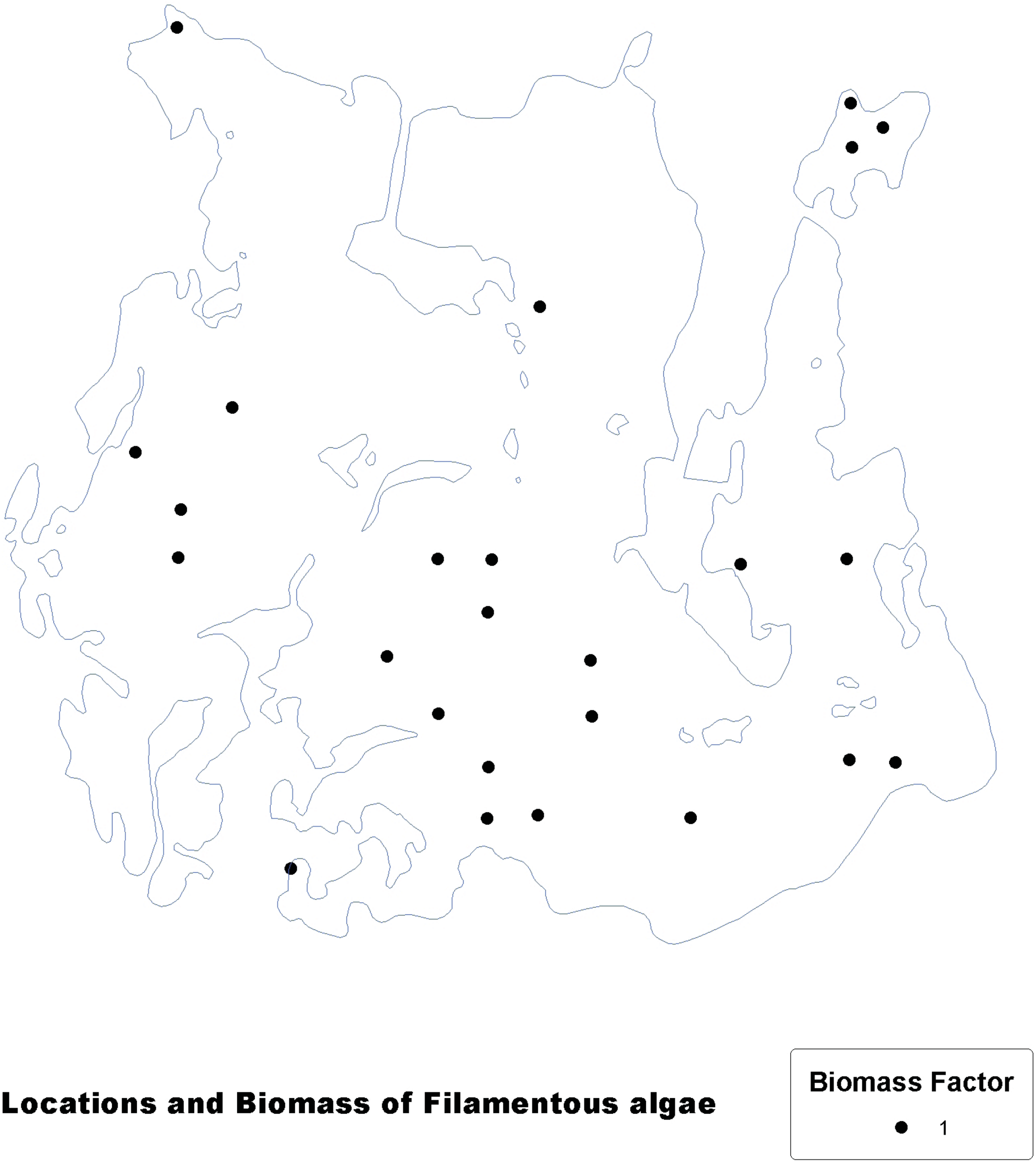


Map 5c

Locations and Biomass of Duckweed

Biomass Factor	
♦	4

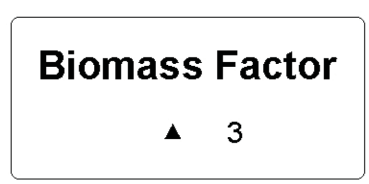
Map 5d



Locations and Biomass of Filamentous algae

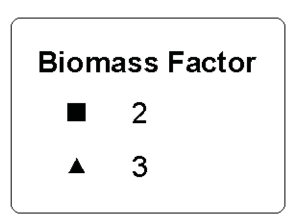
Map 5e

Locations and Biomass of Largeleaf pondweed

