Honeywell

Onondaga Lake

Remedial Design Elements for Habitat Restoration

December 2009

DRAFT

Table of Contents

List of Acronyms **6**

Executive Summary **8**

Section 1: Introduction to the Habitat Plan **18**

1.1 General Description of Habitat Restoration at the Onondaga Lake NPL Site 19

1.2 Habitat Design Background 20

1.3 Areas Requiring Remediation or Habitat Enhancement – Establishing a Framework 21

1.4 Consent Decree and Record of Decision (ROD) Requirements 23

1.5 Goals of the Habitat Plan 25

1.6 Organization of the Habitat Plan 26

Section 2: Conditions in Onondaga Lake **28**

2.1 Summary of Historical Conditions 28

2.2 Changes from Historical Conditions around Onondaga Lake 30

2.3 Existing Habitats 39

2.4 Existing Biological Communities 60

2.5. Summary of Onondaga Lake Conditions 73

Section 3: Effects of Remediation on Onondaga Lake Habitat **74**

3.1 Onondaga Lake Bottom Remedy Expected Effects 78

3.2 Interim Remedial Measures 82

3.3 Other Remediation Sites 87

3.4 Mitigation Requirements 91

3.5 Summary of Habitat Areas to be Affected by Remediation Activities 92

Section 4: Identification of Habitats for Restoration **93**

4.1 General Restoration Goals 93

4.2 Assessing Habitat Conditions 94

4.3 Habitat Restoration Objectives 94

4.4 Identification of Representative Habitats and Associated Species Requirements 96

4.5 Habitat Module Development 102

4.6 Habitat Module Species Use 106

4.7 Existing Conditions Illustrated as Modules 110

Table of Contents (cont.)

Section 5: Preliminary Designs for Lakewide Habitat Restoration 111

5.1 Generation of Restoration Approach 111

5.2 Habitat Layer Characteristics and Thickness 113

5.3 Application of Habitat Modules to Remediation Areas..... 116

5.4 Suitability of Remediation Areas for Representative Species.... 127

5.5 General Specifications for Habitat Restoration..... 131

5.6 Summary of Habitat Restoration Design 135

Section 6: References 136

Tables

Executive Summary

Table ES.1: Habitat Module Characteristics – Onondaga Lake Remedial Design Program

Section 1

Table 1.1: ARARs and TBCs that Pertain to Habitat and Species Considerations

Section 2

Table 2.1: Changes to Level of Onondaga Lake

Table 2.2: Onondaga Lake Elevations, 1970 - 2009

Table 2.3: Delineated Wetlands within the Habitat Plan Boundary

Section 3

Table 3.1: Preliminary Estimate of Areas Impacted by Onondaga Lake Remedy

Table 3.2: Wetland, Open Water, and Upland Acreage Assessment within the Habitat Plan Boundary

Section 4

Table 4.1: Summary of Physical and Biological Factors in Habitat Design for Fish

Table 4.2a: Overview of Physical and Biological Factors in Habitat Designs for Aquatic Plants

Table 4.2b: Phenology Information for Selected Aquatic Plants

Table 4.3: Summary of Physical and Biological Factors in Habitat Designs for Benthic Macroinvertebrates

Table of Contents (cont.)

Tables (cont.)

Table 4.4: Summary of Physical and Biological Factors in Habitat Designs for Mammals

Table 4.5: Summary of Physical and Biological Factors in Habitat Designs for Amphibians

Table 4.6: Summary of Physical and Biological Factors in Habitat Designs for Reptiles

Table 4.7: Summary of Physical and Biological Factors in Habitat Designs for Birds

Table 4.8: Onondaga Lake Remedial design Program Habitat Module Characteristics

Table 4.9: Summary of Acreages within the Areas of Remediation

Section 5

Table 5.1: Summary of Parameters for Onondaga Lake Cap Design

Table 5.2: Summary of Potential Locations for Representative Species within Remedial Areas of Onondaga Lake

Figures

Executive Summary

Figure ES.1: Habitat Module Application (Remediation Area A)

Figure ES.2: Habitat Module Application (Remediation Area B)

Figure ES.3: Habitat Module Application (Remediation Area C)

Figure ES.4: Habitat Module Application (Remediation Area D)

Figure ES.5: Habitat Module Application (Remediation Area E)

Section 1

Figure 1.1: Onondaga Lake Area and NPL Subsites

Figure 1.2: Surface Water Designations and Wave Energy

Section 2

Figure 2.1: Changes in Lake Level

Figure 2.2: Land Use/Land Cover (2001)

Figure 2.3: National Wetlands Inventory Habitats Associated With Onondaga Lake

Figure 2.4: Ninemile Creek Wetlands

Figure 2.5: Onondaga Lake Watershed

Figure 2.6: 2000 and 2008 Aquatic Plant Coverage

Table of Contents (cont.)

Figures (cont.)

Section 3

Figure 3.1: Remediation Areas A and F – Dredge and Cap Areas

Figure 3.2: Remediation Areas B, C, D, and E – Dredge and Cap Areas

Figure 3.3: Willis-Semet, East Flume, and Wastebed B/Harbor Brook IRMs

Figure 3.4: Wastebeds 1 through 8 Area

Figure 3.5: Dredge Spoils Area

Figure 3.6: Summary of Existing Wetland and Open Water Acreages

Figure 3.7: Summary of Restored Wetland and Open Water Acreages

Section 4

Figure 4.1: Existing Habitat Modules within the Habitat Plan Boundary

Figure 4.2: Existing Habitat Modules - Remediation Area A

Figure 4.3: Existing Habitat Modules - Remediation Area B & C

Figure 4.4: Existing Habitat Modules - Remediation Area D

Figure 4.5: Existing Habitat Modules - Remediation Area E

Section 5

Figure 5.1: Restored Habitat Module Application – Remediation Area A

Figure 5.2: Remediation Area A (SMU 4) – Section RAA-1

Figure 5.3: Remediation Area A (SMU 4) – Section RAA-2

Figure 5.4: Restored Habitat Module Application – Remediation Area B

Figure 5.5: Remediation Area B (SMU 3) – Section RAB-1

Figure 5.6: Restored Habitat Module Application – Remediation Area C

Figure 5.7: Remediation Area C (SMU 2) – Section RAC-1

Figure 5.8: Remediation Area C (SMU 2) – Section RAC-2

Figure 5.9: Restored Habitat Module Application – Remediation Area D

Figure 5.10: Remediation Area D (SMU 1) – Section RAD-1

Figure 5.11: Remediation Area D (SMU 1) – Section RAD-2

Figure 5.12: Remediation Area D (SMU 1) – Section RAD-3

Figure 5.13: Remediation Area D (SMU 1) – Section RAD-4

Figure 5.14: Restored Habitat Module Application–Remediation Area E

Figure 5.15: Remediation Area E (SMU 6/7) – Section RAE-1

Table of Contents (cont.)

Figures (cont.)

Figure 5.16: Remediation Area E (SMU 6/7) – Section RAE-2

Figure 5.17: Remediation Area E (SMU 6/7) – Section RAE-3

Figure 5.18: Conceptual Plan for Lower Harbor Brook and Adjacent Wetland Areas

Figure 5.19: Conceptual Profile of Harbor Brook and Adjacent Wetland Area

Figure 5.20: Change in Water Depth – Remediation Area A

Figure 5.21: Change in Water Depth – Remediation Area B

Figure 5.22: Change in Water Depth – Remediation Area C

Figure 5.23: Change in Water Depth – Remediation Area D

Figure 5.24: Change in Water Depth – Remediation Area E

Figure 5.25: Restored Habitat Substrate – Remediation Area A

Figure 5.26: Restored Habitat Substrate – Remediation Area B

Figure 5.27: Restored Habitat Substrate – Remediation Area C

Figure 5.28: Restored Habitat Substrate – Remediation Area D

Figure 5.29: Restored Habitat Substrate – Remediation Area E

Appendices

Appendix A: Amphibian and Reptiles Recorded in the Vicinity of Onondaga Lake

Appendix B: New York State Breeding Bird Atlas Results

Appendix C: Macrophyte Coverage Figures from Habitat Preliminary Design Investigation Report

Appendix D: Suitability of Restoration in Remediation Areas for Representative Species

Appendix E: Master List of Plants

List of Acronyms

AMP	Ambient Monitoring Program
ASLF	Atlantic States Legal Foundation
BAF	biological aerated filter system
BSQV	bioaccumulation-based sediment value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSO	combined sewer overflow
DNAPL	dense non-aqueous phase liquid
DSA	Dredge Spoils Area
EE/CA	Engineering Evaluation/Cost Analysis
ESD	explanation of significant differences
FEMA	Federal Emergency Management Association
FS	feasibility study
HRFS	high rate flocculated settling system
IBA	Important Bird Area
ILWD	in-lake waste deposit
IRM	Interim Remedial Measure
LCP	Linden Chemical and Plastics
MNR	monitored natural recovery
NAPL	non-aqueous phase liquid
NPL	National Priorities List
NWI	National Wetlands Inventory
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OCDWEP	Onondaga County Department of Water Environmental Protection
OEI	Onondaga Environmental Institute
OLMC	Onondaga Lake Management Conference
OLP	Onondaga Lake Partnership
OM&M	operations, maintenance & monitoring

List of Acronyms (cont.)

ROD	Record of Decision
SMU	sediment management unit
SOW	statement of work
SUNY ESF	State University of New York College of Environmental Science and Forestry
TES	Terrestrial Environmental Specialists
TWG	Technical Work Group
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USSCS	United States Soil Conservation Service
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
YOY	young-of-year

Executive Summary

Onondaga Lake
Syracuse, New York

Honeywell continues the progress toward achieving the community's vision of a restored Onondaga Lake with the development of this draft *Remedial Design Elements for Habitat Restoration* (Habitat Plan). The development of this plan, which is referenced in the *Remedial Design Work Plan* for Onondaga Lake, marks an important milestone in the continued revitalization of the lake. Habitat restoration goals and concepts will serve as a guide for future designs for the lake remediation.

Habitat is the physical and biological surroundings that comprise the natural environment of an organism. It is the area where plants and animals normally live, grow, feed, reproduce, and otherwise exist for any portion of their life cycle. These surroundings provide organisms or communities of organisms the necessary elements for life, such as space, food, water, and shelter. The restoration of habitat is an integral component of the overall remedy for Onondaga Lake and, in fact, is one of the most significant elements in the design for the dredging and/or capping activities specified for the lake.

Habitat considerations presented in this plan are at the forefront of the restoration designs for Onondaga Lake, and habitat restoration will continue to play a key role as the remedial activities are advanced. A sustainable habitat that allows for public access has been, and will continue to be, an integral part of the approach for restoring Onondaga Lake.

Largemouth Bass are a popular game fish in Onondaga Lake.

This Habitat Plan presents the conceptual habitat restoration and enhancement designs for Onondaga Lake in those portions of the lake where remediation activities will be conducted. Wherever possible, this design respects the natural processes and conditions to create suitable habitat for various species of plants, mammals, fish, benthic macroinvertebrates (bottom-dwelling organisms such as crayfish), birds, reptiles, and amphibians, while allowing for public access in and around the lake. Creating sustainable habitats while allowing for public access for recreation requires balance and this plan was developed with consideration for the complexities of these relationships in an effort to address the many needs of this unique resource.

Goals for Habitat Restoration in Onondaga Lake

Three overarching goals drive habitat restoration:

1) Maintain or improve the quality and diversity of habitat in the lake;
2) Discourage the establishment of invasive species; and
3) Promote public access and use and minimize future maintenance.

These goals focus on those areas, species, or processes (such as the function of the shallow water zone) that have been altered over time due to industrialization along the shoreline, and areas where physical changes will occur as a result of the remediation program.

AGENCY REPRESENTATIVES

NYSDEC

Honeywell TEAM

ESF State University of New York College of Environmental Science and Forestry

ANCHOR QEA

PARSONS

Terrestrial Environmental Specialists, inc.

O'BRIEN & GERE

MISSISSIPPI STATE UNIVERSITY

Local and national experts prepared this Draft Habitat Plan. Community input will continue to be sought from the Onondaga Nation and local interest groups.

Key benefits that result from this conceptual design include:

- integrating a diverse habitat design with considerations for public access;
- providing deep water nearshore for improved fishing access;
- increasing the size, diversity and function of shoreline wetlands and connectivity with the lake;
- creating conditions suitable for a variety of native and culturally significant species;
- discouraging the establishment of invasive species;
- promoting pike spawning in adjacent wetland areas;
- providing suitable conditions for transient cold water fish (e.g. brown trout) and other game fish (e.g. bass); and
- establishing habitats that are currently lacking in the lake (e.g. floating aquatic plants).

