

Delaware and Raritan Canal

2016 Delineation of Hydrilla and other Submersed Aquatic Vegetation (SAV) in the Delaware and Raritan Canal



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2016 Delineation of Hydrilla and other Submersed Aquatic Vegetation (SAV) in the Delaware & Raritan Canal Report

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Introduction

The Delaware & Raritan (D&R) Canal was constructed in the 1830's to serve as a transport waterway for coal and other goods. The 58 mile canal originates on the Delaware River near Raven Rock and terminates at the Raritan River near New Brunswick. The New Jersey Water Supply Authority (NJWSA) operates and maintains the canal. The canal system supplies water to over 15 water customers in central New Jersey, utilizing approximately 100 million gallons of water per day for drinking water and irrigation. The canal is contained within a linear park managed by the New Jersey Division of Parks and Forestry.

In late July 2016, an aquatic consultant conducting hydro-raking activities on the canal discovered hydrilla (*Hydrilla verticillata*). Hydrilla is a highly invasive submersed aquatic plant that can result in significant negative ecological (such as crowding out desirable native aquatic plants, impairing water quality, and reducing dissolved oxygen), recreational and economical impacts. The Water Supply's primary function is the delivery of raw water, and dense beds of invasive submersed aquatic plants (SAV) reduce water flow through the canal system.

In September 2016, SOLitude Lake Management was awarded the project to conduct the initial delineation of the hydrilla infestation in select sections of the canal, focusing on high use areas, and documented hydrilla infestations. In addition, establishing hydrilla tuber monitoring stations and collecting baseline tuber data was part of this project.

Procedures

Task 1: Point Intercept Submersed Aquatic Plant Mapping

The Point Intercept Method (PIM) of sampling aquatic macrophytes is generally accepted by lake managers as a suitable procedure to map submersed aquatic macrophytes in a lake. By applying a few modifications, this method can be employed on river systems (such as the Cayuga River Inlet and the Croton River, both located in New York). The PIM is designed to be utilized by volunteer and citizen science groups, and is the method often preferred by state regulators. For hydrilla delineation projects, the *2013 Monitoring Report of the Cayuga Inlet and Southern Cayuga Lake Monoecious Hydrilla Eradication Project* (Johnson, 2014) was reviewed to develop similar surveying protocols for this project.

The total number of sample locations is typically based on the total acreage of the lake. As a rule of thumb, one sample location per acre (minimum 50 sample locations) is surveyed at a given site. In a river system, or a canal system (such as the D&R Canal) sample locations are not placed on a grid, but instead are situated 50 meters apart. A total of 597 sites were sampled along 18.31 miles of the canal for this project. Table 1, below is a summary of the six sections surveyed in 2016.

Table 1 2016 Sample Section Summary: D&R Canal

Section	Description	Date	Length (miles)	# Sites Surveyed
1	Rte. 179 to Titusville Bridge	9/15 & 9/23/16	5.23	165
2	Titusville Bridge to Washington's Crossing	9/6 & 9/7/16	1.74	57
3	Washington's Crossing to Lower Ferry Rd.	9/7 & 9/8 & 9/16/16	4.50	149
4	Lower Ferry Rd. to Hermitage Ave.	9/9 & 9/16/16	2.12	69
5	Canal Support Structure to Carnegie Rd.	9/21/16	1.97	65
6	Provinceline Road to Alexander Road	9/22/16	2.75	92

Before the survey began, random sample locations were plotted on an overlay map of the target sections of the canal, 50 meters apart. At GPS-referenced sites, using the overlay grid loaded onto the GPS unit, the canoe was paddled to the first sample location. On arrival, the GPS coordinates of the sample location was recorded **in the center of the canal** using a Trimble GeoXH 2008 series handheld GPS unit with sub-meter accuracy. Any other pertinent field notes (such as floating fragments of hydrilla or established SAV beds not sampled) regarding the sample location were also recorded on a field log.

Next, a weed anchor attached to a 10 meter-long piece of rope is tossed from a random side of the canoe toward or along one of the shorelines. It is important to toss the weed anchor the full 10 meters (a loop at the end of the rope is attached to the boat to prevent losing the anchor). The weed anchor is slowly retrieved along the bottom, and carefully hoisted into the boat. To determine the overall submersed vegetation amount, the weed mass is assigned one of five densities, based on semi-quantitative metrics developed by Cornell University (Lord, et al, 2005). These densities are: **No Plants** (empty anchor), **Trace** (one or two stems per anchor, or the amount that can be held between two fingers), **Sparse** (three to 10 stems, but lightly covering the anchor, or about a handful), **Medium** (more than 10 stems, and covering all the tines of the anchor), or **Dense** (entire anchor full of stems, and one has trouble getting the mass into the boat). See the Appendix of this report for pictures of these representative densities. These densities are abbreviated in the field notes as 0, T, S, M, and D. Next, the submersed weed mass is sorted by genus (or species if possible) and one of the five densities (as described above) is assigned to each genus and/or species. This procedure is then repeated for the remaining sample points.

Following methods established at Cayuga Lake Inlet for the monitoring of hydrilla, we utilized two anchor tosses per site. The toss labeled "A" was always conducted along the west shore of

the canal, while the “B” toss was always conducted on the east shore of the canal. The different shores often supported different SAV abundance and community structure. The data for both of these tosses are included on Table #2, in the Appendix. Each density was assigned a numeric value: 0 for no plants, 1 for trace, 2 for sparse, 3 for medium, and 4 for dense plants. The mean of these three values for both tosses (rounded up) are also displayed on Table #2. These mean values were used to assign overall densities, as depicted on the distribution maps in the Appendix. For example, if toss A was dense density (4), and toss B was sparse density (2) for the same macrophyte, the mean density would be medium ($4+2=6/2=3$). Although using two tosses is ideal for detecting the presence of target species (and species occurring infrequently), these procedures and associated calculations tend to decrease the overall abundance per site. However, our primary goal was to delineate hydrilla, so two tosses per site (and both shorelines) should result in a greater frequency of occurrence for target species. Visual assessments were also used during the data collection. Although not included in this report, since the different tosses were conducted on opposite shorelines, the west versus east shoreline SAV data could be teased out of our overall data.

A sample of each different macrophyte is collected and placed in a bottle or Ziploc-type bag with a letter or number code (A, B, 1, 2, etc.). If possible, these samples included both submersed and floating leaves (if any), seeds, and flowers (if present), to facilitate identification. These bottles are placed in a cooler stocked with blue-ice packs or ice, and returned to SOLitude Lake Management’s lab for positive identification and photographing. Regionally appropriate taxonomic keys are used to identify the aquatic macrophytes (a list of references is included in the appendix) to the lowest practical taxa, typically to species.

The weed anchor used for aquatic macrophyte surveys has a specific design. It is constructed with two 13.5-inch wide metal garden rakes attached back to back with several hose clamps. The wooden handles are removed and a 10 meter-long nylon rope is attached to the rake heads.

Task 2: Hydrilla Tuber Monitoring

For the tuber monitoring at the D&R Canal in 2016, we employed methods established by Johnson (2013). That is, we used a post hole digger with modified handles (to sample deeper water sites) for all sediment core samples. The corer removes a consistent plug of sediment with a surface area of 187 cm² to a depth of 20 cm. Although slightly larger than the corer utilized by Johnson (173 cm²), we can compensate for the larger surface area while calculating our final tuber density, expressed in tubers/m². We planned on collecting three to five cores per site (depending on the suitability of sediments), and compositing them into a single sample. The composite sample was placed in a labeled 5.0 gallon HDPE bucket processed at the canal shore.

Processing the sediment samples is conducted with a custom-designed sieve with a 0.16 inch (0.4 cm) metal mesh. The sediment and sieve is placed in the water and gently shaken to remove sediment particles. The remaining larger sediment and plant material is examined for

tubers and turions. Any hydrilla tubers or turions are collected and placed in a Ziploc-type bag, labeled with the sample location, site number and date. Any remaining organic and inorganic material is discarded. This process is repeated until the entire composited sediment sample has been passed through the sieve. Back at the laboratory, the tubers and turions at each site are counted, photographed, and tuber density per m² is calculated depending on the number of cores (and the surface area per core).

We are confident that three to five cores per site will be suitable to establish baseline tuber densities. However, we fully expect that future monitoring efforts will likely need to increase to 10 cores per site, or even 22 cores per site (as per Johnson, 2013), especially if hydrilla management occurs at this site, when we would expect to see a decline in the number of tubers recovered.

Table 2 Submersed Aquatic Plant Abundance Summary: 2016 D&R Canal

Common Name	Scientific Name	# Occurrences	% Occurrence
Overall SAV		576	96.5%
Small Duckweed	<i>Lemna minor</i>	536	89.8%
Coontail	<i>Ceratophyllum demersum</i>	507	84.9%
Water Stargrass	<i>Zosterella dubia</i>	399	66.8%
Hydrilla	<i>Hydrilla verticillata</i>	337	56.4%
Wild Celery	<i>Vallisneria americana</i>	313	52.4%
Common Waterweed	<i>Elodea canadensis</i>	196	32.8%
Benthic Filamentous Algae		189	31.7%
Brittle Naiad	<i>Najas minor</i>	143	24.0%
Eurasian Water Milfoil	<i>Myriophyllum spicatum</i>	60	10.1%
Water Starwort	<i>Callitriche palustris</i>	59	9.9%
Spatterdock	<i>Nuphar variegata</i>	55	9.2%
Watermoss	<i>Fontinalis</i> sp.	44	7.4%
Leafy Pondweed	<i>Potamogeton foliosus</i>	19	3.2%
Muskgrass	<i>Chara</i> sp.	11	1.8%
Curly-leaf Pondweed	<i>Potamogeton crispus</i>	9	1.5%
Long-leaf Pondweed	<i>Potamogeton nodosus</i>	7	1.2%
Pondweed species	<i>Potamogeton</i> sp.	6	1.0%
White Water Crowfoot	<i>Ranunculus longirostris</i>	3	0.5%
Great Duckweed	<i>Spirodela polyrrhiza</i>	2	0.3%
Common Bladderwort	<i>Utricularia vulgaris</i>	2	0.3%
Arrowhead rosette	<i>Sagittaria</i> sp.	2	0.3%

Macrophyte Summary

The following aquatic macrophytes were collected in the D&R Canal in 2016. The respective macrophyte percent abundance data are summarized in Table #1 in the Appendix, organized by overall distribution (all 597 sites) and by distribution per section. The distribution of all the aquatic macrophytes is summarized in Table #2, above. Below is a short description of each macrophyte and a picture. Twenty aquatic macrophytes (plus benthic filamentous algae) were collected during the 2016 survey. Please note that individual maps of each species are not included in the Appendix of this report, which is routine. It is difficult to display the aquatic plant abundances on the linear 18+ miles of canal surveyed this year. Instead, shapefiles and GIS data were turned over to the client in December to create maps suitable for display.

The brief summaries that follow are organized according to overall (all sections) percent occurrence. When possible, pictures of aquatic macrophytes represent the actual plants located at the D&R Canal, either taken in the field, or from samples returned to SOLitude Lake Management's laboratory. All other photos are from the archives at SOLitude Lake Management.



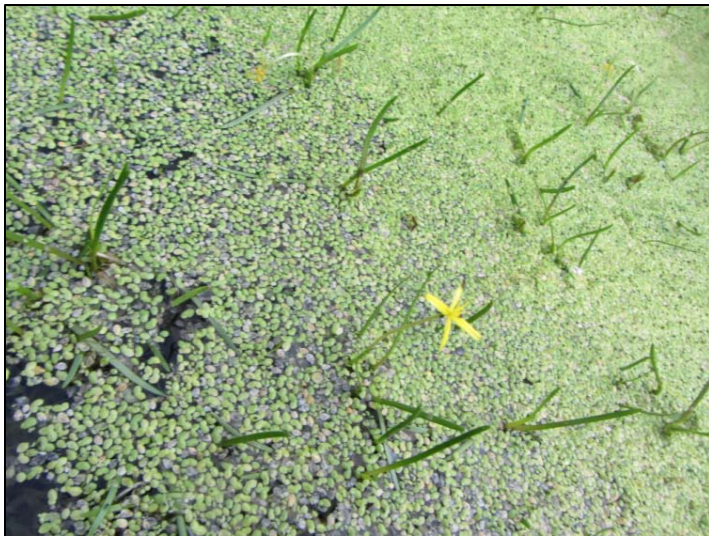
Small Duckweed (*Lemna minor*. Common Names: Small duckweed, water lentil, lesser duckweed. **Native**). Small duckweed is a free floating plant, with round to oval-shaped leaf bodies typically referred to as fronds. The fronds are small (typically less than 0.5 cm in diameter), and it can occur in large densities that can create a dense mat on the water's surface. Each frond contains three faint nerves, a single root (a characteristic used to distinguish it from other duckweeds), and no stem. Although it can produce flowers, it usually reproduces

via budding at a tremendous rate. Its population can double in three to five days. Since it is free floating, it drifts with the wind or water current, and is often found intermixed with other duckweeds. Since it's not attached to the sediment, it derives nutrients directly from the water, and is often associated with eutrophic conditions. It overwinters by producing turions late in the season. Small duckweed is extremely nutritious and can provide up to 90% of the dietary needs for waterfowl. It's also consumed by muskrat, beaver and fish, and dense mats of duckweed can actually inhibit mosquito breeding.



Coontail (*Ceratophyllum demersum*. Common Names: coontail, hornwort. **Native**.): Coontail has long trailing stems that lack true roots, although it can become loosely anchored to sediment by modified leaves. The leaves are stiff, and arranged in whorls of 5-12 at each node. Each leaf is forked once or twice (only), and has teeth along the margins. The whorls of leaves are spaced closer at the end of the stem, creating a raccoon tail appearance. Coontail is tolerant of low light conditions, and since it is not

rooted, it can drift into different depth zones. Coontail can also tolerate cool water and can over winter as a green plant under the ice. Typically, it reproduces via fragmentation. Bushy stems of coontail provide valuable habitat for invertebrates and fish (especially during winter), and the leaves are grazed on by waterfowl.



Water Stargrass (*Zosterella dubia* (=Heteranthera dubia): Common Name: Water stargrass. **Native**): Water stargrass has slender free-branched stems that originate from rhizomes. The leaves are narrow and alternate, attaching directly to the stem. Leaves can be up to 15 cm long, and lack a prominent midvein, a distinguishing characteristic. Water stargrass can inhabit a wide range of water depths and sediment types, and can tolerate reduced clarity environments. Yellow star-shaped

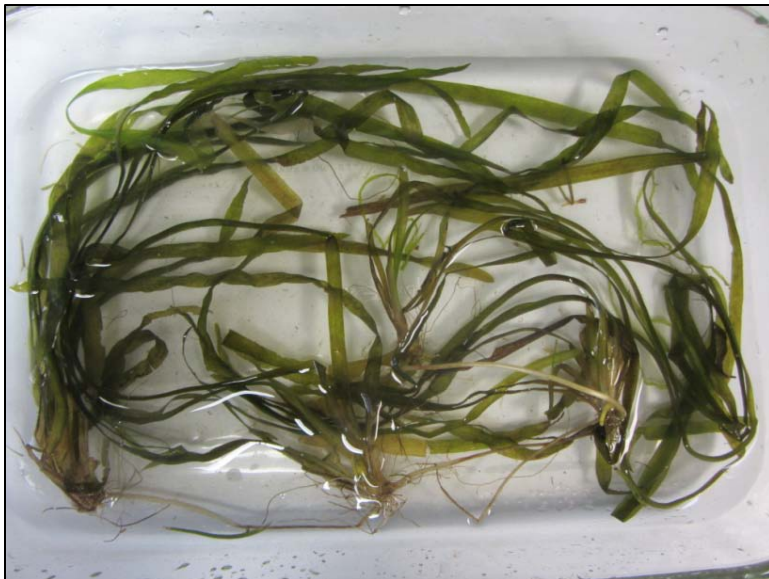
flowers (pictured) are produced by midsummer, but reproduction is usually via over wintering rhizomes. Water stargrass is a locally important waterfowl food source, and provides suitable cover and foraging for fish.



Hydrilla (*Hydrilla verticillata*)

Common Name: Hydrilla, waterweed. **Exotic, aggressive, Invasive.**) : Hydrilla is native to parts of Asia, and was introduced to the Northeast region in the mid-1900's. Hydrilla is the perfect weedy species, able to outcompete desirable native species due to an array of adaptations. These include growing in a variety of substrates, moving or still waters, tolerating up to 10 ppt salinity, and adept at low-light growth. It is typically rooted in

the substrate, but can persist in drifting mats. Although similar to common waterweed, hydrilla has strongly serrated leaves (visible with the naked eye), and have a barbs on the underside of the midrib. The leaves are typically arranged in whorls of 4 to 8, but lower parts of the plant can be in whorls of three, or even opposite in arrangement. Hydrilla readily reproduces via stem fragmentation, and produces turions and hardy tubers to overwinter. Two distinct forms occur in the Northeast: monoecious (generally found in the north) and dioecious (generally more robust and found in southern climes).



Wild Celery (*Vallisneria*

americana. Common Names: Wild celery, eel-grass, tape-grass. **Native.**): Wild Celery has long flowing ribbon-like leaves that have a basal arrangement from a creeping rhizome. The leaves can be up to two meters long, have a cellophane-like texture, with a prominent center stripe and finely serrated edges. The leaves are mostly submersed, although they can reach the surface allowing the tips to trail. Male and female

flowers are produced on separate plants, but reproduction is usually via over wintering rhizomes and tubers. Wild celery usually inhabits hard substrate bottoms in shallow to deep water. It can tolerate a wide variety of water chemistries. Wild celery is the premiere food

source for waterfowl, which greedily consume all parts of the plant. Canvasback ducks (*Aythya vallisneria*) enjoy a strong relationship with wild celery, going so far to alter their migration routes based on its abundance. Extensive beds of wild celery are considered excellent shade, habitat and feeding opportunities for fish, and commonly are used in submersed vegetation restoration projects due to its availability ease of growth and high quality.



Common Waterweed (*Elodea canadensis*: Common Names: elodea, common waterweed.

Native.): Common waterweed has slender stems that can reach a meter in length, and a shallow root system. The stem is adorned with lance-like leaves that are attached directly to the stalk that tend to congregate near the stem tip. The leaves are populated by a variety of aquatic invertebrates. Male and female flowers occur on separate plants, but it can also reproduce via stem fragmentation. Since common waterweed is disease resistant, and tolerant to low-light conditions, it can reach

nuisance levels, creating dense mats that can obstruct fish movement, and the operation of boat motors.



Benthic Filamentous Algae: Filamentous algae is a chain or series of similar algae cells arranged in an end to end manner. Benthic filamentous algae is attached to a hard substrate, such as logs, rocks, a lake bottom, or even other aquatic plants. When growing in heavy densities, benthic filamentous algae can appear as brown or green mats of vegetation that can reach the surface. When large pieces break off the bottom substrate they become floating filamentous algae patches. Benthic filamentous algae can comprise an entire range of morphologies,

but flagellated taxa are far less common.



Brittle Naiad (*Najas minor*. Common Names: brittle water nymph, European naiad. **Exotic, Invasive.**): Brittle naiad is a submersed annual that flowers in August to October. It resembles other naiads, except its leaves are highly toothed with 6-15 spinules on each side of the leaf, visible without the aid of magnification. The leaves are opposite, simple, thread-like, and usually lime-green in color, often with a “brittle” feel to them. Brittle naiad fruit are

narrow, slightly curved, and marked with 10-18 longitudinal ribs, resembling a ladder. Brittle Naiad has been introduced from Europe in the early 1900’s, and can be found in most of the northeastern states. Brittle naiad prefers sandy and gravel substrates, but can tolerate a wide range of bottom types. It’s tolerant of turbid and eutrophic conditions. Waterfowl graze on the fruit.



Eurasian Water Milfoil (*Myriophyllum spicatum*. Common Names: Asian Water milfoil. **Aggressive, Exotic, Invasive.**): Eurasian water milfoil has long (2 meters or more) spaghetti-like stems that grow from submerged rhizomes. The stems often branch repeatedly at the water’s surface creating a canopy that can crowd out other vegetation, and obstruct recreation and navigation. The leaves are arranged in whorls of 4 to 5, and spread out along the stem. The leaves are divided like a feather,

resembling the bones on a fish spine. Eurasian water milfoil is an exotic originating in Europe and Asia, but its range now includes most of the United States. It’s ability to grow in cool water and at low light conditions gives it an early season advantage over most other native submersed plants. Although it can reproduce via fruit production, it typically also reproduces via fragmentation.



Water Starwort (*Callitriche heterophylla*. Common Name: Large water starwort. **Native.**): Water starwort is a shallow-rooted submersed plant with a fine stem, usually less than a meter long. Submersed leaves are opposite and ribbon-like, while floating are rounded and crowded at the top, forming a floating rosette at the surface. Different species of water starwort can be discerned by examining the fruiting bodies, produced by mid- to late summer. It is well adapted to cool

water temperatures, and often starts growing early in the spring. Water starwort provides suitable food for a variety of waterfowl, and the stem clusters offer shelter and forage opportunities for herbivorous fish.



Spatterdock (*Nuphar variegata*. Common Name: yellow pond lily, bullhead pond lily, spatterdock. **Native.**): Spatterdock leaf stalks emerge directly from a submerged fleshy rhizome. Spatterdock has heart-shaped leaves with a prominent notch. Depending on the habitat, these leaves can be held aloft via erect stems. A distinguishing characteristic of spatterdock is the leaf stalk, which bears a winged margin. Flowering occurs in the summer and, the flowers open during the day and close at night.

Spatterdock typically inhabits quiet water less than two meters deep with a soft substrate, such as ponds, shallow lakes and slow-moving streams. The leaves offer shade and protection for fish, and the leaves, stems, and flowers are grazed upon by muskrats, beaver, and sometimes, even deer.



Water Moss (*Fontinalis* sp. Common Name: water moss. **Native.**): Water mosses are submerged mosses that are attached to rocks, trees, logs, and other hard substrates by false rootlets located at the base of their stems. The stems are dark-green to brown, and about one foot long. The leaves share a similar color as the stems, and are usually ovate with fine-toothed margins. Water moss is utilized by aquatic invertebrates, and as a breeding site for small fish. Water moss rarely reaches nuisance levels



Leafy Pondweed (*Potamogeton foliosus*: Common Name: leafy pondweed. **Native.**): Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly narrow as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. It produces early season fruits in tight clusters on short stalks in the leaf axils. These early season fruits are often the first grazed upon by waterfowl during the season. Muskrat, beaver, deer and even moose also graze on the fruit.

