ONONDAGA LAKE BOTTOM SUBSITE
OF THE ONONDAGA LAKE SUPERFUND SITE

SYRACUSE, NEW YORK

RESPONSIVENESS SUMMARY

RECORD OF DECISION
Appendix VI

NYSDEC

USEPA Region 2

JULY 2005

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
NEW YORK, NEW YORK

TAMS/EARTH TECH
NEW YORK, NEW YORK

THIS PAGE INTENTIONALLY LEFT BLANK.

ONONDAGA LAKE RI/FS AND PROPOSED PLAN RESPONSIVENESS SUMMARY

Table of Contents

Please note that a list of acronyms/abbreviations and the references for this Responsiveness Summary are contained in the Record of Decision (Volume 1).

List of Figures

List of Tables

The following tables are in the text of the responses to Technical Comments:

ONONDAGA LAKE RI/FS AND PROPOSED PLAN RESPONSIVENESS SUMMARY

PUBLIC REVIEW PROCESS

INTRODUCTION

This Responsiveness Summary (RS) provides a summary of comments and concerns received during the public comment period related to the Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site remedial investigation and feasibility study (RI/FS) and the Proposed Plan, and provides the responses of the New York State Department of Environmental Conservation (NYSDEC) to those comments and concerns. The RI/FS reports (TAMS, 2002a,b,c; Parsons, 2004) describe the nature and extent of the contamination at the Onondaga Lake site and evaluate remedial alternatives to address this contamination. The Proposed Plan (NYSDEC, 2004) identifies NYSDEC's preferred remedy and the basis for that preference.

Public involvement in the review of Proposed Plans is stipulated in Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and Sections 300.430(f)(3)(i)(F) and 300.430(f)(5)(iii)(B) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). These regulations provide for active solicitation of public comment.

All public comments received are addressed in this RS, which was prepared following guidance provided by the US Environmental Protection Agency (EPA) in EPA 540-R-92-009 and the Office of Solid Waste and Emergency Response (OSWER) in OSWER 9836.0-1A. The comments presented in this document have been considered in NYSDEC and EPA's final decision in the selection of a remedy to address the contamination at the Onondaga Lake site.

The text of this RS explains the public review process and how comments were responded to. In addition to this text, there are three attachments:

Attachment 1	The National Remedy Review Board (NRRB) recommendations letter and responses (see the section below called "EPA's National Remedy Review Board Process").
Attachment 2	The Comment and Response Index, which contains summaries of every comment received and NYSDEC's response.
Attachment 3	Comments provided during the public comment period, including letters, e-mails, and oral statements. This attachment contains copies of every comment received.

EPA's National Remedy Review Board Process

The NRRB is an EPA peer review group that reviews all proposed Superfund cleanup decisions that meet certain cost-based or other review criteria to ensure that these proposed decisions are consistent with Superfund law, regulations, and guidance. EPA asked the Onondaga Nation, Honeywell, and the Atlantic States Legal Foundation (ASLF) to submit comments on the Proposed Plan to the NRRB prior to the Board's meeting with NYSDEC on February 8, 2005. The NRRB reviewed the Proposed Plan and information package provided by EPA Region 2 describing the proposed remedial action and discussed related issues with a number of representatives from EPA Region 2, NYSDEC (including its consultant, TAMS/Earth Tech), and the Onondaga Nation on February 8, 2005.

Following this meeting, the NRRB completed its review of the Proposed Plan for the Onondaga Lake Bottom site and presented a number of written recommendations in a letter dated February 18, 2005. NYSDEC and EPA Region 2 prepared written responses to the NRRB's recommendations in a letter submitted to the Board on March 25, 2005. The letter from the NRRB, along with NYSDEC and EPA Region 2's responses to NRRB's recommendations, was made available to the public on April 1, 2005, and, together with the comments submitted by the Onondaga Nation, Honeywell, and ASLF, these documents have been included in the Administrative Record. Since some, but not all, of the comments submitted to the NRRB were included in the NRRB's recommendations and NYSDEC and EPA Region 2's responses thereto, for completeness of the record, NYSDEC also included the responses to the questions raised in these comment letters in the Comment and Response Index (Attachment 2).

In a March 25, 2005 letter to NYSDEC, EPA indicated that the agency concurs with the Proposed Plan. This letter also indicated that NYSDEC should extend the public comment period to solicit public comments on the Proposed Plan as approved by EPA on March 25, 2005, on the NRRB's recommendations related to its review of the Proposed Plan, and on NYSDEC and EPA Region 2's responses to these recommendations. The comment period was reopened as discussed in the section entitled "Public Comment Period and Public Availability Sessions and Meetings," below.

Public Review Process

NYSDEC relies on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To this end, the Proposed Plan for the Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site, Syracuse, New York was made available to the community on November 29, 2004. A fact sheet and a five-page executive summary were released with the Proposed Plan and are all available on NYSDEC's Web site (http://www.dec.state.ny.us/website/der/projects/ondlake).

The complete Administrative Record file, which contains the information (including the Onondaga Lake RI, Human Health Risk Assessment [HHRA], Baseline Ecological Risk Assessment [BERA], and FS) upon which the selection of the response action has been based, is available at the asterisked locations listed in the text box below. The other listed repositories contain the key documents (e.g., RI/FS reports, Proposed Plan, and Record of Decision [ROD]) but do not contain the entire Administrative Record.

Information Repositories for the Onondaga Lake Superfund Site Administrative Record

***Atlantic States Legal Foundation**
658 West Onondaga Street
Syracuse, NY 13204
(315) 475-1170
Please call for hours of availability

Liverpool Public Library
310 Tulip Street
Liverpool, NY 13088
Hours: M – Th, 9:00 a.m. – 9:00 p.m.; F, 9:00 a.m. – 6:00 p.m.; Sat, 10:00 a.m. – 5:00 p.m.; Sun, 12:00 p.m. – 5:00 p.m.
Phone: (315) 457-0310

Maxwell Memorial Library
14 Genesee Street
Camillus, NY 13031
Hours: M – W, 10:00 a.m. – 8:00 p.m.; Th – F, 10:00 a.m. – 5:00 p.m.; Sat, 10:00 a.m. – 3:00 p.m.
Phone: (315) 672-3661

Moon Library
SUNY ESF
1 Forestry Drive
Syracuse, NY 13210
Hours: check http://www.esf.edu/moonlib/
Phone: (315) 470-6712

*** NYSDEC, Region 7**
615 Erie Blvd. West
Syracuse, NY 13204
(315) 426-7400
Hours: M – F, 8:30 a.m. – 4:45 p.m.
Please call for an appointment

NYSDEC
625 Broadway
Albany, NY 12233-7016
(518) 402-9767
Hours: M – F, 8:30 a.m. – 4:45 p.m.
Please call for an appointment

Onondaga County Public Library
Syracuse Branch at the Galleries
Syracuse, NY 13204-2400
447 South Salina Street
Hours: M, Th, F, Sat, 9:00 a.m. – 5:00 p.m.; Tu, W, 9:00 a.m. – 8:30 p.m.
Phone: (315) 435-1800

PUBLIC COMMENT PERIOD AND PUBLIC AVAILABILITY SESSIONS AND MEETINGS

The public comment period is intended to gather information about the views of the public regarding both the remedial alternatives and general concerns about the site. A notice of the commencement of the public comment period, the public meeting date, the preferred remedy, contact information, and the availability of above-referenced documents was provided in a fact sheet distributed to the public on November 29, 2004 and published in the *Syracuse Post-Standard* on November 29, 2004.