The Habitat Plan was developed by Honeywell with extensive input from members of the Habitat Technical Work Group (TWG) with input from multiple organizations that use the lake on a regular basis. This group was comprised of representatives from the New York State Department of Environmental Conservation (NYSDEC) Bureau of Remediation; NYSDEC Division of Fish, Wildlife and Marine Resources; United States Environmental Protection Agency (USEPA); United States Fish and Wildlife Service (USFWS); and Honeywell and its team from the State University of New York College of Environmental Science and Forestry (SUNY ESF), Mississippi State University, Terrestrial Environmental Specialists (TES), AnchorQEA, O'Brien & Gere, and Parsons. This extensive team of local and national experts encompasses experience in the areas of wetland ecology, limnology, biology, restoration ecology, fisheries biology and sediment remediation. Input was also provided by the Onondaga Nation and local interest groups during the preparation of this plan.

The TWG reviewed information on the historical and current conditions of Onondaga Lake to identify habitat types and species for which *specific* restoration objectives could be developed to meet the goals. Specifically, the habitats and species identified, such as the northern pike, existed historically within the lake, but are currently lacking, or those that currently exist within the lake, but are degraded (such as wetlands dominated by *Phragmites*).

To address the overarching goals and more specific objectives of the Habitat Plan, the TWG identified *representative* species from groups of fish, plants, benthic macroinvertebrates (organisms in the sediment), mammals, amphibians, reptiles, and birds whose habitat requirements could be used to guide the development of the restoration designs.

Semi-Palmated Sandpiper is a representative species for shorebirds.

The representative species *represent* a larger group or guild of species that share similar habitat requirements. For instance, the semi-palmated sandpiper represents shorebirds that would share similar habitats and needs for survival.

Representative Species						
Fish	**Aquatic Plants**	**Benthic Macro-Invertebrates**	**Mammals**	**Amphibians**	**Reptiles**	**Birds**
Northern Pike	Submerged Vegetation	Mayfly	Muskrat	Spotted Salamander	Northern Water Snake	Mallard
Lake Sturgeon	Floating Vegetation/ Aquatic Beds	Caddisfly	Mink	Mudpuppy	Snapping Turtle	Common Goldeneye
Smallmouth Bass	Nonpersistent Emergent Vegetation	True Flies	Otter	Leopard Frog	Painted Turtle	Spotted Sandpiper and Semi-palmated Sandpiper
Largemouth Bass	Persistent Emergent Vegetation	Dragonfly/ Damselfly	Beaver	Wood Frog	Musk Turtle	Bank Swallow
Walleye	Salt Marsh Vegetation	Scud	Indiana Bat	Green Frog		Red-winged Black Bird
Pumpkinseed Sunfish	Unvegetated Shoreline/ Mudflats	Crayfish		Red Spotted Newt		Common Tern
Golden Shiner	Wet Meadow Wetland					Belted Kingfisher
Emerald Shiner	Forested/Scrub-Shrub Wetlands					Osprey
Brown Trout	Forested Scrub-Shrub Uplands					Great Blue Heron
	Open Field Uplands					Green Heron

The habitat requirements for each representative species were then characterized using available Habitat Suitability Index Models (developed by the USFWS), the current literature, professional experience, and judgment gained from field observations. The TWG identified habitat requirements for various life stages of each species for the following physical parameters: water depth, substrate type, wave energy, structure-vegetation cover, structure-woody debris, rooting/burrowing depth, and where appropriate, various water quality parameters. The list of representative species is presented in the table below.

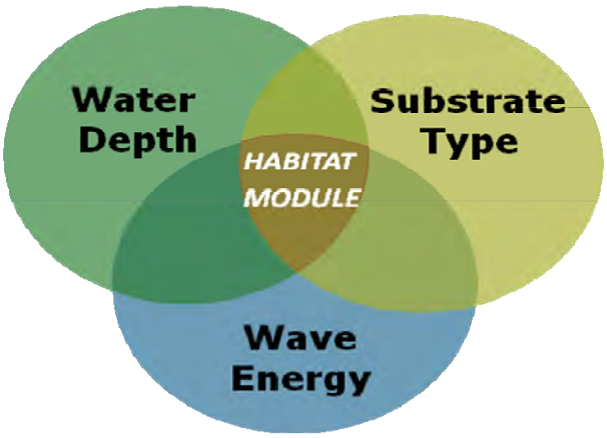
Designing the Habitat Plan

This wood frog represents other frogs that have the same habitat.

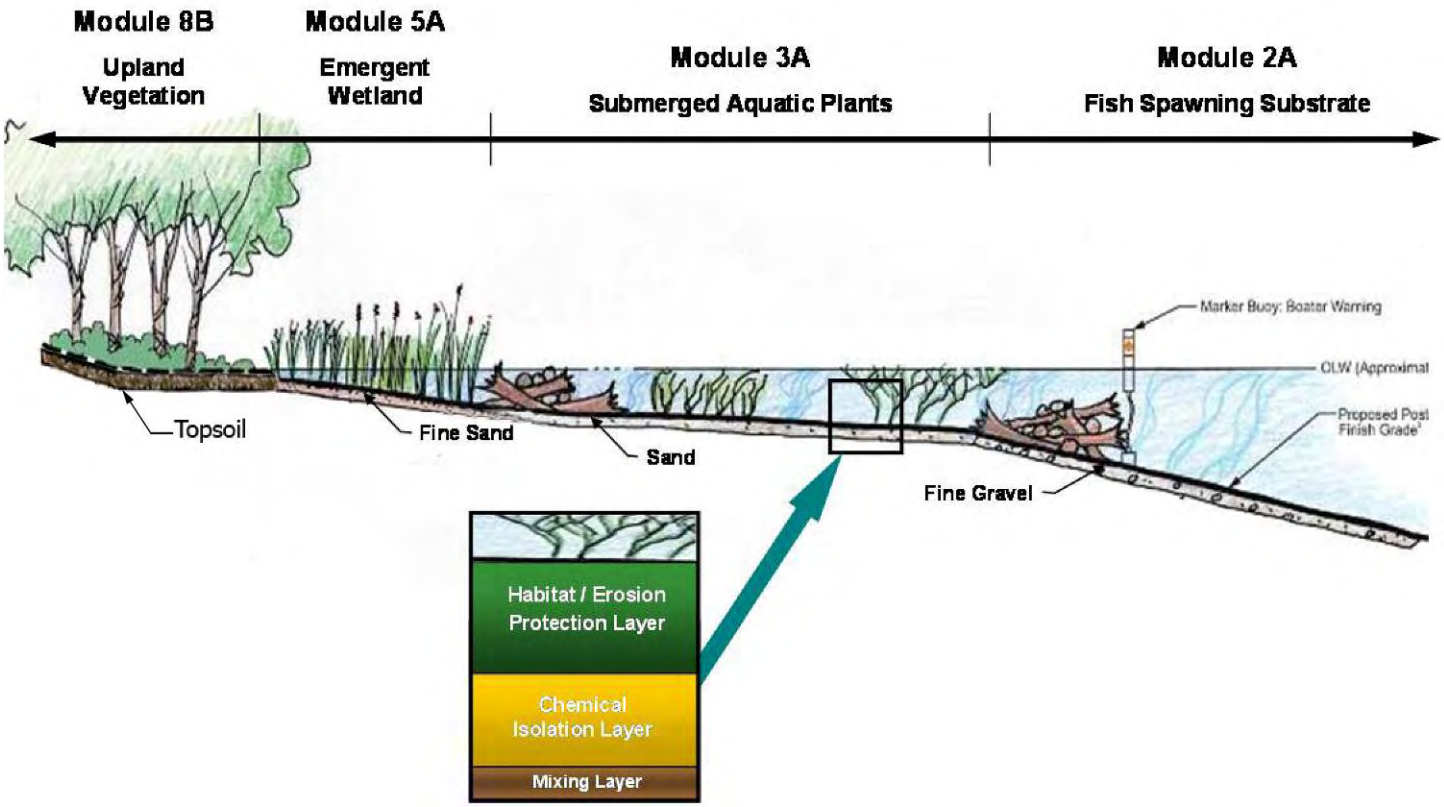
The TWG evaluated current habitat conditions, along with the selected or anticipated site remedies and interim remedial measures adjacent to the lake to identify the potential effects of remediation on existing habitats. Based on this evaluation, the TWG defined the boundary around the lake within which the conceptual habitat designs would be applied. This "red line" boundary was drawn to facilitate a holistic approach that integrates habitat restoration work *within* the lake with areas *adjacent* to the lake to provide habitat connectivity and transition areas.

Once the areas for the habitat designs were identified, the TWG reviewed historic and current conditions to identify representative species and habitat considerations. The habitat requirements for the representative species were then used to identify important factors such as current and future land use, topography (land surface), bathymetry (lake bottom surface), hydrology, and soils/substrate needed to support the various life cycles of the representative species and habitats.

Following the identification of the habitat requirements for each representative species, the TWG developed a method to combine the representative species and their habitat requirements into habitat areas, or "modules," which could be readily integrated with the remedial activities. The in-lake habitat modules are defined by three basic habitat parameters that serve as the basis for the habitat restoration design: water depth, substrate type, and energy. As shown in the figure below, a habitat module was developed where these three elements exist together, such as required for a particular representative species.



Using this method of analysis, the TWG developed seven in-lake modules, each with a specified water depth, energy, and substrate type to provide suitable habitat for the representative species. The modules are numbered starting from the deep waters of the lake to the shoreline areas addressed by this plan. Two additional upland modules were also developed based on elevation and the type of habitat cover in adjacent areas. A summary of each of the modules is included on Table ES-1. Each module has a different color, and those colors correspond to the figures illustrating the application of modules in the different remediation areas (Figures ES-1 through ES-5).

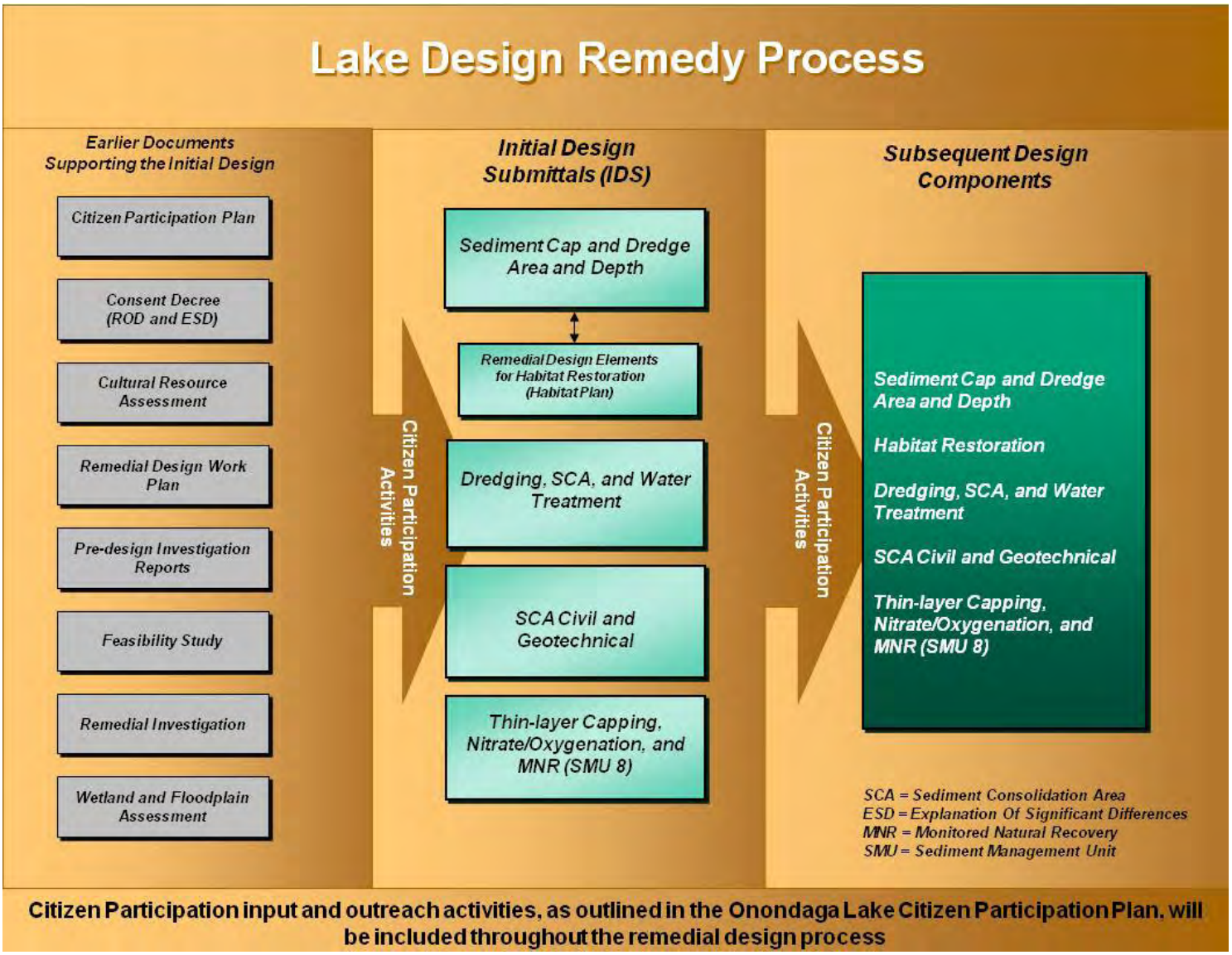


Each module provides suitable habitat for different species, and the combination of modules, applied throughout the areas of remediation, creates a diverse habitat for the group of representative species. Below is a diagram showing an example of how one module cross section may look when integrated with the cap design. In areas of the lake where dredging and/or capping will be conducted, the habitat goals and objectives noted above drive many of the design considerations. Included as part of these considerations is the goal of no net loss of lake surface area as specified in the ROD. Also, the water depth following restoration will be an important factor determining the habitat conditions that will be present in those areas. In order to achieve the desired water depth there are multiple considerations that are integral to the design. Several of those considerations include required thickness of the cap

and habitat materials, erosion protection requirements, wind/wave energy, ice scour, dredging depth, slope stability, and substrate type. These considerations, which can vary depending on the type of remedy and the location in the lake, were then used as guiding assumptions in developing the habitat restoration designs based on the habitat modules.