These fruit are often required to distinguish this pondweed from several other thin-leaved pondweeds that occur in the region. It inhabits a wide range of habitats, but usually prefers shallow water. It has a high tolerance for eutrophic conditions, allowing it to even colonize secondary water treatment ponds.



Muskgrass (*Chara* sp. Common Names: muskgrass, stonewort, chara. **Native.**): Muskgrass is actually a multi-branched algae that appears as a higher plant. It is simple in structure and has rhizoids instead of true roots. The branches of muskgrass has ridges that are often encrusted with calcium carbonate. This grants the entire plant a "crusty" feel and appearance. The side branches develop in whorls that look like the spoke in a wheel. Muskgrass is easily identified by a pungent, skunky odor. It prefers softer sediments, and can often be found in deeper

water than other plants. As such, it's considered an early pioneer, the first species to colonize a disturbed lakebed.



Curly-leaf Pondweed (*Potamogeton crispus*. Common Name: curly-leaf pondweed. **Invasive, aggressive.**): Curly-leaf pondweed has spaghetti-like stems that often reach the surface by mid-June. Its submersed leaves are oblong, and attached directly to the stem in an alternate pattern. The margins of the leaves are wavy and finely serrated, hence its name. No floating leaves are produced. Curly-leaf pondweed can tolerate turbid water conditions better than most other macrophytes. In late summer, Curly-leaf pondweed enters its summer dormancy stage. It naturally dies off (often creating a sudden loss of habitat and releasing nutrients into the water to fuel algae growth) and produces vegetative buds

called turions. These turions germinate when the water gets cooler in the autumn and give way to a winter growth form that allows it to thrive under ice and snow cover, providing habitat for fish and invertebrates.



Long-leaf Pondweed (*Potamogeton nodosus*. Common Name: Long-leaf pondweed. **Native.**): Long-leaf pondweed has stems up to two meters long that originate from a branching rhizome. Submersed leaves can be up to 30 cm long, lance-shaped, and taper to a long leaf stalk. Floating leaves also taper on long leaf stalks, which distinguish this pondweed from other similar pondweed species. Flowers and fruit are produced on a thick cylindrical spike. Fruits are somewhat oval, have a

short beak, and a lumpy dorsal ridge. Long-leaf pondweed prefers flowing water versus lakes. It inhabits a variety of sediments and can tolerate eutrophic conditions and turbid water. Long-leaf pondweed fruit are grazed on by waterfowls, and portions of the plant are eaten by muskrat, beaver, deer and even moose. Long-leaf pondweed offers excellent invertebrate habitat. Researchers estimate a 20 by 60 meter standing patch can support 33 million invertebrates.



White Water Crowfoot (*Ranunculus longirostris*. Common Names: White water crowfoot, water crowfoot. **Native.**): White water crowfoot stems originate from trailing runners and buried rhizomes. The stems are long and branched, with limp leaves (unlike similar water crowfoot species in the region) situated in an alternate pattern. The leaves have a noticeable stalk, and the plant produces white flowers. White water crowfoot prefers high alkalinity water, and usually occurs in water less than two meters deep. It is also common in streams. When

fruit and flowers are produced, white water crowfoot is a preferred food source of dabbling ducks and other waterfowl. If it occurs in shallow water, upland game birds (such as grouse) even graze on it. It provides excellent habitat for invertebrates, but only a fair food producer for trout.



Common Bladderwort (*Utricularia vulgaris*: Common Names: common bladderwort, great bladderwort. **Native.**): Common bladderwort is a free-floating plant that can reach 2-3 meters in length. Since they are free-floating, they can grow in areas with very loose sediment. Along its stem are finely divided leaf-like branches, forked 3-7 times. Scattered about the branches are numerous bladders, used to capture prey ranging from the size of unicellular protozoans (such as Euglena), to mosquito larvae. Prey is slowly digested inside the

bladders by enzymes. Common bladderwort produces small yellow flowers that protrude above the water. Stems of common bladderwort provide food and cover for fish.



Arrowhead (Submersed Rosette) (*Sagittaria* sp. Common Name: Arrowhead. **Native.**): This plant is the submersed rosette of a species of arrowhead. The submersed rosette lacks both flowers and seeds, so further identification is not possible. Arrowhead has emergent leaves, and usually inhabits shallow waters at pond or lake edges, or along sluggish streams. It can tolerate a wide variety of sediment types and pH

ranges. Arrowhead is very suitable for constructed wetland development due to its tolerance of habitats, and ability to act as a nutrient sink for phosphorous. Typical arrowhead reproduction is via rhizomes and tubers although seed production is possible if conditions are ideal. Arrowhead has high wildlife value, providing high-energy food sources for waterfowl, muskrats and beavers. Arrowhead beds provide suitable shelter and forage opportunities for juvenile fish as well.



Great Duckweed (*Spirodela polyrhiza*. Common Names: Great duckweed, large duckweed. **Native**.). Great duckweed is the largest of the duckweeds, but it is still very small compared to other aquatic macrophytes. It has simple flattened fronds with irregular oval shapes, often up to 1 cm in length and 2.5 to 8.0 mm long. The frond surface is usually green with a conspicuous purple dot. The underside of the frond is magenta with a cluster of 5-12 roots that dangle into the water. Indeed, peering at great duckweed from under the water grants

it the appearance a tiny jellyfish. Although great duckweed produces flowers, it usually reproduces via budding, and like other duckweeds, it is capable of rapid growth. It often occurs with other duckweeds, and since it is free floating, it can be moved via the wind or water currents. It derives its nutrients from the water column and often occurs in eutrophic systems. It's an excellent food source for waterfowl, and is also used by muskrat and fish. The dense mats offer shade and cover for fish.

Results

Task 1: Macrophyte Abundance and Distribution Discussion

In September of 2016, sections of the D&R Canal were surveyed for the presence of submersed aquatic vegetation (SAV) and specifically for the delineation of hydrilla. We surveyed over 18 miles of the canal, based on assumed hydrilla locations and other high priority criteria such as water intakes, spillways, and historical aquatic plant abundance. For this discussion, it would be helpful for the reader to refer to the distribution tables and the summary of percent abundance by section data tables, located in the appendix of this report. The following discussion is based on species abundance, presented by section. The purposes of this discussion, medium and dense abundance is typically assumed to be nuisance amounts by lake managers.

Overall, submersed aquatic vegetation was collected at 576 of the 597 sites sampled, representing 96.5% of the total sites. At section 1, submersed aquatic plants occurred at 94% of the sites surveyed with 38% of the sites being considered medium or dense. At section 2, aquatic plants were collected at all 57 sites, and medium and dense sites accounted for 67% of the sites. At section 3, aquatic plants were collected at 97% of the sites, 40% of these sites considered medium or dense. At section 4, aquatic plants occurred at 93% of the sites surveyed, with medium and dense sites only at 25% of the total sites. At section 5, aquatic plants were collected at 100% of the 65 sites, with 14% of the sites being considered medium density, but no dense sites observed. At section 6, aquatic plants occurred at 99% of the 92 sites surveyed, with 13% being medium or dense. Although overall aquatic plant abundance was high at all six sections, there was certainly reduced medium and dense sites observed at section 5 and section 6 (on the opposite side of Trenton). The assumption is that high abundant aquatic plant growth at these sections is suitable habitat for hydrilla infestation.

Section 1

Section 1 was located between the Route 179 Bridge and the Titusville Bridge. This section was 5.23 miles long and we surveyed 165 sites. Overall aquatic plants occurred at 155 (or 94%) of the total sites surveyed.

Coontail was the most common aquatic plant collected at this section. It occurred at 144 (or 87%) of the total sites. Over half these sites were trace density ($n=83$, or 58%), with another 56 sites (or 39%) being sparse density. The remaining five sites (or 4%) were medium or dense.

Small duckweed is actually considered a floating aquatic plant. It is typically not collected on a weed rake toss, so instead the abundance is estimated in a 10 meter radius around the canoe at the sample location. Small duckweed was observed at 141 (or 83%) of the sites surveyed in this section. Half of these sites ($n=70$) were trace density. Another 66 (or 47%) of the sites were sparse density. The remaining five sites were considered to be medium density. As a floating aquatic plant, small duckweed abundance is influenced by wind and water movement. Often it accumulates on other aquatic plants at the surface and other snags along the shoreline.

Water stargrass commonly occurred in this section, collected at 123 (or 75%) of the sites surveyed. It often occurred intermixed with coontail, and at many sites it was in flower. It had a near even distribution between trace and sparse density. At 55 (or 45%) of the sites, it was trace density, and at 56 sites (or 46%) it was at sparse density. Thus, 91% of the sites could be considered at non-nuisance abundance. Twelve medium sites and no dense sites rounded out the abundance of this macrophyte.

Common waterweed is very similar to hydrilla and can be difficult to distinguish in the field. All samples of common waterweed or hydrilla observed were examined closely to determine identification to species. That said, it is possible to misidentify plant specimens, so common waterweed abundance could be underestimated. Common waterweed occurred at 87 (or 53%)

of the sites surveyed. 90% of these sites were considered trace density. The remaining nine sites were considered sparse density.

Wild celery was collected at 50% (n=83) of the sites surveyed. Just over half the sites (n=42) were considered trace density. At 36 sites (or 43%), the density was sparse. The five remaining sites were medium density.

Hydrilla occurred at 67 (or 41%) of the sites we surveyed in this section. However it did not occur until point #12 of sub-section 1.5C, at which point we documented the most northern extent of rooted hydrilla. A few additional scattered patches of hydrilla were located here. In addition, south of this point we began to observe the occasional floating fragment of hydrilla (none were observed before that point). We are reasonably confident this represents the northern most extent of hydrilla on the Delaware River side of the canal. It's possible the initial site of introduction was nearby, just to the north (perhaps the bridge at Old River Road, which features a nearby Delaware River access point and a fishing dock just south of the bridge on the canal). At 43 of the sites (or 64%), hydrilla was considered trace density. At 23 of the sites (or 34%) the abundance was considered sparse. At the remaining one site, the density was medium. In addition to the documented hydrilla, we also observed several rooted patches (or various sizes, but typically less than 5 feet in diameter) while piloting between GPS-referenced sample sites. We also observed a few floating hydrilla fragments. The picture to the right depicts a typical patch of hydrilla occurring along the canal shoreline intermixed with wild celery.



Brittle naiad, an exotic invasive aquatic plant was documented at 33% (n=55) of the sites we surveyed. Most of these sites (89%, or 49 sites) were trace density. Five (or 9%) of the site were sparse density and the final site (2%) was medium density.

Benthic filamentous algae was collected at 45 (or 27%) of the sites we surveyed in 2016. On most occasions, the algae was growing on the rocky bottom substrate or along edge snags. It did not occur on other submersed plants, likely due to water movement. It occurred at 41 (or 91%) of the sites at trace density. Three sites were considered sparse, and there was one dense site observed.

The remaining aquatic plants all occurred at or less than 5% of the sites surveyed. These included Eurasian water milfoil (5%), leafy pondweed (4%), great duckweed (1%), long-leaf

pondweed (1%) and common bladderwort (1%). The great duckweed, which often occurs intermixed with small duckweed could have been underestimated.

Section 2

Section 2 was located between the Titusville Bridge and Washington's Crossing. This section was 1.74 miles long and we surveyed 57 sites. Overall aquatic plants occurred at all 57 (or 100%) of the total sites surveyed.

Small duckweed was the most commonly occurring aquatic plant in this section, occurring at all 57 sites. See the notes above for information on the typical distribution for this floating macrophyte. This section did have the highest abundance of dense and medium (nuisance) sites, which certainly influences small duckweed accumulation, especially when the submersed plants reach the surface. Trace sites accounted for 21%, while sparse sites accounted for just over 50% of the sites. Medium sites were 23% and dense sites were 2% of the total sites surveyed.

Coontail was the second most dominant aquatic plant in this section. It occurred at 52 (or 91%) of the sites surveyed in 2016. Over half the sites (n=28, or 54%) were trace density, and another 21 (or 40%) of the sites were sparse density. The final three sites (or 6%) were considered medium density.

Hydrilla has common throughout this section, occurring at 49 (or 89%) of the total sites surveyed. At 12 sites (or 24%) the hydrilla was considered trace density, while at 18 (or 37%) the density was sparse. At 15 sites (or 31%), the hydrilla was considered medium and at four sites (or 8%) it was dense. Clearly, hydrilla is well established throughout this section, and should be a priority target for 2017 control efforts. In addition to the hydrilla recorded during our GPS survey, numerous established beds, some of them quite large (up to 20 feet long) were observed while paddling between sample sites.

Water stargrass occurred at 47 (or 82%) of the total sites surveyed. Most sites were trace (40%) or sparse (32%) abundance, but there were 12 (or 26%) of the sites at medium density. One site was even considered to be dense abundance. At most sites, small duckweed covered the water stargrass, but often the prominent yellow flowers of water stargrass poked up through the duckweed layer, exposed to the air.

Wild celery was well-established in this section as well. Wild celery occurred at 46 (or 81%) of the total sites surveyed in 2016. Surprisingly, only six (or 13%) of these sites were considered trace density. Most sites were sparse density (n=16, or 35%) or medium (n=22, or 48%) density. At two sites (or 4%) wild celery was considered to be dense abundance. Many of the wild celery plants were in flower during our survey.

Brittle naiad was collected at 32 (or 56%) of the total sites in this section. Most of these sites (22, or 69%) were considered trace density. Seven (or 22%) sparse sites and three (or 9%)

medium sites round out the brittle naiad abundance in this section. Higher density brittle naiad seemed to occur along the east (toss B) shoreline throughout this section.

Benthic filamentous algae was collected at 14 (or 25%) of the sites surveyed in section 2. Four additional submersed plants were collected in this section, but all at 12% or fewer of the sites. Common waterweed occurred at 12% of the sites, but see the notes above regarding the difficulty in identifying this native plant from hydrilla, especially when the hydrilla is as abundant as in this section. Common bladderwort, Eurasian water milfoil and long-leaf pondweed each occurred at one site. The picture to the right depicts the floating leaves of long-leaf pondweed intermixed with hydrilla.



Section 3

Section 3 extended from Washington's Crossing to Lower Ferry Road. This section was 4.50 miles long and we surveyed 149 sites. Overall aquatic plants occurred at 144 (or 97%) of the total sites surveyed.

Hydrilla was the dominant aquatic plant collected and observed in this section. It was collected at 139 (or 93%) of the total sites surveyed in 2016, and this section should be a priority target for control efforts in 2017. At 38 (or 27%) of the sites, the density of hydrilla was considered to be trace. At 69 (or 50%) of the sites, the density was sparse, while another 28 (or 20%) of the sites were medium density. Four (or 3%) of the sites were considered to be dense. In addition to the extensive hydrilla collected via sampling, numerous patches of hydrilla, some as small as 1 foot diameter clumps, to as large as 15 foot diameter established beds were observed while paddling between sampling sites. Despite the abundance of hydrilla in this section, it does not appear to be crowding out other SAV, yet. There just seems to be a high abundance of SAV growth here that is also suitable to hydrilla.

Small duckweed was observed at 137 (or 92%) of the sites surveyed in this section. See above for notes on the distribution of this floating macrophyte. Nearly half the sites (47%) were trace density, with another 43% being considered sparse density. The final 14 sites were medium density.

Wild celery was the second most dominant submersed aquatic plant we collected at this section, occurring at 120 (or 81%) of the sites. Trace and sparse sites were nearly identical at 45

and 46 (38%) sites, respectively. Another 26 (or 22%) of the sites were medium density, while three additional sites rounded out the wild celery abundance in this section.

Coontail was also quite common in this section, occurring at 119 (or 80%) of the sites. Most of these sites (n=92, or 77%) were considered trace density. There were 23 (or 19%) sites of sparse density, and another three medium sites.



Water stargrass occurred at 92 (or 62%) of the sites, and typically was found with coontail. Many of the water stargrass sites (59, or 64%) were trace density. Another 25 (or 27%) of the sites were considered sparse density. Eight (or 9%) medium sites rounded out the water stargrass distribution. We observed numerous water stargrass plants in flower (as depicted in the picture to the left) throughout this section.

Benthic filamentous algae occurred at 58 (or 39%) of the sites. However, it occurred almost exclusively at trace density (57, or 98% of the sites). The last site was considered sparse density.

Brittle naiad occurred at 51 (or 34%) of the sites in this section. Most of these sites were trace density (n=41, or 80%), with the final 10 sites being considered sparse abundance.

Common waterweed was collected at 26 (or 17%) of the total sites. At 88% of these sites, common waterweed was trace density. The remaining three sites (12%) were sparse density. See above for notes on identifying common waterweed in the canal.

Four more aquatic plants rounded out the aquatic plant community at section 3. These included leafy pondweed (5%), spatterdock (3%), Eurasian water milfoil (2%) and long-leaf pondweed (1%). Spatterdock is considered a floating macrophyte, as it is a water lily. The leaves of spatterdock often extend above the water, and it has large yellow flowers. In addition to the GPS sites of spatterdock, we observed a few additional patches some only 1 to 3 feet in diameter, and all occurring right on the shoreline.

Section 4

Section 4 was located between the Lower Ferry Road and Hermitage Ave. This section was 2.12 miles long and we surveyed 69 sites. Overall aquatic plants occurred at 64 (or 93%) of the total sites surveyed.

Hydrilla was the dominant aquatic plant we collected in section 4. It occurred at 60 (or 87%) of the sites we surveyed in 2016. Nearly all of the sites we collected were at trace or sparse

abundance. Trace sites accounted for 31 (or 52%) while sparse sites accounted for 28 (or 47%). Only one medium site was collected. This is logical, based on the linear characteristics of the canal and the flow patterns (North to South). The further one gets away from the site of initial introduction, we should observe a decrease in abundance. We did observe a few additional patches of hydrilla, (most of them small), in between our GPS-logged sites, but the frequency of these decreased the further south we traveled down the canal.

Small duckweed was the second most common aquatic plant we observed and was collected at 58 (or 84%) of the total sites. Just over half the sites (n=30, or 52%) were considered to be trace density, while 28 (or 48%) of the sites were sparse density. No medium or dense sites were observed for small duckweed in section 4.

Coontail was quite common in this section as well, occurring at 55 (or 80%) of the total sites. Most of these sites (n=42, or 76%) were trace abundance. Thirteen sparse sites rounded out the coontail sites in section 4.

Wild celery was collected at 77% (n=53) of the sites in this section. In addition, wild celery was quite abundant compared to most other submersed aquatic plants. At 28 sites, the wild celery was trace density, but 17 sites (or 32%) were considered to be sparse. Furthermore, seven (or 13%) of the sites were medium density and another site (2%) was considered dense.

Water stargrass was collected at less than 50% of the sites (n=34) at this section, representing a decrease as compared to the previous three sections. Most water stargrass sites (31, or 91%) were trace density. The remaining three sites were considered sparse density.

Common waterweed occurred at 33 (or 48%) of the sites in section 4. At 26 (or 79%) of the sites, the density was trace. At seven sites (or 21%) the density of common waterweed was considered sparse. No medium or dense sites were observed/collected.

Benthic filamentous algae was collected at 17 (or 25%) of the total sites. All benthic filamentous algae sites were trace density.

Seven additional aquatic plants were collected in this section, but all occurred at less than 15% of the sites sampled, and all occurrences were considered to be trace density. These included Eurasian water milfoil (13%), curly-leaf pondweed (7%), water starwort (4%), brittle naiad (3%), long-leaf pondweed (1%) and pondweed species (1%). The pondweed could not be identified to species due to a lack of distinguishing characteristics. It was a thin-leaf pondweed, which are impossible to identify without floating leaves or seeds. It is interesting to note the decrease in brittle naiad in this section as compared to the previous three sections. Also, no spatterdock was observed in this section.

Section 5

Section 5 was located on the opposite side of Trenton, away from the Delaware River. This section was located between the canal support structures south of Whitehead Road to Carnegie Road. This section was 1.97 miles long and we surveyed 65 sites. Overall aquatic plants occurred at all 65 (or 100%) of the total sites surveyed. No dense sites of aquatic plants were collected in this section. The aquatic plant community in section 5 (and section 6) was somewhat different from the other sections, along the Delaware River.

The dominant aquatic plant at this section was coontail, which occurred at all 65 (or 100%) of the sites we surveyed. At 25 (or 38%) of the sites, the density was trace. Meanwhile, at 37 (or 57%) of the sites, the density was sparse. Three (or 5%) medium sites rounded out coontail abundance in this section.

Small duckweed, a tiny floating aquatic macrophyte, occurred nearly as often as coontail in this section. It occurred at 64 (or 98%) of the sites surveyed. Most of these sites (52, or 81%) were considered to be trace density. At 12 sites (or 19%), the density of small duckweed was considered sparse. These abundance values were similar to the other sections.

Water stargrass occurred at 47 (or 72%) of the sites surveyed in 2016 at this section. Most sites were trace density (34, or 72%). However, 11 (or 23%) of the sites were sparse density, and an additional two sites (or 4%) at medium were confirmed.

Eurasian water milfoil was collected at 34 (or 52%) of the sites in section 5. This represents a significant increase in percent occurrence for this invasive species. Nearly all sites (32, or 94%) were considered trace density. The remaining two sites were sparse density.

Common waterweed was collected at 32 (or 49%) of the sites, but all were considered to be trace density.

Hydrilla did occur in section 5, but at a much lower percent occurrence than the previous sections. This is logical, based on the linear characteristics of the canal, and water flow. But the presence of hydrilla in this section makes it very likely that hydrilla occurs in the area between section 4 and section 5, which was not surveyed in 2016. This area should be a top priority for monitoring in 2017. **Hydrilla occurred at 22 (or 34%) of the sites in this section.** All sites were considered to be trace density. The hydrilla in this section was right on the shoreline, often obscured under emergent plant growth, duckweed and among other aquatic plants. Most of the hydrilla sites were located near Whitehead Road and toward the canal support structures. In the lower 2/3's of the section, only three hydrilla sites (rooted plants) were found, but we did observe numerous floating fragments of hydrilla throughout much of this section.

Eight additional aquatic plants (plus benthic filamentous algae) were also collected at this section, but all occurred at less than 25% of the sites. These included spatterdock (22%), benthic filamentous algae (14%), wild celery (8%), curly-leaf pondweed (6%), brittle naiad (5%), water starwort (5%), arrowhead rosette (3%), leafy pondweed (2%) and pondweed species.

Once again, we found a thin-leaved pondweed specimen that lacked distinguishing features to identify to species level.

