ADDENDUM 2 (2010)
ONONDAGA LAKE BASELINE MONITORING
BOOK 2
FISH, INVERTEBRATE, AND LITTORAL WATER MONITORING FOR 2008

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JULY 2010

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LIST OF ACRONYMS

DDT	Dichlorodiphenyl trichloroethane
DUSR	Data Usability and Summary Report
NYSDEC	New York State Department of Environmental Conservation
PCB	Polychlorinated Biphenyl
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

This second addendum to the 2008 Book 2 Work Plan (Parsons et al., 2008) presents the scope for the 2010 biota monitoring in the context of the baseline monitoring program objectives, program elements, and data uses, as well as the results of the 2009 program. The 2010 scope is the same as that for 2008 with the exception of modifying the number of sampling locations and frequency of monitoring for macroinvertebrates and adding a telemetry study of bass and walleye to better understand migration into and out of the lake. Key components of the 2010 Book 2 work scope are: 1) fish tissue analysis, 2) food web structure and fish community assessment, 3) benthic macroinvertebrate tissue analysis and community assessment, 4) analysis of sediment co-located with benthic macroinvertebrate tissue, 5) littoral zone water sampling, 6) adult sport fish telemetry work, and 7) community assessment work for lake sturgeon. Laboratory analyses will include mercury in prey fish and four species of adult sport fish; mercury and methylmercury in benthic macroinvertebrates and co-located sediment; polychlorinated biphenyls (PCBs), dichlorodiphenyl trichloroethane (DDT), hexachlorobenzene, dioxin/furans and lipids in a subset of prey fish and adult sport fish; assessment of fish population and community composition; and sampling and identification of fish gut contents. The rationale for the 2010 scope and modifications to the 2008 scope are presented. The work proposed in this addendum will use the 2008 Book 2 Standard Operating Procedures (SOP), the 2008 Book 2 Quality Assurance Project Plan (QAPP), and new SOPs for fish telemetry and lake sturgeon community assessment work. A worksheet revised from the 2008 Book 2 QAPP is provided as Appendix A. The fish telemetry SOP is presented as Appendix B. A community assessment SOP for lake sturgeon is presented as Appendix C.

SECTION 1

INTRODUCTION

This addendum to the 2008 Onondaga Lake Baseline Monitoring Book 2 Work Plan (Parsons, Exponent, and QEA, 2008) presents the scope for Honeywell's 2010 Onondaga Lake biota monitoring in the context of the baseline monitoring program objectives, program elements, and data uses. The rationale for key modifications to the 2008 Book 2 Work Plan is also presented. The Book 2 baseline monitoring data collected during 2008 and 2009 were assessed in the context of the *Baseline Monitoring Scoping Document* (Parsons, Exponent, and QEA, 2009a) to determine an appropriate Book 2 baseline monitoring work scope for 2010.

The work proposed in this addendum will use the 2008 Book 2 Standard Operating Procedures (SOP) and Quality Assurance Project Plan (QAPP). A revised worksheet 18 from the 2008 Book 2 QAPP is provided as Appendix A.

1.1 OBJECTIVES AND DATA USES

Program objectives, program elements, and data uses for Book 2 monitoring previously described in the draft *Baseline Monitoring Scoping Document* are presented in Table 1 along with a summary of how each was addressed in 2008 and 2009 and is addressed by the work described in this addendum for 2010.

1.2 RATIONALE FOR MODIFICATIONS TO THE 2008 BOOK 2 WORK PLAN

This 2010 addendum includes six primary modifications to the 2008 Book 2 Work Plan to streamline monitoring components and add new components to address baseline monitoring objectives. These six modifications and their rationales are as follows:

- Fish tissue preparation

  During 2008 and 2009, fillet and tissue plug samples were collected from each of four sport fish species (i.e., walleye, smallmouth bass, pumpkinseed sunfish, brown bullhead). Tissue plugs were evaluated for use in reducing fish mortality in future years due to continued harvesting while still collecting the required tissue samples for mercury analysis. Evaluation of data from 2008 and 2009 indicates a good correlation among the four species in concentrations, indicating use of fish tissue plugs appears to be suitable for use during future monitoring events for mercury (see Figure 1).

  For 2010, chemical analyses of all four adult sport fish types will be conducted exclusively on fillet samples as requested by the New York State Department of Environmental Conservation (NYSDEC). All of the fillets will be analyzed for mercury, and some will be analyzed for PCBs, DDT and its metabolites, hexachlorobenzene, dioxins/furans, and lipid content.

Consistent with the 2008 work plan, each of the individual adult sport fish and composite prey fish samples will be analyzed for total mercury. In addition, a subset of adult sport fish fillet samples (12 per species for a total of 48 samples) will be analyzed for PCBs, DDT and its metabolites, hexachlorobenzene, and lipids. Dioxins/furans will be analyzed in five samples from each of the four adult sport fish species for a total of 20 samples. PCBs, DDT and its metabolites, hexachlorobenzene, and lipids will also be analyzed in a subset of prey fish (10 composite samples). Samples selected for analysis of PCBs, DDT and its metabolites, hexachlorobenzene, and lipids will be representative of the various lake sampling locations to the extent practical.

- Otolith analysis to estimate ages in adult smallmouth bass and walleye

  In 2009, both scales and otoliths (small ear bones) were obtained from bass and walleye. More accurate estimates of adult smallmouth bass and walleye ages are obtainable from fish otoliths than from fish scales. Therefore, otoliths will be collected from smallmouth bass and walleye and analyzed in 2010 to provide a more accurate assessment of the age of these fish in the lake to help understand mercury dynamics within the lake food web. Spines are typically adequate to estimate ages of brown bullhead, and scales are typically adequate to estimate ages of pumpkinseed.

- Telemetry for adult smallmouth bass and adult walleye

  Tracking of fish movements has been added as part of Honeywell's 2010 baseline monitoring program for Onondaga Lake. Tracking movements will provide additional information to better understand how adult smallmouth bass and walleye are using the lake and thereby help assess mercury bioaccumulation by assessing fish exposure and fish movement. The focus for fish tracking work will be on smallmouth bass and walleye, because these two sport fish have been analyzed over the past several years and represent top predators in the lake food web.

- Benthic macroinvertebrate tissue collection, community composition, and abundance

  Analyzing mercury levels in macroinvertebrates provides additional data that will aid in the future in understanding remedy effectiveness. Benthic macroinvertebrate characterization will be conducted in 2010 with four modifications from the 2008 Book 2 Work Plan. First, due to the similarity of results between samples collected in August and November 2008, benthic macroinvertebrate sampling will be conducted one time in 2010 during the month of August. Second, since many of the 18 locations sampled for benthic macroinvertebrates during 2008 did not contain sufficient mass to obtain tissue mass needed for lab analyses, a total of nine locations will be sampled for macroinvertebrate tissue during 2010. One sample each of chironomids, zebra mussels, and amphipods will be sorted from each of the nine locations. Third (and new for 2010), if sufficient mass of crayfish can be collected from one or more of the

macroinvertebrate sample locations, those samples will be collected for chemical analysis and also sent to a stable isotope laboratory for analysis of ^{15}N and ^{13}C isotopes, consistent with stable isotope work completed for Honeywell during 2009. Fourth, benthic macroinvertebrate community composition will be determined during 2010 from three replicates collected at each location, instead of five, due to the similarity in composition among replicate samples in 2008 (see Parsons, Exponent, and Anchor QEA, 2009b).

