ONONDAGA LAKE PRE DESIGN INVESTIGATION PHASE V DATA SUMMARY REPORT ADDENDUM 1: HABITAT

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JANUARY 2011

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

Onondaga Lake is a 4.6-mi^2 (2900-acre) lake located northwest of the City of Syracuse in central New York State. The lake, its tributaries, and the upland hazardous waste sites related to the lake have been identified as a federal Superfund site on USEPA's National Priorities List (CERCLIS NYD986913580). The remedial investigation (RI) for the Onondaga Lake bottom subsite was completed in December 2002, the Feasibility Study (FS) was completed in November 2004, the Phase I Pre-Design Investigation (PDI) was completed in 2005, the Phase II PDI was completed in 2006, the Phase III PDI was completed in 2007, and the Phase IV PDI was completed in 2008 (in accordance with the procedures described in the Phase I-IV PDI Work Plans, respectively; Parsons, 2005, 2006, 2007, and 2008). Additional information on the site can be found in the FS (Parsons, 2004) and the Record of Decision (ROD) issued by the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) on July 1, 2005 (NYSDEC and USEPA 2005).

The Phase V PDI was structured in a similar fashion as the Phase IV effort to collect additional information for the Onondaga Lake design and to fulfill additional data gaps identified during design. Unless otherwise noted, the field activities identified in this addendum were conducted in accordance with the procedures outlined in the Phase I - V PDI Work Plans and associated appendices (Parsons, 2005, 2006, 2007, 2008, and 2009). This data summary report describes the results of sample collection activities performed in 2009 required to fill several key data needs identified by the Habitat Technical Work Group (TWG). The details regarding the program objectives, methods of sample collection and analysis, and results are described in the sections below.

1.2 PROJECT OBJECTIVES

Before any of the remedial actions are implemented, additional information is required to complete the remedial design. Since many of the details around the design have not been finalized, this work plan is intended to address several remaining gaps within the existing data set that are needed to advance the conceptual design.

The specific objectives for the habitat PDI are as follows:

- Characterize aquatic macrophytes
- Evaluate habitat structure in SMU 5 and reference lakes
- Evaluate the colonization rates of biota on different substrates

The first objective, characterize aquatic macrophytes, addressed the data gap related to macrophyte presence and physical factors (e.g., substrate characteristics, energy regimes, and water depth). In addition, analysis of seasonal changes was completed to document habitat conditions during the various fish life cycles stages (reproductive cover, juvenile cover, adult cover) and potential limitations in habitat during any of these stages. These data are necessary during design to identify suitable or unsuitable conditions for macrophyte recolonization and facilitate the creation of diverse habitats following remediation.

The second objective, evaluate structure in SMU 5 and reference lakes, provided data to assess the need for the addition of structure in remediation areas and the type of structure to be incorporated during design. Structure can be an important component in fish community dynamics including predator-prey relationships related to feeding efficiency and growth (Crowder and Cooper 1982). Structure also can be important for reptiles and amphibians, providing areas for shelter and egg laying (Environment Canada, 1995).

Understanding the current status of structure in areas not being remediated and in local lakes will provide information on suitable density and distribution of structure in remediation areas.

The third objective, evaluate the colonization rates of biota on different substrates, provided natural recolonization data for the type of substrate that may be used for restoration (primarily coarse substrates and sand, likely to be available in the quantities needed for the habitat layer). It is important to determine whether the selected substrates support the selected representative species early in the design to allow time for sourcing of the material.

The Phase V habitat data will be combined with the existing information for the lake for use during remedial design and reviewed to determine whether there are remaining data gaps that need to be addressed for final design.

SECTION 2

SAMPLE COLLECTION AND ANALYSIS

Additional data collection was needed to understand habitat conditions in the lake. To address existing data gaps and further the design process, additional habitat related information was collected from the lake in 2008.

2.1 AQUATIC MACROPHYTE SURVEY

Aquatic macrophytes within the littoral zone of Onondaga Lake were characterized to understand the relationship between physical factors (e.g., substrate, energy, water depth) and the presence of aquatic macrophytes, including the two threatened and endangered species currently known to exist in the lake. In addition, analysis of seasonal changes was completed to document habitat conditions during the various fish life cycle stages (reproductive, juvenile, adult) and potential limitations in habitat during any of these stages. The survey methods are summarized below; detailed methodology is provided in the SOP (Parsons and QEA 2008).

Aquatic macrophyte species composition and distribution was characterized monthly from May to October along the same points sampled in 2008 that are distributed approximately every 2 acres (total of 397 points) in 0 to 7 meter water depths to allow for evaluation of changes in the size and shape of the macrophyte bed and species composition over the growing season (Figure 1). Points were identified based on global positioning system (GPS) coordinates and were sampled each month. These points were also used as the center points for a 300-meter (2 acre) grid created for the nearshore area. Sampling was conducted at each point according to Madsen (1999). Species composition was evaluated using a rake toss method at each point. In addition, water depth was recorded at each point.

During each sampling event, biomass samples were collected at 120 set points: 60 points within the dredge and cap areas, 20 points in the cap only areas, and 40 points in the unremediated areas (Figure 1). This was a slight deviation from 2008 sampling due to limitations of the sampling device to 9 ft or less. The cap areas do not cover a large enough area to include 40 biomass locations using the 2 acre spacing; therefore, 20 locations were added to the cap and dredge areas to maintain the same original balance between unremediated (40 locations) and remediated areas (80 locations). The same areas sampled in 2008 were used, with the modification of the 20 locations noted above.

A 6-inch inside diameter core sampler constructed of PVC was used to collect the plants to determine above ground biomass. The sampler was pushed approximately 20 cm into the sediments and a rubber cap placed on the open end of the core to create a vacuum. The sampler was then removed from the sediment, brought above the water, and placed in a 5-gallon bucket with a mesh bottom. The cap was removed and the entire sample released into the bucket. If necessary, the bucket was dipped in the water several times to remove excess sediment. Plant samples were sorted by species in the field and placed into resealable plastic bags labeled with a unique sample number, date, station, species, and sampler initials, placed in a cooler on wet ice, and transported to the laboratory. In the laboratory, plant samples were separated into above ground (shoots) and below ground (roots and rhizomes) fractions. Wet weight was determined for the below ground and aboveground biomass samples by species and recorded on the field log. Dry weights were obtained by drying samples at 70^{o}C for at least 24 hours until constant mass was obtained. Dry weight was recorded for each species and sample type. Samples were archived and will be stored for one year.

During one of the monthly surveys (October), a substrate evaluation was conducted at each of the biomass locations. Sediment was collected with a petite ponar and placed into a labeled container for grain size analysis by ASTM Method D422 in the laboratory and total organic carbon (TOC) analysis.

Total acreage of all macrophytes was calculated using the 2009 macrophyte sampling data. The nearshore area of the lake (SMUs 1-7) was divided by a 300-meter grid (2 acre areas) centered on the macrophyte sampling locations. For consistency with the 2008 samples, the grid was clipped by the shoreline and the 7-meter depth contour. Total macrophyte acreage was calculated as the sum of all clipped grid cells that contained any SAV at the center sampling point. In addition, the macrophyte acreage was calculated between the 0.6 and 2.1 m (2 to 7 ft) depth contours in SMU 5 using the same procedure. The acreages calculated using this method likely overestimates the macrophyte acreage since the full grid cell was not surveyed by the field sampling crew. Finally, in addition to calculating macrophyte acreage, distribution maps of individual macrophyte species and all macrophytes combined were produced.

2.2 STRUCTURE EVALUATION IN SMU 5 AND REFERENCE LAKES

This task was designed to evaluate structure in the shallow water areas of SMU 5 (approximately 7 ft water depth or less). Based on existing fisheries data from Onondaga County and SUNY-ESF, SMU 5 represents the most productive portion of Onondaga Lake and serves as a reference condition for other portions of the lake where remediation will occur. Structure evaluations were conducted when water clarity was sufficient to see at least through 2 m of water and conditions were calm. Sampling was started prior to the majority of macrophyte establishment so that visibility was not reduced and continued into August; the reference lakes were sampled in October as plants were beginning to senesce. Surveys were conducted by surveying the area by boat and visually identifying underwater structures. The boat started a survey line in approximately 5 ft offshore at the end of SMU 5 near the mouth of Ninemile Creek, and moved parallel to the shore to the Seneca River outlet. Additional survey lines were completed, offset from the initial survey line, based on visibility such that all areas of SMU 5 to a depth of 7 ft deep were surveyed. Once this area had been surveyed, the survey was repeated from east of the Seneca River outlet to the marina, and finally from the marina to the SMU 5 boundary near Ley Creek.

Structure can be comprised of either natural (e.g., logs, boulders) or manmade (e.g., tires) material. Objects larger than approximately 5 inches were recorded. Secchi disk measurements were taken each day surveys were conducted to record water clarity. Each underwater structure was identified and the coordinates recorded using a differential global positioning system (DGPS; sub-meter accuracy) for later plotting on maps. A description of the structure (log, tire, etc), the water depth, and the dimensions of the structure were measured and recorded in the field. Additional observations, including fish presence or spawning activity around a structure, will be recorded, as feasible, during the structure survey. Observations of surrounding vegetation was made and recorded during surveys. In addition, since macrophyte surveys occurred monthly, distribution of macrophytes can be compared with the structure survey.

The presence of structure in area reference lakes was evaluated in the shallow water areas of Oneida Lake on October 20, 2009 and Otisco Lake on October 21, 2009. Surveys were conducted after the majority of macrophytes started to senesce so that visibility was not obscured. The evaluation was conducted by visual observation from a boat when water clarity was sufficient to see at least through 6- to 7 ft of water. Transects parallel to shore and several shorter transects perpendicular to shore were surveyed. A submersible video camera equipped with a wide-angle lens and underwater lights was deployed to survey the bottom features for most transects. The survey documented bottom substrate types and the frequency of habitat structure within the areas surveyed. Ponar dredge samples were taken in each lake at agreed upon locations to document bottom sediment characteristics. The video images were recorded for subsequent analysis. Data recording sheets were prepared to allow for recording the structure features.

2.3 SUBSTRATE SUITABILITY STUDY

This task, initiated in 2008, was designed to evaluate the natural recolonization of different substrate types (primarily coarse substrates and sand, likely available in the quantities needed for the habitat layer) by macrophytes, macroinvertebrates, and fish. Recolonization was evaluated for three substrate types and three energy regimes in 2008 and 2009. Energy regimes were based on the general categories currently used by OCDWEP (EcoLogic et al. 2007). Sampling methods are summarized below and detailed in the SOP (Parsons et al. 2008).

Invertebrate samples were collected from a subset of nine pools at each location using a petite ponar sampler on May 27, 2009. Three pools of each substrate type (sand; sand/gravel; and gravel/cobble) were sampled at each site. In addition, a control sample was collected adjacent to the pool to assess the source population available to colonize the pools. Invertebrates were preserved in 10% buffered formalin with rose bengal dye and identified in the laboratory. Invertebrate samples were processed with a 100 organism subsample using NYSDEC methods (Bode et al., 2002). The organisms were identified to the lowest taxonomic level possible, sorted into vials by taxa, preserved in 75% ethanol, and archived. Each vial was labeled with the sample code, station location, replicate number, date of collection, name of organism, and number of individuals within the vial. The remainder of the sample, as well as the separate vials, will be retained for up to one year.

All remaining pools (48 out of the 54; 6 were lost from Bloody Brook due to weather conditions) were sampled using a petite ponar sampler on June 11, 2009 for total organic carbon and grain size by ASTM Method D422. The details of the procedures, methodology, and results are reported in Appendix C.

SECTION 3

RESULTS

3.1 AQUATIC MACROPHYTE SURVEY

3.1.1 Composition

During the 2009 monthly macrophyte community sampling (May-October), 15 species of aquatic macrophytes were identified, with one unidentified species (Table 1). Three species were identified in 2009 samples that were not collected in 2008: *Najas guadalupensis* (southern water nymph), *Trapa natans* (water chestnut), and *Fontinalis antipyretica* (aquatic moss).

Based on relative abundance, six species were characterized as “abundant” because they were identified at more than 20% of the sample points for at least one month during the sampling season (Tables 1 and 2). Two species were characterized as “common” because they were observed during most months but in less than 20% of the sample points in any given month (Tables 1 and 2). Seven species were characterized as uncommon because they were observed sporadically in the macrophyte community.

The number of species observed in Onondaga Lake changed little from month to month; however, the percent occurrence of each species changed depending on the sampling month. The aquatic macrophyte community in May and June was similar in that curly-leaf pondweed (*Potamogeton cripus)* had the highest percent occurrence followed by Eurasian water milfoil (*Myriophyllum spicatum)* and common waterweed (*Elodea canadensis)* (Table 2). Curly-leaf pondweed reached its peak during the month of June when it occurred in 32.49% of the samples. During July, the aquatic macrophyte community was dominated by common waterweed and Eurasian water milfoil*;* both had their highest occurrence during this month (44.95% and 37.12%, respectively); coontail (*Ceratophyllum. demersum*), leafy pondweed (*P. foliosis*), and curly-leaf pondweed occurred in 24-29% of samples. Four aquatic macrophytes (Eurasian water milfoil, common waterweed, coontail, and slender naiad [*N. flexilis*]) dominated the community from August through October. Coontail and slender naiad both reached their peak during August.

Species distribution was mapped by species for May through October based on presence or absence at each point location (Figures 2 through 7).