Section 6

Section 6 was located between Provinceline Road and Alexander Road. This section was 2.75 miles long and we surveyed 92 sites. Overall aquatic plants occurred at 91 (or 99%) of the total sites surveyed, with most sites being considered trace or sparse density.

Rooted hydrilla was not collected or observed in section 6. We did observe floating hydrilla fragments on six occasions while sampling in this section.

Small duckweed was the most commonly occurring aquatic plant we observed in section 6. It was observed at 89 (or 97%) of the sites we surveyed. At 52 sites (or 58%) the density was trace. At 36 (or 40%) of the sites, the density was sparse. Although no medium sites were observed, we did observe one dense site of small duckweed in this section.

Coontail was the second most common aquatic plant we collected in this section. It was collected at 72 (or 78%) of the total sites. Most of these sites (60, or 83%) were considered trace density. At 11 (or 15%) of the sites, the abundance was sparse, while a single site was considered to be medium.

Water stargrass was commonly collected in section 6, occurring at 56, (or 61%) of the sites. Most sites were trace density (84%), but eight sparse (14%) and one medium (2%) site was also present. Water stargrass typically was found growing with coontail at many of the sites.

We found a significant increase in water starwort abundance in this section of the canal. Water starwort was collected at 53 (or 58%) of the total sites surveyed. Most of these sites (50, or 94%) were trace density. Three sites were considered sparse abundance. Water starwort typically occurred in very shallow water, often on sediments that lacked much other submersed aquatic plant growth.

Benthic filamentous algae occurred at 46 (or 50%) of the sites surveyed in section 6. It occurred at varying abundances, including trace (57%), sparse (30%), and medium (13%) density.

Watermoss was only present at section 6. Yet, it occurred at nearly half (44, or 48%) of the sites. Most sites (42, or 95%) were trace density, with two sites (or 5%) being considered sparse density. Water moss prefers hard substrate to grow on, and was typically affixed to snags, rocks or the rocky bottom in this section.

We observed quite an increase in spatterdock (a yellow flowered water lily) in section 6. It occurred at 37 (or 40%) of the total sites. Many were at trace density (representing a small cluster of leaves from one to three plants). Trace patches of spatterdock accounted for 31 (or 84%) of the sites. In addition, there were six (or 16%) sites with sparse patches of spatterdock.

Seven additional aquatic plants were collected or observed in this section, but all occurred at less than 15% of the total sites. These included common waterweed (12%), muskgrass (12%, actually considered to be a macroscopic algae), wild celery (7%), Eurasian water milfoil (4%), pondweed sp., leafy pondweed (3%) and white water crowfoot (3%). White water crowfoot was only collected in this section, and all three sites were trace density.

Task 2: Hydrilla Tuber Density Discussion

Hydrilla tuber sampling was conducted by SLM field biologists on November 1, 2016. We selected five sampling locations for this season to establish baseline tuber density to direct and track future control efforts. One sample site was placed in each of the five sections (#1-5) that we observed rooted hydrilla. Therefore, section 6 was not sampled for tuber density. A map of the sample sites with GPS coordinates is located in the Appendix of this report. Also located in the Appendix is a summary table of our tuber results. A simpler version of this table is reproduced, below as table 3.

Table 3: D&R Canal 2016 Hydrilla Tuber Summary

Sample Site	# Cores	Tubers (m ²)	Turions (m ²)	Tuber and Turion (m ²)
1	3	462.8	0.0	462.8
2	5	85.6	203.3	288.9
3	5	288.9	42.8	331.7
4	3	320.4	17.8	338.2
5	5	10.7	0.0	10.7

In 2016, hydrilla tuber densities ranged from 10.7 tubers/m² to 462.8 tubers/m². Turion densities ranged from 0.0 turions/m² to 203.3 turions/m². The highest tuber density (462.8 tubers/m²) was in section 1, near the first documented rooted beds of hydrilla. This is logical, as it's assumed this would be the most well-established bed of hydrilla, assuming this is the site of initial introduction. Incidentally, no turions were collected at this site. This is also logical, giving the flow in the canal and the fact that turions are typically attached to vegetative stems of hydrilla. The lowest tuber density occurred at section 5, at 10.7 tubers/m². This is also logical, since we assume that the hydrilla in this section only recently has become rooted here. This is also supported by the SAV data we collected.

Tuber densities decreased at section 2 (85.6 tubers/m²), which is inconsistent with what we would expect, based on the tuber densities observed up canal (section 1, as described above)

and down canal (sections 3 and 4, 288.9 tubers/m² and 320.4 tubers/m², respectively). This was likely a function of substrate type (sandy/tiny rocks), but if one adds the turions collected at section 2 (203.3 turions/m²) to the tuber density, this variability is reduced (288.9/m² to 338.2 m²). This tighter range variability could likely be explained by sampling variability.

Overall, tuber densities are somewhat low compared to similar data collected at other sites in the Northeast by SLM (with tuber densities typically ranging from 1,000 tubers/m² to 2,000 tubers/m²). Again, this is logical as we assume this infestation is relatively recent, likely a few years. Future control efforts will need to be applied to this site long enough to exhaust the tuber bank accumulated in the sediments. Fortunately, this might be a shorter duration, since this infestation was documented in an early stage. The author of this report refers the client to Nawrocki (2016) for an in-depth discussion of hydrilla tuber dynamics.

Summary of Findings

- In September, 2016 SOLitude Lake Management was retained by the NJWSA to conduct SAV mapping in select sections of the D&R Canal. The primary goal of the project was the delineation of hydrilla in the canal system, but using modified Point Intercept Methods, all SAV was surveyed.
- We mapped the SAV in 18.31 miles of the canal, based on high priority sites. These were determined by the presence of hydrilla, intake structures, spillways, or historical high SAV densities.
- We surveyed 597 GPS-referenced sites, spaced 50 meters apart. The canal was divided into six different sections for this project. We conducted two weed rake tosses per site, one on the West Shore (toss A) and one on the East Shore (toss B). We also used visual assessments to support our data collecting.
- A total of 20 different aquatic plants (plus benthic filamentous algae) was collected/observed during this project. Submersed aquatic vegetation was documented at 96.5% of the total sites.
- Small duckweed was the most commonly occurring aquatic plant, observed at 89.8% of the total sites. Coontail (84.9%) and water stargrass (66.8%) were the next most commonly occurring aquatic plants.
- Hydrilla (rooted beds) was documented in sections 1 through 5. No rooted hydrilla was observed in section 6. Hydrilla occurred at 56.4% of the total sites sampled in 2016. We are confident we have documented the northern-most established hydrilla and the southern-most established hydrilla in the sections we surveyed.

- Section 2 (86%), Section 3 (93%) and Section 4 (87%) had the highest percent occurrence of hydrilla. We would say section three had the most overall hydrilla based on number of sites and individual abundances.
- Tuber sampling was conducted at five sites on November 1, 2016. The tuber densities ranged from 10.7 tubers/m² to 462.8 tubers/m². The highest tuber density was in section 1, while the lowest tuber density was in section 5.
- Tuber monitoring was not conducted in section 6, since rooted hydrilla was not documented in that section.

2017 Recommendations

- Although not part of the data analysis for this study, the fact that we consistently surveyed the West Shore with toss A and the East Shore with toss B, teasing the shore to shore comparison of the data might reveal a hydrilla preference based on habitat. It would also give a better understanding of the hydrilla abundance in the canal, since our data discussion was based on averaging the two tosses together. While in the field, we anecdotally observed different abundances (hydrilla and overall SAV) between the shoreline sites at the same location.
- In 2017, it is recommended that the additional 40+ miles of the canal be surveyed for the presence of hydrilla (or any other highly aggressive invasive aquatic plants). Again, sections of the canal should be prioritized based on features, such as water intakes, spillways, proximity to other water bodies (such as Carnegie Lake), or historical high abundance SAV areas. The top priority site would be located between sections 4 and 5, since rooted hydrilla was documented at both sections and this location was not surveyed in 2016. It is recommended that similar sampling procedures (PIM, two tosses per site, one along each shoreline) be used to be able to compare the results for the 2016 and 2017 studies.
- In addition, if hydrilla control methods are employed in sections of the canal in 2017, those areas should be surveyed late in the season (Oct.) as well. For control efficacy, three sample tosses (one on each shoreline and a middle station) might be worth the additional sampling effort.
- Hydrilla tuber monitoring should be conducted again in 2017. The same 5 sites established in 2016 should be used, regardless of the type of control employed on the hydrilla. Assessing the tuber bank is the most efficient way to assess the likely duration of control required at this site, or the potential shift to less aggressive tactics.
- Before selecting an appropriate hydrilla control program for 2017, the first step would be the development of a comprehensive Hydrilla Management Plan for the canal. This

plan should include a summary of the results of the 2016 data collected, select control options within budget and suitable for all water uses of the project site and include short term and long term goals with measurable results. An integrated approach is more likely to provide suitable results, although more aggressive control measures might need to be employed during the early stages. Control options to consider are herbicide use, physical removal (hand pulling or Diver-Assisted Suction Harvesting), benthic barrier use, or biological control (grass carp stocking).

- Any short and long term control programs should include a robust educational/outreach component, since the canal and park is highly visible and an important recreational asset. The New Jersey Water Supply Authority should be commended for already undertaking this task in 2016 and laying the initial groundwork.

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Appendix A: Data Tables

Appendix B: Location Maps

Appendix C: Section Distribution Tables

Appendix D: Aquatic Plant Abundance Tables by Section

Appendix E: Hydrilla Tuber Data and Maps

D&R Canal Survey Section Summary



Date	Section	Description	Miles	# Sites	Sites w/Hydrilla	% Hydrilla	Notes
9/15 and 9/23	1	Rte 179 to Titusville Bridge	5.23	165	67	41.0%	1st occurrenc of hydrilla
9/6 and 9/7	2	Titusville Bridge Washington's Crossing	1.74	57	49	86.0%	
9/7, 9/8, 9/9	3	Washington's Crossing to Lower Ferry Road	4.5	149	139	93.0%	
9/9 and 9/16	4	Lower Ferry Road to Hermitage Ave.	2.12	69	60	87.0%	
9/21/2016	5	Canal Support Structure to Carnegie Road	1.97	65	22	34.0%	All trace sites
9/22/2016	6	Provinceline Road to Alexander Road	2.75	92	0	0.0%	Floating hydrilla fragments observed

Delaware and Raritan Canal
Section 1
Aquatic Vegetation Survey
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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
1	A																									
1	B																									
1	M	40.36539°	-74.94594°	7																						
2	A																									
2	B																									
2	M	40.36497°	-74.94578°	7																						
3	A																									
3	B				S					S																
3	M	40.36453°	-74.94558°	4.5	T					T																
4	A																									
4	B				M					M										T						T
4	M	40.36408°	-74.94538°	5.5	S					S										T						T
5	A				T					T										T						
5	B																									
5	M	40.36366°	-74.94528°	6	T					T										T						
6	A																									
6	B																									
6	M	40.36323°	-74.94504°	6.5																						
7	A				T					T										T						
7	B				M					S										S						M
7	M	40.36279°	-74.94487°	8	S					S										S						
8	A				T					T	T									T		T				
8	B				T		T													T						
8	M	40.36232°	-74.94471°	7.5	T		T			T	T									T		T				
9	A				T		T																			
9	B				M					T																M
9	M	40.36194°	-74.94459°	4.5	S		T			T																S
10	A																									
10	B				S					S																
10	M	40.36148°	-74.94445°	6	T					T																
11	A				T		T																			
11	B				M		T			S	T															M
11	M	40.36105°	-74.94431°	5.5	S		T			T	T															S
12	A				T		T			T										T						
12	B				M		T			T	T			T						T						M
12	M	40.3606°	-74.94416°	6.5	S		T			T	T			T						T						S
13	A				T						T															
13	B				D					S	T									S						D
13	M	40.36015°	-74.9441°	7	M					T	T									T						S
14	A				M		S			T						M										
14	B				S		S				T					S										
14	M	40.36183°	-74.94426°	1	M		S			T	T					M										
15	A				D		D	S		T						T				M						

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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
15	B				D		D	S						T						M						
15	M	40.36177°	-74.94367°	1.5	D		D	S		T				T		T				M						
16	A																									
16	B																									
16	M	40.3588°	-74.94388°	6.5																						
17	A				S						S									T						
17	B				S					T	S									T						
17	M	40.35829°	-74.94381°	4.5	S					T	S									T						
18	A				M		T				M					T				S						
18	B				S		T				S					T				T		T				
18	M	40.35836°	-74.94339°	1.5	M		T				M					T				S		T				
19	A				D					T	D									S		S				T
19	B				D						M									M		M				S
19	M	40.35859°	-74.94363°	1	D						T	D								M		M				S
20	A				T															T		T				
20	B				T															T						
20	M	40.35791°	-74.94348°	3	T															T		T				
21	A																									
21	B				S						S									T						
21	M	40.3579°	-74.94374°	2.5	T						T									T						
22	A				S					T	S									T						
22	B				S					T	S									S						
22	M	40.35742°	-74.94365°	6	S					T	S									S						
23	A																									
23	B				T						T											T				
23	M	40.357°	-74.94356°	6.5	T						T											T				
24	A				S						S									T						
24	B				T						T					T				T		T				
24	M	40.35651°	-74.94356°	6	S						S					T				T		T				
25	A																									
25	B				T					T	T									T						
25	M	40.35604°	-74.94355°	6.5	T					T	T									T						
26	A				S						T									T		S				
26	B				T					T	T									T		T				
26	M	40.35564°	-74.94357°	6	S					T	T									T		S				
27	A																									
27	B				T						T									T						T
27	M	40.35518°	-74.94356°	7	T						T									T						T
28	A																									
28	B																									
28	M	40.35473°	-74.94357°	6.5																						
29	A				T					T	T											T				
29	B																									

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
29	M	40.35428°	-74.94365°	6	T					T	T											T				
30	A																									
30	B				T						T															
30	M	40.35383°	-74.94381°	7	T						T															
31	A																									
31	B																									
31	M	40.35337°	-74.94387°	7.5																						
32	A																									
32	B																									
32	M	40.35291°	-74.94398°	8																						
33	A																									
33	B																									
33	M	40.35247°	-74.94399°	7.5																						
34	A				T					T	T															
34	B																									
34	M	40.35198°	-74.94395°	7.5	T					T	T															
35	A																									
35	B				T						T															
35	M	40.35157°	-74.94396°	7	T						T															
36	A				T		T	T		T	T											T				
36	B																									
36	M	40.35115°	-74.94392°	6.5	T		T	T		T	T											T				
37	A				S						T									T		S				
37	B																									
37	M	40.35069°	-74.94387°	7.5	T						T									T		T				
38	A				T					T	T									T						
38	B																									
38	M	40.35024°	-74.94385°	7	T					T	T									T						
39	A				S		T			T	T									T		S				
39	B				T					T	T									T						
39	M	40.34978°	-74.94385°	6	S		T			T	T									T		T				
40	A				T			T			T															
40	B																									
40	M	40.34935°	-74.94378°	6	T			T			T															
41	A				S						T															S
41	B																									
41	M	40.34886°	-74.94373°	6.5	T						T									T		T				T
42	A				T					T	T									T						T
42	B																									
42	M	40.34845°	-74.94367°	6	T					T	T									T						T
43	A				S			S		T	S									T						T
43	B				T					T	T															
43	M	40.34794°	-74.94363°	7	S			T		T	S									T						T

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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
44	A				T						T									T						
44	B				T					T	T									T						
44	M	40.34752°	-74.9436°	5.5	T					T	T									T						
45	A				T					T	T															
45	B																									
45	M	40.34706°	-74.94349°	6	T					T	T															
46	A																									
46	B																									
46	M	40.34665°	-74.94335°	6.5																						
47	A																									
47	B				T					T	T									T						
47	M	40.34622°	-74.94319°	6	T					T	T									T						
48	A																									
48	B				S					T	S									T		T				
48	M	40.34578°	-74.94297°	6	T					T	T									T		T				
49	A				T															T		T				
49	B				S					T	S									T						
49	M	40.34538°	-74.94274°	6.5	S					T	T									T		T				
50	A				M			T		T	T									T		M				
50	B				S						S									S						
50	M	40.34495°	-74.94249°	7	M			T		T	S									S		M				
51	A				S						T									S		S				T
51	B				T						T									T						
51	M	40.34453°	-74.94222°	6	S						T									S		T				T
52	A				S			T		T	T									T		S				
52	B				S					T	S									T		T				
52	M	40.34414°	-74.94197°	6.5	S			T		T	S									T		S				
53	A				M						T									T		M				T
53	B				T						T									T						
53	M	40.34379°	-74.94174°	7	S						T									T		S				T
54	A				S						S									S		T				S
54	B				M					M	S									T		M				
54	M	40.34338°	-74.94138°	6.5	M					S	S									S		S				
55	A				S			T		T	T									S		S				S
55	B				T					T	T									T		T				
55	M	40.34296°	-74.94115°	6	S			T		T	T									S		S				T
56	A				M			T			S									S		S				S
56	B				M					T	S									M						
56	M	40.3426°	-74.94081°	7	M					T	S									M		S				
57	A				S						T									S		S				
57	B				M			T		T	T									S		M				T
57	M	40.34223°	-74.94045°	6.5	M			T		T	T									S		M				T
58	A				D			T		S	M		S							S		M				M

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
72	M	40.3385°	-74.93337°	7	S						T		T		T					T		T				S
73	A				S					T	T				T					T		T				S
73	B				S			S			T		T		T											S
73	M	40.33816°	-74.93291°	6	S			T		T	T		T		T					T		T				S
74	A				D					T	S				M					M		M				S
74	B				S			T		T	T				S					T						T
74	M	40.3378°	-74.93251°	6.5	M			T		T	S				M					S		S				S
75	A				M			T			S				M					T		S				S
75	B				S			S		T					T					T		T				T
75	M	40.33749°	-74.9321°	6	M			S		T	T				S					T		S				S
76	A				M						S				S					T		S				M
76	B				M			T			S									M		M				T
76	M	40.3372°	-74.93169°	6.5	M			T			S				T					S		M				S
77	A				S						T									T		S				S
77	B				S			S		T	S									T		S				
77	M	40.33686°	-74.93129°	7.5	S			T		T	S									T		S				T
78	A				M			T			S				T					T		T				M
78	B				T					T	T									T		T				T
78	M	40.33653°	-74.93086°	6.5	S			T		T	S				T					T		T				S
79	A				S					T	T									T		S				S
79	B				T						T									T						
79	M	40.33619°	-74.93045°	7	S					T	T									T		T				T
80	A				M						S									S		M				M
80	B				S						T				T					T		S				
80	M	40.33587°	-74.93002°	7.5	M						S				T					S		M				
81	A				M						T									T		T				M
81	B				T			T			T				T					T		T				
81	M	40.33557°	-74.92961°	7.5	S			T			T				T					T		T				S
82	A				M						T				M					S		S				M
82	B				S						S									T						T
82	M	40.33521°	-74.92918°	7	M						S				S					S		T				S
83	A				M					T	S									S		M				M
83	B				S			S		T	S									S		T				
83	M	40.33491°	-74.9288°	7	M			T		T	S									S		S				S
84	A				S						T									S						T
84	B				T						T									T		T				
84	M	40.33462°	-74.92839°	6.5	S						T									S		T				T
85	A				S			T		T	S									S		T				S
85	B				S						T									S						S
85	M	40.33428°	-74.92796°	6	S			T		T	S									S		T				S
86	A				S			T		T	T									S		S				S
86	B				T															T						
86	M	40.33395°	-74.9275°	6.5	S			T		T	T									S		T				T

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
87	A				M			T		T	S				T		S			S		M				
87	B				S						T				S					T		T				
87	M	40.33365°	-74.92707°	6	M			T		T	S				S		T			S		S				
88	A				M					T	M									T		T				S
88	B				S						S									S		S				S
88	M	40.33333°	-74.92664°	5.5	M					T	M									S		S				S
89	A				M		S				S				M					M		T				S
89	B				S						S									T						
89	M	40.33297°	-74.92629°	4	M		T				S				S					S		T				T
90	A				M			T			T				S					S		T				M
90	B				T						T									T						
90	M	40.33258°	-74.92604°	5.5	S			T			T				T					S		T				S
91	A				M						T				M					S		M				T
91	B				T						T									T						
91	M	40.33217°	-74.92591°	6	S						T				S					S		S				T
92	A				S						T									S		S				
92	B				S						S									T						
92	M	40.33174°	-74.92571°	6.5	S						S									S		T				
93	A				M			S		S	S									S		M				T
93	B				S			T		T	T						T			S		S				
93	M	40.33131°	-74.92559°	7.5	M			S		S	S						T			S		M				T
94	A				S			S			T									T						
94	B				T		T				T									T		T				
94	M	40.33085°	-74.92551°	6	S		T	T			T									T		T				
95	A				S					T										S		S				
95	B				M					M										S		T				
95	M	40.3304°	-74.9253°	7	M					S										S		S				
96	A				T						T				T					T		T				
96	B				T						T									T		T				
96	M	40.33001°	-74.92503°	6.5	T					T	T				T					T		T				
97	A				S					T										S		T				
97	B				M			T		M	S				S					S		S				
97	M	40.32968°	-74.92463°	6	M			T		S	T				T					S		S				
98	A				T					T	T									T		T				
98	B				T					T	T									T		T				
98	M	40.3294°	-74.9242°	6.5	T					T	T									T		T				
99	A				T					T	T									T						
99	B				T		T													T						
99	M	40.32906°	-74.92377°	6.5	T		T			T	T									T						
100	A				S						T				T					T		T				S
100	B				S		T				T				T					S						
100	M	40.32879°	-74.92334°	6	S		T				T				T					S		T				T
101	A				M			T		T	T									S		T				M