The public comment period for the Onondaga Lake RI/FS and Proposed Plan commenced on November 29, 2004 and continued until March 1, 2005. During that period, two public availability sessions were held on January 6 and 12 and a public meeting was held on January 12, 2005 at the New York State Fairgrounds in Syracuse, New York. Approximately 150 people, including residents, local business people, university students, media, and state and local government officials, attended the public meeting and approximately 75 people attended each availability session.

At the request of many concerned citizens, an additional availability session and public meeting were held at the New York State Fairgrounds in Syracuse on February 16, 2005. Approximately 100 people attended this availability session and public meeting. A question-and-answer session followed the formal presentation at both public meetings. Complete transcripts of both public meetings can be found in Appendix VII of the ROD.

Pursuant to terms of the Consent Decree entered in federal court, the ROD, of which this RS is a part, was to be issued by NYSDEC on April 1, 2005. However, at EPA's request, NYSDEC requested the Court to extend the ROD date until July 1, 2005. This allowed time for the new public comment period (see the "EPA's National Remedy Review Board Process" section, above), which ran from April 1 to 30, 2005. Not only did the extended public comment period provide more time for the public to review the Proposed Plan and other project-related documents, but it afforded NYSDEC and EPA the opportunity to have further dialogue with the Onondaga Nation regarding the Proposed Plan.

The NRRB's recommendations related to its review of the Proposed Plan, along with NYSDEC and EPA Region 2's responses to these recommendations, were posted on NYSDEC's Web site so as to be available for review by the public during the new public comment period.

RECEIPT AND IDENTIFICATION OF COMMENTS

Public comments on the RI/FS, Proposed Plan, and NRRB recommendations and NYSDEC and EPA Region 2 responses were received in several forms, including:

- Written comments submitted to NYSDEC via e-mail.
- Written comments submitted at one of the public availability sessions or meetings.
- Written comments mailed or faxed to NYSDEC.

- Oral comments made at the first public meeting (no oral comments were given at the second public meeting).

Each submission received, whether written or contained in the transcript of the first public meeting, was assigned one of the following letter codes:

S – State agencies and officials.
N – Onondaga Nation.
R – Regional agencies and officials.
L – Local agencies and officials.
G – Groups and associations.
H – Honeywell.
P – Public (individuals).
O – Oral (comments presented at the January 12, 2005 public meeting; there were no oral comments presented at the February 16, 2005 public meeting).

These codes were assigned for the convenience of readers and to assist in the organization of this RS; there was no priority or special treatment given to one commentor over another in the responses to comments.

Within each of the coded categories, the comments were put in alphabetical order (based on last name) and assigned a number, such as S-1, P-1, and so on. In addition, each separate comment was assigned a separate sub-number. Thus, if a citizen made three different comments (e.g., within a letter), they are designated as P-1.1, P-1.2, and P-1.3. The exception to this alphabetization is the comments received during the second comment period; they were placed after those received during the first comment period.

Directories that list all comments received and the associated coding for the initial comment period and the second comment period are included in the Tables section of this RS (RS Tables 1 and 2).

In addition to being summarized in the Comment and Response Index (Attachment 2), copies of all written submissions have been included in Attachment 3. The alphanumeric code associated with each written submission is marked at the top of the first page of each letter and the sub-numbers of the individual comments are marked in the margin next to the text that begins the comment.

Oral comments (i.e., made at the January 12, 2005 public meeting) are part of the transcript, and have been coded in the same manner as the written comments. In addition to being summarized in the Comment and Response Index (Attachment 2), oral comments are in Attachment 3, which provides full copies of all comments. It should be noted that a distinction has been made between oral comments delivered at the first public meeting and questions that were asked and responded to during the question-and-answer session at each of the public meetings. Because these questions have already been replied to as recorded in the transcripts (Appendix VII of the ROD), they have not been summarized in the Comment and Response Index (Attachment 2).

LOCATING RESPONSES TO COMMENTS

COMMENT AND RESPONSE INDEX

The Comment and Response Index (Attachment 2) contains a complete listing of all comments and NYSDEC's responses. The index allows readers to find answers to specific questions they have raised and is organized as follows:

- The first column lists the name of the commentor, according to type (e.g., group, public).
- The second column identifies the alphanumeric file code assigned to each comment (e.g., G-11.3, P-3.2, etc.).
- The third column provides a summary of the comment.
- The fourth column provides the response to the comment or a reference to see responses to frequent, technical, or other comments (see section below).

Example:

Name/Agency	Comment Code	Comment Summary	Response
Mary Ann Coogan, Supervisor, Town of Camillus	L-1.6	Ability of Wastebed 13 to carry the load of the SCA should be evaluated now. If there are any doubts, the siting of the SCA should be reevaluated.	No final site (e.g., Wastebed 13) for the SCA has been identified. Before a final site is selected, candidate locations will undergo a geotechnical evaluation to determine, among other things, their load-carrying capacity. The final site selection will be made during the remedial design.

In a few instances, a commentor may appear in the Comment and Response Index more than once, because he/she sent different letters, sent letters that were different from their oral statements, or made different oral statements. If an individual spoke for a group and then wrote a letter in his/her own name (or vice-versa), the submissions were coded separately and each appears in the Comment and Response Index.

It was not always clear if a commentor intended to represent an organization/group or simply himself/herself. The reader is advised to examine both the group (G) listing for the name of the group, firm, or association used on the letterhead of a written submission and the public (P) list for his/her own name.

KINDS OF RESPONSES

Due to the complexity of the Onondaga Lake project and the large number of comments received, comments are addressed according to three categories: frequent comments, technically detailed comments, and individual comments. These categories are defined as follows:

- **Frequent comments** are comments that were made by many commentors. A frequent comment may be a combination of several comments on a similar topic. Frequent comments and the associated responses are in the text of the RS below, in the section called “Summary of Public Comments and NYSDEC Responses.”

- **Technically detailed comments** are those that required a lengthy scientific or engineering explanation. Technical comments and the associated responses are in the text of the RS below, in the section called “Summary of Public Comments and NYSDEC Responses.”

- **Individual comments** are answered directly in the Comment and Response Index (Attachment 2).

