
ONONDAGA LAKE BASELINE MONITORING REPORT FOR 2010

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LIST OF ACRONYMS

| | |
|----------|--|
| CPUE | Catch (of fish) per unit of effort |
| DDT | Dichloro Diphenyl Trichloroethane |
| DO | Dissolved Oxygen |
| DUSR | Data Usability and Summary Report |
| GPS | global positioning system |
| ISUS | <i>in situ</i> ultraviolet spectroradiometer |
| mg/kg | milligrams per kilogram (or parts per million in water) |
| NYSDEC | New York State Department of Environmental Conservation |
| OCDWEP | Onondaga County Department of Water Environment Protection |
| PCBs | Polychlorinated Biphenyls |
| QA/QC | Quality Assurance / Quality Control |
| RI | remedial investigation |
| ROD | Record of Decision |
| SMU | Sediment Management Unit |
| SUNY-ESF | State University of New York College of Environmental Science and Forestry |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| UFI | Upstate Freshwater Institute |
| USEPA | United States Environmental Protection Agency |

DEFINITIONS

| | |
|---------------|--|
| Benthic | Bottom dwelling (<i>i.e.</i> , in sediment) |
| Epilimnion | During summer stratification, the upper portion of the thermally-stratified water column located between the 0- and 30-ft. (0- and 9-meter) water depth in Onondaga Lake. The epilimnion is warmer than the underlying stratified layers and relatively well-mixed by wind and waves. |
| Hypolimnion | The lower portion of the water column during summer stratification where water temperatures are cooler than upper waters (typically in the portion of Onondaga Lake where water depths exceed 30 ft. [9 meters]). Mixing levels are diminished in the hypolimnion relative to the epilimnion. |
| Invertebrates | Animals without a backbone. |
| Littoral | Zone within a body of water adjacent to shore where waters do not thermally stratify. In Onondaga Lake, the outer extent of the littoral zone corresponds to a water depth of 30 feet (9 meters). |
| ng/L | Nanogram per liter or part per trillion in water. |
| Profundal | The profundal portion of a water body where water depths are greater than the depth to which sunlight can penetrate to support aquatic plants, in contrast with the littoral zone closer to shore. In Onondaga Lake, the profundal zone stratifies each year from May to October based on water temperature. The profundal zone of Onondaga Lake occupies 64 percent of the lake surface area based on a minimum water depth of 30 ft. (9 meters). |
| Seston | A collective term for all particulate matter present in the water column which consists of living, biological material (plankton) and nonliving particulate material. |
| Thermocline | Located within the interval of water between the epilimnion and hypolimnion corresponding to the water depth of the maximum rate of decrease in temperature with respect to depth. |

EXECUTIVE SUMMARY

The objectives of baseline monitoring are to document lake conditions before the remedial action begins and to provide groundwork for future evaluation of the effectiveness of the lake bottom remedy. This report presents results from the 2010 Onondaga Lake baseline monitoring efforts. These baseline monitoring efforts in Onondaga Lake were initiated during 2008. Baseline monitoring in Onondaga Lake associated with remedial construction was initiated as a separate effort late in 2010 and is being conducted and reported as part of the lake pre-design investigation efforts.

Baseline monitoring within Onondaga Lake includes sampling media for which preliminary remediation goals were established in the lake bottom Record of Decision (ROD) issued by the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) in 2005. Baseline monitoring will continue in Onondaga Lake through 2011 because dredging of lake sediment is scheduled to begin early in 2012.

Honeywell's baseline monitoring during 2010 consisted of two distinct types of efforts (called books), each of which was conducted based on a work plan addendum approved by the NYSDEC prior to monitoring:

- Book 1 work during 2010 included collection and analysis of deep basin water samples by the Upstate Freshwater Institute (UFI). Zooplankton and sediment trap samples were also collected at South Deep and analyzed for mercury.
- Book 2 work during 2010 included collection and chemical analysis of 192 adult sport fish and 40 composited samples of smaller prey fish, fish community assessments, fish population surveys, an evaluation of fish diet, and an evaluation of walleye movements. Book 2 work during 2010 also included collection and analysis of benthic macroinvertebrate and littoral water samples as a follow up to a similar effort conducted on behalf of Honeywell in 2008. The Cornell Stable Isotope Laboratory analyzed water column particulate matter and crayfish samples collected during August-October 2010 for stable carbon and nitrogen isotopes to further assess food web interconnections within the lake.

Reports were prepared previously that document results from the 2008 and 2009 Onondaga Lake baseline monitoring efforts conducted on behalf of Honeywell.

SECTION 1

INTRODUCTION

Baseline monitoring in Onondaga Lake was initiated on behalf of Honeywell in 2008 to document lake conditions before starting dredging and capping. This baseline monitoring lays the groundwork for evaluating the effectiveness of the lake bottom remedy identified in the ROD issued by the NYSDEC and the USEPA (NYSDEC and USEPA, 2005) and described in the Remedial Design Work Plan for the Lake Bottom (Parsons, 2009). Baseline monitoring is being conducted on behalf of Honeywell throughout the remedial design phase until the clean up begins in 2012.

The program objectives for baseline monitoring were presented in the *Baseline Monitoring Scoping Document* (Parsons, Exponent, and Anchor QEA, 2010a) as follows:

- Establish a comprehensive description of baseline chemical conditions prior to remediation to assess remedy effectiveness and to facilitate remedy design.
- Provide additional data for future understanding of remedy effectiveness in achieving remediation goals for Onondaga Lake.
- Provide habitat-related information.

The Baseline Monitoring Scoping Document also describes program elements (i.e., activities such as lake water sampling) and data uses and provides a summary of monitoring being conducted by Honeywell and other entities such as the Onondaga County Department of Water Environment Protection (OCDWEP), UFI, the State University of New York College of Environmental Science and Forestry (SUNY-ESF), and the United States Geological Survey.

The 2010 work scopes for baseline monitoring efforts conducted in Onondaga Lake that began during 2008 are called addenda to the Book 1 and Book 2 work plans prepared for baseline monitoring work completed in Onondaga Lake in 2008 and approved by NYSDEC.

- Addendum 2 (for 2010) to the 2008 Book 1 Work Plan includes water quality, zooplankton and sediment trap monitoring in the deep basins of Onondaga Lake where water depths exceed 30 ft. (Parsons and Exponent, 2010).
- Addendum 2 (for 2010) to the 2008 Book 2 Work Plan includes fish, benthic macroinvertebrate, and littoral surface water sampling as well as sediment sampling where benthic macroinvertebrates were collected (Parsons, Exponent and Anchor QEA, 2010b).

These work plan addenda were approved by NYSDEC and are available in the public document repositories. The baseline monitoring program objectives, program elements, and data uses relevant to Books 1 and 2 are presented in Table 1. Baseline monitoring in Onondaga Lake associated with remedial construction was initiated as a separate effort in late 2010 and is being conducted again during 2011 and reported as part of the lake pre-design investigation efforts.

This third yearly report describes results from the 2010 Onondaga Lake baseline monitoring program. The report follows the same format applied in the baseline monitoring reports for 2008 and 2009 (Parsons, Exponent, and Anchor QEA, 2010a and 2010b, respectively). Section 1 is an introduction. Section 2 presents a summary of the sampling and analytical work. Section 3 is a summary of data management and data validation. Section 4 presents a brief assessment of the 2010 data. Appendices A and B, respectively, provide the 2010 Data Usability and Summary Reports (DUSR) for Books 1 and 2. The DUSRs include laboratory data verification, data validation, and data usability. Appendix C presents detailed data plots from the 2010 Book 1 work.

SECTION 2

SAMPLING AND ANALYSIS SUMMARY FOR 2010

Sample collection, sample management, equipment decontamination, and other baseline monitoring field procedures were conducted in accordance with work plan addenda for Book 1 and Book 2 approved in advance by NYSDEC (Parsons and Exponent, 2010 for Book 1 and Parsons, Exponent and Anchor QEA, 2010 for Book 2). Details on the sampling and analysis program are provided in the Book 1 and Book 2 work plan addenda for 2010. Table 2 summarizes the media, sampling locations, and primary activities for the Honeywell 2010 baseline monitoring work efforts.

A second type of lake monitoring effort conducted on behalf of Honeywell beginning in October 2010 has the objective of assessing lake conditions prior to in-lake dredging and capping. Results from this other lake baseline monitoring work effort are presented in a separate report.

2.1 BOOK 1: DEEP BASIN WATER AND ZOOPLANKTON SAMPLING

Book 1 baseline monitoring for 2010 consisted of deep basin water and zooplankton monitoring and sediment trap sampling. Unless indicated otherwise in this report, the completed field sampling work was consistent with the scope presented in the Book 1 Work Plan Addendum for 2010 (Parsons and Exponent, 2010). UFI collected water column samples from the South Deep location at multiple depths and times from May 3 through November 29. UFI collected vertically detailed *in situ* water quality measurements at 10 locations throughout the North and South Basins using a rapid profiling instrument *in situ* ultraviolet spectroradiometer (ISUS). UFI also collected zooplankton samples at South Deep at a frequency ranging from weekly to monthly. UFI attempted to collect samples of large *Daphnia* zooplankton (at least 1 millimeter in length), however unlike during 2009, large *Daphnia* were not found during any of these sampling events in Onondaga Lake during 2010. UFI also deployed sediment traps from April through November to collect sediment samples at South Deep at the 10-meter water depth (below the thermocline) to track short-term variations in solids and mercury deposition. The elements of the Book 1 sampling program for 2010 are summarized in Table 3.

2.2 BOOK 2: FISH SAMPLING

The 2010 baseline monitoring included adult sport fish and prey fish, benthic invertebrate, and littoral water sample collection throughout the lake (Figures 1, 2, and 3). Unless indicated otherwise, the completed field sampling work was consistent with the scope presented in the Book 2 Work Plan Addendum for 2010 (Parsons, Exponent, and Anchor QEA, 2010). Fish sampling for tissue chemical analyses, benthic invertebrate tissue and community sampling, and littoral water sampling were conducted during 2010 primarily by Anchor QEA. Fish population, fish community assessments (including lake sturgeon), fish telemetry, and fish gut content work

were conducted during 2010 primarily by SUNY-ESF under the supervision of Dr. Neil Ringler with support and oversight by Anchor QEA.

Sampling locations for fish tissue chemical analyses were the same as those sampled during 2008 and 2009, coinciding with historical tissue sampling locations occupied during the remedial investigation (RI), as well as sampling locations included as part of the Onondaga County Ambient Monitoring Program.

Adult sport fish sampling for tissue chemical analyses was conducted from June 15 through July 8, 2010, while prey fish sampling for tissue chemical analyses was conducted from August 23 through August 25, 2010. Fish samples for tissue analyses were collected and analyzed using the same methods employed during 2008 and 2009. Fish sampling methods consisted of electrofishing, gill netting, trap netting, and seining. Electrofishing was the preferred method for sampling bullhead and pumpkinseed, since both species tend to move inshore during the night and are susceptible to capture. Trap nets were a secondary source of pumpkinseed and bullhead which may be captured in these passive nets while moving along the shoreline. Walleye and smallmouth bass were primarily captured in gill nets set at the 13 to 23-ft. (4 to 7-meter) water depth also during the night time when they are more active. Occasionally walleye or smallmouth bass were captured by electroshocking. Forage fish were captured during seining events along the shoreline where they typically congregate during the day.

Four adult sport fish species including smallmouth bass (*Micropterus dolomieu*), brown bullhead (*Ameiurus nebulosus*), walleye (*Sander vitreus*), pumpkinseed sunfish (*Lepomis gibbosus*), and prey fish from the minnow and topminnow families (Cyprinidae and Fundulidae), excluding carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*) were collected. Due to the limited availability of smallmouth bass, the target of 50 adult smallmouth bass was not obtained. Smallmouth bass were very difficult to collect during June due to apparent movement offshore to feed in deeper waters. As described in the Book 2 Work Plan Addendum for 2010, carp and goldfish were not included as part of prey fish collection for tissue chemical analysis due to their large size. Exact species of prey fish were determined based on availability and included the two most common species being captured in the lake which are banded killifish (*Fundulus diaphanus*) and golden shiner (*Notemigonus crysoleucas*). Small alewife also was targeted, although none were captured for chemical analysis during the seining events. Alewife were not collected during the prey fish sampling in mid-August most likely due to the fish moving to deeper waters.

The objective of the adult sport fish sampling for tissue chemical analysis was to sample 50 individual fish from each of the four adult sport fish species for a total of 200 adult sport fish with a target of six to seven individual fish from each species at each of the eight adult sport fish sampling locations. Each adult sport fish sample consisted of a single fish. The number of fish samples collected and analyzed during 2010 for tissue chemical concentrations was similar to the numbers for each adult fish species collected and analyzed on behalf of Honeywell during 2008 and 2009. 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 21 smallmouth bass with lengths of 8 to 12 in. (200 to 302 mm) was collected during 2010 for chemical analyses.

For 2010, unlike samples collected and analyzed on behalf of Honeywell during 2008 and 2009, chemical analyses of all four adult sport fish types were conducted on fillet samples that were different from the NYSDEC standard fish fillet which includes skin on with ribs and belly flap intact except for brown bullhead. The 2010 adult sport fish samples submitted for chemical analysis were filleted with scales or skin, ribs and belly flap removed.

Scales from each adult pumpkinseed, a pectoral spine from each adult brown bullhead, and otoliths (small ear bones) from each smallmouth bass and walleye were collected during 2010 to assess ages of fish. Lengths and weights of each of these adult sport fish were recorded as well.

For prey fish, five composite samples were collected during 2010 by seining at each of the eight locations, for a total of 40 composite samples submitted for chemical analyses. Composite samples were comprised of 10 to 15 prey fish per sample, depending on weight.

As a follow up to comparable work conducted on behalf of Honeywell during 2008 and 2009, the 2010 baseline fish monitoring included sampling and analysis of fish gut contents, and an assessment of fish population and community composition. In addition to the smaller mesh gillnet used during community surveys, a larger sized gill net was used (starting in September) to better understand lake sturgeon abundance and distribution. Community sampling was conducted with 5.9-inch stretch mesh netting, and sturgeon gillnetting was conducted with an eight panel experimental gillnet with two panels each of 6, 8, 10, and 12-inch stretch mesh in sequence for two series.

Tracking of fish movements was added as part of Honeywell's 2010 Baseline Monitoring Program for Onondaga Lake. The focus for fish tracking work was on smallmouth bass and walleye, because these two sport fish have been analyzed for chemical content in tissue since 2008 and they represent top predators in the lake food web and as a result are the fish most likely to show high mercury concentrations. However, due to the difficulty capturing smallmouth bass in 2010 (only two were tagged), walleye were tracked primarily. Passive receivers were placed at the lake outlet and at the mouths of Onondaga Creek and Ninemile Creek by attaching the receiver to a cinder block using a chain and clasp and then attaching the chain to a permanent structure in each area (e.g., a pier or bridge support).

Fish gut contents were checked in the four adult sport fish species collected for tissue analysis (smallmouth bass, walleye, pumpkinseed, and brown bullhead) and also in largemouth bass, yellow perch, and white perch. Gut contents from each of the fish types were identified to the lowest taxonomic order reasonably achievable and abundance of each reported.

The density and distribution of adult sport fish were assessed monthly from May through October of 2010 at over 30 locations around the lake using gill and trap netting to determine overall community structure (Figure 2). Individual largemouth bass, pumpkinseed, and bluegill sunfish were measured for total length (mm), marked with a fin clip (for smaller fish) or uniquely numbered t-bar anchor floy tag (for larger fish), and examined for visible marks. Similar to 2008 and 2009, multiple fish population and fish community sampling efforts were completed during 2010 with each month representing one sampling period extending three to five days per month. Population estimates for largemouth bass, pumpkinseed, and bluegill

sunfish were calculated using the modified Schnabel estimator (Ricker, 1975), as described in the *Book 2 Work Plan for 2008* (Parsons, Exponent, and QEA, 2008). Sample size was not sufficient to conduct a smallmouth bass population estimate in 2010. These species were assessed based on their dominance over the years in the lake and the likelihood of obtaining enough samples to calculate a population estimate.

2.3 BOOK 2: BENTHIC MACROINVERTEBRATE, SEDIMENT AND LITTORAL WATER SAMPLING

Benthic macroinvertebrates for tissue analysis and associated sediment samples were collected during August 2010 from nine locations (Figure 3). Since zebra mussel tissue samples were obtained from only five of the nine original locations, four additional locations also were sampled for zebra mussels, in accordance with the work plan. Amphipods, chironomids, and zebra mussels were separated from sediment collected at each location with a ponar sampler. Crayfish were sampled by setting five minnow traps at each of the nine locations for 24 hours. During 2010, nine amphipod samples, nine chironomid samples, six zebra mussel samples (two samples included a mix of zebra and quagga mussels due to limited mass of zebra mussels), and three crayfish samples were obtained. Water temperature, pH, conductivity, and dissolved oxygen (DO) were recorded at each sampling location prior to sampling.

Three samples of benthic macroinvertebrates for community composition and abundance were collected during August 2010 from each of the nine benthic macroinvertebrate locations. Samples were sorted and identified in a laboratory.

In conjunction with the benthic macroinvertebrate samples, a sediment sample was collected from each of the nine benthic macroinvertebrate sample locations, consisting of two sediment depth segments, 0 to 2 centimeters (cm) (0 to 1 inches) and 2 to 15 cm (1 to 6 inches) below the top of sediment.

Littoral zone (nearshore) water samples were collected at a water depth of 3 to 5 ft. (1 to 1.5 meters) at the same six fish sampling locations within the littoral zone as sampled in 2008. Four of the littoral zone water samples were collected in the southern half of the lake and two were collected in the northern half. The littoral zone surface water samples were collected on August 16, 2010 while profundal zone waters were stratified and on October 27 and November 11, 2010 following summer stratification and fall turnover of the lake's deep waters. These surface water samples were collected using clean hands techniques so low-level mercury concentrations could be quantified.

2.4 SAMPLE ANALYSES

The extent of chemical analyses conducted on Book 1 and Book 2 2010 samples was consistent with the analytical scope outlined in the baseline monitoring work plan addenda for 2010.

Book 1 samples collected and analyzed during 2010 consisted of surface water, zooplankton, and sediment trap solids. Book 1 water samples collected during 2010 were analyzed for numerous water quality parameters including total mercury and methylmercury.

Selected water samples from the 2-meter and 14-meter water depths were also analyzed for filtered (i.e., dissolved) total mercury. Zooplankton samples were also analyzed for total mercury and methylmercury. Sediment trap solids (slurry) were analyzed for total suspended solids (TSS), fixed and volatile suspended solids, inorganic carbon, calcium, and total mercury. Solids from one of the sediment trap samples collected in triplicate were analyzed for total mercury while samples from the two other sediment traps collected on the same date were archived for potential future analyses.

The 2010 adult sport fish samples collected for tissue chemical analyses included 41 smallmouth bass, 50 walleye, 50 pumpkinseed, and 51 brown bullhead that were analyzed for mercury in fillets. The 2010 prey fish samples consisted of 40 composite prey fish samples that were also analyzed for mercury.

In addition to being analyzed for mercury, a subset of adult sport fish fillet samples (12 per species for a total of 48 samples) were analyzed for polychlorinated biphenyls (PCBs), dichlorodiphenyl trichloroethane (DDT) and its metabolites, hexachlorobenzene, and lipids, except that 11 instead of 12 adult pumpkinseed samples were analyzed for hexachlorobenzene. Dioxins/furans were analyzed in five fillet samples from each of the species of adult sport fish for a total of 20 samples. PCBs, DDT and its metabolites, hexachlorobenzene, and lipids were also analyzed in a subset of prey fish (10 composite samples). Samples selected for analysis of PCBs, DDT and its metabolites, hexachlorobenzene, and lipid content were representative of the various locations in the lake and were similar to samples selected in 2008 for the same chemical analyses.

The other types of Book 2 samples collected during 2010 were analyzed primarily for mercury. Benthic macroinvertebrate samples collected during 2010 were analyzed for total mercury and methylmercury. When sample mass was limited, analysis of methylmercury was prioritized over total mercury. Samples of sediment associated with each of the nine benthic macroinvertebrate sample locations were analyzed for total mercury, methylmercury, and total organic carbon. Littoral water samples were analyzed for unfiltered total mercury, unfiltered methylmercury, and TSS; two samples per event also were sampled for filtered methylmercury.