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
101	B				S						T									S						
101	M	40.32846°	-74.9229°	6	M			T		T	T									S		T				S
102	A				S						T				T					S		S				M
102	B				T															T						
102	M	40.32813°	-74.92246°	6.5	S						T				T					S		T				S
103	A				T															T						
103	B				M						M									S						
103	M	40.3278°	-74.92206°	6	S						S									S						
104	A				M			T		T					T					S		S				M
104	B				S						S									S		T				T
104	M	40.32751°	-74.92166°	6.5	M			T		T	T				T					S		S				S
105	A				T					T					T					T		T				
105	B				T						T									T						
105	M	40.3272°	-74.92121°	6	T					T	T				T					T		T				
106	A				M		T				S				S							S				M
106	B				S		T				S									T						
106	M	40.32685°	-74.92079°	7	M		T				S				T					T		T				S
107	A				S			T		T	T		T		S					T						
107	B				S		T				T				T					T						S
107	M	40.32651°	-74.92041°	6	S		T	T		T	T		T		S					T						T
108	A				S			T		T	T				S					T		T				S
108	B				S		S				S				T					T		T				
108	M	40.32619°	-74.92°	6.5	S		T	T		T	S				S					T		T				T
109	A				M			T			T		T		T					T		T				M
109	B				S		T				S				T					T		S				S
109	M	40.32585°	-74.91962°	6	M		T	T			S		T		T					T		S				M
110	A				M			T		T	T				T					S		T				M
110	B				T		T			T	T				T					T		T				
110	M	40.32554°	-74.91922°	6.5	S		T	T		T	T				T					S		T				S
111	A				M			S			T				S					S		T				S
111	B				S		T				T				T					T		S				
111	M	40.32522°	-74.91875°	6	M		T	T			T				S					S		S				T
112	A				M						S				T					T		T				M
112	B				S			T			T				S					S		S				
112	M	40.3249°	-74.91836°	6.5	M			T			S				S					S		S				S
113	A				M						S				M							T				S
113	B				S						T				T					S		T				
113	M	40.32457°	-74.91796°	6	M						S				S					T		T				T
114	A				M						T									M						
114	B																									
114	M	40.32428°	-74.91758°	7	S						T									S						
115	A				M						S				S					S		T				S
115	B				T						T									T						

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
115	M	40.32394°	-74.91713°	6.5	S						S				T					S		T				T
116	A																									
116	B																									
116	M	40.32361°	-74.91677°	6																						
117	A				S						T				T					T		T				S
117	B				S					T	T				T					T						S
117	M	40.32325°	-74.91631°	6.5	S					T	T				T					T		T				S
118	A				T						T				T					T						T
118	B				M			T			M				T					T		S				
118	M	40.32293°	-74.91594°	6	S			T			S				T					T		T				T
119	A				S						S				T					T		T				
119	B				M		T			T	S				T					M		M				
119	M	40.32262°	-74.91552°	5	M		T			T	S				T					S		S				
120	A				S			S			S				T					S		S				
120	B				M			T			T				S					M		T				
120	M	40.32229°	-74.91513°	5.5	M			S			S				S					M		S				
121	A				M						S				T					M		M				S
121	B				S						S				T					S		T				T
121	M	40.32195°	-74.91472°	6	M						S				T					M		S				S
122	A				T						T				T	T				T		T				T
122	B				S						S				S					S		S				T
122	M	40.32162°	-74.91432°	6	S						S				S	T				S		S				T
123	A				M						S				M					S		M				S
123	B				M		T				T				T					S		T				M
123	M	40.32129°	-74.91392°	5.5	M		T				S				S					S		S				M
124	A				S			T			S				T					T		S				S
124	B				M					T	T				T					S		S				S
124	M	40.32099°	-74.9135°	6	M			T		T	S				T					S		S				S
125	A				M			S			T				T					S		M				
125	B				T						T				T					T		T				T
125	M	40.32068°	-74.91302°	6.5	S			T			T				T					S		S				T
126	A				T		T								T					T		T				
126	B				S		S			S	T				T					T						
126	M	40.32044°	-74.9126°	6	S		S			T	T				T					T		T				
127	A				T										T					T		T				
127	B				T		T			T	T				T					T						
127	M	40.32016°	-74.91212°	6	T		T			T	T				T					T		T				
128	A				S		T	S			T				S					S		M				
128	B				S		S				S				T							T				
128	M	40.31989°	-74.91162°	6	S		S	T			S				S					T		S				
129	A				T			T			T				T							M				T
129	B				T		T													T						
129	M	40.31966°	-74.91113°	6.5	T		T	T			T				T					T		S				T

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
130	A				S						T				S					T		T				
130	B				S		S				S				T					T		T				T
130	M	40.31941°	-74.91061°	7	S		T				S				S					T		T				T
131	A				T		T			T					T					T		T				
131	B				T			T			T									T						T
131	M	40.31917°	-74.91014°	5.5	T		T	T		T	T				T					T		T				T
132	A				S			T		T	S				S					T		T				
132	B				T		T			T	S				T					T		T				
132	M	40.31893°	-74.90965°	6	S		T	T		T	S				S					T		T				
133	A				M						S									T		M				
133	B				S						S		T		T					T						
133	M	40.31872°	-74.90911°	7	M						S		T		T					T		S				
134	A				S						T									S		S				
134	B				S						T		T							S						
134	M	40.31851°	-74.90858°	6	S						T		T							S		T				
135	A				T				T		T				T					S		T				M
135	B																									
135	M	40.31833°	-74.90807°	6	T				T		T				T					T		T				S
136	A				S					T	T				T					S		S				S
136	B				T		T				T				T					T						
136	M	40.31811°	-74.90746°	6.5	S		T			T	T				T					S		T				T
137	A				M						T				T					S		M				T
137	B				T		T				T				T					T						
137	M	40.31794°	-74.90698°	6	S		T				T				T					S		S				T
138	A				S						T				S					T		M				
138	B				M		T				T									M						
138	M	40.31777°	-74.90645°	6	M		T				T				T					S		S				
139	A				S						T				T							S				S
139	B				S					T	T				S					S						
139	M	40.31756°	-74.9059°	6	S					T	T				S					T		T				T
140	A				M						S				S					T		M				
140	B				S						T									S		T				T
140	M	40.31737°	-74.90537°	6.5	M						S				T					S		S				T
141	A				S			T		T	S				T					S		M				
141	B																									
141	M	40.31717°	-74.9048°	6	T			T		T	T				T					T		S				
142	A				S						S									S		S				S
142	B				T					T	T									T		T				
142	M	40.31705°	-74.90428°	6.5	S					T	S									S		S				T
143	A				M						T				S					S		M				S
143	B																									
143	M	40.31692°	-74.90369°	6	S						T				T					T		S				T
144	A				D						T				T					S		D				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long Leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
158	M	40.31593°	-74.89513°	6.5	T		T																			
159	A				S		T				T				T					T						S
159	B				S		T				T				S					T		T				
159	M	40.31577°	-74.89459°	6	S		T				T				S					T		T				T
160	A				D						S				T					S		D				
160	B				T		T			T	T															
160	M	40.31557°	-74.89403°	6.5	M		T			T	S				T					T		S				
161	A				T															T						
161	B				S		S				T											T				
161	M	40.31539°	-74.8935°	6	S		T				T									T		T				
162	A				M			T			T									S		S				M
162	B				M		S				M				S							T				T
162	M	40.31522°	-74.893°	6.5	M		T	T			S				T					T		S				S
163	A				S			T		T	T				S					S		T				
163	B				S		T	S			S				T							T				
163	M	40.315°	-74.89241°	7	S		T	S		T	S				S					T		T				
164	A				M			M			S									S		S				
164	B				M		T	S			S				T					S		S				S
164	M	40.31483°	-74.89191°	6	M		T	M			S				T					S		S				T
165	A				M						S		T							S		S				T
165	B				M						S									S		S				S
165	M	40.31451°	-74.89134°	6.5	M						S		T							S		S				S

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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
1	A				M						T				T					S		T				M
1	B				M			S			S				T					M		M				T
1	M	40.314115°	-74.890707°	7	M			T			S				T					M		S				S
2	A				M			T		T										T						M
2	B				T			T		T	T									S		T				T
2	M	40.313834°	-74.890256°	6.5	S			T		T	T									S		T				S
3	A				S						T									T						S
3	B				T			T												T						T
3	M	40.313555°	-74.889805°	6	S			T			T									T						S
4	A				S			T			S									T						
4	B				T															T		T				
4	M	40.313271°	-74.889342°	5.5	S			T			T									T		T				
5	A				S						T									S		T				S
5	B				M			S			S									T						M
5	M	40.313005°	-74.888939°	4.5	M			T			S									S		T				M
6	A				T										T					T						
6	B				T															T						
6	M	40.312694°	-74.888443°	7	T										T					T						
7	A				T						T									T						
7	B				S			T			S									S						
7	M	40.312418°	-74.887991°	6.5	S			T			S									S						
8	A				S						S				S					S		S				
8	B				S						S				T					T		S				
8	M	40.312112°	-74.887541°	6	S						S				S					S		S				
9	A				M			T			S				S					S		S				
9	B				M			S			M				M					T		S				M
9	M	40.311853°	-74.887053°	6.5	M			S			M				M					S		S				S
10	A				M			S			S				T					M		M				
10	B				M			M			S				T					S		M				
10	M	40.311567°	-74.886588°	6.5	M			M			S				T					M		M				
11	A				S						T				S					T		T				S
11	B				S						T				S					T		S				T
11	M	40.311272°	-74.886143°	6	S						T				S					T		S				S
12	A				S						S									S						
12	B				S						T									S		S				
12	M	40.311011°	-74.885676°	6.5	S						S									S		T				
13	A				T					T	T									T						
13	B				S					S	T									T						
13	M	40.310725°	-74.885227°	6	S					S	T									T						
14	A				M					S	M				S					M		S				
14	B				M					S	S									S		M				
14	M	40.310478°	-74.884734°	6.5	M					S	M				T					M		M				
15	A				S						S				S					S		S				
15	B				S						T				T					S		S				
15	M	40.310223°	-74.884234°	7	S						S				S					S		S				

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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
16	A				S					T	S									T						T
16	B				S					S	S									T						S
16	M	40.309985°	-74.883738°	6.5	S					S	S									T						S
17	A				T			T			T				T					T						T
17	B				S			S			S									S						T
17	M	40.309707°	-74.883255°	7	S			S			S				T					S						T
18	A				S						T				T					S		S				T
18	B				S						T									S		S				S
18	M	40.309433°	-74.882802°	6	S						T				T					S		S				S
19	A				M						S				S					S		M				
19	B				M						S				T					M		M				T
19	M	40.309178°	-74.88232°	5.5	M						S				S					M		M				T
20	A				M			M			S				M					M		S				
20	B				M			S			S				S					M		T				
20	M	40.308899°	-74.881831°	6	M			M			S				M					M		S				
21	A				M						T				M					S		M				T
21	B				M										M					S		M				S
21	M	40.308598°	-74.881371°		M						T				M					S		M				S
22	A				M						S				M					T		M				T
22	B				M			T			S				M					M		S				T
22	M	40.308338°	-74.880896°	6.5	M			T			S				M					S		M				T
23	A				D			T			T				D					S		T				D
23	B				M			S							M					M		T				M
23	M	40.308108°	-74.880421°	6	D			S			T				D					M		T				D
24	A				D						T				D					S		M				S
24	B				D										D					M		M				M
24	M	40.307823°	-74.879925°	7	D						T				D					M		M				M
25	A				M			T			S				S					T		M				T
25	B				D		T	T			S				M					S		D				S
25	M	40.307565°	-74.879416°	6.5	D		T	T			S				M					S		D				S
26	A				D			T			S				D					M						T
26	B				D						T				S					M		M				D
26	M	40.307355°	-74.878957°	6	D			T			S				M					M		S				M
27	A				M						T				T					T		M				M
27	B				D			T			S				M					T		M				S
27	M	40.307017°	-74.878477°	7.5	D			T			S				S					T		M				M
28	A				D			T			S		T		S					S		S				M
28	B				M		T	T			T		T		M					S						S
28	M	40.306767°	-74.878095°	8	D		T	T			S		T		M					S		T				M
29	A				M						S				M					T		M				T
29	B				S						S				T					S		S				T
29	M	40.306531°	-74.877574°	6	M						S				S					S		M				T
30	A				M			T			S				T					S		M				M
30	B				D						S				D					S		S				S
30	M	40.306284°	-74.877126°	6.5	D			T			S				M					S		M				M

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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
31	A				D			S			S				D					M		T				S
31	B				S			T			M				T					D		M				M
31	M	40.305995°	-74.876632°	6	M			S			M				M					D		S				M
32	A				D					T					T					S		S				D
32	B				M						T				S					S		M				S
32	M	40.305753°	-74.876127°	5.5	D					T	T				S					S		M				M
33	A				D			T	S						S					S						D
33	B				S			S		S	T				T					S		S				
33	M	40.305518°	-74.875717°	5	M			S	T	T	T				S					S		T				S
34	A				M		T				T				S					T						M
34	B				D						T				D					S		T				T
34	M	40.305256°	-74.87522°	6.5	D		T			T	T				M					S		T				S
35	A				D						T				D					T						M
35	B				S			T			T				S					T		T				T
35	M	40.304978°	-74.874741°	6	M			T			T				M					T		T				S
36	A				S			S							T					S						S
36	B				S			M			T				T					S		S				S
36	M	40.304709°	-74.874261°	5.5	S			M			T				T					S		T				T
37	A				M			S			T				T					S		T				M
37	B				M						T				S					T						M
37	M	40.304441°	-74.873787°	6.5	M			T			T				S					S		T				M
38	A				M		T								M					S		T				T
38	B				M						T				S					T		S				M
38	M	40.304107°	-74.873339°	7	M		T				T				M					S		S				S
39	A				D		S								S					T		S				D
39	B				S										T					S		T				T
39	M	40.303795°	-74.872952°	5.5	M		T								S					S		S				M
40	A				S										S					S		S				S
40	B				M						S				M					T						M
40	M	40.303455°	-74.872527°	6.5	M						T				M					S		T				M
41	A				D						T				D					T		S				M
41	B				S						T				S					S		S				S
41	M	40.303086°	-74.872198°	5	M						T				M					S		S				M
42	A				D			T			T				S					S						D
42	B				S										T					S		S				S
42	M	40.302727°	-74.871936°	5.5	M			T			T				S					S		T				M
43	A				M										M					M		S				S
43	B				D						T				D					T		T				D
43	M	40.302338°	-74.87161°	4.5	D						T				D					S		S				M
44	A														T					S						D
44	B				S		S								T					S		T				S
44	M	40.301916°	-74.87134°	5.5	T		T								T					S		T				M
45	A				M			T			T				S					M						M
45	B				T										T					T						T
45	M	40.301528°	-74.871062°	6.5	S			T			T				S					S						S

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Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
46	A				M			S			T				T					M						S
46	B				M		T	T							S					S						M
46	M	40.301167°	-74.870782°	6.5	M		T	S			T				S					M						M
47	A				M		T				S				S					M						M
47	B				M						T				S					S		T				M
47	M	40.300742°	-74.870432°	6	M		T				S				S					M		T				M
48	A				M		T	S			T				M					S		T				S
48	B				D						S				M					M		T				M
48	M	40.300346°	-74.870189°	7	D		T	T			S				M					M		T				M
49	A				D		T				T				T					T						D
49	B				M			T			T				M					T		M				T
49	M	40.299948°	-74.869843°	7	D		T	T			T				S					T		S				M
50	A																									
50	B				S			T			T				S					S		T				
50	M	40.299592°	-74.869485°	7.5	T			T			T				T					T		T				
51	A				S			T			T				S					S		T				S
51	B				D			M			T				T					D		T				M
51	M	40.299222°	-74.869111°	7	M			S			T				S					M		T				M
52	A				T		T								T					T						T
52	B				S		T	T							T					S						
52	M	40.298871°	-74.868725°	6.5	S		T	T							T					S						T
53	A				D						S									M		S				D
53	B				D						T				S					M		M				D
53	M	40.298524°	-74.868404°	6	D						S				T					M		M				D
54	A				D		T				T				D					S		M				S
54	B				D		S								M					T		M				M
54	M	40.298145°	-74.868031°	6.5	D		S				T				D					S		M				M
55	A				S										T					S						S
55	B				M						S				T		T			S		S				M
55	M	40.297725°	-74.86769°	6	M										T		T			S						M
56	A				M		T								S					T		T				M
56	B				T			T			T				T											
56	M	40.297359°	-74.867435°	6.5	S		T	T			T				S					T		T				S
57	A				D			T			T				M					S		M				D
57	B				T		T				T															
57	M	40.296947°	-74.867117°	7	M		T	T			T				S					T		S				S

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
1	A				T						T									T						
1	B				T															T						
1	M	40.296546°	-74.866829°	6.5	T						T									T						
2	A																									
2	B				S						T				S					T						T
2	M	40.29618°	-74.866554°	7	S						T				T					T						T
3	A				M															S						M
3	B				T						T									T						
3	M	40.29584°	-74.866264°	7.5	S						T									S						S
4	A				M			T			T				S					T						M
4	B																									
4	M	40.295446°	-74.86597°	7	S			T			T				T					T						S
5	A				M										M					S		T				M
5	B				T						T															T
5	M	40.295074°	-74.86566°	6	S						T				S					T		T				S
6	A				D		T	T							D					M						S
6	B				D					T	T				M					T		M				M
6	M	40.294682°	-74.865359°	6.5	D		T	T		T	T				D					S		S				M
7	A				M										M					S		T				S
7	B				T						T				T					T						T
7	M	40.294264°	-74.865042°	7	S						T				S					S		T				S
8	A				M		T				T				M							T				M
8	B																									
8	M	40.2939°	-74.864743°	6.5	S		T				T				S							T				S
9	A				D					T					D					M		S				D
9	B				S						T									T						S
9	M	40.293527°	-74.864451°	7	M					T	T				S					S		T				M
10	A				D						T				D					S						M
10	B				M										T					T		T				M
10	M	40.293113°	-74.864109°	6	D						T				M					S		T				M
11	A				M		T	T							M					S		S				M
11	B				S			S			T				T					S						S
11	M	40.29272°	-74.86382°	6	M		T	S			T				S					S		T				M
12	A				D		T	S			S				M					M		M				M
12	B				M		T				T				S					S		T				M
12	M	40.292358°	-74.863541°	7	S		T	T			S				M					M		S				M
13	A				D		T								D					S		M				M
13	B				M										S					S		S				M
13	M	40.291977°	-74.863239°	6.5	D		T								M					S		M				M
14	A				D										D					M		S				M
14	B				S										T					S		S				
14	M	40.291574°	-74.862921°	7.5	M										M					M		S				S
15	A				M										M					S		S				S
15	B				S		T								S					M		T				S
15	M	40.291196°	-74.862617°	6	M		T								M					M		S				S
16	A				D						S				T					S						D
16	B				D			S							S					M						D
16	M	40.290831°	-74.862318°	4	D			T			T				S					M						D
17	A				M		S								M					S		T				M
17	B				M			T			T				T					S						M

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
17	M	40.29041°	-74.862023°	6.5	M		T	T			T				S					S		T				M
18	A				M		T								M					T		T				S
18	B				D		T				T				T					T						D
18	M	40.290044°	-74.861716°	6	D		T				T				S					T		T				M
19	A				D		T	S							M					S		S				M
19	B				T						S				T					T						T
19	M	40.289644°	-74.861453°	6	M		T	T			T				S					S		T				S
20	A				M						S				M					T						M
20	B				S		T								T					T						S
20	M	40.289215°	-74.861139°	7.5	M		T				T				S					T						M
21	A				M			S			T				S					S		S				M
21	B				T			T							T					T		T				
21	M	40.288837°	-74.860873°	6	S			S			T				S					S		S				S
22	A				S		T								S					T		M				S
22	B				S										T					T						S
22	M	40.28843°	-74.860582°	6	S		T								S					T		S				S
23	A				M			S			T				M					T						T
23	B																									
23	M	40.288092°	-74.860285°	6	S			T			T				S					T						T
24	A				M			T			S				M					S		M				M
24	B				T						T				T					T						
24	M	40.287659°	-74.859989°	5.5	S			T			S				S					S		S				S
25	A				S			T			S				S					S						S
25	B				T						T									T						
25	M	40.287273°	-74.859684°	6	S			T			S				T					S						T
26	A				M										T					T		T				M
26	B				S		T								T					T						S
26	M	40.2869°	-74.859399°	6.5	M		T								T					T		T				M
27	A				D						M				M					M		M				M
27	B				T						T				T					T						T
27	M	40.286485°	-74.859077°	6	M						S				S					S		S				S
28	A				M			T							M					T		S				M
28	B																									
28	M	40.286109°	-74.858807°	6.5	S			T							S					T		T				S
29	A				M					S					M					D						M
29	B				T						S				T					T		T				
29	M	40.285667°	-74.858579°	6	S					T	T				S					M		T				S
30	A				M						T				M	T				T		T				S
30	B				S						T									S						
30	M	40.285248°	-74.858368°	6.5	M						T				S	T				S		T				T
31	A				D					S	T				D					T						M
31	B									S	T				T					T		S				S
31	M	40.284782°	-74.85822°	6	S					S	T				M					T		T				M
32	A				T		T								T					T		T				T
32	B				T		T				T									T						
32	M	40.284377°	-74.858039°	6.5	T		T				T				T					T		T				T
33	A				D			T							M							S				D
33	B				S						S				S					T						S
33	M	40.283939°	-74.857803°	7	M			T			T				M					T		T				M
34	A				T		T								T					T						

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
34	B				T											T				T						
34	M	40.283515°	-74.857542°	6.5	T		T								T	T				T						
35	A				M		S			T	M				S											M
35	B				T										T	T										
35	M	40.283103°	-74.857216°	5.5	S		T			T	S				S	T										S
36	A				M			S			S				S					S						S
36	B				T															T						T
36	M	40.282784°	-74.857006°	6.5	S			T			T				T					S						S
37	A				M		S				T				S					S		S				S
37	B				T										T					T						
37	M	40.282387°	-74.856615°	6	S			T			T				S					S		T				T
38	A				S			T			S				S					T		S				S
38	B				T						T				T					T						
38	M	40.282001°	-74.856287°	5.5	S			T			S				S					T		T				T
39	A				M						S				S					T		T				M
39	B				T		T								T					T		T				
39	M	40.281654°	-74.855964°	5	S		T				T				S					T		T				S
40	A				M					T					M					T						S
40	B				T		T	T			T				T					T						
40	M	40.281209°	-74.85567°	6	S		T	T		T	T				S					T						T
41	A																									
41	B																									
41	M	40.280874°	-74.855375°	6.5																						
42	A				M										T					S		M				S
42	B				T						T				T					T						
42	M	40.280498°	-74.855018°	6	S						T				T					S		S				T
43	A				S										S					T						S
43	B				T										T					T						
43	M	40.280084°	-74.854746°	6.5	S										S					T						T
44	A				D					T	S				S					D						M
44	B				T						T				T					T						
44	M	40.279674°	-74.854471°	6.5	M					T	S				S					M						S
45	A				M						S				S							S				S
45	B				T		T				T				T					T						
45	M	40.279273°	-74.854222°	6	S		T				S				S					T		T				T
46	A				M						T				S					M		T				M
46	B				T															T						
46	M	40.278868°	-74.853971°	5	S						T				T					S		T				S
47	A				M		T				T				T					M		M				M
47	B				D						D				M					S		S				T
47	M	40.278463°	-74.853723°	6	D		T				M				S					M		M				S
48	A				D						S				T					S						D
48	B				S			T							S					T		T				T
48	M	40.278049°	-74.853467°	7.5	M			T			T				S					S		T				M
49	A				M						S				S					S		S				M
49	B				S						S				S					S						T
49	M	40.277626°	-74.853203°	6	M						S				S					S		T				S
50	A				D						S				S					S						D
50	B							T			M				M					M		S				T
50	M	40.277246°	-74.853003°	6	S			T			M				M					M		T				M