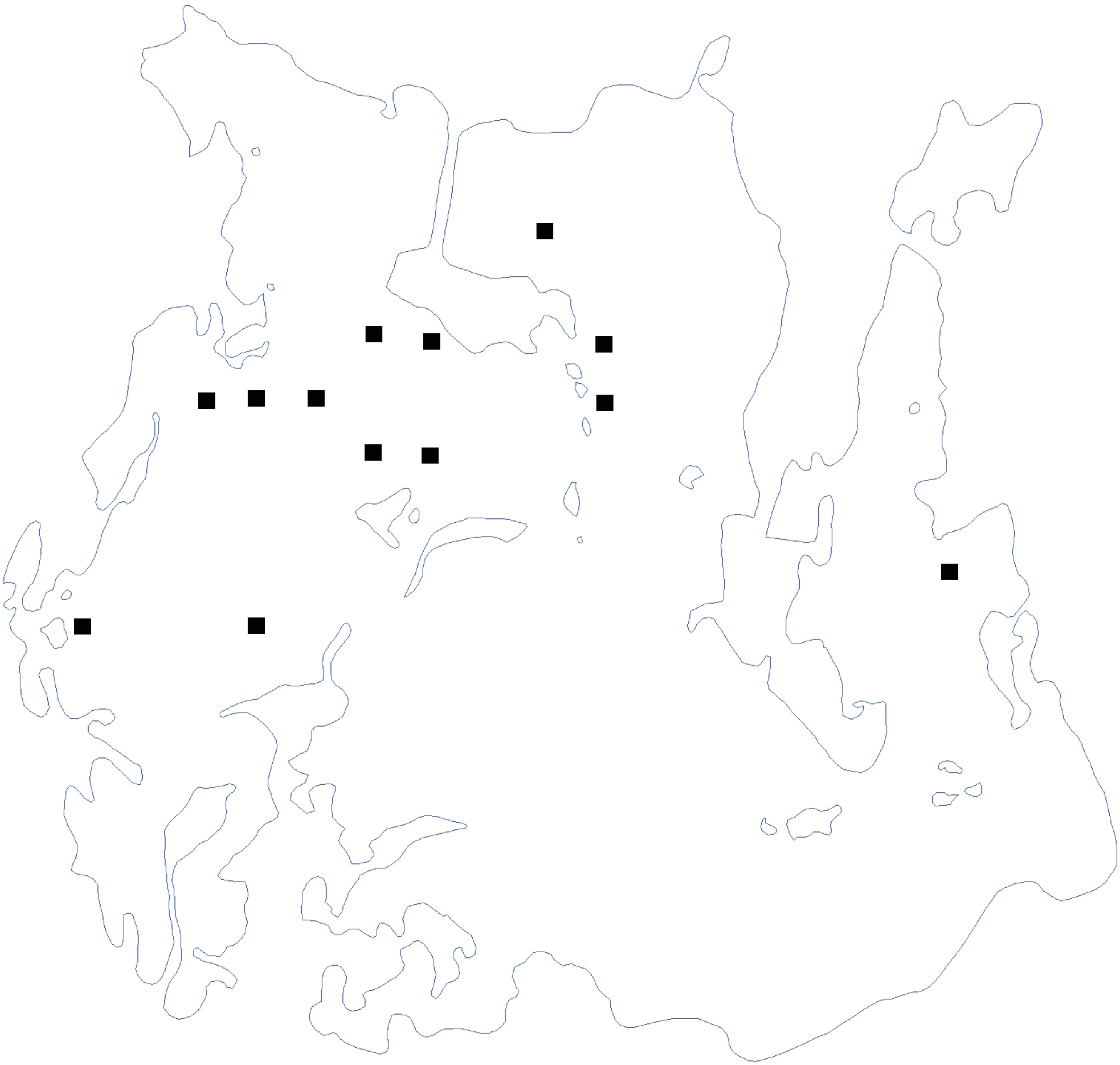


Map 5f

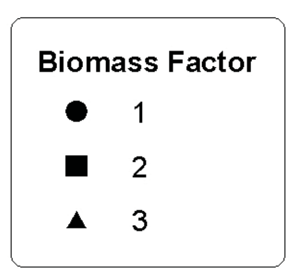
Locations and Biomass of Mermaidweed



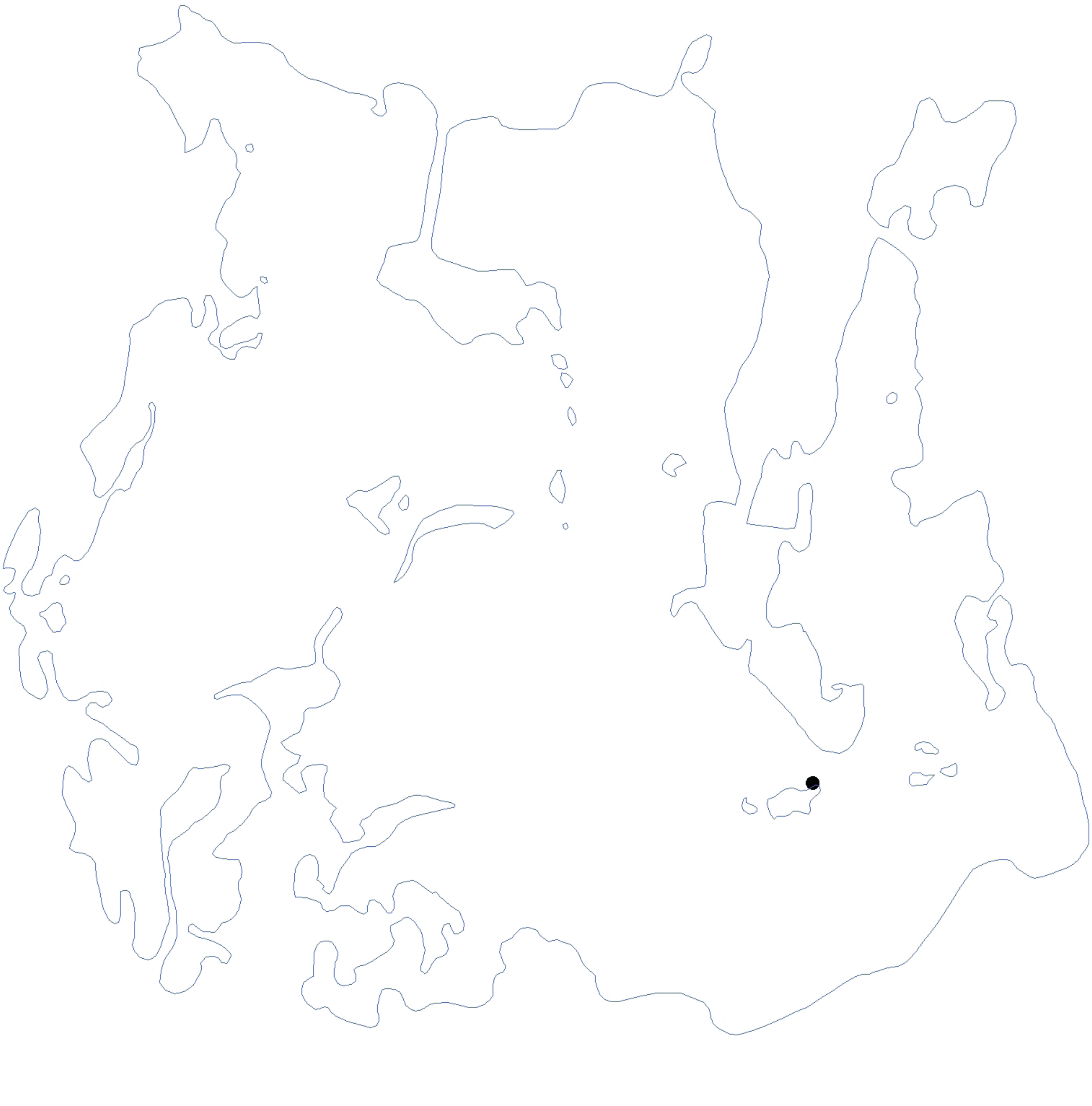
Map 5g



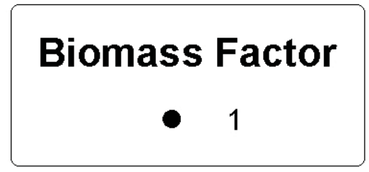
Locations and Biomass of Naiad



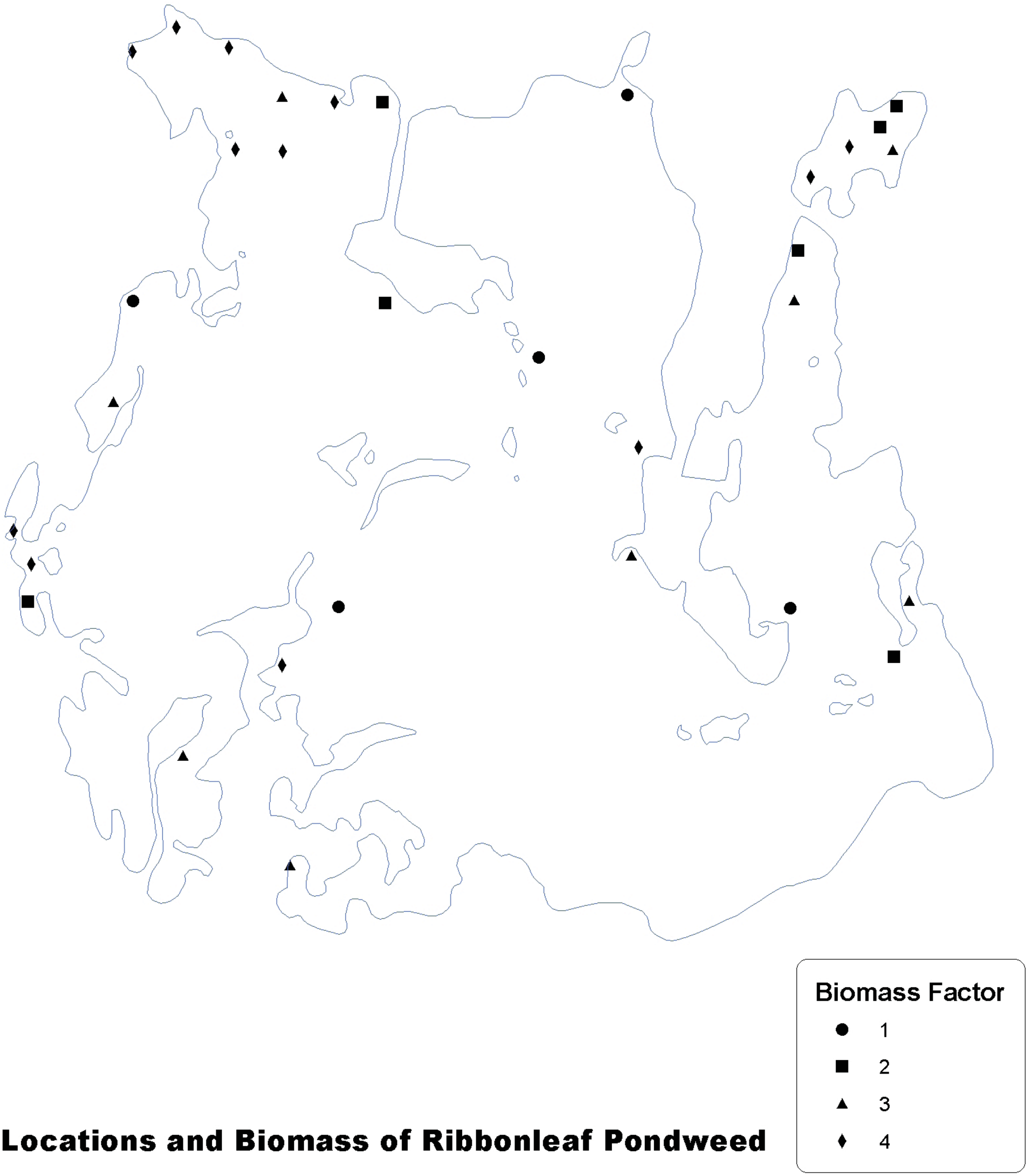