The aquatic macrophyte species dominance and Shannon-Weiner diversity varied from May to October. The lowest diversity was found in May and October (1.79 and 1.80, respectively) while the highest diversity was found in July (2.06) (Table 3). Species richness was highest in September with 14 species and lowest in May and June with 9 species.

3.1.2 Biomass

Over 950 g (wet weight) of plant material was collected from 119 different sites in the lake from May to October 2009 for biomass analysis. Macrophytes were not commonly seen growing greater than 3.0 m and the deepest macrophytes found during the 2009 season were at

4.4 m. Macrophyte biomass (g wet weight) was highest in the month of June for roots and September for shoots (Table 4). Collectively, macrophyte biomass (shoot and root wet weight g) was highest during the month of June.

Water weed was the most abundant species collected, comprising 33% of the total collected root and shoot biomass (Table 5). Species richness within the biomass samples was highest for the months of June and August, with ten different macrophyte species collected. Overall species richness was discussed above in Section 3.1.1.

Lake-wide macrophyte biomass was dominated by curly-leaf pondweed in May and June, with approximately 40% and 43%, respectively, of the total biomass (Table 5). Water weed dominated biomass samples in July through October, with combined root and shoot dry weight ranging from 51% of the total in August to 34% in September.

Average monthly biomass was used to compare the aquatic plant biomass in the different SMU's (Table 6). The average monthly biomass was highest in SMU 3 and lowest in SMU 5 throughout the sampling season. SMU 3 had high biomass in May (Table 6). The month of peak biomass varied among SMU's. June was the peak biomass month for SMU's 1, 2, and 7; September was the peak biomass month for SMU's 4, 5, and 6; and October was the peak biomass month for SMU 3.

3.1.3 Spatial Extent

Data from the point surveys in May through October were used to estimate overall macrophyte distribution around the lake (Figures 8 through 13). Based on the point data collected in 2009, there were approximately 406 acres of aquatic macrophytes in May, 373 acres in June, 518 acres in July, 421 acres in August, 394 acres in September, and 338 acres in October. Within SMU 5, during July and August, there were approximately 160 acres of macrophytes within the 2 to 7 ft water depth range, resulting in approximately 73% coverage in this area.

3.1.4 TOC and Grain Size Results

Samples were obtained from the 120 biomass locations in October 2009 to assess for total organic carbon (TOC) and grain size distribution within the macrophyte areas (Figures 14-24). Three locations were sampled, but no sediment was obtained after several attempts; results for the remaining 117 locations are provided on Tables 7 and 8. TOC varied considerably among the locations, with values from 1850 mg/kg (0.18%) to a maximum of 223,000 mg/kg (22.3%). Average TOC in each SMU ranged from 10,766 mg/kg (1.08%) in SMU 3 to 38,807 mg/kg (3.88%) in SMU 7 (Table 7).

Grain size varied from silts to gravel. Within the areas sampled, silty sand and sand with silt were the predominant grain sizes (>50% of all samples were described as one of these two types). Grain size varied within each SMU, with at least four sediment types identified within a SMU (Table 8).

3.2 STRUCTURE SURVEY

There were 657 structures identified in SMU 5 (Figures 25-36). There were 117 concrete structures, which included cinder blocks and concrete wave breaks (South of the Marina). Also identified were 66 large rocks or rock piles, and 266 woody structures, which include logs, large branches, root masses, and beams (railroad ties). A majority of the woody debris is located in the area between Ninemile Creek and the Outlet. Identified were 163 tires, primarily between Ley Creek and Bloody Brook, and 45 miscellaneous objects, including barrels, metal pipes, and road cones. A majority of the structures were at the two shallowest depth intervals, 31% at 0 – 0.5 meters and 54% at 0.5 – 1 meters. Only 2% of the structures were located at depths greater than 2 meters and most of them were woody debris (remnants of old piers). During sampling, visibility was generally very good with secchi disk readings consistently greater than 3 meters.

The presence of structure was evaluated in the shallow water areas of Oneida Lake on 10/20/09 and Otisco Lake on 10/21/09, after the majority of macrophytes started to senesce so that visibility was not obscured. The survey documented bottom substrate types and the frequency of habitat structure within the areas surveyed. Several ponar dredge samples were taken in each lake at agreed upon locations to document bottom sediment characteristics. A brief report on the survey was developed and submitted to NYSDEC on January 6, 2010 (see Appendix 1).

3.3 SUBSTRATE SUITABILITY STUDY

3.3.1 Fish Use Observation

Largemouth bass (*Micropterus salmoides*) were observed guarding nests, which were built on the substrate contained in the wading pools at Sawmill Creek and Nine Mile Creek. At Sawmill Creek, largemouth bass built nests on 5 out of the 9 deep (0.75 to 1.5 m) wading pools. Largemouth bass nests were found on all three of the sand/gravel pools, 2 out of 3 of the gravel/cobble pools and none of the pools containing sand. At Ninemile Creek, one bass nest was found on one deep sand/gravel substrate pool.

Pumpkinseed sunfish (*Lepomis gibbosus*) were observed nesting on substrate contained in the wading pools at all three sites. At Sawmill Creek, pumpkinseed nested on two sand/gravel pools in the shallow (<0.75 m) area. At Ninemile Creek, one pumpkinseed nest each was observed in one sand pool in the shallow area and two sand pools in the deeper area. At Bloody Brook, two pumpkinseed nests were observed in the deep area; one on sand and the other on sand/gravel substrate.

3.3.2 Aquatic Macrophytes

In June the majority of the macrophyte cover occurred at the Bloody Brook site with two outer deep gravel/cobble pools having 90% and 80% cover, and one inner deep gravel/cobble pools having 60% cover. Three inner gravel/cobble pools had 10% cover. The main species found were small pondweed and leafy pondweed. At Ninemile Creek, two pools were found with aquatic macrophytes; one outer deep sand/gravel pool had 60% cover mostly of Eurasian watermilfoil. The other pool was an inner deep gravel/cobble pool and had 5% cover. Sawmill Creek had one shallow sand pool with 5% curly-leaf pondweed cover.

In November, there were more wading pools with macrophytes but they all had 10% cover or less. Five wading pools at the Ninemile Creek site had macrophytes, all of which were in the deep section. They had between 5-10% coverage of Eurasian watermilfoil or curly-leaf pondweed and no plants were observed in gravel/cobble substrate pools. The Sawmill Creek site had the most wading pools with macrophytes; four in both the deep and shallow lines. Macrophytes were observed in sand and sand/gravel pools and coverage was between 5-10% dominated by common waterweed or Eurasian watermilfoil. None of the wading pools at Bloody Brook contained macrophytes in November.

3.3.3 Macroinvertebrate Data

Organisms from ten orders were identified from within the pools (Table 9). Generally, the control areas outside the pools had a higher dominance of bivalves compared to each of the pools at all locations and of all substrate types (Tables 10, 11, 12). At the Sawmill Creek site, both pool and control samples were dominated by amphipods and bivalves (Table 10). Pools that contained a gravel/cobble mix contained primarily bivalves and chironomids. Amphipods were the most prevalent organism found in both sand and sand/gravel mix pools at Sawmill Creek (Table 8). At the time of sampling, five pools remained at the Bloody Brook site: one sand, two sand/gravel, and two gravel/cobble. Invertebrate abundance was low for this site. A total of 168 organisms were collected in the five pools (Table 11). Pools largely contained bivalves, chironomids, and oligochaetes (Table 11). All substrate types were dominated by bivalves, chironomids, and oligochaetes. Chironomids were the most abundant organism found for all three substrate types at Nine Mile (Table 12). Oligochaetes and amphipods were the most prevalent in pools that contained sand. Bivalves were the most prevalent in pools that contained a gravel/cobble mix (Table 12).

Samples were obtained from the remaining pools on June 11, 2009 to assess total organic carbon (TOC) and grain size distribution within each pool. Forty eight pools were sampled, although many of the pools did not contain enough fine material to conduct a TOC analysis; results are reported for those samples with sufficient material. Among the three locations, TOC ranged from 283 mg/kg (0.02%) to 33100 mg/kg (3.31%), with the highest value from a gravel/cobble pool at Bloody Brook (Table 13).

SECTION 4

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TABLES

TABLE 1

MACROPHYTE SPECIES IDENTIFIED DURING SAMPLING IN 2009

Species	Common Name	Dominance level
Myriophyllum spicatum	Eurasian water milfoil	Abundant
Elodea canadensis	Common waterweed	Abundant
Ceratophyllum demersum	Coontail	Abundant
Potamogeton crispus	Curly-leaf pondweed	Abundant
Potamogeton foliosis	Leafy pondweed	Abundant
Najas flexilis	Slender naiad	Abundant
Stuckenia pectinatus	Sago pondweed	Common
Heteranthera dubia	Water stargrass	Common
Potamogeton pusillus	Small pondweed	Uncommon
Najas guadalupensis	Southern water nymph	Uncommon
Fontinalis antipyretica	Aquatic moss	Uncommon
Lemna minor	Duckweed	Uncommon
Chara	Stonewort	Uncommon
Spirodela polyrhiza	Great duckweed	Uncommon
Trapa natans	Water chestnut	Uncommon
Unknown		Uncommon

TABLE 2

PERCENT OCCURRENCE BY MONTH IN 2009 OF ABUNDANT AND COMMON MACROPHYTE SPECIES IN ONONDAGA LAKE

Species	Common Name	May	June	July	August	September	October
Myriophyllum spicatum	Eurasian water milfoil	29.22	21.91	37.12	27.53	26.01	26.01
Elodea canadensis	Common waterweed	24.94	18.64	44.95	36.11	28.03	27.27
Ceratophyllum demersum	Coontail	16.62	14.61	29.29	29.29	26.01	20.96
Potamogeton crispus	Curly-leaf pondweed	31.99	32.49	24.24	5.30	6.31	5.30
Potamogeton foliosis	Leafy pondweed	11.08	12.34	26.52	7.32	3.03	0.25
Najas flexilis	Slender naiad	7.30	4.53	8.08	22.47	22.73	21.97
Stuckenia pectinatus	Sago pondweed	1.51	13.35	16.41	6.57	2.78	2.02
Heteranthera dubia	Water stargrass	1.01	1.26	4.04	9.09	10.35	10.10

TABLE 3

SHANNON WEINER DIVERSITY OF ONONDAGA LAKE AQUATIC MACROPHYTES IN 2009

Month	Diversity	Number of species
May	1.79	9
June	1.90	9
July	2.06	13
August	1.98	13
September	1.98	14
October	1.80	10

TABLE 4

TOTAL MACROPHYTE BIOMASS BY MONTH

Month	Shoot biomass (g wet weight)	Root biomass (g wet weight)	Shoot biomass (g dry weight)	Root biomass (g dry weight)
May	48.286	18.867	6.445	3.476
June	204.162	32.458	25.951	6.175
July	141.246	10.795	23.527	1.466
August	112.718	3.747	13.998	0.464
September	214.679	2.243	29.799	0.345
October	172.906	0.536	23.238	0.168

TABLE 5

TOTAL MACROPHYTE BIOMASS BY SPECIES AND MONTH (GRAMS DRY WEIGHT)

Species	May		June		July		August		Sept		Oct		Total	
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
C. demersum	0.56	0.00	1.47	0.00	3.35	0.00	1.42	0.00	4.78		6.56			
Chara			0.06	0.00			0.36	0.00	0.19		1.47			
E. canadensis	1.81	0.09	3.96	1.52	10.89	0.18	7.16	0.19	10.14	0.08	9.15	0.02		
H. dubia			0.05	0.00	0.16	0.01	2.49	0.00	0.88		0.30			
M. spicatum	2.24	0.49	5.43	0.18	3.74	0.31	0.59	0.07	6.07		1.04	0.00		
N. flexilis	0.11	0.21	0.19	0.27	0.83	0.03	1.45	0.16	6.95	0.26	4.61	0.13		
N. guadalupensis									0.34					
P. crispus	1.57	2.61	12.57	3.52	0.56	0.03	0.00	0.03	0.46	0.01	0.10	0.01		
P. foliosus	0.04	0.05	0.41	0.12	0.66	0.04	0.04	0.00						
P. pusillus	0.01	0.02	0.02	0.00	0.01	0.14								
S. pectinata	0.12	0.02	1.81	0.57	3.33	0.73	0.48	0.01						

Blanks indicate no samples collected from area.

TABLE 6

MEAN MONTHLY BIOMASS OF MACROPHYTES BY SMU IN GRAMS DRY WEIGHT PER CORE

	May		June		July		August		September		October	
SMU	**Above**	**Below**	**Above**	**Below**	**Above**	**Below**	**Above**	**Below**	**Above**	**Below**	**Above**	**Below**
1	0.35	0.08	0.60	0.08	0.25	0.00	0.26	0.00	0.09	0.01	0.34	
2	0.03	0.02	0.85	0.00	0.48	0.00	0.10	0.00	0.09		0.02	0.01
3	0.33	0.41	0.25	0.00	0.30	0.00	0.17	0.01	0.08		0.84	
4	0.06	0.00	0.14	0.05	0.21	0.01	0.11	0.01	0.67	0.01	0.25	0.03
5	0.07	0.09	0.09	0.04	0.14	0.01	0.12	0.01	0.20	0.04	0.17	0.05
6	0.12	0.02	0.16	0.00	0.12	0.04	0.16	0.00	0.24	0.00	0.15	0.00
7	0.05	0.02	0.21	0.20	0.30	0.00	0.14	0.00	0.05		0.31	

Blanks indicate no samples collected from area.