- Co-located sediment samples

  Sediment sampling conducted in conjunction with the 2008 macroinvertebrate sampling served as a reference point of conditions to which the organisms are exposed. Co-located sediment samples were collected in 2008 during both the August and November invertebrate sampling efforts with little difference in sediment concentrations observed between August and November. Sediment concentrations at these littoral zone sampling locations are in all likelihood not significantly different in 2010 from sediment concentrations quantified in 2008. Nonetheless, as requested by NYSDEC, co-located sediment samples will be collected in conjunction with the 2010 macroinvertebrate sampling work. The co-located sediment samples will be processed into 0 to 2- centimeter and 2 to 15-centimeter depth intervals and analyzed consistent with the 2008 Book 2 sediment sampling effort.

- Lake sturgeon community assessment

  Fish community assessment procedures have been modified for 2010 to more fully assess the presence of lake sturgeon in Onondaga Lake.

The phytophilous community was not highly abundant in 2008 and, therefore, these surveys will not be repeated during 2010. Phytophilous invertebrates will be surveyed in 2011 consistent with the procedures in the *2008 Book 2 Work Plan* (Parsons Exponent, and QEA, 2008) and in conjunction with Honeywell's 2011 habitat monitoring work. The Onondaga County Department of Water Environment Protection will conduct a macrophyte (vascular aquatic plant) survey during 2010.

SECTION 2

2010 BOOK 2 BIOTA MONITORING

The 2010 biota monitoring consists of three components: fish tissue analysis, food web structure and fish community assessment, and benthic macroinvertebrate tissue analysis and community assessment. These components are briefly described below and summarized in Table 2.

2.1 FISH TISSUE ANALYSIS

Prey fish and adult sport fish will be collected from eight locations in the lake, consistent with Honeywell's 2008 baseline fish sampling and analysis work (Parsons, Exponent, and QEA, 2008) and the 2009 Book 2 Addendum 1 work (Parsons, Exponent, and QEA, 2009c). As in 2008 and 2009, 50 samples of each of the four adult sport fish species (i.e., pumpkinseed, brown bullhead, smallmouth bass, and walleye) will be targeted with approximately even distribution among the sampling locations. A maximum of 40 composite samples of prey fish (minnow species) will be collected from each of the eight locations (five composites per location) as was also conducted in 2008. Reasonable attempts will be made to include at least two alewife (less than 7 inches – 180 millimeters (mm) - total length) composites from each location. As part of the 2009 prey fish sampling, gillnets were set during nighttime hours in approximately 4 to 6 meters of water depth at each prey fish location to capture alewife less than 180 mm long to yield two composites per location for mercury analysis. Due to the lower mercury levels observed in these samples and the extra effort required for capture, gillnetting will not be performed in 2010 for alewife collection.

Sport fish samples will be collected starting in June and composite prey fish samples will be collected in August. Sampling in late August 2008 yielded few smallmouth bass, so sampling was moved to mid-June 2009 in an attempt to obtain more smallmouth bass just after nesting. While more samples were collected in 2009 compared to 2008, smallmouth bass of adequate size were still difficult to capture. Due to the availability of slightly smaller smallmouth bass in 2008 and 2009, and to help better understand mercury dynamics in this species, a subset of smallmouth bass in the 8 to 12 inches (200 to 300 mm) total length range will be collected. Prey fish will be collected in August, consistent with the 2008 and 2009 sampling programs. Figure 2 shows the 2010 fish sampling locations. Every reasonable effort will be made to collect fish during 2010 from the locations where fish were collected during 2008 and 2009.

Age will be estimated for each individual adult sport fish collected for tissue chemical analysis using one of three different fish aging techniques: scales, spines, and otoliths. Scales will be used to estimate fish age for pumpkinseed. Pectoral spines will be used to estimate fish age for bullhead. Otoliths will be used to estimate fish age for smallmouth bass and walleye. For

older fish, otoliths can quantify fish age more distinctively that scales. Otoliths from smallmouth bass and walleye will be removed prior to submittal to the analytical laboratory.

Mercury will be analyzed in all fish samples collected for chemical analysis. In addition, PCBs, DDT and metabolites, hexachlorobenzene, and lipids will be analyzed in 12 samples from each of the four adult sport fish species and in 10 composite prey fish samples. Dioxins/furans will be analyzed in five samples from each of the four adult sport fish types being analyzed. Fillet samples will be prepared for analyses of all four adult sport fish types to be collected. Every reasonable effort will be made to collect and analyze fish for PCB, DDT, hexachlorobenzene, and lipid analysis during 2010 from the locations where fish were collected during 2008 and analyzed for PCB, DDT, and lipids.

2.2 FOOD WEB STRUCTURE AND FISH COMMUNITY ASSESSMENT

The 2010 biota monitoring will continue the 2008 Book 2 work on food web structure and fish community assessment. The three sampling activities are 1) assessment of fish population, 2) assessment of fish community composition, and 3) sampling and analysis of fish gut contents.

Fish population will be evaluated in 2010 with the same mark-recapture techniques used in 2008 and 2009. The Onondaga Lake fish community will be assessed in 2010 at a minimum of eight of the locations sampled during 2008 and 2009. Sampling at all locations will include seining, gill netting, trap netting, and electrofishing as was done during 2008 and 2009. Pop netting will not be used in 2010 due to the relative inefficiency of fish capture in the lake using this technique in 2008. Vegetated littoral zone habitats will be sampled using a combination of trap netting, seining, and electrofishing. Fish community assessments will be conducted several times from June through October to account for species shifts due to changes in water temperature and dissolved oxygen concentrations, as well as fish immigration and emigration. These data also will be used to assess the reproductive success of sport fish species.

Sampling and analysis of fish gut contents will be conducted from adult sport fish samples collected for tissue sample analysis. Stomachs will be pumped by gastric lavage and preserved in buffered formalin prior to processing. Prey fish submitted for tissue analysis will not be sampled for stomach contents. In addition, sport fish collected as part of the fish community assessment will be sampled for stomach contents as time permits. This analysis will provide an estimate of the trophic structure within the lake and facilitate understanding of the lake's food web.

