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September 19, 2014

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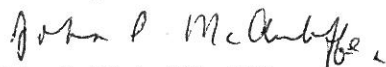
**RE: Onondaga Lake Natural Recovery Monitoring Work Plan for 2014-2015**

Dear Mr. Larson:

Enclosed you will find one bound and three CDs (2 PDF, 1 PDF & Original versions) of the Onondaga Lake Natural Recovery Monitoring Work Plan for 2014-2015.

Please feel free to contact Dave Babcock at 315-451-9560 or me if you have any questions.

Sincerely,



John P. McAuliffe, P.E.  
Program Director, Syracuse

Enclosure

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Page 2

cc: Continued

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# ONONDAGA LAKE NATURAL RECOVERY MONITORING WORK PLAN FOR 2014 - 2015

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*Prepared For:*

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*Prepared By:*

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**SEPTEMBER 2014**

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**LIST OF ACRONYMS**

DGPS	digital global positioning system
GPS	global positioning system
MNR	monitored natural recovery
NYSDEC	New York State Department of Environmental Conservation
PDI	pre-design investigation
PFF	Personal flotation device
QA/QC	quality assurance/quality control
ROD	Record of Decision
SMU	sediment management unit
SOP	standard operating procedure
USEPA	United States Environmental Protection Agency

Note: One cm (cm) of length is approximately equivalent to 0.4 inch. One inch is approximately equivalent to 2.5 cm. 15 cm is approximately equivalent to 6 inches or 0.5 foot.

## **ONONDAGA LAKE NATURAL RECOVERY MONITORING WORK PLAN FOR 2014 - 2015**

### **SUMMARY**

Natural recovery as a result of gradual sediment burial over time is ongoing in Sediment Management Unit (SMU) 8 of Onondaga Lake. SMU 8 is the lake sediment in two-thirds of the lake with water depths over 30 feet (ft) where waters stratify thermally each summer. Sediment sampling in SMU 8 for mercury analysis is being conducted on behalf of Honeywell every three years to monitor ongoing natural recovery in accordance with the final design for the lake bottom remedy (Parsons and Anchor QEA, 2012). SMU 8 sediments were most recently sampled for this purpose in 2011. Other types of sampling described in this work plan have been conducted at varying time intervals to date.

SMU 8 sediment sampling described in this work plan is planned for 2014-2015 and includes three components:

- Mercury analyses of surface sediment (2014)
- Documenting sediment accumulation and layering with depth at representative microbead plots over time (2014)
- Documenting mercury in settling sediment (2014 and 2015)
- Assessing the presence of benthic macroinvertebrates in SMU 8 (2015)

This work plan documents how, where and when samples will be collected and how samples will be processed and analyzed.

### **1.0 BACKGROUND**

This Work Plan describes sediment sampling and analysis to be conducted for Sediment Management Unit (SMU) 8 of Onondaga Lake during 2014 on behalf of Honeywell. SMU 8 is the sediment in the profundal zone of Onondaga Lake where water depths exceed 30 ft (9 meters) which is approximately 65 percent of the lake's surface area.

Monitored natural recovery (MNR) is ongoing in SMU 8 through burial of older sediment as new sediment enters the lake as inflows from tributaries and direct runoff to the lake. As remediation of Onondaga Lake sub-sites impacted by mercury is completed, mercury concentrations in sediment entering the lake are expected to decline.

Results from the sediment sampling and analysis described in this work plan will be used to provide additional information about ongoing sediment accumulation rates, settling sediment mercury concentrations, and the presence and distribution of benthic macroinvertebrates. This work is consistent with the monitoring and contingency approach approved by the State of New

York Department of Environmental Conservation (NYSDEC) for monitoring natural recovery in SMU 8 (Parsons and Anchor QEA, 2012).

Surface sediment samples are being collected in SMU 8 and analyzed for total mercury every three years (see Section 2.1). The most recent SMU 8 surface sediment sampling and analysis for mercury was completed in 2011.

Fluorescent microbeads were placed in nine plots in SMU 8 during 2009 to provide a vertical marker of the SMU 8 sediment. The depth of sediment above the sand microbead marker is being measured over in intervals of time up to three years to provide a quantitative demonstration of the extent that sediment burial is ongoing in SMU 8 (see Section 2.2).

Sediment deposition rates and mercury concentrations in settling sediment have been monitored in SMU 8 annually since 2009 by deploying three sediment traps at a time to provide data to assess gross sedimentation of solids and total mercury (see Section 2.3).

Benthic macroinvertebrates (such as worms) in SMU 8 can, if present in significant numbers, increase the extent to which sediment is mixed vertically which, in turn, could affect ongoing natural recovery (see Section 2.4).

## **2.0 SAMPLING SCOPE**

The SMU 8 sediment sampling scope for 2014 - 2015 has four distinct objectives

1. Collect and analyze surface sediment samples for total mercury (2014)
2. Collect, freeze, and record observations of sediment cores from representative microbead plots to document the depth of the sand microbead marker placed in 2009 (2014)
3. Deploy and retrieve sediment traps, and analyze settling sediment for total mercury (2014 and 2015)
4. Collect sediment to evaluate the abundance and composition of benthic macroinvertebrates (2015)

### **2.1 Mercury in SMU 8 Surface Sediment (2014)**

Shallow sediment cores will be collected at 20 locations previously sampled (Table 1 and Figures 1A and 1B). Cores collected from each location will be segmented and sediment from depth intervals of 0 to 2 cm, 2 to 4 cm, and 4 to 10 cm will be submitted to a commercial laboratory for analysis of total mercury using a standard United States Environmental Protection Agency (USEPA) 7400 series method. Appendix A includes procedures to be used for collecting and processing sediment cores.