How does this Plan fit within the Lake Remedy?

This Habitat Plan is just one of several documents that will be provided to the public for comment as part of the comprehensive remedial design process for Onondaga Lake. The Remedial Design Work Plan describes the four design components, each of which will be documented in separate initial design submittals, to address various elements of the remedy. The design for habitat restoration presented in this Habitat Plan will be integrated with the remedial design presented in the forthcoming *Sediment Capping and Dredge Area and Depth* Initial Design Submittal. The figure below illustrates how this Habitat Plan fits within the various submittals for the Onondaga Lake remedial design.



A musk turtle basks on a shoreline log.

Public participation is a critical component of the overall lake remedy, and will continue throughout the entire schedule of design preparation and submittal. Over the past several years, the NYSDEC and Honeywell have solicited opinions and perspectives on this conceptual plan from local habitat conservation and environmental organizations such as Salt City Bassmasters, Izaak Walton League of America, Audubon Society, Ducks Unlimited, and Citizen's Campaign for the Environment.

NYSDEC and Honeywell are committed to continuing to work with community leaders, environmental groups, fishing and wildlife enthusiasts, interested stakeholders and citizens so their input, recommendations, comments, and perspectives can be thoroughly evaluated by the technical design team. As part of the NYSDEC Citizen Participation Plan, community members will have the opportunity to participate during the design, construction, and post-construction periods. Further details on citizen participation activities are outlined in NYSDEC's *Citizens Participation Plan* (NYSDEC, 2009).

History of Onondaga Lake

While Onondaga Lake is important to the present-day community, its significance began much earlier than the settling of what has become modern-day Syracuse.

Statement of Onondaga Nation[1]

Onondaga Lake is the spiritual, cultural and historic center of the Haudenosaunee Confederacy. Over one thousand years ago, the Peacemaker brought the Mohawk, Oneida, Onondaga, Cayuga, and Seneca Nations together on the shores of Onondaga Lake. At the lakeshore, these Nations accepted the message of peace, laid down their arms, and formed the Haudenosaunee Confederacy. The Confederacy was the first representative democracy in the West and inspired the founders of the United States.

Onondaga Lake is sacred to the Haudenosaunee. The Onondaga Nation has resided on the Lake and throughout its watershed since time immemorial, building homes and communities, fishing, hunting, trapping, collecting plants and medicine, planting agricultural crops, performing ceremonies with the natural world dependent on the Lake, and burying ancestors - the mothers, fathers and children of the Onondaga Nation. The Onondaga Nation views its relationship to this area as a place where they will forever come from and will return to; they will continue to work for the healing of the lake.

The Habitat Plan addresses needs for birds like the Virginia Rail — a culturally significant species.

[1] The Onondaga Nation requested that the following oral tradition be included in this Habitat Plan. The inclusion of the Onondaga Nation's oral tradition in this Habitat Plan is not intended as, and shall not constitute, an admission of any fact or law in any judicial or administrative proceeding.

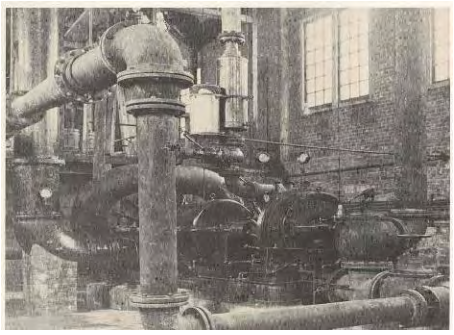
Jesuit missionaries from Quebec later established a mission on the shores of Onondaga Lake in 1656.(Ste Marie, 2006). Father LeMoyne learned of the salt springs from the Onondaga Nation, and the salt industry began operations in 1793. The industry thrived for over 100 years, and the extraction and processing of salt fostered the development of an extensive infrastructure in the region, including railroads and the Erie Canal system. The region lost its monopoly on salt production due to changing industrial demands for salt and the discovery of large sources of salt in other areas of the United States. However, despite the dwindling market for Syracuse salt, many different industries took advantage of the naturally occurring salt in this region for use in the manufacture of various chemicals and in chemical processes necessary for refining metal (Hohman, 2004).

Salt Works on the shores of Onondaga Lake.

The infrastructure initially developed for the salt industry later supported the establishment of a number of additional industries near Onondaga Lake, including soda ash and hydrogen peroxide manufacturing facilities; petroleum-product storage facilities; a fertilizer production plant; a steel foundry; a manufacturing plant for vehicle accessories; a pottery and china manufacturing plant; and industries including pharmaceuticals, air conditioning, general appliances, and electronics manufacturing.

By 1920, the region around Onondaga Lake was a national center of manufacturing for metal products, automobiles, typewriters, pottery, and other small machinery (de Laubenfels, 1977). By 1950, 139 industries used Onondaga Lake for waste disposal (Ferrante, 2005), often directly to the lake.

In addition to industrial development, the Onondaga Lake area experienced further residential and economic growth during the twentieth century. Paralleling the rise of development in the area, the population of Onondaga County rose from approximately 160,000 in 1900 to 458,336 in 2000 (US Census Bureau, 2002). Much of the population is, and has historically been, located in the Syracuse metropolitan area, which is located on the southeastern end of Onondaga Lake.



10 Million gallon pump erected in 1904 at the Onondaga Lake pump station.

Over 150 years of manufacturing, industrialization, and population growth altered the habitat and fisheries in Onondaga Lake and in the region. These changes also impacted the water level of the lake and had a significant impact on the diversity of habitat within the lake. For example, northern pike was a common fish predator in the region in the late 1800s and early 1900s; but lowering of the lake level for the construction of the Barge Canal system reduced the availability of wetland spawning habitats for this species, and the number of fish declined. The disposal of industrial wastes, including Solvay Waste, in and around the lake also decreased the overall lake surface area and resulted in the loss of historic wetlands. Based on a variety of resources, it is clearly documented that industrialization and community development altered the landscape, impacted lake levels, and degraded the lake's habitat. Today, industries and communities recognize the importance of the lake's future and are working to restore it.

Current Conditions of the Lake

Industrial and urban pollution, urbanization, and municipal waste have reduced the suitability of Onondaga Lake habitats for a variety of species. The cumulative effects of human-induced disturbances, such as tree clearing, agriculture, filling, dam construction, industrialization, and urbanization have reduced terrestrial, floodplain, and aquatic habitats and have altered species diversity and abundance.

Metro's upgrades have greatly improved the water quality in Onondaga Lake.

Onondaga County has conducted extensive upgrades to the Metro sewage treatment facility, and these changes have resulted in greatly improved water quality. One measure of this improvement is seen in the increase of aquatic plant species. Since 1991, the number of aquatic plant species in the lake has increased by almost 70%. The abundance of aquatic plants in the lake has also increased. The percent cover and biomass of aquatic plants were, on average, slightly more than three times greater in 2005 compared to 2000 (Ecologic *et al*., 2006).

Honeywell has begun cleaning up and restoring areas adjacent to the lake. The Linden Chemical and Plastic (LCP) Bridge Street site, one of two primary sources of mercury entering the lake, has been cleaned up and restored. Along the southern shore of the lake, a barrier wall and groundwater extraction system was installed to prevent contaminated groundwater from entering the lake. These activities are the first important steps in cleaning up and restoring the lake. There are still many issues to address, but recent investigations reveal that the lake is improving.

Restored wetland marsh at LCP Site

Effects of the Remedy on Existing Habitats

Much of the remediation program for the Onondaga Lake bottom is focused on reducing or eliminating the hazardous substances in the sediments that pose the risk of adverse effects to the organisms living in the sediments on the lake bottom. Organisms may experience adverse effects as acute (short-term) or chronic (long-term) toxicity directly from exposure to the contaminants in the sediments, or they can experience indirect exposure when contaminants enter into the food chain and affect organisms which feed on other contaminated species. Another area of focus for remedial efforts is the adjacent upland sites and shoreline areas. Addressing these sites will ensure that contaminants are not reintroduced to remediated areas in the lake, thus eliminating the process of acute toxicity in organisms. These key wetland and shoreline areas along the lake have been included in this Habitat Plan to ensure a holistic approach to the conceptual designs.

A portion of the Willis-Semet barrier wall is installed along the lakeshore.

The actual construction phase of the lake bottom remedy will have a short-term impact on existing habitats in remediation areas, but overall habitat conditions within remediation areas will be maintained or improved after the implementation of the designs presented in this Plan. The dredging and/or capping of areas within the lake, along with remedial activities at several upland areas adjacent to the site will also cause short term, temporary loss of habitat and displacement of some species. However, the restoration of these areas will result in improved habitat conditions throughout the areas of the lake that require remediation.

The Future of Onondaga Lake

Bald eagles have returned to Onondaga Lake.

The habitat designs described in this Plan were developed using many different criteria, including the integration of habitat needs for representative species with the requirements associated with the dredging and capping design specified in the Onondaga Lake Bottom Record of Decision, the physical conditions of the site, and the habitat goals and objectives. The holistic approach for integrating multiple remedial considerations from the related lake and shoreline areas will result in improved conditions for a wide variety of species in these areas.

Onondaga Lake continues to show progress toward becoming the thriving, dynamic, natural resource and community asset that it once was and this comprehensive plan for habitat restoration is another important step toward realizing that vision.

TABLE ES.1
HABITAT MODULE CHARACTERISTICS
ONONDAGA LAKE REMEDIAL DESIGN PROGRAM

HABITAT MODULE AREAS[a] [b] [e]	REPRESENTATIVE SPECIES/HABITAT						
	Fish	Plants	Benthic Macroinvertebrates[c]	Mammals	Reptiles and Amphibians	Birds	Minimum Habitat Layer Thickness[d]
1. Deep water (20-30 ft) (6-9 m) Sand substrate Low to medium energy Note: This module also generally applies to deeper water (profundal) areas. [f]	Transient cold water fish (brown trout), lake sturgeon, emerald shiner, bass, walleye and pumpkinseed	None	Amphipoda (Pontoporeia affinis), Annelida (Oligochaeta, Diptera (Chironomidae), Mollusca, and Annelida	None	None	Common goldeneye, mallard, osprey and bank swallow	1 ft. (30 cm) (Average of 1.25 ft.)
2A. Mid water depth (7-20 ft) (2-6 m) Sand/fine gravel substrate Low to medium energy	Lake sturgeon, transient cold water fish, bass, northern pike and pumpkinseed; additionally, walleye and bass if structure is present	Submerged aquatics in shallow portion	Diptera (Chironomidae) Annelida, Ephemeroptera, Odonata, and Mollusca; diptera if structure is present	Otter	None; mudpuppy if structure is present	Mallard, common tern, osprey and bank swallow	1 ft. (30 cm) (Average of 1.25 ft.)
2B. Mid water depth (7-20 ft) (2-6 m) Coarse gravel/cobble substrate High energy	Lake sturgeon, transient cold water fish, bass, smallmouth bass and pumpkinseed; additionally walleye if structure is present	Limited	Diptera (Chironomidae)	Otter	None; mudpuppy if structure is present	Mallard, common tern, osprey and bank swallow	1 ft. (30 cm) (Average of 1.25 ft.)
3A. Shallow water depth (2-7 ft) (0.5-2 m) Sand/fine gravel substrate Low energy	Largemouth bass, pumpkinseed, golden shiner and northern pike	Medium to dense submerged aquatic vegetation	Ephemeroptera, Trichoptera, Diptera, Odonata, Amphipoda, and Decapoda	Otter, mink, beaver; additionally muskrat if structure is present	Snapping turtle; additionally mudpuppy if structure is present	Mallard, belted kingfisher, osprey, great blue heron and bank swallow	1.5 ft. (45 cm) (Average of 2.0 ft.)
3B. Shallow water depth (2-7 ft) (0.5-2 m) Coarse gravel/cobble substrate High energy	Bass, pumpkinseed, golden shiner and northern pike	Sparse to medium submerged aquatic vegetation	Ephemeroptera, Trichoptera, Diptera, Odonata, Amphipoda, and Decapoda	Otter, mink, beaver, muskrat	Limited/none; mudpuppy and snapping turtle if structure is present	Mallard, belted kingfisher, great blue heron, common tern and bank swallow	1.5 ft. (45 cm) (Average of 2.0 ft.)