The three crayfish samples and a total of nine samples of filtered material collected by UFI from the water column at the 2-meter water depth at South Deep on five different dates from September 7 through November 1, 2010 were analyzed for stable isotopic ratios of carbon ($^{13}\text{C}/^{12}\text{C}$) and nitrogen ($^{15}\text{N}/^{14}\text{N}$). The filtered water column samples were collected as 20 liters of whole (unfiltered) water from a water depth of 2 meters at South Deep. These samples were filtered through a tangential flow filtration system with a pore size of 0.45 microns. The particle-rich material retained on the filter (called seston) was subsequently centrifuged to produce a final sample volume. The seston samples were sent to Cornell University's stable isotope laboratory for analysis of specific carbon and nitrogen isotopes. These analyses were conducted to improve understanding of food web patterns and contaminant bioaccumulation in aquatic systems.

SECTION 3

DATA MANAGEMENT AND VALIDATION SUMMARY

3.1 FIELD DATABASE

Validated samples from each of the 2010 baseline monitoring efforts have been stored and accounted for in Honeywell's Locus Focus data management system for Onondaga Lake. The data collection program implemented for the 2010 baseline monitoring efforts for Onondaga Lake is the same as was implemented for the Honeywell pre-design investigation efforts.

3.2 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Sample identification, QA/QC procedures, sample collection, data entry, and data validation for the 2010 baseline monitoring efforts work were conducted in accordance with the agency-approved work plan addenda for Books 1 and 2 for 2010 (Parsons and Exponent, 2010; and Parsons, Exponent, and QEA, 2010; respectively). Verification of sampling information and chemical data occurred at several levels during the field and laboratory work. Data verification included checking procedures for compliance with the project plan, correctness of protocols used in the field and at the laboratory, comparability of the data collection and analysis procedures, and completeness of the data set and supporting documentation.

Accutest, Brooks Rand, UFI, and SGS Laboratory conducted the 2010 baseline monitoring laboratory analyses on behalf of Honeywell. Brooks Rand conducted the analyses for low-level mercury and low-level methylmercury. SGS Laboratory conducted the analyses for dioxins and furans.

3.3 DATA VALIDATION

Chemical analytical data for the 2010 baseline monitoring efforts were generated by Accutest, Brooks Rand and UFI were reviewed and validated by Parsons for usability in accordance with data validation procedures described in the DUSRs that are presented as Appendices A and B to this report. Baseline monitoring results presented in Appendix A and Appendix B have been incorporated into the Locus Focus database.

SECTION 4

DATA ASSESSMENT

4.1 BOOK 1 RESULTS FOR 2010

4.1.1 Deep Basin Water Quality

The deep basin water monitoring data provide a basis to measure if surface water quality standards (one of the preliminary remediation goals identified in the ROD) have been achieved and a basis to measure success in controlling key processes (such as, mercury methylation in the hypolimnion and mercury release from profundal sediment), as indicated in Table 1. The deep basin water column sampling focuses on mercury, which undergoes a dynamic cycling process each summer in Onondaga Lake, primarily as a function of lake stratification and subsequent oxygen depletion. Mercury is of concern because methylmercury accumulates in the hypolimnion during stratification, bioaccumulates, and poses potential risks to human health and the environment if fish are consumed.

Other water quality parameters were also monitored to provide insight into lake stratification and mercury cycling. DO and nitrate are particularly important parameters because methylmercury production occurs in the absence of DO and only at low concentrations of nitrate as discussed in the Interpretive Report (Upstate Freshwater Institute and Syracuse University, 2008). The addition of oxygen and nitrate is being evaluated as a means to control methylmercury accumulation in the hypolimnion of Onondaga Lake. A three-year nitrate addition pilot test is scheduled for 2011 through 2013 based on a work plan submitted to the agencies in June 2010 (Parsons and UFI, 2010).

Figures 4 through 7 present the 2010 DO, nitrate-nitrogen, unfiltered methylmercury and unfiltered total mercury results measured at South Deep over time at depths of 2 meters (epilimnion), 12 meters (near the top of the hypolimnion), 16 meters (mid-hypolimnion), and 18 meters (bottom of the hypolimnion). Plots for these water depths are presented because they were the water depths most consistently sampled during 2010.

As a result of summer stratification, DO was entirely depleted in the lower hypolimnion and nitrate levels dropped below 1 mg/L over time which resulted in methylmercury being released from underlying sediment to lower hypolimnion waters (Figures 4 through 6). During 2010, DO concentrations declined to zero at 18-meter water depth by early July, nitrate concentrations declined to their lowest levels at the 18-meter water depth in late September to early October, and methylmercury concentrations correspondingly reached their peak (1.3 nanograms per liter or ng/L) two to three weeks prior to fall turnover, which occurred during the week of October 17, 2010. At the 2-meter water depth, a depth which likely reflects the water quality conditions to which biota are primarily exposed, methylmercury concentrations were less than 0.2 ng/L throughout the summer and fall of 2010. Total mercury concentrations at the 16-meter and 18-meter depths in the water column increased during August and September prior to fall turnover. At fall turnover, the lake mixes and the concentrations of DO, nitrate, and methylmercury are

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generally equivalent throughout the water column. These patterns can be seen in plots of DO, nitrate-nitrogen, methylmercury, and total mercury by depth for each sampling date provided in Appendix C. In addition, dissolved total mercury concentrations at the 2-meter water depth are presented in Table 4.

4.1.2 Zooplankton Mercury Concentrations

Table 5 and Figure 8 present total mercury and methylmercury concentrations measured in zooplankton collected during 2010. Figure 9 presents methylmercury as a percent of total mercury for these samples. Total mercury concentrations in zooplankton were less than 0.05 mg/kg on a wet-weight basis prior to July while the highest concentrations were observed prior to and following fall turnover. Methylmercury concentrations followed the same trend as concentrations of total mercury with relatively low concentrations throughout the season and highest concentrations during September approximately four weeks prior to fall turnover. Methylmercury as a percent of total mercury remained between 6 and 28 percent throughout the sampling period.

4.1.3 Zooplankton Community Composition

The zooplankton community during 2010 was primarily composed of cladocerans, copepods, and rotiferers. Their occurrence and biomass are presented in Figure 10. The largest biomass quantities were observed in early July. Large *Daphnia* were not observed throughout the entire sampling period.

4.1.4 Sediment Trap Solids and Mercury

Table 6 presents mercury in slurry, triplicate TSS results, and calculated mercury on slurry solids collected from the sediment traps as part of the Book 1 effort in 2010. Average suspended solids contents in these samples ranged from 559 to 20,847 mg/l. Mercury concentrations on sediment trap solids ranged from 0.30 to 1.71 mg/kg with the highest concentration observed on September 20 approximately four weeks prior to fall turnover. The arithmetic average mercury content of sediment trap solids measured during 2010 was 1.06 mg/kg. Mercury deposition rates averaged 10.8 micrograms per square meter per day.

4.2 BOOK 2 RESULTS FOR 2010

4.2.1 Adult Sport Fish and Prey Fish Chemical Results

Mercury was detected in each of the 192 samples from adult sport fish fillets (0.01 to 3.70 milligram per kilogram or mg/kg [approximately the same as one part per million]), and 40 whole-body prey fish composite samples (0.05 to 0.80 mg/kg) (Table 7). One milligram per kilogram is approximately the same as one part per million. Mercury concentration versus age in adult sport fish was evaluated to assess trends with age. Mercury concentration tends to increase with age in smallmouth bass, walleye, and pumpkinseed sunfish; no trend is apparent for brown bullhead (Figures 12 and 13).

Results from analyses for fish tissue collected during 2010 presented herein included a fish filleting procedure implemented by the laboratory that was not in full conformance with the

NYSDEC procedure for fish filleting. The filleting procured implemented by the laboratory included the fish fillet but did not include the skin or scales, rib cage and belly flap.

Results from fish tissue analysis for mercury have been assessed and determined to be comparable with prior year results. Since the fillet to whole body ratio of mercury in fish was calculated at 0.7 during the Onondaga Lake Remedial Investigation (TAMS, 2002), it is likely that the 2010 fish are biased high, if anything due to the lack of dilution from the belly flap and bone. Using the 2010 fish fillet data is likely to be a conservative estimate of mercury compared to prior years, but is within the range expected based on the data from 2008-2009.

PCBs were detected in two of 12 smallmouth bass, 10 of 12 walleye, and four of 12 brown bullhead fillet samples (0.132 to 0.182 mg/kg in smallmouth bass; 0.023 to 5.77 mg/kg in walleye; 0.041 to 0.068 mg/kg in brown bullhead); PCBs were not detected in any pumpkinseed or prey fish samples (Table 7).

DDT and metabolites were detected in one of 10 prey fish sample (0.0044 mg/kg), one of 12 pumpkinseed sample (0.0055 mg/kg), two of 12 smallmouth bass samples (0.005 to 0.0085 mg/kg), and four of 12 walleye samples (0.0102 to 0.202 mg/kg); DDT and metabolites were not detected in any of the 12 brown bullhead samples analyzed (Table 7).

Hexachlorobenzene was detected in four of 10 prey fish samples (0.0028 to 0.0474 mg/kg), seven of 12 walleye samples (0.0022 to 0.0426 mg/kg), three of 12 brown bullhead samples (0.0024 to 0.0141 mg/kg), and two of 11 pumpkinseed samples (0.0035 and 0.0047 mg/kg) (Table 7). Hexachlorobenzene was not detected in any of the 12 smallmouth bass samples analyzed.

Lipid contents ranged from 0.53 to 3.9 percent in whole body prey fish, non-detect to 2.60 percent in brown bullhead fillets, non-detect to 2.50 percent in pumpkinseed fillets, 0.19 to 0.85 percent in smallmouth bass fillets, and 0.44 to 14.20 percent in walleye fillets (Table 7).

Dioxins were detected in each of the five brown bullhead, smallmouth bass, and walleye fillet samples and in two of the five pumpkinseed samples analyzed. Ranges of detected dioxin and furan concentrations are presented in Table 7. Detections of dioxins and furans are also reported as toxicity equivalents on a nanogram per kilogram basis (Table 7A). One ng/kg is approximately the same as one part per trillion or 0.000001 part per million.

4.2.2 Stable Isotope Results

Results of stable isotope analyses can be used to evaluate position of the lake's organisms within the food web as well as diet and original carbon source, both of which help to better understand local bioaccumulation pathways. A value called "δ" is calculated using the equation:

$$\delta = [(R_{\text{SAMPLE}}/R_{\text{STANDARD}} - 1)] * 1000$$

where R is the ratio of the heavy isotope to the light (and generally most abundant) isotope.

δ is reported in parts per thousand (‰), where a value of 0 ‰ means that the sample is identical to the standard. A negative δ value indicates that the sample is lighter and a positive value

indicates that the sample is heavier than the standard. In general, an increase in $\delta^{15}\text{N}$ represents an increase in trophic level. Differences in $\delta^{13}\text{C}$ show differences in food sources.

Patterns in $\delta^{15}\text{N}$ values provide information on relative position in the food web. As shown in Figure 20a, relatively low $\delta^{15}\text{N}$ values represent lower trophic level consumers.

Patterns in $\delta^{13}\text{C}$ provide insight about diet of various lake organisms. Distinct $\delta^{13}\text{C}$ clusters are evident in organisms from Onondaga Lake, which represent different food sources (Figure 20b). One cluster represents a benthic food source and includes amphipods, chironomids, golden shiners, and minnows sampled during 2009 as well as crayfish sampled during 2010. The other cluster represents a water column food source as presented in the Baseline Monitoring Report for 2009 (Parsons, Exponent, and Anchor QEA, 2011) which includes zebra mussels, zooplankton, smallmouth bass, and walleye.

4.2.3 Fish Diet

Fish diets, as determined by SUNY-ESF based on gut content analysis, are presented in Table 8. The majority of stomachs from fish collected for tissue analysis were empty when pumped following electroshocking; a few fish and fish parts were noted from walleye and smallmouth bass guts during processing.

The majority of white perch (total length per fish of 117 to 263 mm [4.6 to 10.3 in.]) stomachs examined contained food items (49 out of 52 examined) with 8 taxa of prey items identified (Table 8). White perch diets were dominated by amphipods, zygopterans, and chironomids. Plant material was found in 11 of the 52 white perch examined. Yellow perch (total lengths per fish were 145 to 324 mm [5.7 to 12.8 in.]) stomachs contained 10 taxa of prey items in their diet (Table 8). Amphipods were the most dominant food item in yellow perch stomachs with zygopterans, chironomids, and fish making up a smaller portion of the diet. Plant matter was found in 8 of the 74 yellow perch examined.

The majority of bass sampled to assess fish diet (41 out of 51) had empty stomachs. The only contents found in any of the bass stomachs were fish or fish parts. Ten of the 51 smallmouth bass processed to assess fish diet (total lengths were 240 to 445 mm [9.4 to 17.5 in.]) contained fish or fish parts, including alewife (in three bass), banded killifish (in one bass), and a yellow perch (in one bass); five bass contained unidentified fish parts.” The alewife were all recorded from bass greater than 400 mm (15.7 inches) total length which may indicate these larger bass are feeding more in the deep water pelagic zone than the smaller fish.

4.2.4 Fish Community Assessment

Fish representing 42 species were captured or observed in Onondaga Lake during fish community sampling at 10 locations (stations) from May through October 2010. Fish representing 37 species were captured with trapnets, 19 species with gill nets, 8 species with a boat electroshocker, and 22 species with seines (Table 9).

During trap net sampling, nets were set during an evening and checked the following morning once a month at each location. A total of 6,134 fish representing 37 species were captured during 60 nights of trap netting during 2010 (Table 10). The fish community sampled

via trap netting was dominated by alewife (21.4 percent), with more than half of these captured at the Metro site. Bluegill made up 20.7 percent of the community followed by pumpkinseed (15.8 percent), largemouth bass (7.6 percent), and golden shiners (6.3 percent). Each of eight species made up between 1 and 6 percent of the catch, and each of 24 species contributed less than 1 percent of the total catch. The number of species captured at each location using trap nets varied from 17 species at the Wastebeds 1-8 location to 26 species captured at the Metro location (see Table 10).

Sixty-two gill nets were set for approximately two hours between May 24, 2010 and October 13, 2010 at 12 different locations throughout Onondaga Lake (Table 11). A total of 568 fish and 19 species were captured during sampling. The most common fish captured were walleye (38 percent), channel catfish (18.5 percent), and gizzard shad (13 percent) (Table 12). Two lake sturgeon were captured, each of which was captured at a different gill net location. Twelve brown trout also were captured during sampling, four in May, 6 in June, one in July, and one in October. The number of species captured with gill nets per location varied between zero captured South of Ley Creek (1 net set) to 13 captured at the Causeway location (6 net sets) (see Table 12).

Seventeen sturgeon gill nets were set at the same general locations as the 12 gill net locations from September 27, 2010 through November 1, 2010. They were fished for an average of 3.9 hrs per net. Nine lake sturgeon were captured with a catch per unit of effort (CPUE) (fish per hour) of 0.14. A total of ten sturgeon were tagged (one was captured at the 690 Point location during community gill netting and is excluded from this section). Average total length was 52 in. (1332 mm with a range from 42 to 62 in. or 1055 mm to 1572 mm). Six sturgeon were weighed with an average weight of 37 pounds (16.7 kg) and a range of weights from 20 to 56 pounds (8.9 kg to 24.9 kg). Sturgeon were captured at five locations; three at the outlet (2 net sets), two at Hiawatha Point (2 net sets), two at the Wastebeds 1-8 location (2 net sets), one at the Marina location (3 net sets), and one at the Iron Bridge location (1 net set) (Table 13).

Seining was conducted during the week of August 22, 2010 (see Figure 1 for seining locations and Table 14 for location names). Seining for fish was completed at nine locations with a total of 6,974 fish within 23 species captured. Fish catch was dominated in numbers by banded killifish (84 percent). Young of the year largemouth bass (9 percent), tessellated darter (2 percent), and adult pumpkinseed (1.5 percent) also were captured. All of the other 19 species contributed less than 1 percent of total catch. The number of species captured at each location ranged from four captured at the Ninemile Creek Outlet and Marina to 11 species captured at Willow Bay (Table 14).

4.2.5 Fish Population Assessment for Adult Pumpkinseed, Bluegill and Largemouth Bass

For adult pumpkinseed fish total lengths of 100 mm (4 in.) or more, a total of 2,045 fish were captured during 2010, including five recaptures, during seven sampling events. The lakewide pumpkinseed population for 2010 was estimated at 299,247 using the Schnabel estimator (Ricker 1975); the 95 percent confidence interval could not be determined due to the low number of recaptures. This estimate is believed to be biased high and the actual population

estimate is likely lower than in 2009 since the catch CPUE in May and June 2010 (84 fish per hour) was approximately 50 percent less than the CPUE during the same two months in 2009 (176 fish per hour), based on a similar number of hours fished.

For adult bluegill (fish total lengths of 100 mm or more), a total of 382 fish were captured from May to September 2010, with two recaptures. The lakewide population of bluegill sunfish (100 mm or larger) was estimated to be 30,031. Due to the low number of recaptures, a confidence interval could not be determined. Catch per unit effort for bluegill from May to September 2010 was 9.97 fish per hour.

For adult largemouth bass (fish total lengths of 300 mm or more), a total of 187 fish were captured during seven sampling efforts with zero recaptures (average catch per unit effort was 3.67 fish/hr). The lakewide largemouth bass population for 2010 could not be estimated due to the lack of recaptures.

4.2.6 Assessment of Walleye and Smallmouth Bass Movement Using Telemetry

Telemetry data were collected beginning in 2010 to assess the amount of time individual fish are in Onondaga Lake throughout the season and to assess movements of fish within the lake. Nineteen fish (17 walleye and two smallmouth bass) were captured and tagged with sonic telemetry tags during the summer and fall of 2010 (Table 15). Fish that were tagged were captured using short gill net sets to reduce stress to the fish. Fish that were deemed suitable for tagging were held in a net pen near the marina for up to 24 hours to assess condition prior to tagging. Thirteen walleye were tagged on May 24-25, three walleye were tagged on July 19, and one walleye was tagged on October 14. In addition, two smallmouth bass were tagged on October 14; no other smallmouth bass were captured and deemed suitable prior to October 14.

Use of the lake by individual fish was assessed with manual and passive tracking techniques. Manual tracking was conducted 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. Manual tracking of fish was conducted for one to two days approximately every other week (May 24 to November 11, 2010) with 8 hour and 24 hour surveys. During the 8-hour surveys attempts were made to identify as many tagged fish as possible and record fish location at least once during this time period, while 24-hour surveys tracked the same two fish every hour for 24 hours to gather data on short-term movements. During each survey, locations and depths were recorded of each fish being tracked. During each tracking, fish location was determined and global positioning system (GPS) coordinates recorded, as well as the temperature of the fish (which can be used to estimate depth of the fish in the water column based on temperature profiles). Passive tracking was conducted by installing automated underwater receivers at the Onondaga Lake outlet, at the mouth of Ninemile Creek, and at the mouth of Onondaga Creek to assess movements of fish in and out of the lake. These receivers recorded data on fish movement into or out of the lake and can record up to 210,000 detections.

4.2.6.1 Eight-Hour Fish Trackings

Twelve eight-hour fish trackings were conducted from May 27, 2010 to November 11, 2010. All fish were located at least once after being tagged and released. Five walleye were assumed

dead due to of a lack of movement (Table 15). One walleye (ID 69) was only located during the first eight hour survey and then never located again; two walleye (ID's 66 and 63) were located during all but one of the eight hour surveys. Tags were detected a total of 98 times during the eight hour surveys. The majority of tag detections were found in sediment management unit (SMU) 8 (i.e., within the pelagic zone) (Table 16).

4.2.6.2. Twenty-Four Hour Fish Trackings

Walleye were tracked 23 times between June 3, 2010 to November 2, 2010. During these tracking events, 13 individual fish were tracked; one fish was tracked seven times, another fish was tracked three times, two other fish were tracked two times, and nine fish were each tracked once (Figure 14a-14m). Fish were tracked for 24 hours on ten dates and for 12 hours instead of 24 hours on two dates: June 16, 2010 (due to boat limitations) and November 2, 2010 (too cold for night tracking).

The sonic tags used to track fish also recorded fish temperature which provides an estimate of water temperature where the fish is located. Based on temperature, the depth of the fish may be approximated based on the lake temperature profile available from UFI's robotic buoy. Throughout the fish trackings, the maximum temperature recorded for a fish was 25.5 degrees Celsius observed in late July, while the minimum fish temperature of 11 degrees Celsius was observed during the last sampling period in early November (Table 18). This temperature range is consistent with known temperature preferences for walleye.

Walleye that were tracked stayed within the lake boundaries during each tracking event (Figure 14a-14l). The total distance travelled by a walleye being tracked over 24 hours varied between 1.16 miles (1,880 meters) on July 28, 2010 and 7.0 miles (11,300 meters) on October 4, 2010 with an average distance travelled being 3.9 miles (6,210 meters). The average speed travelled by tracked walleye over 24 hours was 0.16 miles (257 meters) per hour.