### **2.2 Sand Microbead Marker in SMU 8 Surface Sediment (2014)**

One sediment core will be collected from two locations within each of three microbead plots (Station 80094 in the eastern portion of the North Basin, Station 80098 in the western portion of the South Basin, and Station 80101 in the South Corner; Figure 2). Each of these six cores will

**PARSONS**



be stored in a vertical position and frozen as quickly as possible using dry ice or equivalent. After each core is sufficiently frozen, the tubing and sediment making up the core will be sliced vertically to expose the core in cross section. Visual observations of the sand microbead marker and observations of sediment varves/layers will be recorded and documented with photos from each sliced core. If sand microbead marker is not encountered, sampling will be moved to another location. The procedure for processing sediment cores is described in Appendix A.2 and was completed most recently in the fall of 2012.

### **2.3 Mercury in SMU 8 Settling Sediment (2014 and 2015)**

Sediment trap samples will be collected during 2014 and 2015 at South Deep (see Figure 2) by UFI using the same sediment trap design and deployment protocols employed annually beginning in 2009. A set of three traps will be deployed every other week from mid-May through August, weekly during September and October, and every other week again following fall turnover until late November. Sediment traps will be deployed at the South Deep sampling location to a water depth below the thermocline (approximately 33 ft or 10 meters). Sediment traps will generally be deployed for seven-day intervals. After retrieval, supernatant will be drained off via an opening located in the side of the traps well above the deposited sediments. The samples will then be homogenized, poured into bottles, and placed on ice.

Analyses of sediment trap slurry samples to be collected in 2014 and 2015 will include total mercury using a low-level USEPA 6030 series method at a commercial laboratory and total, fixed, and volatile suspended solids at UFI's laboratory using standard methods (Table 2).

### **2.4 Benthic Macroinvertebrates in SMU 8 Surface Sediment (2015)**

Sediment samples for assessing benthic macroinvertebrates in SMU 8 will be collected at nine locations using a petite ponar. Sediment samples for benthic macroinvertebrates will be collected at three different water depths (at 33 ft or 10 meters, at 43 to 45 ft or 13 to 14 meters and at either 49 or 52 ft (15 or 16 meters) depending on the transect) in the vicinity of former sample location OL-STA-80101 approximately 3,500 ft southeast of Willow Bay near the east end of SMU 8, in the vicinity of former sample location OL-VC-80032 off Remediation Area D adjacent to the in-lake waste deposit at the south end of SMU 8 outside the thin-layer cap area, and off Wastebeds 1-8 at the west end of SMU 8. In addition, sediment samples for assessing benthic macroinvertebrates will be collected at two deeper locations (one in the north basin and one in the south basin where water depths exceed 60 ft (18 meters) (Figure 2). Sediment cores collected during 2011 and 2012 off Wastebeds 1-8 showed that the top of the first varve/layer was observed at 7 and 13 cm below the top of sediment at a water depth of 38 ft. The two locations where samples will be collected off Remediation Area D will be adjusted as needed at the time of sampling to avoid any area that has already been thin-layer capped as part of the lake remedy.

Three replicate petite ponar samples will be collected at each location for total of 33 ponar samples (Appendix A.3).

A total of 33 SMU 8 sediment samples will be processed and then sent to a laboratory for counting and identification of benthic macroinvertebrates to the lowest taxonomic level practical, similar to previous years (to the species level for many invertebrates and to the genus level for some).

In addition to samples for macroinvertebrates, one sediment core representing at least the top 30 cm of sediment also will be collected from each of the eleven macroinvertebrate sample locations to assess the extent of sediment varves/layers. Each of these eleven cores will be frozen and later sliced vertically onshore (see Appendix A.2). Visual observations of varves/layers in these six sediment cores will be documented as field notes and photographs.

Prior to collecting sediment samples at each benthic macroinvertebrate location, water quality measurements of temperature, dissolved oxygen, pH, and conductivity will be recorded at every meter of water depth for the water column with the bottom measurement targeted at 1 ft above the lake bottom.

### **3.0 SAMPLING AND ANALYSIS PROCEDURES**

#### **3.1 Mobilization and Sample Location Positioning**

Sediment sampling will be conducted on a relatively calm weather day with little to no wind to allow sampling at each location without the need to anchor. Boat/barge positioning for sediment sample collection and the determination of core locations will be accomplished using a global positioning system (GPS) receiver (or equivalent). Differential GPS coordinates and water depth will be reported for each sediment sampling location.

The gravity corer used successfully since 2009 for SMU 8 sediment sampling will be used again in 2014 to collect sediment samples for this effort.

#### **3.2 2014 SMU 8 Shallow Sediment Sampling and Sample Management**

Corer penetration at each sample location will be to a depth of at least 9 to 12 inches below the top of sediment. Sample recovery with the selected gravity corer is expected to be at or near 100 percent. If at least 9 inches of sediment is not obtained from a location, the sediment sampler will be moved approximately 10 ft to a new location where a second attempt will be made to collect a suitable sample. If the second attempt is also not successful, a third attempt will be made at a location approximately 10 ft away from the original sample location in another direction. If cap material is visible in any of the cores, the sample location and cap material encountered will be recorded and the sample will subsequently be collected at a different location.

Once collected, cores will be capped on both ends and stored vertically on the boat and in a cooler with ice. Sediment depth within each tube will be measured soon after collection. Sample processing will start with measuring the total depth of sediment within each tube. Sediment for analysis will then be cut or extruded from one sampling tube per sample location into slices of sediments 2 cm to 6 cm thick using the sample processing SOP presented in Appendix A.2.

Sample management, equipment decontamination, and other field procedures not specified in this work plan will follow procedures provided in the Onondaga Lake Quality Assurance Project Plan (Parsons, Anchor QEA and UFI, 2012).