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
51	A				M										S					S						
51	B				S			T			S				S					S		T				M
51	M	40.276813°	-74.852894°	5	M			T			T				S					S		T				S
52	A				M		T	T			M				S					S						T
52	B				S						S				S					T		S				
52	M	40.276366°	-74.852861°	5.5	M		T	T			M				S					S		T				T
53	A				S					T					T					T		S				T
53	B				M					M					T					S		M				
53	M	40.275953°	-74.852852°	5	M					S					T					S		M				T
54	A				S																					S
54	B				M					M					T					S		S				T
54	M	40.275499°	-74.852842°	6	M					S					T					S		T				S
55	A				S																					S
55	B				M					T					M					T		T				S
55	M	40.275047°	-74.852837°	4.5	M					T					S					T		T				S
56	A				S		T								S					S						T
56	B										T				S					S						S
56	M	40.274593°	-74.852745°	5	T		T				T				S					S						S
57	A				S						T									S						S
57	B				T															T						
57	M	40.274148°	-74.852659°	5.5	S						T									S						T
58	A				T			T							T					T						
58	B																									
58	M	40.273719°	-74.852573°	6	T			T							T					T						
59	A				T						T				T					T						T
59	B																									
59	M	40.273245°	-74.852444°	5.5	T						T				T					T						T
60	A				T						T				T					T						T
60	B										T				T					T						T
60	M	40.272815°	-74.852283°	6.5	T						T				T					T						T
61	A				T															T						T
61	B				S										T					S						
61	M	40.272378°	-74.852088°	7	S										T					S						T
62	A				T																	T				T
62	B				M						M				M					S		S				T
62	M	40.271954°	-74.85188°	6	S						S				S					T		S				T
63	A				M						T				M					T						T
63	B				D		T	M			M		T		M					S						
63	M	40.271543°	-74.85167°	7	D		T	S			S		T		M					S						T
64	A				D						T				D											M
64	B														D							S				T
64	M	40.271105°	-74.851471°	7.5	S						T				D							T				S
65	A				M										M					T		S				T
65	B				D						T				S					S		T				D
65	M	40.270681°	-74.851263°	6.5	D						T				M					S		S				M
66	A				D			M			T		T		D					M						S
66	B				S						S				S					S						S
66	M	40.270284°	-74.851066°	6.5	M			S			S		T		M					M						S
67	A				M						T				M					T						M
67	B				D					T	S				M	T				S						M

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
67	M	40.269826°	-74.850826°	6	D					T	S				M	T				S						M
68	A				T		T								T					T						T
68	B				S						T				S					S		S				T
68	M	40.269416°	-74.850578°	6.5	S		T				T				S					S		T				T
69	A				M										T					T						M
69	B				M			T			S				M					S		M				T
69	M	40.269024°	-74.850312°	5	M		T				T				S					S		S				S
70	A				S			S			T				T					S						S
70	B				T			T			S				T					T		S				T
70	M	40.268636°	-74.850048°	5.5	S			S			S				T					S		S				S
71	A				S		T								T					S						S
71	B				D						T				D	T				M		S				S
71	M	40.268219°	-74.849791°	6	M		T				T				M	T				M		T				S
72	A				M										S					T						M
72	B				M			S		S	T				M	T				T		S				T
72	M	40.267813°	-74.849517°	5	M		T			T	T				M	T				T		T				S
73	A				M						T				M					T		S				S
73	B				M						T				M					S		S				M
73	M	40.267427°	-74.849256°	5	M					T	T				M					S		S				M
74	A				S						T				T					T						S
74	B							T			T				T					T		T				
74	M	40.267024°	-74.848988°	6.5	T			T			T				T					T		T				T
75	A				M						T				T					T						M
75	B				S						S				S					S						
75	M	40.266603°	-74.848714°	6	M						S				S					S						S
76	A				S										S					T						S
76	B				S																					S
76	M	40.266179°	-74.848451°	5	S										T					T						S
77	A				S										T					T						S
77	B				S						S				T					T						T
77	M	40.265798°	-74.84819°	5.5	S						T				T					T						S
78	A				S			T			S				S					T						S
78	B				T						S				T											T
78	M	40.265411°	-74.847958°	5.5	S			T			S				S					T						S
79	A				M						T				S					T		T				M
79	B				S						T									S						S
79	M	40.265007°	-74.84765°	4.5	M						T				T					S		T				M
80	A				D						T				D					M		M				S
80	B				D						S				D					T		M				S
80	M	40.264612°	-74.847406°	5	D						S				D					S		M				S
81	A				D						T				S					M		S				D
81	B				D					T	T				M					M		S				D
81	M	40.264231°	-74.847059°	5	D					T	T				M					M		S				D
82	A				M					T	S				S					M		T				M
82	B				S			T							T					T						S
82	M	40.263816°	-74.846743°	4.5	M			T		T	T				S					S		T				M
83	A				D			T							M					T		M				M
83	B				D						S				T					M		M				M
83	M	40.263449°	-74.846483°	4	D			T			T				S					S		M				M
84	A				M		S				S				M					S		S				S

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
84	B				M			T			T				S					M		T				M
84	M	40.263104°	-74.846081°	5	M		T	T			S				M					M		S				M
85	A				D						T				M					M		M				D
85	B				M						T				M					S		S				M
85	M	40.262765°	-74.845683°	5	D						T				M					M		M				D
86	A				M			T		T					S					T		S				M
86	B										T				T					T		T				S
86	M	40.262406°	-74.845341°	5.5	S			T		T	T				S					T		T				S
87	A				M						T				M					T						S
87	B				S			T			T				T					T		S				S
87	M	40.262088°	-74.844934°	6	M			T			T				S					T		T				S
88	A				D		S								D					S		T				S
88	B				M						S				S	T				S		T				M
88	M	40.261749°	-74.844512°	5	D		T				T				M	T				S		T				M
89	A				D		S				T				D					S		S				M
89	B				M			T		T	S				M					S		T				M
89	M	40.261444°	-74.844088°	5	D		T	T		T	S				D					S		S				M
90	A																									
90	B																									
90	M	40.261108°	-74.843631°	5																						
91	A				M						S				M	T	T					T				M
91	B				S						M				S					M		T				S
91	M	40.260801°	-74.84324°	6	M						M				M	T	T			S		T				M
92	A				S						T				S					S						S
92	B				T						T				T					T		T				T
92	M	40.260521°	-74.842824°	5	S						T				S					S		T				S
93	A				S										T					T						S
93	B				M						T				S					S		S				S
93	M	40.260219°	-74.842372°	5	M						T		T		S					S		T				S
94	A				M						T				S					S		S				M
94	B				M						T				M					M		M				M
94	M	40.259923°	-74.84194°	5	M						T				M					M		M				M
95	A				M			M							M					T		T				S
95	B				T			T			T				T											
95	M	40.259591°	-74.841497°	6	S			S			T				S					T		T				T
96	A				M			M			T				M					T		M				S
96	B				S		T	S			T				S											
96	M	40.25931°	-74.841091°	6.5	M		T	S			T				M					T		S				T
97	A				M		T	S		S					S					S						S
97	B				S			T			T				S					T						T
97	M	40.258988°	-74.840651°	6	M		T	S		T	T				S					S						S
98	A				M			M		T	T				M					S		T				S
98	B				S		S	T		T	T				S					T		S				
98	M	40.258676°	-74.84021°	6.5	M		T	S		T	T				M					S		S				T
99	A				D										D					T						M
99	B				M		T				T				S					T		S				M
99	M	40.258375°	-74.839775°	6	D		T				T				M					T		T				M
100	A				M						T				S					T		M				S
100	B				M		T	T		T	S				M					T		S				T
100	M	40.258056°	-74.839331°	5.5	M		T	T		T	S				M					T		M				S

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
101	A				M						T				M							T				T
101	B						T								T											
101	M	40.257762°	-74.838932°	6	S		T				T				S							T				T
102	A							T			S				M					S						S
102	B						T								T							T				
102	M	40.257439°	-74.838528°	5.5			T	T			T				S					T		T				T
103	A				D			T			T				D					S		M				T
103	B																									
103	M	40.257099°	-74.83809°	6	S			T			T				S					T		S				T
104	A				S										S						T					S
104	B				T										T											
104	M	40.256745°	-74.837754°	4.5	S										S					T						T
105	A				T						T				T						T					T
105	B														T						T					
105	M	40.2564°	-74.837368°	4	T						T				T					T						T
106	A				S			T			T				T						T					S
106	B				T		T								T											
106	M	40.256049°	-74.836996°	5	S		T	T			T				T					T						T
107	A				M						T				M					T		T				S
107	B				T										T											
107	M	40.255699°	-74.836607°	5.5	S						T				S					T		T				T
108	A				M			S							M					S		M				S
108	B																			S						
108	M	40.25535°	-74.836268°	6.5	S			T							S					S		S				S
109	A				S		T								T					S		T				
109	B				T		T								T											
109	M	40.255009°	-74.835852°	6	S		T								T					S		T				
110	A				T										T						T					T
110	B				T		T				T				T						T					
110	M	40.254679°	-74.83552°	6.5	T		T				T				T					T						T
111	A				D			T							D					S		M				T
111	B				S		T				S				T					T		T				
111	M	40.254319°	-74.835114°	7	M		T	T			T				M					S		S				T
112	A				T						T				T					T						T
112	B						T				T				T					S	T					
112	M	40.253995°	-74.834619°	6	T		T				T				T					S	T					T
113	A				M			S							M					S		S				S
113	B				S		T				T				S											
113	M	40.253719°	-74.834207°	6.5	M		T	T			T				M					T		T				T
114	A				S						T				S					S	T					T
114	B				T		T				T				T											
114	M	40.253367°	-74.833772°	6	S		T				T				S					T	T					T
115	A																									
115	B																									
115	M	40.25305°	-74.833363°	6.5																						
116	A				S						S				S					T	T					
116	B						T				T				T					T	T					
116	M	40.252669°	-74.833025°	6	T		T				S				S					T	T					
117	A				S		T				T				S						S					T
117	B				S		T								S						T	T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
117	M	40.252263°	-74.832795°	4.5	S		T				T				S						S	T				T
118	A																									
118	B				T		T								T											
118	M	40.251919°	-74.832568°	6	T		T								T											
119	A				T																					
119	B				S															S						
119	M	40.251419°	-74.832263°	5	S																T					
120	A				T						T				T					T						
120	B																									
120	M	40.250995°	-74.831917°	4.5	T						T				T					T						
121	A				T					T	T				T					T						
121	B										T				T					T						
121	M	40.250693°	-74.831519°	5	T					T	T				T					T						
122	A				T		T				T				T					T		T				
122	B				T		T								T					T						
122	M	40.250372°	-74.83109°	4.5	T		T				T				T					T		T				
123	A				S			S		T					T					T		S				
123	B				S			S			S				S					T						
123	M	40.25011°	-74.830634°	5.5	S			S		T	T				S					T		T				
124	A				T		T			T	T				T					T						
124	B				T		T																			
124	M	40.250427°	-74.830219°	2	T		T			T	T				T					T						
125	A				S		S			T										T						
125	B				S		S													T						
125	M	40.250744°	-74.830028°	0.5	S		S			T										T						
126	A				T						T				T					T						
126	B				T						T									T						
126	M	40.250239°	-74.829992°	1.5	T						T				T					T						
127	A						T				T				S					T		T				T
127	B				T		T								T					T						
127	M	40.249816°	-74.830169°	5	T		T				T				S					T		T				T
128	A				T										T					T						
128	B				T															T						
128	M	40.249518°	-74.829667°	4.5	T										T					T						
129	A				T															T						
129	B				T		T								T					T						
129	M	40.249255°	-74.829218°	6	T		T								T					T						
130	A				S															S		T				
130	B				S		T				T				S					S						
130	M	40.248957°	-74.828744°	5	S		T				T				S					S		T				
131	A				T						T				T					T						
131	B				S						T				S					S						
131	M	40.248714°	-74.828265°	6	S						T				S					S						
132	A				M			S			S				M					S						
132	B				T		T								T					T						
132	M	40.248459°	-74.82781°	6	S		T	T			T				S					S						
133	A				S						T				S					S		S				
133	B				T		T								T					T						
133	M	40.248196°	-74.82734°	6	S		T				T				S					S		T				
134	A				M		T	T			T				M					S		T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
134	B				M		T	T		T	M				M					T		S				T
134	M	40.24791°	-74.82689°	6.5	M		T	T		T	S				M					S		S				T
135	A				T										T					T						
135	B				T		T	T							T					T						
135	M	40.24767°	-74.826389°	5	T		T	T							T					T						
136	A				T															T						
136	B																									
136	M	40.247356°	-74.825936°	6	T															T						
137	A				T						T				T											T
137	B																									
137	M	40.247072°	-74.825468°	5.5	T						T				T											T
138	A				S										S					S		T				S
138	B				S						S				T					T						
138	M	40.246838°	-74.82502°	5	S						T				S					S		T				T
139	A				M										M					T		T				S
139	B				T															T						
139	M	40.246592°	-74.824539°	6	S										S					T		T				T
140	A				S						T				S					T		T				S
140	B				T						T				T					T						T
140	M	40.246381°	-74.824013°	5.5	S						T				S					T		T				S
141	A				M			S			S				M					M		S				S
141	B				T						T				T					T						T
141	M	40.246144°	-74.823511°	6	S			T			S				S					S		T				S
142	A				T		T																			
142	B				S		T				S				S					T						
142	M	40.245979°	-74.822941°	6.5	S		T				T				T					T						
143	A				M		S								S					S		S				T
143	B				S						S				T					S		T				
143	M	40.245777°	-74.822417°	6	M		T				T				S					S		S				T
144	A																									
144	B				M		T				S				M											T
144	M	40.245635°	-74.821759°	7	S		T				T				S											T
145	A				S										T					T						S
145	B																									
145	M	40.245471°	-74.821282°	6	T										T					T						T
146	A				T						T				T					T						
146	B				T															T						
146	M	40.245315°	-74.820763°	6.5	T						T				T					T						
147	A																									
147	B																									
147	M	40.245153°	-74.820215°	6.5																						
148	A				S						T				S		T			S		T				
148	B				M						T				T					S						M
148	M	40.245001°	-74.81965°	6	M						T				S		T			S		T				S
149	A				S		T			S					S					T		S				
149	B				M		T				T				T					T		T				
149	M	40.244875°	-74.819145°	6	M		T				T				S					T		S				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Baldnerwort	Common Waterweed	Coontail	Curly leaf pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Watermoss	Waterstarwort	White Water Crowfoot	Wild Celery
1	A				T		T				T				T					T						
1	B																									
1	M	40.244583°	-74.818575°	6	T		T				T				T					T						
2	A				M										T					S						M
2	B																									
2	M	40.244317°	-74.818126°	7	S										T					T						S
3	A				S						T				S					T						T
3	B									T	T				S					T						T
3	M	40.244039°	-74.817631°	6	T					T	T				S					T						T
4	A				M										S					S						M
4	B				M					M	S				S					S						
4	M	40.243775°	-74.817092°	5	M					S	T				S					S						S
5	A				M					S					S		S									S
5	B				S					T	T		T		S											
5	M	40.24357°	-74.816592°	5.5	M					S	T		T		S		T									T
6	A				M								T		S					S		T				S
6	B				T		T			T					T											
6	M	40.243363°	-74.816092°	6	S		T			T			T		S					T		T				T
7	A				S										S					S						S
7	B				S										S					T						
7	M	40.243195°	-74.815508°	6.5	S										S					S						T
8	A				S						T				T					S						S
8	B				T										T					T						
8	M	40.242998°	-74.814936°	7	S						T				T					S						T
9	A				S		T	T					T		S					S		T				S
9	B				D		T				T				T					S						D
9	M	40.242856°	-74.814451°	6.5	M		T	T			T		T		S					S		T				M
10	A				S						T						T			S						S
10	B				S		S			S			T							S						T
10	M	40.242699°	-74.813862°	3	S		T			T	T		T				T			S						S
11	A				M					S	M				T					S						S
11	B				S					T					T					S						S
11	M	40.242576°	-74.813334°	2	M					S	S				T					S						S
12	A				S										T					S						S
12	B				S						S				T					S						
12	M	40.242369°	-74.8128°	2.5	S						T				T					S						T
13	A									T	T				T					S		T				S
13	B				T						T				T					T						
13	M	40.242191°	-74.812205°	4	T					T	T				T					S		T				T
14	A				S					T	T				T					S						S
14	B				M						S				T					S						M
14	M	40.241999°	-74.811709°	4.5	M					T	S				T					S						M
15	A				M					T	T				M					S						S
15	B				S						S									S						
15	M	40.241833°	-74.811131°	4.5	M					T	S				S					S						T
16	A				S		T			S	T				T					S						
16	B				S					S	T		T		T					T		T				
16	M	40.241661°	-74.810572°	5	S		T			S	T		T		T					S		T				
17	A				M					T	T				S					S		T				S

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Baldnerwort	Common Waterweed	Coontail	Curly leaf pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Watermoss	Waterstarwort	White Water Crowfoot	Wild Celery
17	B				S						S				S					S						
17	M	40.241475°	-74.810079°	5	M					T	S				S					S						S
18	A				S						T				T					T						S
18	B				T						T				T					T						
18	M	40.241284°	-74.80952°	5	S						T				T					T						T
19	A				M					T	T		T		M					M		T				S
19	B				M						T									T						M
19	M	40.241149°	-74.808977°	5.5	M					T	T		T		S					S		T				M
20	A				M						T				M					S						T
20	B																									
20	M	40.240968°	-74.80845°	5	S						T				S					T						T
21	A				T						T				T					T						
21	B				T						T				T					T						
21	M	40.240778°	-74.807889°	5.5	T						T				T					T						
22	A				S						T				S					S						S
22	B				T						T				T					T		T				
22	M	40.240595°	-74.807375°	6	S						T				S					S		T				T
23	A				S						T	T			S					S						
23	B				S					T	T				S					S						T
23	M	40.240328°	-74.806888°	6	S					T	T	T			S					S						T
24	A				S		T			T	T				T					T						T
24	B				S						T				S					S		T				
24	M	40.240094°	-74.806383°	5	S		T			T	T				S					S		T				T
25	A																									
25	B																									
25	M	40.239828°	-74.80592°	6																						
26	A																									
26	B																									
26	M	40.239615°	-74.805435°	6.5																						
27	A				T						T				T					T						T
27	B				M						S				M					S		S				S
27	M	40.239366°	-74.804941°	6	S						S				S					S		T				S
28	A				T						T				T					T						T
28	B				S						T				S					S		S				T
28	M	40.239172°	-74.804395°	5.5	S						T				S					S		T				T
29	A				S					T	T				S					T						S
29	B				T						T				T					T						T
29	M	40.238968°	-74.8039°	6	S					T	T				S					T						S
30	A																									
30	B				M										T											M
30	M	40.238828°	-74.803362°	6.5	S										T											S
31	A				T																					
31	B				T																					
31	M	40.238661°	-74.802757°	6.5	T															T						T
32	A				T										T					T						T
32	B				M						M				S					S		T				S
32	M	40.238505°	-74.802176°	6	S						S				S					S		T				S
33	A																									
33	B				S		T				T				S					T		T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Baldnerwort	Common Waterweed	Coontail	Curly leaf pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Watermoss	Waterstarwort	White Water Crowfoot	Wild Celery
33	M	40.238365°	-74.80163°	7	T		T				T				T					T		T				
34	A				T										T					T						T
34	B														T							T				
34	M	40.238175°	-74.801053°	6.5	T										T					T		T				T
35	A				M						S				S					S						M
35	B																									
35	M	40.238046°	-74.800565°	6	S						T				T					T						S
36	A				T		T	T			T	T			T									T		
36	B									S	T		T		T					T		T			T	
36	M	40.237835°	-74.800008°	6.5	T			T		T	T	T	T		T					T		T		T		
37	A																									
37	B				S		T			S	T				T					S						T
37	M	40.237702°	-74.799446°	6	T		T			T	T				T					T						T
38	A				T		T								T					T						T
38	B																									
38	M	40.23754°	-74.798845°	6.5	T		T								T					T						T
39	A				S					T	T				T					T		T				T
39	B				S						S				S					T		T				T
39	M	40.237272°	-74.798336°	6	S					T	S				S					T		T				T
40	A				S						T				S	T				T		T				S
40	B				M					T	M				T					T		T				S
40	M	40.237053°	-74.797865°	6.5	M					T	S				S	T				T		T				S
41	A				S					T	T				S					S		T				S
41	B				D		T			S	T				T					T		S				D
41	M	40.236796°	-74.797371°	6.5	M		T			S	T				S					S		S				M
42	A				M						S				T					S		S				S
42	B				M					T	S				T					T		S				M
42	M	40.236603°	-74.796858°	6	M					T	S				T					S		S				M
43	A				M										M					T						
43	B				T					T	T				T					T						
43	M	40.236445°	-74.796308°	6.5	S					T	T				S					T						
44	A				T		T				T				T					T						T
44	B				S					T					T					T		S				S
44	M	40.236296°	-74.795763°	7	S		T			T	T				T					T		T				S
45	A				T										T					T		T		T		S
45	B				S						T									T						S
45	M	40.236201°	-74.795207°	5	S						T				T					T		T		T		S
46	A																									
46	B				T						T															
46	M	40.236043°	-74.794608°	6	T						T															
47	A				T					T										T						T
47	B				D		S			S	S	T			M					S		M				S
47	M	40.235945°	-74.794081°	7	M		T			S	T	T			S					S		S				S
48	A																									
48	B				T						T				T											
48	M	40.23581°	-74.793481°	6.5	T						T				T											
49	A				T					T	T				T					T						T
49	B				S					S	T				S							T				T
49	M	40.235631°	-74.792921°	6	S					S	T				S					T		T				T