On average, walleye were observed to be suspended over water outside of the littoral zone (water depths greater than 23.3 ft. or 7 meters). During the warmer summer months (July and August) walleye were located over shallower water (water depths less than 10 meters) than they were over the early summer (June) and fall months (September, October, November) (water depths greater than 33 ft. or 10 meters) (Table 18). There was only one tracking event (July 1, 2010) in which the average and maximum water depths of 8 and 16 ft. (2.5 and 4.8 meters), respectively where the walleye were located were less than 23 ft. (7.0 meters).

One smallmouth bass (ID 132) was tracked on November 2, 2010 for 12 hours during the day (Figure 14m). The smallmouth bass moved 3,700 ft. (1,132 meters) in 12 hours with an average distance travelled of 0.09 miles (145 meters) per hour. The smallmouth, which was tagged at the outlet, stayed between Willow and Maple Bay at the north end of the lake (Figure 14m). The smallmouth bass was located at temperatures of 10.0°C and 10.5°C and was found suspended over water depths between 4 and 35 ft. (1.2 and 10.6 meters).

4.2.6.3. Passive Receivers

Passive sonic receivers were deployed at three locations during the late summer of 2010 to record movements of tagged fish in and out of the lake (slight delay in deployment due to timing on receipt of all equipment). The Onondaga Lake outlet receiver was deployed on August 10, 2010, the Onondaga Creek receiver on August 24, 2010, and the Ninemile Creek receiver on September 9, 2010. The outlet receiver had 4,071 detections from August 10, 2010 through November 24, 2010 (Table 17). None of the 19 tagged fish were detected moving in or out of Onondaga Creek or Ninemile Creek. At the outlet, 13 of the 19 walleye and both smallmouth bass were detected moving in or out of the lake. Two walleye (ID's 62 and 79) that were not detected in the outlet are presumed dead in the lake (detected over deep water in the exact same location during multiple surveys). Two other walleye (ID's 69 and 71) were not detected moving out of the lake, however, fish ID 69 was only located during the first 8-hour survey and was not subsequently documented within the lake. Fish ID 71 was routinely found within the lake and apparently has not moved past the outlet. Three of the fish detected moving past the outlet receiver (ID's 77, 97, 105) are among the fish presumed dead within the lake (Table 15); these three fish were presumed dead, because they were located numerous times in the exact same location, without any detection of movement (as indicated by the D in Table 16) and at a hypolimnion water temperature (8 to 10 degrees Celsius) that coincided with no oxygen. Two of the fish (97 and 105), although seemingly noted at the outlet receiver following their listing as "dead" are likely erroneous readings (under ideal conditions this receiver can pick up fish as much as two miles away). The fish with the highest number of detections (2,641) in the outlet was a smallmouth bass (ID 143), far greater than the next largest number of detections (444 from ID 78) (Table 17).

4.2.7 Benthic Macroinvertebrate Chemical Results

Nine samples (one composite sample from each of nine locations) were targeted from each invertebrate taxa (amphipods, chironomids, zebra mussels) in August 2010 for chemical analyses. Amphipod and chironomid samples were obtained from each of the nine locations in sufficient quantities of biomass for chemical analyses, while sufficient biomass of zebra mussels was only obtained from five of the nine original locations; four additional locations also were sampled for zebra mussels, in accordance with the work plan, with one location yielding a sufficient biomass (Figure 3). Crayfish traps were set at each of the nine locations, but crayfish were only collected at the SMU 1 and SMU 7 locations.

Amphipod total mercury concentrations ranged 0.004 to 0.256 mg/kg and methylmercury concentrations ranged 0.003 to 0.174 mg/kg, with highest concentrations in SMU 1 (Table 19 and Figure 15). Chironomids total mercury concentrations ranged from 0.004 to 0.127 mg/kg and methylmercury concentrations ranged from 0.001 to 0.036 mg/kg with highest concentrations in SMU 1 (Table 19 and Figure 15). Zebra mussel total mercury concentrations ranged from 0.015 to 0.118 mg/kg and methylmercury concentrations ranged from 0.003 to 0.076 mg/kg with highest concentrations in SMU 1 (Table 19 and Figure 16). Mercury was analyzed in three crayfish samples with total mercury concentrations ranging from 0.153 to 0.216 mg/kg and

methylmercury concentrations ranging from 0.114 to 0.44 mg/kg (Table 19 and Figure 16). All of the mercury results for macroinvertebrate samples are reported on a wet-weight basis.

4.2.8 Benthic Macroinvertebrate Population and Community Results

Onondaga Lake benthic macroinvertebrate community composition work for 2010 indicated a dominance or highest percentage of amphipods, annelids, bivalves, or gastropods depending on location (Figure 17). In total, 14 orders of benthic macroinvertebrates were identified from areas around the lake representing approximately 66 taxa (genus or species level). Dipterans were dominated by taxa within the Chironomidae family, which represented between 2 percent (OL-STA-40124) and 17 percent (OL-STA-60226) of the sample from each location. Dreissenids (zebra and quagga mussels) represented between 1 percent (OL-STA-50064) and 32 percent (OL-STA-50060) of the sample from each location.

The NYSDEC Biological Assessment Profile (BAP) was used as an assessment of water quality based on the macroinvertebrate community samples collected during 2010. Utilizing this procedure, five individual biological metrics (indexes) were calculated based on the ponar samples including species richness, Hilsenhoff Biotic Index (HBI) score, Shannon diversity, percent contribution of the three most numerous species (DOM3), and the measure of similarity to a non-impacted community termed Percent Model Affinity (PMA). Each metric was calculated and the values were converted to a common scale from 0 to 10, with 0 to 2.5 severely impacted, 2.5 to 5.0 moderately impacted, 5.0 to 7.5 slightly impacted, and 7.5 to 10.0 non-impacted. The common scale values from each metric were then averaged to obtain a score denoting overall water quality assessment (see Bode et al. 2002). The five metrics were calculated for each replicate sample, and the replicate samples from each location were averaged to obtain the mean index value for each location. These values were then converted to the common scale and the overall mean water quality assessment value was calculated.

Benthic macroinvertebrate community metrics are presented in Table 20. The benthic invertebrate community from the nine locations sampled was characterized as moderately impacted with mean water quality index values ranging from 3.11 at Location 30095). The benthic invertebrate community from the nine locations sampled was characterized in SMUs 1 through 7 as moderately impacted at eight locations with mean water quality index values ranging from 3.28 (Location 30095) to 4.67 (Location 20160) and slightly impacted at one of the three SMU 5 locations (a mean water quality index value of 5.11 at Location 50062). Overall, 63 benthic macroinvertebrate species were identified from nine locations.

4.2.9 Chemical Results for Sediments Associated with Benthic Macroinvertebrates

Sediment samples were collected from each of the benthic macroinvertebrate locations in August 2010 and analyzed for total and methylmercury from surface sediments (0 to 2 cm) and from subsurface sediments (2 to 15 cm; Figure 18). Total mercury concentrations ranged from 0.086 to 7.6 mg/kg dry weight in the surface sediments and 0.017 to 10.6 mg/kg dry weight in the subsurface sediments (Table 21 and Figure 18). Methylmercury concentrations ranged from 0.00026 to 0.00914 mg/kg dry weight in the surface sediments and 0.000032 to 0.00686 mg/kg dry weight in the subsurface sediments (Table 21 and Figure 18). There was a similar pattern

among locations for surface and subsurface samples with the locations in SMUs 1 and 7 having the highest mercury concentrations. Total organic carbon (TOC) was also measured in each of the sediment samples (Table 21). TOC concentrations in the surface sediments ranged from 9620 to 48900 mg/kg (or 0.096 to 4.8 percent) and from 4480 to 47200 mg/kg (or 0.045 to 4.7 percent) in subsurface sediments (Table 21).

4.2.10 Littoral Zone Surface Water Quality Results

Littoral water samples were collected from six locations during three 2010 sampling events: one in August when the profundal zone of the lake was thermally stratified, a second sampling event approximately one week following turnover when the profundal zone was no longer thermally stratified (on October 27, 2010) and a third sampling event three weeks post-turnover (on November 11, 2010). These littoral zone water samples were collected at the 3 to 5-ft. (1 to 1.5-meter) water depth. Total and methylmercury were analyzed in grab samples from each location (Table 22). Total mercury ranged from 2.4 to 18 ng/L in August and 2.38 to 13.3 ng/L one week post-turnover and 1.08 to 6.51 ng/L three weeks post-turnover (Figure 19). Methylmercury ranged from 0.103 to 0.237 ng/L in August, 0.086 to 0.159 ng/L one week post-turnover and 0.048 to 0.079 ng/L three weeks post-turnover (Figure 19). Total mercury and methylmercury concentrations were higher during August than they were following fall turnover (Figure 20). Filtered total mercury was analyzed in two samples from each sampling event with concentrations of 0.68 and 1.1 ng/L during August, 0.86 and 1.03 ng/L during October, and 0.30 and 0.35 ng/L during November (Figure 19).

Table 22 presents a comparison of total mercury and methylmercury water concentrations measured at the two-meter water depth at the South Deep station with littoral zone results from the same timeframes. This comparison shows some mercury concentrations in littoral surface water (at the 3 to 5-ft. or 1 to 1.5-meter water depth) are higher than mercury concentrations at the 7-ft. (2-meter) water depth at South Deep. The highest littoral zone surface water mercury concentrations were observed at SMU 1 in the area of the in-lake waste deposit.

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TABLES

TABLE 1

**ONONDAGA LAKE BASELINE MONITORING PROGRAM OBJECTIVES,
PROGRAM ELEMENTS, AND DATA USES RELEVANT TO BOOKS 1 AND 2 FOR 2010**

| Program Objective | Program Element | Data Use (as Baseline for Remedy Effectiveness) |
|--|-----------------------------------|--|
| Establish baseline chemical and physical conditions | Sport and prey fish sampling | Provide basis to measure achievement of PRG2 (fish tissue target concentrations) |
| | Lake water sampling | Provide basis to measure achievement of PRG3 (surface water quality standards) Provide basis to measure success in controlling key processes (e.g., mercury methylation, sediment resuspension from the in-lake waste deposit, mercury release from profundal sediment) |
| Provide additional data for future understanding of remedy effectiveness in achieving PRGs | Other biota sampling ^a | Assess biological factors that may contribute to variability in fish mercury concentrations |

Adapted from Table 1 of Baseline Monitoring Scoping Document (Parsons, Exponent, and QEA, 2010)

^aOther than adult sport and prey fish (i.e zooplankton and benthic macroinvertebrates)

PRG - preliminary remediation goal

TABLE 2

SUMMARY OF ONONDAGA LAKE BASELINE MONITORING WORK COMPLETED DURING 2010
AS BOOK 1 AND BOOK 2

| WORK PLAN AND MEDIA | LOCATIONS | PRIMARY ACTIVITY (May through November) |
|---|----------------------------------|--|
| BOOK 1 Deep Basin Water and Zooplankton Monitoring | | |
| Surface Water | South Deep (3 to 5 water depths) | Collected and analyzed monthly, biweekly or weekly grab samples for multiple parameters, including total mercury and methylmercury. |
| | 10 locations | Collected weekly rapid profiling measurements for nitrate, sulfide, and six other parameters. |
| Zooplankton | South Deep | Monthly to weekly sampling and analyses for total mercury and methylmercury. |
| Sediment Traps | South Deep | Monthly to biweekly sampling and analyses for total suspended solids, fixed and volatile suspended solids, particulate carbon, total and acidified calcium and total mercury. |
| BOOK 2 Fish Monitoring | | |
| Adult Sport Fish | SMUs 2 through 7 (8 locations) | Collected and analyzed a total of 192 adult fish during June and early September from four fish species (51 brown bullhead, 50 walleye, 50 pumpkinseed, and 41 smallmouth bass). Assessed fish age, population, and community composition, including fish gut content. |
| Prey (forage) Fish | SMUs 2 through 7 (8 locations) | Collected and analyzed five composites of prey fish during August from each of the eight locations (40 composites). Assessed fish populations, fish community composition (including lake sturgeon) and fish gut content. Also tracked movements of tagged adult walleye using telemetry techniques. |
| BOOK 2 Benthic Macroinvertebrate and Littoral Surface Water Monitoring | | |
| Benthic Macroinvertebrates | SMUs 1 through 7 (9 locations) | Collected during August and analyzed three representative types of benthic macroinvertebrates. Assessed community composition and abundance. |
| Sediment associated with benthic macroinvertebrates | SMUs 1 through 7 (9 locations) | Collected during August and analyzed samples from 0-2 cm and 2-15 cm depths for total mercury, methylmercury, and total organic carbon. |
| Littoral Zone Surface Water | Six fish sampling locations | Sampled at six fish sampling locations three times when surface water from SMU 8 was sampled. Sampling was conducted on August 16 prior to lake turnover and on October 27 and November 11, 2010 following lake turnover. |

Notes:

(1) Fall turnover during 2010 occurred in Onondaga Lake during the week October 17.

(2) Additional baseline surface water monitoring work completed in Onondaga Lake during 2010 on behalf of Honeywell as part of the pre-design investigation has been reported separate from this baseline monitoring report.

TABLE 3
2010 ONONDAGA LAKE BOOK 1 SMU 8 WATER COLUMN WORK SUMMARY

| Date | Water column | | Zooplankton South Deep (1) | Sediment Trap Analyses for Mercury South Deep (10- meter water depth) | Dissolved Gas Measurements |
|--------------|---------------|-------------------------------|-------------------------------|--|-------------------------------|
| | South Deep | ISUS profiling 10 sites | | | |
| May 3 | 3 depths | ◇ | □ | ○ (3) | ⊙ |
| May 24 | 3 depths | ◇ | □ | ○ | ⊙ |
| June 21 | 3 depths | ◇ | □ | ○ | ⊙ |
| July 6 | 4 depths | ◇ | □ | ○ | ⊙ |
| July 19 | 4 depths | ◇ | □ | ○ | ⊙ (4) |
| August 2 | 4 depths | ◇ | □ | ○ | ⊙ |
| August 16 | 4 depths | ◇ | □ | ○ | ⊙ |
| August 30 | 4 depths | ◇ | □ | ○ | ⊙ |
| September 7 | 5 depths | ◇ | □ | ○ | ⊙ |
| September 13 | 5 depths | ◇ | □ | ○ | ⊙ |
| September 20 | 5 depths | ◇ | □ | ○ | ⊙ |
| September 27 | 5 depths | ◇ | □ | ○ | ⊙ |
| October 4 | 5 depths | ◇ | □ | ○ | ⊙ |
| October 11 | 5 depths | ◇ | □ | ○ | ⊙ |
| October 18 | 5 depths | ◇ | □ | ○ | ⊙ |
| October 26 | 3 depths | ◇ | □ | ○ | |
| November 11 | 3 depths | ◇ | (2) | ○ (3) | ⊙ |
| November 29 | 3 depths | ◇ | □ | ○ | |

Notes:

- (1) Daphnia zooplankton were not observed at all during 2010.
- (2) Zooplankton were collected on November 11, however biomass could not be analyze due to quantity.
- (3) Sediment trap sample for mercury was collected on April 26 rather than May 3 and on November 10 rather than November 11.
- (4) Total dissolved gas was measured on July 12 rather than on July 19.

TABLE 4

**2010 DISSOLVED MERCURY WATER
CONCENTRATIONS: SOUTH DEEP
AT 2-METER DEPTH**

| Sample Date | DISSOLVED MERCURY ng/L (average of field duplicates) | Data Qualifier |
|-------------|---|----------------|
| 5/3/2010 | 0.49 | J |
| 5/24/2010 | 0.97* | |
| 6/21/2010 | 0.75* | |
| 7/6/2010 | 0.90* | |
| 7/19/2010 | 0.52 | |
| 8/2/2010 | 0.81* | |
| 8/16/2010 | 0.55 | |
| 9/7/2010 | 1.07* | |
| 9/13/2010 | 0.46 | |
| 9/20/2010 | 0.42 | |
| 9/27/2010 | 0.43 | |
| 10/4/2010 | 0.45 | |
| 10/11/2010 | 0.44 | |
| 10/18/2010 | 0.53 | |
| 10/26/2010 | 0.84* | |
| 11/11/2010 | 0.62 | |
| 11/29/2010 | 0.37 | J |

* Exceeds New York State surface water quality standard of 0.7 ng/L for class C/D waters based on human consumption of fish.

J - estimated value

TABLE 5

**MERCURY CONCENTRATIONS IN ZOOPLANKTON SAMPLES COLLECTED AT
SOUTH DEEP DURING 2010**

| Field Sample ID | Date | Total mercury (mg/kg wet weight) | Methylmercury (mg/kg wet weight) | Methylmercury (Percent of Total Mercury) |
|-----------------|------------|--|-------------------------------------|--|
| OL-1096-06 | 5/3/2010 | 0.025 | 0.0018 | 7.2% |
| OL-1096-07 | 5/3/2010 | 0.0307 | 0.0018 | 5.9% |
| OL-1100-06 | 5/24/2010 | 0.0149 | 0.0011 | 7.4% |
| OL-1105-06 | 6/21/2010 | 0.0412 | 0.0058 | 14% |
| OL-1108-07 | 7/6/2010 | 0.0422 | 0.0093 | 22% |
| OL-1111-07 | 7/19/2010 | 0.0696 | 0.0069 | 9.9% |
| OL-1111-08 | 7/19/2010 | 0.0715 | 0.0082 | 11% |
| OL-1114-07 | 8/2/2010 | 0.0697 | 0.0086 | 12% |
| OL-1117-07 | 8/16/2010 | 0.0677 | 0.0123 | 18% |
| OL-1120-07 | 8/30/2010 | 0.0422 | 0.0107 | 25% |
| OL-1122-08 | 9/7/2010 | 0.0508 | 0.0071 | 14% |
| OL-1124-08 | 9/13/2010 | 0.0536 | 0.0121 | 23% |
| OL-1128-08 | 9/20/2010 | 0.148 | 0.0229 | 15% |
| OL-1132-08 | 9/27/2010 | 0.0149 | 0.0035 | 23% |
| OL-1134-08 | 10/4/2010 | 0.0396 | 0.0096 | 24% |
| OL-1137-08 | 10/11/2010 | 0.0262 | 0.0074 | 28% |
| OL-1140-08 | 10/18/2010 | 0.0171 | 0.0025 | 15% |
| OL-1140-09 | 10/18/2010 | 0.0381 | 0.0054 | 14% |
| OL-1142-06 | 10/26/2010 | 0.094 | 0.0137 | 15% |
| OL-1148-06 | 11/29/2010 | 0.0324 | 0.0058 | 18% |

TABLE 6

2010 BOOK 1 SEDIMENT TRAP MERCURY AND CORRESPONDING TOTAL SUSPENDED SOLIDS (TSS) RESULTS
(traps set at 33 ft (10-meter) water depth)

| Trap Deploy Date | Trap Recovery Date | Deployment Duration (days) | Sample Volume (mL) | Slurry Mercury Results (ng per mL) | Triplicate TSS Results (mg/L) | TSS Average (mg/L) | TSS Deposition (mg per m ² per day) | Mercury Concentration (mg/kg) | Mercury Deposition (ug per m ² per day) |
|------------------|--------------------|----------------------------|--------------------|------------------------------------|-------------------------------|--------------------|--|-------------------------------|--|
| 4/19/10 | 4/26/10 | 7 | 142 | 1.7 | 1216 / 1056 / 1248 | 1160 | 5187 | 1.47 | 7.60 |
| 5/17/10 | 5/24/10 | 7 | 142 | 0.86 | 1300 / 1200 / 1248 | 1249 | 5587 | 0.69 | 3.85 |
| 6/14/10 | 6/21/10 | 7 | 162 | 0.7 | 1104 / 652 / 632 | 796 | 4061 | 0.88 | 3.57 |
| 6/28/10 | 7/6/10 | 8 | 146 | 2.25 | 3544 / 2180 / 2028 | 2584 | 10395 | 0.87 | 9.05 |
| 7/12/10 | 7/19/10 | 7 | 124 | 1.24 | 3048 / 3608 / 2708 | 3121 | 12188 | 0.40 | 4.84 |
| 7/26/10 | 8/2/10 | 7 | 146 | 1.36 | 1208 / 1008 / 892 | 1036 | 4763 | 1.31 | 6.25 |
| 8/9/10 | 8/16/10 | 7 | 162 | 0.55 | 460 / 588 / 628 | 559 | 2850 | 0.98 | 2.81 |
| 8/23/10 | 8/30/10 | 7 | 162 | 2.66 | 3752 / 4132 / 3836 | 3907 | 19930 | 0.68 | 13.57 |
| 8/30/10 | 9/7/10 | 8 | 142 | 0.88 | 2732 / 3148 / 3036 | 2972 | 11629 | 0.30 | 3.44 |
| 9/7/10 | 9/13/10 | 6 | 138 | 2.61 | 1184 / 2368 / 1728 | 1760 | 8923 | 1.48 | 13.23 |
| 9/13/10 | 9/20/10 | 7 | 145 | 2.8 | 1568 / 1604 / 1752 | 1641 | 7495 | 1.71 | 12.79 |
| 9/20/10 | 9/27/10 | 7 | 157 | 0.95 | 812 / 1044 / 860 | 905 | 4476 | 1.05 | 4.70 |
| 9/27/10 | 10/4/10 | 7 | 144 | 1.08 | 1608 / 1552 / 1748 | 1636 | 7419 | 0.66 | 4.90 |
| 10/4/10 | 10/11/10 | 7 | 132 | 3.69 | 3028 / 3428 / 3388 | 3281 | 13640 | 1.12 | 15.34 |
| 10/11/10 | 10/18/10 | 7 | 145 | 7.5 | 4648 / 5092 / 4200 | 4647 | 21218 | 1.61 | 34.25 |
| 10/18/10 | 10/26/10 | 8 | 140 | 5.09 | 3808 / 3856 / 3876 | 3847 | 14839 | 1.32 | 19.64 |
| 10/26/10 | 11/8/10 | 13 | 146 | 4.9 | 4932 / 4008 / 3980 | 4307 | 10662 | 1.14 | 12.13 |
| 11/8/10 | 11/29/10 | 21 | 145 | 14.7 | 42700 / 9680 / 10160 | 9920* | 15099 | 1.48 | 22.37 |
| Arithmetic Mean | | - | - | - | - | - | 10020 | 1.06 | 10.80 |

TSS is total suspended solids.