Samples of sediment collected for analysis of macroinvertebrates will be sieved using a sieve mesh size of 500 microns. Materials remaining on the sieve will be composited from each depth interval and preserved with 10 percent buffered formalin. Samples will be labeled and recorded on a field log before being sent to a specialty laboratory for macroinvertebrate counts and identifications.

Samples for benthic macroinvertebrate community composition and abundance will be sorted and identified in a laboratory to the lowest taxonomic level reasonably achievable. Prior to sorting, samples will be rinsed through a sieve with water and returned the original container with 75 percent ethanol and rose bengal stain to assist with sorting. Benthic macroinvertebrates will be sub-sampled and sorted prior to identifying individual organisms (Appendix A.3). The extent to which benthic macroinvertebrate samples will be composited and analyzed for other parameters will be discussed with, and approved by, NYSDEC prior to initiating sample collection.

#### 4.0 HEALTH AND SAFETY

Parsons ranks health and safety as the highest priority. The Honeywell HSP2 *Project Safety Plan* (Parsons and O'Brien & Gere, 2010) and subcontractors' safety plans will be applied for this work. Job safety/activity hazard analyses will be reviewed and made more specific for this work effort as appropriate before beginning field efforts.

A safety briefing will be held at the beginning of each day and as new activities are conducted. Safety considerations for near-water and lake sampling include: caution deploying and retrieving heavy equipment; stepping in the sight of lines or cables; slips, trips, falls; and the proper use of personal flotation devices. Boats will be loaded evenly and not overloaded so they are not prone to capsizing.

#### 5.0 QUALITY ASSURANCE AND DATA MANAGEMENT

Sample names, quality assurance/quality control (QA/QC) samples (Table 3), procedures, sample collection, data entry, and data validation for this portion of the work will be conducted in accordance with procedures summarized in the *Quality Assurance Project Plan* (Parsons, Anchor QEA and UFI, 2012). Results from laboratory determinations of mercury and solids content will be incorporated into the Honeywell LocusFocus database and provided to NYSDEC in the preferred electronic data deliverable format following validation.

#### 6.0 SCHEDULE

Cores for surface sediment mercury analysis and cores from microbead plots will be collected during October 2014.

Sediment trap samples will be collected in 2014 and 2015 over a 7-day period every other week from late May through August, weekly during September and October until the lake is no longer stratified, and every other week again until late November.

Benthic macroinvertebrate ponar samples and cores will be collected in June and August of 2015 to coincide with recent prior macroinvertebrate sample collections.

## 7.0 REPORTING

Once the 2014 sample collection and processing, laboratory analyses, and data evaluation efforts are completed, a data summary report will be prepared and submitted to NYSDEC that describes results from the 2014 sampling effort. The report will include presentations of results, recommendations for follow up efforts such as MNR modeling if appropriate, and a data usability summary report for the laboratory analyses of mercury and solids content.

A separate data summary report will be prepared to document the 2015 MNR sampling efforts which will include an assessment of 2015 sediment trap results and an assessment of 2015 benthic macroinvertebrate results based on Bode *et al* (2002) and NYSDEC (2012).

## 8.0 REFERENCES

- Bode, R. W., M. Novak, L. Abele, D. Heitzman, and A. Smith. 2002. Quality Assurance Work Plan For Biological Stream Monitoring in New York State. NYSDEC Division of Water.
- Honeywell, Parsons, and O'Brien & Gere (OBG). 2008. Honeywell Syracuse Portfolio Health and Safety Program. Updated June 2008.
- NYSDEC and USEPA Region 2. 2005. *Record of Decision. Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site*. July 2005.
- NYSDEC, 2012. *Standard Operating Procedure: Biological Monitoring of Surface Waters in New York State*. Division of Water. NYSDEC SOP 208-12, Revision 1. March 29, 2012.
- Parsons and Anchor QEA, 2012. *Onondaga Lake Capping, Dredging, Habitat and Profundal Zone (Sediment Management Unit 8) Final Design*. Prepared for Honeywell. March 2012.
- Parsons, Anchor QEA, and Upstate Freshwater Institute, 2012. *Quality Assurance Project Plan for Onondaga Lake Construction and Post-Construction Media Monitoring (Surface Water, Biota and Sediment)*. Prepared for Honeywell. December 2012. Draft.
- Parsons and O'Brien & Gere, 2010. *Honeywell Syracuse Portfolio Health and Safety Program*. Prepared for Honeywell. May 2010 with Emergency Response Plan updated in 2012.

**TABLE 1**

**SURFACE SEDIMENT SAMPLING ASSOCIATED WITH MERCURY ANALYSIS  
FOR 2014**

<p>20 Sampling Locations</p> <ul style="list-style-type: none"> <li>• Throughout SMU 8</li> <li>• Most recently sampled between 2007 and 2011</li> <li>• See Figures 1A and 1B for locations.</li> </ul>	<p><u>Four locations in the North Basin:</u> OL-VC-80157, OL-STA-80069, OL-STA-80225, and OL-VC-80068</p> <p><u>Three locations in the Ninemile Creek Outlet Area:</u> OL-VC-80073, OL-STA-80226, and OL-STA-80227</p> <p><u>Three locations in the Saddle between the North Basin and South Basin:</u> OL-VC-80075, OL-STA-80103, and OL-STA-80234</p> <p><u>Six locations in the South Basin:</u> OL-STA-80076, OL-STA-80229, OL-VC-80078, OL-VC-80080, OL-STA-80082, and OL-STA-80084</p> <p><u>Four locations in the South Corner south of the South Basin:</u> OL-STA-80085, OL-VC-80172, OL-VC-80177, and OL-STA-80088</p>
Sample Collection Method	Gravity corer used previously with success in SMU 8 with a diameter large enough to collect sufficient sample volume for mercury analysis
Sample Depth Intervals for Analyses (3 depth intervals at each location)	<p>0 to 2 cm (0 to 0.8 in);</p> <p>2 to 4 cm (0.8 to 1.6 in); and</p> <p>4 to 10 cm (1.6 to 4 in.)</p>
Field Observations	Standard soil-sediment classification
Laboratory Analyses (60 matrix samples)	Total mercury (Method USEPA SW7470A or 7471A)
Quality Assurance Samples (field duplicates, matrix spikes, and matrix spike duplicates)	Four sets (12 samples)