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Baldenwort	Common Waterweed	Coontail	Curly leaf pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Watermoss	Waterstarwort	White Water Crowfoot	Wild Celery
50	A																									
50	B																									
50	M	40.235468°	-74.7924°	6																						
51	A																									
51	B				S										S				T	T						S
51	M	40.235311°	-74.791822°		T										T				T	T						T
52	A																									
52	B																									
52	M	40.235144°	-74.791285°																							
53	A																									
53	B				T						T				T					T						
53	M	40.234998°	-74.790717°		T						T				T					T						
54	A																									
54	B				M		T			S	S				M							S				M
54	M	40.234865°	-74.790178°		S		T			T	T				S							T				S
55	A				S										S					S						S
55	B				M		T			T	S				M					S		S				T
55	M	40.234695°	-74.78963°		M		T			T	T				M					S		T				S
56	A				D																	S				D
56	B				M							T										S				M
56	M	40.23452°	-74.789109°		D							T										T				D
57	A				S										S					T						T
57	B				S						S				T					S		T				S
57	M	40.234321°	-74.788521°	6.5	S						T				S					S		T				S
58	A																									
58	B				S					T	T				S					S		T				
58	M	40.234134°	-74.787992°	6	T					T	T				T					T		T				
59	A																									
59	B				M					T	S		T		M					T		T				S
59	M	40.233906°	-74.787413°	2.5	S					T	T		T		S					T		T				T
60	A				T																	T				T
60	B				S		T				S		T		S					S		T				
60	M	40.233774°	-74.786973°	4	S		T				T		T		T					T		T				T
61	A				M					T	T				T					T						M
61	B				S					T	S				T					T		T				S
61	M	40.23353°	-74.7864°	4.5	M					T	S				T					T		T				M
62	A				S						T				T					S						S
62	B				S					T	S									T						
62	M	40.233299°	-74.785911°	4.5	S					T	S				T					S						T
63	A				S						S	T			T					T		S				S
63	B				M															T						M
63	M	40.233082°	-74.785338°	5	M						T	T			T					T		T				M
64	A				T						T				T					T		T				T
64	B				T						S				T					T						
64	M	40.232876°	-74.784845°	5.5	T						S				T					T		T				T
65	A				M		T				T				M							T				T
65	B				T						T									T						
65	M	40.232663°	-74.784332°	3.5	S		T				T				S					T		T				T
66	A				T		T				T				T					T		T				

Delaware and Raritan Canal
Section 4
Aquatic Vegetation Survey
September 9 and 16, 2016

[illegible]

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Plant Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
1	A				S						T	T	S							T						S
1	B				M																					M
1	M	40.245537°	-74.733112°	7	M						T	T	T							T						M
2	A				M					T	S	T	S							M		T				
2	B				M					T	M	T	T													
2	M	40.245844°	-74.732621°	7.5	M					T	M	T	S							S		T				
3	A				S					T	S	T	S		T					S		T				
3	B				S		T			T	T	T	T							T		T				S
3	M	40.246183°	-74.732228°	7	S		T			T	S	T	S		T					S		T				T
4	A				S								S		T					T		T				T
4	B				S						S				T					T						
4	M	40.246505°	-74.731816°	7.5	S						S		T		T					T		T				T
5	A				S		T			T	S		T		T					T						
5	B				T		T				T															
5	M	40.246836°	-74.731415°	6.5	S		T			T	S		T		T					T						
6	A				T						T				T											
6	B				S					T	S		T							T						
6	M	40.247154°	-74.731012°	5.5	S					T	S		T		T					T						
7	A				T						T															
7	B				T						T															
7	M	40.247502°	-74.730615°	6	T					T	T									T						
8	A				T						T	S														
8	B				S					T	T		T		T					S		S				
8	M	40.247807°	-74.730198°	6	S					T	S		T		T					S		S				
9	A				T						T		T													
9	B				T						T	T	T		T					T						
9	M	40.248118°	-74.72982°	5.5	T						T	T	T		T					T						
10	A				S					T	S				T											
10	B				T					T	T		T		T	T				T		T				
10	M	40.248432°	-74.729337°	3	S					T	S		T		T	T				T		T				
11	A				S					T	S		T													
11	B				S						S		T		S					S						
11	M	40.248701°	-74.728894°	3.5	S					T	S		T		T					S						
12	A				S					T	T		T							T	S	T				S
12	B				T		T			T	T									T						
12	M	40.248949°	-74.728403°	3	S		T			T	T		T							T	T	T				T
13	A				S					S	S		T		T					T	S					
13	B				M						M		T		T											
13	M	40.249099°	-74.727782°	3.5	M					T	M		T		T					T	T					
14	A				S					S	S		T		T											
14	B				T						T															
14	M	40.249266°	-74.727265°	3	S					T	S		T		T					T		T				
15	A				S					T	T		S		T											
15	B																									
15	M	40.249452°	-74.72664°	4	T					T	T		T		T							T				
16	A				S					T	S		T							T		S				
16	B				T						T															
16	M	40.249525°	-74.72595°	3.5	S					T	S		T							T		T				
17	A				S					S	S		T							T	T	S				
17	B				S						S		T		T							T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Plant Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
17	M	40.24969°	-74.725573°	2.5	S					T	S		T		T					T	T	S				
18	A				S						T		T		S					S		T				
18	B				S					T	S		T									S				
18	M	40.249854°	-74.725008°	2	S					T	S		T		T					T		S				
19	A				S						S		T							T	S					
19	B				T						T		T		T					T						
19	M	40.250047°	-74.72447°	3.5	S						S		T		T					T	T					
20	A				S						T		T		S					T						
20	B				T						T		T													
20	M	40.250319°	-74.723995°	3	S						T		T		T					T						
21	A				S			T			S		T		T					T						
21	B				S					T	S				T					T						
21	M	40.250576°	-74.723503°		S			T			T	S		T		T				T						
22	A				S	T					T	S		T						T						
22	B																									
22	M	40.250849°	-74.72299°	6	S	T				T	T		T							T						
23	A				S					S	S		T							S		T				
23	B				T						T				T					T	T	T				
23	M	40.25108°	-74.72252°	5	S						S				T					S	T	T				
24	A				T					T	T		T							T		T				
24	B				T						T				T					T		T				
24	M	40.25137°	-74.722093°	5.5	T					T	T		T		T					T	T	T				
25	A				S						S									T		T				
25	B				T						T				T					T		T				
25	M	40.251673°	-74.721648°	5.5	S						S				T					T		T				
26	A				M					S	M									T						
26	B				T						T									T						
26	M	40.252029°	-74.721274°	5.5	S					T	S									T						
27	A				T						T		T							T		T				
27	B				T						T									T	T	T				
27	M	40.252355°	-74.720864°	5	T						T		T							T	T	T				
28	A				T					T	T		T							T	T					
28	B				T						T									T						
28	M	40.252709°	-74.720497°	5.5	T					T	T		T							T	T					
29	A				S						T		T							S	S	T				
29	B				T						T															
29	M	40.253064°	-74.720178°	5	S						T		T							T	T	T				
30	A				M					T	M		T							T		S				
30	B				S						S															
30	M	40.253419°	-74.719831°	6	M					T	M		T							T		T				
31	A				S						S		T							T						
31	B																									
31	M	40.253803°	-74.71945°	6	T						T		T							T						
32	A				T						T		T							T						
32	B				S						S											T				
32	M	40.254132°	-74.719155°	6.5	S						S		T							T		T				
33	A				S						S		T		T					T						
33	B				S															T		S				
33	M	40.25452°	-74.718843°	7	S						T		T		T					T		T				
34	A				S						S		T							T		T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Plant Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
34	B				T	T					T		T							T		T				
34	M	40.254945°	-74.71855°	6.5	S	T					S		T							T		T				
35	A				T						T									T						
35	B				T						T									T						
35	M	40.255326°	-74.718305°	6	T						T									T						
36	A				T						T									T						
36	B				T					T	T									T						
36	M	40.255757°	-74.718069°	6	T					T	T									T						
37	A				T					T	T									T						T
37	B				T						T									T						
37	M	40.256184°	-74.717899°	5	T					T	T									T						T
38	A				S						S									T		T				
38	B				T			T		T	T									T		T				
38	M	40.256632°	-74.717748°	5.5	S			T		T	S									T		T				
39	A				M						M									T		T				
39	B				T						T									T		T				
39	M	40.257062°	-74.717648°	6.5	S						S									T		T				
40	A				M						T									T		M				
40	B				T					T	T									T		T				
40	M	40.257478°	-74.717526°	7	S					T	T									T		S				
41	A				D						S									T		D				
41	B				T						T									T						
41	M	40.257956°	-74.717366°	5	M						S									T		S				
42	A				M						S									T		M				
42	B				T						T									T	T					
42	M	40.258429°	-74.717215°	5.5	S						S									T	T	S				
43	A				T						T				T					T		T				
43	B																									
43	M	40.258869°	-74.716998°	6	T						T				T					T	T	T				
44	A				S						S				T					T	T					
44	B				S															T		S				
44	M	40.259302°	-74.716768°	6.5	S						T				T					T	T	T				
45	A				S						S									T		T				
45	B				T			T																		
45	M	40.259706°	-74.716519°	6	S			T			T									T		T				
46	A				S						S									T		T				
46	B				S		T			T	S									T		T				
46	M	40.260123°	-74.716263°	6.5	S		T			T	S									T		T				
47	A				S						S									T						
47	B				S		T				S									T		S				
47	M	40.260475°	-74.715927°	7	S		T				S									T		T				
48	A				T															T		T				
48	B				T						T		T													
48	M	40.2609°	-74.715704°	6	T						T		T							T		T				
49	A				T					T	S										T	T				
49	B				S		T				T									T						
49	M	40.261338°	-74.715482°	6	S		T			T	S									T	T	T	S			
50	A				M					T	S		T							S	S	S				
50	B																									
50	M	40.261758°	-74.715359°	7	S					T	T		T							T	T	T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Plant Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
51	A				S						S									T		S				
51	B				S						S									T						
51	M	40.262213°	-74.715243°	7.5	S						S									T		T				
52	A				S						T									T		S				
52	B				S						S									S						
52	M	40.262669°	-74.715119°	7	S						S									S		T				
53	A				S						S		T							S		S				
53	B				S						S									T		T	T			
53	M	40.263105°	-74.715003°	6	S						S		T							S		S	T			
54	A				D					T	S									S		D				
54	B				S		T				S									T		T				
54	M	40.263534°	-74.714757°	7	M		T			T	S									S		M				
55	A				M						S											M				
55	B				T						T									T		T				
55	M	40.26392°	-74.714511°	6	S						S									T		S				
56	A				M						S								T	S		M				
56	B				S					T	S									T	T	T				
56	M	40.264346°	-74.714202°	6	M					T	S								T	T	T	S				
57	A				S						T									T		S				
57	B				T						T															
57	M	40.264692°	-74.71384°	6.5	S						T									T		T				
58	A				M						S									S		M				T
58	B				T						T									T						
58	M	40.265033°	-74.713423°	5	S						S									S		S				
59	A				S					T	S									S		S				
59	B				T		T				T									T						
59	M	40.265365°	-74.712983°	4.5	S		T			T	S									S		T				
60	A				D						S									T		D				
60	B				T						T									T						
60	M	40.265691°	-74.71258°	4	M						S									T		S				
61	A				D		M				S											D				
61	B				S		T			T	S		T							T		S				
61	M	40.265989°	-74.712182°	6.5	M		S			T	S		T							T		M				
62	A				T						T									T		T				
62	B				T						T									T		T				
62	M	40.266327°	-74.71177°	6.5	T						T									T		T				
63	A				T						T									T		T				
63	B																									
63	M	40.266644°	-74.711382°	6.5	T						T									T		T				
64	A				S					T	S									S		T				
64	B				T						T									T			T			
64	M	40.266988°	-74.710961°		S						S									S			T			
65	A				S						S									S		T				
65	B				S						S									T		T				
65	M	40.267307°	-74.710594°		S						S									S		T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
1	A				M						T									T		M				
1	B				T						T									T						
1	M	40.302483°	-74.688213°	8	S						T									T		S				
2	A				T						T								T	T	T					
2	B				M		M				T									S	S		T			
2	M	40.302818°	-74.687764°	7.5	S		S				T								T	S	S	T	T			
3	A				S		S				T									T		T	T			
3	B				T						T									T	T					
3	M	40.303085°	-74.687302°	7	S		T				T									T	T	T	T			
4	A				S		S				T									S	T		T			
4	B				S		T				S									S		T	T			S
4	M	40.303404°	-74.68687°	8	S		S				S									S	T	T	T			T
5	A				S		T			T	T		T							S		T	S			
5	B				S		T				T									T		T	S	S		
5	M	40.303669°	-74.686413°	7.5	S		T			T	T		T							S		T	S	T		
6	A				T						T								T	T						
6	B				T		T				T									T			T			
6	M	40.303962°	-74.685992°	6.5	T		T				T								T	T			T			
7	A				S		S				T									T	T	T				
7	B				S		S				S									S		T	T			
7	M	40.30425°	-74.685519°	7	S		S				S									S	T	T	T			
8	A				S		S				T							T		S		S				
8	B				M		T				T							M		T	T	T				
8	M	40.304557°	-74.685094°	5	M		S				T							S		S		S				
9	A				D		T				M							S		S		D				
9	B																									
9	M	40.30479°	-74.684713°	5.5	S		T				S							T		T		S				
10	A				S		T				T							S		S		T				
10	B				T						T									T			T			
10	M	40.305136°	-74.684167°	6.5	S		T				T							T		S		T	T			
11	A				S		T				T							T		S		T				
11	B				S		T				T							S		T			T	T		
11	M	40.305429°	-74.683716°	6.5	S		T				T							S		S		T	T	T		
12	A				M		T				T								T	T	T	M				
12	B				S		S				T							T	T	T		S	T	S		
12	M	40.305719°	-74.683244°	6	M		S				T							T	T	T	T	M	T	T		
13	A				D						S									D						
13	B				D						M															
13	M	40.305568°	-74.682786°	2	D						M										D					
14	A				S		S				S									T	T	S				
14	B				M		M				S							S		M	S	S	T			
14	M	40.30601°	-74.682795°	6	M		M				S							T		S	S	S	T			
15	A				S		S				T									S		T				
15	B				M		M			T	T								S		S	S	T			
15	M	40.306279°	-74.682355°	6.5	M		M			T	T								T	S		S	T			
16	A				T															T	T	T				
16	B				S		S				T									T		T	T	T		
16	M	40.306572°	-74.68192°	6	S		T				T									T	T	T	T	T		
17	A				S		T				T									S		T	T			

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
17	B				S		T				T									T		T		S		
17	M	40.306877°	-74.681457°	6.5	S		T				T									S		T	T	T		
18	A				S		S				T		T							T		T	T			
18	B				T													T		T		T	T			
18	M	40.307168°	-74.681041°	6.5	S		T				T		T					T		T		T	T	T		
19	A				S		S				T							T		S		T	T			
19	B				M		M			T	T							S		S		T	T			
19	M	40.307434°	-74.680587°	6	M		M			T	T							S		S		T	T			
20	A				S						T					T				T		T				S
20	B				M		S			T	T							S		S		T	S	T		
20	M	40.307729°	-74.680128°	7	M		T			T	T					T		T		S		T	T	T		T
21	A				S		S				T							T		S		T				
21	B				S		S				T							T		S		S		S		
21	M	40.308021°	-74.679657°	6.5	S		S				T							T		S		S		T		
22	A				T		T													T		T	T			
22	B				S		S				T									S		S	T			
22	M	40.308286°	-74.679216°	6	S		S				T									S		S	T			
23	A				T		T				T									T		T	T	T		
23	B				T						T									T	T	T	T	T		
23	M	40.308576°	-74.678771°	6.5	T		T				T									T	T	T	T	T		
24	A				T		T													T		T	T			
24	B				S		S				T									S		S	S	T		
24	M	40.308874°	-74.678296°	6	S		S				T									S		T	S	T		
25	A				M					T													T			M
25	B				S		S				T									S			T	T		
25	M	40.309154°	-74.677851°	6	M		T			T	T									T			T	T		S
26	A				S		T				T									T		T				S
26	B				M						S									M			T			T
26	M	40.30948°	-74.677456°	5	M		T				S									S		T	T			S
27	A				S		T				T					T				T			T			S
27	B				T		T													T	T		T			
27	M	40.309784°	-74.676986°	5.5	S		T				T					T				T	T		T			T
28	A				M		M				T									T		T	S			
28	B				M		M				T									S		T	T			
28	M	40.310127°	-74.676628°	6	M		M				T									S		T	S			
29	A				S		S				T									T	T					
29	B				S		T				T									T		T	S			
29	M	40.31052°	-74.6763°	6.5	S		S				T									T	T	T	T			
30	A				S		T				T									S		T	T			
30	B				S		S				T									T		T				
30	M	40.310865°	-74.675999°	6.5	S		S				T									S		T	T			
31	A				M		M				T								T	T	T					
31	B				S		S				T									T		T	S			
31	M	40.311259°	-74.675679°	6	M		M				T								T	T	T	T	T			
32	A				T															T				T		
32	B				T						T									T			T	T		
32	M	40.311658°	-74.675366°	5.5	T						T									T			T	T		
33	A				T						T									T		T				
33	B				T						T									T		T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
33	M	40.312035°	-74.67501°	5.5	T						T									T		T				
34	A				T															T			T			
34	B				T															T		T	T	T		
34	M	40.312417°	-74.674723°	6	T															T		T	T	T		
35	A				T						T											T				
35	B				S															T				S		
35	M	40.312812°	-74.674443°	6	S						T									T		T		T		
36	A				T						T									T			T			
36	B				S															T	T		T	S		
36	M	40.313185°	-74.674098°	6.5	S						T									T	T		T	T		
37	A				T						T									T		T	T			
37	B				T															T		T	T	T		
37	M	40.313551°	-74.673764°	7	T						T									T		T	T	T		
38	A				S		S						T							T		T	T	T		
38	B				T		T													T		T	T	T		
38	M	40.313927°	-74.673475°	5	S		S						T							T		T	T	T		
39	A																									
39	B				T		T			T										T			T		T	
39	M	40.314323°	-74.673133°	6.5	T		T			T										T			T		T	
40	A				T						T									T				T		
40	B				T															T				T		
40	M	40.314691°	-74.672883°	6	T						T									T				T		
41	A				T																			T		
41	B																									
41	M	40.315104°	-74.672484°	5	T																			T		
42	A				T						T									T				T		
42	B				T						T									T		T		T		
42	M	40.315504°	-74.672188°	6.5	T						T									T		T		T		
43	A				T						T									T				T		
43	B				S						T									T				S	T	
43	M	40.315787°	-74.671859°	6	S						T									T			T	S	T	
44	A				T						T									T	T	T	T	T		
44	B				T						T									T		T	S			
44	M	40.316147°	-74.671449°	6.5	T						T									T	T	T	T	T		
45	A				S		S				T									T		T	T			
45	B				T						T									T	T			T		
45	M	40.316429°	-74.670996°	7	S		T				T									T	T	T	T	T		
46	A				T		T				T									T		T	T			
46	B				S															T			T	S		
46	M	40.316741°	-74.670499°	6.5	S		T				T									T		T	T	T		
47	A				T						T									T						
47	B				T															T		T	T	T		
47	M	40.316977°	-74.670075°	6	T						T									T		T	T	T		
48	A				S						S									S	T			T		
48	B				T															T		T	T	T		
48	M	40.317237°	-74.669584°	6.5	S						T									S	T	T	T	T		
49	A				T						T									T					T	
49	B				T															T			T	T		
49	M	40.31751°	-74.669093°	6.5	T						T									T			T	T	T	

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
50	A				T															T						
50	B				T															T						
50	M	40.317766°	-74.668606°	7	T															T						
51	A				T						T									T			T			
51	B				T		T				T									T			T	T		
51	M	40.318032°	-74.668165°	5	T		T				T									T			T	T		
52	A				S						T									S	T		T			
52	B				T															T			T			
52	M	40.318257°	-74.667674°	5	S						T									S	T		T			
53	A				S		S				T									T			T			
53	B				S															S		T	T	S		
53	M	40.318514°	-74.667179°	5	S		T				T									S		T	T	T		
54	A				T															T						
54	B				T															T						
54	M	40.318764°	-74.666688°	5.5	T															T						
55	A				T		T				T									T			T			
55	B				S					T										S			T			
55	M	40.319013°	-74.666203°	6.5	S		T			T	T									S			T			
56	A				S		T				S									S	T					
56	B				S						S									T		T		T		
56	M	40.319266°	-74.66572°	6	S		T				S									S	T	T		T		
57	A				T						T									T				T		
57	B				T						T									T				T		
57	M	40.319533°	-74.66518°	6.5	T						T									T				T		
58	A				T						T									T						
58	B																									
58	M	40.31978°	-74.664728°	6.5	T						T									T						
59	A				T						T									T	T					
59	B				T						T									T			T	T		
59	M	40.320042°	-74.664235°	6	T						T									T	T		T	T		
60	A				T						T									T		T				
60	B				S						S									S		T		T		
60	M	40.320296°	-74.663718°	6	S						S									S		T		T		
61	A				S						T									S	T					
61	B				T															T		T	T	T		
61	M	40.320558°	-74.663228°	6.5	S						T									S	T	T	T	T		
62	A				S					T										T	S		S			
62	B				S						T									T		T				
62	M	40.320816°	-74.662759°	6.5	S					T	S									T	T	T	T			
63	A				S		S													S		T				
63	B				T		T													T				T		
63	M	40.321108°	-74.662308°	6	S		S													S				T		
64	A				S					T	T									T	S	T	T			
64	B				S		T				S									S		T				
64	M	40.321444°	-74.661902°	4.5	S		T			T	S									S	T	T	T			
65	A				S		S				T									T		T				
65	B				M		M				S									S						
65	M	40.321789°	-74.661494°	5	M		M				S									S		T				
66	A				T						T									T		T				