Mercury concentration = Slurry mercury result divided by TSS average times a units conversion of 1,000.

Calculations of mercury deposition include the surface area of the sediment traps (45 square centimeters).

* The TSS result of 42,700 mg/L for November 8 has been determined to be an outlier and is not included when quantifying deposition rates.

Table 7
Summary of Book 2 2010 fish tissue chemical concentrations measured in Onondaga Lake (wet weight basis)

| Parameter | Prep | Species | Sample Size | Mean | Min | Max | Standard Deviation | Standard Error |
|------------------------------------|------------|-----------------|-------------|----------|-----------|---------|--------------------|----------------|
| Mercury (mg/kg) | whole body | Prey fish | 40 | 0.26 | 0.050 | 0.80 | 0.17 | 0.026 |
| | fillet | Brown bullhead | 51 | 0.25 | 0.082 | 0.64 | 0.11 | 0.016 |
| | fillet | Pumpkinseed | 50 | 0.21 | 0.012 | 0.66 | 0.16 | 0.022 |
| | fillet | Smallmouth bass | 41 | 0.96 | 0.25 | 2.70 | 0.62 | 0.10 |
| | fillet | Walleye | 50 | 1.88 | 0.34 | 3.70 | 0.83 | 0.12 |
| Total PCBs (mg/kg) | whole body | Prey fish | 10 | 0.0049 U | 0.0047 U | 0.005 U | -- | -- |
| | fillet | Brown bullhead | 12 | 0.034 | 0.005 | 0.068 | 0.026 | 0.0076 |
| | fillet | Pumpkinseed | 12 | 0.027 U | 0.0048 U | 0.05 U | -- | -- |
| | fillet | Smallmouth bass | 12 | 0.030 | 0.0047 | 0.18 | 0.060 | 0.017 |
| | fillet | Walleye | 12 | 0.90 | 0.0047 | 5.77 | 1.71 | 0.49 |
| Sum of DDT and metabolites (mg/kg) | whole body | Prey fish | 10 | 0.0022 | 0.0019 U | 0.004 | 0.0008 | 0.0001 |
| | fillet | Brown bullhead | 12 | 0.002 U | 0.002 U | 0.002 U | -- | -- |
| | fillet | Pumpkinseed | 12 | 0.0022 | 0.0019 U | 0.01 | 0.0010 | 0.0001 |
| | fillet | Smallmouth bass | 12 | 0.0027 | 0.0019 U | 0.0085 | 0.0020 | 0.0002 |
| | fillet | Walleye | 12 | 0.022 | 0.0019 U | 0.20 | 0.057 | 0.0047 |
| Hexachlorobenzene (mg/kg) | whole body | Prey fish | 10 | 0.0063 | 0.00095 U | 0.048 | 0.015 | 0.0046 |
| | fillet | Brown bullhead | 12 | 0.0023 | 0.00095 U | 0.014 | 0.0037 | 0.0011 |
| | fillet | Pumpkinseed | 11 | 0.0016 | 0.00095 U | 0.0047 | 0.0013 | 0.0004 |
| | fillet | Smallmouth bass | 12 | 0.0010 U | 0.00095 U | 0.001 U | -- | -- |
| | fillet | Walleye | 12 | 0.0069 | 0.00095 U | 0.043 | 0.012 | 0.0036 |
| Total Dioxin (ng/kg) | fillet | Brown bullhead | 5 | 13.30 | 1.93 | 33.35 | 13.05 | 5.84 |
| | fillet | Pumpkinseed | 5 | 0.66 | 0.37 U | 1.05 | 0.34 | 0.15 |
| | fillet | Smallmouth bass | 5 | 13.08 | 1.85 | 23.50 | 9.04 | 4.04 |
| | fillet | Walleye | 5 | 43.61 | 8.46 | 76.60 | 30.28 | 13.54 |
| Total Furans (ng/kg) | fillet | Brown bullhead | 5 | 13.00 | 2.11 | 31.25 | 11.30 | 5.06 |
| | fillet | Pumpkinseed | 5 | 1.29 | 0.47 | 2.84 | 1.04 | 0.46 |
| | fillet | Smallmouth bass | 5 | 13.31 | 1.01 | 30.07 | 11.71 | 5.24 |
| | fillet | Walleye | 5 | 57.05 | 11.68 | 120.43 | 41.21 | 18.43 |
| Percent Lipid (% by weight) | whole body | Prey fish | 10 | 1.15 | 0.53 | 3.90 | 0.99 | 0.20 |
| | fillet | Brown bullhead | 12 | 0.50 | 0.02 | 2.60 | 0.70 | 0.12 |
| | fillet | Pumpkinseed | 12 | 0.29 | 0.023 | 1.50 | 0.40 | 0.069 |
| | fillet | Smallmouth bass | 12 | 0.39 | 0.19 | 0.85 | 0.24 | 1.07 |
| | fillet | Walleye | 12 | 2.87 | 0.44 | 14.20 | 3.69 | 0.31 |

TABLE 7A
CALCULATED DIOXIN/FURAN HUMAN/MAMMALIAN TEQs IN 2010 BOOK 2 FISH TISSUE SAMPLES

| Location ID | Field Sample ID | Fish Type | Date Sampled | TEQ (full dl) (ng/kg) | TEQ (half dl) (ng/kg) | TEQ (ND=0) (ng/kg) |
|--------------|-----------------|-----------|--------------|-----------------------|--------------------------|-----------------------|
| OL-STA-20158 | OL-1305-01F | W | 6/15/2010 | 5.56 | 3.55 | 1.55 |
| OL-STA-20158 | OL-1305-08F | BB | 6/15/2010 | 3.14 | 1.89 | 0.64 |
| OL-STA-20158 | OL-1306-04F | PKSD | 6/15/2010 | 1.31 | 0.72 | 0.14 |
| OL-STA-20158 | OL-1322-01F | SMB | 7/1/2010 | 3.96 | 2.21 | 0.46 |
| OL-STA-20158 | OL-1322-04F | SMB | 7/1/2010 | 4.58 | 2.79 | 0.99 |
| OL-STA-20158 | OL-1322-05F | SMB | 7/1/2010 | 4.55 | 2.64 | 0.74 |
| OL-STA-40212 | OL-1311-08F | PKSD | 6/16/2010 | 4.07 | 2.07 | 0.07 |
| OL-STA-40212 | OL-1311-18F | W | 6/16/2010 | 2.93 | 1.80 | 0.67 |
| OL-STA-50057 | OL-1314-04F | BB | 6/18/2010 | 3.21 | 1.64 | 0.06 |
| OL-STA-50057 | OL-1322-10F | SMB | 7/1/2010 | 3.68 | 1.88 | 0.07 |
| OL-STA-50057 | OL-1322-12F | SMB | 7/1/2010 | 3.73 | 1.89 | 0.05 |
| OL-STA-50058 | OL-1307-19F | W | 6/15/2010 | 5.61 | 3.34 | 1.08 |
| OL-STA-50058 | OL-1312-01F | PKSD | 6/16/2010 | 2.55 | 1.30 | 0.05 |
| OL-STA-60225 | OL-1305-19F | BB | 6/15/2010 | 1.98 | 1.13 | 0.29 |
| OL-STA-60225 | OL-1306-09F | PKSD | 6/15/2010 | 1.62 | 0.85 | 0.08 |
| OL-STA-70124 | OL-1306-15F | PKSD | 6/15/2010 | 1.42 | 0.78 | 0.14 |
| OL-STA-70124 | OL-1307-01F | BB | 6/15/2010 | 7.33 | 6.90 | 6.48 |
| OL-STA-70124 | OL-1307-02F | BB | 6/15/2010 | 4.22 | 3.11 | 2.00 |
| OL-STA-70124 | OL-1307-13F | W | 6/15/2010 | 1.53 | 0.89 | 0.25 |
| OL-STA-70124 | OL-1312-18F | W | 6/16/2010 | 9.42 | 6.34 | 3.25 |

Notes:

dl - detection limit

TEQ - toxicity equivalent quotient calculated using human and mammalian toxic equivalency factors (TEFs) from Van den Berg et al. (2006)

Fish Types:

PKSD - pumpkinseed

BB - Brown Bullhead

SMB - Small mouth Bass

W - Walleye

TABLE 8

SUMMARY OF FISH GUT CONTENTS IN ONONDAGA LAKE - 2010

| Species/Taxa | Count | | | |
|-------------------|---------------------------|---------------------------|-----------------------|------------------------|
| | Largemouth bass (n=14) | Smallmouth bass (n=51) | White perch (n=52) | Yellow perch (n=74) |
| Amphipoda | | | 49 | 56 |
| Fish | 3 | 10 | 5 | 7 |
| Alewife | 1 | 3 | | |
| Banded killifish | 1 | 1 | | |
| Tessalated darter | 1 | | | |
| Yellow perch | | 1 | | |
| Unidentified | | 5 | | |
| Zygoptera | | | 16 | 15 |
| Trichoptera | | | 4 | 2 |
| Chironomidae | | | 10 | 7 |
| Lepidoptera | | | | 2 |
| Oligochaeta | | | | 1 |
| Plant matter | | | 11 | 8 |
| Isopoda | | | 1 | 3 |
| Zebra mussel | | | 4 | 5 |
| Gastropoda | | | | 1 |
| Number Empty | 11 | 41 | 3 | 17 |

Empty cells indicate species not found in gut contents.

N is the number of fish for which gut contents were assessed.

Count is the total number of individuals encountered in all fish samples.

TABLE 9

SUMMARY OF SPECIES COLLECTED BY GEAR TYPE MAY - OCTOBER 2010

| | Common Name | Scientific name | Trapnet | Gillnet | Electroshocker | Seining |
|-------|--------------------|------------------------------------|---------|---------|----------------|---------|
| 1 | Alewife | <i>Alosa pseudoharengus</i> | X | X | | X |
| 2 | Banded killifish | <i>Fundulus diaphanus</i> | X | | | X |
| 3 | Black crappie | <i>Pomoxis nigromaculatus</i> | X | | | X |
| 4 | Bluegill | <i>Lepomis macrochirus</i> | X | | X | X |
| 5 | Bluntnose minnow | <i>Pimephales notatus</i> | X | | | X |
| 6 | Bowfin | <i>Amia calva</i> | X | X | | |
| 7 | Brook silverside | <i>Labidesthes sicculus</i> | | | | X |
| 8 | Brook stickleback | <i>Culaea inconstans</i> | X | | | |
| 9 | Brown bullhead | <i>Ameiurus nebulosus</i> | X | X | | X |
| 10 | Brown trout | <i>Salmo trutta</i> | X | X | X | X |
| 11 | Central mudminnow | <i>Umbra limi</i> | | | | X |
| 12 | Channel catfish | <i>Ictalurus punctatus</i> | X | X | | |
| 13 | Common carp | <i>Cyprinus carpio</i> | X | X | | X |
| 14 | Common shiner | <i>Luxilus cornutus</i> | X | | | |
| 15 | Emerald shiner | <i>Notropis atherinoides</i> | X | | | X |
| 16 | Fathead minnow | <i>Pimephales promelas</i> | X | | | |
| 17 | Freshwater drum | <i>Aplodinotus grunniens</i> | X | X | | |
| 18 | Gizzard shad | <i>Dorosoma cepedianum</i> | X | X | | |
| 19 | Golden shiner | <i>Notemigonus crysoleucas</i> | X | | | X |
| 20 | Goldfish | <i>Carassius auratus</i> | X | | X | |
| 21 | Green sunfish | <i>Lepomis cyanellus</i> | X | | X | |
| 22 | Lake sturgeon | <i>Acipenser fulvescens</i> | | X | | |
| 23 | Largemouth bass | <i>Micropterus salmoides</i> | X | X | X | X |
| 24 | Longnose gar | <i>Lepisosteus osseus</i> | X | X | | |
| 25 | Northern pike | <i>Esox lucius</i> | X | X | | |
| 26 | Pumpkinseed | <i>Lepomis gibbosus</i> | X | | X | X |
| 27 | Quillback | <i>Carpoides cyprinus</i> | | X | | |
| 28 | Rainbow trout | <i>Oncorhynchus mykiss</i> | X | | | |
| 29 | Rock bass | <i>Ambloplites rupestris</i> | X | | | X |
| 30 | Round goby | <i>Neogobius melanostomus</i> | | | | X |
| 31 | Rudd | <i>Scardinius erythrophthalmus</i> | X | | | |
| 32 | Shorthead redhorse | <i>Moxostoma macrolepidotum</i> | X | X | | |
| 33 | Silver redhorse | <i>Moxostoma anisurum</i> | X | X | | |
| 34 | Smallmouth bass | <i>Micropterus dolomieu</i> | X | X | X | X |
| 35 | Spottail shiner | <i>Notropis hudsonius</i> | X | | | |
| 36 | Tadpole madtom | <i>Noturus gyrinus</i> | X | | | X |
| 37 | Tessellated darter | <i>Etheostoma olmstedii</i> | X | | | X |
| 38 | Walleye | <i>Sander vitreus</i> | X | X | X | |
| 39 | White perch | <i>Morone americana</i> | X | X | | X |
| 40 | White sucker | <i>Catostomus commersoni</i> | X | X | | X |
| 41 | Yellow bullhead | <i>Ameiurus natalis</i> | X | | | |
| 42 | Yellow perch | <i>Perca flavescens</i> | X | | | X |
| Total | | | 37 | 19 | 8 | 22 |

TABLE 10
SUMMARY OF NUMBER OF INDIVIDUALS PER SPECIES CAPTURED IN TRAP NETS MAY-OCTOBER 2010

| | | Station Description (Station Identifier: OL-STA) | | | | | | | | | | Total Fish Captured |
|----------------------------|------------------------------------|--|----------------------|-------------------|-------------------|------------------|----------------------------------|-------------------|--------------------|----------------|---------------------|---------------------|
| Common Name | Scientific Name | Metro (70124) | Harbor Brook (70124) | Rt 690 Pt (20158) | Wastebeds (30093) | Ninemile (40212) | Permanent Habitat Module (50057) | Maple Bay (50057) | Willow Bay (50057) | Marina (50058) | Iron Bridge (50059) | |
| Alewife | <i>Alosa pseudoharengus</i> | 721 | 295 | 33 | 38 | 6 | | | 17 | 105 | 98 | 1313 |
| Banded killifish | <i>Fundulus diaphanus</i> | 162 | 36 | 3 | 19 | 16 | 3 | 7 | 2 | 52 | 23 | 323 |
| Black crappie | <i>Pomoxis nigromaculatus</i> | 1 | 1 | 2 | | 5 | 5 | 23 | 6 | 5 | 1 | 49 |
| Bluegill | <i>Lepomis macrochirus</i> | 137 | 151 | 129 | 14 | 127 | 152 | 63 | 143 | 116 | 239 | 1271 |
| Bluegill (yoy) | <i>Lepomis macrochirus</i> | | | | | | | 30 | | | | 30 |
| Bluntnose minnow | <i>Pimephales notatus</i> | 1 | 2 | | | | 1 | | | | | 4 |
| Bowfin | <i>Amia calva</i> | 7 | 11 | 5 | 6 | 9 | 4 | 3 | 13 | 2 | 1 | 61 |
| Brook stickleback | <i>Culaea inconstans</i> | 2 | | | | | | | | | | 2 |
| Brown bullhead | <i>Ameiurus nebulosus</i> | 51 | 73 | 104 | 11 | 32 | 28 | 6 | 23 | 31 | 14 | 373 |
| Brown trout | <i>Salmo trutta</i> | | | | | | | | | 1 | | 1 |
| Channel catfish | <i>Ictalurus punctatus</i> | 2 | 13 | | 1 | 2 | 3 | 1 | | 5 | 1 | 28 |
| Common carp | <i>Cyprinus carpio</i> | 5 | 9 | 13 | | 10 | 4 | 10 | 8 | 11 | 4 | 74 |
| Common shiner | <i>Luxilus cornutus</i> | 3 | | | | | | | 1 | | | 4 |
| Emerald shiner | <i>Notropis atherinoides</i> | 5 | 5 | | | | 1 | 1 | 1 | | | 13 |
| Fathead minnow | <i>Pimephales promelas</i> | | | | | | | | | | 1 | 1 |
| Freshwater drum | <i>Aplodinotus grunniens</i> | | 2 | 1 | 4 | | 1 | 1 | | | | 9 |
| Gizzard shad | <i>Dorosoma cepedianum</i> | 14 | 1 | 2 | 2 | 1 | 16 | 1 | 1 | 3 | 1 | 42 |
| Golden shiner | <i>Notemigonus crysoleucas</i> | 187 | 19 | 11 | 13 | 4 | 11 | 21 | 35 | 26 | 60 | 387 |
| Goldfish | <i>Carassius auratus</i> | | 1 | 1 | | | | | | | | 2 |
| Green sunfish | <i>Lepomis cyanellus</i> | | | | | | | | 1 | 1 | | 2 |
| Largemouth bass | <i>Micropterus salmoides</i> | 140 | 57 | 52 | 2 | 16 | 17 | 26 | 48 | 52 | 53 | 463 |
| Longnose gar | <i>Lepisosteus osseus</i> | | 3 | | | 1 | | | 1 | | | 5 |
| Northern pike | <i>Esox lucius</i> | | | | | | | | 1 | | | 1 |
| Pumpkinseed | <i>Lepomis gibbosus</i> | 107 | 56 | 124 | 11 | 68 | 83 | 71 | 205 | 136 | 108 | 969 |
| Pumpkinseed (yoy) | <i>Lepomis gibbosus</i> | | | 1 | | | | | | | | 1 |
| Rainbow trout | <i>Oncorhynchus mykiss</i> | 1 | 1 | | | | | | | | | 2 |
| Rockbass | <i>Ambloplites rupestris</i> | 4 | 2 | 4 | 4 | 9 | 5 | 9 | 10 | 13 | 13 | 73 |
| Rudd | <i>Scardinius erythrophthalmus</i> | 12 | 5 | 3 | 1 | | | | | 1 | 5 | 27 |
| Shorthead redhorse | <i>Moxostoma macrolepidotum</i> | | 6 | | | | | | | | | 6 |
| Silver redhorse | <i>Moxostoma anisurum</i> | | | | | 1 | | | | | | 1 |
| Smallmouth bass | <i>Micropterus dolomieu</i> | 1 | 1 | | 2 | | 2 | | 3 | 8 | | 17 |
| Spottail shiner | <i>Notropis hudsonius</i> | 1 | | | | | | | | | | 1 |
| Tadpole madtom | <i>Noturus gyrinus</i> | | | | | | | | 1 | | | 1 |
| Tessellated darter | <i>Etheostoma olmstedii</i> | | | | | 1 | | | | | | 1 |
| Walleye | <i>Sander vitreus</i> | 1 | | | | 1 | | | | | | 2 |
| White perch | <i>Morone americana</i> | 67 | 18 | 9 | 21 | 5 | 1 | 12 | 19 | 18 | 37 | 207 |
| White sucker | <i>Catostomus commersoni</i> | 27 | 21 | 8 | 1 | 2 | 4 | 4 | 5 | 3 | 16 | 91 |
| Yellow bullhead | <i>Ameiurus natalis</i> | 1 | | | | 2 | 7 | 3 | 10 | 11 | 3 | 37 |
| Yellow perch | <i>Perca flavescens</i> | 1 | 7 | 40 | 1 | 38 | 11 | 9 | 70 | 18 | 45 | 240 |
| Total Fish Captured | | 1661 | 796 | 545 | 151 | 356 | 359 | 301 | 624 | 618 | 723 | 6134 |
| Species Richness | | 26 | 25 | 18 | 17 | 21 | 20 | 18 | 23 | 21 | 19 | 37 |