TABLE 7
TOC RESULTS FROM MACROPHYTE BIOMASS LOCATIONS
OCTOBER 2009

SMU location	Location	Sample Date	TOC (mg/kg)		% solids	notes
1	281	10/12/2009	4670	J	36.9	
1	264	10/12/2009	5400		52.2	
1	283	10/12/2009	5990		50.5	
1	283	10/12/2009	9090	J	49.8	FD
1	261	10/1/2009	9520	J	49.9	
1	252	10/12/2009	10200		50.9	
1	247	10/12/2009	10900		52.6	
1	263	10/12/2009	10900		50.4	
1	238	10/12/2009	11000	J	45.5	
1	241	10/1/2009	11500		52.2	
1	280	10/1/2009	11500		57.2	
1	258	10/12/2009	14800	J	45.4	
1	259	10/12/2009	15700	J	43.6	
1	276	10/12/2009	15900	J	44	
1	253	10/12/2009	16500	J	51.2	
1	270	10/12/2009	16600		54.2	
1	249	10/1/2009	16800	J	38.2	
1	284	10/12/2009	17600		53.8	
1	271	10/12/2009	18100	J	37.4	
1	269	10/12/2009	19700		50.1	
1	274	10/12/2009	19900	J	33.6	
1	256	10/1/2009	26100	J	30.4	
1	282	10/12/2009	27800	J	30.9	
1	246	10/12/2009	28400		57.7	
1	289	10/12/2009	37100	J	47	
1	265	10/12/2009	42400		57.6	
1	288	10/12/2009	47700	J	42	
1	277	10/12/2009	59100	J	38.8	
2	212	10/1/2009	8050		59.6	
2	227	10/1/2009	12600		54.9	
2	220	10/1/2009	12900	J	39.6	
2	213	10/12/2009	17000	J	43.7	
2	218	10/12/2009	17900		51.9	
3	126	10/12/2009	2300		69.5	
3	162	10/12/2009	3630		62.9	
3	126	10/12/2009	4280		64.1	FD
3	135	10/12/2009	6790		53.7	
3	169	10/12/2009	7880		57.3	
3	186	10/12/2009	8030		50.7	

TABLE 7
TOC RESULTS FROM MACROPHYTE BIOMASS LOCATIONS
OCTOBER 2009

SMU location	Location	Sample Date	TOC (mg/kg)		% solids	notes
1	281	10/12/2009	4670	J	36.9	
3	177	10/1/2009	8480	J	49.4	
3	148	10/12/2009	12100		54.2	
3	196	10/1/2009	12600	J	39.8	
3	199	10/12/2009	17600	J	38.6	
3	132	10/12/2009	21400		54.6	
3	124	10/12/2009	24100		54.4	
4	111	10/12/2009	5130		63.8	
4	83	10/12/2009	7020		89.1	
4	100	10/12/2009	11700		86.2	FD
4	94	10/12/2009	13000		88.2	
4	109	10/12/2009	13100		51.3	
4	77	10/12/2009	13600	J	51.4	
4	100	10/12/2009	15500		80.3	
4	88	10/12/2009	16100		86.1	
4	112	10/12/2009	17500		53	
4	82	10/12/2009	17700		81.9	
4	92	10/12/2009	19100		54	
4	106	10/12/2009	24300	J	40.6	
4	89	10/12/2009	26300		54.6	
4	95	10/12/2009	39700	J	40.4	
4	95	10/12/2009	47000	J	37.7	FD
4	101	10/12/2009	52400	J	33.9	
5	15	10/12/2009	9250	J	48.8	
5	60	10/12/2009	12300		56.5	
5	4	10/12/2009	12600		50.3	
5	25	10/12/2009	13100		50.9	
5	46	10/12/2009	13600		50.4	
5	41	10/12/2009	14200	J	48.4	
5	371	10/1/2009	14600	J	42.5	
5	19	10/12/2009	16300		53.7	
5	53	10/12/2009	16500		55.3	
5	66	10/12/2009	17400	J	47.7	
5	39	10/12/2009	18600	J	37.7	
5	69	10/12/2009	30300		57.1	
6	375	10/1/2009	1850		75.4	
6	378	10/1/2009	2160		69.4	
6	341	10/1/2009	2300		76.9	
6	373	10/1/2009	2530		71	

TABLE 7
TOC RESULTS FROM MACROPHYTE BIOMASS LOCATIONS
OCTOBER 2009

SMU location	Location	Sample Date	TOC (mg/kg)		% solids	notes
1	281	10/12/2009	4670	J	36.9	
6	377	10/1/2009	2860		72.9	
6	340	10/1/2009	3180		75.6	
6	377	10/1/2009	3180		70.6	FD
6	342	10/1/2009	3480		67.1	
6	376	10/1/2009	3710		65.7	
6	390	10/1/2009	3770		66.7	
6	390	10/1/2009	4010		66	FD
6	374	10/1/2009	4290		72.1	
6	328	10/1/2009	4340		75.1	
6	327	10/1/2009	4470		67	
6	388	10/1/2009	4840		63.3	
6	359	10/1/2009	5670		77.7	
6	389	10/1/2009	6830		64.5	
6	358	10/1/2009	7890		73.4	
6	386	10/1/2009	8080		62.9	
6	391	10/1/2009	8510		57.3	
6	369	10/1/2009	11700	J	44.8	
6	380	10/1/2009	16500		54.7	
6	381	10/1/2009	16900		50.9	
6	382	10/1/2009	18700	J	49.2	
6	337	10/1/2009	20400	J	39.4	
6	365	10/1/2009	21000	J	43.1	
6	343	10/1/2009	21200		54.8	
6	364	10/1/2009	23600	J	47.6	
6	393	10/1/2009	26800	J	30.1	FD
6	392	10/1/2009	31100	J	47	
6	360	10/1/2009	34300		51.9	
6	393	10/1/2009	43400	J	39.7	
6	379	10/1/2009	50600		54.2	
6	363	10/1/2009	56800	J	47.1	
6	329	10/1/2009	63700		50.3	
6	339	10/12/2009	208000	J	36.2	
7	326	10/12/2009	5040		74.1	
7	314	10/12/2009	8600		59.1	
7	317	10/1/2009	8830		74.8	
7	304	10/12/2009	9440		64.6	
7	303	10/1/2009	10600		51.1	
7	315	10/12/2009	11000		59.1	

TABLE 7
TOC RESULTS FROM MACROPHYTE BIOMASS LOCATIONS
OCTOBER 2009

SMU location	Location	Sample Date	TOC (mg/kg)		% solids	notes
1	281	10/12/2009	4670	J	36.9	
7	316	10/12/2009	14600		72.1	
7	312	10/1/2009	15800	J	37.3	
7	296	10/12/2009	23600	J	49.6	
7	306	10/1/2009	32200	J	42.9	
7	295	10/12/2009	33300	J	47.7	
7	297	10/1/2009	41000	J	38.8	
7	305	10/12/2009	61700		53.6	
7	325	10/12/2009	83400		55	
7	290	10/12/2009	223000	J	38.5	

FD = field duplicate

TABLE 8
GRAIN SIZE DATA FROM SELECT MACROPHYTE LOCATIONS
OCTOBER 2009

SMU Location	Location ID	Sample Description	Grain Size (ASTM D422) Percent Composition					Treatment
			Gravel	Sand	Fines (clay and silt)	Clay-sized Particle Content (0.005 mm)	Clay-sized Particle Content (0.002 mm)	
5	4	Sandy Silt	5.3	38.7	56.0	20	13	
5	15	Sand with Silt	0.0	90.4	9.6	2	1	
5	19	Silty Sand with Gravel	35.2	52.8	12.0	4	2	
5	25	Silty Sand	1.6	72.5	25.9	7	3	
5	39	Silty Gravel with Sand	52.5	34.5	13.0	7	7	
5	41	Silty Sand	11.8	66.7	21.5	9	6	
5	46	Sand with Silt and Gravel	19.3	71.0	9.7	3	3	
5	53	Gravel with Silt and Sand	56.8	33.0	10.2	3	1	
5	60	Sand with Silt and Gravel	40.0	48.4	11.6	6	3	
5	66	Gravel with Sand	50.7	45.7	3.6			
5	69	Gravel with Silt and Sand	62.9	29.2	7.9	3	1	
4	77	Silty Sand	11.6	75.1	13.3	4	2	
4	82	Silt	0.0	5.5	94.5	35	26	Dredge and Cap
4	83	Silty Sand	14.2	54.2	31.6	12	8	Cap only
4	88	Sandy Silt	0.0	42.4	57.6	19	11	Dredge and Cap
4	89	Sandy Silt	0.4	40.1	59.5	14	9	Dredge and Cap
4	92	Gravel with Silt and Sand	44.7	44.5	10.8	6	3	
4	94	Sandy Silt	0.0	45.5	54.5	20	16	Dredge and Cap
4	95	Sandy Silt	0.1	49.4	50.5	13	7	Dredge and Cap
4	100	Silt with Sand	0.4	16.1	83.5	15	9	Dredge and Cap
4	101	Silt	0.2	10.1	89.7	37	24	Cap only
4	106	Silt	0.0	14.3	85.7	24	14	Dredge and Cap
4	109	Sand with Silt and Gravel	35.6	52.7	11.7	5	2	
4	111	Silty Sand	0.9	73.8	25.3	7	4	Dredge and Cap
4	112	Silty Sand	0.0	59.9	40.1	8	5	Dredge and Cap
3	124	Silty Sand	0.9	79.3	19.8	5	2	
3	126	Silty Sand	0.0	77.9	22.1	8	5	
3	132	Sand with Silt and Gravel	39.9	51.8	8.3	4	3	
3	135	Sand with Silt and Gravel	16.8	71.6	11.6	4	3	
3	148	Silty Sand with Gravel	26.2	60.2	13.6	4	2	
3	162	Sand	0.0	96.8	3.2			
3	169	Silty Sand with Gravel	16.4	69.4	14.2	4	3	
3	177	Silty Sand	0.3	85.0	14.7	5	2	
3	186	Sand with Silt and Gravel	27.4	63.8	8.8	3	1	
3	196	Silty Sand with Gravel	31.5	55.4	13.1	6	3	

TABLE 8
GRAIN SIZE DATA FROM SELECT MACROPHYTE LOCATIONS
OCTOBER 2009

SMU Location	Location ID	Sample Description	Grain Size (ASTM D422) Percent Composition					Treatment
			Gravel	Sand	Fines (clay and silt)	Clay-sized Particle Content (0.005 mm)	Clay-sized Particle Content (0.002 mm)	
3	199	Silty Sand	7.9	45.6	46.5	15	10	
2	212	Sand with Silt	13.6	74.5	11.9	4	2	
2	213	Gravel with Sand	67.4	28.9	3.7			
2	218	Silty Sand	1.2	84.1	14.7	7	5	Dredge and Cap
2	220	Silty Sand with Gravel	19.1	43.0	37.9	10	6	
2	227	Sand with Silt	9.2	83.3	7.5	3	3	
1	238	Sand with Silt and Gravel	21.0	70.1	8.9	5	4	Dredge and Cap
1	241	Silty Sand	9.5	70.1	20.4	6	4	
1	242	no sample obtained						Dredge and Cap
1	243	no sample obtained						Dredge and Cap
1	246	Silty Sand	7.0	80.8	12.2	4	2	Dredge and Cap
1	247	Sand with Gravel	42.3	55.4	2.3			Dredge and Cap
1	249	Sand with Silt	11.3	78.5	10.2	4	2	
1	252	Silty Sand	12.2	64.7	23.1	2	1	Dredge and Cap
1	253	Silty Sand with Gravel	20.1	30.6	49.3	15	11	Dredge and Cap
1	256	Silty Sand	3.0	54.4	42.6	9	6	
1	258	Silty Gravel with Sand	44.6	41.3	14.1	3	1	Dredge and Cap
1	259	Silty Gravel with Sand	45.9	42.0	12.1	4	2	Dredge and Cap
1	261	Silty Sand	0.0	80.0	20.0	6	3	
1	263	Sand with Silt and Gravel	27.7	63.8	8.5	3	1	Dredge and Cap
1	264	Silty Sand with Gravel	35.3	40.7	24.0	8	2	Dredge and Cap
1	265	Silty Sand with Gravel	20.5	57.6	21.9	5	3	Dredge and Cap
1	269	Silty Sand with Gravel	24.5	40.6	34.9	5	2	Dredge and Cap
1	270	Silty Sand with Gravel	25.9	37.6	36.5	9	5	Dredge and Cap
1	271	Silty Sand	10.7	51.4	37.9	8	4	Dredge and Cap
1	274	Sand with Silt	5.4	84.8	9.8	3	2	Dredge and Cap
1	275	No sample obtained						Dredge and Cap
1	276	Silty Sand	10.7	54.3	35.0	13	10	Dredge and Cap
1	277	Silty Sand with Gravel	15.3	53.8	30.9	15	9	Dredge and Cap
1	280	Sand with Silt and Gravel	26.3	63.6	10.1	4	2	
1	281	Silty Sand	14.0	65.7	20.3	6	4	Dredge and Cap
1	282	Silt with Sand	4.7	18.9	76.4	26	16	Dredge and Cap
1	283	Silt with Sand	4.2	22.5	73.3	24	12	Dredge and Cap
1	284	Silt with Sand	0.0	16.1	83.9	22	6	Dredge and Cap
1	288	Sandy Silt	0.5	48.8	50.7	15	7	Dredge and Cap