Footnotes:
a. High, medium, and low energy designations were developed by Anchor-QEA in the Wind/Wave Analysis from the Capping and Dredge Area and Depth Technical Document (Parsons, 2009).
b. Selection of modules for specific areas around the lake will consider the presence/occurrence of invasive species.
c. Diversity of species for benthos will be evaluated during the next phase of design.
d. See representative species Tables 4.1 to 4.7 for substrate depth and minimum habitat size information for specific organisms.
e. Structure can be added to any module. Species that would benefit from structure have been noted on the table.
f. A habitat layer will not be required in areas of the Profundal zone that do not have an isolation cap.

TABLE ES.1 (Continued)
HABITAT MODULE CHARACTERISTICS
ONONDAGA LAKE REMEDIAL DESIGN PROGRAM

HABITAT MODULE AREAS[a] [b] [e]	REPRESENTATIVE SPECIES/HABITAT						
	Fish	Plants	Benthic Macroinvertebrates[c]	Mammals	Reptiles and Amphibians	Birds	Minimum Habitat Layer Thickness[d]
4A. Floating aquatics wetland (1-3 ft) (0.3-1 m) Organics/fines/sand substrate Very low energy	Northern pike and Pumpkinseed	Floating aquatics, some submerged aquatics in deeper portions, some nonpersistent emergents in shallower portion	Ephemeroptera, Trichoptera, Diptera, Odonata, Amphipoda, and Decapoda	Otter, mink, muskrat and beaver	Snapping turtle, painted turtle, musk turtle and water snake; additionally mudpuppy if structure is present	Mallard, belted kingfisher, great blue heron, common tern, green heron and bank swallow	2.0 ft. (60 cm) (Average of 2.5 ft.)
5A. Non-persistent emergent wetland (0.5-2 ft) (0.1-0.6 m) Organics/fines/sand substrate Low energy	Northern pike and pumpkinseed	Non-persistent emergent vegetation. Some persistent emergents in shallows.	Ephemeroptera, Trichoptera, Diptera, Odonata, Amphipoda, and Decapoda	Otter, mink, muskrat and beaver	Snapping turtle, painted turtle, musk turtle, water snake, red spotted newt, green frog and leopard frog; additionally mudpuppy if structure is present	Mallard, belted kingfisher, great blue heron, green heron, common tern and bank swallow	2.0 ft. (60 cm) (Average of 2.5 ft.)
5B. Shoreline shallows/limited emergent wetland (0.5-2 ft) (0.1-0.6 m) Gravel/cobble substrate High energy	Smallmouth bass; additionally walleye if structure is present	Limited/none	Limited numbers Trichoptera, Ephemeroptera; Trichoptera, Ephemeroptera and Decapoda if structure is present	Otter and mink	Limited/none; Turtle, water snake, and mudpuppy if structure is present	Mallard, belted kingfisher, great blue heron, green heron and bank swallow	2.0 ft. (60 cm) (Average of 2.5 ft.)

Footnotes:
a. High, medium, and low energy designations were developed by Anchor-QEA in the Wind/Wave Analysis from the Capping and Dredge Area and Depth Technical Document (Parsons, 2009).
b. Selection of modules for specific areas around the lake will consider the presence/occurrence of invasive species.
c. Diversity of species for benthos will be evaluated during the next phase of design.
d. See representative species Tables 4.1 to 4.7 for substrate depth and minimum habitat size information for specific organisms.
e. Structure can be added to any module. Species that would benefit from structure have been noted on the table.
f. A habitat layer will not be required in areas of the Profundal zone that do not have an isolation cap.

TABLE ES.1 (Continued)
HABITAT MODULE CHARACTERISTICS
ONONDAGA LAKE REMEDIAL DESIGN PROGRAM

HABITAT MODULE AREAS[a] [b] [e]	REPRESENTATIVE SPECIES/HABITAT						
	Fish	Plants	Benthic Macroinvertebrates[c]	Mammals	Reptiles and Amphibians	Birds	Minimum Habitat Layer Thickness[d]
6A. Persistent emergent wetland or salt marsh (1 ft above water to 1 ft deep) (0.3 m above water to 0.3 m deep) Organics/fines/sand substrate Low energy	Northern pike	Persistent emergent vegetation, salt marsh vegetation	Trichoptera, Diptera, Odonata and Decapoda; additionally Amphipoda if structure is present	Otter, mink, muskrat and beaver	Snapping turtle, painted turtle, musk turtle, water snake, red-spotted newt, leopard frog and green frog; additionally mudpuppy if structure is present	Mallard, spotted sandpiper, semi-palmated sandpiper, red-winged blackbird, great blue heron, green heron, common tern and bank swallow	2.0 ft. (60 cm) (Average of 2.5 ft.)
6B. On shore to shallows/limited emergent wetland or salt marsh (1 ft above water to 1 ft deep) (0.3 m above water to 0.3 m deep) Cobble/coarse gravel/sand High energy	Limited use	Limited/none	Trichoptera, Ephemeroptera and Decapoda	Otter and mink	Limited/none, snapping turtle	Mallard, spotted sandpiper, semi-palmated sandpiper, great blue heron, green heron and bank swallow	2.0 ft. (60 cm) (Average of 2.5 ft.)cm)
7A. Mudflats/unvegetated shoreline (0.7 ft above water to 0.7 ft deep) (0.2 m above water to 0.2 m deep) Fines/sand substrate or cobble/gravel High energy or fluctuating water levels	None	Limited/none	Limited-Annelida	Otter and mink	Snapping turtle	Mallard, spotted sandpiper, semi-palmated sandpiper, great blue heron and green heron	2.0 ft. (60 cm) (Average of 2.5 ft.)

Footnotes:
a. High, medium, and low energy designations were developed by Anchor-QEA in the Wind/Wave Analysis from the Capping and Dredge Area and Depth Technical Document (Parsons, 2009).
b. Selection of modules for specific areas around the lake will consider the presence/occurrence of invasive species.
c. Diversity of species for benthos will be evaluated during the next phase of design.
d. See representative species Tables 4.1 to 4.7 for substrate depth and minimum habitat size information for specific organisms.
e. Structure can be added to any module. Species that would benefit from structure have been noted on the table.
f. A habitat layer will not be required in areas of the Profundal zone that do not have an isolation cap.

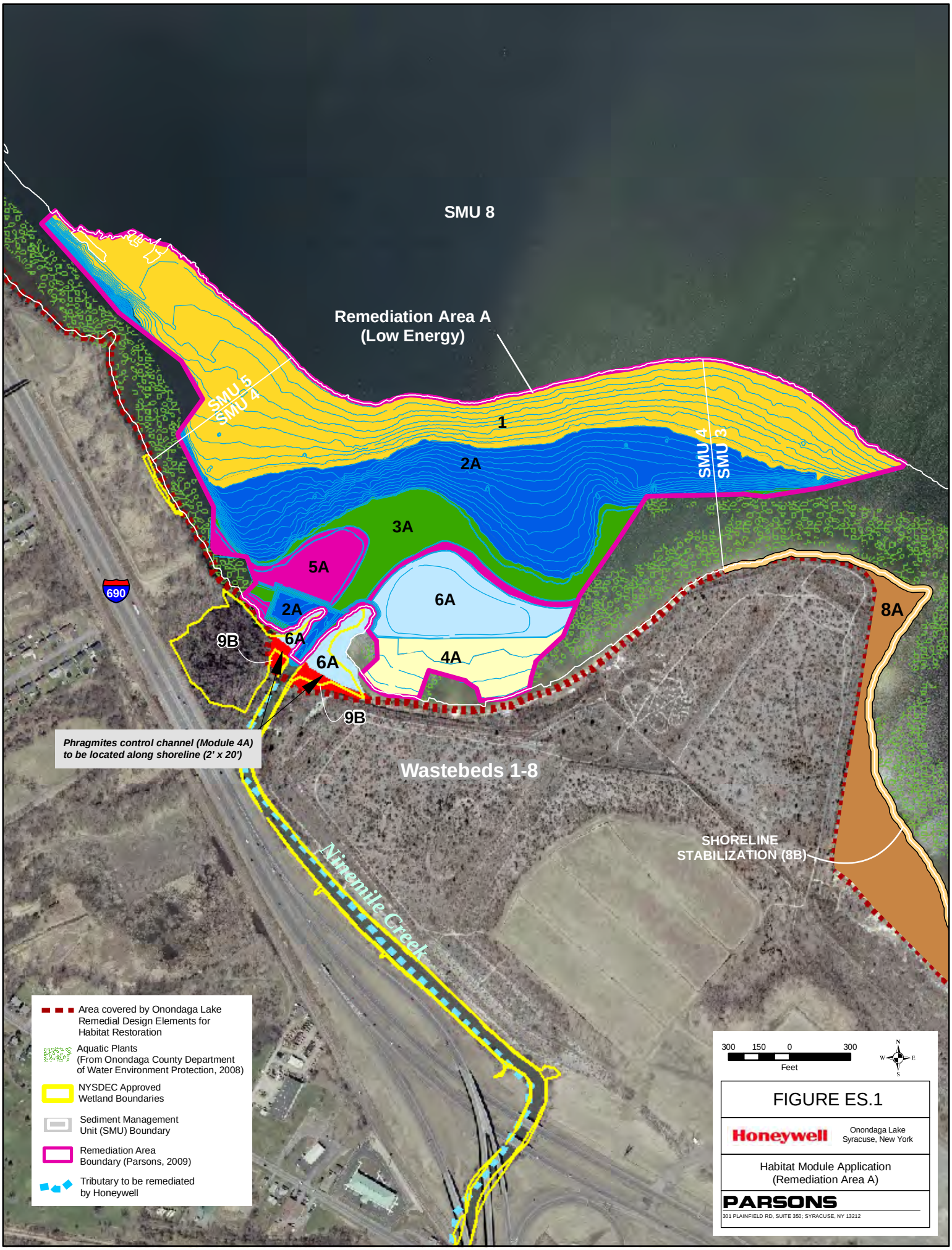
TABLE ES.1 (Continued)
HABITAT MODULE CHARACTERISTICS
ONONDAGA LAKE REMEDIAL DESIGN PROGRAM