NYSDEC carefully considered each comment received and made every effort to be fully responsive. All comments received are addressed in this RS, and a copy of every comment is provided in Attachment 3. A summary of the selected remedy and the public response to the Proposed Plan is provided below.

SUMMARY AND PUBLIC RESPONSE

OVERVIEW

SELECTED REMEDY

The selected remedy addresses all areas of the lake where the surface sediments exceed a mean probable effect concentration quotient (PECQ) of 1 or a mercury PEC of 2.2 milligrams per kilogram (mg/kg).[1] The selected remedy will also attain a 0.8 mg/kg bioaccumulation-based sediment quality value (BSQV) for mercury on an area-wide basis for the lake and for other applicable areas of the lake to be determined during remedial design. The selected remedy is also intended to achieve lakewide fish tissue mercury concentrations ranging from 0.14 mg/kg, which is for protection of ecological receptors, to 0.3 mg/kg, which is based on EPA's methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms. The major components of the selected remedy include:

- Dredging up to an estimated 2,653,000 cubic yards (cy) of contaminated sediment from the littoral zone[2] in Sediment Management Units (SMUs)[3] 1 through 7 to a depth that will prevent the loss of lake surface area, ensure cap effectiveness, remove non-aqueous-phase liquids (NAPLs), reduce contaminant mass, allow for erosion protection, and reestablish the littoral zone habitat. Most of the dredging will be performed in the in-lake waste deposit (ILWD) (which largely exists in SMU1) and in SMU 2.

- Dredging, as needed, in the ILWD to remove materials within hot spots and to ensure stability of the cap.

- Placement of an isolation cap over an estimated 425 acres within SMUs 1 through 7.

- Construction/operation of a hydraulic control system along the SMU 7 shoreline to maintain cap effectiveness. In addition, the remedy for SMUs 1 and 2 will rely upon the proper operation of the hydraulic control system, which is being designed to control the migration of contamination to the lake via groundwater from the adjacent upland areas.

---

1 These cleanup criteria were developed to address acute toxicity to the sediment-dwelling (benthic) community in Onondaga Lake.

2 The portion of the lake in which water depths range from 0 to 30 ft.

3 For investigation and remediation purposes, the site has been divided into eight SMUs based on water depth, sources of water entering the lake, and physical, ecological, and chemical characteristics.

- Placement of a thin-layer cap over an estimated 154 acres of the profundal zone (the portion of the lake in which water depths exceed 30 feet [ft]) within SMU 8.

- Treatment and/or off-site disposal of the most highly contaminated materials (e.g., pure phase chemicals segregated during the dredging/handling process). The balance of the dredged sediment will be placed in a Sediment Consolidation Area (SCA), which will be constructed on one or more of Honeywell's Solvay wastebeds that historically received process wastes from Honeywell's former operations. The containment area will include, at a minimum, the installation of a liner, a cap, and a leachate collection and treatment system.

- Treatment of water generated by the dredging and sediment handling processes to meet NYSDEC discharge limits.

- Completion of a comprehensive lakewide habitat restoration plan.

- Habitat reestablishment will be performed consistent with the lakewide habitat restoration plan in areas of dredging/capping.

- Performance of an oxygenation pilot study to evaluate the effectiveness of oxygenation at reducing the formation of methylmercury in the water column, fish tissue methylmercury concentrations, and methane gas ebullition as well as to understand any other impacts. The pilot study would be followed by full-scale implementation (if supported by the pilot study) in SMU 8.

- Monitored natural recovery (MNR) in SMU 8.

- Institutional controls consisting of notification of appropriate government agencies with authority for permitting potential future activities which could impact the implementation and effectiveness of the remedy.

- Implementation of a long-term operation, maintenance, and monitoring (OM&M) program to monitor and maintain the effectiveness of the remedy (e.g., cap repair).

PUBLIC COMMENTS

The public response to NYSDEC's Proposed Plan was generally supportive. Many of the public's comments indicate that the cleanup should proceed without delay. However, this support was not without concerns and additional desires. A large number of comments expressed the desire for a holistic vision of the lake post-remediation. As part of this "vision," many citizens indicated that the lake should be cleaned up for use by the community and that public access to the entire shoreline should be guaranteed. The idea of extending the current park system and bike path completely around the lake was very popular.

Many citizens asked for better access to information regarding the remediation and increased and continued communication with the public. Several comments called for formal mechanisms to encourage citizen participation as the project goes forward into design and construction. These suggestions included the formation of a Citizens Advisory Committee, the creation of a "lake keeper" position, and the direct involvement of communities in the design process. Information (e.g., scheduling) on the upland sites was also requested.

Many in the community expressed concern regarding the safety and potential impacts of the SCA, particularly with regard to releases of toxics (including volatile compounds), odors, impacts of noise and traffic, stability of the wastebeds, and the reliability of the dredging/pumping equipment. Commentors also often requested further study on the siting of the SCA and asked that locations other than Wastebed 13 (or any other area not near residences) be considered.

Multiple comments touched on two related concerns: environmental sampling and mercury modeling. A great deal of concern was expressed that sampling programs (pre-design and long-term monitoring) be capable of enabling NYSDEC and other reviewers to be able to:

- Confirm all of the sources of contamination.

- Understand the relative importance of each source.

- Understand how contamination from each source is transported to the rest of the lake.

- Understand any fate processes (e.g., methylation of mercury) that are relevant.

- Based on these understandings, confirm that the remedial action objectives (RAOs) and the preliminary remediation goals (PRGs) are appropriate and that the selected remedy will address the RAOs and PRGs.

- Be able to measure whether the RAOs and PRGs are achieved after remediation is complete (measure the success of the remedy).

It should be noted that commentors often seemed to confuse pre-design sampling with long-term monitoring. To clarify, pre-design sampling refers to data that will be used directly in engineering and design, such as the characteristics (e.g., chemical concentrations and geotechnical aspects) of sediments to be dredged or capped, or concentrations of chemicals in supernatant (water above the settled dredged material at the SCA) that are needed to design the water treatment systems. Long-term monitoring incorporates data that will be used to assess the effectiveness of remedial actions (caps, oxygenation, etc.) and any changes in the lake as a whole, such as concentrations of mercury in water or fish, and methylation or resuspension rates.

With respect to pre-design sampling and long-term monitoring, comments urged that data collection should be of high quality and extensive, and should begin as soon as possible. It was strongly suggested that local highly respected research institutions be directly involved in the sampling programs or constitute a peer review panel. To assist in the interpretation of these data, the development of a mechanistic model for mercury and other contaminants was urged.

Several technically knowledgeable groups or agencies (e.g., Upstate Freshwater Institute [UFI], Onondaga County, Syracuse University, State University of New York – College of Environmental Science and Forestry [SUNY ESF], ASLF, Honeywell) submitted comments and questions on specific technical aspects of the RI, FS, and Proposed Plan. These topics included, among others, mapping of contamination, cleanup criteria, mercury cycling, modeling (e.g., of groundwater and capping), MNR, oxygenation, and removal and disposal of sediments and NAPLs.