TABLE 8
GRAIN SIZE DATA FROM SELECT MACROPHYTE LOCATIONS
OCTOBER 2009

SMU Location	Location ID	Sample Description	Grain Size (ASTM D422) Percent Composition					Treatment
			Gravel	Sand	Fines (clay and silt)	Clay-sized Particle Content (0.005 mm)	Clay-sized Particle Content (0.002 mm)	
1	289	Silt	0.1	6.8	93.1	24	13	Dredge and Cap
7	290	Sandy Silt	2.3	29.1	68.6	16	10	Dredge and Cap
7	295	Sandy Silt	0.3	45.4	54.3	7	3	Dredge and Cap
7	296	Sandy Silt	0.0	47.1	52.9	6	3	Cap only
7	297	Silt with Sand	0.0	22.7	77.3	23	14	Cap only
7	303	Sand with Silt and Gravel	37.6	51.6	10.8	4	2	
7	304	Sand with Silt	1.0	89.6	9.4	2	0	Dredge and Cap
7	305	Silty Sand	0.0	75.0	25.0	6	4	Cap only
7	306	Sandy Silt	0.0	32.0	68.0	21	14	Cap only
7	312	Sand with Silt	14.1	75.5	10.4	3	3	
7	314	Silty Sand	0.0	84.3	15.7	2	1	Dredge and Cap
7	315	Sand with Silt	0.0	90.9	9.1	3	1	Dredge and Cap
7	316	Silty Sand	1.0	86.3	12.7	5	3	Cap only
7	317	Sand with Silt	2.4	86.2	11.4	3	1	Cap only
7	325	Silty Sand	0.0	86.8	13.2	4	2	Dredge and Cap
7	326	Sand with Silt	0.0	90.5	9.5	2	1	Dredge and Cap
6	327	Sand with Silt	0.3	91.9	7.8	1		Dredge and Cap
6	328	Sand with Silt	0.1	91.0	8.9	2	1	Cap only
6	329	Silty Sand	1.7	72.1	26.2	8	5	Cap only
6	337	Gravel with Silt and Sand	45.9	44.5	9.6	4	1	
6	339	Sand with Silt	2.5	91.0	6.5	2	2	Dredge and Cap
6	340	Sand with Silt	2.1	91.3	6.6	3	1	Dredge and Cap
6	341	Sand with Silt	0.5	89.9	9.6	2	1	Dredge and Cap
6	342	Silty Sand	0.2	86.7	13.1	3	2	Cap only
6	343	Sandy Silt	0.5	45.2	54.3	12	9	Cap only
6	358	Sand with Silt	1.2	89.2	9.6	3	1	Dredge and Cap
6	359	Sand with Silt	0.2	91.6	8.2	1	1	Dredge and Cap
6	360	Silty Sand	1.3	66.5	32.2	10	7	Dredge and Cap
6	363	Silty Sand	5.3	60.2	34.5	13	8	Cap only
6	364	Silty Sand	1.4	61.5	37.1	14	9	Cap only
6	365	Silty Sand	1.4	72.4	26.2	7	4	Cap only
6	369	Silty Sand	2.5	62.0	35.5	10	7	Cap only
5	371	Gravel with Sand	66.4	30.4	3.2	1	0	
6	373	Sand with Silt	0.0	90.8	9.2	2	1	Dredge and Cap
6	374	Sand with Silt	0.0	90.2	9.8	3	1	Dredge and Cap

TABLE 8
GRAIN SIZE DATA FROM SELECT MACROPHYTE LOCATIONS
OCTOBER 2009

SMU Location	Location ID	Sample Description	Grain Size (ASTM D422) Percent Composition					Treatment
			Gravel	Sand	Fines (clay and silt)	Clay-sized Particle Content (0.005 mm)	Clay-sized Particle Content (0.002 mm)	
6	375	Sand with Silt	0.0	90.6	9.4	3	2	Dredge and Cap
6	376	Sand with Silt	0.1	92.0	7.9	2	2	Dredge and Cap
6	377	Sand with Silt	0.0	91.4	8.6	2	2	Dredge and Cap
6	378	Silty Sand	0.5	86.6	12.9	4	1	Dredge and Cap
6	379	Sandy Silt	1.5	45.4	53.1	19	11	Cap only
6	380	Silt with Sand	0.7	13.1	86.2	22	17	Cap only
6	381	Silty Sand	0.8	51.2	48.0	12	7	Cap only
6	382	Silty Sand	12.1	56.4	31.5	13	9	Cap only
6	386	Sand	0.0	87.5	12.5	2	1	
6	388	Sand with Silt	0.1	90.1	9.8	4	1	Dredge and Cap
6	389	Silty Sand	0.0	88.0	12.0	4	2	Dredge and Cap
6	390	Sand with Silt	0.5	89.2	10.3	3	2	Dredge and Cap
6	391	Silty Sand	4.2	75.5	20.3	7	6	Dredge and Cap
6	392	Silt with Sand	0.1	23.5	76.4	20	12	Dredge and Cap
6	393	Silty Sand	11.2	48.0	40.8	12	9	

Notes:
1. Samples were collected with a petite ponar at mudline. Sample was unobtainable at three locations as indicated.
2. Empty entries in clay-sized particle content columns indicate hydrometer tests were not performed due to insufficient fines.

TABLE 9

TAXA IDENTIFIED FROM WADING POOLS IN MAY 2009

Order	Family	Genus	Species
Trichoptera	Hydroptilidae	*Hydroptila*	
	Leptoceridae	*Oecetis*	
Diptera	Chironomidae	*Chironomini*	
		Chironomus	
		Cryptochironomus	
		Dicrotendipes	
		Polypedilum	
		Microspectra	
		Paratanytarsus	
		Tanytarsus	
		Orthocladiinae	
		Cricotopus	
		Metrocnemius	
		Tanypodinae	
		Procladius	
Amphipoda	Gammaridae	*Gammarus*	
	Talitridae	*Hyalella*	
Isopoda	Asellidae	*Caecidotea*	
Bivalvia	Dreissenoidea	*Dreissena*	*polymorpha*
			rostriformis-bugensis
	Sphaeridae	*Musculium*	
		Pisidium	
Gastropoda	Hydrobiidae	*Amnicola*	*limosa*
	Lymnaeidae	*Fossaria*	
	Physidae	*Physa*	
	Planorbidae	*Gyralus*	*circumstriatus*
	Valvatidae	*Valvata*	*bicarinata*
			Tricarinata
Oligochaeta	Enchytraeidae		
	Lumbriculidae		
	Naididae		
	Tubificidae		
Hydrachnidia			
Hirudinea			
Platyhelminthes			

TABLE 10
SAWMILL CREEK SUMMARY OF INVERTEBRATES IN WADING POOLS, MAY 2009

Shallow (S) or Deep (D) Pool	**S**	**S**	**S**	**S**	**D**	**D**	**D**	**D**	**D**	**S**	**S**	**S**	**S**	**S**	**D**	**D**	**D**	**D**
Substrate Type	**Snd**	**Snd/Grvl**	**Grvl/Cbl**	**Grvl/Cbl**	**Snd**	**Snd**	**Snd/Grvl**	**Snd/Grvl**	**Grvl/Cbl**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**
Replicate	2	2	1	3	1	3	2	3	3	1	2	3	4	5	1	2	3	4
Number of Organisms																		
Lepidoptera	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	1	0	0
Odonata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	0	0	3	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Diptera (Chironomidae)	1	0	9	4	0	3	0	1	9	0	0	0	0	15	0	8	0	6
Amphipoda	8	2	17	1	18	10	37	5	2	18	26	26	14	2	11	35	2	75
Bivalvia	0	0	17	48	2	0	4	0	27	4	31	18	13	0	50	12	94	48
Gastropoda	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	8
Oligochaeta	0	0	6	0	6	5	7	0	2	0	0	0	20	9	25	11	4	6
Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hydrachnidia	15	0	0	4	0	0	0	1	0	14	0	8	0	0	0	0	0	0
Isopoda	0	0	1	0	3	0	3	2	1	1	2	2	2	0	0	0	0	7
Unknown pupae	0	1	5	1	0	0	0	1	1	0	1	0	0	0	3	1	0	0
Total Organisms	24	4	58	60	30	19	52	10	42	39	61	56	52	26	90	68	100	150
Percentage of Sample																		
Lepidoptera	0	0	0	0	0	0	2	0	0	0	2	4	0	0	0	1	0	0
Odonata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	0	0	5	2	3	0	0	0	0	0	0	0	0	0	1	0	0	0
Diptera (Chironomidae)	4	0	16	7	0	16	0	10	21	0	0	0	0	58	0	12	0	4
Amphipoda	33	50	29	2	60	53	71	50	5	46	43	46	27	8	12	51	2	50
Bivalvia	0	25	29	80	7	0	8	0	64	10	51	32	25	0	56	18	94	32
Gastropoda	0	0	0	0	0	0	0	0	0	5	0	0	4	0	0	0	0	5
Oligochaeta	0	0	10	0	20	26	13	0	5	0	0	0	38	35	28	16	4	4
Platyhelminthese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
Hydrachnidia	63	0	0	7	0	0	0	10	0	36	0	14	0	0	0	0	0	0
Isopoda	0	0	2	0	10	0	6	20	2	3	3	4	4	0	0	0	0	5
Unknown pupae	0	25	9	2	0	0	0	10	2	0	2	0	0	0	3	1	0	0

TABLE 11
BLOODY BROOK SUMMARY OF INVERTEBRATES IN WADING POOLS, MAY 2009

Shallow (S) or Deep (D) Pool	S	S	D	D	D	S	S	D	D	D
Substrate Type	**Snd**	**Grvl/Cbl**	**Snd/Gvl**	**Snd/Gvl**	**Grvl/Cbl**	**Control**	**Control**	**Control**	**Control**	**Control**
Replicate	1	1	1	2	3	1	2	1	2	3
Number of Organisms										
Lepidoptera	0	0	0	0	0	0	0	0	0	0
Odonata	0	0	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	0	0	0	0	0	0
Trichoptera	0	0	0	0	0	0	0	0	0	0
Diptera	16	9	2	5	12	19	8	5	2	0
Amphipoda	0	1	1	0	0	5	4	0	3	14
Bivalvia	17	6	5	12	11	2	13	9	38	40
Gastropoda	0	0	0	0	0	0	0	0	5	9
Oligochaeta	23	4	15	0	22	33	3	4	2	0
Platyhelminthes	0	0	0	0	0	0	0	0	2	0
Hirudinea	0	0	0	0	0	0	0	0	0	1
Hydrachnidia	0	0	0	0	0	0	0	0	0	0
Isopoda	0	0	0	0	0	0	7	0	0	0
Unknown pupae	6	0	0	1	0	0	0	0	2	0
Total organisms	62	20	23	18	46	59	35	18	54	64
Percentage of Sample										
Lepidoptera	0	0	0	0	0	0	0	0	0	0
Odonata	0	0	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	0	0	0	0	0	0
Trichoptera	0	0	0	0	0	0	0	0	0	0
Diptera	26	45	9	28	26	32	23	28	4	0
Amphipoda	0	5	4	0	0	8	11	0	6	22
Bivalvia	27	30	22	67	24	3	37	50	70	63
Gastropoda	0	0	0	0	0	0	0	0	9	14
Oligochaeta	37	20	65	0	48	56	9	22	4	0
Platyhelminthes	0	0	0	0	0	0	0	0	4	0
Hirudinea	0	0	0	0	0	0	0	0	0	2
Hydrachnidia	0	0	0	0	0	0	0	0	0	0
Isopoda	0	0	0	0	0	0	20	0	0	0
Unknown pupae	10	0	0	6	0	0	0	0	4	0