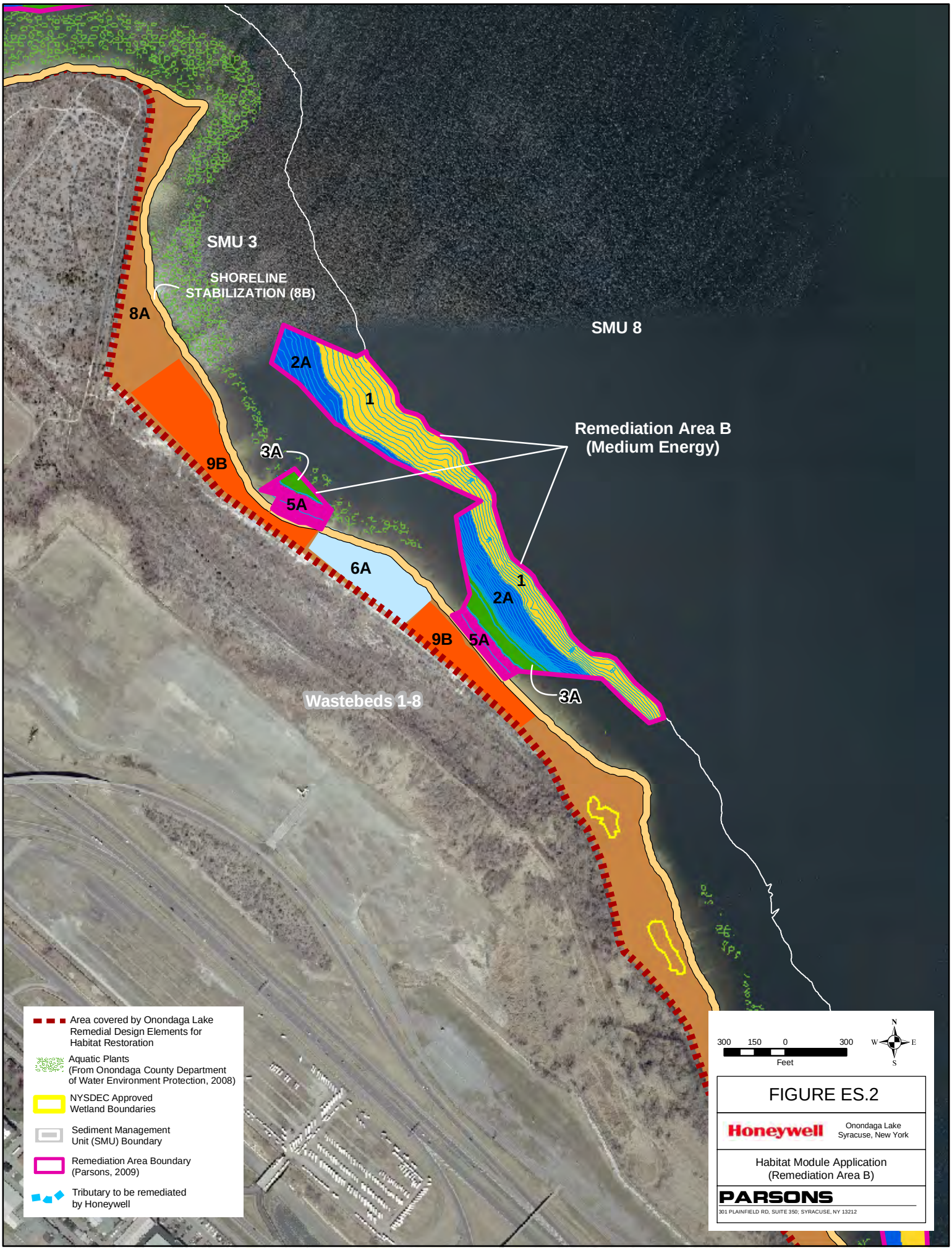
HABITAT MODULE AREAS[(a) (b) (e)]	REPRESENTATIVE SPECIES/HABITAT						
	Fish	Plants	Benthic Macroinvertebrates[(c)]	Mammals	Reptiles and Amphibians	Birds	Minimum Habitat Layer Thickness[(d)]
8A. Shoreline uplands/riparian Topsoil substrate	None	Successional fields	None	Otter and mink	Leopard frog	Mallard, great blue heron, green heron and red-winged blackbird	1.5 ft. (45 cm) (Average of 2.0 ft.)
8B. Shoreline uplands/riparian Topsoil substrate	None	Scrub-shrub or forested	None	Otter, mink, beaver and Indiana bat	Leopard frog and water snake	Mallard and green heron	1.5 ft. (45 cm) (Average of 2.0 ft.)
9A. Inland wetlands not associated with the lake (saturated soils to pooled water that may be temporary) Topsoil substrate	None	Wet meadow and persistent emergent wetland species, primarily herbaceous	Limited numbers/species, Annelida and Mollusca	Muskrat and mink	Leopard frog, red spotted newt, water snake and green frog	Red-winged blackbird, green heron, great blue heron, spotted sandpiper and bank swallow	2.0 ft. (60 cm) (Average of 2.5
9B. Inland wetlands not associated with the lake (saturated soils to pooled water that may be temporary) Topsoil substrate	None	Forested wetland and scrub-shrub wetland species	Limited numbers/species, Annelida and Mollusca	Mink and beaver	Spotted salamander and wood frog	Red-winged black bird and green heron	2.0 ft. (60 cm) (Average of 2.5

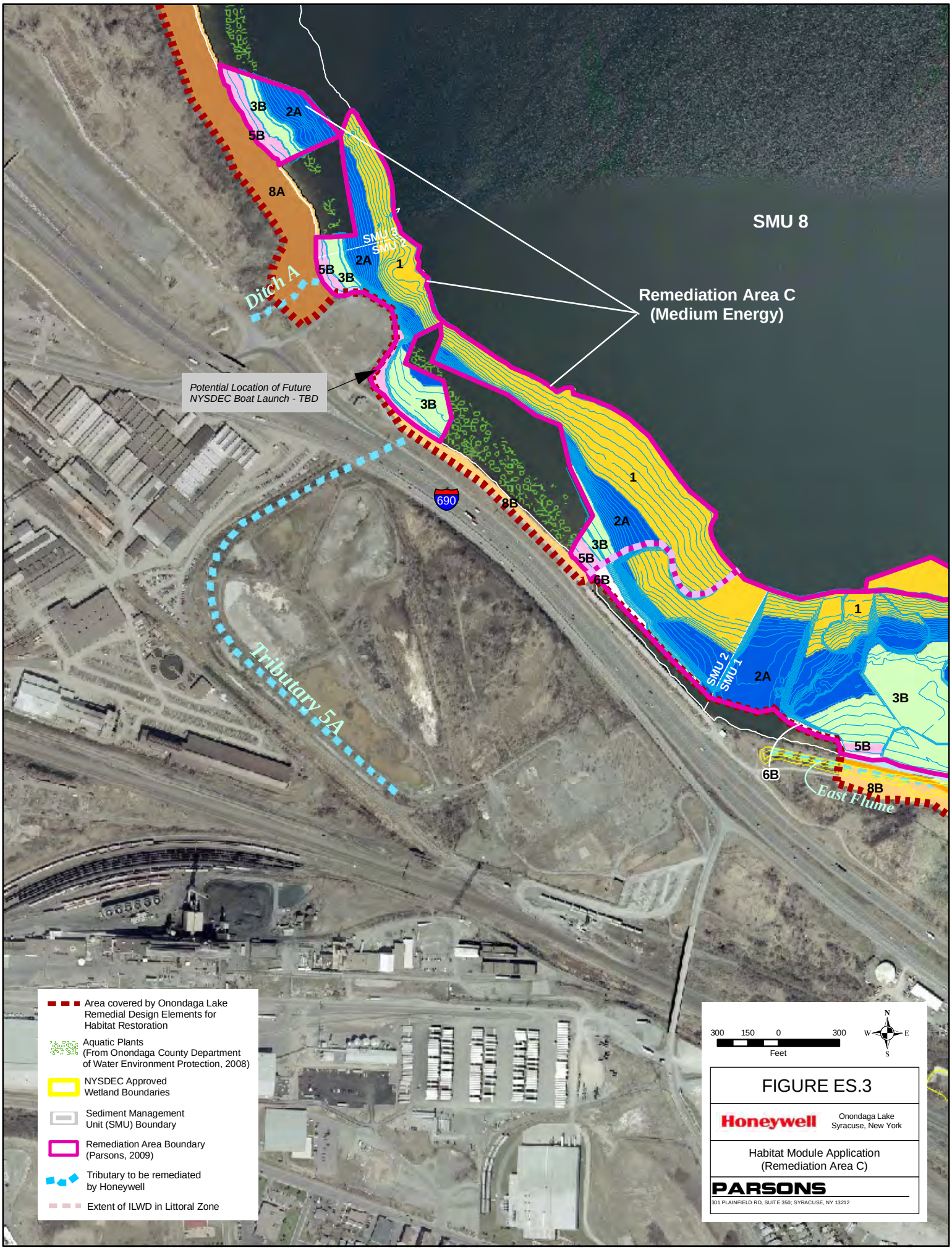
SPECIAL FEATURES/CONSIDERATIONS

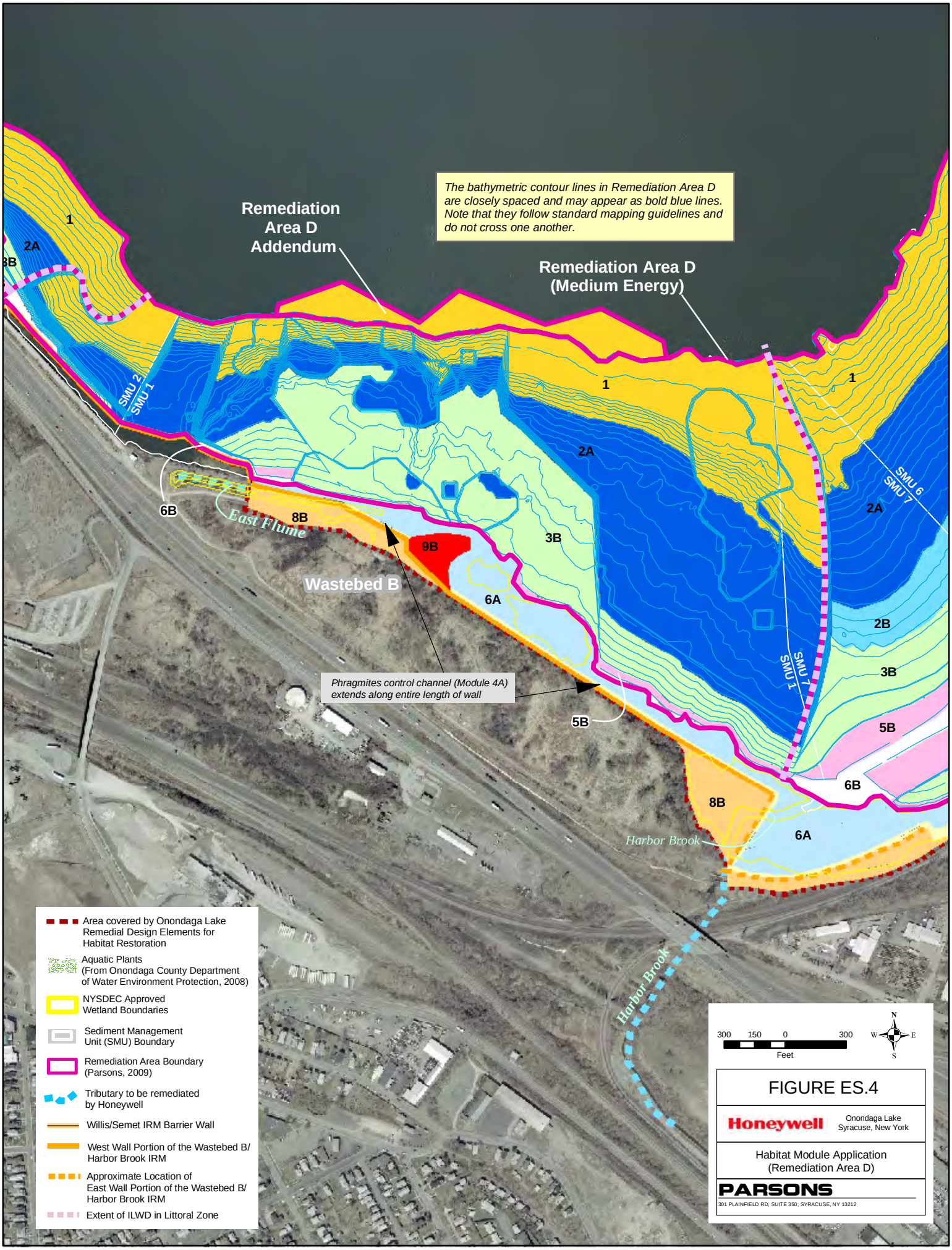
Endangered aquatic plants (*Potamogeton strictifolius, Najas guadalupensis* var. muenscheri, or Najas *guadalupensis* var. olivacea)	Potential for these species where submerged aquatic vegetation is targeted. These would most likely fall under Module 3A.
Northern Pike Spawning Wetlands	Provide spawning habitat for northern pike.