Map 5h



Locations and Biomass of Quillwort

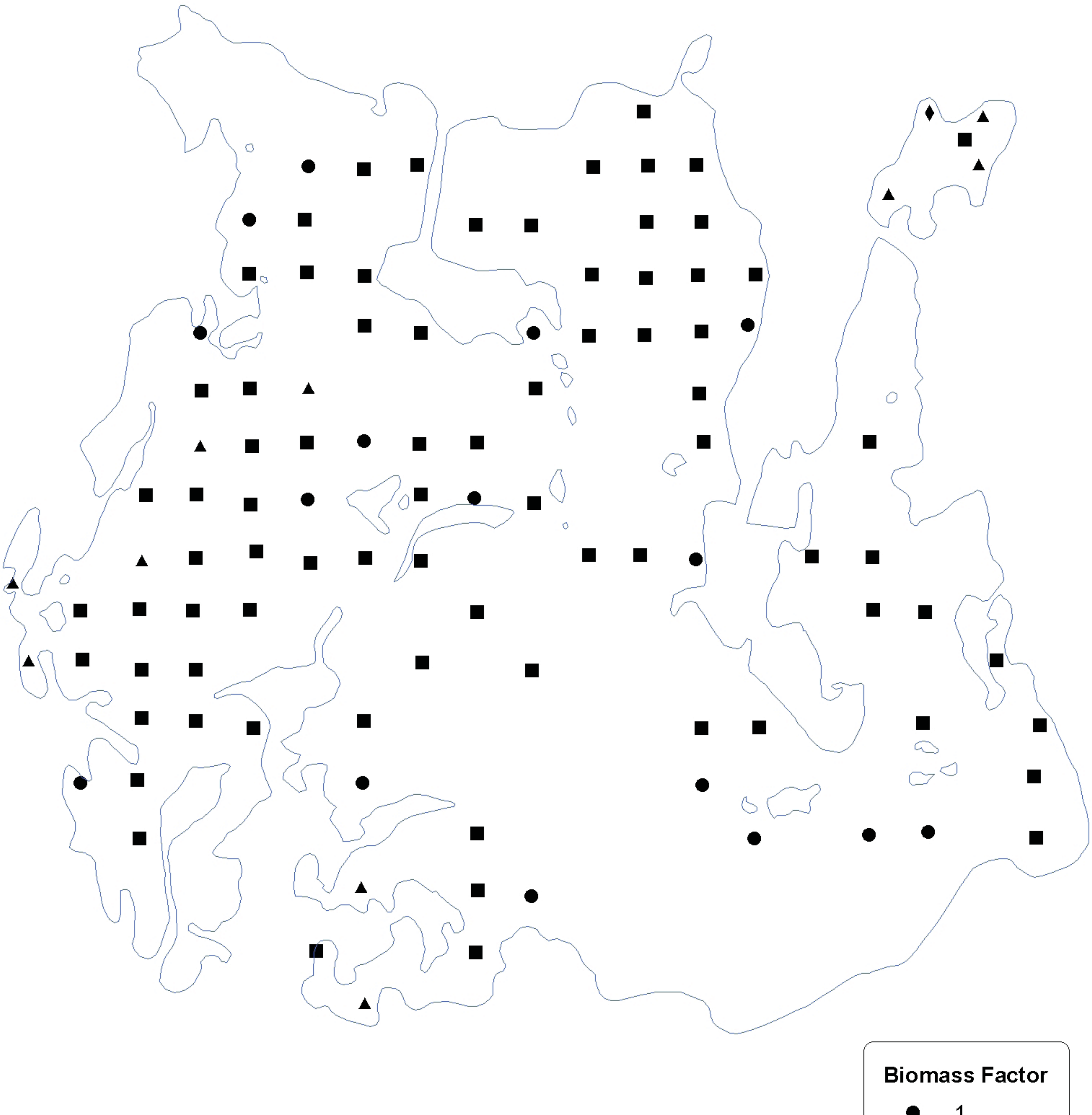


Map 5I



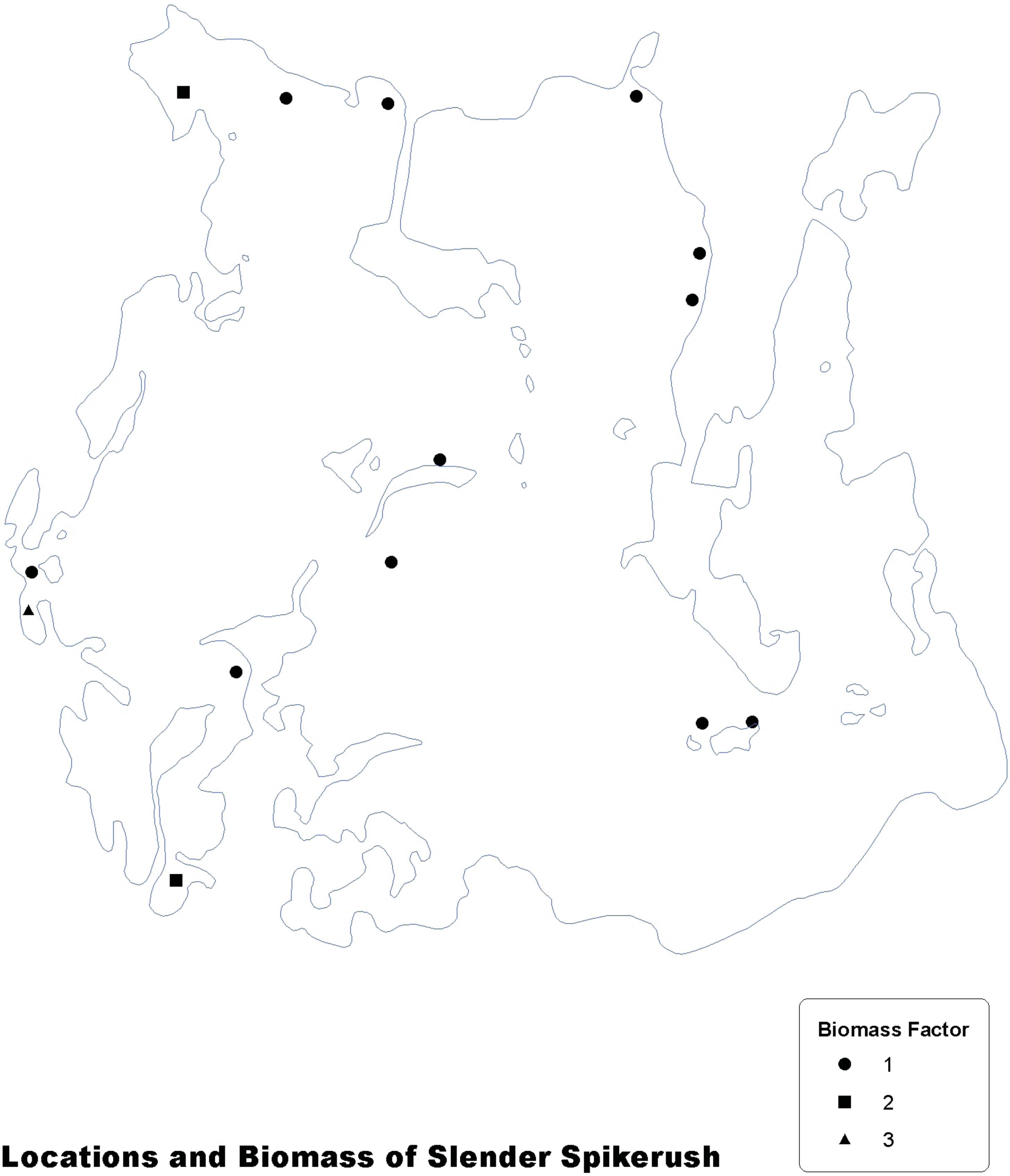
Locations and Biomass of Ribbonleaf Pondweed

Map 5j



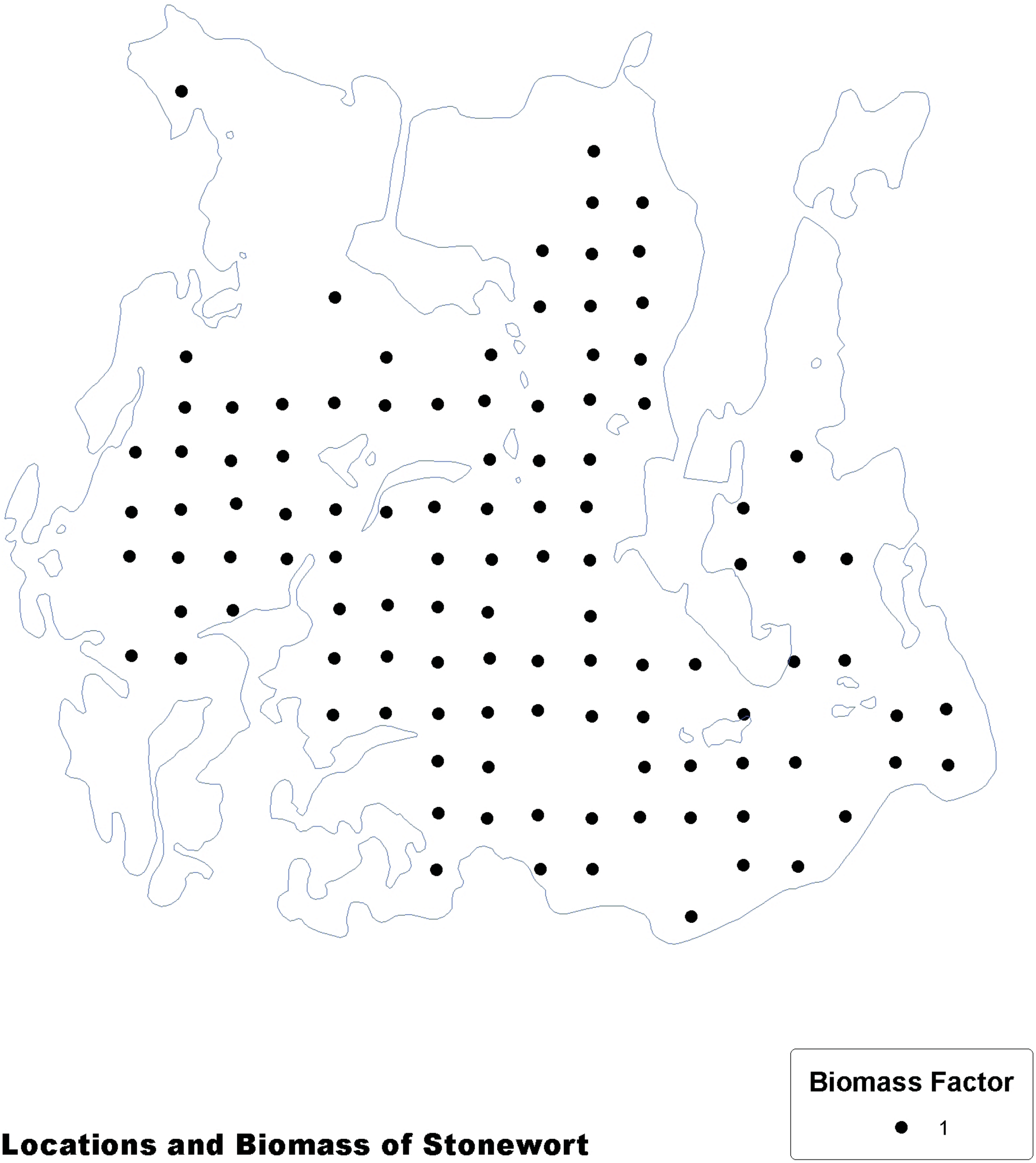
Locations and Biomass of Robbins Pondweed