TABLE 11
2010 GILL NET SAMPLING LOCATIONS IN ONONDAGA LAKE

| Location Name | Sampling Date | Set Time | End Time | Water Depth Shallow (m) | Water Depth Deep (m) | Number Times Sampled |
|--|---------------|-------------|-------------|-------------------------|----------------------|----------------------|
| METRO (OL-STA-70124) | 6/15/2010 | 11:30:00 PM | 1:00:00 AM | 32 | 34 | 1 |
| Harbor Brook (OL-STA-70124) | 5/27/2010 | 8:59:00 PM | 11:20:00 PM | 4.4 | 5.1 | 6 |
| | 6/14/2010 | 12:15:00 AM | 1:20:00 AM | 2.8 | 4.5 | |
| | 7/20/2010 | 9:00:00 PM | 10:00:00 PM | 4.8 | 5.6 | |
| | 8/12/2010 | 10:44:00 PM | 11:44:00 PM | 4.8 | 6.1 | |
| | 9/28/2010 | 8:40:00 PM | 9:40:00 PM | 4.8 | 5.5 | |
| | 10/13/2010 | 10:35:00 PM | 11:35:00 PM | 4.8 | 5.3 | |
| 690 Pt (OL-STA-20158) | 5/26/2010 | 9:07:00 PM | 10:06:00 PM | 2.6 | 6.9 | 6 |
| | 6/21/2010 | 8:22:00 PM | 9:45:00 PM | 7 | 25.4 | |
| | 7/20/2010 | 9:20:00 PM | 10:25:00 PM | 4 | 6.9 | |
| | 8/10/2010 | 8:51:00 PM | 9:47:00 PM | 3.6 | 7.3 | |
| | 9/28/2010 | 9:10:00 PM | 10:10:00 PM | 3.2 | 7.2 | |
| | 10/12/2010 | 10:35:00 PM | 11:35:00 PM | 3 | 6.6 | |
| Causeway (OL-STA-20158) | 5/27/2010 | 11:18:00 PM | 11:18:00 PM | 3.5 | 8 | 6 |
| | 6/14/2010 | 11:20:00 PM | 12:25:00 PM | 3.2 | 6.2 | |
| | 7/19/2010 | 9:43:00 PM | 11:02:00 PM | 3.9 | 8.9 | |
| | 8/12/2010 | 9:03:00 PM | 10:16:00 PM | 4.3 | 9 | |
| | 9/28/2010 | 7:45:00 PM | 8:45:00 PM | 4 | 7 | |
| | 10/13/2010 | 9:53:00 PM | 10:53:00 PM | 3.9 | 7.1 | |
| Wastebeds 1-8 (OL-STA-30093) | 5/26/2010 | 9:47:00 PM | 11:07:00 PM | 3 | 8 | 6 |
| | 6/14/2010 | 9:45:00 PM | 10:45:00 AM | 1.5 | 7.2 | |
| | 7/20/2010 | 10:20:00 PM | 11:20:00 PM | 3 | 7.6 | |
| | 8/12/2010 | 8:41:00 PM | 9:41:00 PM | 4 | 8 | |
| | 9/28/2010 | 9:55:00 PM | 10:55:00 PM | 3 | 8.1 | |
| | 10/12/2010 | 10:05:00 PM | 11:05:00 PM | 4.1 | 8 | |
| Ninemile Creek Outlet (OL-STA-40212) | 5/26/2010 | 8:34:00 PM | 9:35:00 PM | 5 | 8.8 | 6 |
| | 6/15/2010 | 9:30:00 PM | 10:30:00 PM | 4 | 8.4 | |
| | 7/20/2010 | 11:00:00 PM | 12:00:00 AM | 5 | 8.5 | |
| | 8/8/2010 | 10:33:00 PM | 11:33:00 PM | 5.8 | 8.5 | |
| | 9/27/2010 | 7:30:00 PM | 8:30:00 PM | 5.5 | 8.5 | |
| | 10/13/2010 | 9:10:00 PM | 10:10:00 PM | 4.3 | 8.9 | |
| Permanent Habitat Module (PHM) (OL-STA-5--57) | 5/25/2010 | 10:20:00 PM | 11:20:00 PM | 3.9 | 7.8 | 6 |
| | 6/15/2010 | 10:25:00 PM | 11:45:00 PM | 5 | 8.2 | |
| | 7/21/2010 | 8:57:00 PM | 9:57:00 PM | 2 | 8.2 | |
| | 8/8/2010 | 9:05:00 PM | 10:06:00 PM | 4 | 8.8 | |
| | 9/27/2010 | 7:55:00 PM | 8:55:00 PM | 4.2 | 8.2 | |
| | 10/13/2010 | 7:47:00 PM | 8:47:00 PM | 3.9 | 9 | |
| Lake Outlet (OL-STA-50057) | 5/25/2010 | 11:05:00 PM | 12:05:00 PM | | | 6 |
| | 6/21/2010 | 10:35:00 PM | 11:35:00 PM | 12.7 | 22.5 | |
| | 7/21/2010 | 9:22:00 PM | 10:45:00 PM | 4.2 | 6.9 | |
| | 8/8/2010 | 8:38:00 PM | 9:38:00 PM | 4 | 6.5 | |
| | 9/27/2010 | 9:57:00 PM | 10:57:00 PM | 3.7 | 6.5 | |
| | 10/13/2010 | 7:12:00 PM | 8:12:00 PM | 3.8 | 6.8 | |
| Hiawatha Pt (OL-STA-50057) | 5/24/2010 | 9:50:00 PM | 11:14:00 PM | 2.8 | 9.5 | 6 |
| | 6/21/2010 | 11:05:00 PM | 12:05:00 PM | 9 | 35.4 | |
| | 7/21/2010 | 10:39:00 PM | 11:34:00 PM | 5 | 10.2 | |
| | 8/8/2010 | 10:02:00 PM | 11:03:00 PM | 2.4 | 10.2 | |
| | 9/27/2010 | 9:00:00 PM | 10:00:00 PM | 4 | 10.2 | |
| | 10/13/2010 | 8:35:00 PM | 9:35:00 PM | 4 | 9.1 | |
| Marina (OL-STA-50058) | 5/25/2010 | 9:20:00 PM | 10:25:00 PM | 4.8 | 7 | 6 |
| | 6/14/2010 | 10:10:00 PM | 11:25:00 PM | 3.2 | 9.2 | |
| | 7/19/2010 | 9:10:00 PM | 10:12:00 PM | 3.2 | 9.5 | |
| | 8/8/2010 | 11:28:00 PM | 12:28:00 PM | 5 | 10.2 | |
| | 9/27/2010 | 10:25:00 PM | 11:04:00 PM | 4 | 10 | |
| | 10/12/2010 | 8:40:00 PM | 9:40:00 PM | 3.8 | 5.3 | |
| Iron Bridge (OL-STA-50059) | 5/27/2010 | 8:46:00 PM | 9:46:00 PM | 2.5 | 9 | 6 |
| | 6/21/2010 | 7:40:00 PM | 8:40:00 PM | 13 | 30 | |
| | 7/19/2010 | 10:57:00 PM | 11:57:00 PM | 4.9 | 9.5 | |
| | 8/12/2010 | 10:11:00 PM | 11:11:00 PM | 4.2 | 10.1 | |
| | 9/28/2010 | 7:20:00 PM | 8:20:00 PM | 3.2 | 9.2 | |
| | 10/12/2010 | 9:00:00 PM | 10:01:00 PM | 3.2 | 9.3 | |
| Ley Creek Outlet (OL-STA-60225) | 6/15/2010 | 12:45:00 PM | 1:45:00 PM | 20 | 24 | 1 |
| Total Number of Gill Net Sets | | | | | | 62 |

Blank cells indicate data were not recorded for the sampling event.

TABLE 12
SUMMARY OF NUMBER OF INDIVIDUALS PER SPECIES CAPTURED IN GILL NETS MAY-OCTOBER 2010

| Common Name | Scientific Name | Station Description (Station Identifier: OL-STA) | | | | | | | | | | | | Total Fish Captured |
|---------------------|---------------------------------|--|----------------------|-------------------|------------------|-----------------------|-------------------|----------------------------------|----------------|------------------|----------------|---------------------|-------------------|---------------------|
| | | Metro (70124) | Harbor Brook (70124) | Rt 690 Pt (20158) | Causeway (20158) | Wastebeds 1-8 (30093) | Nine Mile (40212) | Permanent Habitat Module (50057) | Outlet (50057) | Hiawatha (50057) | Marina (50058) | Iron Bridge (50059) | Ley Creek (60225) | |
| Alewife | <i>Alosa pseudoharengus</i> | | | 1 | | | | | | | | | | 1 |
| Bowfin | <i>Amia calva</i> | | | | 1 | | | | | | | | | 1 |
| Brown bullhead | <i>Ameiurus nebulosus</i> | | | | 1 | | | | | | | | | 1 |
| Brown trout | <i>Salmo trutta</i> | | | | | 3 | 4 | 3 | | | | 1 | | 12 |
| Common carp | <i>Cyprinus carpio</i> | | | 4 | 5 | 1 | 1 | 1 | 4 | 5 | 3 | | | 24 |
| Channel catfish | <i>Ictalurus punctatus</i> | 6 | 7 | 11 | 19 | 15 | 2 | 10 | 4 | 6 | 6 | 19 | | 105 |
| Freshwater drum | <i>Aplodinotus grunniens</i> | | 1 | 10 | 11 | 3 | | 2 | 1 | 3 | | 5 | | 36 |
| Gizzard shad | <i>Dorosoma cepedianum</i> | 1 | 3 | 13 | 3 | 13 | 1 | 8 | 19 | 1 | 2 | 9 | | 73 |
| Lake sturgeon | <i>Acipenser fulvescens</i> | | | 1 | | 1 | | | | | | | | 2 |
| Largemouth bass | <i>Micropterus salmoides</i> | | | | 1 | | | 1 | 1 | | | | | 3 |
| Longnose gar | <i>Lepisosteus osseus</i> | | | | | | 1 | | | | 1 | | | 2 |
| Northern pike | <i>Esox lucius</i> | | | 1 | | | | | | | | 1 | | 2 |
| Quillback | <i>Carpoides cyprinus</i> | | 2 | | 1 | | | | | | | | | 3 |
| Shorthead redhorse | <i>Moxostoma macrolepidotum</i> | | | 13 | 1 | 5 | 1 | 2 | 1 | | 1 | 4 | | 28 |
| Smallmouth bass | <i>Micropterus dolomieu</i> | | | | 3 | 1 | | | 2 | | | 3 | | 9 |
| Silver redhorse | <i>Moxostoma anisurum</i> | | | 1 | | 1 | | | 3 | | 2 | 1 | | 8 |
| Walleye | <i>Sander vitreus</i> | 1 | 3 | 30 | 39 | 17 | 7 | 14 | 23 | 12 | 27 | 43 | | 216 |
| White perch | <i>Morone americana</i> | | | 1 | 1 | | | | | | 1 | | | 3 |
| White sucker | <i>Catostomus commersoni</i> | 3 | | 2 | 11 | 6 | | 2 | 2 | 3 | 2 | 5 | | 36 |
| Total Species Count | | 11 | 16 | 88 | 97 | 66 | 19 | 43 | 60 | 30 | 45 | 92 | 0 | 568 |
| Species Richness | | 4 | 5 | 12 | 13 | 11 | 7 | 9 | 10 | 6 | 9 | 10 | 0 | 19 |

TABLE 13
LAKE STURGEON CATCH AND TAG INFORMATION - 2010

| Location Name | Sampling Date | Coordinates | Total Length (mm) | Weight (kg) | Carlin Tag Number | USGS tag number |
|----------------|---------------|-------------------|----------------------|----------------|----------------------|--------------------|
| 690 Point | 7/20/2010 | 430451 N 761234 W | 1530 | | | |
| Marina | 9/27/2010 | 430515 N 761232 W | 1340 | | 0 | |
| Wastebeds 1-8 | 9/27/2010 | 430515 N 761310 W | 1341 | | 1 | |
| Wastebeds 1-8 | 9/28/2010 | 430521 N 761320 W | 1383 | | 2 | 1187 |
| Iron Bridge | 10/4/2010 | 430524 N 761139 W | 1055 | 8.89 | 3 | |
| Hiawatha Point | 10/4/2010 | 430310 N 761259 W | 1434 | 22.07 | 4 | |
| Wastebeds | 10/4/2010 | 430515 N 761310 W | 1304 | 13.71 | 6 | |
| Hiawatha Point | 10/5/2010 | 430310 N 761259 W | 1400 | 24.92 | 5 | |
| Lake Outlet | 10/13/2010 | 430651 N 761425 W | 1141 | 10.85 | 7 | |
| Lake Outlet | 10/27/2010 | 430651 N 761425 W | 1402 | 19.5 | 8 | |
| Lake Outlet | 10/28/2010 | 430651 N 761425 W | 1572 | | 9 | |

Notes: Sturgeon caught at the 690 Point location were captured during gill netting for fish community analysis and therefore were not tagged. Weights were not recorded for all sturgeon

TABLE 14
SUMMARY OF NUMBER OF INDIVIDUALS PER SPECIES CAPTURED BY SEINING - AUGUST 2010

| Common Name | Scientific Name | Metro (70124) | Rt 690 Pt (20158) | Wastebeds 1-8 (30093) | Ninemile Creek Outlet (40212) | Permanent Habitat Module (50057) | Maple Bay (50057) | Willow Bay (50057) | Marina (50058) | Iron Bridge (50059) | Total Fish Captured |
|----------------------------|--------------------------------|------------------|----------------------|--------------------------|--|---|----------------------|-----------------------|-------------------|------------------------|------------------------|
| Alewife | <i>Alosa pseudoharengus</i> | | 7 | | | | | | | | 7 |
| Banded killifish | <i>Fundulus diaphanus</i> | 71 | 232 | 2581 | 623 | 41 | 57 | 143 | 1244 | 893 | 5885 |
| Black crappie | <i>Pomoxis nigromaculatus</i> | | | | | | | 1 | | | 1 |
| Bluegill | <i>Lepomis macrochirus</i> | 6 | | | | 4 | 12 | 6 | | | 28 |
| Bluegill (YOY) | <i>Lepomis macrochirus</i> | | | | | | 11 | 29 | | | 40 |
| Bluntnose minnow | <i>Pimephales notatus</i> | 5 | | | | | | | | | 5 |
| Brook silverside | <i>Labidesthes sicculus</i> | | | | | 4 | | | | | 4 |
| Brown bullhead | <i>Ameiurus nebulosus</i> | 1 | | 1 | | 5 | 2 | | 2 | | 11 |
| Brown trout | <i>Salmo trutta</i> | | | | | | | | | 1 | 1 |
| Central mudminnow | <i>Umbra limi</i> | | | | | | | 1 | | | 1 |
| Common carp | <i>Cyprinus carpio</i> | | 3 | 2 | | | | | | 1 | 6 |
| Emerald shiner | <i>Notropis atherinoides</i> | | | 1 | | | | | | | 1 |
| Golden shiner | <i>Notemigonus crysoleucas</i> | | | | | 3 | | | | | 3 |
| Largemouth bass | <i>Micropterus salmoides</i> | 52 | 45 | 6 | 46 | 76 | 32 | 336 | 50 | 38 | 681 |
| Pumpkinseed | <i>Lepomis gibbosus</i> | 20 | 10 | | | 43 | 8 | 21 | | 2 | 104 |
| Pumpkinseed (YOY) | <i>Lepomis gibbosus</i> | | | | | | | 7 | | | 7 |
| Rockbass | <i>Ambloplites rupestris</i> | 2 | | | 1 | | | 3 | | | 6 |
| Round goby | <i>Neogobius melanostomus</i> | 1 | | | | | | | | | 1 |
| Smallmouth bass | <i>Micropterus dolomieu</i> | | | | | | | | | 1 | 1 |
| Tadpole madtom | <i>Noturus gyrinus</i> | 7 | | | | | 1 | 3 | | | 11 |
| Tessellated darter | <i>Etheostoma olmstedii</i> | | | 13 | 6 | 16 | 29 | 8 | 98 | | 170 |
| Unidentified sunfish | <i>Lepomis spp.</i> | | | | | | | 1 | | | 1 |
| White perch | <i>Morone americana</i> | | 2 | | | | | | | | 2 |
| White sucker | <i>Catostomus commersoni</i> | 1 | | | | | | 2 | | | 3 |
| Yellow perch | <i>Perca flavescens</i> | | 2 | | | | | | | 8 | 10 |
| Total Fish Captured | | 165 | 297 | 2604 | 676 | 192 | 152 | 558 | 1394 | 936 | 6974 |
| Species Richness | | 10 | 7 | 6 | 4 | 8 | 7 | 11 | 4 | 7 | 23 |

TABLE 15
FISH TAG INFORMATION FOR SONIC TELEMTRY

| Tag Date | Fish ID | Species | Total Length (mm) | Catch location | Dead or alive (November) |
|------------|---------|-----------------|----------------------|----------------|-----------------------------|
| 5/24/2010 | 62 | walleye | 580 | Hiawatha | Dead |
| 5/24/2010 | 63 | walleye | 465 | Wastebeds 1-8 | |
| 5/24/2010 | 64 | walleye | 527 | Hiawatha | |
| 5/25/2010 | 65 | walleye | 501 | Iron Bridge | |
| 5/24/2010 | 66 | walleye | 546 | Wastebeds 1-8 | |
| 5/25/2010 | 68 | walleye | 507 | PHM | |
| 5/25/2010 | 69 | walleye | 644 | Iron Bridge | |
| 5/24/2010 | 70 | walleye | 534 | Wastebeds 1-8 | |
| 5/25/2010 | 71 | walleye | 622 | Marina | |
| 5/25/2010 | 77 | walleye | 523 | PHM | Dead |
| 5/24/2010 | 78 | walleye | 540 | Hiawatha | |
| 5/25/2010 | 79 | walleye | 573 | Marina | Dead |
| 5/25/2010 | 81 | walleye | 556 | Iron Bridge | |
| 7/19/2010 | 97 | walleye | 520 | Marina | Dead |
| 7/19/2010 | 103 | walleye | 579 | Marina | |
| 7/19/2010 | 105 | walleye | 548 | Marina | Dead |
| 10/14/2010 | 119 | walleye | 510 | :Lake Outlet | |
| 10/14/2010 | 132 | smallmouth bass | 442 | Lake Outlet | |
| 10/14/2010 | 143 | smallmouth bass | 489 | Lake Outlet | |

TABLE 16
TAG DETECTIONS AND LOCATION DURING 8-H SONIC TELEMETRY SURVEYS MAY-NOVEMBER, 2010

| Fish ID | 62 | 63 | 64 | 65 | 66 | 68 | 69 | 70 | 71 | 77 | 78 | 79 | 81 | 97 | 103 | 105 | 119 | 132 | 143 | Total |
|--------------------------------------|----------|-----------|-----------|-----------|-----------|----------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| Date/species | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | WAE | SMB | SMB | |
| 5/27/2010 | | 2 | 6 | 5 | | | 5 | 5 | | 8 | | 8 | | | | | | | | 7 |
| 6/10/2010 | 8 | 8 | 8 | 8 | 8 | 5 | | 8 | 8 | 8 | 5 | 8 | 1 | | | | | | | 12 |
| 7/9/2010 | 8 | 8 | 5 | 5 | 8 | 5 | | 5 | 8 | 8 | 5 | D | 8 | | | | | | | 11 |
| 7/26/2010 | | 5 | 8 | 5 | 8 | 8 | | | | 8 | 5 | D | 8 | | | 8 | | | | 9 |
| 8/3/2010 | D | 8 | 8 | 8 | 8 | 8 | | | | | 8 | D | 8 | D | 8 | D | | | | 8 |
| 8/19/2010 | D | 8 | 4 | 8 | 8 | 8 | | 8 | 8 | 8 | 8 | D | 8 | D | 8 | D | | | | 11 |
| 9/1/2010 | D | 5 | 8 | 5 | 8 | | | 8 | 8 | 8 | | D | | D | 8 | D | | | | 8 |
| 9/14/2010 | D | 8 | 8 | 8 | 8 | | | 8 | 8 | | | D | 8 | D | | D | | | | 7 |
| 10/1/2010 | D | 8 | | 8 | 8 | | | 8 | 8 | D | | D | | D | | D | | | | 5 |
| 10/13/2010 | D | | | 8 | 8 | | | 8 | 8 | D | 8 | D | | D | | D | | | | 5 |
| 10/26/2010 | D | 8 | 8 | | 8 | | | 8 | 8 | D | | D | 5 | D | | D | 8 | | | 7 |
| 11/10/2010 | D | 8 | 8 | | 8 | | | 8 | 8 | D | | D | | D | | D | 8 | 8 | 5 | 8 |
| Total number of times located | 2 | 11 | 10 | 10 | 11 | 5 | 1 | 10 | 9 | 6 | 6 | 2 | 7 | 0 | 3 | 1 | 2 | 1 | 1 | |

Number = SMU fish found in, D = dead.