To more fully assess the Onondaga Lake fish community, a larger sized gill net than was used during adult sport fish sample collections during 2008 and 2009 will be used during community surveys to better understand lake sturgeon abundance and distribution. Sampling will be similar to that conducted in Oneida Lake to more fully assess the size range of sturgeon potentially residing in the lake. The SOP for this work is presented as Appendix C.

2.3 BENTHIC MACROINVERTEBRATE TISSUE ANALYSIS

The macroinvertebrate community and tissue analysis of three taxa (zebra mussels, chironomids, and amphipods) will be conducted in 2010 following the same protocols as used during 2008. If available, crayfish will be added as an additional taxon at each location. Benthic macroinvertebrates will be collected during August 2010 from nine locations (one location in each of SMUs 1 through 4, SMU 6, and SMU 7 and three locations in SMU 5) as shown in Figure 3. Macroinvertebrate stations were selected to provide a sampling station within each SMU, to incorporate those stations which yielded the more abundant samples during 2008, and to spread the sampling stations around the lake. In addition, for SMU 2, Station 20160 was selected since Station 20159 is no longer available due to placement of the barrier wall. For SMU 1, Station 10161 was selected since Station 10162 will be influenced by the barrier wall construction in 2010. Due to variability in invertebrate presence and abundance, it is possible that there may be insufficient tissue mass for analysis at one or more of the sampling locations. If this occurs, a second sample will be collected in SMUs 1, 2, 3, 4, and 6 at locations shown on Figure 3 of the Baseline Monitoring Report for 2008. If any of the second sample locations has been impacted since 2008 by construction of the shoreline barrier wall, a location outboard of the barrier wall in the vicinity will be sampled. For SMU 7, where only one location was included in the 2008 macroinvertebrate sampling work, the second location in the event there is insufficient mass collected at OL-STA-70125 will be elsewhere in SMU 7 at a similar water depth.

Macroinvertebrate samples will be collected using a petite ponar dredge in water depths between 3 and 5 ft. Samples will be sieved in the field using a U.S. Standard Number 30 sieve (mesh size 0.6 microns) and sieved material placed into a plastic bucket for picking on shore. Five to 25 ponar dredge samples will be collected at each location, depending on conditions. The samples will be sorted on land at the Parsons' site trailer using plastic utensils. A composite of each target organism will be placed into a labeled glass vial. Zebra mussel shell length will be measured and recorded, and a composite sample of 10 to 15 similar-sized mussels will be placed into a sample container. Mussels within each sample will be counted and a total sample weight will be measured. Crayfish will be sampled by setting up to five minnow traps at each location for 24 hours. Tissue removal will be completed in the analytical laboratory.

Invertebrate samples will be submitted to the analytical laboratory for total and methylmercury (United States Environmental Protection Agency (USEPA) Method SW7471 and USEPA Method SW1630) analysis in accordance with the Book 2 Work Plan. If sample mass is limited, analysis of methylmercury will be prioritized ahead of total mercury. If sufficient mass of crayfish is collected, samples will be sent to Cornell University's stable isotope laboratory for analysis of ^{15}N and ^{13}C isotopes, consistent with stable isotope work completed by Cornell for Honeywell during 2009.

In conjunction with the benthic macroinvertebrate tissue analysis, a surface sediment sample will be collected from each benthic macroinvertebrate sample location for comparison with tissue concentrations. One push core sample will be collected, and the sample will be split into

two sediment depth segments, 0 to 2 cm and 2 to 15 cm. Each segment will be homogenized and the sediment placed into a labeled glass jar and submitted to the laboratory for analysis of total mercury, methylmercury, and total organic carbon.

2.4 BENTHIC MACROINVERTEBRATE COMMUNITY ASSESSMENT

A benthic macroinvertebrate community analysis will be conducted during 2010 following the same protocols used for Honeywell during 2008. Nine locations rather than 18 locations will be sampled during 2010, and three samples rather than five samples will be collected at each location. The number of samples was reduced from five to three since the majority of replicates collected in 2008 were dominated by the same taxa. The nine locations are the same locations shown in Figure 3 for macroinvertebrate tissue analyses. Following sieving, each sample will be placed in a labeled polyethylene container and preserved with a 10 percent buffered formalin solution following the Book 2 Work Plan.

Samples for benthic macroinvertebrate community composition and abundance will be sorted and identified in a laboratory following procedures used during 2008 and described in the approved Book 2 (2008) Work Plan. 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. Zebra mussel abundance will be determined for the entire sample; all other macroinvertebrates will be subsampled and then identified to the lowest taxonomic level reasonably achievable.

2.5 LITTORAL WATER SAMPLING

Littoral water sampling was conducted during August and November 2008 to improve understanding of the movement of mercury and methylmercury generated from the hypolimnion during and following fall turnover into the littoral surface waters of the lake for assessing exposure to biota. August littoral water sampling provided baseline water quality data to compare with water quality data following fall turnover when hypolimnion waters are low or devoid of oxygen and nitrate and can release methylmercury to lake waters. Annual littoral zone water analyses are not necessary as the high frequency data for total mercury and methylmercury concentrations at the 2-meter water depth at South Deep is considered representative of concentrations lake-wide. Littoral water sampling will be conducted once during August 2010 and twice within two to three weeks following 2010 fall turnover of the lake. The lake typically turns over in mid-to-late October. Littoral surface water samples will be collected and analyzed at six locations consistent with the procedures in the 2008 Book 2 Work Plan. All 18 littoral water samples will be analyzed for total mercury and methylmercury. Six of the 18 will also be filtered prior to analysis for total mercury. Every reasonable effort will be made to collect these littoral water samples on the same day that deep basin water samples are collected for Honeywell by Upstate Freshwater Institute as part of the Book 1 2010 baseline monitoring effort.

2.6 HEALTH AND SAFETY

The safety of field team members and the general public is the highest Honeywell priority. The Parsons Project Safety Plan and the Anchor QEA Project Safety Plan prepared for previous Onondaga Lake field activities will be reviewed and strictly followed by all personnel. Any task outside of the 2010 work scope defined in the relevant safety plans will have new job safety analyses completed as warranted before the task begins. Copies of these safety plans will be maintained at the support zone along the lakeshore and on the sampling boat.

2.7 DATA MANAGEMENT AND REPORTING

Analytical data will be submitted to the NYSDEC consistent in content and timing with submissions being provided for other pre-design investigation and baseline monitoring efforts for Onondaga Lake. Analytical data generated during this investigation will be reviewed and validated as described in detail in the QAPP associated with the 2008 Book 2 Work Plan. All analytes will be subject to Level III validation as described in the QAPP for the Phase I Pre-design Investigation (Parsons, 2005). In addition, 10 percent of the total mercury, methylmercury, and PCB results will be validated based on Level IV protocols. The validated results will be incorporated into the Locus Focus database by Parsons following validation.