Map 5k



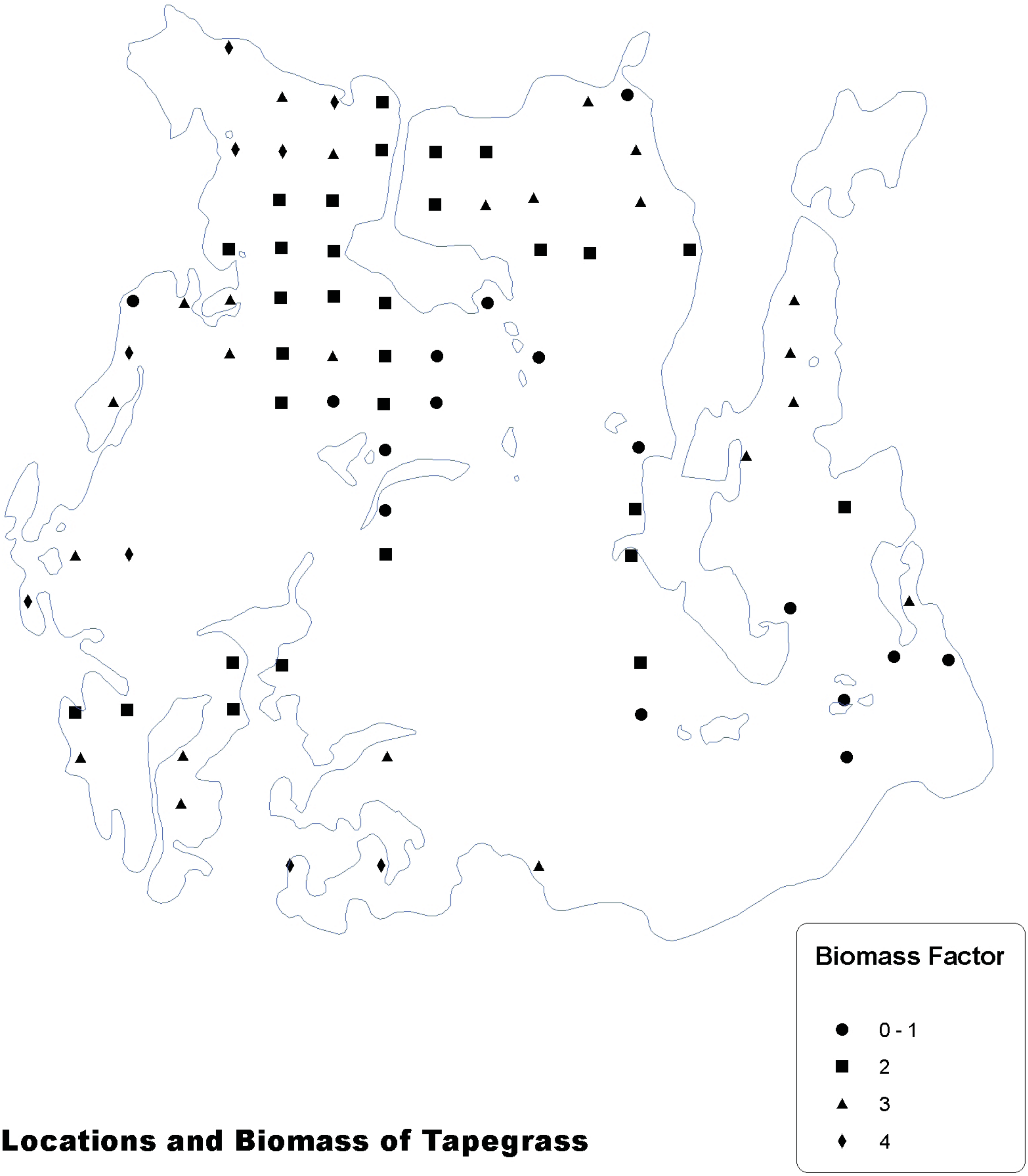
Locations and Biomass of Slender Spikerush