WAE = Walleye; SMB = Smallmouth bass

blanks indicate fish not detected during survey

TABLE 17
NUMBER OF PASSIVE RECEIVER DETECTIONS WITHIN THE ONONDAGA LAKE OUTLET

| Date | Fish ID (see Table 15) | | | | | | | | | | | | | | | Total |
|----------------------|------------------------|-----|----|----|-----|-----|----|-----|----|----|-----|-----|-----|-----|------|-------|
| | 63 | 64 | 65 | 66 | 68 | 70 | 77 | 78 | 81 | 97 | 103 | 105 | 119 | 132 | 143 | |
| 8/24/2010 | | | | | 19 | | | 8 | | | | | | | | 27 |
| 8/25/2010 | | | | | 112 | | 1 | | | | | | | | | 113 |
| 8/26/2010 | | | | | 12 | | | | | | | 1 | | | | 13 |
| 8/27/2010 | | | | | 4 | | | | | | | | | | | 4 |
| 8/28/2010 | | | | | 1 | | | | | | | | | | | 1 |
| 8/31/2010 | | | | | 2 | | | | | | | | | | | 2 |
| 9/12/2010 | | | | | | | | 13 | | | | | | | | 13 |
| 9/13/2010 | | | | | 8 | | | | | | | | | | | 8 |
| 9/15/2010 | | | | 1 | | | | | | | | | | | | 1 |
| 9/17/2010 | | | | | 3 | | | | | | | | | | | 3 |
| 9/19/2010 | | | | | 17 | | | | | | | | | | | 17 |
| 9/20/2010 | | | | | | | | | | | | | | | | 0 |
| 9/22/2010 | | | | 1 | | | | | | | | | | | | 1 |
| 9/29/2010 | | | | | | | | | | 1 | | | | | | 1 |
| 9/30/2010 | | | | | | | | | 1 | | | | | | | 1 |
| 10/1/2010 | | | | | | | | | 1 | | | | | | | 1 |
| 10/2/2010 | 7 | | | | | | | | 4 | | | | | | | 11 |
| 10/3/2010 | 2 | | | | 8 | | | | 1 | | | | | | | 11 |
| 10/4/2010 | 7 | | | | | 57 | | | 2 | | | | | | | 66 |
| 10/5/2010 | 12 | | | | | 39 | | | | | | | | | | 51 |
| 10/6/2010 | 2 | | | | | | | | | | | | | | | 2 |
| 10/7/2010 | 4 | | | | | | | | | | | | | | | 4 |
| 10/8/2010 | | 8 | | | | | | | | | | | | | | 8 |
| 10/9/2010 | 13 | 22 | | | | | | | 10 | | | | | | | 45 |
| 10/14/2010 | 4 | | | | | | | | 13 | | | | | | | 17 |
| 10/15/2010 | | | | | | | | | | | | | | | | 0 |
| 10/16/2010 | | | | | | | | | | | | | | 10 | 250 | 260 |
| 10/17/2010 | | | | | | | | | | | | | | | 211 | 211 |
| 10/18/2010 | 19 | | 8 | | | | | | | | | | | | | 27 |
| 10/19/2010 | | 13 | | | | | | | | | | | | | | 13 |
| 10/20/2010 | | | | | | 33 | | | | | | | | | | 33 |
| 10/21/2010 | | | | | | 24 | | 13 | | | | | 16 | | | 53 |
| 10/22/2010 | | 15 | | | | | | 23 | | | | | 9 | | | 47 |
| 10/23/2010 | | | | | | | | 41 | 3 | | | | | | | 44 |
| 10/24/2010 | | | | | | | | 19 | | | | | | | 9 | 28 |
| 10/25/2010 | | | | | | | | 8 | | | | | | | 37 | 45 |
| 10/26/2010 | 6 | | | | | | | 17 | | | | | | | 113 | 136 |
| 10/27/2010 | | | | | | | | | | | | | | | 35 | 35 |
| 10/28/2010 | | | | | | | | 13 | | | | | | | 57 | 70 |
| 10/29/2010 | | | | | | | | 20 | | | | | 12 | | 27 | 59 |
| 10/30/2010 | | 1 | | | | | | 29 | | | | | 14 | | 88 | 132 |
| 10/31/2010 | | 44 | | | | | | 21 | | | | | | 15 | 9 | 89 |
| 11/1/2010 | 7 | 8 | | | | | | 34 | 9 | | | | | | 10 | 68 |
| 11/2/2010 | | 23 | | | | | | 25 | 2 | | | | | | 14 | 64 |
| 11/3/2010 | | | | | | | | 15 | | | | | | | 4 | 19 |
| 11/4/2010 | | | | | | | | | | | | | | | 5 | 5 |
| 11/5/2010 | | 22 | | | | | | 27 | | | | | | | | 49 |
| 11/6/2010 | | 35 | | | | 3 | | | | | | | | | 7 | 45 |
| 11/7/2010 | | | | | | 35 | | | | | | | | | 22 | 57 |
| 11/8/2010 | | | | | | | | | 7 | | | | 11 | | 34 | 52 |
| 11/9/2010 | | | | | | | | | | | | | 11 | | 26 | 37 |
| 11/11/2010 | | | | | | | | | | | | | | | 33 | 33 |
| 11/12/2010 | | | | | | | | | | | | | | | 51 | 51 |
| 11/13/2010 | | | | | | | | 14 | | | | | | | | 14 |
| 11/14/2010 | | | | | | | | | | | | | 13 | | 320 | 333 |
| 11/15/2010 | | | | | | | | | | | | | | | 433 | 433 |
| 11/16/2010 | | | | | | | | | | | | | | | 146 | 146 |
| 11/17/2010 | | | | | | | | | | | 15 | | | | 79 | 94 |
| 11/18/2010 | | | | | | | | | | | 26 | | | | 163 | 189 |
| 11/19/2010 | | | | | | | | 71 | | | 19 | | | | 363 | 453 |
| 11/20/2010 | | | | | | | | 33 | | | | | | | | 33 |
| 11/21/2010 | 28 | | | | | | | | | | 33 | | 16 | | | 77 |
| 11/22/2010 | | | | | | | | | | | 9 | | | | 82 | 91 |
| 11/23/2010 | | | | | | | | | | | | | | | 13 | 13 |
| 11/24/2010 | | | | 12 | | | | | | | | | | | | 12 |
| Number of detections | 111 | 191 | 8 | 14 | 186 | 191 | 1 | 444 | 53 | 1 | 102 | 1 | 102 | 25 | 2641 | 4071 |

TABLE 18
TEMPERATURE AND DEPTH OF WATER WHERE FISH WERE LOCATED DURING 24-HOUR SONIC TELEMETRY TRACKING

| Date | Average temperature °C of fish | Maximum temperature °C of fish | Minimum temperature °C of fish | Average water depth (m) at fish location | Maximum water depth (m) at fish location | Minimum water depth (m) at fish location |
|------------|--------------------------------|--------------------------------|--------------------------------|--|--|--|
| 6/3/2010 | 20.9 | 22.5 | 16.5 | 11.8 | 19.5 | 1.9 |
| 6/16/2010 | 18.7 | 20.5 | 16.5 | 8.8 | 14.4 | 0.8 |
| 7/1/2010 | 20.2 | 21.5 | 18 | 2.5 | 4.8 | 0.4 |
| 7/13/2010 | 24 | 26 | 20.5 | 9.1 | 18.9 | 1.5 |
| 7/28/2010 | 24.4 | 25.5 | 23 | 9.4 | 18.1 | 2.5 |
| 8/10/2010 | 23.5 | 24.5 | 22 | 9 | 17.3 | 1.5 |
| 8/24/2010 | 20.7 | 23 | 18 | 13.3 | 18.6 | 3.3 |
| 9/10/2010 | 18.8 | 19.5 | 18 | 15.8 | 20.1 | 6.5 |
| 9/22/2010 | 16.6 | 17.5 | 10 | 10.4 | 18.3 | 5.1 |
| 10/4/2010 | 15.5 | 16.5 | 13.5 | 11.7 | 19.2 | 3.5 |
| 10/18/2010 | 13.2 | 14.5 | 12 | 12.5 | 19.2 | 2.9 |
| 11/2/2010 | 10.4 | 11 | 10 | 14.3 | 16.3 | 13.4 |

NOTES:

1. Water depths indicate the depth of water and not the depth of the fish.
2. Walleye that were tagged were tracked for 24 continuous hours numerous times during 2010 (Figures 14a through 14l). In addition, one smallmouth bass was tracked for 12 continuous hours on November 2, 2010 (Figure 14m).

TABLE 19
BENTHIC MACROINVERTEBRATE AND CRAYFISH TISSUE MERCURY CHEMICAL CONCENTRATIONS MEASURED IN ONONDAGA LAKE - AUGUST 2010 (wet weight basis)

| Location (OL-STA-) | Amphipod | | Chironomid | | Zebra Mussel | | Crayfish | |
|-----------------------|---------------------|------------------|---------------------|------------------|---------------------|------------------|---------------------|------------------|
| | Total Hg (mg/kg) | Me Hg (mg/kg) | Total Hg (mg/kg) | Me Hg (mg/kg) | Total Hg (mg/kg) | Me Hg (mg/kg) | Total Hg (mg/kg) | Me Hg (mg/kg) |
| OL-STA-10161 | 0.256 | 0.174 | 0.127 | 0.036 | 0.118 | 0.076 | 0.196 J 0.216 J | 0.118 0.44* J |
| OL-STA-20160 | 0.004 | 0.003 | 0.004 | 0.001 J | 0.011 | 0.003 | | |
| OL-STA-30095 | 0.050 | 0.048 | 0.006 J | 0.002 J | 0.042 | 0.032 | | |
| OL-STA-40124 | 0.014 | 0.009 | 0.042 J | 0.002 J | 0.028 | 0.016 | | |
| OL-STA-50060 | 0.050 J | 0.051 J | 0.048 J | 0.003 J | | | | |
| OL-STA-50062 | 0.034 J | 0.034 J | 0.014 J | 0.018 | 0.042 | 0.038 | | |
| OL-STA-50063 | | | | | 0.015 | 0.004 | | |
| OL-STA-50064 | 0.035 | 0.034 | 0.012 | 0.006 | | | | |
| OL-STA-60226 | 0.009 | 0.005 | 0.009 | 0.001 J | | | | |
| OL-STA-70125 | 0.044 | 0.028 | 0.048 | 0.002 J | | | 0.153 J | 0.114 |

Note: Blank cells indicate a sample was not collected from that location.

* For one of the crayfish collected from location OL-STA-10161, the methylmercury concentration was reported to be about two times the total mercury concentration. The laboratory then checked their documentation and could not identify any basis for revising their analytical report.

TABLE 20
SUMMARY OF BENTHIC MACROINVERTEBRATE METRICS FROM ONONDAGA LAKE IN 2010

| | Mean Index Value | | | | | | Mean NYSDEC Water Quality Impact Value | | | | | | |
|----------|-----------------------------------|-----------------|-----------|----------------------|-------|-------|--|-----------|----------------------|------|------|------------------|--------------------|
| Location | Total number of individuals | Spp Richness | HBI score | Shannon Diversity | DOM3 | PMA | Spp Richness | HBI score | Shannon Diversity | DOM3 | PMA | WQ Index Mean | Level of Impact |
| 10161 | 176 | 9.33 | 8.53 | 1.75 | 71.81 | 50.58 | 2.15 | 3.68 | 1.26 | 5.53 | 4.12 | 3.35 | Moderate |
| 20160 | 300 | 17.00 | 8.53 | 1.91 | 69.00 | 56.67 | 6.27 | 3.68 | 2.05 | 6.00 | 5.33 | 4.67 | Moderate |
| 30095 | 300 | 12.33 | 8.83 | 1.42 | 76.67 | 50.67 | 3.75 | 2.92 | 0.89 | 4.69 | 4.13 | 3.28 | Moderate |
| 40124 | 300 | 11.00 | 8.41 | 1.91 | 67.33 | 53.00 | 2.98 | 3.98 | 2.03 | 6.28 | 4.60 | 3.97 | Moderate |
| 50060 | 300 | 12.67 | 8.13 | 1.72 | 75.33 | 43.33 | 3.93 | 4.67 | 1.46 | 4.94 | 2.67 | 3.53 | Moderate |
| 50062 | 276 | 15.67 | 7.82 | 2.16 | 60.30 | 48.02 | 5.76 | 5.45 | 3.29 | 7.45 | 3.60 | 5.11 | Slight |
| 50064 | 149 | 9.67 | 8.32 | 1.66 | 75.61 | 52.75 | 2.42 | 4.20 | 0.85 | 4.90 | 4.55 | 3.38 | Moderate |
| 60226 | 241 | 11.00 | 8.18 | 1.82 | 69.47 | 54.36 | 3.05 | 4.54 | 1.62 | 5.92 | 4.87 | 4.00 | Moderate |
| 70125 | 300 | 15.67 | 8.62 | 1.92 | 71.33 | 51.00 | 5.48 | 3.45 | 2.66 | 5.53 | 4.40 | 4.30 | Moderate |

Mean based on 3 replicates per station

HBI - Hilsonhoff Biotic Index

DOM3 - Percent contribution of the three most numerous species

PMA - Percent Model Affinity

TABLE 21
2010 MERCURY AND TOC CONCENTRATIONS IN LITTORAL SEDIMENT AT
ONONDAGA LAKE MACROINVERTEBRATE SAMPLING LOCATIONS (dry weight basis)

| Location ID | Date Sampled | 0-2 cm sediment depth | | | 2-15 cm sediment depth | | |
|--------------|--------------|---------------------------|----------------------------|-----------------|---------------------------|----------------------------|-----------------|
| | | Total Mercury (mg/kg dry) | Methyl Mercury (mg/kg dry) | TOC (mg/kg dry) | Total Mercury (mg/kg dry) | Methyl Mercury (mg/kg dry) | TOC (mg/kg dry) |
| OL-STA-10161 | 8/2/2010 | 7.300 | 0.00914 | 16000 J | 10.600 | 0.00312 J | 15500 J |
| OL-STA-20160 | 8/3/2010 | 0.510 J | 0.00313 J | 30200 J | 0.530 J | 0.00187 | 19100 J |
| OL-STA-30095 | 8/4/2010 | 0.140 | 0.00097 | 11300 J | 0.048 | 0.00007 | 4480 J |
| OL-STA-40124 | 8/4/2010 | 0.830 J | 0.00134 J | 21100 J | 0.37 (0.24) | 0.00007 (0.00033) | 11900 (11200) J |
| OL-STA-50060 | 8/5/2010 | 1.600 J | 0.00336 | 11300 J | 1.000 | 0.00030 | 8490 J |
| OL-STA-50061 | 8/10/2010 | 0.470 | 0.00037 J | 11900 J | 0.084 (0.12) | 0.00008 (0.00008) | 6750 (7280) J |
| OL-STA-50062 | 8/5/2010 | 0.410 | 0.00078 | 13200 J | 0.120 | 0.00017 | 8540 J |
| OL-STA-50063 | 8/10/2010 | 0.086 | 0.00038 | 8790 J | 0.017 U | 0.00003 J | 4770 J |
| OL-STA-50064 | 8/6/2010 | 0.120 | 0.00052 | 9620 J | 0.130 | 0.00013 | 8150 J |
| OL-STA-60226 | 8/3/2010 | 0.980 | 0.00026 | 24200 J | 0.580 | 0.00020 | 24700 J |
| OL-STA-70125 | 8/2/2010 | 7.600 | 0.00473 | 48900 J | 7.000 | 0.00686 | 47200 J |

Field blank values provided in parentheses

TABLE 22

**2010 TOTAL MERCURY AND METHYLMERCURY
CONCENTRATIONS IN UNFILTERED SURFACE WATER AT
LITTORAL AND SOUTH DEEP SAMPLING LOCATIONS**

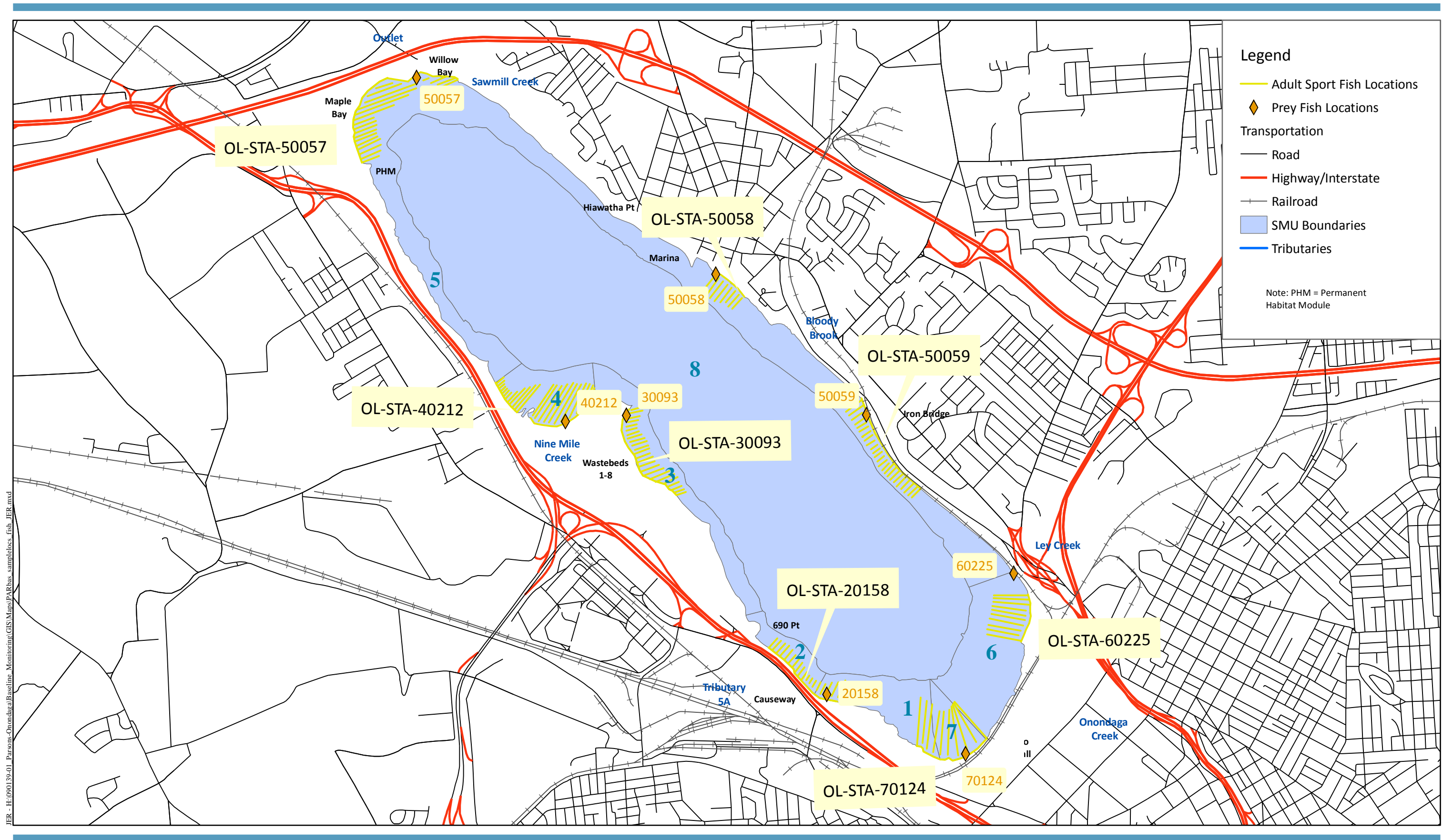
| 2010 Date | Location ID | Total Hg ng/L | Methyl Hg ng/L |
|------------------|--------------------|--------------------------|---------------------------|
| August 16 | OL-STA-10161 | 18 | 0.231 |
| | OL-STA-20160 | 3.39 | 0.149 |
| | OL-STA-30095 | 2.4 | 0.225 |
| | OL-STA-40124 | 3.53/3.76 | 0.148/0.164 |
| | OL-STA-50062 | 2.5 | 0.237 |
| | OL-STA-60226 | 7.79 | 0.103 |
| | South Deep (2 m) | 2.71/2.88 | 0.129/0.183 |
| October 27 | OL-STA-10161 | 13.3 J | 0.132 |
| | OL-STA-20160 | 6.38 J | 0.086 |
| | OL-STA-30095 | 2.95 J | 0.098 |
| | OL-STA-40124 | 2.38 J | 0.133 |
| | OL-STA-50062 | 2.66 J | 0.159 |
| | OL-STA-60226 | 5.46 J | 0.099 |
| | South Deep (2 m)* | 3.26/3.79 | 0.093/0.094 |
| November 11 | OL-STA-10161 | 6.51 | 0.079 |
| | OL-STA-20160 | 1.93 | 0.064 |
| | OL-STA-30095 | 1.57 | 0.048 |
| | OL-STA-40124 | 1.08/1.47 | 0.051/0.053 |
| | OL-STA-50062 | 1.49 | 0.056 |
| | OL-STA-60226 | 3.24 | 0.074 |
| | South Deep (2 m) | 4.64/4.72 | 0.087/0.080 |