TABLE 12
NINEMILE CREEK SUMMARY OF INVERTEBRATES IN WADING POOLS, MAY 2009

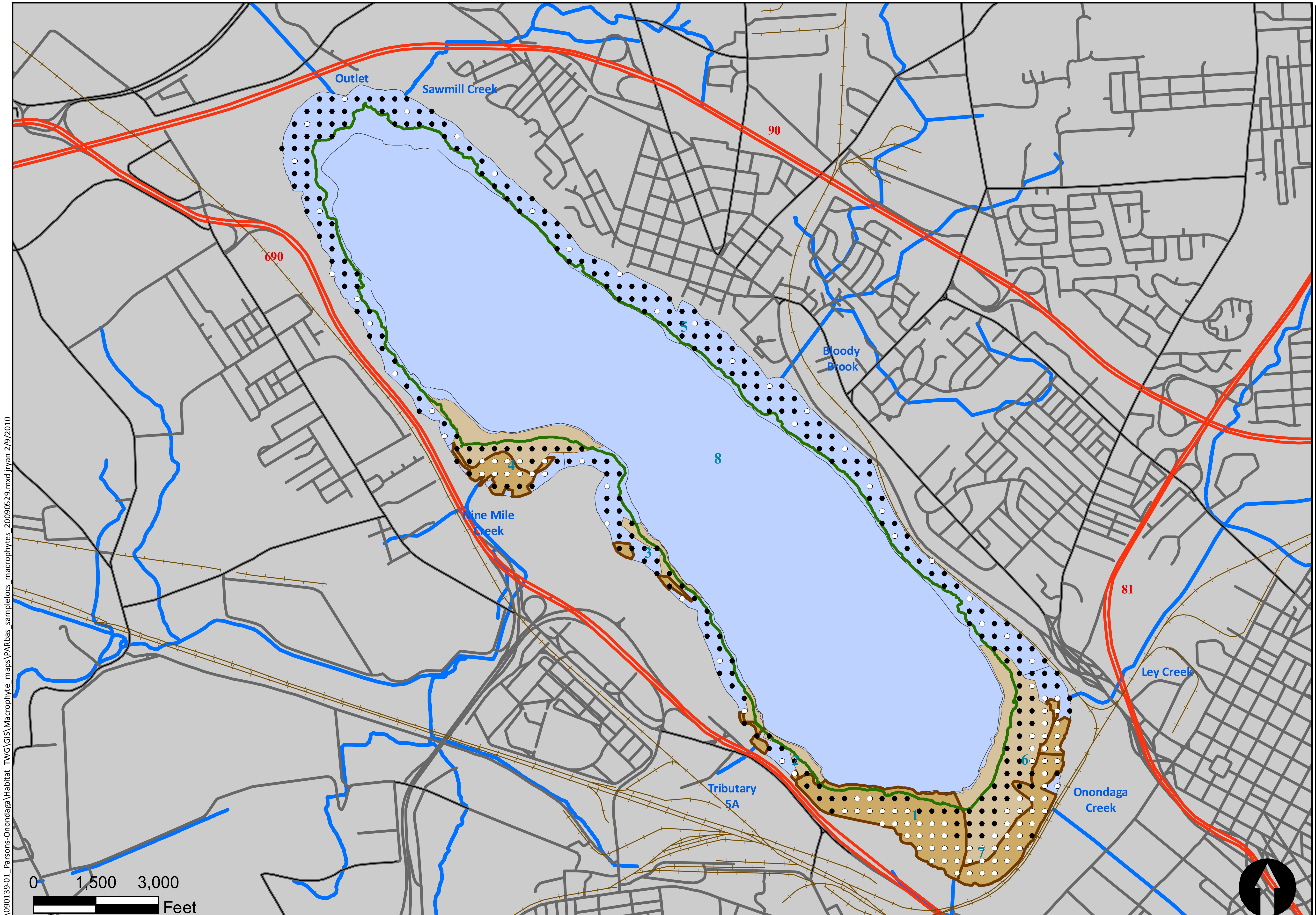
Shallow/Deep	**S**	**S**	**S**	**S**	**S**	**D**	**D**	**D**	**D**	**S**	**S**	**S**	**S**	**S**	**D**	**D**	**D**	**D**
Substrate Type	**Snd**	**Snd**	**Snd/Grvl**	**Snd/Grvl**	**Grvl/Cbl**	**Snd**	**Snd/Grvl**	**Grvl/Cbl**	**Grvl/Cbl**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**	**Control**
Replicate	**1**	**3**	**2**	**3**	**3**	**1**	**3**	**1**	**2**									
Number of Organisms																		
Lepidoptera	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0
Odonata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	3	37	32	33	25	61	4	9	30	10	18	11	24	39	15	4	22	18
Amphipoda	10	9	3	1	1	33	0	32	4	4	0	0	0	2	11	7	28	22
Bivalvia	0	0	3	4	16	12	13	37	7	1	1	6	3	2	4	78	13	20
Gastropoda	0	0	0	0	0	0	0	1	0	0	13	0	0	0	2	2	3	8
Oligochaeta	26	13	9	8	12	7	0	0	0	0	25	6	32	30	12	8	21	15
Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hydrachnidia	0	0	0	0	0	0	0	0	0	8	0	3	2	0	0	0	0	0
Isopoda	0	0	0	0	1	2	0	7	0	0	0	5	0	0	0	0	3	0
Unknown pupae	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Total organisms	40	59	48	46	59	117	17	86	41	23	57	31	61	73	48	100	90	83
Percentage of Sample																		
Lepidoptera	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	1.0	0.0	0.0
Odonata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coleoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Trichoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diptera	7.5	62.7	66.7	71.7	42.4	52.1	23.5	10.5	73.2	43.5	31.6	35.5	39.3	53.4	31.3	4.0	24.4	21.7
Amphipoda	25.0	15.3	6.3	2.2	1.7	28.2	0.0	37.2	9.8	17.4	0.0	0.0	0.0	2.7	22.9	7.0	31.1	26.5
Bivalvia	0.0	0.0	6.3	8.7	27.1	10.3	76.5	43.0	17.1	4.3	1.8	19.4	4.9	2.7	8.3	78.0	14.4	24.1
Gastropoda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	22.8	0.0	0.0	0.0	4.2	2.0	3.3	9.6
Oligochaeta	65.0	22.0	18.8	17.4	20.3	6.0	0.0	0.0	0.0	0.0	43.9	19.4	52.5	41.1	25.0	8.0	23.3	18.1
Platyhelminthes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hirudinea	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrachnidia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.8	0.0	9.7	3.3	0.0	0.0	0.0	0.0	0.0
Isopoda	0.0	0.0	0.0	0.0	1.7	1.7	0.0	8.1	0.0	0.0	0.0	16.1	0.0	0.0	0.0	0.0	3.3	0.0
Unknown pupae	0.0	0.0	2.1	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 13
SUMMARY OF TOC AND SOLIDS FOR SUBSTRATE SUITABILITY STUDY IN JUNE 2009

Site	Water Depth	Substrate	Sample Rep	TOC (mg/kg)	Lab Qualifier	Percent Solids
Bloody Brook	deep	gravel/cobble	1	33100		84.6
		gravel/cobble	3	15800		97
		sand	3	9810		82.6
	shallow	gravel/cobble	1	16800		87
Nine Mile Creek	deep	sand	1	8070		81.2
		sand	2	554	U	84
		sand	3	398	B	85.3
	shallow	sand	1	4810		86.4
		sand	2	283	B	78.2
		sand	3	4910		83.5
Sawmill Creek	deep	sand	2 (duplicate)	4360		85.3
		sand	1	2020		87.3
		sand	2	4440		86.6
		sand	3	532	U	87.4
		sand/gravel	2	16000		97.9
	shallow	sand	1	572	U	86.6
		sand	2	355	B	82.3
		sand	2 (duplicate)	10600		84.2
		sand	3	581	U	82.6

all samples collected June 11, 2009 (approx. 11 months following placement)
48 of 54 pools were sampled (6 pools moved and lost most of substrate at Bloody Brook site);
only pools with reportable results shown

FIGURES



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LOCATOR

LEGEND

- Community Samples
- Community and Biomass Samples*
- Railroad

Roads

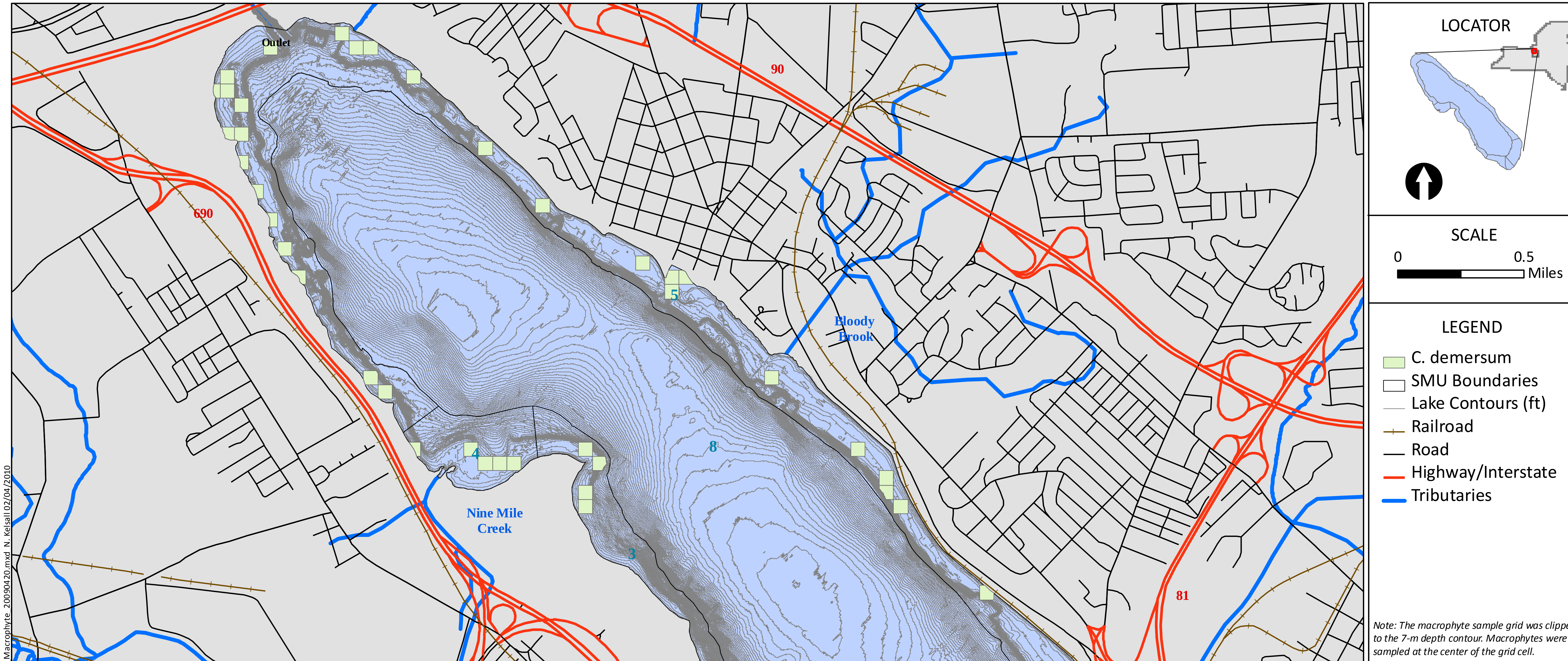
- Road
- Highway/Interstate
- Shore to 7m Bathymetry
- Drege and Cap Areas
- Cap Only
- SMU Boundaries
- Tributaries

Notes:
** Indicated as white dots on the map.*
Biomass samples were limited to areas shallower than 3 meters.

Figure 1.

Macrophyte Sampling Locations.
Honeywell/PARhwg
February 2010

Honeywell
PARSONS
ANCHOR QEA



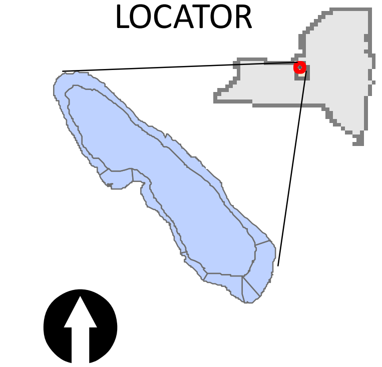
Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 2a.
Macrophyte sample grid results in Onondaga Lake in May 2009: Ceratophyllum demersum.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

H:\090139-01 Parsons-Onondaga\Habitat TWG\GIS\Macrophyte maps\May Macrophyte 20090420.mxd N. Kelsall 02/04/2010

LOCATOR



SCALE

0 0.5 Miles

LEGEND

E. canadensis
SMU Boundaries
Lake Contours (ft)
Railroad
Road
Highway/Interstate
Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 2b.
Macrophyte sample grid results in Onondaga Lake in May 2009:
Elodea canadensis.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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Figure 2c.
Macrophyte sample grid results in Onondaga Lake in May 2009: Heteranthera dubia.
Honeywell Inc./090139
February 2010

Honeywell
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ANCHOR QEA

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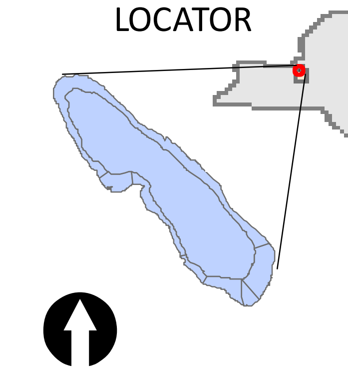