Map 51



Locations and Biomass of Stonewort

Map 5m

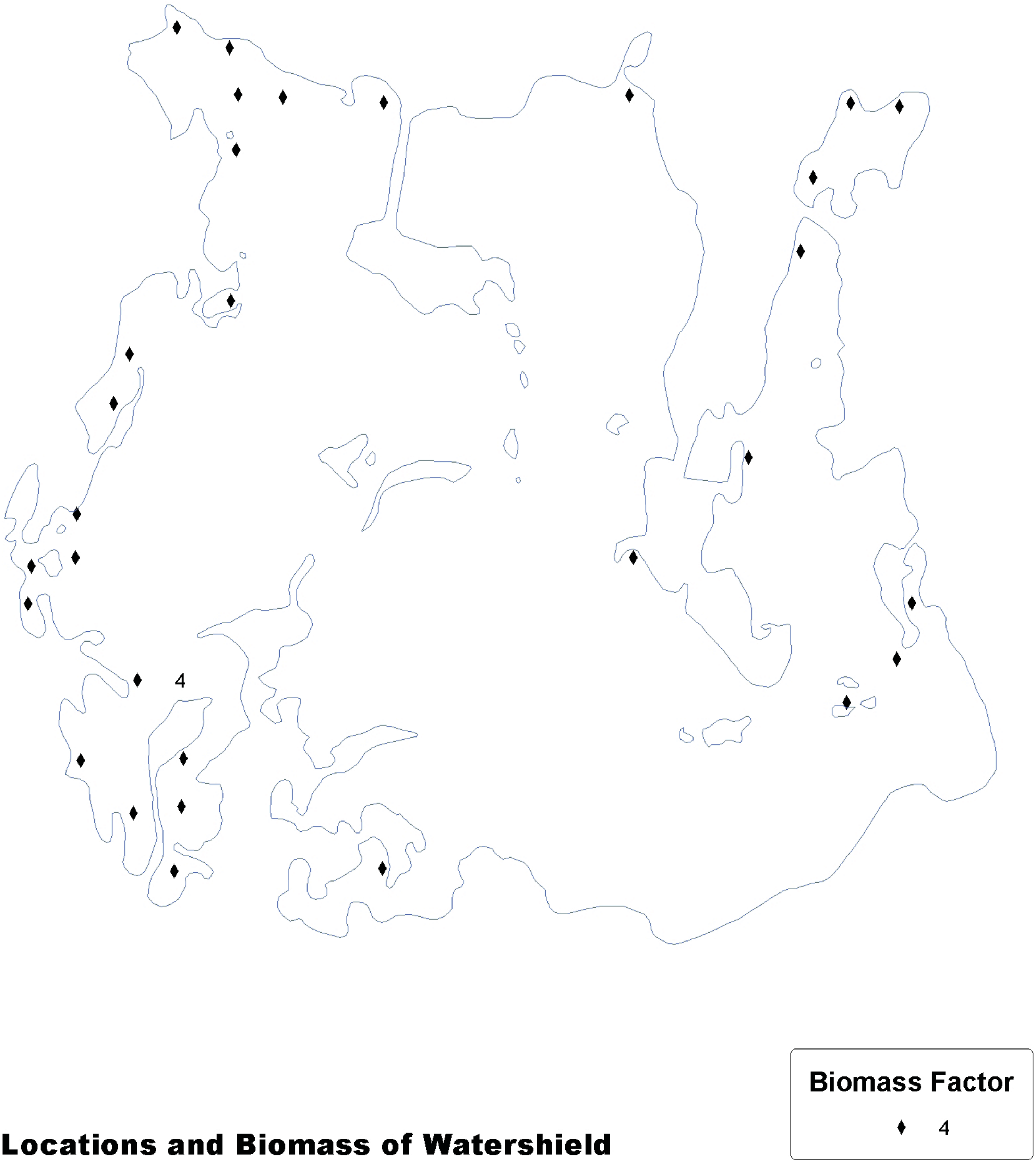


Locations and Biomass of Tapegrass

Map 5n

Locations and Biomass of Thinleaf pondweed

Map 5o



Locations and Biomass of Watershield

Map 5p

Locations and Biomass of White waterlily

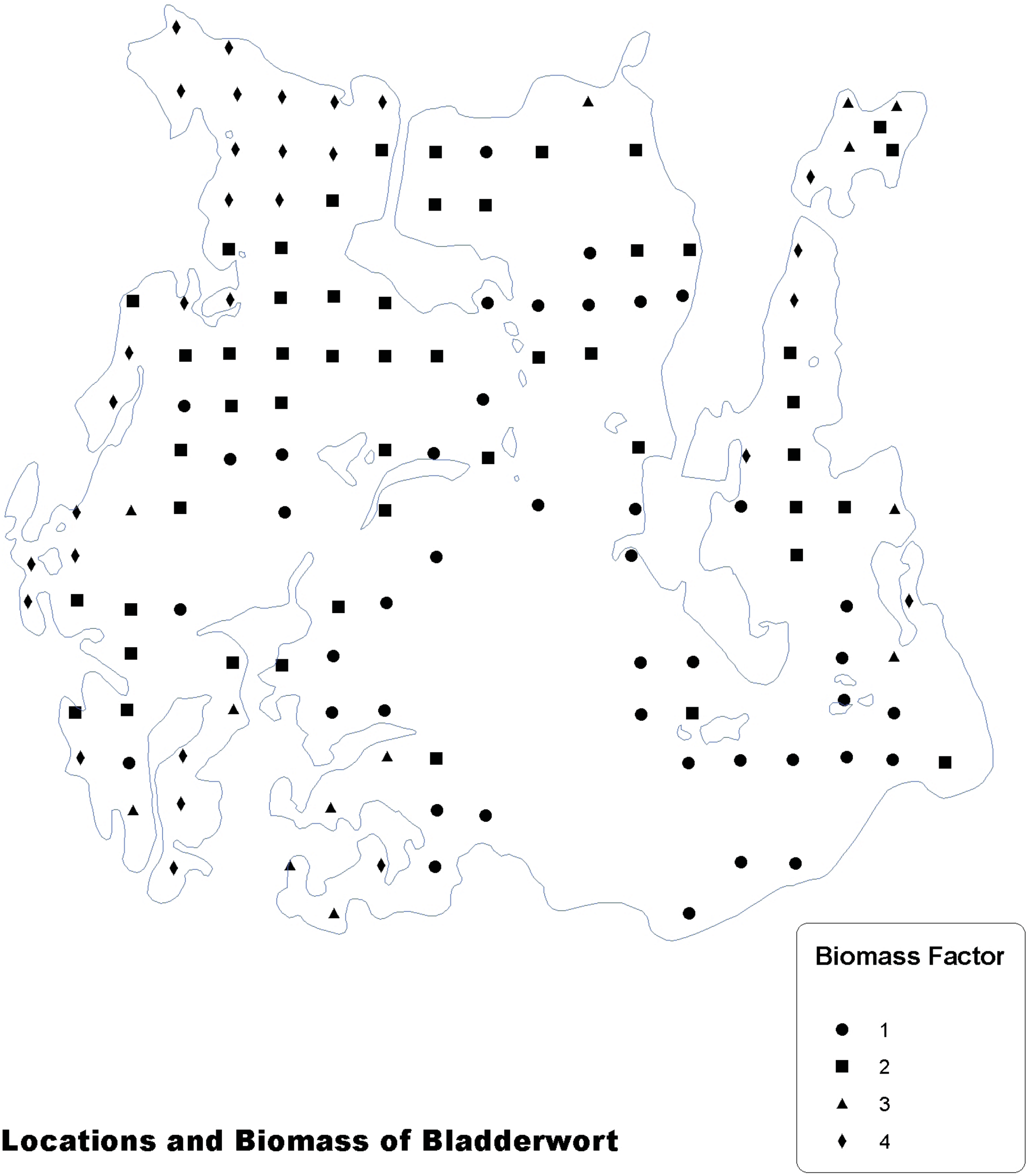
Biomass Factor	
♦	4

Map 5q

Locations and Biomass of Yellow waterlily

Biomass Factor	
♦	4

Map 5r



Locations and Biomass of Bladderwort

Attachment B – Survey Point Data Sheet

Point	Depth	Sed Type	LAT	LONG_	U	Ubio	V	Vbio	Pe	PeBio	B	Bbio	PR	PrBio	Ni	NiBio	Pp	PpBio	Eo	EoBio	Mw	MwBio	Pa	PaBio	Nj	NjBio	Ny	NyBio	Nu	NuBio	Fa	FaBio	Sg	SgBio	Io	IoBio	Cd	CdBio	Lm	LmBio
1	5	MG	42.6056	-71.7098	30	3	0	0	0	0	0	0	40	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	18	-	42.6056	-71.703	5	1	0	0	0	0	0	0	0	0	70	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	5	MG	42.60623	-71.7129	40	3.5	0	0	0	0	5	4	0	0	0	0	0	0	10	2	15	2.5	15	3	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0
4	4	MG	42.60627	-71.7107	30	2.5	10	3	5	3	0	0	30	2	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	20	1	0	0	0	0	0	0	0	0
5	4	MG	42.60627	-71.7089	35	3.5	30	3.5	0	0	25	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0
6	13	-	42.60626	-71.7079	5	1	0	0	0	0	0	0	10	2	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	14	-	42.60627	-71.7059	0	0	40	2	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	16	-	42.60627	-71.7049	0	0	0	0	0	0	0	0	0	0	80	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	20	-	42.60629	-71.704	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	18	-	42.6063	-71.703	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	18	-	42.60633	-71.702	5	1	0	0	0	0	0	0	0	0	70	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	17	-	42.60632	-71.701	10	1	0	0	0	0	0	0	0	0	5	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	6	-	42.60704	-71.7137	40	2.5	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0
14	5	M	42.60714	-71.7128	70	3.5	10	2	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0
15	5	M	42.60709	-71.7099	50	2.5	0	0	0	0	0	0	40	2.5	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0
16	16	-	42.60705	-71.7078	30	1	0	0	0	0	0	0	30	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	16	-	42.60698	-71.7069	10	1	0	0	0	0	0	0	5	1	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
18	17	-	42.60703	-71.7059	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0
19	18		42.60699	-71.7049	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	18	-	42.607	-71.704	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	18		42.607	-71.703	0	0	0	0	0	0	0	0	0	0	45	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
22	17	-	42.60702	-71.702	0	0	0	0	0	0	0	0	0	0	20	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	20	-	42.60699	-71.701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	16	-	42.60702	-71.7001	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	7	G	42.60782	-71.7088	50	3	40	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	17	-	42.60779	-71.7079	20	1.5	0	0	0	0	0	0	5	2	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	17	-	42.60771	-71.7069	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
28	20	-	42.60771	-71.7059	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	17	-	42.6077	-71.705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	16	-	42.60771	-71.7039	0	0	0	0	0	0	0	0	0	0	20	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	17	-	42.60774	-71.703	5	1	0	0	0	0	0	0	5	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	5	M	42.60779	-71.7147	30	3.5	20	2	0	0	20	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	9	-	42.60772	-71.7138	10	1	0	0	0	0	0	0	30	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	5	M	42.60782	-71.7127	40	3.5	10	2	5	3	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	17	-	42.60778	-71.702	10	1	0	0	0	0	0	0	0	0	40	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	18	-	42.60779	-71.701	10	1	0	0	0	0	0	0	5	1	50	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	9	-	42.60783	-71.7	20	1	50	1	0	0	0	0	5	1	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0
38	16	-	42.60779	-71.6991	5	1	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0
39	16	-	42.60775	-71.6981	10	1.5	0	0	0	0	0	0	5	1.5	60	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	6	M	42.60843	-71.7148	30	1.5	20	1.5	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	10	-	42.60847	-71.7138	20	2	20	1.5	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	7	-	42.60848	-71.7117	60	3	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	15	-	42.60844	-71.7099	30	1	0	0	0	0	0	0	10	1	50	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	16	-	42.60846	-71.7089	20	1	0	0	0	0	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	17	-	42.60846	-71.7079	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
46	18	-	42.60848	-71.7069	0	0	0	0	0	0	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	17	-	42.60851	-71.7059	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	17	-	42.60843	-71.7049	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
49	6	G	42.60842	-71.7039	10	1	30	1	0	0	0	0	10	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	5	G	42.60845	-71.7029	10	2	0	0	0	0	0	0	0	0	0	0	5	1	30	1	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0
51	4	R	42.60846	-71.702	0	0	0	0	0	0	0	0	0	0	5	1	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0
52	2	RG	42.60851	-71.701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0
53	6	MG	42.60863	-71.7	5	1	10	1	0	0	5	4	0	0	20	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	16	-	42.60845	-71.6991	20	1	0	0	0	0	0	0	0	0	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	16	-	42.60855	-71.6981	0	0	0	0	0	0	0	0	10	1.5	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	10	-	42.60927	-71.7137	10	1.5	0	0	0	0	0	0	5	1.5	30	1	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	9	-	42.60924	-71.7128	0	0	0	0	0	0	0	0	40	1.5	20	1	0	0	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	8	-	42.60914	-71.7118	20	1.5	10	1.5	0	0	0	0	30	1.5	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	15	-	42.60924	-71.7098	10	1	0	0	0	0	0	0	5	1.5	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
959	8	MG	42.60911	-71.7108	40	1.5	30	1.5	5	3.5	0	0	0	0	0	0	0	0	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	16	-	42.60927	-71.7088	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0
61	19	-	42.60918	-71.7079	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	18	-	42.60924	-71.7069	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	17	-	42.6092	-71.7059	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	16	-	42.60922	-71.7049	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
65	9	-	42.60916	-71.7039	30	1	10	1.5	0	0	0	0	10	1.5	20	1	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	12	-	42.60917	-71.7029	20	1	0	0	0	0	0	0	10	1.5	40	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	12	-	42.60921	-71.701	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	12	-	42.60923	-71.7001	10	1	0	0	0	0	0	0	30	2	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	7	M	42.60925	-71.6991	60	3	20	1	10	2	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	11	-	42.6092	-71.698	0	0	10	1	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	15	-	42.60993	-71.7097	20	1.5	0	0	5	1	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	13	-	42.60999	-71.7088	5	1	0	0	0	0	0	0	5	1.5	30	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Point	Depth	Sed Type	LAT	LONG_	U	Ubio	V	Vbio	Pe	PeBio	B	Bbio	PR	PrBio	Ni	NiBio	Pp	PpBio	Eo	EoBio	Mw	MwBio	Pa	PaBio	Nj	NjBio	Ny	NyBio	Nu	NuBio	Fa	FaBio	Sg	SgBio	Io	IoBio	Cd	CdBio	Lm	LmBio
73	14	-	42.60997	-71.7079	0	0	0	0	0	0	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	14	-	42.60989	-71.7069	0	0	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0
75	16	-	42.60997	-71.7059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	12	-	42.60984	-71.7049	0	0	0	0	0	0	0	0	0	0	70	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	5	RG	42.60987	-71.7039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	4	M	42.61	-71.7157	40	3.5	10	3.5	5	2	5	4	5	2.5	0	0	0	0	5	2.5	5	2	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0
79	11	-	42.61002	-71.7148	10	2	0	0	0	0	0	0	30	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	11	-	42.6099	-71.7137	10	1.52	0	0	0	0	0	0	30	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	12	-	42.60989	-71.7128	20	1	0	0	0	0	0	0	20	1.5	20	1	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	12	-	42.60992	-71.7118	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	4	S	42.60993	-71.7011	0		60	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	12	-	42.60997	-71.7	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	2	MG	42.61053	-71.7156	25	4	0	0	5	3.5	5	4	0	0	0	0	0	0	15	1	0	0	0	0	0	0	40	4	0	0	0	0	0	0	0	0	5	2	0	0
86	7	MG	42.61065	-71.7148	30	3.5	20	2.5	0	0	25	4	20	1.5	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	12	-	42.61068	-71.7138	0	0	20	3.5	0	0	0	0	30	2	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	12	-	42.61066	-71.7128	0	0	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
89	13	-	42.61067	-71.7118	0	0	0	0	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	13	-	42.61067	-71.7098	0	0	0	0	0	0	0	0	0	0	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	5	RG	42.61068	-71.7088	0	0	60	1.5	0	0	0	0	0	0	0	0	0	0	20	1	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	14	-	42.61065	-71.7079	5	1	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
93	14	-	42.61064	-71.7068	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
94	15	-	42.61069	-71.7059	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	14	-	42.61064	-71.705	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	4	G	42.61068	-71.7041	30	1	20	1.5	10	2.5	30	4	0	0	0	0	0	0	0	0	0	0	10	3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	11	-	42.61058	-71.7021	0	0	0	0	0	0	0	0	5	15	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
98	11	-	42.61069	-71.701	5	2	0	0	0	0	0	0	5	2	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	11	-	42.61066	-71.7	0	0	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0
100	1	M	42.61101	-71.716	0	0	0	0	10	4	0	0	10	3	0	0	0	0	0	0	10	2	0	0	0	0	20	4	20	4	0	0	0	0	0	0	0	3.5	5	4
101	6	MG	42.61127	-71.7148	40	3.5	0	0	0	0	60	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	12	-	42.6113	-71.7137	20	2.5	0	0	0	0	0	0	30	2.5	10	1	0	0	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	13	-	42.61134	-71.7128	10	1.5	0	0	0	0	0	0	20	2	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1	0	0	0	0	0	0	0	0