J - Estimated result

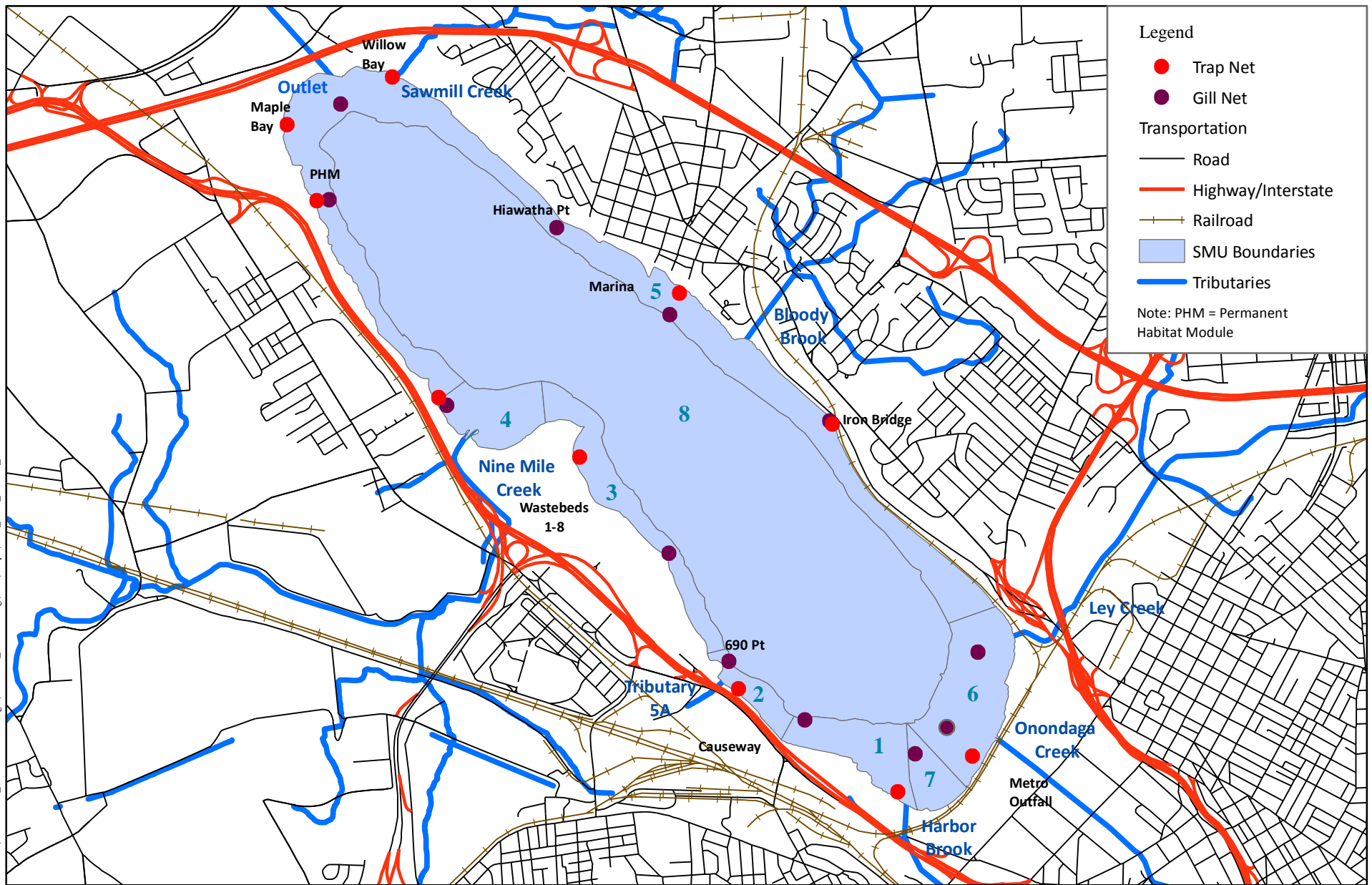
*South Deep samples collected at the 2-meter water depth on August 16, October 26 and November 11, 2010.

Note: Lake turnover during 2010 occurred on or about October 17.

FIGURES



JER - H:\090139-01_Parsons-Onondaga\Baseline_Monitoring\GIS\Maps\PARbas_samplelocs_fish_JER.mxd



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

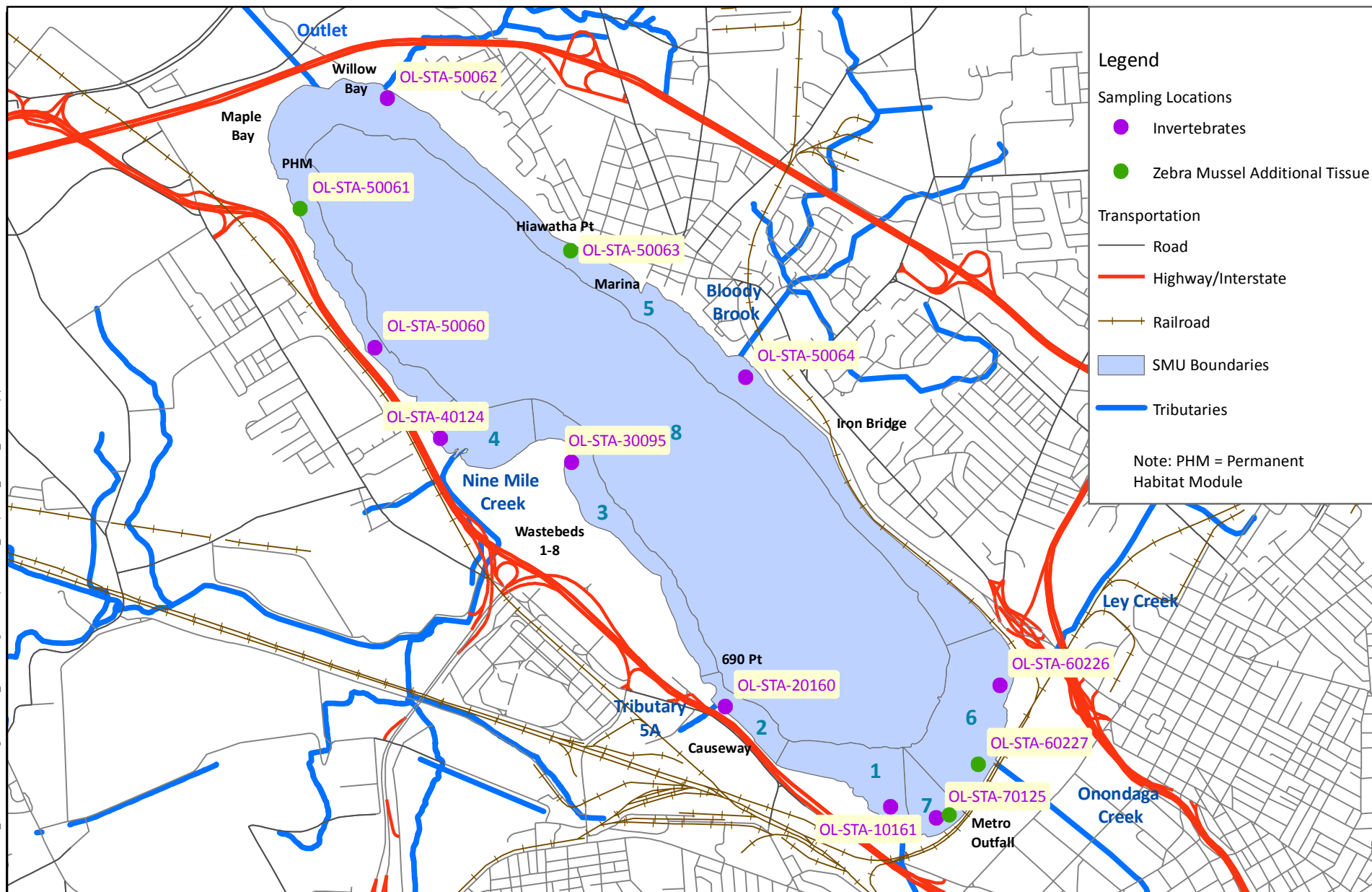


Figure 3
Baseline monitoring macroinvertebrate
tissue and community sampling
locations for 2010.

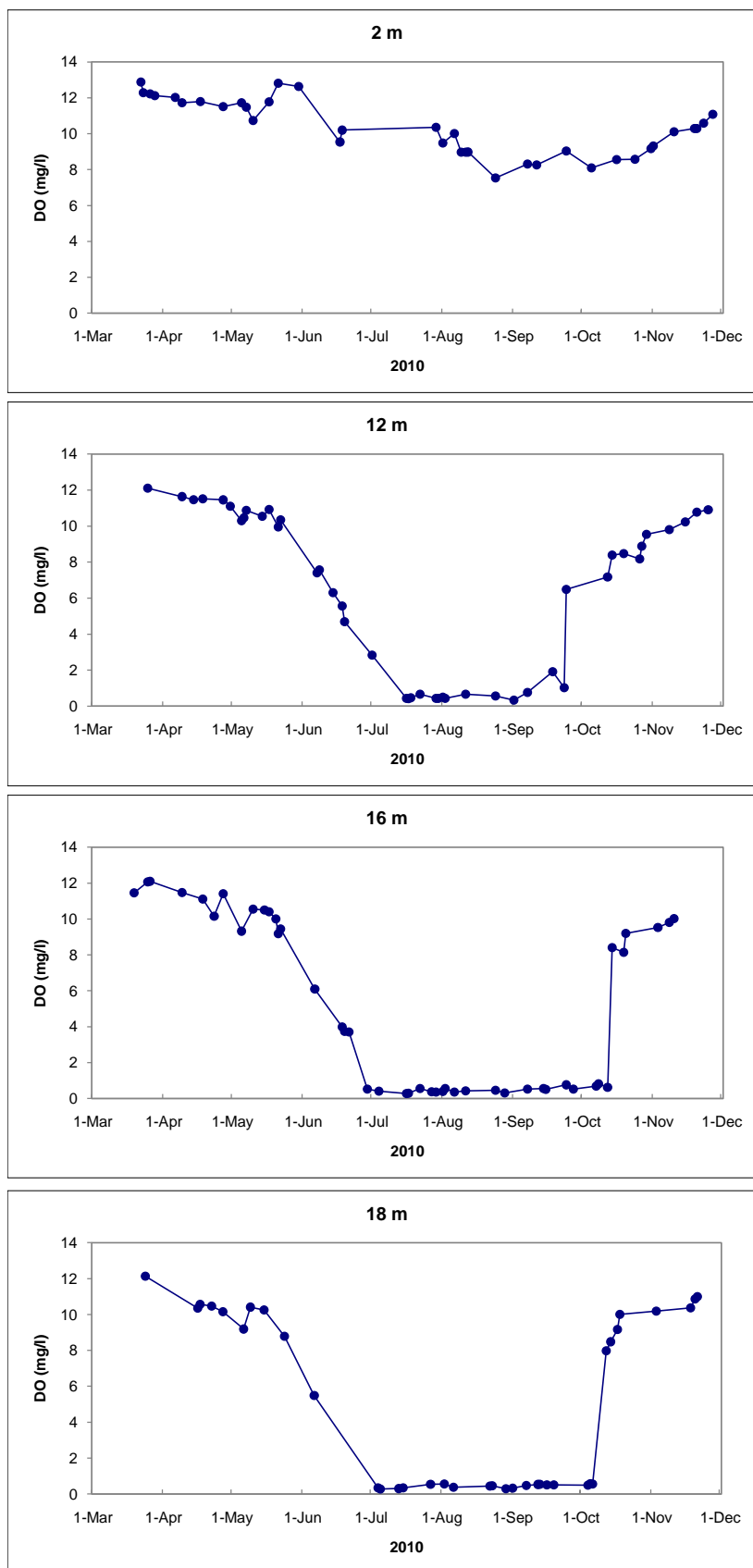


Figure 4. Dissolved oxygen concentrations at 2, 12, 16 and 18 m water depth at South Deep in 2010

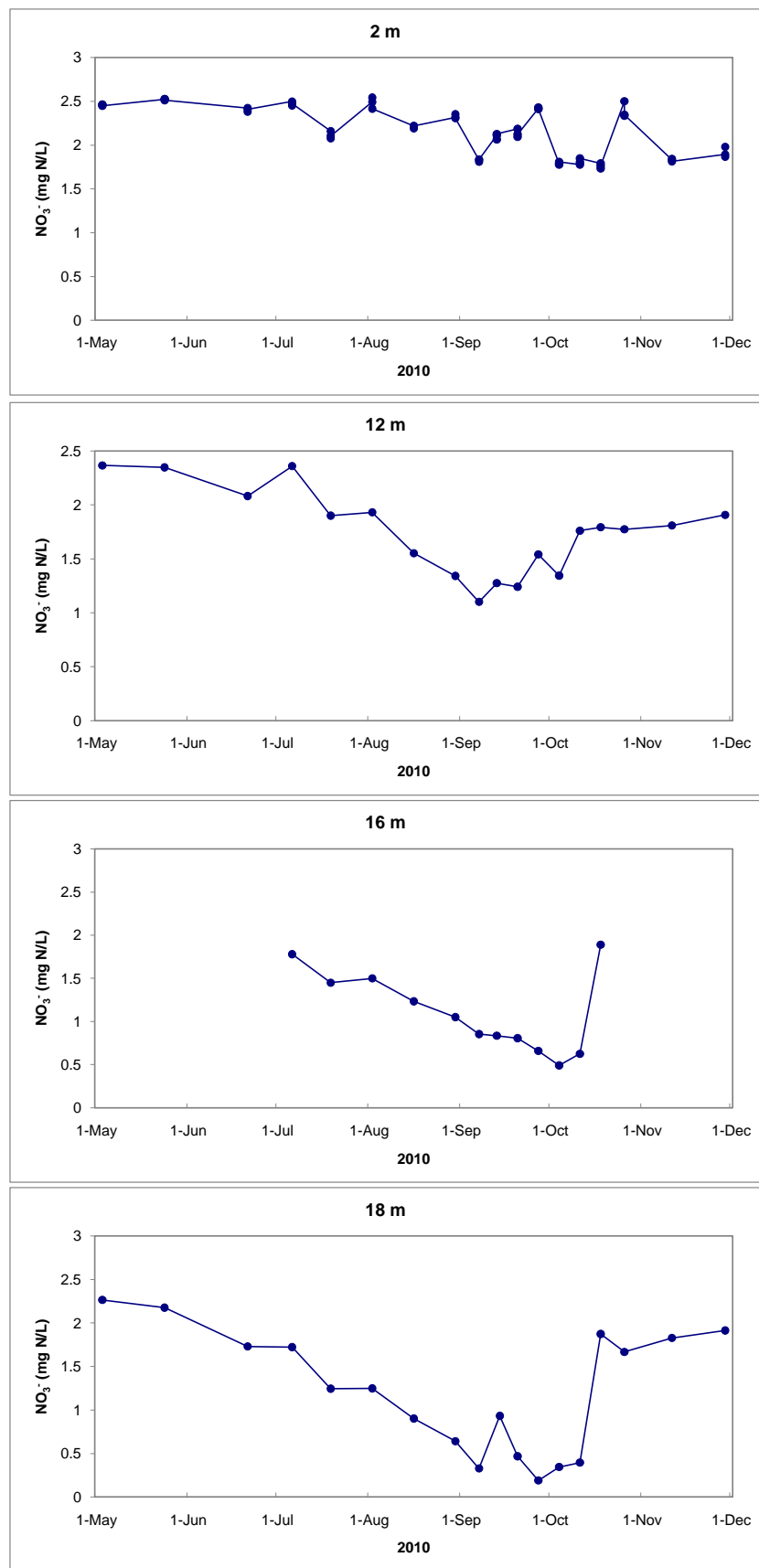


Figure 5. Nitrate concentrations at 2, 12, 16 and 18 m water depth at South Deep in 2010

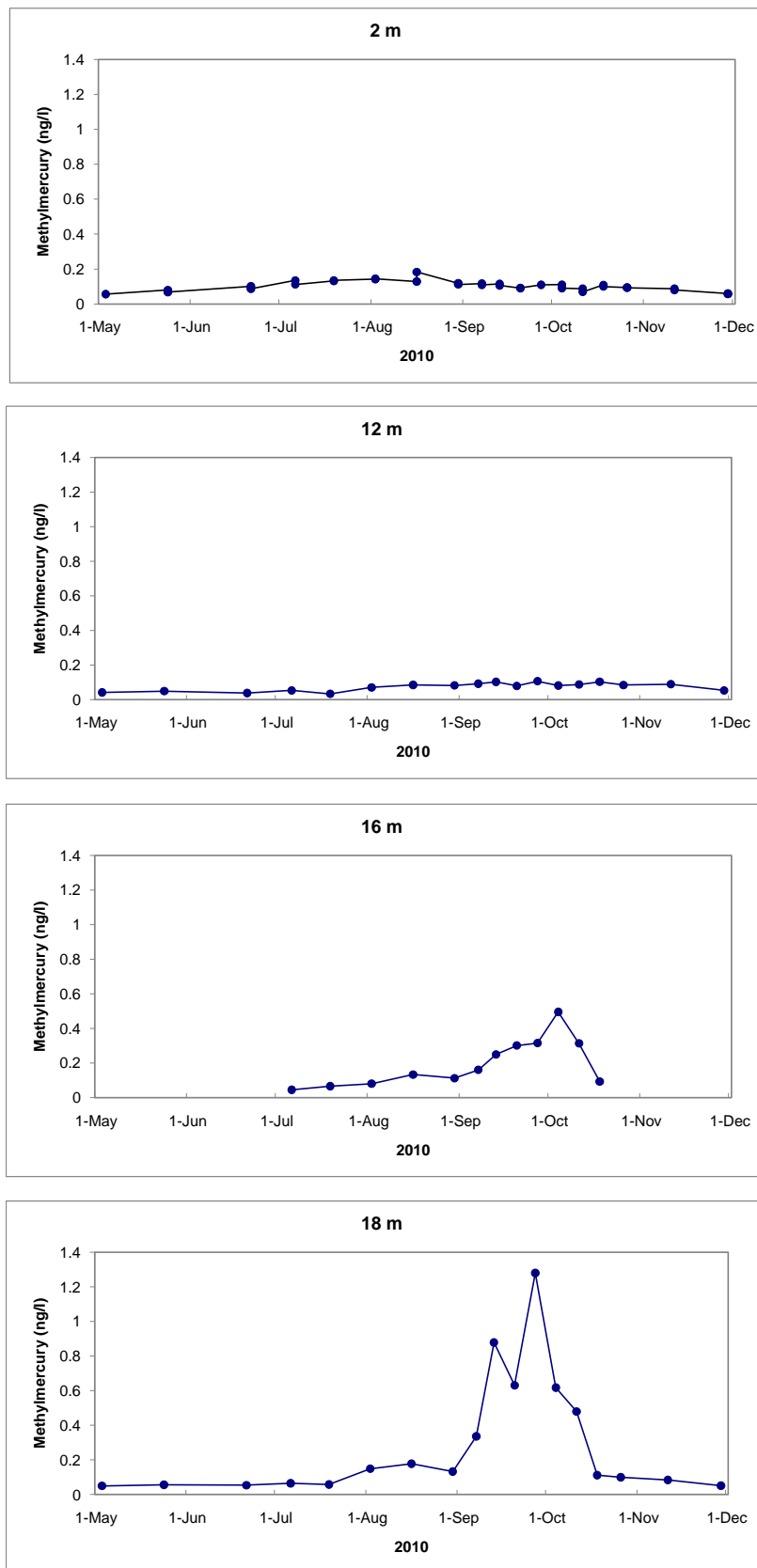


Figure 6. Methylmercury concentrations at 2, 12, 16, and 18 m water depth at South Deep in 2010