Sample Point	Sample	Latitude (NAD83)	Longitude (NAD83)	Depth (feet)	Overall Abundance	Arrowhead Rosette	Benthic Filamentous Algae	Brittle Naiad	Common Bladderwort	Common Waterweed	Coontail	Curly-leaf Pondweed	Eurasian Water Milfoil	Great Duckweed	Hydrilla	Leafy Pondweed	Long-leaf Pondweed	Muskgrass	Pondweed sp.	Small Duckweed	Spatterdock	Water Stargrass	Water Starwort	Watermoss	White Water Crowfoot	Wild Celery
66	B				T		T													T		T				
66	M	40.322126°	-74.661094°	5.5	T		T				T									T		T				
67	A				T						T									T		T				
67	B				T					T										T		T				
67	M	40.32245°	-74.660651°	6.5	T					T	T									T		T				
68	A				T					T	T									T		T				
68	B				S						T									S	T		T			
68	M	40.322757°	-74.660256°	7	S						T									S	T	T	T			
69	A				T															T						
69	B				T															T						
69	M	40.323081°	-74.659879°	6	T															T						
70	A				T						T									T						
70	B				T						T		T							T		T				
70	M	40.323394°	-74.659496°	5.5	T						T		T							T		T				
71	A				S															S	T					
71	B				T						T									T		T		T		
71	M	40.323705°	-74.659072°	5.5	S						T									S	T	T		T		
72	A				S						T									S						
72	B				S		T													S	S					
72	M	40.324022°	-74.658647°	6	S		T				T									S	T					
73	A				T															T						
73	B				T															T						
73	M	40.324357°	-74.658223°	6.5	T															T						
74	A				T						T									T	T	T				
74	B				S					T	S									T	S	S				
74	M	40.324673°	-74.657812°	4	S					T	S									T	S	S				
75	A				T															T	T			T		
75	B				T						T									T	T		T			
75	M	40.324991°	-74.657416°	6	T															T	T		T	T		
76	A				T															T	T			T		
76	B				S															S	S					
76	M	40.325316°	-74.657005°	6	S															S	S			T		
77	A				T															T						
77	B				T															T						
77	M	40.325648°	-74.656609°	6	T															T						
78	A				S		T				T									T	S	T		T		
78	B				T															T	T					
78	M	40.325996°	-74.656155°	6.5	S		T				T									T	S	T		T		
79	A				S		S													T	T					
79	B				S		S													T	T					
79	M	40.32631°	-74.655802°	6	S		S													T	T					
80	A				S		S				T									T						
80	B				S		S													S	T					
80	M	40.326669°	-74.655439°	6.5	S		S				T									S	T					
81	A				T															T						
81	B				T		T				T									T	T	T		T		T
81	M	40.327047°	-74.655145°	5	T		T				T									T	T	T		T		T
82	A				T															T						
82	B				T															T						

[illegible]

Delaware and Raritan Canal
Section 1
Aquatic Macrophyte Abundance Distribution
September 15 and 23, 2016

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	165									
Overall Abundance	155	94%	37	24%	61	39%	52	34%	4	3%
Coontail	144	87%	83	58%	56	39%	4	3%	1	1%
Small Duckweed	141	85%	70	50%	66	47%	5	4%	0	0%
Water Stargrass	123	75%	55	45%	56	46%	12	10%	0	0%
Common Waterweed	87	53%	78	90%	9	10%	0	0%	0	0%
Wild Celery	83	50%	42	51%	36	43%	5	6%	0	0%
Hydrilla	67	41%	43	64%	23	34%	1	1%	0	0%
Brittle Naiad	55	33%	49	89%	5	9%	1	2%	0	0%
Benthic Filamentous Algae	45	27%	41	91%	3	7%	0	0%	1	2%
Eurasian Water Milfoil	9	5%	9	100%	0	0%	0	0%	0	0%
Leafy Pondweed	6	4%	5	83%	0	0%	1	17%	0	0%
Great Duckweed	2	1%	2	100%	0	0%	0	0%	0	0%
Long Leaf Pondweed	2	1%	2	100%	0	0%	0	0%	0	0%
Common Bladderwort	1	1%	1	100%	0	0%	0	0%	0	0%
Arrowhead Rosette	0	0%	0	0%	0	0%	0	0%	0	0%
Curly-leaf Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%
Muskgrass	0	0%	0	0%	0	0%	0	0%	0	0%
Pondweed sp.	0	0%	0	0%	0	0%	0	0%	0	0%
Spatterdock	0	0%	0	0%	0	0%	0	0%	0	0%
Water Starwort	0	0%	0	0%	0	0%	0	0%	0	0%
Watermoss	0	0%	0	0%	0	0%	0	0%	0	0%

Delaware and Raritan Canal
Section 2
Aquatic Macrophyte Abundance Distribution
September 6-7, 2016

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	57									
Overall Abundance	57	100%	3	5%	16	28%	24	42%	14	25%
Small Duckweed	57	100%	12	21%	31	54%	13	23%	1	2%
Coontail	52	91%	28	54%	21	40%	3	6%	0	0%
Hydrilla	49	86%	12	24%	18	37%	15	31%	4	8%
Water Stargrass	47	82%	19	40%	15	32%	12	26%	1	2%
Wild Celery	46	81%	6	13%	16	35%	22	48%	2	4%
Brittle Naiad	32	56%	22	69%	7	22%	3	9%	0	0%
Benthic Filamentous Algae	14	25%	13	93%	1	7%	0	0%	0	0%
Common Waterweed	7	12%	4	57%	3	43%	0	0%	0	0%
Common Bladderwort	1	2%	1	100%	0	0%	0	0%	0	0%
Eurasian Water Milfoil	1	2%	1	100%	0	0%	0	0%	0	0%
Long-leaf Pondweed	1	2%	1	100%	0	0%	0	0%	0	0%
Arrowhead Rosette	0	0%	0	0%	0	0%	0	0%	0	0%
Curly-leaf Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%
Great Duckweed	0	0%	0	0%	0	0%	0	0%	0	0%
Leafy Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%
Muskgrass	0	0%	0	0%	0	0%	0	0%	0	0%
Pondweed sp.	0	0%	0	0%	0	0%	0	0%	0	0%
Spatterdock	0	0%	0	0%	0	0%	0	0%	0	0%
Water Starwort	0	0%	0	0%	0	0%	0	0%	0	0%
Watermoss	0	0%	0	0%	0	0%	0	0%	0	0%
White Water Crowfoot	0	0%	0	0%	0	0%	0	0%	0	0%

Delaware and Raritan Canal
Section 3
Aquatic Macrophyte Abundance Distribution
September 7-9, 2016

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	149									
Overall Abundance	144	97%	26	18%	60	42%	42	29%	16	11%
Hydrilla	139	93%	38	27%	69	50%	28	20%	4	3%
Small Duckweed	137	92%	64	47%	59	43%	14	10%	0	0%
Wild Celery	120	81%	45	38%	46	38%	26	22%	3	3%
Coontail	119	80%	92	77%	23	19%	4	3%	0	0%
Water Stargrass	92	62%	59	64%	25	27%	8	9%	0	0%
Benthic Filamentous Algae	58	39%	57	98%	1	2%	0	0%	0	0%
Brittle Naiad	51	34%	41	80%	10	20%	0	0%	0	0%
Common Waterweed	26	17%	23	88%	3	12%	0	0%	0	0%
Leafy Pondweed	8	5%	8	100%	0	0%	0	0%	0	0%
Spatterdock	4	3%	3	75%	1	25%	0	0%	0	0%
Eurasian Water Milfoil	3	2%	3	100%	0	0%	0	0%	0	0%
Long-leaf Pondweed	2	1%	2	100%	0	0%	0	0%	0	0%
Arrowhead Rosette	0	0%	0	0%	0	0%	0	0%	0	0%
Common Bladderwort	0	0%	0	0%	0	0%	0	0%	0	0%
Curly-leaf Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%
Great Duckweed	0	0%	0	0%	0	0%	0	0%	0	0%
Muskgrass	0	0%	0	0%	0	0%	0	0%	0	0%
Pondweed sp.	0	0%	0	0%	0	0%	0	0%	0	0%
Water Starwort	0	0%	0	0%	0	0%	0	0%	0	0%
Watermoss	0	0%	0	0%	0	0%	0	0%	0	0%
White Water Crowfoot	0	0%	0	0%	0	0%	0	0%	0	0%

Delaware and Raritan Canal
Section 4
Aquatic Macrophyte Abundance Distribution
September 9 and 16, 2016

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	69									
Overall Abundance	64	93%	16	25%	32	50%	15	23%	1	2%
Hydrilla	60	87%	31	52%	28	47%	1	2%	0	0%
Small Duckweed	58	84%	30	52%	28	48%	0	0%	0	0%
Coontail	55	80%	42	76%	13	24%	0	0%	0	0%
Wild Celery	53	77%	28	53%	17	32%	7	13%	1	2%
Water Stargrass	34	49%	31	91%	3	9%	0	0%	0	0%
Common Waterweed	33	48%	26	79%	7	21%	0	0%	0	0%
Benthic Filamentous Algae	17	25%	17	100%	0	0%	0	0%	0	0%
Eurasian Water Milfoil	9	13%	9	100%	0	0%	0	0%	0	0%
Curly leaf pondweed	5	7%	5	100%	0	0%	0	0%	0	0%
Waterstarwort	3	4%	3	100%	0	0%	0	0%	0	0%
Brittle Naiad	2	3%	2	100%	0	0%	0	0%	0	0%
Long-leaf Pondweed	2	3%	2	100%	0	0%	0	0%	0	0%
Leafy pondweed	1	1%	1	100%	0	0%	0	0%	0	0%
Pondweed sp.	1	1%	1	100%	0	0%	0	0%	0	0%
Arrowhead Rosette	0	0%	0	0%	0	0%	0	0%	0	0%
Common Baldderwort	0	0%	0	0%	0	0%	0	0%	0	0%
Great Duckweed	0	0%	0	0%	0	0%	0	0%	0	0%
Muskgrass	0	0%	0	0%	0	0%	0	0%	0	0%
Spatterdock	0	0%	0	0%	0	0%	0	0%	0	0%
Watermoss	0	0%	0	0%	0	0%	0	0%	0	0%
White Water Crowfoot	0	0%	0	0%	0	0%	0	0%	0	0%

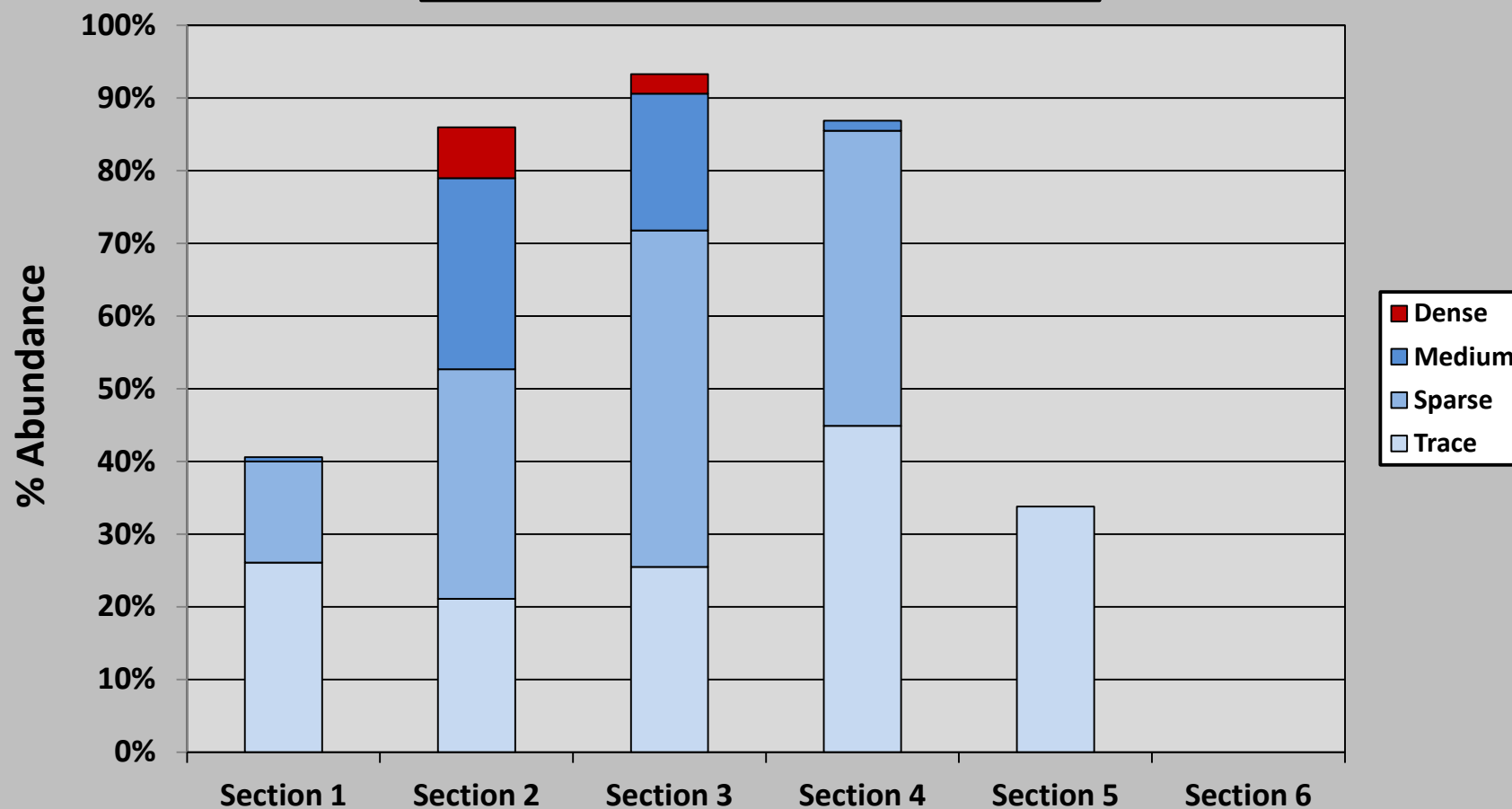
Delaware and Raritan Canal
Section 5
Aquatic Macrophyte Abundance Distribution
September 21, 2016

	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	65									
Overall Plant Abundance	65	100%	14	22%	42	65%	9	14%	0	0%
Coontail	65	100%	25	38%	37	57%	3	5%	0	0%
Small Duckweed	64	98%	52	81%	12	19%	0	0%	0	0%
Water Stargrass	47	72%	34	72%	11	23%	2	4%	0	0%
Eurasian Water Milfoil	34	52%	32	94%	2	6%	0	0%	0	0%
Common Waterweed	32	49%	32	100%	0	0%	0	0%	0	0%
Hydrilla	22	34%	22	100%	0	0%	0	0%	0	0%
Spatterdock	14	22%	14	100%	0	0%	0	0%	0	0%
Benthic Filamentous Algae	9	14%	8	89%	1	11%	0	0%	0	0%
Wild Celery	5	8%	4	80%	0	0%	1	20%	0	0%
Curly-leaf Pondweed	4	6%	4	100%	0	0%	0	0%	0	0%
Brittle Naiad	3	5%	3	100%	0	0%	0	0%	0	0%
Water Starwort	3	5%	3	100%	0	0%	0	0%	0	0%
Arrowhead Rosette	2	3%	2	100%	0	0%	0	0%	0	0%
Leafy Pondweed	1	2%	1	100%	0	0%	0	0%	0	0%
Pondweed sp.	1	2%	1	100%	0	0%	0	0%	0	0%
Common Bladderwort	0	0%	0	0%	0	0%	0	0%	0	0%
Great Duckweed	0	0%	0	0%	0	0%	0	0%	0	0%
Long-leaf Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%
Muskgrass	0	0%	0	0%	0	0%	0	0%	0	0%
Watermoss	0	0%	0	0%	0	0%	0	0%	0	0%
White Water Crowfoot	0	0%	0	0%	0	0%	0	0%	0	0%

Delaware and Raritan Canal
Section 6
Aquatic Macrophyte Abundance Distribution
September 22, 2016

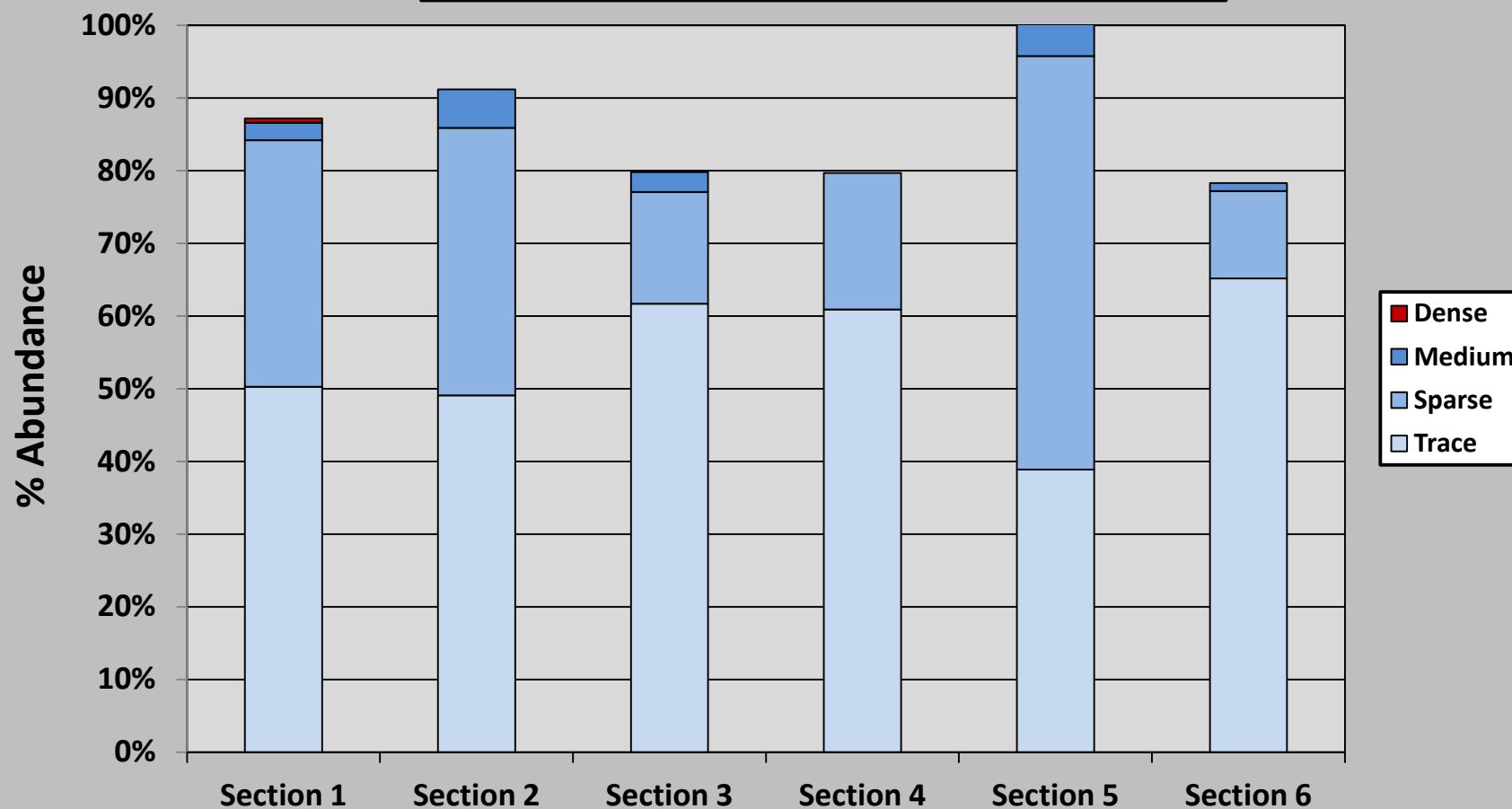
	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	92									
Overall Abundance	91	99%	33	36%	46	51%	11	12%	1	1%
Small Duckweed	89	97%	52	58%	36	40%	0	0%	1	1%
Coontail	72	78%	60	83%	11	15%	1	1%	0	0%
Water Stargrass	56	61%	47	84%	8	14%	1	2%	0	0%
Water Starwort	53	58%	50	94%	3	6%	0	0%	0	0%
Benthic Filamentous Algae	46	50%	26	57%	14	30%	6	13%	0	0%
Watermoss	44	48%	42	95%	2	5%	0	0%	0	0%
Spatterdock	37	40%	31	84%	6	16%	0	0%	0	0%
Common Waterweed	11	12%	11	100%	0	0%	0	0%	0	0%
Muskgrass	11	12%	8	73%	3	27%	0	0%	0	0%
Wild Celery	6	7%	4	67%	2	33%	0	0%	0	0%
Eurasian Water Milfoil	4	4%	4	100%	0	0%	0	0%	0	0%
Pondweed sp.	4	4%	4	100%	0	0%	0	0%	0	0%
Leafy Pondweed	3	3%	3	100%	0	0%	0	0%	0	0%
White Water Crowfoot	3	3%	3	100%	0	0%	0	0%	0	0%
Arrowhead Rosette	0	0%	0	0%	0	0%	0	0%	0	0%
Brittle Naiad	0	0%	0	0%	0	0%	0	0%	0	0%
Common Bladderwort	0	0%	0	0%	0	0%	0	0%	0	0%
Curly-leaf Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%
Great Duckweed	0	0%	0	0%	0	0%	0	0%	0	0%
Hydrilla	0	0%	0	0%	0	0%	0	0%	0	0%
Long-leaf Pondweed	0	0%	0	0%	0	0%	0	0%	0	0%