104	13	-	42.61142	-71.7117	0	0	0	0	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	13	-	42.61127	-71.7108	20	1	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	12	-	42.61134	-71.7098	0	0	0	0	0	0	0	0	5	1.5	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	10	-	42.6113	-71.7088	20	1.5	10	1	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	14	-	42.61138	-71.7079	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	13	-	42.61136	-71.7069	0	0	0	0	0	0	0	0	0	0	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	14	-	42.61139	-71.7059	10	1	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	14	-	42.61139	-71.705	0	0	0	0	0	0	0	0	5	2	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	6	-	42.61134	-71.704	20	1	20	1.5	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	12	-	42.61138	-71.702	5	1	0	0	0	0	0	0	5	2	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	12	-	42.61136	-71.701	10	2	0	0	0	0	0	0	20	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	8	-	42.61137	-71.7	20	2	20	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1.5	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	12	-	42.61203	-71.7118	5	1	0	0	0	0	0	0	10	2	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	11	-	42.6121	-71.7108	5	1	0	0	0	0	0	0	5	1	40	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	7	-	42.61217	-71.7089	30	1.5	20	1	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	5	R	42.61212	-71.7079	10	1	0	0	0	0	0	0	5	1	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	10	-	42.61206	-71.7069	10	1.5	0	0	0	0	0	0	10	1.5	50	1	0	0	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122	14	-	42.61204	-71.7059	0	0	0	0	0	0	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
123	14	-	42.61205	-71.705	0	0	0	0	0	0	0	0	0	0	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124	8	-	42.61221	-71.704	30	1.5	10	1	5	3.5	0	0	0	0	20	1.5	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	10	-	42.61211	-71.701	10	1.5	0	0	0	0	0	0	0	0	30	1	0	0	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126	11	-	42.61215	-71.7137	0	0	0	0	0	0	0	0	10	2	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1	0	0	0	0	0	0	0	0
127	12	-	42.61216	-71.7128	20	1.5	0	0	0	0	0	0	20	1.5	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128	12	-	42.61278	-71.7127	10	1	0	0	0	0	0	0	20	2.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9128	6	MR	42.61283	-71.7141	40	3.5	30	2	5	3	5	4	0	0	0	0	0	0	0	0	0	0	5	3	0	0	5	4			0	0	0	0	0	0	0	0	0	0
129	12	-	42.61278	-71.7118	20	1.5	0	0	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	5	1.5	0	0	0	0	0	0	30	1	0	0	0	0	0	0	0	0
130	10	-	42.61283	-71.7108	10	1.5	20	1.5	0	0	0	0	10	1.5	20	1	0	0	0	0	0	0	10	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131	10	-	42.61285	-71.7098	0	0	20	1	0	0	0	0	20	1	20	1	0	0	0	0	0	0	5	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132	11	-	42.61282	-71.7089	0	0	10	1.5	0	0	0	0	30	1.5	30	1	0	0	0	0	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133	11	-	42.61283	-71.7079	0	0	10	1	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134	13	-	42.61288	-71.707	5	1	0	0	0	0	0	0	0	0	40	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	13	-	42.61281	-71.706	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	14	-	42.6129	-71.705	0	0	0	0	0	0	0	0	0	0	50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137	12	-	42.61285	-71.7039	0	0	0	0	0	0	0	0	10	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
138	10	-	42.61286	-71.701	30	2	20	2	0	0	0	0	30	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
139	8	-	42.61353	-71.7138	70	3.5	10	3	0	0	20	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	11	-	42.61349	-71.7127	20	1.5	0	0	0	0	0	0	20	2	50	1	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
141	9	-	42.61352	-71.7118	30	2	20	2	0	0	0	0	20	2	0	0	0	0	0	0	0	0	10	2	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142	9	-	42.61353	-71.7108	10	1.5	30	1.5	0	0	0	0	20	2.5	0	0	0	0	0	0	0	0	5	2	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143	9	-	42.61349	-71.7099	10	1.5	20	2	0	0	0	0	0	0	0	0	5	1	0	0	0	0	20	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
144	9	-	42.61349	-71.7089	10	1.5	20	1.5	0	0	0	0	0	0	10	1	0	0	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	9	-	42.6135	-71.7079	20	1.5	20	1	0	0	0	0	0	0	0	0	5	1.5	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Point	Depth	Sed Type	LAT	LONG_	U	Ubio	V	Vbio	Pe	PeBio	B	Bbio	PR	PrBio	Ni	NiBio	Pp	PpBio	Eo	EoBio	Mw	MwBio	Pa	PaBio	Nj	NjBio	Ny	NyBio	Nu	NuBio	Fa	FaBio	Sg	SgBio	Io	IoBio	Cd	CdBio	Lm	LmBio
146	12	-	42.61354	-71.7068	0	0	0	0	0	0	0	0	5	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147	9	-	42.61348	-71.7059	10	1.5	20	1	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
148	13	-	42.61354	-71.7049	5	1.5	0	0	0	0	0	0	0	0	40	1	0	0	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149	13	-	42.61347	-71.704	0	0	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	9	-	42.61355	-71.7011	30	2	30	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
151	6	MG	42.61429	-71.7118	30	3.5	10	2	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152	8	-	42.61432	-71.7109	20	2	30	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
153	8	-	42.61434	-71.7098	10	1.5	20	1.5	0	0	0	0	10	1.5	5	1	0	0	0	0	0	0	10	3	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
154	8	-	42.61425	-71.7089	40	1.5	20	1.5	5	1.5	0	0	20	1.5	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	7	-	42.61425	-71.7069	20	1	10	1	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
156	12	-	42.61422	-71.7059	20	1	0	0	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	5	1	0	0	0	0	30	0	0	0	0	0	0	0	0	0
157	13	-	42.61423	-71.705	10	1	0	0	0	0	0	0	5	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158	13	-	42.61428	-71.704	5	1	0	0	0	0	0	0	10	1.5	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
159	7	-	42.61436	-71.7032	10	1	0	0	0	0	0	0	20	1	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	7	-	42.61429	-71.701	60	3.5	20	2	10	3	0	0	0	0	0	0	0	0	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	7	G	42.61424	-71.7127	60	3.5	20	2	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162	8	-	42.61501	-71.7119	50	2	10	1.5	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163	7	-	42.61502	-71.7109	10	2	20	1.5	0	0	0	0	20	1.5	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
164	8	-	42.61498	-71.7098	0	0	20	1.5	0	0	0	0	20	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	11	-	42.61501	-71.7059	0	0	30	1.5	0	0	0	0	10	1.5	20	1	0	0	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
166	12	-	42.61496	-71.7049	5	1	10	1.5	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
167	12	-	42.615	-71.704	5	1.5	0	0	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
168	8	-	42.61501	-71.703	10	1.5	30	1.5	0	0	0	0	10	1.5	0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
169	7	-	42.6157	-71.7109	50	3.5	20	1.5	0	0	0	0	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	8	-	42.61565	-71.7079	10	1.5	40	1.5	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
171	8	-	42.6157	-71.7099	50	2	20	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
172	9	-	42.61564	-71.7069	10	1.5	40	2	0	0	0	0	20	1.5	0	0	0	0	0	0	0	0	5	1.5	5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
173	11	-	42.61574	-71.706	0	0	40	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174	11	-	42.61568	-71.7049	0	0	0	0	0	0	0	0	20	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	11	-	42.61569	-71.704	0	0	40	2	0	0	0	0	20	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
176	7	-	42.6157	-71.7119	60	3.5	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177	5	M	42.6164	-71.7108	30	4	30	3	20	3.5	0	0	5	1	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178	6	M	42.61636	-71.7099	40	3.5	20	2.5	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
179	8	-	42.61641	-71.7089	40	2	10	1.5	0	0	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	6	S	42.61639	-71.7079	40	1.5	20	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
181	5	S	42.6164	-71.7069	30	1	30	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182	10	-	42.6164	-71.7059	10	1.5	0	0	0	0	0	0	40	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
183	11	-	42.61642	-71.7049	0	0	0	0	0	0	0	0	10	1.5	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
184	9	-	42.61643	-71.7041	20	2	40	2	0	0	0	0	10	2	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
185	5	M	42.61642	-71.7117	25	4	25	3	10	4	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	4	0	0	0	0	0	0	0	0	0	0	0	0
186	5	S	42.61648	-71.7	30	3	0	0	10	3.5	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	30	1	0	0	0	0	0	0	0	0
187	5	S	42.61643	-71.6991	20	1.5	0	0	10	3	0	0	10	3	0	0	0	0	0	0	0	0	5	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
188	1	S	42.61724	-71.7128	25	4	0	0	0	0	0	0	0	0	25	1	0	0	5	2	0	0	0	0	0	0	35	4	0	0	0	0	5	4	0	0	0	0	0	0
189	2	S	42.6172	-71.7117	60	4	0	0	0	0	40	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190	4	M	42.61717	-71.7108	20	3.5	10	2	10	3	10	4	0	0	0	0	0	0	10	1	0	0	0	0	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0
191	4	M	42.61709	-71.7098	20	3.5	30	3.5	10	4	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	30	4	0	0	0	0	0	0
192	5	M	42.6171	-71.7089	60	4	10	1.5	10	2	5	4	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0
194	3	S	42.61706	-71.6991	20	2.5	0	0	5	1.5	40	4	5	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195	4	M	42.6178	-71.7137	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0
196	1	M	42.61815	-71.7129	20	4	0	0	10	4	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0
197	3	M	42.61786	-71.7119	10	3.5	5	3.5	20	4	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0
198	6	M	42.61711	-71.705	30	2.5	20	2	0	0	0	0	10	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
199	5	S	42.6172	-71.7042	0	0	30	1	5	1	5	4	0	0	0	0	0	0	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	6	MG	42.61427	-71.7137	30	2	20	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201	12	-	42.61064	-71.7108	0	0	0	0	0	0	0	0	0	0	60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202	4	S	42.6171	-71.7	20	3	0	0	0	0	30	4	20	3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	1	0	0	0	0	0	0	0	0
203	4	M	42.61501	-71.7009	40	3.5	0	0	10	2	40	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0
204	7	MG	42.61209	-71.7019	50	3.5	10	2	0	0	40	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	8	-	42.61135	-71.6991	60	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	6	G	42.61004	-71.6988	50	4	15	2	10	3	5	4	15	1.5	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
316	4	S	42.61605	-71.7007	60	3.5	0	0	5	4	20	4	10	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
318	7	S	42.61676	-71.6994	25	2	0	0	10	2	0	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1	0	0	0	0	0	0	0	0