**TABLE 2**  
**2014 MNR LABORATORY ANALYSES**

<b>Parameter</b>	<b>Method(s)</b>	<b>Locations</b>	<b>Total Number of Samples for 2014<sup>x</sup> MNR monitoring</b>
Total Hg in sediment <sup>+</sup>	EPA 7400 series	20 throughout SMU 8 (see Table 1)	60
Total Hg in sediment trap slurry <sup>+</sup>	EPA 1631E (low level)	1 station (South Deep) at the 10-meter water depth bi-weekly from mid-May until mid-November and weekly during September and October until fall turnover	18
Total suspended solids, fixed and volatile solids in sediment trap slurry	Standard Methods	1 station (South Deep) at the 10-meter water depth bi-weekly from mid-May until mid-November and weekly during September and October until fall turnover	18

**Footnotes:**

<sup>x</sup> Field samples only. See Table 3 for total numbers of samples to be analyzed at a laboratory including field duplicates.

<sup>+</sup> Total mercury analysis of sediment will be performed by a qualified commercial laboratory contracted by Honeywell.

**TABLE 3  
QAPP WORKSHEET 20 – FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE  
FOR 2014 MNR MONITORING**

<b>Matrix</b>	<b>Analytical Group</b>	<b>Concentration Level</b>	<b>No. of Sampling Locations</b>	<b>No. of Field Duplicate Pairs</b>	<b>No. of Matrix Spikes</b>	<b>No. of Matrix Spike Duplicates</b>	<b>Total No. of Samples to Lab</b>
Sediment	Total mercury	Moderate	20 stations and 3 depth intervals per station (60 samples)	4	4	4	72
Sediment slurry from sediment traps	Total mercury	Low	1 station, 1 trap, 18 sampling trips	0	2	2	22
Sediment slurry from sediment traps	Total, fixed, and volatile suspended solids	Moderate	1 station, 18 sampling trips				18