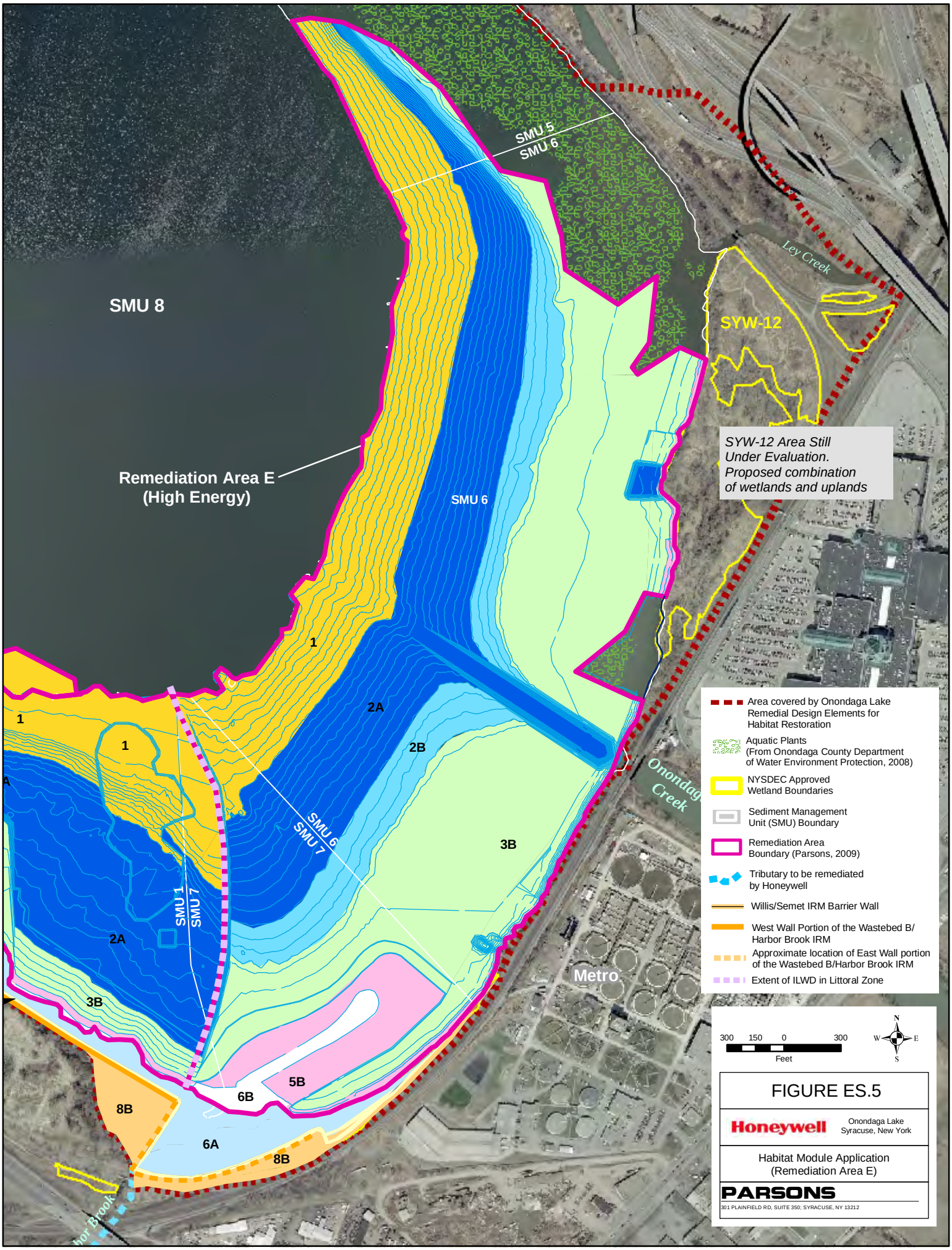
Footnotes:
a. High, medium, and low energy designations were developed by Anchor-QEA in the Wind/Wave Analysis from the Capping and Dredge Area and Depth Technical Document (Parsons, 2009).
b. Selection of modules for specific areas around the lake will consider the presence/occurrence of invasive species.
c. Diversity of species for benthos will be evaluated during the next phase of design.
d. See representative species Tables 4.1 to 4.7 for substrate depth and minimum habitat size information for specific organisms.
e. Structure can be added to any module. Species that would benefit from structure have been noted on the table.
f. A habitat layer will not be required in areas of the Profundal zone that do not have an isolation cap.


SMU 8
Remediation Area A
(Low Energy)
SMU 5
SMU 4
1
2A
SMU 4
SMU 3
3A
5A
6A
2A
6A
9B
6A
4A
9B
8A
690
Phragmites control channel (Module 4A)
to be located along shoreline (2' x 20')
Wastebeds 1-8
SHORELINE
STABILIZATION (8B)
Ninemile Creek
Area covered by Onondaga Lake Remedial Design Elements for Habitat Restoration
Aquatic Plants (From Onondaga County Department of Water Environment Protection, 2008)
NYSDEC Approved Wetland Boundaries
Sediment Management Unit (SMU) Boundary
Remediation Area Boundary (Parsons, 2009)
Tributary to be remediated by Honeywell
300 150 0 300
Feet
N
W
E
S
FIGURE ES.1
Honeywell
Onondaga Lake
Syracuse, New York
Habitat Module Application
(Remediation Area A)
PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212


SMU 3
SHORELINE STABILIZATION (8B)
8A
SMU 8
2A
1
Remediation Area B (Medium Energy)
3A
9B
5A
6A
1
2A
9B
5A
3A
Wastebeds 1-8
Area covered by Onondaga Lake Remedial Design Elements for Habitat Restoration
Aquatic Plants (From Onondaga County Department of Water Environment Protection, 2008)
NYSDEC Approved Wetland Boundaries
Sediment Management Unit (SMU) Boundary
Remediation Area Boundary (Parsons, 2009)
Tributary to be remediated by Honeywell
300 150 0 300
Feet
N
W
E
S
FIGURE ES.2
Honeywell
Onondaga Lake
Syracuse, New York
Habitat Module Application
(Remediation Area B)
PARSONS
301 PLAINFIELD RD, SUITE 350; SYRACUSE, NY 13212


SMU 8
Remediation Area C
(Medium Energy)
Potential Location of Future
NYSDEC Boat Launch - TBD
Ditch A
Tributary 5A
East Flume
690
SMU 3
SMU 2
SMU 1
3B
2A
5B
8A
1
8B
6B
Area covered by Onondaga Lake Remedial Design Elements for Habitat Restoration
Aquatic Plants (From Onondaga County Department of Water Environment Protection, 2008)
NYSDEC Approved Wetland Boundaries
Sediment Management Unit (SMU) Boundary
Remediation Area Boundary (Parsons, 2009)
Tributary to be remediated by Honeywell
Extent of ILWD in Littoral Zone
300 150 0 300
Feet
N
W
E
S
FIGURE ES.3
Honeywell
Onondaga Lake
Syracuse, New York
Habitat Module Application
(Remediation Area C)
PARSONS
301 PLAINFIELD RD, SUITE 350; SYRACUSE, NY 13212


The bathymetric contour lines in Remediation Area D are closely spaced and may appear as bold blue lines. Note that they follow standard mapping guidelines and do not cross one another.
Remediation Area D Addendum
Remediation Area D (Medium Energy)
Wastebed B
East Flume
Harbor Brook
Phragmites control channel (Module 4A) extends along entire length of wall
SMU 1
SMU 2
SMU 6
SMU 7
1
2A
2B
3B
5B
6A
6B
8B
9B
Area covered by Onondaga Lake Remedial Design Elements for Habitat Restoration
Aquatic Plants (From Onondaga County Department of Water Environment Protection, 2008)
NYSDEC Approved Wetland Boundaries
Sediment Management Unit (SMU) Boundary
Remediation Area Boundary (Parsons, 2009)
Tributary to be remediated by Honeywell
Willis/Semet IRM Barrier Wall
West Wall Portion of the Wastebed B/ Harbor Brook IRM
Approximate Location of East Wall Portion of the Wastebed B/ Harbor Brook IRM
Extent of ILWD in Littoral Zone
300 150 0 300
Feet
N
W
E
S
FIGURE ES.4
Honeywell
Onondaga Lake
Syracuse, New York
Habitat Module Application
(Remediation Area D)
PARSONS
301 PLAINFIELD RD, SUITE 350; SYRACUSE, NY 13212


SMU 8
SMU 5
SMU 6
Ley Creek
SYW-12
SYW-12 Area Still Under Evaluation. Proposed combination of wetlands and uplands
Remediation Area E (High Energy)
SMU 6
1
2A
2B
3B
SMU 6
SMU 7
SMU 1
SMU 7
Onondaga Creek
Metro
5B
6B
8B
6A
8B
Area covered by Onondaga Lake Remedial Design Elements for Habitat Restoration
Aquatic Plants (From Onondaga County Department of Water Environment Protection, 2008)
NYSDEC Approved Wetland Boundaries
Sediment Management Unit (SMU) Boundary
Remediation Area Boundary (Parsons, 2009)
Tributary to be remediated by Honeywell
Willis/Semet IRM Barrier Wall
West Wall Portion of the Wastebed B/ Harbor Brook IRM
Approximate location of East Wall portion of the Wastebed B/Harbor Brook IRM
Extent of ILWD in Littoral Zone
300 150 0 300
Feet
N
W
E
S
FIGURE ES.5
Honeywell
Onondaga Lake
Syracuse, New York
Habitat Module Application
(Remediation Area E)
PARSONS
301 PLAINFIELD RD, SUITE 350; SYRACUSE, NY 13212

Section 1: Introduction to the Habitat Plan

Restoring diverse, functioning and sustainable habitats in Onondaga Lake is a key component of the overall Onondaga Lake cleanup program that drives many other stages of remediation. Understanding the types of species that are native to the lake, their needs for habitat and where these habitats need to be restored are some of the main requisites for designing a plan that also takes into account the lake's history, natural setting and community importance. The group responsible for molding these requisites into a unique plan is known as the Habitat Technical Work Group (TWG), which combines experts from a cross-section of disciplines and organizations. This diversity of experts has allowed for a thorough and integrative approach in design.

This plan addresses the Remedial Design Elements for Habitat Restoration (hereafter referred to as the Habitat Plan). It presents conceptual designs for habitat restoration that will be integrated into the Onondaga Lake Bottom Remedy. This remedy pertains only to remediation areas in the lake related to sediment. However, because habitats are part of a complex ecosystem, designs are not restricted to lake-bottom sediments. Portions of adjacent Honeywell sites known as interim remedial measures (IRMs) will also be included in the habitat restoration process, and will incorporate habitat restoration into individual IRM remedies. The Onondaga Lake Bottom, a subsite of the Onondaga Lake Superfund Site, is on the New York Sate Registry of Inactive Hazardous Waste Sites. The New York State Department of Environmental Conservation (NYSDEC) and Honeywell have agreed to conditions under which Honeywell will design and implement the selected remedy, as set forth in the Consent Decree (United States District Court, Northern District of New York, 2007) (89-CV-815). The remedial investigation, planning, and design to date is the result of an intensive effort by scientists, engineers, and technicians working with the NYSDEC, United States Environmental Protection Agency (USEPA), and numerous public interest groups to formulate this Habitat Plan, placing Onondaga Lake on a path toward a restored natural resource.

The Consent Decree encompasses Onondaga Lake and several upland sites that have contributed to contamination to the lake system, many of which are IRMs. These various sites have been listed on USEPA's National Priorities List (NPL). The NYSDEC and USEPA have, to date, organized the environmental cleanup of the Onondaga Lake NPL site into eight subsites (Figure 1.1). In addition, Honeywell is responsible for the following NPL subsites: Linden Chemical and Plastics (LCP) Bridge Street, Semet Residue Ponds, Willis Avenue, Wastebed B/Harbor Brook, and Geddes Brook/Ninemile Creek. Other Honeywell sites (those not on the NPL) in proximity to the lake include Willis Ballfield, Wastebeds 1 through 8, Mathews Avenue Landfill and the Dredge

Spoils Area. See Section 3.2 of this Plan for more information on the IRMs.

1.1 General Description of Habitat Restoration at the Onondaga Lake NPL Site

Habitat is the physical and biological surroundings of an organism. It can be broadly defined as an area where plants and animals (including humans) normally live, grow, feed, reproduce, and otherwise exist for any portion of their life cycle. Habitat provides organisms or communities of organisms the necessary elements of life, such as space, food, water, and shelter (Federal Interagency Stream Restoration Working Group, 1998).

Great blue heron is a species that uses Onondaga Lake.

Habitat re-establishment and enhancement have been defined in the ROD (NYSDEC and USEPA, 2005) as noted below:

> "*Habitat re-establishment* is the restoration of habitat in areas where remediation substantially alters existing conditions. Re-establishment can be either restoring the same type of habitat that existed prior to remediation, or establishing a different type of habitat that has been deemed appropriate for the ecological conditions of the area."
>
> "*Habitat enhancement* is improvement of habitat conditions in areas where CERCLA contaminants do not occur at levels that warrant active remediation, but where habitat impairment due to stressors has been identified as a concern."

Habitat restoration (re-establishment, enhancement, replacement, and improvement) is an integral part of the overall cleanup plan for Onondaga Lake and will provide habitat value beyond what is currently available[2]. More specifically, restoration will be implemented in designated lake-bottom sediment, upland, and tributary (Tributary 5A, East Flume, Lower Harbor Brook) IRM areas, and Geddes Brook/Ninemile Creek. An overall goal of habitat restoration in these areas is to achieve ecological systems that function naturally, are self-sustaining, and are integrated with the surrounding habitats.

This Habitat Plan describes conceptual habitat restoration designs that will be implemented as part of, or following, remedial actions (*e.g.* dredging and/or capping). These restoration designs are based on the

[2] All references in this Habitat Plan to habitat enhancement, habitat reestablishment, or restoration are limited to how those terms are defined in the ROD for the Onondaga Lake Superfund site. If Honeywell elects to claim natural resource damages credit for work described in this report, it shall do so pursuant to the term and conditions set forth in Paragraph 75 of the Consent Decree between Honeywell and the State of New York. Nothing herein shall constitute an agreement by New York State that any work described in this report is eligible for natural resource damages credit.

historical and current habitat (or ecological system) conditions within Onondaga Lake and the adjacent shoreline areas.

1.2 Habitat Design Background

This Habitat Plan has been developed through a review and approval process with representatives from NYSDEC Division of Environmental Remediation, NYSDEC Fish and Wildlife, United States Environmental Protection Agency (USEPA), United States Fish and Wildlife Service, and the Honeywell team from the State University of New York College of Environmental Science and Forestry (SUNY ESF), Mississippi State University, Terrestrial Environmental Services (TES), AnchorQEA, O'Brien & Gere, and Parsons. The extensive team of local and national experts from all parties included wetland ecologists, limnologists, biologists, restoration ecologists and fisheries biologists. Collectively, the combined group was called the TWG as further discussed below.