Attachment C – Lab Reports

Microbac Laboratories, Inc.
Massachusetts Division
100 Barber Avenue • Worcester, MA 01606
Phone: 508-595-0010
Fax: 508-595-0008
www.microbac.com

CERTIFICATE OF ANALYSIS

AQUATIC CONTROL TECHNOLOGY	Project: Hickory Hills	Report: 1228288
11 JOHN ROAD	Project Number: Water Testing	Reported: 09/06/2012 15:09
SUTTON, MA 01590	Project Manager: Gerry Smith	

HICKORY HILLS LAKE

1228288-01 (Surface Water) Sampled: 08/24/2012 12:30; Type: Grab

Analyte	Result	Reporting Limit	Units	Prepared	Analyzed	Analyst	Method	Notes
MICROBIOLOGY (MASSACHUSETTS DIVISION)								
E. coli	ND	10.0	CFU/100 ml	082412 1440	082412 1440	LBL	SM9213D	
WET CHEMISTRY (MASSACHUSETTS DIVISION)								
Alkalinity to pH 4.5	**14.5**	2.00	mg CaCO3/L	082912 0851	082912 0851	NGB	SM 2320B	
Ammonia as N	ND	0.100	mg/L	082912 0849	082912 0849	NGB	SM18 4500-NH3-F	
Color, Apparent	**10.0**		Pt-Co	082412 1608	082412 1608	RGC	SM18 2120B	
Chlorophyll-a	ND	0.100	mg/m³	082712 1100	082712 1100	NGB	SM 10200H	
Color, True	**10**	0	Pt-Co	082412 1300	082412 1300	RGC	SM 2120B	
Conductivity	**117**	10.0	umhos/cm	090612 1011	090612 1415	NGB	SM 2510B	
Nitrate as N	ND	0.100	mg/L	082712 0838	082712 1630	NGB	SM 4500-NO3-E	
pH	**6.53**	0.0100	S.U.	082412 1300	082412 1300	RGC	SM 4500-H B	
Phosphorus, P	ND	0.0100	mg/L	082812 1311	082812 1311	NGB	SM18 4500-P B, E	
Phosphorus, Total Dissolved	ND	0.0100	mg/L	083012 1457	090412 1057	NGB	SM 4500 P E	
Total Kjeldahl Nitrogen	**0.200**	0.100	mg/L	082812 0000	082812 0000	SUB	SM 4500 Norg B	SUB
Turbidity	**0.490**	0.200	NTU	082412 1300	082412 1300	RGC	SM 2130B	

HICKORY HILLS LAKE MULPUS BROOK INLET

1228288-02 (Surface Water) Sampled: 08/24/2012 12:30; Type: Grab

Analyte	Result	Reporting Limit	Units	Prepared	Analyzed	Analyst	Method	Notes
MICROBIOLOGY (MASSACHUSETTS DIVISION)								
E. coli	ND	10.0	CFU/100 ml	082412 1440	082412 1440	LBL	SM9213D	
WET CHEMISTRY (MASSACHUSETTS DIVISION)								
Alkalinity to pH 4.5	**14.5**	2.00	mg CaCO3/L	082912 0851	082912 0851	NGB	SM 2320B	
Ammonia as N	ND	0.100	mg/L	082912 0849	082912 0849	NGB	SM18 4500-NH3-F	
Color, Apparent	**15.0**		Pt-Co	082412 1608	082412 1608	RGC	SM18 2120B	
Chlorophyll-a	ND	0.100	mg/m³	082712 1100	082712 1100	NGB	SM 10200H	
Color, True	**10**	0	Pt-Co	082412 1300	082412 1300	RGC	SM 2120B	
Conductivity	**118**	10.0	umhos/cm	090612 1011	090612 1415	NGB	SM 2510B	
Nitrate as N	ND	0.100	mg/L	082712 0838	082712 1630	NGB	SM 4500-NO3-E	
pH	**6.55**	0.0100	S.U.	082412 1300	082412 1300	RGC	SM 4500-H B	
Phosphorus, P	ND	0.0100	mg/L	082812 1311	082812 1311	NGB	SM18 4500-P B, E	
Phosphorus, Total Dissolved	ND	0.0100	mg/L	083012 1457	090412 1057	NGB	SM 4500 P E	
Total Kjeldahl Nitrogen	**0.500**	0.100	mg/L	082812 0000	082812 0000	SUB	SM 4500 Norg B	SUB