**FIGURE 1A**

**SMU 8 SEDIMENT SAMPLE LOCATIONS FOR MERCURY IN NORTH  
HALF OF ONONDAGA LAKE**



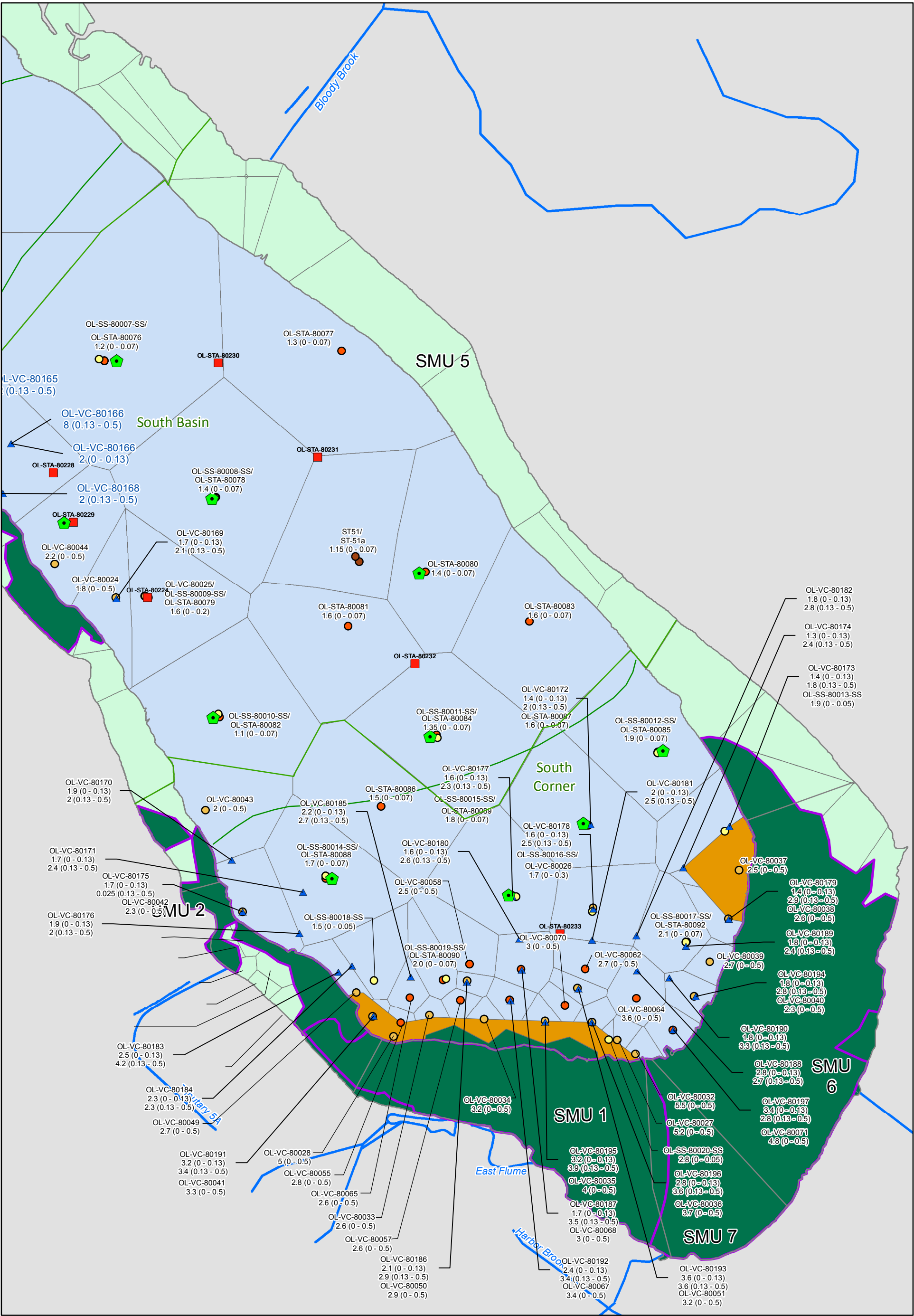


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## FIGURE 1B

### SMU 8 SEDIMENT SAMPLE LOCATIONS FOR MERCURY IN SOUTH HALF OF ONONDAGA LAKE

05/06/2010



Legend

- RI (1992 and 2000)
- PDI Phase 1 (2005)
- PDI Phase 2 (2006)
- PDI Phase 3 (2007)
- PDI Phase 4 (2008)
- PDI Phase 5 (2009)
- PDI Phase 6 (2010)
- PDI Phase 7 (2011)

Remediation Areas

SMU 8 zone polygons based on PDI Phases 1 through 5

Littoral zone

NYSEDEC Demarcation for SMU 8

Thin-Layer Cap Boundary

Sediment Sample Location ID with mercury result (mg/kg) and depth interval.

2014 Sample Locations

NOTES

- The 30-foot water depth contour is the boundary between the littoral zone and SMU 8.
- Water depth is based on average lake elevation of 362.82 feet.
- 0.X is total mercury concentration in mg/kg (ppm). 0.Y is the sample bottom depth in feet.
- RI results are included for the littoral zone but not for SMU 8 because of natural recovery ongoing in SMU 8.

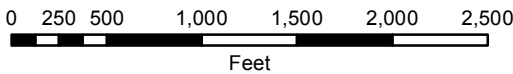


FIGURE 1B

Honeywell

Onondaga Lake  
Syracuse, New York

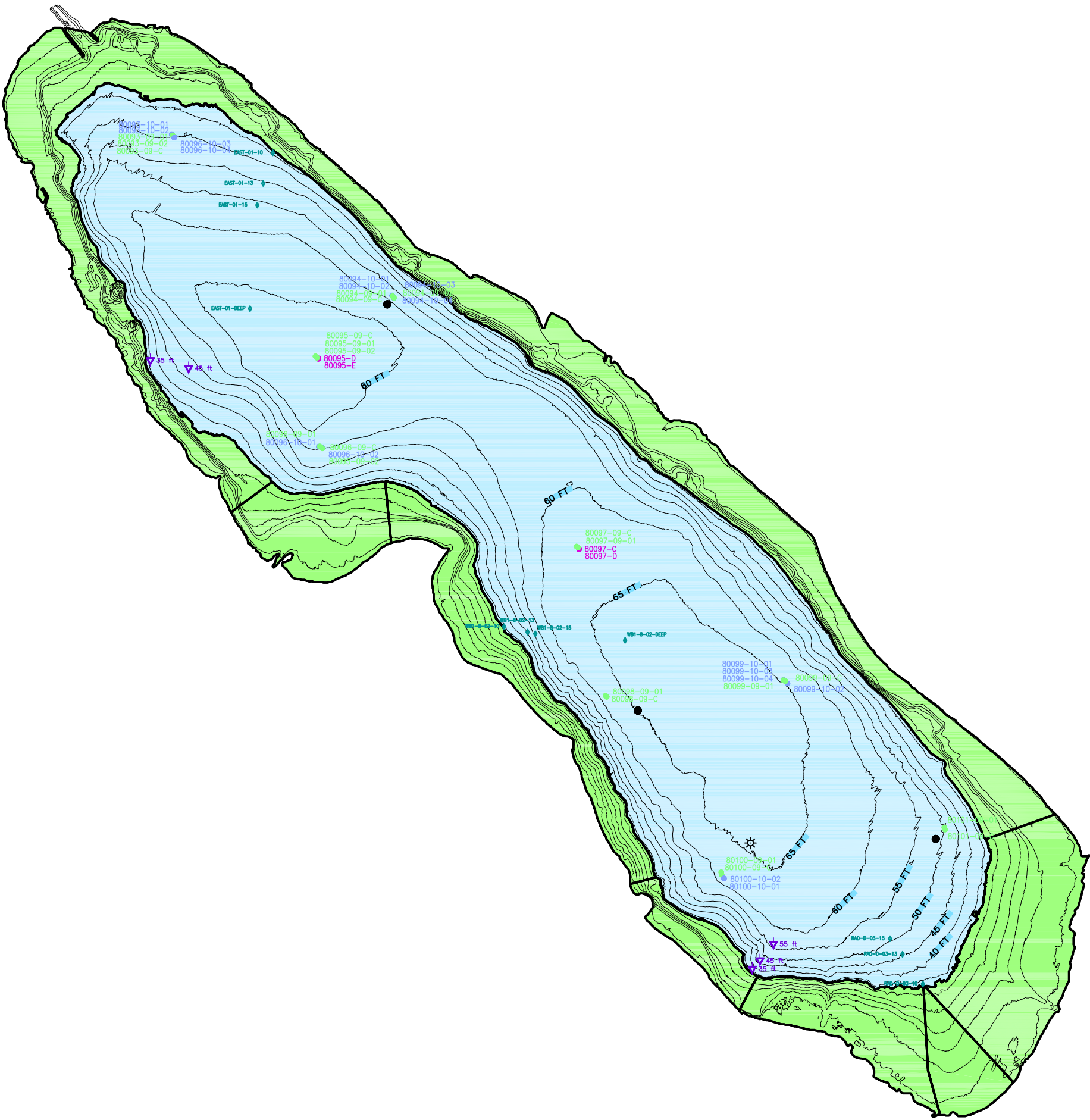
SMU 8 Sediment Sample Locations for Mercury  
in South Half of Onondaga Lake (mg/kg)

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**FIGURE 2**

**MICROBEAD PLOT AND BENTHIC MACROINVERTEBRATE  
SEDIMENT SAMPLE LOCATIONS IN SMU 8**



NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT.