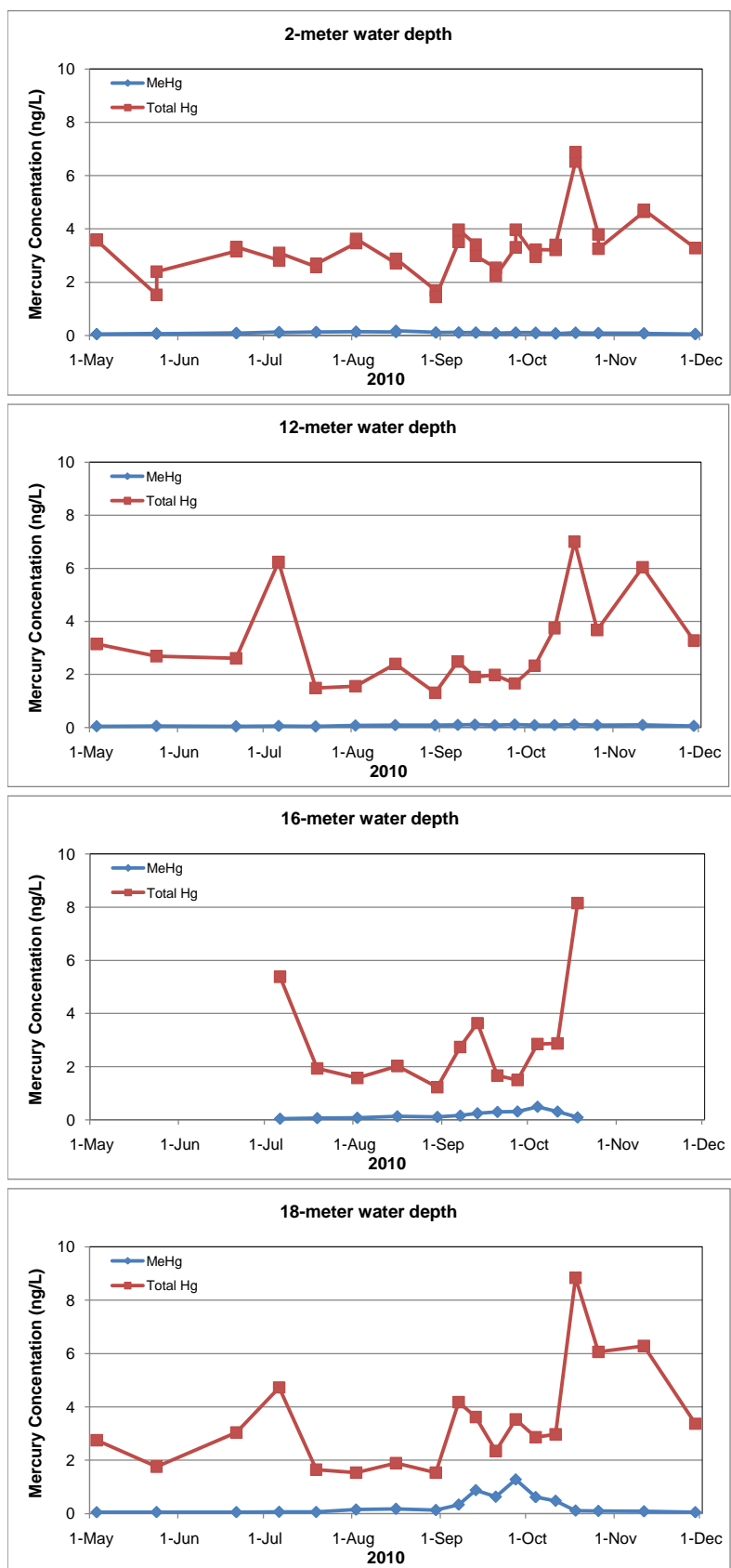


Figure 7. Total and Methylmercury concentrations at 2, 12, 16, and 18 meter water depths at South Deep in 2010

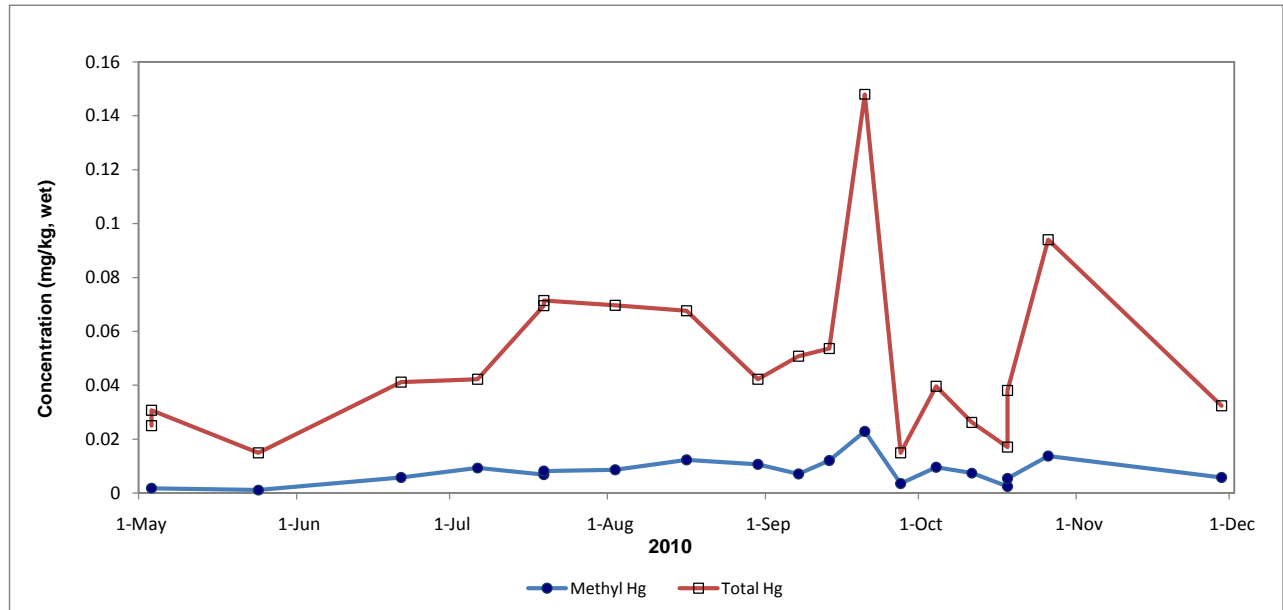


Figure 8. Total Mercury and Methylmercury Concentrations in Zooplankton in 2010

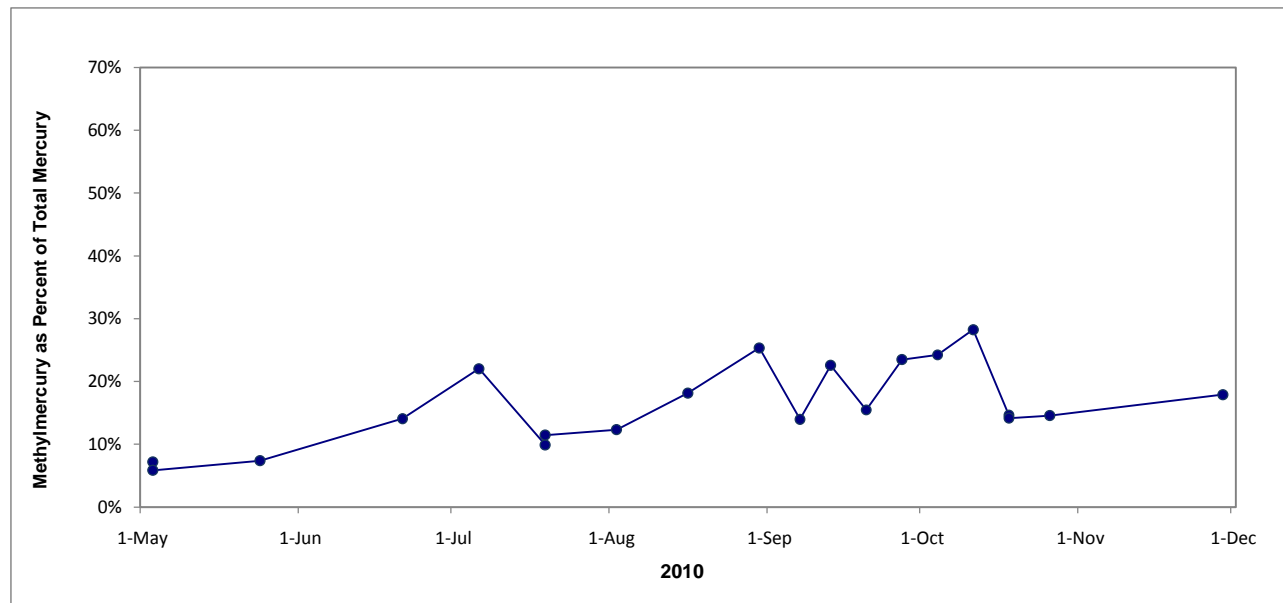
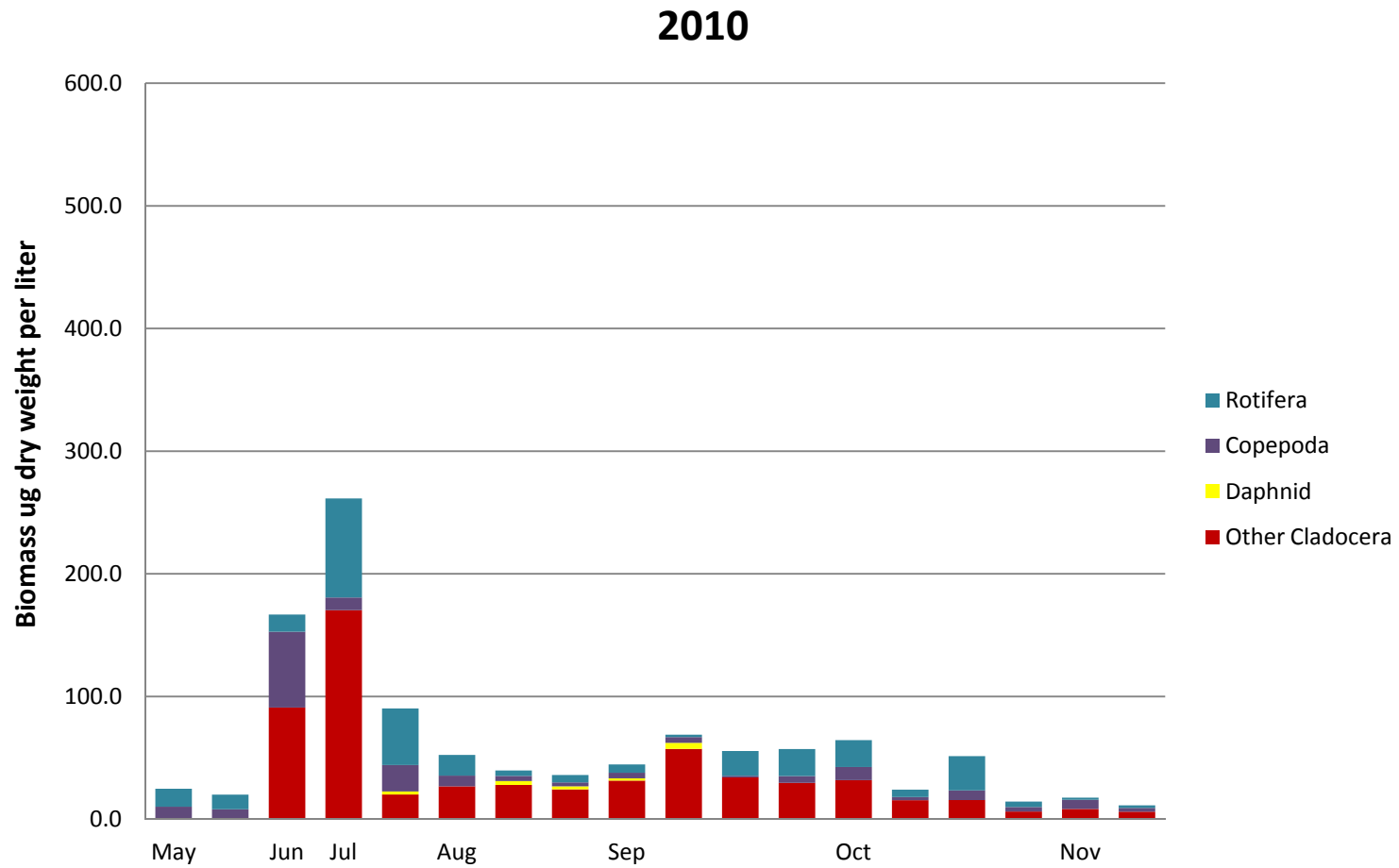


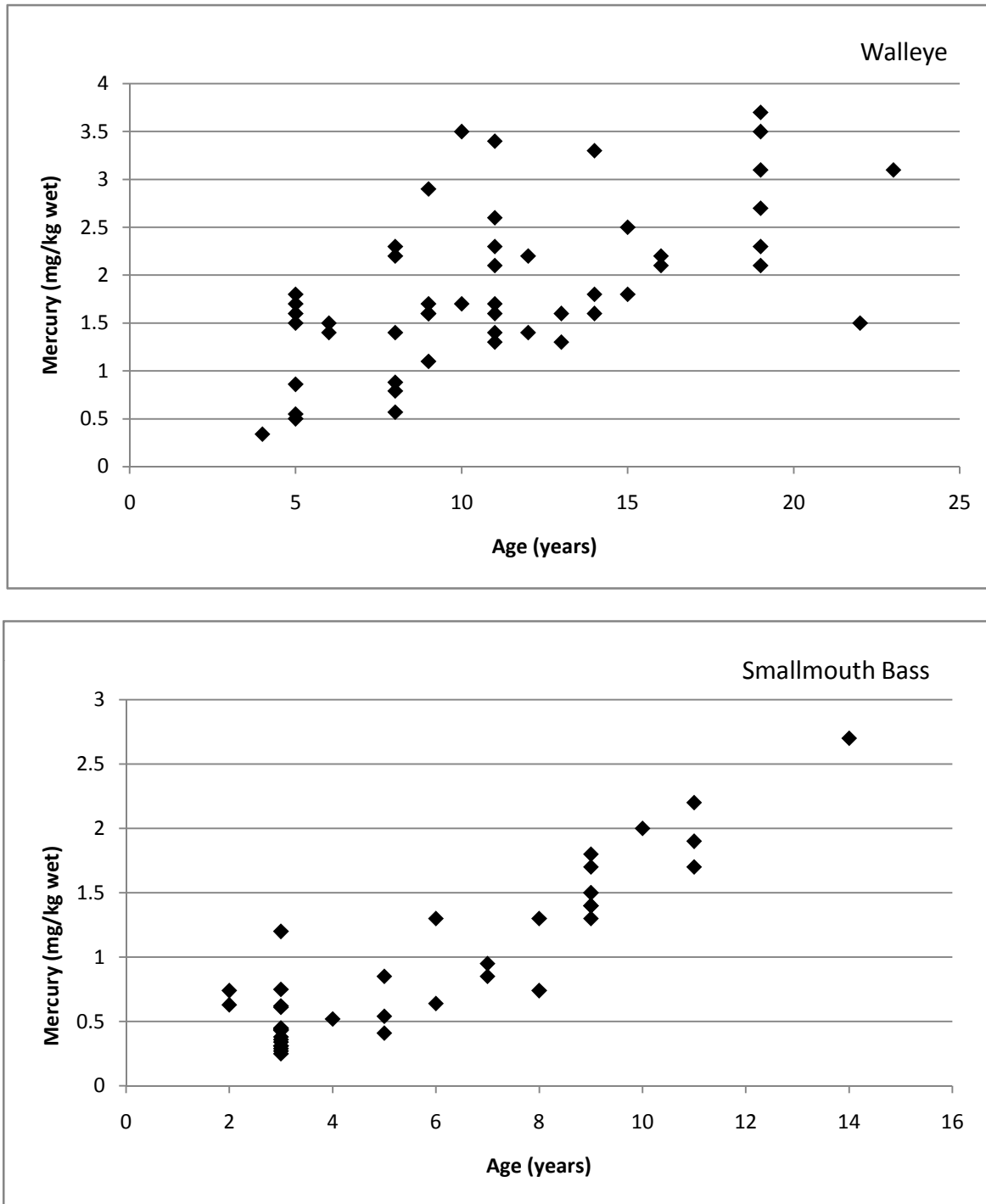
Figure 9. Methylmercury as a Percent of Total Mercury in Zooplankton

Notes:

1. These results are for zooplankton assemblages and do not include daphnia results.
2. These results are based on validated mercury data from laboratory analyses conducted by Brooks Rand.

Figure 10. Zooplankton Community Composition in 2010

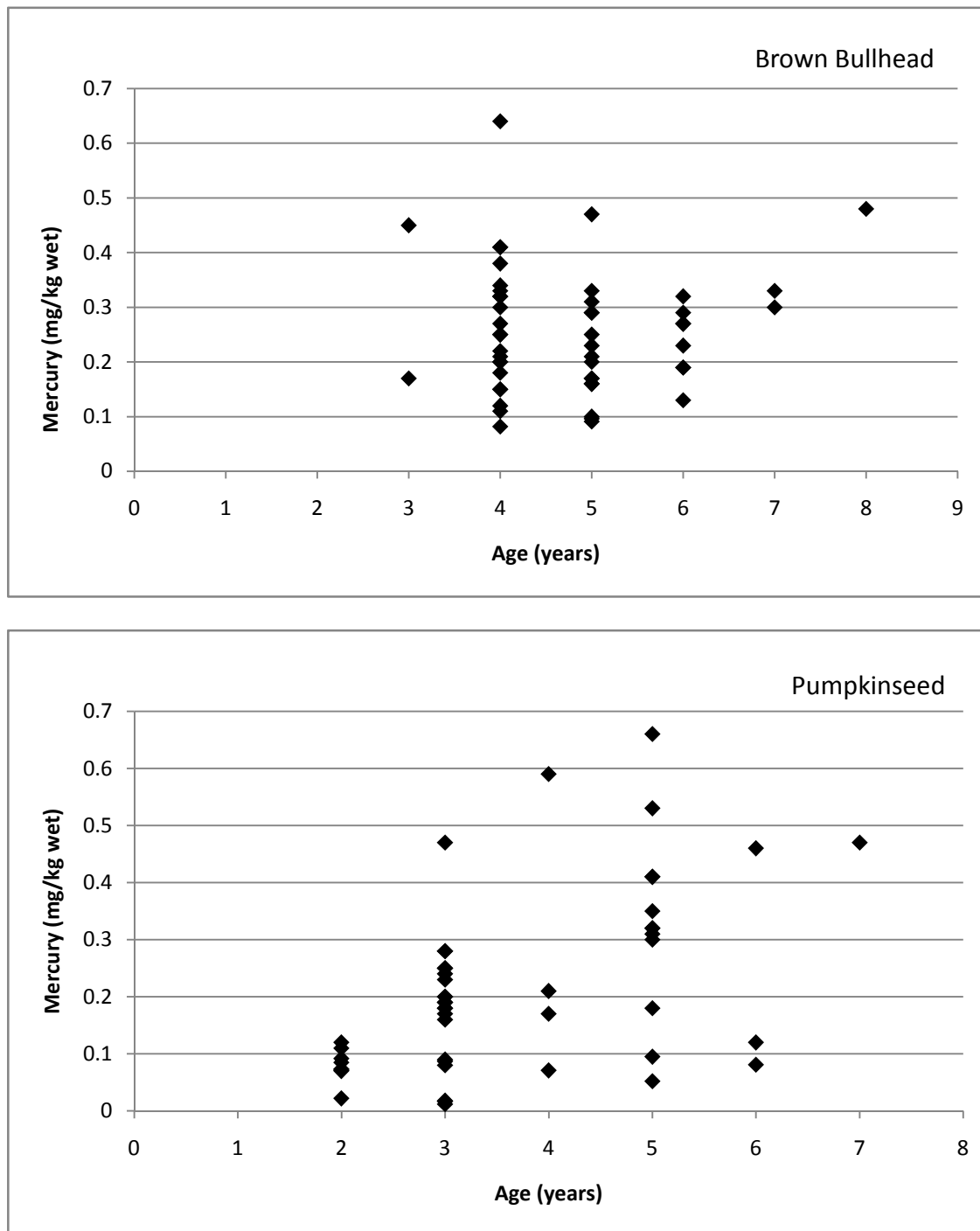




*Ages based on otolith analysis

Figure 12. Mercury vs age in walleye and smallmouth bass from Onondaga Lake 2010.

Data source: 2010 Baseline Monitoring Program (BLM), Honeywell International, Inc.



*Ages based on spines in bullhead and scales in pumpkinseed

Figure 13. Mercury vs age in brown bullhead and pumpkinseed from Onondaga Lake in 2010.

Data source: 2010 Baseline Monitoring Program (BLM), Honeywell International, Inc.