Microbac

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CERTIFICATE OF ANALYSIS

AQUATIC CONTROL TECHNOLOGY	Project: Hickory Hills	Report: 1228288
11 JOHN ROAD	Project Number: Water Testing	Reported: 09/06/2012 15:09
SUTTON, MA 01590	Project Manager: Gerry Smith	

HICKORY HILLS LAKE MULPUS BROOK INLET

1228288-02 (Surface Water) Sampled: 08/24/2012 12:30; Type: Grab

Analyte	Result	Reporting Limit	Units	Prepared	Analyzed	Analyst	Method	Notes
WET CHEMISTRY (MASSACHUSETTS DIVISION)								
Turbidity	**0.590**	0.200	NTU	082412 1300	082412 1300	RGC	SM 2130B	

LITTLE HICKORY LAKE

1228288-03 (Surface Water) Sampled: 08/24/2012 12:30; Type: Grab

Analyte	Result	Reporting Limit	Units	Prepared	Analyzed	Analyst	Method	Notes
MICROBIOLOGY (MASSACHUSETTS DIVISION)								
E. coli	ND	10.0	CFU/100 ml	082412 1440	082412 1440	LBL	SM9213D	
WET CHEMISTRY (MASSACHUSETTS DIVISION)								
Alkalinity to pH 4.5	**23.0**	2.00	mg CaCO3/L	082912 0851	082912 0851	NGB	SM 2320B	
Ammonia as N	ND	0.100	mg/L	082912 0849	082912 0849	NGB	SM18 4500-NH3-F	
Color, Apparent	**10.0**		Pt-Co	082412 1608	082412 1608	RGC	SM18 2120B	
Chlorophyll-a	**3.00**	0.100	mg/m³	082712 1100	082712 1100	NGB	SM 10200H	
Color, True	**10**	0	Pt-Co	082412 1300	082412 1300	RGC	SM 2120B	
Conductivity	**200**	10.0	umhos/cm	090612 1011	090612 1415	NGB	SM 2510B	
Nitrate as N	ND	0.100	mg/L	082712 0838	082712 1630	NGB	SM 4500-NO3-E	
pH	**6.72**	0.0100	S.U.	082412 1300	082412 1300	RGC	SM 4500-H B	
Phosphorus, P	**0.0130**	0.0100	mg/L	082812 1311	082812 1311	NGB	SM18 4500-P B, E	
Phosphorus, Total Dissolved	ND	0.0100	mg/L	083012 1457	090412 1057	NGB	SM 4500 P E	
Total Kjeldahl Nitrogen	**0.300**	0.100	mg/L	082812 0000	082812 0000	SUB	SM 4500 Norg B	SUB
Turbidity	**0.550**	0.200	NTU	082412 1300	082412 1300	RGC	SM 2130B	

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CERTIFICATE OF ANALYSIS

AQUATIC CONTROL TECHNOLOGY	Project: Hickory Hills	Report: 1228288
11 JOHN ROAD	Project Number: Water Testing	Reported: 09/06/2012 15:09
SUTTON, MA 01590	Project Manager: Gerry Smith	

Notes and Definitions

SUB	Analysis performed by New England Testing Laboratory, Inc. M-RI010
ND	Analyte NOT DETECTED at or above the reporting limit
dry	Sample results reported on a dry weight basis

Certifications

Below is a list of certifications maintained by Microbac Laboratories, Inc. All data included in this report has been reviewed for and meets all project specific and quality control requirements of the applicable accreditation, unless otherwise noted. A complete list of individual analytes pursuant to each certification below is available upon request.

Massachusetts DEP M-MA003
Massachusetts DPH State Dairy Laboratory 0056

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Nancy Burnett

Nancy Burnett, Laboratory Director

For any feedback, please contact Nancy Burnett, Laboratory Director. You may also contact Sean Hyde, Chief Operating Officer at sean.hyde@microbac.com or James Nokes, President at james.nokes@microbac.com.

AQUATIC CONTROL TECHNOLOGY, I

1228288

Microbac Laboratories, Inc., 100 Barber Avenue Worcester, MA 01606 Phn: 508-595-0010 Fax: 508-595-0

PARAMETERS REQUESTED	Hickory Hills Lake	Hickory Hills Lk Mailpus Brook Inlet	Little Hickory Lake					
pH	•	•	•					
TOTAL ALKALINITY	•	•	•					
SUSPENDED SOLIDS								
DISSOLVED SOLIDS								
TURBIDITY	•	•	•					
CONDUCTIVITY	•	•	•					
CHLORIDE								
KJELDAHL NITROGEN	•	•	•					
AMMONIA NITROGEN	•	•	•					
NITRATE NITROGEN	•	•	•					
TOTAL PHOSPHORUS	•	•	•					
TOTAL DISSOLVED PHOSPHORUS	•	•	•					
TRUE COLOR	•	•	•					
APPARENT COLOR	•	•	•					
TOTAL COLIFORM BACTERIA								
FECAL COLIFORM BACTERIA								
E. COLI BACTERIA	•	•	•					
CHLOROPHYLL-A	•	•	•					

A.C.T. JOB#

TITLE: Hickory Hills Lake Survey

TASK: Water Quality Sampling

DATE SAMPLED: 8/24/12 1230p

SAMPLED BY: D Meringolo

MICROBAC LAB

REC"D BY: [signature] 8/24/12

DATE & TIME: 13:28p

NOTE: *Aquatic Control requires the following minimum detection limits for all samples: Nitrate (<0.1 mg/l); Ammonia (<0.1 mg/l); Total and Dissolved Phosphorus (<0.01 mg/l) and Alkalinity (<5 mg/l). Total and dissolved phosphorus detection limits of <0.001 mg/l are only to be performed upon Aquatic Control's request and at an additional charge.*

Attachment D – Zooplankton Report

ZOOPLANKTON DENSITY (#/L)

TAXON	Hickory Hills 8/24/12
PROTOZOA	
Ciliophora	0.0
Mastigophora	0.0
Sarcodina	0.0
ROTIFERA	
Conochilus	8.7
Keratella	5.6
COPEPODA	
Copepoda-Cyclopoida	
Mesocyclops	2.0
Copepoda-Calanoida	
Diaptomus	1.0
Copepoda-Harpacticoida	0.0
Other Copepoda-Adults	0.0
Other Copepoda-Copepodites	0.0
Other Copepoda-Nauplii	5.1
CLADOCERA	
OTHER ZOOPLANKTON	
Bryozoa	0.0
Chaoboridae	0.0
Chironomidae	0.0
Coelentarata	0.0
Culicidae	0.0
Eubranchiopoda	0.0
Gastrotrichia	0.0
Hydracarina	0.0
Mysidacea	0.0
Nematoda	0.0
Ostracoda	0.0
SUMMARY STATISTICS	
DENSITY	
PROTOZOA	0.0
ROTIFERA	14.3
COPEPODA	8.2
CLADOCERA	0.0
OTHER ZOOPLANKTON	0.0
TOTAL ZOOPLANKTON	22.4
TAXONOMIC RICHNESS	
PROTOZOA	0
ROTIFERA	2
COPEPODA	3
CLADOCERA	0
OTHER ZOOPLANKTON	0
TOTAL ZOOPLANKTON	5
S-W DIVERSITY INDEX	0.61
EVENNESS INDEX	0.88
MEAN LENGTH (mm): ALL FORMS	0.21
MEAN LENGTH: CRUSTACEANS	0.40

ZOOPLANKTON BIOMASS (UG/L)

TAXON	Hickory Hills 8/24/12
PROTOZOA	
Ciliophora	0.0
Mastigophora	0.0
Sarcodina	0.0
ROTIFERA	
Conochilus	0.3
Keratella	0.5
COPEPODA	
Copepoda-Cyclopoida	
Mesocyclops	2.6
Copepoda-Calanoida	
Diaptomus	0.5
Copepoda-Harpacticoida	0.0
Other Copepoda-Adults	0.0
Other Copepoda-Copepodites	0.0
Other Copepoda-Nauplii	13.5
CLADOCERA	
OTHER ZOOPLANKTON	
Bryozoa	0.0
Chaoboridae	0.0
Chironomidae	0.0
Coelentarata	0.0
Culicidae	0.0
Eubranchiopoda	0.0
Gastrotrichia	0.0
Hydracarina	0.0
Mysidacea	0.0
Nematoda	0.0
Ostracoda	0.0
SUMMARY STATISTICS	
BIOMASS	
PROTOZOA	0.0
ROTIFERA	0.9
COPEPODA	16.6
CLADOCERA	0.0
OTHER ZOOPLANKTON	0.0
TOTAL ZOOPLANKTON	17.4