-  SOUTH DEEP LOCATION
-  2009 MICROBEAD LOCATIONS
-  2010 MICROBEAD LOCATIONS
-  2011 MICROBEAD LOCATIONS
-  2011 FROZEN CORE LOCATIONS (WITH WATER DEPTHS SPECIFIED)
-  PROPOSED 2014 MICROBEAD LOCATIONS
-  FUTURE MACROINVERTEBRATE SAMPLE LOCATIONS

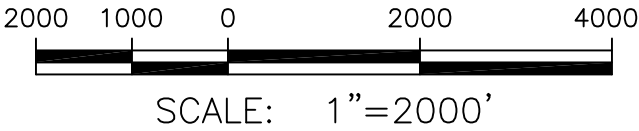


FIGURE 2	
<b>Honeywell</b>	ONONDAGA LAKE SYRACUSE, NEW YORK
MICROBEAD PLOT, MICROINVERTEBRATE AND OTHER SAMPLE LOCATIONS IN SMU 8	
<b>PARSONS</b> 301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560	



**APPENDIX A**

**STANDARD OPERATING PROCEDURES**

**A.1 SMU 8 SEDIMENT CORE COLLECTION**

**A.2 SMU 8 SEDIMENT CORE PROCESSING**

**A.3 BENTHIC MACROINVERTEBRATE COLLECTION AND  
PROCESSING**

## **A.1 STANDARD OPERATING PROCEDURE (SOP) FOR SMU 8 SEDIMENT CORE COLLECTION**

Based on assessing numerous types of sediment cores for SMU 8-related sampling work, a particular gravity corer was selected and used beginning in 2009 to collect sediment samples from the upper few inches of SMU 8 sediment for microbead placement analyses. The selected gravity corer is manufactured by Eijkelpamp, The Netherlands, and was pre-tested extensively in SMU 8 during 2009 before being used effectively in Onondaga Lake during 2010, 2011 and 2012. The gravity corer consists of a frame with strengthening ribs, falling weight, and sampler. This corer was selected due to its ability to collect samples while not disturbing the surface sediment.

Sediment samples approximately 2 to 4 inches in diameter that are relatively undisturbed are collected with the gravity corer. Weights can be placed over the gravity corer as needed to improve penetration into the sediment. Using a hoisting unit on board of a boat, the sampler can be lowered in free fall. By its own weight and velocity, the apparatus penetrates the submerged sediment. The depth of penetration is in part determined by the composition of the submerged sediment. Two different cores may need to be collected from each location to provide sufficient quantity of sample for the specified laboratory analyses.

Sample handling, equipment decontamination, and sample management is to be conducted as described in the appropriate standard operating procedures (SOPs) developed for Onondaga Lake PDI work (Parsons, 2005a and b). Suitable gloves are to be used while handling the corer to minimize any potential cuts or scrapes.

1. Check corer condition prior to each use.
2. Measure water depth.
3. Securely attach the corer to a winch with cable or line of sufficient strength to accommodate the weight of the sampler, any additional weights, and sediment to be sampled.
4. Slowly lower the corer using a winch and A-frame or boom arm through a moon pool or over the side of the vessel. Maintain tension on the corer to keep it vertical.
5. After the corer contacts the sediments on the bottom, relax the tension as needed to allow the corer to penetrate into the sediment.
6. Place tension on the cable/line and slowly retrieve the corer and sediment sample.
7. Discard the sample if less than 9 inches of sediment are collected or if there is any sign of sample washout.

8. Set the corer into a bracket on the boat deck to hold the corer in a stable vertical position.
9. Record observations about the suitability of the sample including penetration depth, sample depth, presence of any debris, bubbles, coloring, or evidence of agitation due to sample collection. Also, record any evidence that the surface sediment is undisturbed and intact (e.g., any different color or texture and corresponding depth). If the sample is collected within a microbead plot, note any visual band of microbeads or spread down the edges, measure any definite band or layer. Take 2-3 digital photographs of the core.
10. Unthread the core from the corer apparatus.
11. Set the corer into a bracket on the boat deck to hold the corer in a stable vertical position.
12. Carefully siphon off excess water and cap the top of each tube while minimizing head space.
13. Wipe the outside of each tube.
14. While maintaining tubes in a vertical position, record any visual variations in sediment characteristics with depth.
15. Seal the top end with cap.
16. Label the outside of each core tube with the sample identification (ID) and core orientation with an up arrow. Also label the top cap with the sample ID.
17. Maintain core in a vertical position while transporting to a processing facility on shore.
18. Decontaminate the corer as needed and discard any excess sample as non-hazardous waste.

#### Gravity core apparatus

- Core tube (3-5/8 inch dia.)
- Rubber ‘Fernco’ coupling (attaches core tube to core apparatus)
- Hose clamps (secures rubber coupling)
- Weight carabineer (secures gravity core apparatus and rope)
- Rope (approx 50 ft long)
- 4 lengths of chain (20-30 links each)
- 8 threaded chain links
- Round flange weights

#### Tools

- Measuring tape
- Hacksaw (for cutting lengths of core tube)
- Crescent wrench (for threaded chain links)
- Nut driver or flathead screwdriver (for hose clamps)
- Large putty knife



## Additional Items

- Duct tape (sample labels) and permanent marker
- 5gal/2gal buckets with lids

## **A.2 STANDARD OPERATING PROCEDURE FOR SMU 8 SEDIMENT SAMPLE PROCESSING (SEGMENTING)**

This procedure describes how sediment samples will be segmented from each collected sediment core. Samples for chemical analysis to further assess natural recovery in SMU 8 are to be discrete depth sections with no transferring of sediment between subsections. This segmenting is essential to obtain accurate depth profiles, and it was tested and used successfully during 2009 to document the presence of microbead markers at various SMU 8 locations.