A few comments suggested different and/or innovative technologies that could be considered for remediation.

Several commentors opposed the preferred remedy. These typically fell into two groups: those that felt the plan was too aggressive and those that felt that the plan was not extensive enough.

The commentors who stated that the plan was too aggressive overwhelmingly believed that dredging will only cause more problems, chiefly by resuspending the contamination in the lake and stirring things up. They also tended to feel that the current risks were minimal and called for letting the natural sediment burial process continue to prevent releases of contaminants. It should be noted that some of these comments appeared to confuse the processes and remedial actions in the littoral and profundal zones, which are two distinct areas within the lake.

Those commentors who felt that the remedial plan was not adequate tended to call for complete removal of contaminated material from the lake, and stated that leaving any contamination in the lake was simply postponing the final resolution of the problem to future generations.

SUMMARY OF PUBLIC COMMENTS AND NYSDEC RESPONSES

FREQUENT COMMENTS AND RESPONSES

Frequent comments are comments that were made by many commentors. A frequent comment is typically a combination of several comments on a similar topic. One answer has been provided for each frequent comment. If a specific comment is considered part of a frequent comment, the response in the Comment and Response Index will indicate to “see response to Frequent Comment #1” (or other appropriate comment number). If a specific comment needed response beyond what is in the frequent comment response, that additional, comment-specific response is in the Comment and Response Index.

Frequent Comment #1: What additional benefits and associated risk reductions are afforded by dredging increasing volumes of sediment in Alternatives 2 through 5?
(Comments L-1.7, H-1.1, H-1.12, P-53.6)

Response to Frequent Comment #1: While the components of Alternatives 2 through 5 are identical in SMUs 3, 4, 5, 6, and 8, they differ with respect to both the remediation of the ILWD in SMUs 1, 2, and 7 and the NAPLs containing chlorinated benzenes present in SMU 2. The removal of portions of the ILWD prior to isolation capping has the potential to greatly reduce the mass of chemical parameters of interest (CPOIs) in SMU 1 and portions of SMUs 2 and 7, leaving behind significantly lower volumes and masses of wastes (and residual NAPLs) and significantly lower concentrations of many of the CPOIs beneath the cap. This will improve the effectiveness of the cap in isolating contaminants beneath the cap. The occurrence of “slumps” or slope failures within the ILWD, as was noted during side-scan sonar imaging of the lake bottom, as well as the generally soft nature of the wastes/sediments (resulting in very low shear strengths in certain areas), represent a significant engineering concern associated with capping in this area. Thus, dredging to improve slope stability of the ILWD and to improve overall geotechnical conditions for cap placement are also important considerations for SMU 1 and portions of SMUs 2 and 7.

In SMU 2, NAPLs have been observed in the sediments (up to a depth of 13 ft [4 m]), although the full extent has not been defined. Based on the vertical extent of NAPLs in the NAPL recovery Interim Remedial Measure (IRM) area (which is immediately adjacent to Onondaga Lake), the possibility exists that the NAPLs in SMU 2 are as deep as 30 ft (9 m) below the top of the sediments. With regard to NAPLs in SMU 2, Alternatives 2 and 3 include partial NAPL removal (to a depth of 4 m), while Alternatives 4 and 5 include full NAPL removal (to a depth of 9 m) in SMU 2.

NYSDEC and EPA believe that the additional dredging afforded by Alternative 4 (the selected remedy) relative to Alternatives 2 and 3 is warranted because Alternative 4 involves more removal of contaminated sediments and NAPL, which corresponds to a greater degree of cap effectiveness, and long-term reliability and permanence of the overall remedy for the lake and a reduced possibility of remedy failure. All of the alternatives which employ capping in a given area would be protective to the extent that the cap functions properly. If the cap fails via contaminant breakthrough and/or a catastrophic event (e.g., slope failure), it would need to be repaired and sediments contaminated by the release would need to be remediated (e.g., removed, capped in place). In the event of a failure, the impacts would be expected to be greatest under those alternatives that involve capping of the greatest mass/highest concentrations of contaminants. Accordingly, Alternative 4 provides more protection than Alternatives 2 and 3 would.

It should also be noted that the ILWD is in an area of the lake that is likely to be subjected to high erosive forces from wave action, ice scour, anchor drag, etc., and much of the additional dredging would be in areas near creek mouths and along an exposed shoreline where flow from the creeks can be extreme in flood conditions, or where wave action is high. In addition, some of the additional waste materials which would be removed from the lake under Alternative 4, but would remain under an isolation cap under Alternatives 2 and 3, have been characterized as principal threat wastes including large quantities of highly contaminated waste material and NAPLs. The implementation of any of these alternatives would include the off-site treatment and/or disposal of all NAPLs that were segregated during the dredging/handling process. The treatment of NAPLs at an off-site facility is a critical component of the alternatives that meets EPA's treatment preference. The larger the volume of NAPLs that are removed from the lake and sent for off-site treatment, the more an alternative satisfies this preference for treatment. Thus, Alternative 4 would satisfy the NCP's preference for treatment of principal threat waste to a greater degree than would Alternatives 2 and 3. While Alternative 5 would remove more contaminated materials from the ILWD than Alternative 4, cap reliability would not increase commensurately with the increased $86 million in estimated present-worth cost over Alternative 4 since Alternative 5 would involve the capping of sediments with contaminant concentrations similar to those for Alternative 4.

The human health and ecological risk reductions associated with various remedial alternatives were presented in the FS report. Table I.26 (included in Attachment 1 of this RS) shows the estimated residual surface-weighted average concentrations (SWACs) for mercury and polychlorinated biphenyls (PCBs) in sediment for the various remedial alternatives evaluated in the FS report. Table I.28 (included in Attachment 1 of this RS) shows the estimated percent reductions and the estimated residual tissue concentrations for prey fish and sport fish prior to and following remediation. Table I.28 shows that under the no-action alternative on both a littoral and lakewide basis, the estimated concentrations of mercury and PCBs would exceed the upper end of the target tissue concentration range for sport fish, and that the estimated concentrations of mercury would exceed the upper end of the target concentration range for prey fish greater than 18 centimeters (cm) in length.

Following implementation of Alternative 4 (see values under column F1 – H in Table I.28), the estimated concentrations of mercury and PCBs in fish would be at or below the upper end of the target tissue concentration range for all fish on both a littoral and lakewide basis. While the residual risks for Alternatives 2 through 5 (which are equivalent to the residual risks presented in the tables for Alternatives F1 through H in the FS report) are shown to be equal, it should be understood that Honeywell's analysis in the FS report assumed that these alternatives would be equally successful in achieving RAO 2, which is to eliminate or reduce releases of contaminants from the ILWD and other littoral areas around the lake. However, as discussed above, the selected alternative (Alternative 4) would employ more reliable capping in the ILWD and more removal of NAPL in SMU 2 and thus would be better able to meet the RAOs for the site than would Alternatives 2 and 3, and would be more cost-effective than Alternative 5.