Once the data validation has been completed, a Data Usability and Summary Report (DUSR) will be prepared and submitted to NYSDEC. The DUSR will present the results of data validation and data usability assessment. A data export will be provided in the DUSR on CD/DVD. Data interpretation and trend analysis will be discussed with the agencies and summarized in a technical report.

SECTION 3

SMALLMOUTH BASS AND WALLEYE MOVEMENTS

3.1 INTRODUCTION

Telemetry can provide insight into overall movements of fish species and the amount of time fish may be spending in Onondaga Lake. Tracking movement of adult sport fish should help to assess biological factors that may contribute to variability in fish mercury concentrations thereby providing insight into contaminant bioaccumulation. Accordingly, tracking of fish movements has been added as part of Honeywell's baseline monitoring program for Onondaga Lake for 2010. Tracking fish movements will provide additional information to better understand how adult smallmouth bass and walleye are using the lake and better assess fish use of the lake relative to the lake remedy.

3.2 APPROACH

Radio telemetry and sonic telemetry are commonly used to track movements of freshwater fish. Radio telemetry has limited effectiveness in waterways with high conductivity and is limited to species that typically occupy water depths less than 40 to 50 ft. Sonic telemetry works better in high conductivity water and at greater water depths. Since bass and walleye can spend more time in deeper waters and given Onondaga Lake has higher conductivity than most fresh water lakes, sonic telemetry will be used.

A maximum of 30 fish per species will be surgically implanted with a sonic tag during a two-week period in mid-May in accordance with the SOP (see Appendix B). The mid-May timeframe for implanting tags allows tracking devices to be inserted into smallmouth bass at least 21 days prior to the opening of bass fishing season (i.e., the third Saturday in June) so the preferred anesthetic (MS-222) can be used. Because walleye fishing season opens on May 1, walleye will be anesthetized with carbon dioxide. Using carbon dioxide presents a greater challenge to field sampling, but it does not have withdrawal time concerns of MS-222. Submersible receivers will be placed at the lake outlet, and at the mouths of Onondaga Creek and Ninemile Creek to assess movements into and out of the lake. In addition, in-lake movements will be tracked using a hydrophone and boat within the lake to develop a better understanding of areas visited and potential implications for mercury bioaccumulation.

3.3 METHODS

Adult smallmouth bass and walleye will be captured in mid-May and surgically implanted with a sonic transmitter in accordance with the SOP (see Appendix B). Ultrasonic transmitters uniquely coded for identifying individuals along with a temperature sensor will be used to track fish. Two types of tracking devices will be used. First, underwater automated receivers will be installed at the Onondaga Lake outlet, mouth of Ninemile Creek, and the mouth of Onondaga Creek to assess movement in and out of the lake. These receivers will record data on fish movement into or out of the lake and can record up to 210,000 detections. Second, manual tracking will be done by boat using a hydrophone lowered over the side of the boat and a receiver to locate tagged fish in real time throughout the lake to assess in-lake movement patterns. Manual tracking of fish will be conducted for one to two days approximately every other week. During alternating weeks, movements of several fish will be tracked approximately hourly over a 24-hour tracking event. Locations and depths of each being fish being tracked will be recorded. Individual fish movements during each 24-hour tracking effort will be determined. The duration for fish tracking associated with the telemetry work will extend at least through the 2010 fall turnover.

3.4 DATA ANALYSIS

Telemetry data will be used to assess the amount of time individual fish are in Onondaga Lake throughout the season and to assess within lake movements. Use of the lake by individual fish will be assessed, and an evaluation of the potential for separate population groups using the lake will be conducted based on the amount of time individuals spend in the lake or moving in and out of the lake. Data interpretation will be discussed with the agencies and summarized in an appendix to the future *Baseline Monitoring Report for 2010.*

SECTION 4

REFERENCES

Parsons. 2005. *Onondaga Lake Pre-Design Investigation: Phase I Work Plan*. Prepared for Honeywell. September 2005.

Appendix A *Phase I Sampling And Analysis Plan*

Appendix B *Quality Assurance Project Plan*

Appendix C *Project Safety Plan* Updated March 2007

Parsons, Exponent, and Quantitative Environmental Analysis (QEA). 2008. *Onondaga Lake Baseline Monitoring Book 2 Fish, Invertebrate, and Littoral Water Monitoring Work Plan for 2008*. Prepared for Honeywell, Inc., East Syracuse, New York. Parsons, Exponent, and QEA, Liverpool, New York. September 2008.

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TABLES

TABLE 1
ONONDAGA LAKE BASELINE MONITORING BOOK 2 SAMPLING FOR ADDENDUM 2 (2010)

Objective/Data Use	Program Element	2008 Monitoring	2009 Monitoring	2010 Monitoring	Comments
Establish baseline chemical and physical conditions to provide basis to measure achievement of target fish tissue concentrations	Sport and prey fish sampling	Included analysis of total mercury in four sport fish species and composite prey fish. A subset of sport fish and composite prey fish samples was analyzed for hexachlorobenzene, PCBs, DDT, and dioxins/furans (sport fish only). Fish age was determined using scales.	Same as 2008 except no HCB or DDT analysis; PCB analysis in smallmouth bass (SMB) and walleye (W) only. SMB and W were aged using otoliths and scales, brown bullhead (BB) using spines, and pumpkinseed (PKSD) using scales. Prey fish included 16 alewife composites to better assess pelagic bioaccumulation.	Same fish sampling and adult fish aging as 2009 except a smaller size range of bass (200 to 300 mm) will be targeted for a subset of the samples primarily to aid in understanding bioaccumulation patterns and no alewife sampling from pelagic zone. For littoral prey fish, include alewife if collected. Analyze fillets (no plugs). Same analytical scope as 2008.	Fish monitoring will be conducted annually during design. Scope for alewife for 2010 is based on 2009 tissue samples which had lower mercury concentrations compared to littoral prey fish (alewife average 0.112 mg/kg; banded killifish 0.303 mg/kg; golden shiner 0.17 mg/kg).
Provide basis to measure achievement of surface water quality standards and basis to establish water quality goals during remedy implementation	Lakewide water quality sampling	SMU 1 associated with sediment sampling for treatability testing.	None	To be determined as part of dredging operations.	