SCALE

0 0.5 Miles

LEGEND

- M. spicatum
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 2d.
Macrophyte sample grid results in Onondaga Lake in May 2009: Myriophyllum spicatum.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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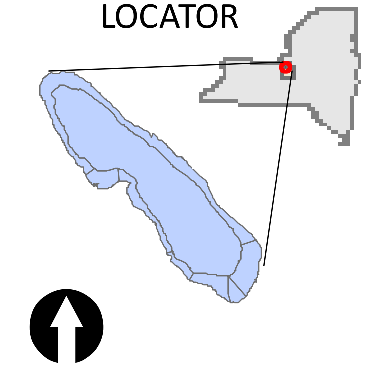
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- N. flexilis
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 2e.
Macrophyte sample grid results in Onondaga Lake in May 2009: Najas flexilis.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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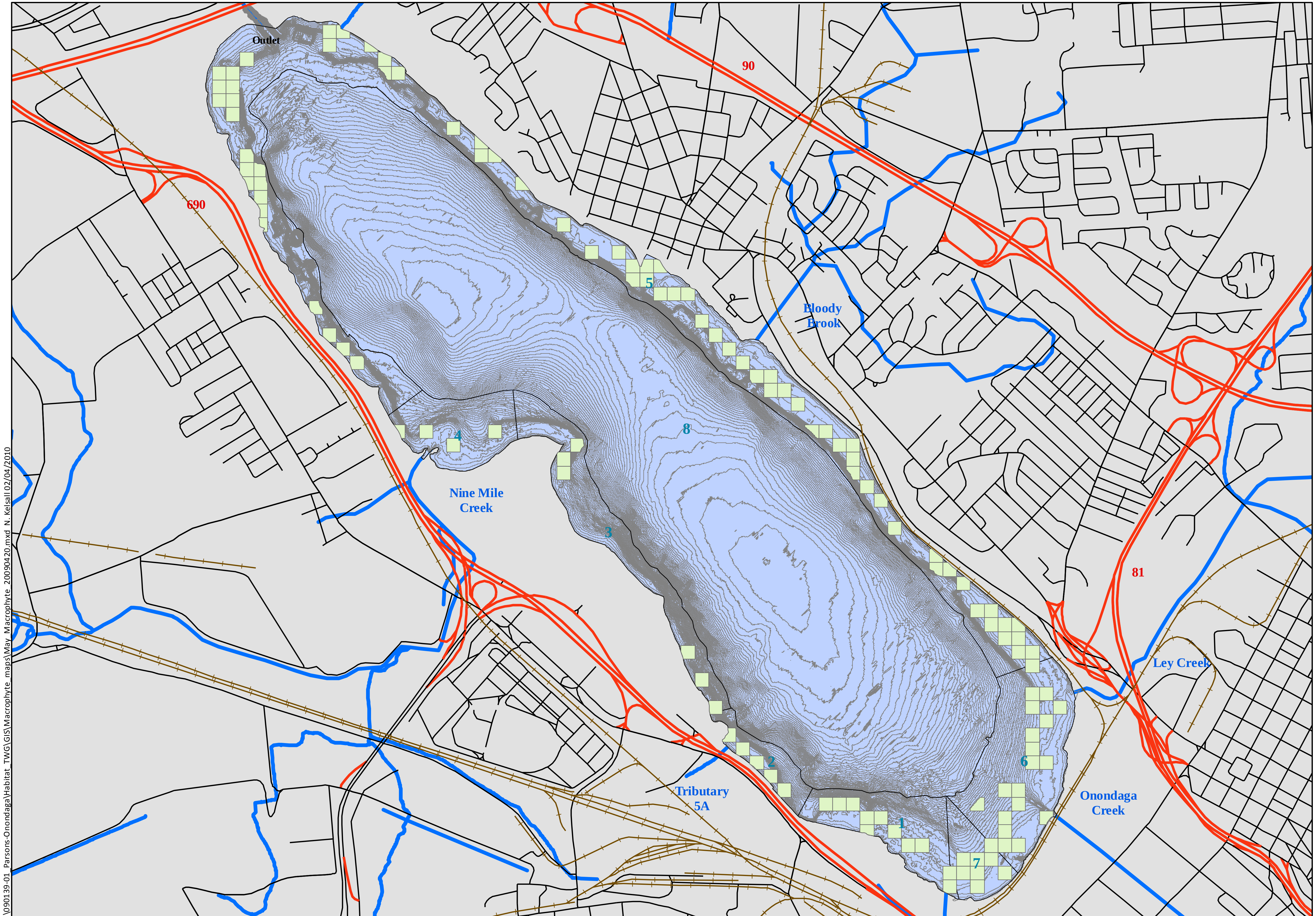
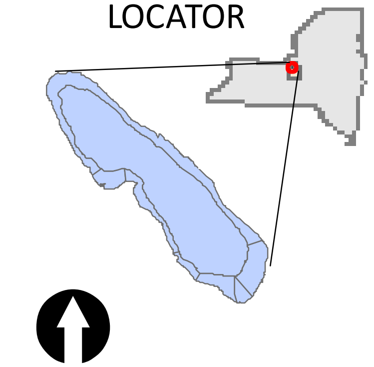


LOCATOR



SCALE

0 0.5 Miles

LEGEND

- P. crispus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 2f.
Macrophyte sample grid results in Onondaga Lake in May 2009: Potamogeton crispus.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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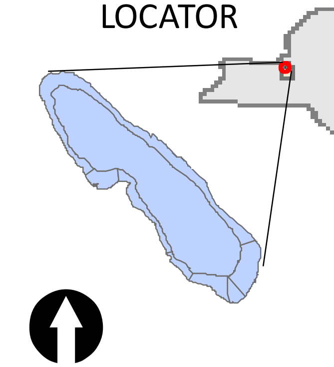
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- P. foliosus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 2g.
Macrophyte sample grid results in Onondaga Lake in May 2009: Potamogeton foliosus.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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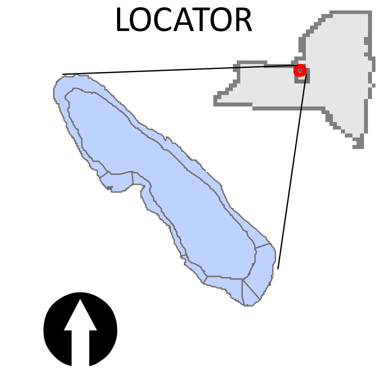
LOCATOR



SCALE

0 0.5 Miles

LEGEND

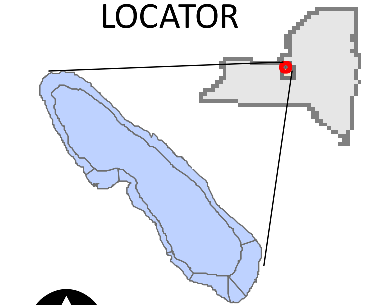
C. demersum
SMU Boundaries
Lake Contours (ft)
Railroad
Road
Highway/Interstate
Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3a.
Macrophyte sample grid results in Onondaga Lake in June 2009: Ceratophyllum demersum.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

LOCATOR



SCALE

0 0.5 Miles

LEGEND

- E. canadensis
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3b.
Macrophyte sample grid results in Onondaga Lake in June 2009:
Elodea canadensis.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3c.
Macrophyte sample grid results in Onondaga Lake in June 2009: Heteranthera dubia.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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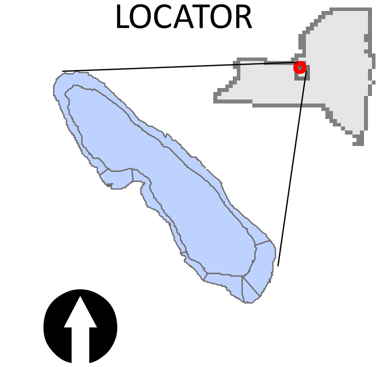
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- M. spicatum
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3d.
Macrophyte sample grid results in Onondaga Lake in June 2009: Myriophyllum spicatum.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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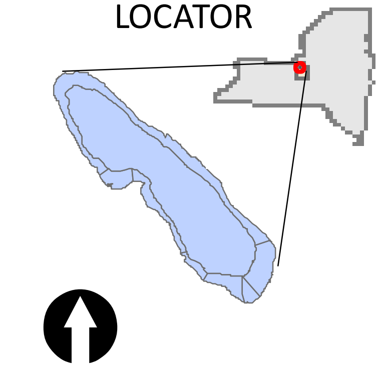
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- N. flexilis
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3e.
Macrophyte sample grid results in Onondaga Lake in June 2009:
Najas flexilis.
Honeywell Inc./090139
February 2010

Honeywell
PARSONS
ANCHOR QEA

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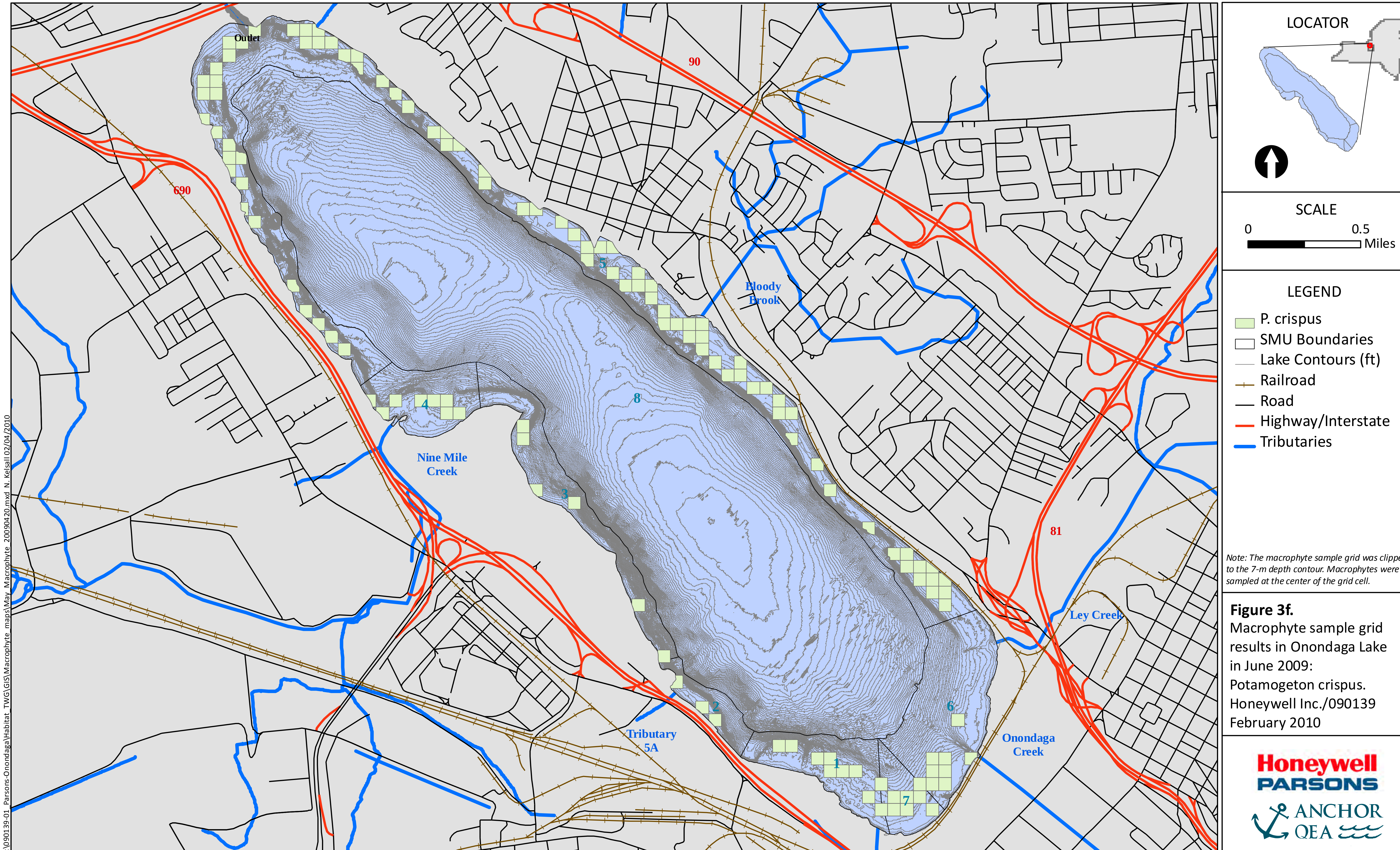