Frequent Comment #2: An alternative should be included that isolates the waste in place by moving the barrier wall far out into the lake past the edge of the ILWD and filling in the area rather than dredging. Also consider damming portions of the lake, dewatering the area, and then capping. (Comments P-3.2, O-13.2)

Response to Frequent Comment #2: The construction of a barrier wall around the ILWD, followed by capping, was not carried forward in the development of alternatives during the FS for the site because of regulatory and construction issues regarding filling in a portion of Onondaga Lake.

Regulatory Concerns

Any remedy incorporating dredging or placement of fill in protected streams or navigable waters in New York State must meet the substantive technical requirements of Environmental Conservation Law (ECL) Article 15 Water Resources Title 5 Protection of Water. The applicable standards are found at 6 New York Code of Rules and Regulations (NYCRR) Part 608.8 and require that the proposal: a) is reasonable and necessary; b) will not endanger the health, safety or welfare of the people of the State; and c) will not cause unreasonable, uncontrolled or unnecessary damage to the natural resources of the State.

This applicable, or relevant and appropriate requirement (ARAR) protects the waters of the state from unreasonable or unnecessary impact from dredge and fill activities. A barrier wall around the ILWD would result in the loss of at least 84 acres of littoral habitat, impact navigation, and decrease the natural resource value of the lake. This damage would not be warranted as there are other options available (as were evaluated in the FS report and the Proposed Plan) for remediating the ILWD portion of Onondaga Lake that would meet the requirements of 6 NYCRR Part 608 and not result in unreasonable and unnecessary damage.

Construction Concerns

The ILWD covers about 84 acres of the lake bottom with water depths ranging from under 1 ft to over 30 ft. The quantity of materials needed to fill this area to above flood level would likely be in excess of 2 million cy. The in-lake barrier wall would be several thousand feet in length and would need to be constructed in a manner where it would be strong enough to support the ILWD and the fill materials and be able to withstand wind, wave, and ice erosive forces. Accordingly, a cofferdamtype barrier wall might be required, which would involve the placement of a large quantity of additional materials. Therefore, it is likely that the construction of a barrier wall around the ILWD and the subsequent filling of this area would require the placement of a larger quantity of materials than the total quantity of capping materials that would be required by Alternative 4 for all of the SMUs combined.

Frequent Comment #3: Why does NYSDEC believe that Honeywell's recommended alternative and other alternatives based on the mean probable effect concentration quotient (PECQ) of 2 are not protective?
(Comments H-1.3, H-1.16, H-2.3)

Response to Frequent Comment #3: One of the RAOs identified in the Onondaga Lake RI report is to eliminate or reduce existing and potential future adverse effects on fish and wildlife resources. To address this RAO in the FS report, areas of sediment were selected for inclusion in the remedial alternatives based on various site-specific criteria.

The mean PECQ approach was proposed by Honeywell as one of the criteria to use for determining remedial areas. The mean PECQ is a single unitless index that has the potential to account for both the presence and concentrations of multiple contaminants in sediment samples. NYSDEC evaluated the mean PECQ approach to determine whether it could be applied to Onondaga Lake.

There were three main reasons for selecting the mean PECQ of 1 as the basis for remediating Onondaga Lake sediments:

- First, a mean PECQ value of 1 can be considered an "average" hazard quotient. The concept of the hazard quotient is based on the inference that if the concentration of a CPOI is less than or equal to its corresponding toxicity threshold (e.g., the PEC for that CPOI), then toxicity would not be anticipated to occur. The mean PECQ is the "average" hazard quotient for the number of CPOIs detected in the sediments. Discounting additive toxicity, a mean PECQ of 1 signifies that on average, none of the CPOIs are present in concentrations that exceed their corresponding PEC, and that acute toxicity is not likely to occur.

- Second, the mean PECQs were derived using only acute toxicity data for a single, relatively insensitive species.[4] They do not take into account the potential for chronic toxicity impacts or variations in sensitivity by other benthic species. Given the lack of chronic toxicity data in the derivation of the PECs, the selection of a remediation value higher than a mean PECQ of 1 cannot be justified.

---

[4] Two species were used for toxicity testing done in 1992, *Chironomus tentans* and *Hyalella azteca*, using both mortality and growth as test effects. Since *C. tentans* mortality was the most sensitive effect, only those test results were used to derive mean PECQs. Forty-two day toxicity tests were conducted in 2000, also using *C. tentans* and *H. azteca*, but including the more sensitive endpoint of chironomid emergence. Too few studies, however, were conducted in 2000 to be integrated into (or otherwise used in) the derivation of mean PECQs. Those tests do add qualitative credibility to the usefulness of the mean PECQ of 1.

- Third, a review of all of the sediment toxicity data collected in 1992 (see Slides 1 and 2 in Attachment 1 of this RS) and 2000 (see Slides 3, 4, and 5 in Attachment 1of this RS) shows that the areas of the lake that exceed the mean PECQ of 1 and a mercury PEC of 2.2 mg/kg generally coincide well with the areas of the lake where acute toxicity to the benthic macroinvertebrates was shown to occur.[5]

For these reasons, the mean PECQ of 1 was determined to be protective and was used along with exceedances of the mercury PEC of 2.2 mg/kg in five of the seven alternatives in the Proposed Plan and this ROD, including NYSDEC's selected alternative.

There was no apparent statistical basis for the use of a mean PECQ of 2 for defining areas for remediation. There was no clear inflection point at a mean PECQ of 2 and the use of the PECQ of 2 was not supported by the toxicity data. Alternatives based on the mean PECQ of 2, including Honeywell's recommended alternative, were included in Honeywell's FS report but were not carried into the Proposed Plan since they were determined by NYSDEC not to be protective.