TABLE 1 (CONT.)
ONONDAGA LAKE BASELINE MONITORING BOOK 2 SAMPLING FOR ADDENDUM 2 (2010)

Objective/Data Use	Program Element	2008 Monitoring	2009 Monitoring	2010 Monitoring	Comments
Provide additional data for future understanding of remedy effectiveness in achieving PRGs to assess biological factors that may contribute to variability in fish mercury concentrations	Other biota, co-located sediment, and littoral water sampling	Benthic macroinvertebrate community survey and chemical analysis of tissue, co-located sediment, and littoral water sampling three times at six locations (total mercury and methylmercury).	None	Same macroinvertebrate and co-located sediment sampling as August 2008 except samples will be collected at 9 locations and crayfish will be collected and analyzed if present.	Crayfish were the primary fish gut content of smallmouth bass evaluated during 2008.
		Fish community assessment, phytophilous macroinvertebrate community, sport fish population estimate, and fish diet assessment included.	Fish community assessment, fish diet assessment, and sport fish population estimate consistent with 2008 baseline monitoring efforts.	Fish community assessment, fish diet assessment, and sport fish population estimate consistent with 2008 and 2009 baseline monitoring efforts with a lake sturgeon community assessment added for 2010. Assess movements of adult smallmouth bass and walleye (to improve bioaccumulation understanding).	
		Littoral water sampling once during August and twice one to three weeks following lake turnover to assess whether methylmercury from SMU 8 hypolimnion can affect littoral zone.	No littoral water sampling was conducted for this purpose.	Same littoral zone water sampling and purpose as during 2008.	

TABLE 2
SUMMARY OF PROPOSED BOOK 2 MONITORING ACTIVITIES FOR ADDENDUM 2 (2010)

Activity	Number of Locations	Number of Samples per Location	Number of Species	Sample Preparation	Sampling Duration / Timeframe	Chemical Analytes
Adult Sport Fish Tissue Sampling [1]	8	6-7	4	Fillets for SMB, W, PKSD, and BB	Approximately 15 days in mid-June	Total mercury for all samples and organics for sample subset
Prey Fish Tissue Sampling (minnow species and alewife, if available)	8	5	Variable (composites of a prey species)	Whole body composites	Approximately five days in August	Total mercury for all samples and organics for sample subset
Sport fish Population Estimate	Lakewide	NA	4	NA	June-September	NA
Fish Community Assessment	8	NA	NA	NA	June to October	NA
Fish Diet Assessment	Lakewide	50 per species	5	Dissection for smaller fish	June to September	NA
Fish Migration Assessment	Lakewide and Seneca River	Maximum of 50 individuals per species	2 (SMB and W)	NA	June to November	NA
Benthic macroinvertebrate tissue	9	3	Up to 4	Whole body composites	Approximately 10 days during August	Total mercury and methylmercury; ^{13}C and ^{15}N on crayfish
Sediment co-located with macroinvertebrate tissue	9	2	NA	0 to 2 cm and 2 to 15 cm depth intervals	Approximately 10 days during August	Total mercury, methylmercury; and total organic carbon
Benthic macroinvertebrate community assessment	9	3	NA	NA	Approximately 10 days during August	NA

TABLE 2 (CONT.)
SUMMARY OF PROPOSED BOOK 2 MONITORING ACTIVITIES FOR ADDENDUM 2 (2010)

Activity	Number of Locations	Number of Samples per Location	Number of Species	Sample Preparation	Sampling Duration / Timeframe	Chemical Analytes
Littoral water sampling	6	3	NA	NA	1 day in August 1 day within one week following fall turn over and 1 day within 2 to 3 weeks following.	Total mercury and methylmercury

NA – not applicable SMB – smallmouth bass W – walleye PKSD – pumpkinseed (sunfish) BB – brown bullhead

[1] Target for adult sampling is 6 to 7 individuals per location. The goal is to evenly distribute these numbers of individuals from each location. However, if species are sparse at one location, additional individuals will be collected from one of the other locations to achieve the target numbers.