Contact between sampler gloves and sample must be avoided. For each sample location, the procedure for processing the tubes of sediment is as follows:

### Procedure for transporting and slicing frozen cores

During transport, every effort should be made to ensure that each core is not disturbed.

1. Place the core vertically into a cooler and pack with dry ice to freeze the sediment so it can be cut without disturbing the sediment cross section.
2. Once the core has been completely frozen (generally after 24 hours on dry ice), lay flat into a crib to prevent the cores from moving. The cores should be frozen to a point where it difficult to scrape excess ice off the surface of the exposed cross-section following cutting.
3. Using a reciprocating saw, cut the core lengthwise into two cross sections.
4. Apply a heat source sparingly to melt the ice slightly along the cut surface to allow excess ice to be scraped from the cores using a standard dry wall tapping knife. Following heating and additional scraping, the exposed cross-surfaces of the frozen cores can be visually inspected for varves/layers.

### Preparation of sediment cores for sub-sampling

Prior to sub-sampling the collected sediment cores it is necessary to remove the overlying water. Additionally, each sediment core is to be photographed and described, with particular detail being paid to the following:

- Evidence of microbeads (if the core is from a microbead plot), including details of whether present as a band, as a smear on the core tube, present on the surface
- Evidence of disturbance to sediment core, particularly due to gas escaping from the sediment during or after collection
- Physical features, such as presence of varves (annually laminated sediments)

After the core is photographed and described, record total sediment depth (or top of sediment position) within each tube. Note any settling which may have occurred between the top

of sediment in the core tube recorded on the boat and the top of sediment in the core tube recorded prior to beginning sample extrusion.

#### Sample processing

1. Carefully and slowly siphon overlying water from each core using a clean, plastic syringe (or equivalent). Note that the siphoning speed can be adjusted by raising or lowering the discharge hose with the slowest speeds experienced when the discharge is just below the water level inside the core tube. Do not elevate the discharge hose above the level of water in the core tube because this may cause the siphon to reverse direction and cause a jet of water to be directed onto the sediment surface. Slight disturbance of the sediment at or near the outside rim of each core is acceptable when siphoning water; however it is essential that the surface sediment in the center of the core remains undisturbed.
2. Remove the bottom cap of the core and insert a PVC plug into the base of the tube to allow the tube and its contents to be placed on a pedestal. Slowly push down the tube on the pedestal forcing the sediment to be pushed up to extract the necessary intervals.
3. While on the pedestal, use a pre-cut piece of tube measured to the appropriate sample thickness (i.e., 2 cm for the 0 to 2 cm and 2 to 4 cm depth intervals and 6 cm for the 4 to 10 cm depth interval). Place the pre-cut tube on top of the core tube, and then pull down to extract the sediment into the pre-cut piece. Next, insert a putty knife at the bottom of the pre-cut piece. After inserting the putty knife, the pre-cut piece should be easily removed with little or no loss of sediment. This method of extraction ensures that the proper sample interval is collected and analyzed.
4. Place a small amount of sediment from each of the intervals into the appropriate jar with as little headspace as possible. Be cautious not to collect any sediment that was touching the sides of the sample core tube.
5. Place the remaining sample and putty knife into a clean aluminum pan.
6. Remove the center portion of the sample by inserting a clean, small-diameter plastic tube into the sediment. Remove the outer pre-cut tube and wipe clean from the inner portion of the tube the sediment on the perimeter.
7. Transfer the sediment sample to a clean aluminum pan to homogenize the sediment within a particular sampling interval from a single sampling location. Designate one pan for each vertical interval.
8. Homogenize the sediment using plastic spoons or nitrile-gloved hands.
9. Place individual subsamples into appropriate jars provided by the laboratory conducting the chemical analyses and label each jar and chain-of-custody.

10. Send the jarred samples to the laboratory that day or refrigerate and send to the lab as soon as practical.
11. Repeat Steps 3–10 above until each sample interval has been collected. Clean equipment between uses.

### **A.3 STANDARD OPERATING PROCEDURE FOR BENTHIC MACROINVERTEBRATE COLLECTION AND PROCESSING**

#### **A.3.1 PURPOSE AND SCOPE**

The purpose of this document is to define the SOP for benthic macroinvertebrate collection in Onondaga Lake. Benthic invertebrate sampling will be conducted to collect organisms for assessing community composition. This SOP describes the necessary equipment, field procedures, materials, and documentation procedures necessary to conduct the benthic macroinvertebrate sampling. The scope of work including quantities and locations is defined in the Work Plan.

#### **A.3.2 EQUIPMENT LIST**

- petite ponar with rope
- US Standard No. 30 mesh (600µm opening) Nalgene sieve
- Benthic sieve bucket (500 µm mesh)
- 5 gal buckets
- wash bottle and garden sprayer
- water quality meter
- sampling vessel
- Personal flotation device (PFD) to be worn by each person on water and on land within 6 ft of the lakeshore
- sample containers
- 10 percent buffered formalin
- rose bengal dye
- sample labels
- Digital global positioning system (DGPS)
- resealable plastic bags
- sample containers
- ethanol
- sorting tray
- Plexiglas divider for sub-sampling
- forceps
- spatula
- dissecting microscope

- Petri dish
- vials
- labels
- alcohol proof marker
- deionized water
- balance for weighing samples
- cellular phone
- digital camera
- field notebook