LEGEND

- P. crispus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3f.
Macrophyte sample grid results in Onondaga Lake in June 2009: Potamogeton crispus.
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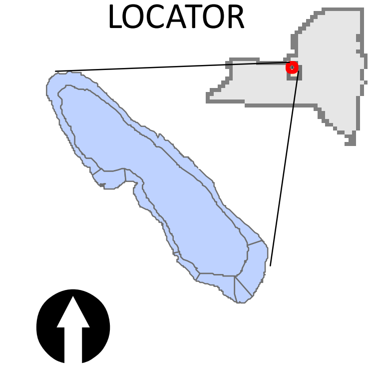
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- P. foliosus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 3g.
Macrophyte sample grid results in Onondaga Lake in June 2009: Potamogeton foliosus.
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Figure 3h.
Macrophyte sample grid results in Onondaga Lake in June 2009: Potamogeton pusillus.
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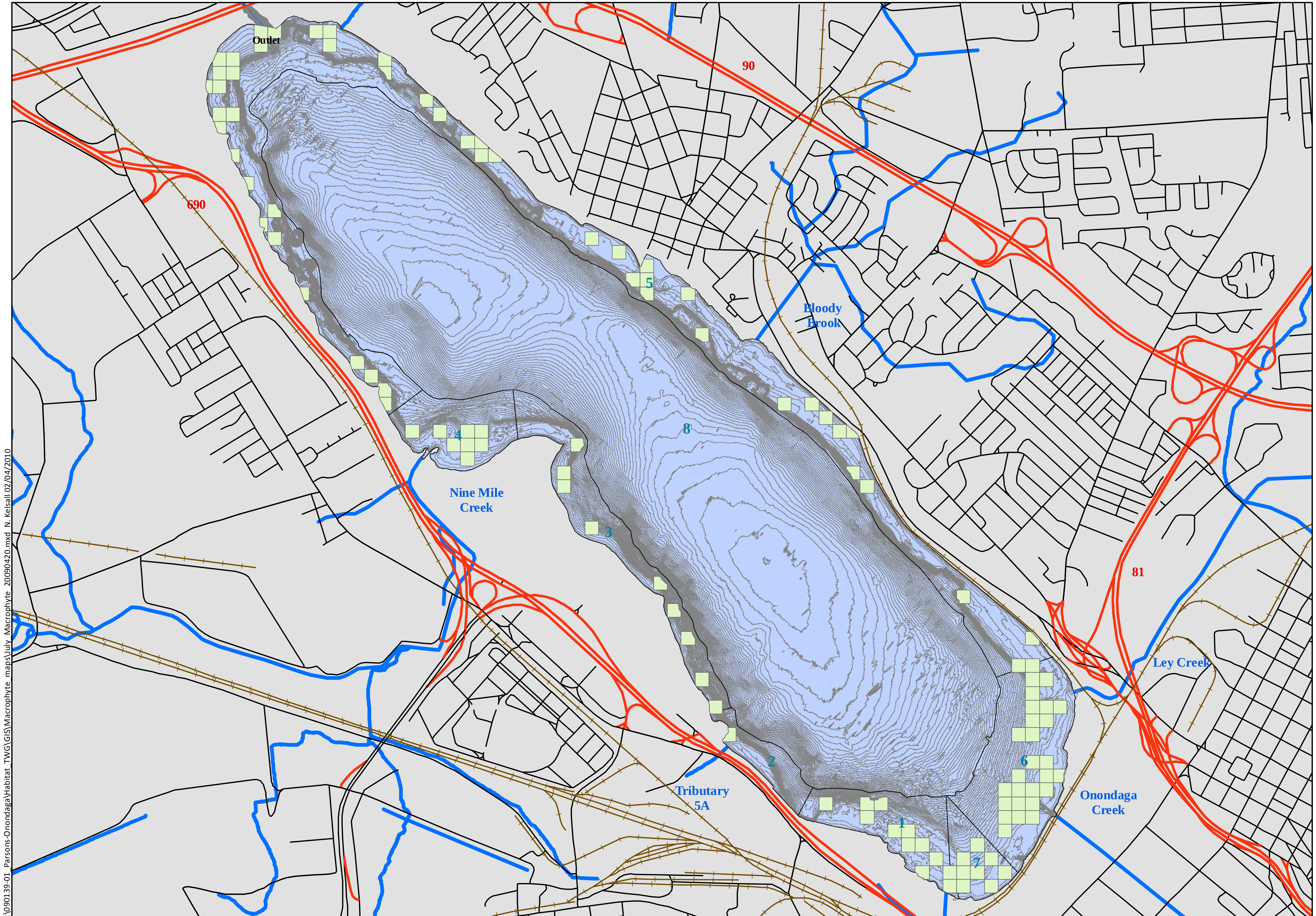

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4a.
Macrophyte sample grid results in Onondaga Lake in July 2009: Ceratophyllum demersum.
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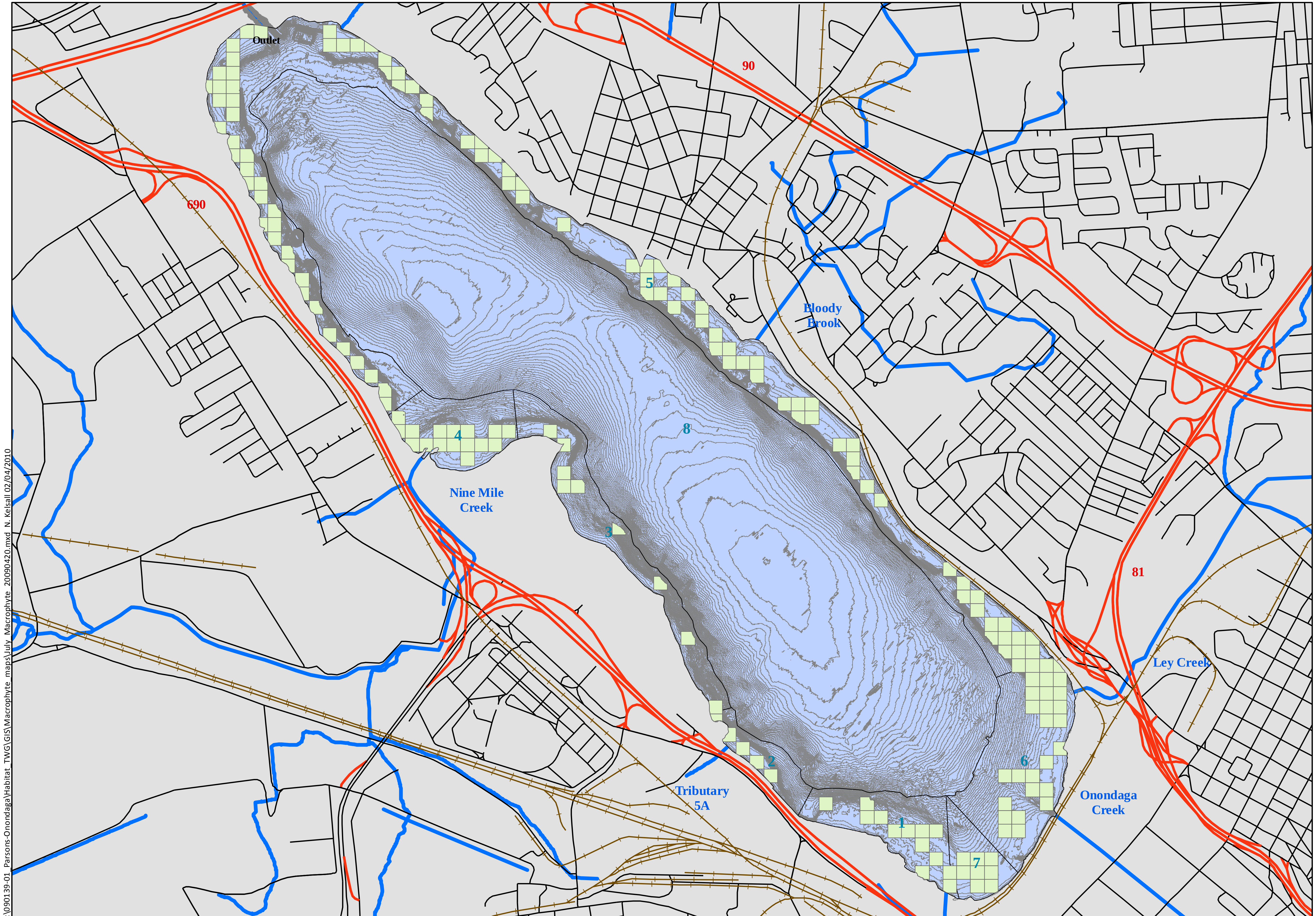

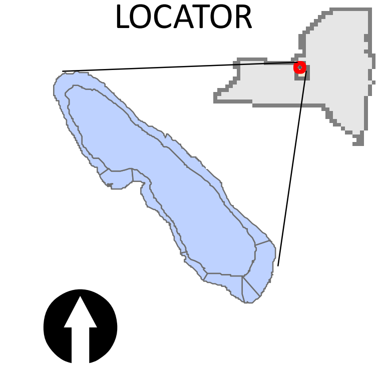

SCALE

0 0.5 Miles

LEGEND

- E. canadensis
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4b.
Macrophyte sample grid results in Onondaga Lake in July 2009:
Elodea canadensis.
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Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4c.
Macrophyte sample grid results in Onondaga Lake in July 2009: Heteranthera dubia.
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LOCATOR

SCALE

0 0.5 Miles

LEGEND

- L. minor
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4d.
Macrophyte sample grid results in Onondaga Lake in July 2009:
Lemna minor.
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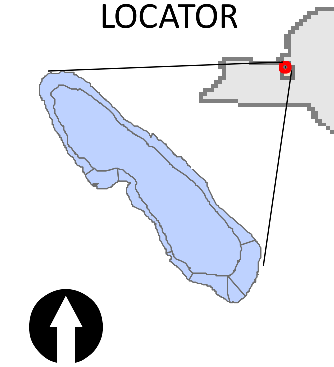
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- M. spicatum
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4e.
Macrophyte sample grid results in Onondaga Lake in July 2009: Myriophyllum spicatum.
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LOCATOR

SCALE

0 0.5 Miles

LEGEND

N. flexilis
SMU Boundaries
Lake Contours (ft)
Railroad
Road
Highway/Interstate
Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4f.
Macrophyte sample grid results in Onondaga Lake in July 2009:
Najas flexilis.
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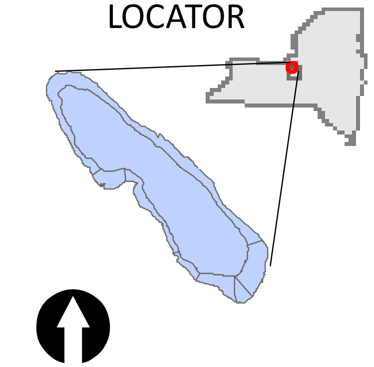

SCALE

0 0.5 Miles

LEGEND

- P. crispus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4g.
Macrophyte sample grid results in Onondaga Lake in July 2009: Potamogeton crispus.
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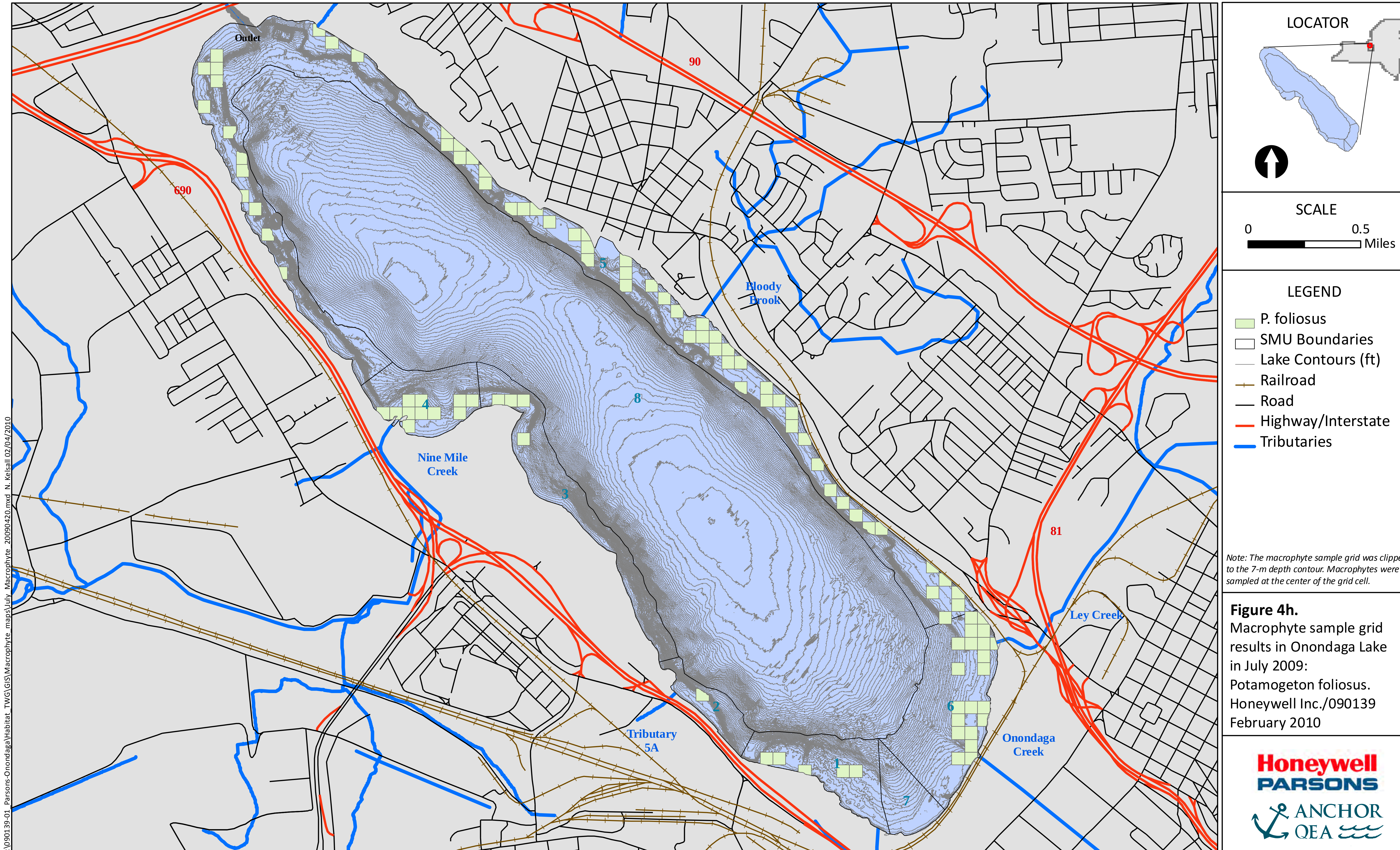