Frequent Comment #4: A monitoring program for sediment, water, and biota should begin as soon as possible. These data may be used to develop a fate and transport model to optimize the remedial design. The work should also include a biological assessment for wildlife and vegetation and monitoring of mercury in fish, waterfowl, and deer. These data should be available to all stakeholders. Monitoring efforts should be coordinated with existing monitoring programs conducted by Onondaga County, Upstate Freshwater Institute, and the State University of New York - College of Environmental Science and Forestry. Atlantic States Legal Foundation suggested that an independent scientific team be assembled to develop the plans.
(Comments G-1.8, G-4.7, G-4.8, G-9.3, G-10.2, G-11.16, G-11.18, G-11.19, O-1.7, O-7.3, O-7.5, O-20.4)

Response to Frequent Comment #4: The development and implementation of a monitoring program for various site media (e.g., sediment, water, and biota) is required in this ROD and will begin as soon as practicable. The monitoring will be designed to serve as the baseline against which remedy performance can be measured. Sampling and analysis of fish will be a critical part of the monitoring program. The inclusion of wildlife and vegetation in the program will be considered by NYSDEC. As additional data are acquired, NYSDEC will consider whether it is appropriate to develop or refine fate and transport models for the site. If such models are developed or refined, they will be used, as appropriate, to optimize the remedial design as implementation proceeds. The monitoring program will be overseen by NYSDEC as part of the Superfund process. However, since NYSDEC is aware that numerous experts in the field are already conducting monitoring of the lake under various programs and exploring the development of models for Onondaga Lake, the Superfund monitoring program will consider the possibility of

---

5 It should be noted that the relationship between the mean PECQ values and the toxicity data from 1992 was not particularly strong (see Slides 1 and 2 in Attachment 1 of this RS). This is due in part to the high degree of variability in the occurrence of toxicity in Onondaga Lake sediments, which may be related to the wide range of concentrations of the CPOIs in any given sediment sample. Such problems are inherent in any large scale sediment study, and are exacerbated in Onondaga Lake because of the extensive perturbation of the lake ecosystem that occurred over an extended period of time.

the existing programs and expertise locally available in both the design and execution of the monitoring program, as appropriate under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA, also known as Superfund), and the NCP. It is expected that efforts will be made to release the results of this monitoring as quickly as possible.

Frequent Comment #5: There appears to be a lack of progress and coordination in addressing the upland sites relative to the lake. The Administrative Record should include a matrix showing the expected sequence and schedule of remedial actions at all external sources, in relation to the start of design and actual implementation of the lakewide cleanup that is ultimately selected. Start and end dates should be specified for each upland site, as well as the lake.
(Comments N-1.3, G-3.1, G-6.6, G-11.1, G-11.14, P-49.1, O-1.1, O-1.2, O-7.7)

Response to Frequent Comment #5: As is identified in the Proposed Plan and this ROD, the timing of remedial activities in Onondaga Lake will need to be coordinated with the remedial work performed as part of the interim and final remedies at these upland areas. Provided below is the "Onondaga Lake and Upland Site Remedial Work Sequencing Matrix," which is based on currently available information. The matrix identifies those upland remedial activities that will be required to address the migration of contaminants (via the groundwater and surface water pathways) to Onondaga Lake. In general, these activities will need to be performed prior to the performance of remedial activities within a respective SMU, or a portion of a SMU, of Onondaga Lake.

Such remedial activities will be performed via various means (e.g., as part of the remedy selected in a ROD for the upland site [identified as ROD/RD/RA {Record of Decision, Remedial Design, Remedial Action} in the matrix], or as part of an IRM that a responsible party has agreed to implement). The upland remedial work components associated with addressing the groundwater and/or surface water pathways at the Semet Residue Ponds site, the Linden Chemicals and Plastics (LCP) Bridge Street site, and the Ley Creek Dredgings site have already been selected in RODs issued for those sites. It is possible that additional IRMs will be performed to address the migration of contaminants from the upland sites to Onondaga Lake. Please note that if additional areas are identified as contaminant sources to Onondaga Lake via the groundwater or surface water pathways, they will be added to this matrix.

While specific future dates are not provided, the matrix clearly identifies those upland sites where remedial work will be required to eliminate ongoing releases of contaminants to a given portion of the lake, prior to performing cleanup activities in that area of the lake. Projected dates for performing remedial activities in the lake, as well as at the various upland sites, will be provided to the public as they become available.

There has been considerable progress made with addressing the upland sites over the past few years. Remedial construction work has been performed in the lakeshore area (north of the former Willis Avenue Plant) through the operation of recovery wells to collect chlorinated benzene product from the subsurface, as well as work to stop the flow of contaminants from the I-690 storm drain system into Onondaga Lake. Construction of a wastewater treatment plant on the former Willis Avenue site commenced in the spring of 2005. This plant will be used to clean (treat) contaminated groundwater that will be collected from a number of sites, as well as from shoreline areas, to prevent the continued discharge of contaminated groundwater to the lake.

It is anticipated that the final construction activities associated with the cleanup of the former LCP Bridge Street site will be completed this year. In addition, NYSDEC and EPA anticipate proposing a cleanup plan for Geddes Brook and Ninemile Creek (downstream of the LCP Bridge Street site) for public review during 2005.

Work is also underway to design extensive subsurface barrier walls and groundwater collection systems along portions of the lakeshore to stop the flow of contaminated groundwater to the lake in these areas. Furthermore, a number of significant remedial activities have been performed at sites adjacent to Ley Creek and upstream of Onondaga Lake. Several investigations are underway for a number of other upland sites. The results of these investigations will be used to identify proposed remedies for these upland sites. As indicated by the above examples, considerable progress has been made with the various subsites. NYSDEC is committed to completing remediation at these upland sites in a timely manner to allow remedial activities to begin in the lake.

In regard to coordination, as is stated in the Proposed Plan, the remediation of the Onondaga Lake Bottom subsite will need to be coordinated with upland remedial activities. The control of contamination migrating to the lake from the various upland sites (e.g., Willis Avenue, Semet Residue Ponds, Wastebed B/Harbor Brook, LCP Bridge Street, and Geddes Brook/Ninemile Creek) is an integral part of the overall cleanup of Onondaga Lake. To prevent the recontamination of lake sediments, ongoing releases of contamination to a given portion of the lake will need to be eliminated prior to performing cleanup activities in that area of the lake. For example, the hydraulic control systems which will be installed/operated as part of the Wastebed B/Harbor Brook and Willis/Semet Barrier IRMs will address the ongoing releases of contaminants via migration of groundwater from these upland areas to SMUs 1 and 2, respectively. These systems will need to be constructed and operating prior to cleanup activities commencing in that part of the lake.

Furthermore, the effectiveness of the capping proposed for SMUs 1 and 2 would rely upon the proper functioning of the noted hydraulic control systems. Likewise, the effectiveness of capping in SMU 7 would be a function of the effectiveness of the hydraulic control system, which is proposed to be installed along the lakeshore as part of the remedy for that portion of the lake.