FIGURES

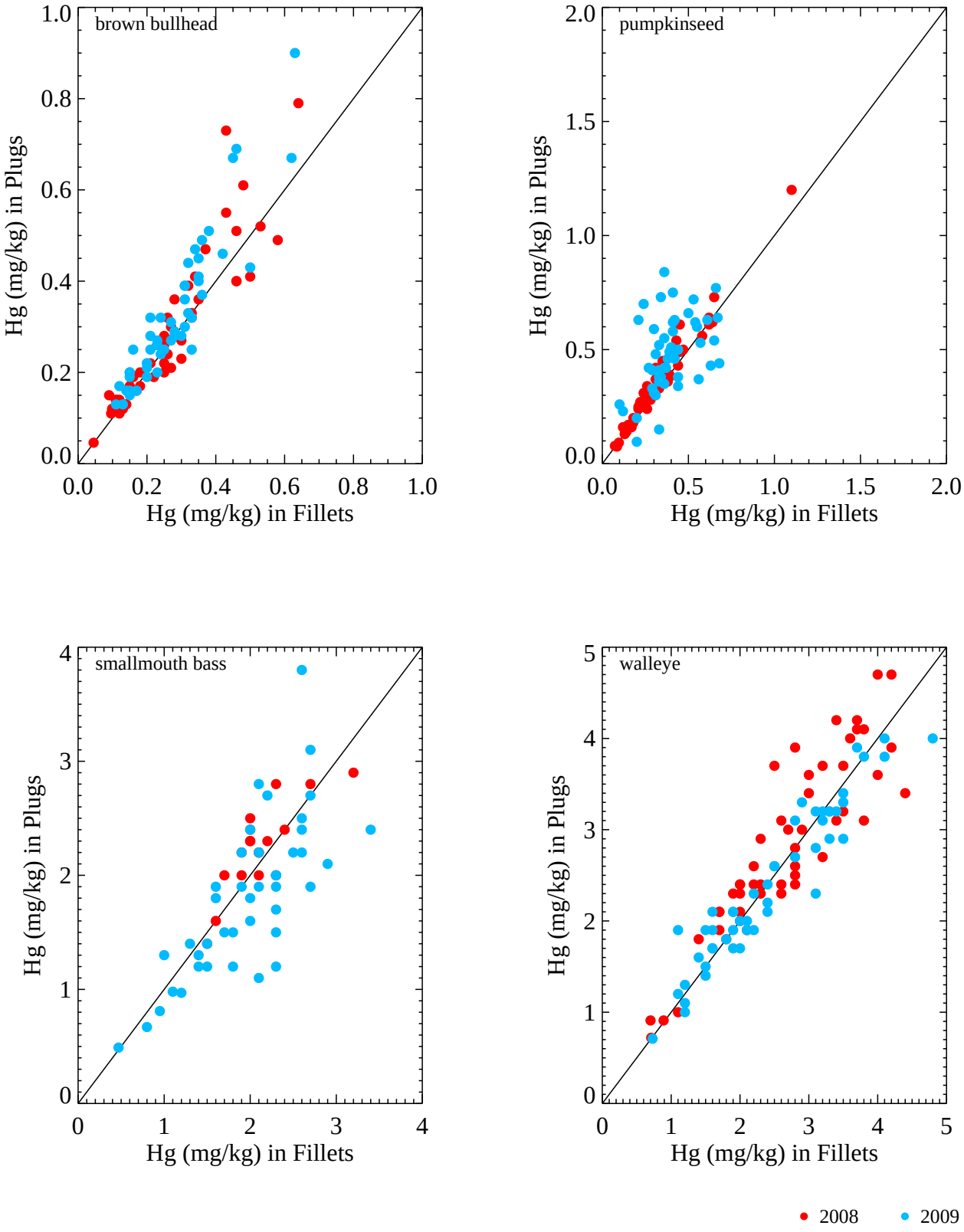
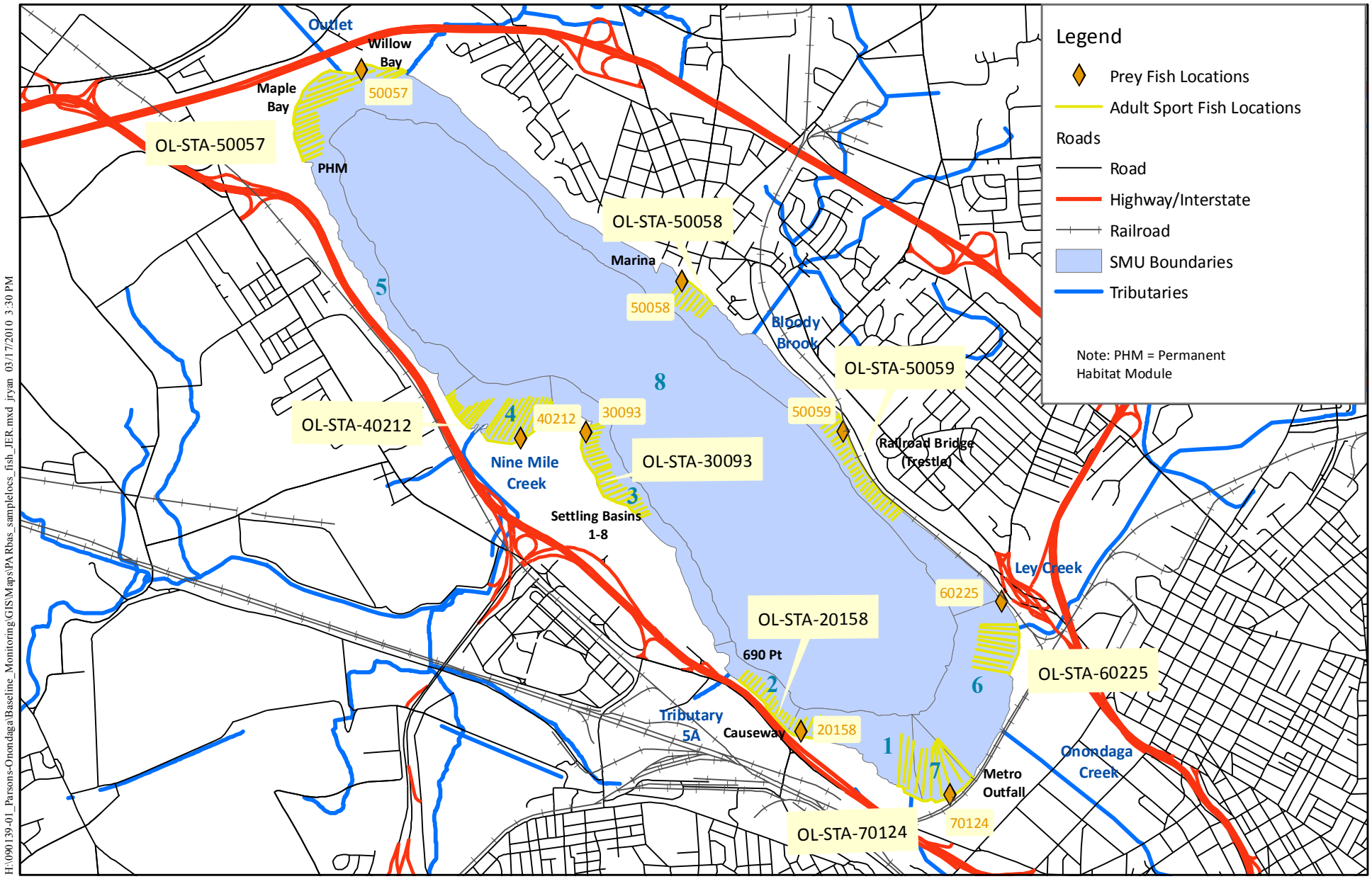


Figure 1. Scatter plot of fillet vs plug mercury concentrations (ppm wet) in fish collected from Onondaga Lake.

Data source: 2008-2009 Baseline Monitoring Program (BLM); non-detects reported at 1/2 the MDL.
Notes: all ages and genders combined.



H:\090139-01_Parsons-Onondaga\Baseline_Monitoring\GIS\Maps\PARbas_sampleslocs_fish_JER.mxd jryan 03/17/2010 3:30 PM

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Honeywell PARSONS

Figure 2
Baseline monitoring fish sampling locations for 2010.