### A.3.3 PROCEDURES

#### Sample Collection

1. Upon arrival at a sampling station, position the boat at desired water depth. Record water depth.
2. Collect water quality data at one meter intervals through the water column, and just off the bottom (pH, DO, temperature, conductivity). Log data on the meter to download at the end of the day.
3. Collection at each station will begin with community samples followed by the sediment sample. Decon the ponar sampler prior to collection of the first sample in accordance with previously-implemented decontamination procedures (SOP 3; Parsons, 2005).
4. Tie one end of a rope to the ponar and the other to the boat. Before lowering the ponar into the water, with the line taut, remove the safety pin and replace with the pinch pin. As long as the line is taut the pinch pin will stay in place. The petite ponar is now set, and will be lowered into the water, and allowed to free-fall for the last 0.5 m [1.6 ft] to the bottom with a slack line. The impact with the bottom activates the closing mechanism, and the dredge is then slowly brought to the surface.
5. Retrieve the ponar sampler. Once at the surface, place the petite ponar over a 500  $\mu$ m mesh sieve pail), check the surface of the sample prior to opening the jaws allowing the contents to drop into the pail. Resample if no overlying water is present (over penetrated), if sampler is only partially filled with sediment, or if sample is not relatively uniform across. Record the depth of sediment sampled. If a sample is rejected, repeat procedure. Rinse off any remaining material from the ponar with lake water.
6. Repeat procedure to obtain the necessary number of samples (three each for community composition).

## Community Composition Collection

1. Collect 3 replicate ponar samples following sample collection steps 4-6 and place each sample into a separately labeled bucket, or sieve bucket (be sure to sample at different points on the boat so as not to sample the exact same location twice).
2. Gently agitate the sieve bucket over the side of the boat until all fine sediment particles are removed. Transfer the contents remaining on the sieve to a labeled wide mouth plastic sample jar (size may vary depending on amount of material). Add buffered 10 percent formalin with rose Bengal dye (wear Nitrile gloves and goggles during this operation), and fill the sample jar to just below the shoulder. Cap tightly and gently invert the sample several times to distribute the fixative solution. Double check the label(s), making sure all required information is recorded.
3. Proceed to the next location and repeat procedures for sample collection.

## Laboratory Sorting

1. In the laboratory (under the laboratory exhaust hood), pour the contents of sample into a sieve with a mesh size of 500  $\mu$ m. Rinse with tap water to remove any fine particles left in the sample from the field.
2. Transfer the sample to a sorting tray and distribute homogeneously over the bottom of the pan.
3. With the use of an over-head illuminated magnifier, scan the sample and sub-sample 100 random organisms according to Bode et al (2002). For large samples, divide the sample into quarters to prevent biasing the data by selecting the larger easily located organisms. As they are removed, sort the organisms into major groups. After the major groups are sorted, place individual groups into four dram (0.5 ounce) vials containing 70 percent ethyl alcohol, and count them. Record the counts on the tally sheet.  
**Note:** If an entire sample is sorted and less than 100 organisms are found, make a note on the tally sheet stating that the entire sample was sorted.  
**Note:** Identify all organisms to order, with the exception of chironomids and oligochaetes.
4. Count dreissenid mussels within the first 100 random macroinvertebrate sorted (Sort 1). Next, sort out an equal number of non-zebra mussel macroinvertebrates from the original sample (or quarter) (Sort 2). Place the additional macroinvertebrates in separate vials from the initial sorting. Distinguish on the container labels as 1st and 2nd sorting. The objective is to obtain a sample of 100 macroinvertebrates including dreissenid mussels, and a sample of 100 macroinvertebrates without dreissenid mussels.
5. With an alcohol proof pen make a small label with date, Station ID, Replicate Number, Identification (order or family), and sampler initials and place into four dram (0.5 ounce) vials.

6. Place vials into a whirl-pak, fill out chain of custody and log sample into log book. Place chain of custody and whirl-pak with vials into a one gallon zip lock bag and place into QA/QC box.
7. Return remaining sample to original container in 70 percent ethanol and indicate on the cap that the sample was sorted, then initial and date.

QA/QC for Sample Sorting - The following quality assurance and quality control procedures will be utilized for every sample location, and every replicate corresponding to that location.

1. Quality control checks will not be performed by the original sorter. Identify all samples that did not have 100 organisms sorted. Double check the original sample for any organisms that may have been overlooked.
2. With the logbook in hand, remove the first 10 samples sorted and identified. Following the steps listed below, determine if a sample passes or fails QA/QC. If all 10 “pass” the quality control, the sorter may randomly select one out of the next 10 samples. If this sample passes, randomly select one out of the next 10 samples again, utilizing this procedure for the entire sample.
3. Determine if sample passes or fails QA/QC:
  - If less than 100 organisms are present in sample. Check/sort the original full sample for additional organisms. If additional organisms are found, add to the tally (up to 100), sample fails QA/QC.
  - Check counts for the breakdown by family. If incorrect, start again.
  - If a sample fails quality control, the next 10 samples will be checked before the one in 10 procedures is resumed.
4. Once the QA/QC is corrected or confirmed, record this information on the chain of custody and in the log book.

#### **A.3.4 PERSONNEL**

Field personnel assigned to the various site activities are responsible for completing their tasks according to this and other appropriate procedures. Field personnel are responsible for reporting deviations from the procedure or nonconformance to the Field Sampling Manager. Only qualified field personnel shall be allowed to perform this procedure. Qualifications will be based on previous experience and health and safety training. An aquatic biologist with invertebrate experience will oversee these activities.

The sample remaining following initial sorting and qualified control checks will be sent to an outside laboratory for identification to the lowest taxonomic level reasonably achievable.

#### **A.3.5 REFERENCES**

R.W. Bode, M. Novak, L. Abele, D. Heitzman, and A. Smith. 2002. Quality Assurance Work Plan For Biological Stream Monitoring in New York State. NYSDEC Division of Water.

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