Onondaga Lake and Upland Site Remedial Work Sequencing Matrix

SMU	Upland Remedial Work to be Completed Prior to Work in Respective Sediment Management Units (SMUs) of Onondaga Lake[1]	
	Groundwater Pathway[2]	**Surface Water Pathway[2]**
SMU 1	– Wastebed B/Harbor Brook barrier IRM	East Flume (East Flume IRM) Harbor Brook (Wastebed B/Harbor Brook ROD/RD/RA)
SMU 2	– Willis/Semet IRM	Tributary 5A – groundwater barrier (Semet Residue Ponds ROD/RD/RA) – sediment (Willis Avenue ROD/RD/RA)
SMU 3	– Wastebeds 1 – 8 ROD/RD/RA	– Wastebeds 1-8 ROD/RD/RA
SMU 4	– Wastebeds 1 – 8 ROD/RD/RA	Ninemile Creek System – LCP Bridge Street ROD/RD/RA *(major construction began in late 2004, anticipated construction completion December 2005)* – Upland area – Wetlands and ponded area – West Flume – Geddes Brook sediment/floodplain soil IRM – Geddes Brook/Ninemile Creek ROD/RD/RA
SMU 5	N/A	
SMU 6		Upper Ley Creek – General Motors – IRMs *(construction completed on landfill cap, end-of-pipe treatment, and drainage swale IRMs by late spring 2005)* – ROD/RD/RA – Ley Creek floodplains – Ley Creek Dredgings ROD/RD/RA (completed) Lower Ley Creek – Salina Landfill ROD/RD/RA – Old Ley Creek Channel ROD/RD/RA – Wetland SYW-12 under Wastebed B/Harbor Brook ROD/RD/RA
SMU 7	– Wastebed B/Harbor Brook (IRM) – SMU 7 barrier wall (Lake ROD/RD/RA)	Harbor Brook (Wastebed B/Harbor Brook ROD/RD/RA)
SMU 8	Contingent on completion of remedial work in SMUs 1 to 7. To the extent that appropriate opportunities may arise for beginning some portion of work in SMU 8 in advance of all such completion, such opportunities would be explored. The oxygenation pilot will be implemented as soon as possible.	
Notes:	[1] Refers to upland remedial work which will need to be completed prior to working in a SMU (or a specific portion of the SMU). [2] If additional areas are identified that are contaminant sources to Onondaga Lake via the groundwater or surface water pathways, they will be added to this matrix.	

Frequent Comment #6: NYSDEC's preferred alternative is inadequate as it will leave some contaminants in place. The entire lake should be cleaned up regardless of time and cost. Capping only certain areas of contamination is not "treating" the problem but only covering it up. (Comments N-1.2, G-11.13, P-6.1, P-39.1, P-45.2, P-52.10, P-52.12, P-54.1, O-22.1)

Response to Frequent Comment #6: Consistent with EPA's guidance for conducting remedial investigations and feasibility studies (RI/FSs) under CERCLA and the NCP, the time needed to implement the remedy (which relates to implementability and short-term effectiveness) and its cost must be considered as part of a nine-criteria evaluation.[6] Based on NYSDEC and EPA's evaluation of these criteria, the selected alternative provides the best balance of tradeoffs among the remedial alternatives with respect to the NCP's evaluation criteria. In addition, because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory five-year review will be conducted within five years after initiation of remedial action. The five-year reviews will evaluate the results from monitoring programs established as part of this remedy to ensure that the remedy remains protective of human health and the environment.

While up to approximately 2.65 million cy of the most contaminated material in the lake will be removed by dredging, some contaminated material will be left in place. However, the remaining contaminated material will contain generally lower levels of contamination than the dredged material. Contaminated sediments remaining in the littoral zone will be capped and isolated from the environment. Isolation capping involves placement of an engineered cap on top of the contaminated sediment. This material helps to prevent or retard the movement of contaminated porewater into the water column and minimize exposure of benthic organisms to the contaminated sediments. The use of an isolation cap in the lake would achieve the following objectives:

- Provide physical isolation of the impacted sediments from benthic organisms, other animals, and human contact.
- Physically stabilize the sediment to prevent resuspension, contaminant mobilization, and sediment transport.
- Provide physical isolation of chemically contaminated sediments from advective or diffusive flux or resuspension into the overlying surface waters.

Specific factors that would be evaluated as part of the design of the engineered cap include erosion, bioturbation, chemical isolation, habitat protection, settlement, static and seismic stability, and placement techniques. Modeling performed for chemical isolation was used to produce preliminary cap designs to ensure that there would be no predicted exceedances of the PEC of any of the CPOIs that have been shown to exhibit acute toxicity on a lakewide basis or NYSDEC sediment screening criteria for benzene, toluene, and phenol.

The modeling indicates that the chemical isolation component of these caps should be from 1 to 2.5 ft (0.3 to 0.76 m) thick, depending on the area of the lake. The isolation caps will be sufficiently thick to effectively separate contaminated sediment from aquatic organisms which dwell or feed on, above, or within the caps. To ensure protection of human health and the environment, the caps

---

[6] The nine evaluation criteria consist of: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; support agency acceptance; and community acceptance.

would be designed to be an additional 50 percent thicker as a safety factor, plus an additional 6 inches (15 cm) to address possible mixing with underlying sediment and uneven application, which results in a total thickness of 2 to 4.5 ft (0.6 to 1.3 m) for the various SMUs. In-situ isolation capping has been successfully used to address contaminated sediment at several Superfund sites, many of which were constructed over a decade ago.

In the profundal zone, sediments would not be dredged. A thin-layer cap would be placed over the sediments in a portion of this zone.

Frequent Comment #7: Dredging could have serious adverse impacts on the lake and its downstream flow, as well as the biological community. If there is any dredging, it should be limited to nearshore areas.
(Comments R-3.4, P-5.1, P-16.5, P-17.1, P-17.5, P-18.1, P-21.1, P-21.3, P-25.1, P-25.3, P-32.1, P-45.1, P-53.1, P-53.6)

Response to Frequent Comment #7: Dredging will have some short-term water quality impacts. The disturbance of bottom sediments by dredging will result in increases in the levels of some suspended solids in the lake near the area of dredging. However, modern environmental dredges are relatively precise machines that can carefully remove targeted sediments without excessive disturbance of the lake bottom. Thus, it is expected that only a small fraction of the material dredged will actually enter the water column and that much of this material will settle in the immediate work area and will, as a result, be removed by continuing dredging operations. The remaining dredged material that does not quickly settle to the bottom within the work zone will be contained with a silt curtain that will encircle the work zone.

The FS report provides estimates of the water quality impacts of dredging operations. The analysis suggests that, except in the immediate work vicinity, dredging operations will not cause a contravention of the New York State water quality standards applicable to the lake. In addition, considerable monitoring will occur during both dredging and capping operations. Should it be determined that unacceptable levels of suspended sediments are being generated by dredging operations, there will be an opportunity to modify operations so as to reduce those levels. Possible actions that could be taken in this regard include slowing down the rate of sediment removal, changes to the depth of the dredge cut, and modifications to the movement of the dredge equipment.

It should also be noted that all dredged areas and some areas that are not to be dredged will be capped by covering any residual contamination with clean material. The cap will isolate any solids that migrate to these areas during dredging operations. Thus, for a number of reasons, environmental dredging is not expected to have long-term adverse impacts on the lake, its downstream flow, and the biological community. There will be a recolonization of the benthic community after dredging/capping and associated habitat enhancements. It should also be remembered that the areas selected for dredging and capping, which are generally limited to the nearshore areas of the lake (i.e., from the shore out to the 9-m water depth), are not currently isolated from the environment. The RI report indicated that resuspension of contaminated material in the littoral zone is currently one of the largest sources of contamination to the lake. With the proper controls and monitoring programs in place, the short-term impacts from dredging are expected to be considerably less than the current impacts from resuspension.