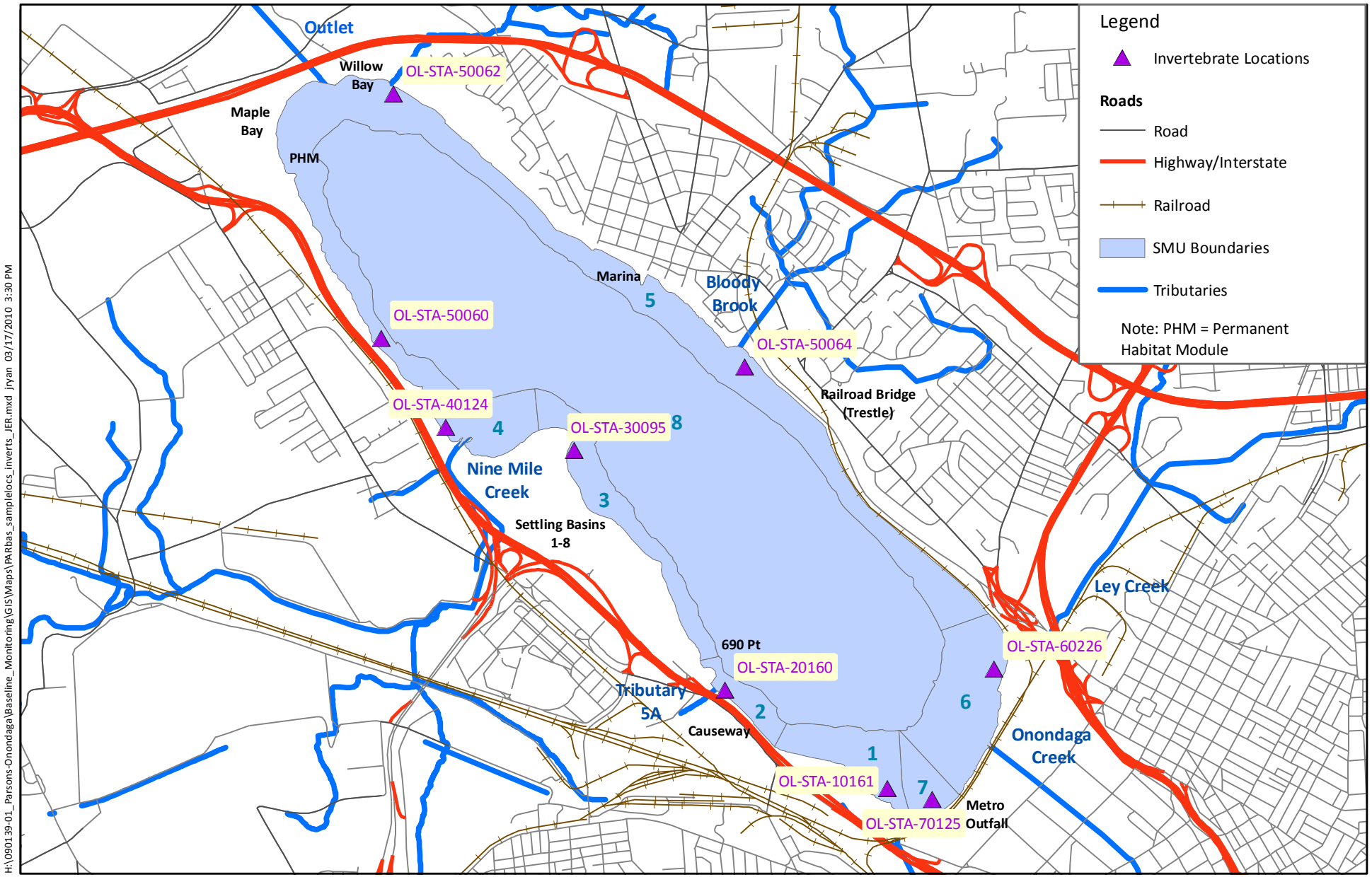

Figure 3
Baseline monitoring macroinvertebrate tissue and community sampling locations for 2010.

APPENDIX A

REVISED WORKSHEET 18 FOR THE QUALITY ASSURANCE PROJECT PLAN

QAPP Worksheet #18 *Sampling Locations and methods/SOP Requirements Table* *(Continued)*	**Title: Book 2 Addendum – Fish and Invertebrate Sampling for 2010** **Revision Number : 0** **Revision Date: June 16, 2010**

See Figures 1 and 2 in this Book 2 Work Plan addendum for sampling locations. See Worksheet #18 in the 2008 Book 2 Work Plan for matrices, analytical groups, concentration levels, and number of samples. The number of locations, samples per location, and sampling duration are presented in this worksheet.

Activity	Number of Locations[1]	Number of samples per location	Number of species	Sample Preparation	Duration
Adult sport fish tissue	8	6-7	4	Fillets	Approximately 15 days in late June/July
Prey fish tissue	8	5	Variable (samples are composites of a prey species)	Whole body composite	Approximately 5 days in August
Benthic Invertebrate tissue	9	3	Up to 4	Whole body composite	Approximately 10 days in August
Benthic Invertebrate Community Assessment	9	5	N/A	N/A	Approximately 10 days in August
Water	6	1	N/A	N/A	Three events from August to November
Sediment	9	2	N/A	N/A	Approximately 10 days in August and following fall turnover (October/November)

[1] Adult samples will be targeted from eight locations around the lake; if sampling is difficult in some locations, a maximum of 25 adults per species will be collected from each basin.
[2] Water samples will be surface grabs.
[3] Sediment samples will consist of two segments 0-2 cm and 2-15 cm.

QAPP Worksheet #18 *Sampling Locations and methods/SOP Requirements Table* *(Continued)*	**Title: Book 2 Addendum – Fish and Invertebrate Sampling for 2010** **Revision Number : 0** **Revision Date: June 16, 2010**

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (field duplicates)[1]	Sampling SOP Reference[2]	Rationale for Sampling Location
Lakewide	Adult sport fish (4 species)	Littoral zone	Total mercury	Low	200	SB-1	See Worksheet #17
			PCBs	Low	48		
			DDT and metabolites	Low	48		
			Hexachlorobenzene	Low	48		
			Dioxins/Furans	Low	20		
			%Lipids	Low	48		
Lakewide	Prey fish (composite samples)	Littoral zone	Total mercury	Low	40	SB-1	
			PCBs	Low	10		
			DDT and metabolites	Low	10		
			Hexachlorobenzene	Low	10		
Lakewide	Benthic macroinvertebrate tissue (Zebra mussels, chironomids, amphipods)	1.0 to 1.5 m	Total mercury[3]	Low	27	SB-2	
			Methyl mercury[3]	Low	27		

Lakewide	Macroinvertebrate Community	1.0 to 1.5 m	None	None	27[4]	SB-2; SB-8	
Lakewide	Water	Littoral zone	Total mercury	Low	18 (3)	SB-9	
			Methyl mercury	Low	18 (3)		
Lakewide	Sediment	0 to 15 cm	Total mercury	Low	18 (1)	SB-7	
			Methyl mercury	Low	18 (1)		
			Total organic carbon	Medium	18 (1)		

[1] Field duplicates not collected for tissue.

[2] See Worksheet #21.

[3] If sample mass is limited, sample will be analyzed for methylmercury only.

[4] Three replicate samples collected per location for benthic macroinvertebrates.

APPENDIX B

SOP FOR FISH TELEMETRY

APPENDIX B

STANDARD OPERATING PROCEDURE SB-10: FISH TELEMETRY

B.1 PURPOSE AND SCOPE

This document provides the standard operating procedures (SOP) for Honeywell's fish telemetry work in Onondaga Lake during 2010. Fish telemetry involves capturing, affixing a transmitter, tagging, and releasing target fish species to monitor their movements within Onondaga Lake. This SOP describes the necessary equipment, field procedures, materials, and documentation procedures necessary to conduct fish telemetry. The scope of fish telemetry work including number of individual fish to be tagged and locations to be monitored is defined in this work plan's main text. These procedures are to be followed, and any substantive modifications to the procedures need to be approved in advance by the Honeywell Field Sampling Manager in consultation with NYSDEC.

B.2 HEALTH AND SAFETY CONSIDERATIONS

A safety briefing will be held at the beginning of each day and before any new activity is conducted. The designated safety officer shall be responsible for ensuring the safety of personnel and will be contacted immediately in the event of an emergency. Safety considerations for near-water and lake sampling include caution deploying and retrieving heavy equipment; careful stepping around lines or cables; slips, trips, falls; and the proper use of personal flotation devices, sharp objects, night work, shift changes and personal protective equipment (PPE). Vessels will be loaded evenly so they are not prone to capsizing, and no vessel will be overloaded. These safety considerations apply to the vessel and sampling crews whenever working on the water.