Submerged aquatic vegetation

1.2.1 Habitat Technical Work Group

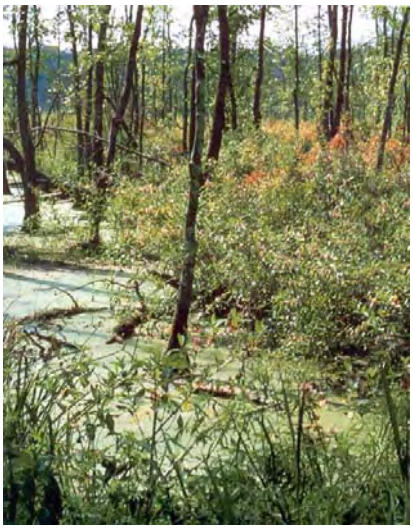
The TWG was formed shortly after the signing of the Consent Decree to provide a forum for technical experts to develop an approach for incorporating habitat considerations into the remedial design for Onondaga Lake. The TWG evaluated current habitat conditions, along with the selected or anticipated site remedies and IRMs adjacent to the lake to identify the potential effects of remediation on existing habitats. Based on this evaluation, the TWG defined the boundaries within which the conceptual habitat designs would be applied. This boundary, shown as a dashed red line on Figure 1.2 was selected to facilitate a holistic approach that integrates habitat restoration work *within* the lake with areas *adjacent* to the lake to provide habitat connectivity and transition areas.

Remediation Area D and the mouth of Harbor Brook

Once the areas where the habitat designs would be applied had been identified, the TWG reviewed historic and current conditions to identify representative species and habitat considerations for each remediation area. The habitat requirements for the representative species were then used to identify important factors such as current and future land use, topography (land surface), bathymetry (lake bottom surface), hydrology, and soils/substrate needed to support the various life cycles of the representative species and habitats. This information was used as the basis for developing the conceptual habitat designs and will also be integrated into the detailed design of the Lake Bottom Remedy. The detailed remedial designs will provide the overall plans and specifications for all of the areas requiring remediation or habitat enhancement.

The conceptual designs presented in this document have been integrated with upland IRMs and remedies and comply with applicable state and federal laws and regulations, executive orders and policies for floodplains, wetlands and surface waters.

1.3 Areas Requiring Remediation or Habitat Enhancement – Establishing a Framework



Scrub-shrub wetlands

To facilitate evaluation and remedy development during the Feasibility Study (FS), the lake was divided into eight Sediment Management Units (SMUs) based on water depth, source of water entering the lake, and physical, ecological and chemical characteristics (NYSDEC and USEPA, 2005). SMUs 1 through 7 are located in the shallow (littoral) zone (less than 30 feet) of the lake where most aquatic vegetation and aquatic life reside, while SMU 8 consists of sediment in the deeper (profundal) zone (deeper than 30 feet) (see Figure 1.2).

Since the submittal of the FS, a significant amount of new data has been collected throughout Onondaga Lake in accordance with the requirements of the ROD and Consent Decree. Based on an understanding of these additional data, an updated framework for identifying littoral (shallow) areas of the lake has been developed called "Remediation Areas." The SMU designations have been left in this document for reference, but this Habitat Plan and future design documents will be organized by remediation area and include SMU 8 as a separate remedy area.

The remediation area designations help to identify the specific characteristics of each remediation area and focus the habitat restoration to enhance the entire lake system. The characteristics of each remediation area that are important for the habitat restoration designs include extent and type of remediation, location within the lake, presence of tributary stream discharge, wind/wave energy, adjacent habitats in the lake, adjacent habitat on the shoreline and in upland areas, adjacent land use, and opportunities for recreational access and

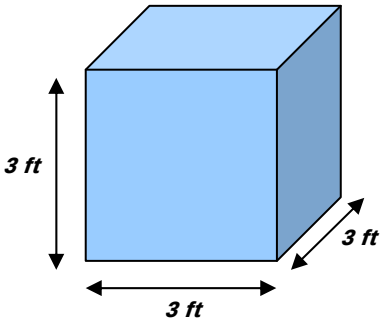
use. Based on a survey of these defining factors, seven remediation areas were established.

Figure 1.2 illustrates these seven remediation areas as well as the SMU boundaries as defined in the ROD. Characteristics of each remediation area are summarized below. Note that a key consideration for all areas is the placement, monitoring, and maintenance of a multi-layered cap.

Remediation Area	Sediment Management Unit (SMU)	Key Characteristics and Considerations
A	SMU 4 and portions of SMUs 3 and 5	Low wave energy area Connectivity to Ninemile Creek Integration with SYW-10 wetlands and Wastebeds 1-8 remedy Public access and recreation considerations
B	SMU 3	Medium wave energy area Shoreline stabilization requirements Integration with Wastebeds 1-8 remedy and wetland mitigation areas
C	SMU 2 and small portion of SMU 3	Medium wave energy area Minor tributary (Ditch A) present Shoreline IRM Barrier Walls Public access and recreation considerations
D	SMU 1 and small portions of SMU 2 and SMU 7	Medium wave energy area Shoreline IRM Barrier Wall Shallow water from in-lake waste deposits Integration with shoreline wetlands along Wastebed B/Harbor Brook
D Addendum	Small portion of SMU 8	Very low energy Deep water (Profundal zone)
E	SMUs 7 and 6	High wave energy

Remediation Area	Sediment Management Unit (SMU)	Key Characteristics and Considerations
E	SMUs 7 and 6	Three major tributary systems (Onondaga Creek, Harbor Brook and Ley Creek) Navigation into Onondaga Creek IRM Barrier wall along shoreline near mouth of Harbor Brook Wetlands at mouth of Harbor Brook SYW-12 wetlands along shoreline Discharge from Metro wastewater treatment facility Active railroad track along shoreline
F	Small portions of SMU 5	Medium energy area Small areas that require dredging
	SMU 8	Profundal area Details of remedy will be included in subsequent design documents.

In addition to the remediation areas described above, the ROD identifies two distinct areas within the lake where Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) contaminants do not occur at levels that warrant active remediation, but where habitat impairment due to stressors has been identified as a concern -- the shoreline of SMU 3 and the calcite and oncolite deposits in SMU 5. Habitat enhancement activities planned to stabilize the Remediation Area B (SMU 3) shoreline are described following the description of restoration in Remediation Area B. The habitat enhancement activities for Remediation Area F (SMU 5) are described in Section 5.3.10.



One cubic yard is equivalent to a cube that is 3x3x3 ft.

1.4 Consent Decree and Record of Decision (ROD) Requirements

As a key component of the restoration program specified for Onondaga Lake, this Habitat Plan will meet the requirements specified in the decision documents for the lake. A general overview of the in-lake components of the selected remedy set forth in the Consent Decree is summarized below:

- dredging up to an estimated 2,653,000 cubic yards of contaminated sediments and wastes;
- placement of an isolation cap over an estimated 425 acres in shallow water areas (littoral zone);

- construction of a thin-layer cap over an estimated 154 acres in the deep water areas (profundal zone);
- performance of a pilot study that evaluates methods to prevent the formation of methylmercury in the deeper areas;
- re-establishment of habitat affected by implementation of the remedy and enhancement of habitat in certain near-shore areas in Remediation Areas B and F (SMUs 3 and 5);
- monitored natural recovery (MNR) in portions of the deep water areas (profundal zone);
- implementation of institutional controls; and
- long-term operation, maintenance and monitoring.

Additional details regarding the lake remedy are provided in Section 3 of this plan. Specific issues which this Habitat Plan must address are listed in the ROD, the Explanation of Significant Differences (ESD), and the Statement of Work (SOW), all of which are appended documents to the Consent Decree. Specifically, the issues that must be addressed in the Habitat Plan are:

- thickness and substrate of the habitat layer;
- habitat restoration following dredging and/or capping;
- habitat enhancement in Remediation Areas B and F (SMUs 3 and 5);
- the details for construction of the shoreline lakeward of the barrier wall in portions of Remediation Areas C and D (SMUs 1 and 2);
- mitigation of aquatic habitat lost as a result of the off-shore placement of the shoreline barrier wall in portions of Remediation Areas A and B (SMUs 1 and 2); and
- details for placement of the isolation cap in portions of the littoral area without prior dredging.

In addition to the list above, other issues that are addressed in this plan include the following:

- habitat goals for the conceptual design;
- representative species and habitats;
- water depth and substrate requirements for representative habitats;
- description and thickness of materials for habitat design;
- description and thickness of thin-layer capping; and
- monitoring and maintenance requirements for habitat restoration;

These topics are discussed in Section 5 of this Habitat Plan.

Habitat restoration activities for other areas impacted by the remedy or implementation of the remedy (staging/processing areas, dredge

material pipeline and pump stations, SCA, etc.) will be addressed in the relevant design documents.

1.5 Goals of the Habitat Plan

The overall purpose of this Habitat Plan is to develop a habitat restoration and enhancement plan for remedial actions associated with the Lake Bottom Remedy and with remedies and IRMs for adjacent Honeywell sites that complies with applicable state and federal laws and regulations, executive orders and policies for floodplains, wetlands and surface waters. In addition, the implementation of the plan is intended to provide ecological, recreational and aesthetic benefits.

Specific objectives to achieve that goal are as follows:

- Objective 1 - Provide a comprehensive analysis of the habitats that will be affected by the various remedial activities in the lakeshore, floodplains, littoral, profundal, and wetland areas within and adjacent to Onondaga Lake.
- Objective 2 - Provide conceptual and/or preliminary design plans for:
  - Habitat restoration for the ROD in areas of the lakeshore, floodplains, littoral, profundal, and wetland areas that will be affected by the remedial activities for Onondaga Lake.
  - Habitat enhancement in Onondaga Lake as defined in the Onondaga Lake Bottom ROD.
  - Habitat restoration for the remedies and IRMs for adjacent Honeywell sites where remedial activities will affect Onondaga Lake lakeshore, floodplains, littoral, and wetland areas.

The “dashed red line” identified in Figure 1.2 indicates the areas of the lake and adjacent shoreline that are addressed by the Habitat Plan. The Habitat Plan will coordinate and describe the habitat restoration design requirements for remedial impacts within the “dashed red line”. However, the alignment may be adjusted following approval by Honeywell and NYSDEC based on new information regarding the extent of remediation. While the areas outside (and/or upland of) this line are not specifically addressed by this plan, the types and values of habitats in these areas will be considered when evaluating and identifying habitat restoration requirements within the area of study.

Scrub-shrub uplands

The “dashed red line” is generally aligned with the lakeshore and encompasses several lakeshore wetlands. A general description of the alignment adjacent to/within each of the littoral SMUs is provided below:

- SMU 1: The line is drawn along the alignment of the Willis IRM and Wastebed B/Harbor Brook IRM barrier walls.
- SMU 2: The line is drawn along the alignment of the Semet/Willis IRM barrier wall.

- SMU 3: The line is drawn along the upland edge of the shoreline area adjacent to Wastebeds 1-8.
- SMU 4: In the area east of Ninemile Creek, the line is drawn along the upland edge of the shoreline area adjacent to Wastebeds 1-8. In the immediate vicinity of Ninemile Creek, the line extends a short distance up Ninemile Creek. In the area west of Ninemile Creek, the line is drawn along the shoreline.
- SMU 5: The line is drawn along the shoreline.
- SMU 6: The line is generally drawn along the shoreline. However, in the area of Ley Creek, the line is drawn to encompass wetland SYW-12, which is currently being investigated by Honeywell.
- SMU 7: In the area immediately east of Harbor Brook, the line is drawn along the alignment of the Wastebed B/Harbor Brook IRM barrier wall. Further to the east, the line is drawn along the shoreline.

1.6 Organization of the Habitat Plan

This Habitat Plan consists of six sections and six appendices. A summary of the document is presented below:

- **Section 1**: Introduction – provides a general description of habitat restoration at the Onondaga Lake site and adjacent wetlands and goals and objectives of this Habitat Plan.
- **Section 2**: Conditions in Onondaga Lake – provides an overview of historical habitat conditions as well as existing habitat conditions and biological communities related to Onondaga Lake and adjacent Honeywell sites.
- **Section 3**: Potential Effects of Remediation on Onondaga Lake Habitat – describes the anticipated effects of remedial activities on lake and adjacent habitats.
- **Section 4**: Identification of Representative Habitats for Restoration – describes how the representative species were selected and provides a summary of the goals and objectives, as well as the framework for the restoration modules addressed in Section 5.
- **Section 5**: Preliminary Design for Lakewide Habitat -- furthers this discussion of modules by describing how they will be implemented in different parts of the lake. The modular approach helps create a holistic, sustainable method for restoring the targeted habitats in and around Onondaga Lake.
- **Section 6**: References
- **Appendix A:** *Amphibian and Reptiles Recorded in the Vicinity of Onondaga Lake* summarizes the number and types of amphibians and reptiles recorded in the vicinity of Onondaga Lake.