Hydrilla (*Hydrilla verticillata*)
Percent Abundance by Section
D&R Canal

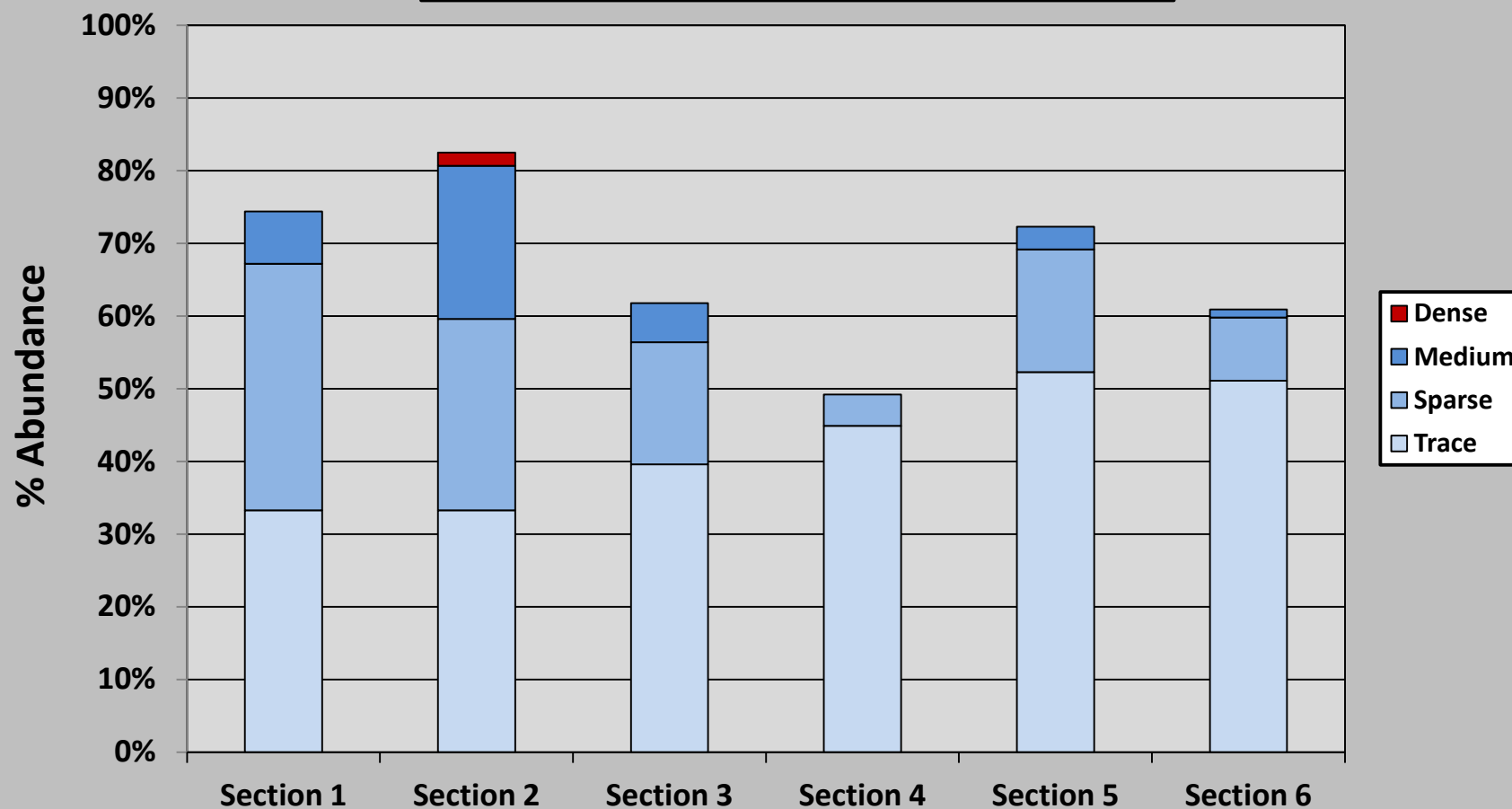


Coontail (*Ceratophyllum demersum*)

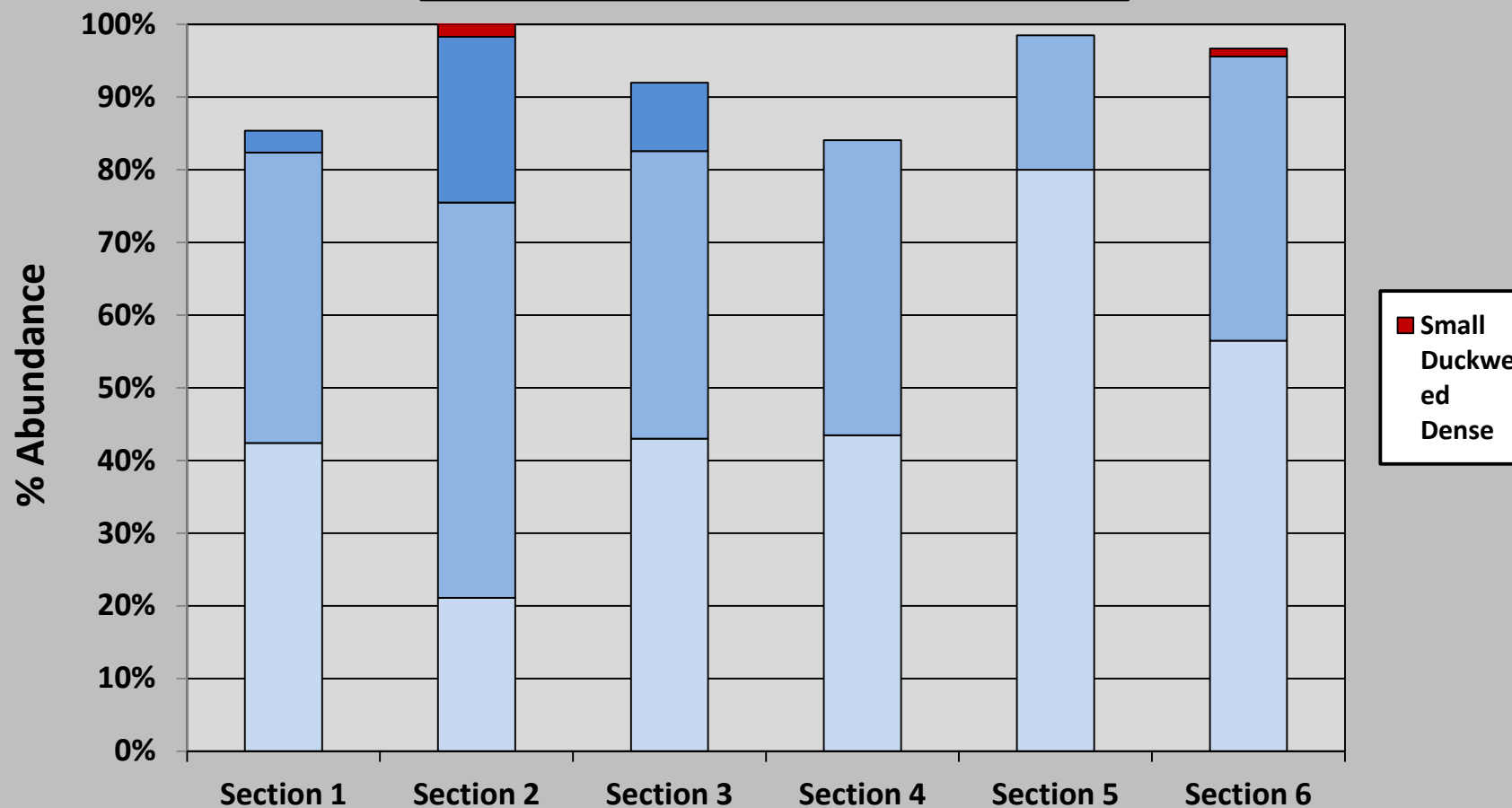
**Percent Abundance by Section
D&R Canal**



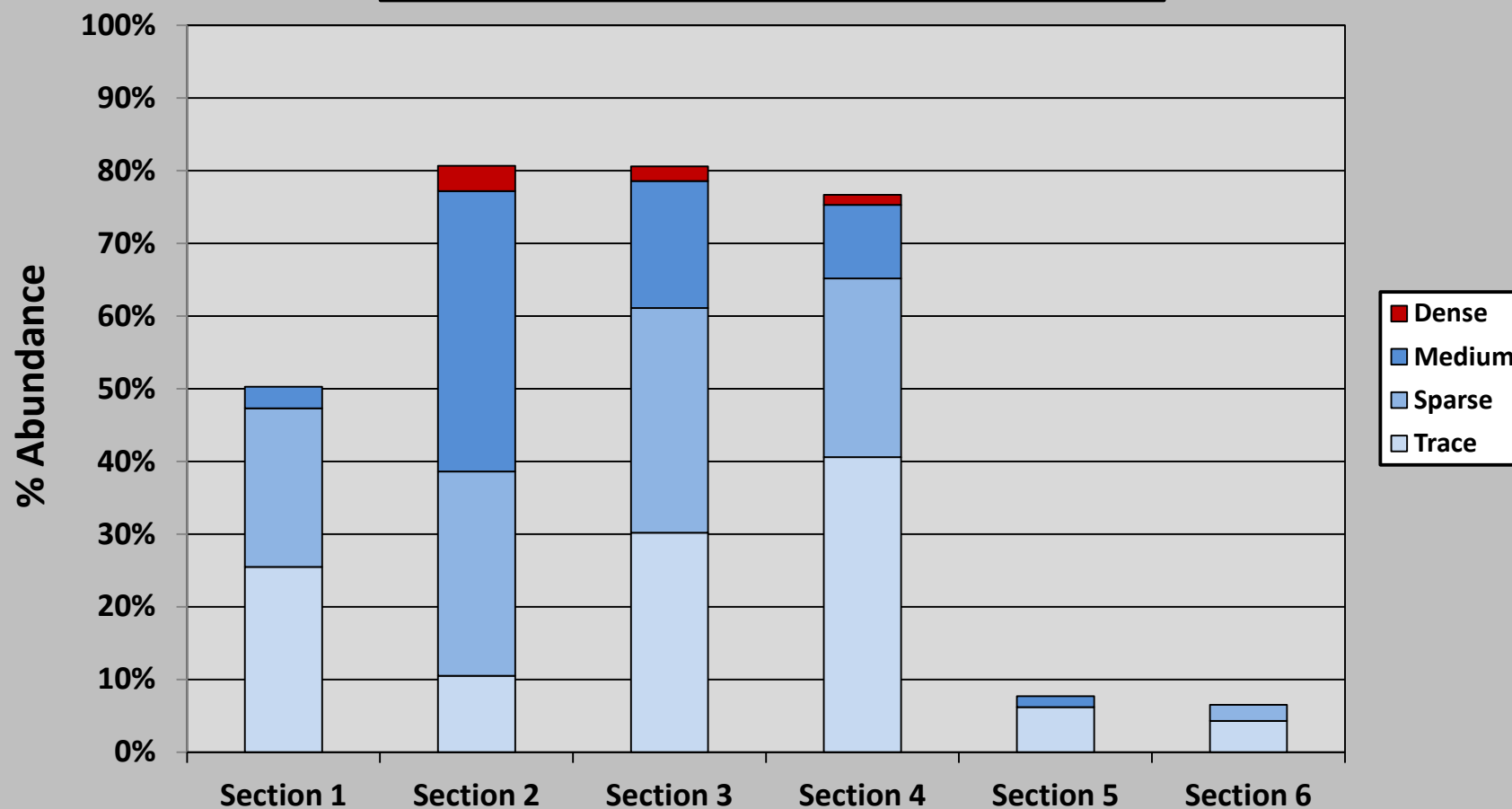
Water Stargrass (*Zosterella dubia*)
Percent Abundance by Section
D&R Canal



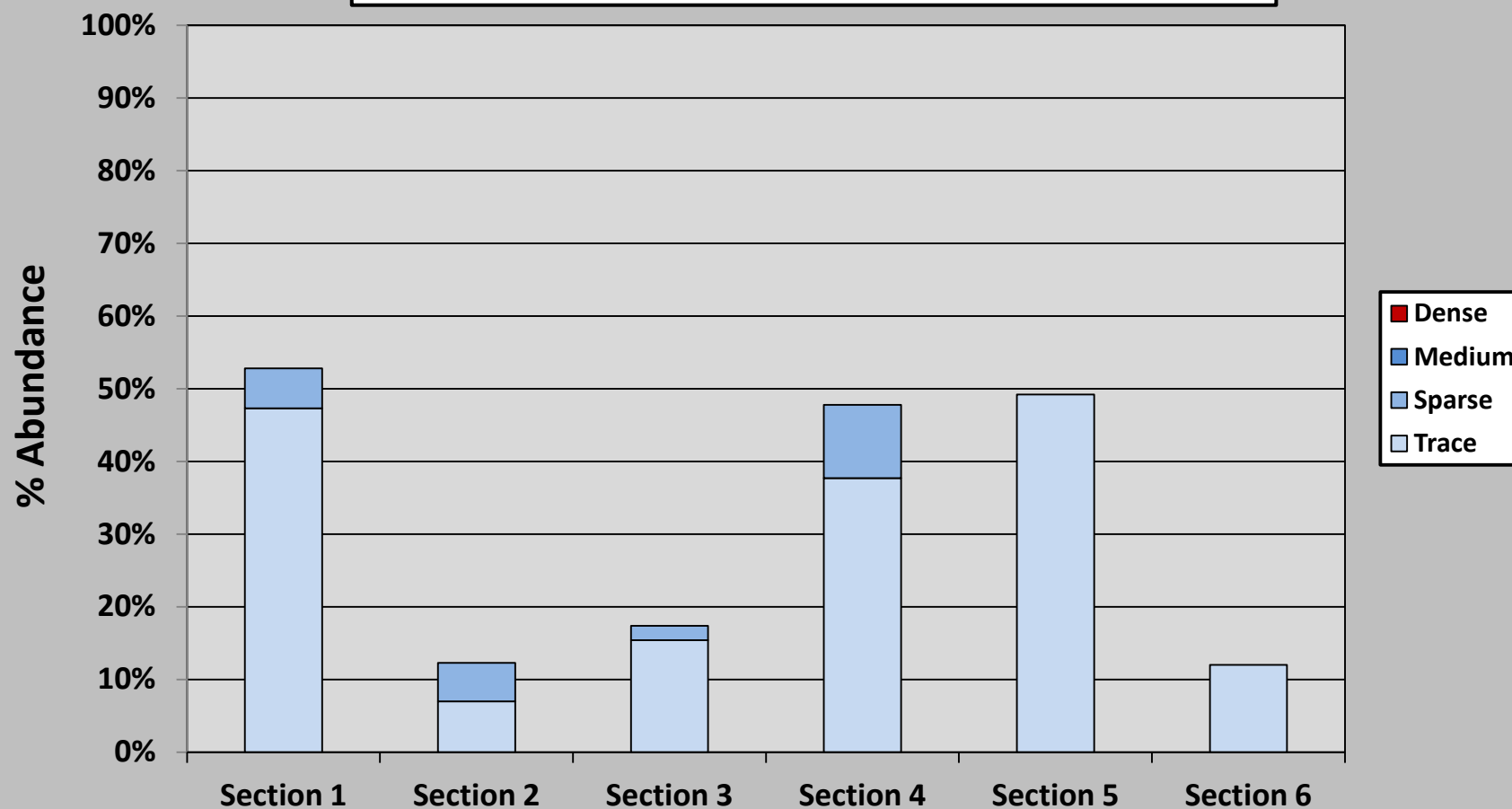
Small Duckweed (*Lemna minor*)
Percent Abundance by Section
D&R Canal



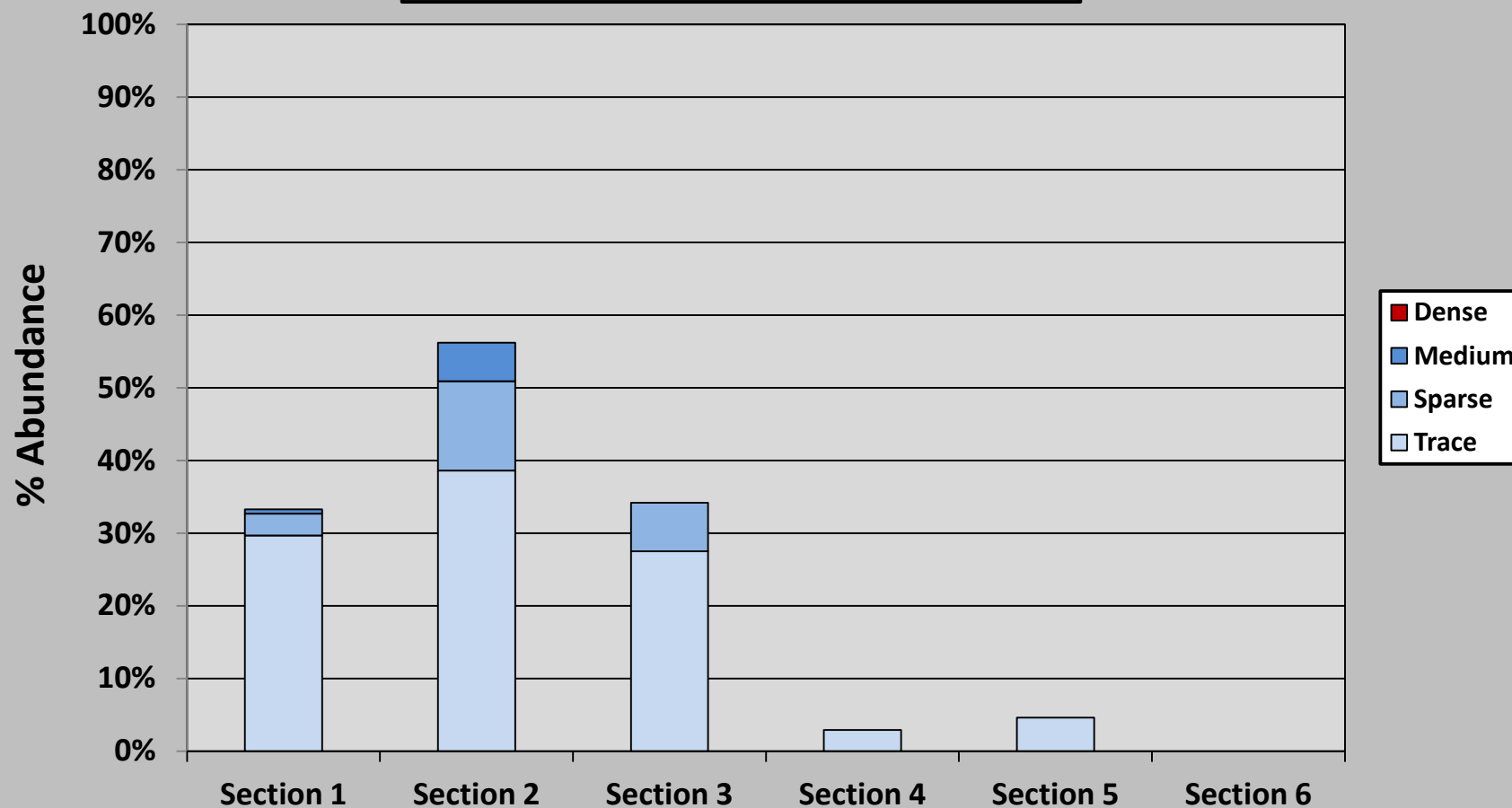
Wild Celery (*Vallisneria americana*)
Percent Abundance by Section
D&R Canal



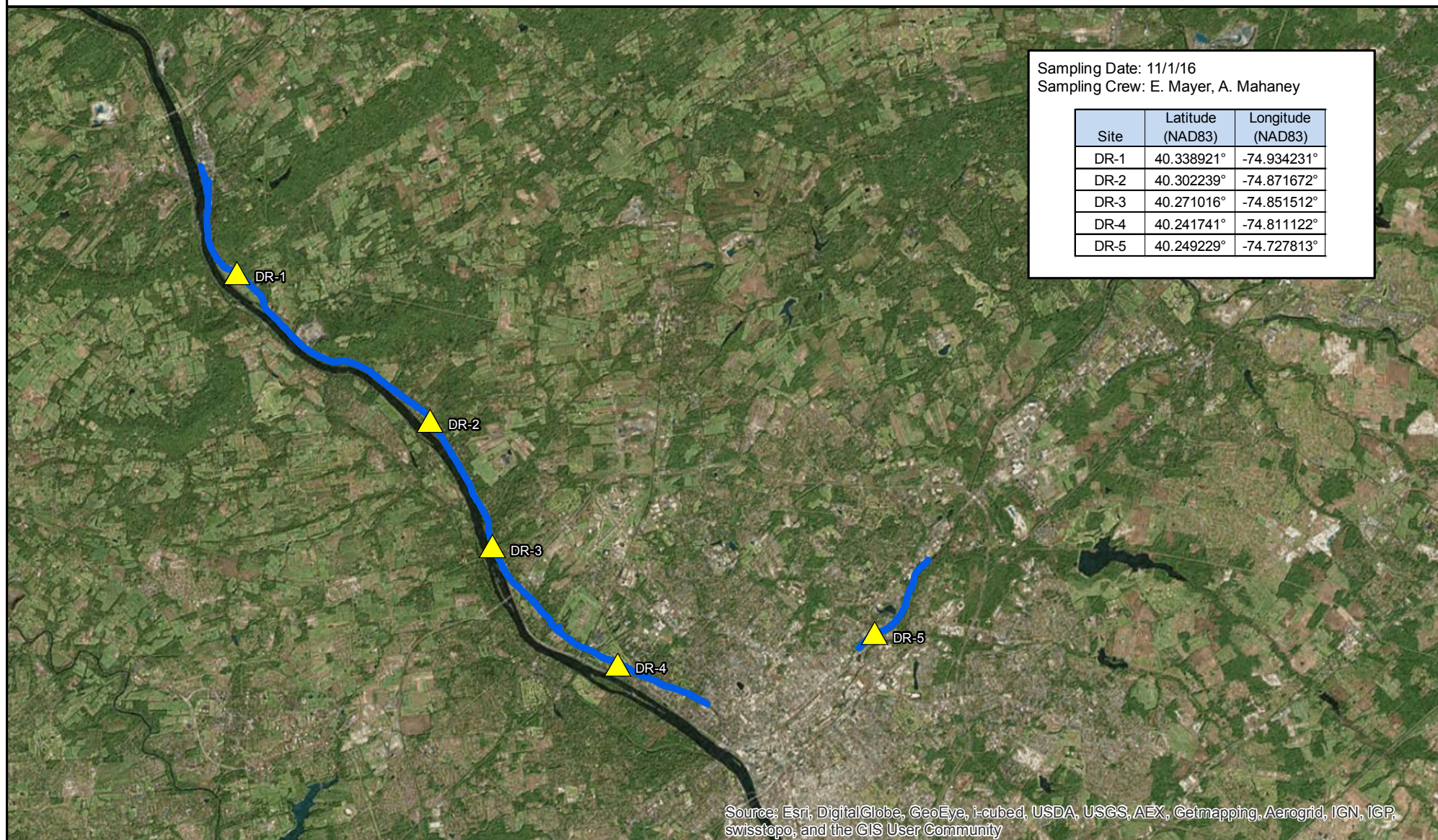
Common Waterweed (*Elodea canadensis*)
Percent Abundance by Section
D&R Canal



Brittle Naiad (*Najas minor*)
Percent Abundance by Section
D&R Canal



DELAWARE AND RARITAN CANAL
Mercer County, New Jersey



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2016 HYDRILLA TUBER SAMPLING



0 1.75 3.5 Miles

D&R Canal

Hydrilla Tuber Density Summary



Sample Location	Section	Description	# Cores	Tubers (m2)	Turions (m2)
D&R Canal	1	Muddy, rocky, many pre-emerg. turions	3	462.8	0.0
	2	Sandy, tiny rocks	5	85.6	203.3
	3	Soft muck, tiny rocks, shells	5	288.9	42.8
	4	Heavy leaf debris, soft, small rocks	3	320.4	17.8
	5	Heavy leaf debris, soft, many pre-emerg. turions	5	10.7	0.0