B.3 EQUIPMENT LIST

- Measuring board
- Balance for weighing samples
- Small and large baskets for weighing fish
- Live well for holding fish
- MS-222 anesthetic (see Material Safety Data Sheet attached)
- Sodium bicarbonate to create carbon dioxide anesthetic
- Knife
- Deionized water
- Alconox

- Telemetry equipment: transmitters, hydrophone, receiver, and submersible receiver
- Global positioning system equipment
- Cellular phone
- Digital camera
- Trough for tagging
- Fish line
- T-bar anchor tags for fish
- Field notebook

B.4 PROCEDURES

Fish will be captured according to methods in the Fish Collection SOP (Parsons et al. 2008). All fish will be brought to shore and held in a live well prior to processing.

B.4.1 Attaching Transmitter

1. Individual smallmouth bass and walleye adult fish for telemetry monitoring will be collected from various locations around the lake.
   - Smallmouth bass (target lengths of individual fish 8 to 24 inches)
   - Walleye (target lengths of individual fish 12 to 28 inches)
2. For each fish, the total length and weight will be recorded on the field log.
3. Prior to transmitter implantation, fish will be held in aerated live-wells for a maximum of 10 hours to minimize potential loss due to capture-induced stress.
4. Fish showing no signs of stress (e.g. excessive gilling, loss of buoyancy and equilibrium control) will be used.
5. All equipment will be cleaned with distilled water and alcohol prior to implanting transmitters in each fish.
6. Fish will be placed in a dilute solution (i.e., 15 to 33 mg/L) of tricaine methanesulfonate (MS-222) or be treated with gas containing 142 to 642 mg/L of carbon dioxide (generated by mixing sodium bicarbonate with lake water) to anesthetize prior to transmitter implantation (in accordance with standard procedures based on fish size). Carbon dioxide has a narrow range of producing anesthetic effects, whereas MS-222 is easier to dose and does not have a narrow effects range. However, MS-222 needs to be applied at least 21 days prior to the opening of the fishing season for the fish type being tagged.
7. Fish will be placed in a V-shaped tagging trough that is lined with clean foil.
8. Water will be passed over the gills via a squeeze bottle or siphon.
9. An incision will be made to one side of the midventral line that is large enough for transmitter insertion. Location of the incision will vary depending upon species and

size. Incisions will be made at the deepest part of the body, so as to avoid cutting major organs.

10. Transmitters will be placed in the body cavity.
11. After implantation, the incision will be sutured using nylon sutures obtained from a veterinary supply company. Muscle and skin will be sutured together.
12. Fish also will be tagged with a standard T-bar anchor tag that includes an individual tag number, contact phone number, and instructions to release the fish upon capture.
13. Fish will be monitored in aerated live-wells until they appear to have resumed normal swimming behaviors, at which point they will be released at the site of capture.

B.4.2 Tracking Fish

Fish will be tracked using passive and active methods. Passive tracking will be conducted using submersible ultrasonic receivers placed at three locations: the mouth of Ninemile Creek, the mouth of Onondaga Creek, and the Onondaga Lake outlet. These receivers have the ability to scan large numbers of transmitters with unique frequencies that are also used in manual tracking. Receivers will be deployed late spring 2010 and checked a maximum of twice a month during the field season (May through November) to obtain data and ensure equipment is working properly (e.g. battery replacement).

Active tracking will be conducted from a boat using a hydrophone and an ultrasonic receiver. The position (coordinates and depth) of each fish that is located during the event will be recorded. During alternating weeks, a 24-hour fish monitoring event will be conducted during which several fish will be tracked approximately hourly. The position (coordinates and depth) of each fish located during each monitoring event will be recorded and individual fish movement during the event will be determined.

B.5 PERSONNEL

The field sampling manager is responsible for assigning appropriate field personnel to be responsible for the various site activities. The field sampling manager is also responsible for making sure that this SOP and any other appropriate procedures are followed by field personnel. Field personnel assigned to the various site activities are responsible for completing their tasks according to this SOP 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 appropriate health and safety training. A certified fisheries professional will oversee the QA/QC as appropriate for the various activities.

APPENDIX C

COMMUNITY ASSESSMENT SOP FOR LAKE STURGEON

APPENDIX C

STANDARD OPERATING PROCEDURE SB-11: COMMUNITY ASSESSMENT SOP FOR LAKE STURGEON

Community sampling is conducted on Onondaga Lake as part of Honeywell's baseline monitoring program every three to four weeks from May through October. Sampling methods include electroshocking, trap netting, seining, and gill netting. Numerous lake sturgeon have been captured to date and average approximately 1200 mm in total length. The ability to capture fish the size of lake sturgeon with the mesh size used in the current surveys (maximum 4 inches) is low and suggests that methods for the assessment of the lake sturgeon community in Onondaga Lake need to be expanded. Gill net surveys targeting lake sturgeon on Oneida Lake currently use gill nets with mesh sizes ranging from 6 to 12 inches, while those on the Seneca River range from 8 to 10 inches. The Seneca River sampling is targeting a specific age class and eliminated the 6 inch mesh size to reduce the carp by catch. To more fully assess the Onondaga Lake fish community, a larger sized gill net will be used during community surveys to better understand lake sturgeon abundance and distribution. Sampling will be similar to that conducted in Oneida Lake.

Methods

Beginning in 2010, the fish community survey work will include use of variable-mesh monofilament gill nets placed on the lake bottom. Nets will be 8 ft. deep x 300 ft. long, with 8 panels (37.5 ft. each) of mesh sizes of 6, 8, 10, and 12 inch stretch mesh oriented in sequence for two series. Twine size for the 2 smallest meshes will be #177, twine size for the 2 larger meshes will be #208. Nets will be constructed with a 3/8" foamcore floatline and leadcore bottom line. Nets will be placed perpendicular to shore on bottom during the day in four hour intervals. Longer intervals or overnight sets will be conducted if sturgeon are not captured during the daytime surveys. Nets will be fished at the current sampling stations, with the shallow end of the net in water no less than 8 ft. deep. Set time, retrieval time, location, and water depths at each end of the net will be recorded. Setting and retrieval will follow the gill netting SOP.

Captured sturgeon will be measured for total length in cm, weighed (g), tagged with an individually marked Carline dangler tag attached below the dorsal fin, implanted with a PIT tag, and the basal portion of the pectoral fin ray will be removed for age estimation. The Carline dangler tag will include a unique identification number and contact information to facilitate reports of incidental catch by other parties as well as identifying fish that may be recaptured in gill nets. The PIT tag will allow for unique identification in case of loss of the Carline dangler tag. The PIT tag will be inserted into the fish at the base of the skull or under the anterior dorsal scute using a PIT tag implanter. Mesh size of capture also will be recorded. Fish will be returned to the water unharmed. Appropriate permits will be obtained from the New York State Department of Environmental Conservation (NYSDEC) prior to collection.