Figure 4h.
Macrophyte sample grid results in Onondaga Lake in July 2009: Potamogeton foliosus.
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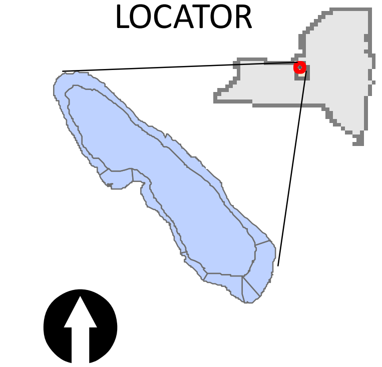
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- P. pusillus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 4i.
Macrophyte sample grid results in Onondaga Lake in July 2009: Potamogeton pusillus.
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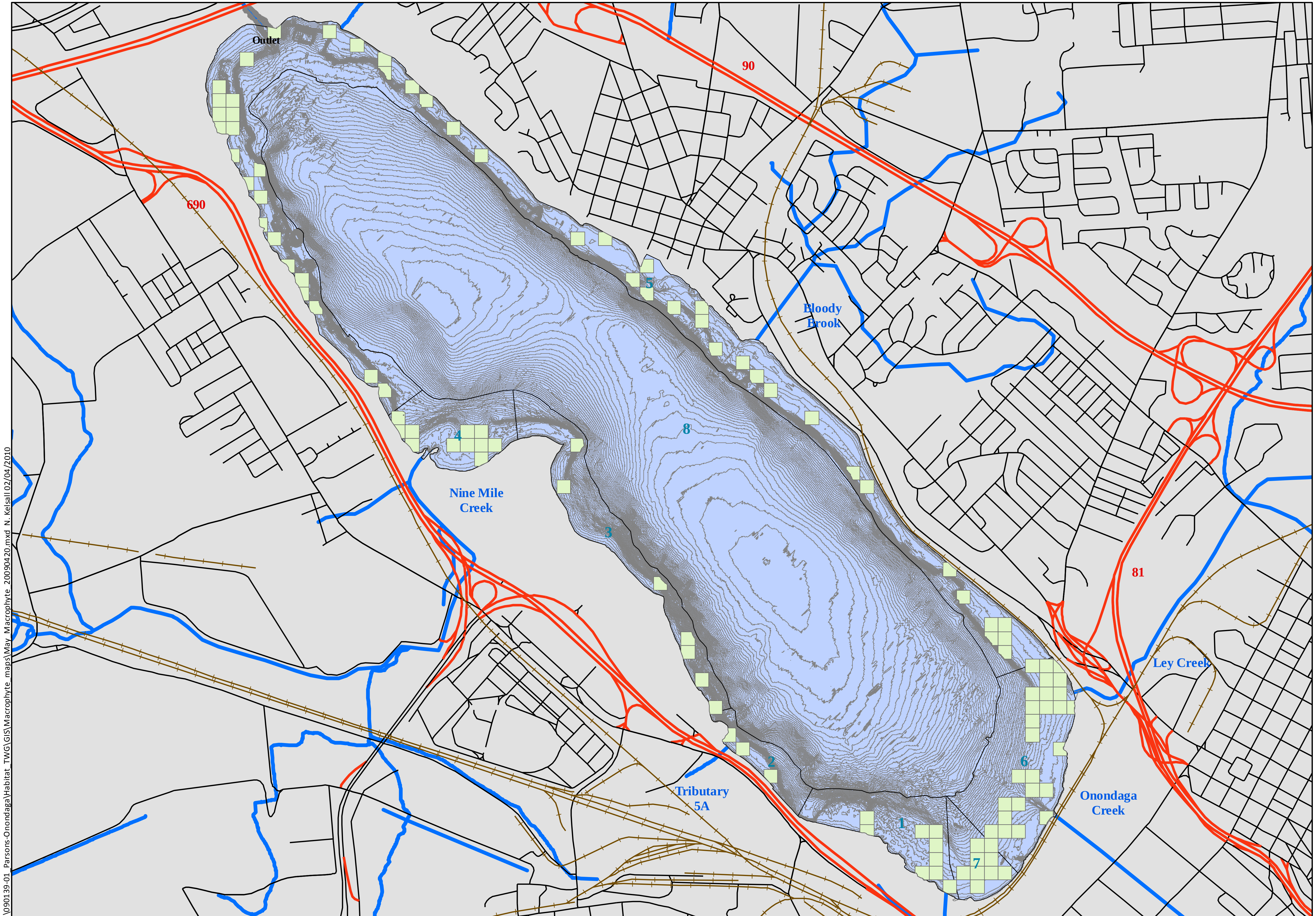

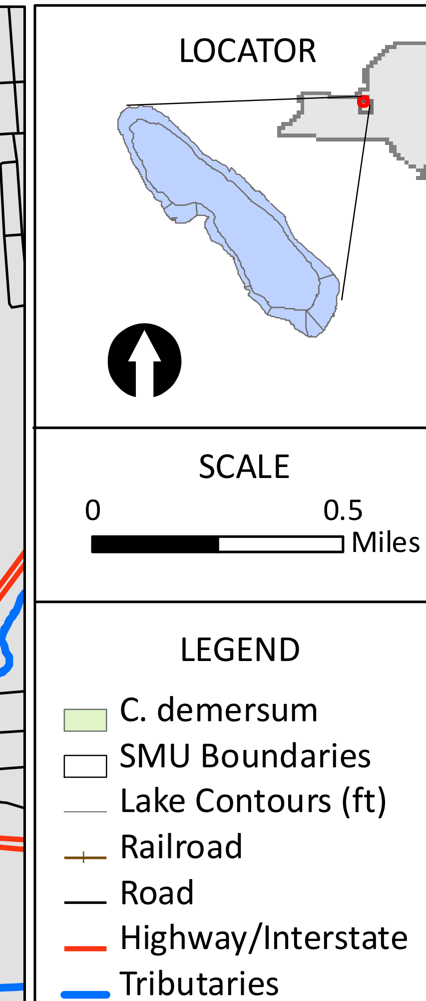

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5a.
Macrophyte sample grid results in Onondaga Lake in August 2009: Ceratophyllum demersum.
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Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5b.
Macrophyte sample grid results in Onondaga Lake in August 2009:
Elodea canadensis.
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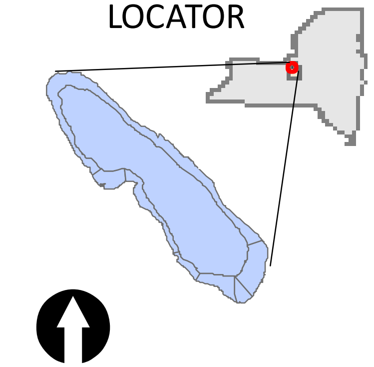

SCALE

0 0.5 Miles

LEGEND

- H. dubia
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5c.
Macrophyte sample grid results in Onondaga Lake in August 2009: Heteranthera dubia.
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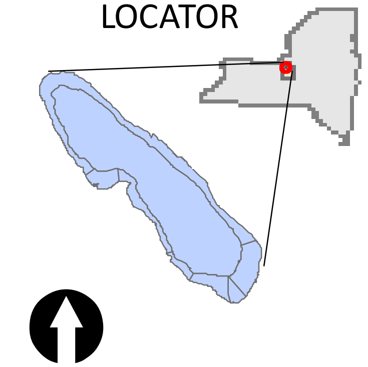

SCALE

0 0.5 Miles

LEGEND

- L. minor
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5d.
Macrophyte sample grid results in Onondaga Lake in August 2009: Lemna minor.
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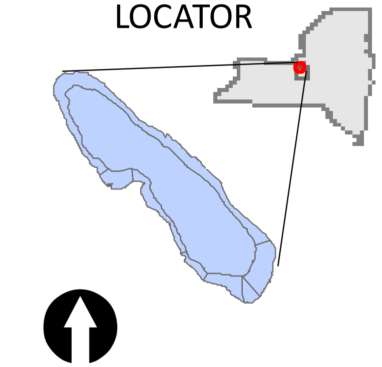
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- M. spicatum
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5e.
Macrophyte sample grid results in Onondaga Lake in August 2009: Myriophyllum spicatum.
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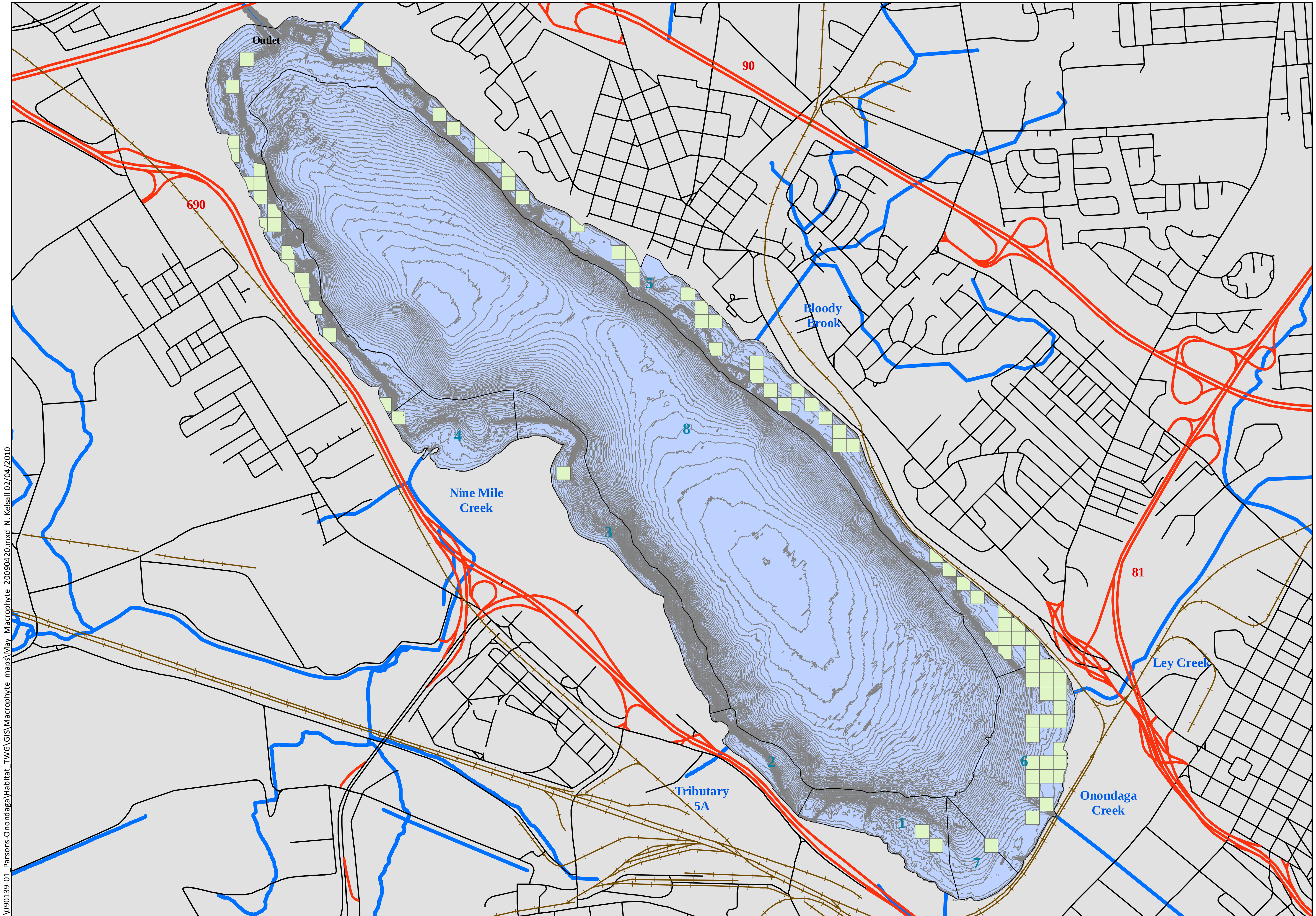

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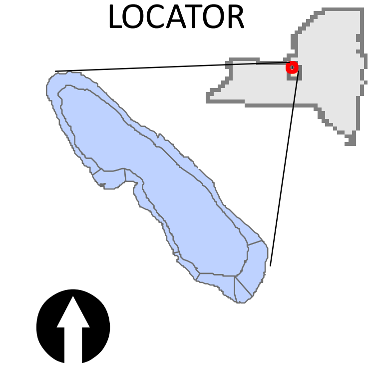

SCALE

0 0.5 Miles

LEGEND

- N. flexilis
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5f.
Macrophyte sample grid results in Onondaga Lake in August 2009: Najas flexilis.
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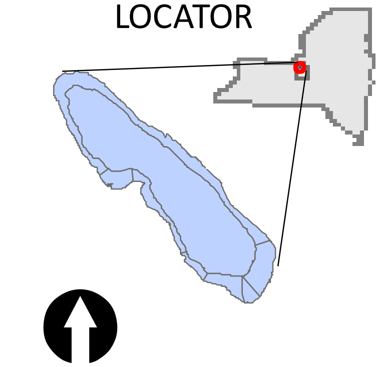

SCALE

LEGEND

- P. crispus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5g.
Macrophyte sample grid results in Onondaga Lake in August 2009: Potamogeton crispus.
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Figure 5h.
Macrophyte sample grid results in Onondaga Lake in August 2009: Potamogeton foliosus.
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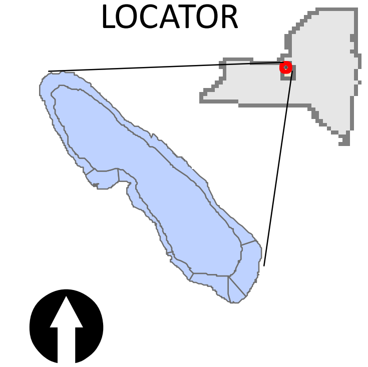
LOCATOR



SCALE

0 0.5 Miles

LEGEND

- P. pusillus
- SMU Boundaries
- Lake Contours (ft)
- Railroad
- Road
- Highway/Interstate
- Tributaries

Note: The macrophyte sample grid was clipped to the 7-m depth contour. Macrophytes were sampled at the center of the grid cell.

Figure 5i.
Macrophyte sample grid results in Onondaga Lake in August 2009: Potamogeton pusillus.
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