Damselfly is a representative species for benthic macroinvertebrates.

- **Appendix B:** *New York State Breeding Bird Atlas Results* contains information about birds found near Onondaga Lake
- **Appendix C:** *Macrophyte Coverage Figures from Habitat Preliminary Data Investigation (PDI) Report* contains information from the most recent Onondaga Lake macrophyte survey.
- **Appendix D:** *Suitability of Restoration in Remediation Areas for Representative Species* contains more detailed information about how each remediation area is suited for the representative species.
- **Appendix E:** *Master List of Plants* summarizes the plants targeted for use in the restoration of wetland and upland habitats in and around Onondaga Lake.

TABLE 1.1

ARARS AND TBCS THAT PERTAIN TO HABITAT AND SPECIES CONSIDERATIONS

Medium/Authority	Citation	Requirement Synopsis
New York State Environmental Conservation Law (ECL) Article 15	6 NYCRR Part 608	Note that: Section 608(a) requires development and submission of a sufficiently detailed construction plan with a map): Section 608.9(a) requires that construction or operation of facilities that may result in a discharge to navigable waters demonstrate compliances with CWA §§ 301 – 303. 306 and 307 and 6 NYCRR §§ 751.2 (prohibited discharges) and 754.1 (effluent prohibitions; effluent limitations and water quality-related effluent limitations; pretreatment standards; standards of performance for new sources.)
New York State ECL Article 24	6 NYCRR Part 663	Defines procedural requirements for undertaking different activities in and adjacent to freshwater wetlands, and establishes standards governing the issuance of permits to alter or fill freshwater wetlands.
40 CFR Part 6, Appendix A Executive Order No. 11988 Executive Order No. 11990	Floodplain Management Wetlands Protection	Floodplain Management requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative exists. Protection of Wetlands requires federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with destruction or loss of wetlands if a practicable alternative exists. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative exists.
Policy on Floodplains and Wetland Assessments for CERCLA Actions	August 1985	Superfund actions must meet the substantive requirements of the Floodplain Management Emergency Executive Order (E.O. 11988) and The Protection of Response 1975 Wetlands Executive Order (E.O. 11990). This memorandum discusses situations that require preparation of a floodplain or wetlands assessment and the factors that should be considered in preparing an assessment for response actions taken pursuant to Section 104 or 106 of CERCLA. For remedial actions, a floodplain/wetlands assessment must be incorporated into the analysis conducted during the planning for the remedial action.
Section 10, Rivers and Harbors Act,	33 USC § 403	U.S. Army Corps of Engineers approval is generally required to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States.

TABLE 1.1 (Continued)

ARARS AND TBCS THAT PERTAIN TO HABITAT AND SPECIES CONSIDERATIONS

Medium/Authority	Citation	Requirement Synopsis
National Historic Preservation Act 16 USC § 470 *et seq*.	36 CFR Part 800	Remedial Action must take into account effects on properties in or eligible for inclusion in the National registry of Historic Places.
Endangered Species Act	16 USC 35	The stated purpose of the Endangered Species Act is not only to protect species, but also "the ecosystems upon which they depend." It encompasses plants and invertebrates as well as vertebrates. It does not expressly include fungi, which were widely considered to be plants in 1973. The ESA forbids Federal Agencies from authorizing, funding or carrying out actions which may "jeopardize the continued existence of" endangered or threatened species (Section 7(a) (2)). It forbids any government agency, corporation, or citizen from taking (i.e. harming, harassing, or killing) endangered animals without a permit. Once a species is listed as threatened or endangered, the ESA also requires that "critical habitat" be designated for that species, including areas necessary to recover the species (Section 3(5) (A)). Federal agencies are forbidden from authorizing, funding, or carrying out any action which "destroys or adversely modifies" critical habitat (Section 7(a) (2)).
New York State ECL Article 11, Title 5	6 NYCRR Part 182	The taking of any endangered or threatened species is prohibited, except under a permit or license issue by NYSDEC. The destroying or degrading the habitat of a protected animal likely constitutes a “taking” of the animal under NY ECL §11-0535.

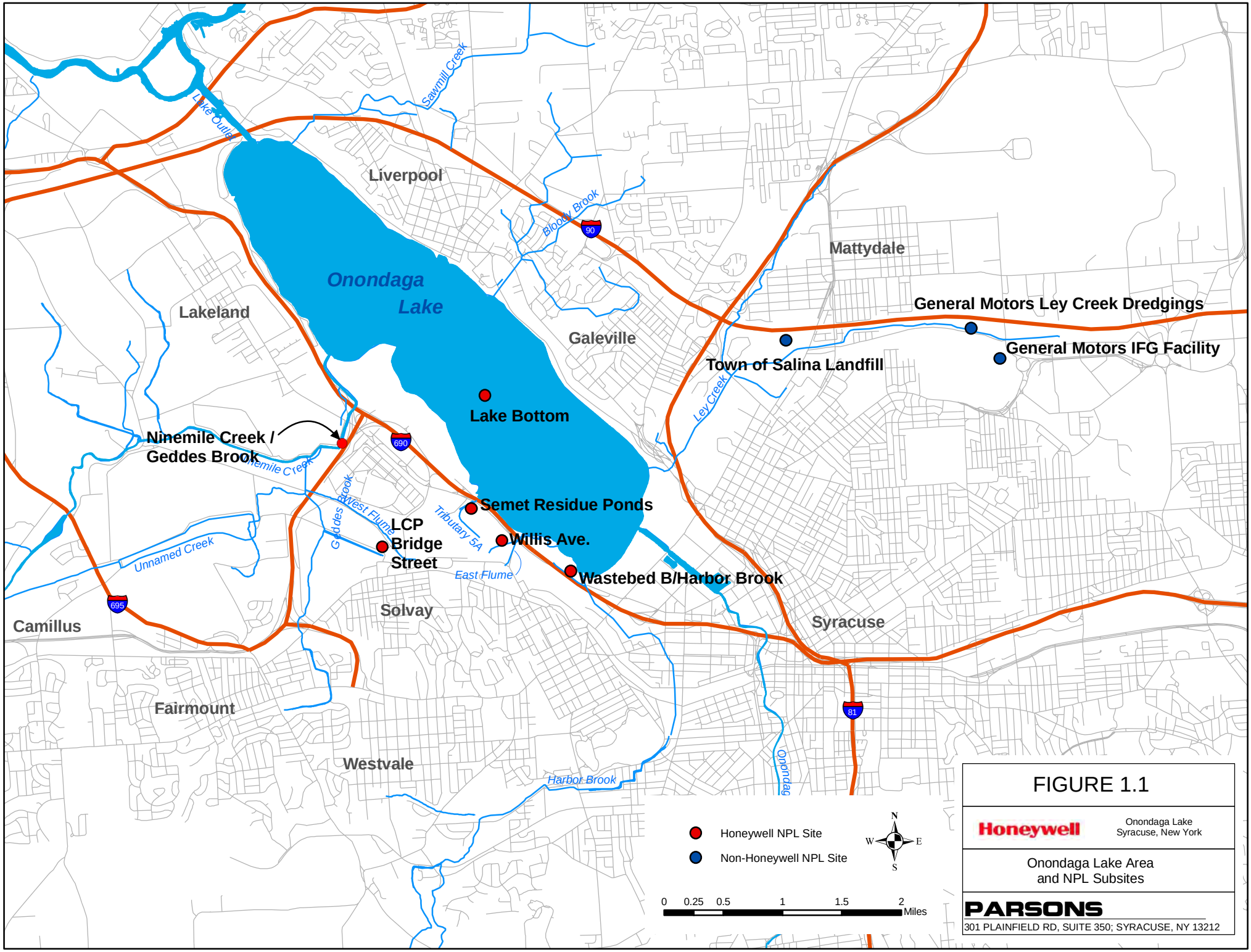


FIGURE 1.1

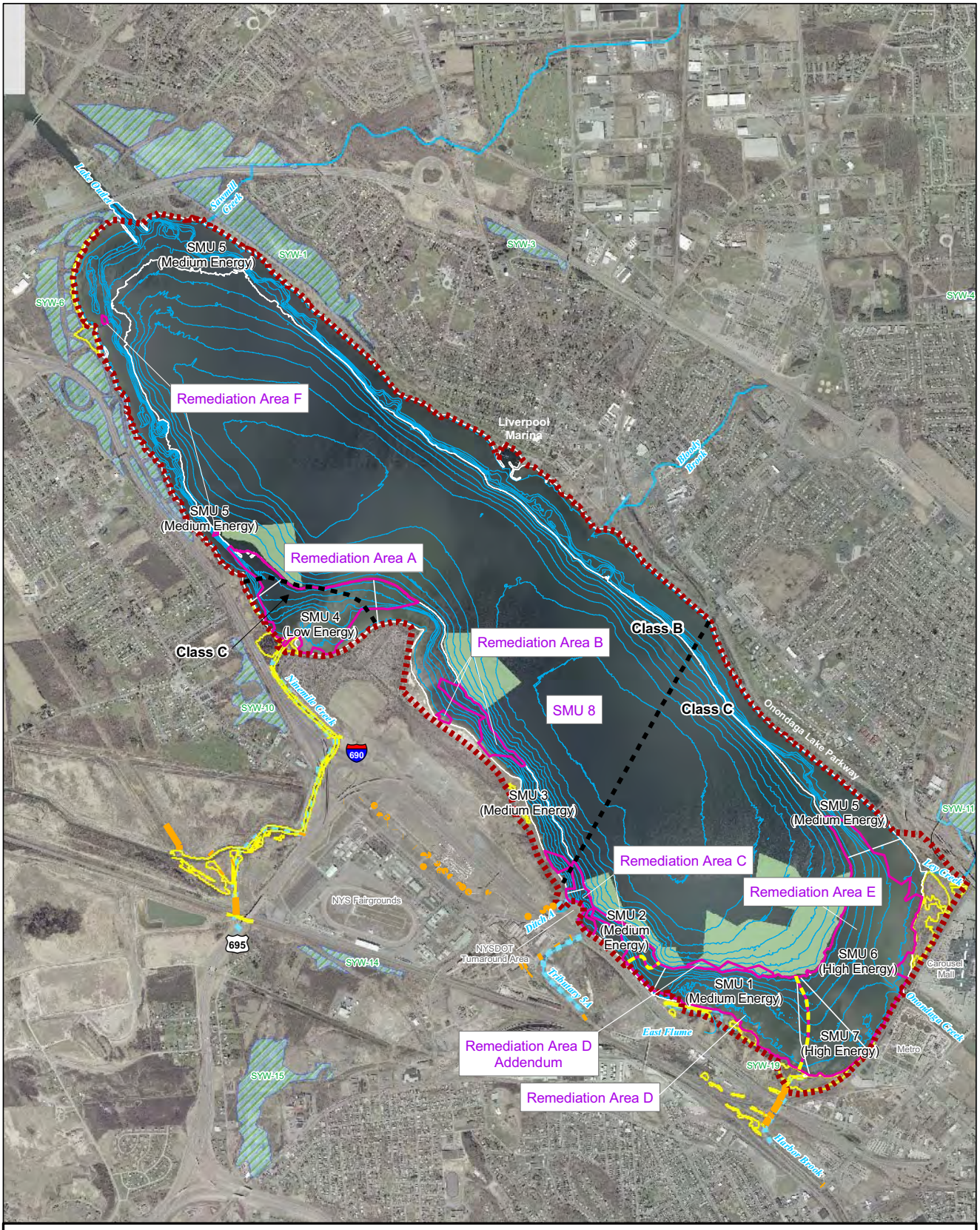
Honeywell

Onondaga Lake
Syracuse, New York

Onondaga Lake Area
and NPL Subsites

PARSONS

301 PLAINFIELD RD, SUITE 350; SYRACUSE, NY 13212



Sediment Management Unit (SMU) Boundary

Remediation Area Boundary (Parsons, 2009)

NYSDEC/EPA Approved Wetland Boundaries

NYSDEC Wetland (NYSDEC, 2007)

NYSDEC Water Quality Classification

Area Covered by Onondaga Lake Remedial Design Elements for Habitat Restoration

SMU 8 Thin-layer Capping (May by revised during design)

Culvert

Tributary to be remediated by Honeywell

Extent of ILWD in the Littoral Zone

Notes:
1. Water depth based on lake surface elevation of 362.5' NAVD88.
2. Bathymetry shown in 5' intervals.

N
W E
S

New York State Digital Orthoimagery from 2003

1,500 750 0 1,500
Feet

FIGURE 1.2

Honeywell

Onondaga Lake
Syracuse, New York

Surface Water Designations and Wave Energy

PARSONS

301 PLAINFIELD RD, SUITE 350; SYRACUSE, NY 13212