Frequent Comment #8: A fund should be set up by Honeywell in advance of the remediation to cover the cost of the remediation and associated long-term monitoring and maintenance of the remedial systems in the lake (e.g., isolation caps, oxygenation systems), at the SCA (e.g., liner and treatment systems), and at the upland sites (e.g., groundwater barrier walls/collection systems). The county and local communities should not have to pay for expenses resulting from the lake cleanup. NYSDEC should require Honeywell to remain involved for at least 30 years after the remediation is completed. The final plan should include formal legal protections, long-term financial assurances, or other protections to address this concern.
(Comments R-3.8, L-1.12, L-2.2, L-3.5, G-1.2, G-1.3, G-3.3, G-11.17, O-1.3, O-6.5, O-7.4, O-11.2)

Response to Frequent Comment #8: As a preliminary point of clarification, the ROD does not address who will implement the selected remedy. Rather, the ROD documents the selection of a particular remedy. However, EPA and NYSDEC agree that financial assurance options will be evaluated. For EPA, such an approach is a matter of established policy. For example, EPA's model consent decree for the performance of remedial design and remedial action (RD/RA) by responsible parties, which is used across the country at federal Superfund sites, includes a financial assurance provision that may be used to secure a responsible party's financial commitment to remediate, operate and maintain a site. Recent New York State legislation has provided NYSDEC with enhanced legal authority concerning financial assurance.

Frequent Comment #9: Has the final location for the SCA been determined? How will NYSDEC determine which wastebed to use? Some commentors have concerns with their future well being due to living near the site proposed for the SCA. The SCA should be located in or near the lake rather than in the town of Camillus. Using a site along the lakeshore, such as Wastebeds 1 through 8, will significantly reduce the length of slurry pipeline that would be needed. If the SCA is ultimately located in the town of Camillus, the town should be involved in the design process for the development of the area after closure of the SCA. Some commentors expressed concern regarding noise and traffic issues related to the SCA.
(Comments L-1.1, L-1.3, L-1.4, G-3.18, G-11.32, P-4.1, P-11.1, P-11.3, P-28.1, P-28.3, P-33.1, O-3.1, O-3.2, O-9.3, O-18.3)

Response to Frequent Comment #9: The final location for the SCA has not been determined. Potential SCA locations include Wastebeds 1 through 8, Wastebeds 9 through 11, and Wastebeds 12 through 15. For cost-estimating purposes in the FS report, it was assumed that an SCA would be constructed on one of the Solvay wastebeds (e.g., Wastebed 13). Wastebed 13 could accommodate a large sediment volume (potentially 2,400,000 cy or more, depending on final elevation), and its relatively remote location would minimize disruption to and impacts on the community during construction and operation of an SCA. However, the actual Solvay wastebed location(s) on which the SCA(s) would be constructed would be determined during remedial design and be based on an evaluation of the potential impacts on the local community, geotechnical stability of the wastebeds, SCA construction requirements, wastebed size, the means for transporting dredged materials to the SCA, costs, etc.

Once the SCA location has been determined, NYSDEC and EPA will work with the local community to address the various concerns that the community may have (e.g., noise, odors, traffic).

Frequent Comment #10: The operations at the SCA should be shut down if there are unacceptable odor releases. Will there be a daily cover placed to eliminate releases from the SCA during the period of operation until final capping? NYSDEC and Honeywell should monitor air

quality in and around the SCA and keep the homeowners informed of the results and any issues. A demonstration-size SCA in the area farthest from residential areas should be used to evaluate odor-control techniques. There should also be monitoring of noise, groundwater quality, and surface water quality and the operation of the SCA should not violate federal, state, or local standards and regulations.
(Comments L-1.2, L-1.9, G-11.32, P-4.3, P-28.1, P-32.1, O-3.1, O-18.3)

Response to Frequent Comment #10: An odor mitigation plan will be developed during the project's design phase. The plan will be based, in part, on results of the large-scale sediment sampling and analysis program that will be conducted prior to initiation of remedial design. As a result of this sampling, it is expected that considerable information will be accumulated on the potential for odor generation at the wastebeds and the best techniques for controlling those odors. The potential need for a demonstration-size SCA will be evaluated as part of remedial design.

An extensive monitoring program will be conducted during operation of the SCA. The program will encompass variables such as air, water, and groundwater quality; noise levels; and potential odor emissions. Details of the program will be shared with the public during the project's design phase, which is when the type and locations of monitors, as well as the performance standards, will be established. Measures to minimize or eliminate impacts on the surrounding community, such as use of a daily cover, will be selected during the design phase. The SCA will be designed to be operated in conformance with federal, state, and local standards and regulations.

Frequent Comment #11: Why does NYSDEC believe that Honeywell's recommended alternative, which includes much less dredging than NYSDEC's preferred remedy and thus a smaller SCA, is not sufficiently protective of humans and the environment?
(Comments L-1.7, H-1.1, H-1.12, P-10.3, P-22.2, P-40.1, P-43.1)

Response to Frequent Comment #11: There are three main differences between the selected remedy and the alternative that was recommended by Honeywell in its FS report, as described below. The items noted below account for the approximately 2 million cy difference between the selected remedy and Honeywell's recommended alternative. The selected remedy was determined by NYSDEC and EPA to be more protective of human health and the environment; provides greater long-term effectiveness; is cost effective; and offers the best balance of the evaluation criteria between the two alternatives. The selected remedy also will meet the statutory preference for the use of treatment as a principal element to a greater extent than would Honeywell's recommended alternative. An additional discussion on the benefits of NYSDEC and EPA's selected remedy and the associated risk reductions is included in the response to Frequent Comment #1, above.

1. Cleanup Criteria

The selected remedy uses a protective value of a mean PECQ of 1 (instead of the mean PECQ value of 2 proposed by Honeywell), which results in the remediation of an estimated 223 acres not addressed in Honeywell's recommended alternative (89 acres in the littoral zone and 134 acres in the profundal zone). A discussion as to why NYSDEC and EPA believe that use of a mean PECQ of 2 (as proposed by Honeywell) is not an appropriate cleanup value for Onondaga Lake is included in the response to Frequent Comment #3, above.

2. Cap Effectiveness and Long-Term Reliability

The selected remedy includes a significant level of reliability (beyond that included in Honeywell's recommended alternative) since it includes dredging and removal in the ILWD of 6.5 ft (2 m) (on average) with additional removal in hot spots[7] (up to an additional 3.3 ft [1 m] in depth), whereas only the top 2.6 ft (0.8 m) (on average) of the ILWD would be dredged and removed under Honeywell's recommended alternative. The reliability of the cap is enhanced since this area contains some of the highest concentrations of the more mobile (and thus difficult to isolate with a cap) contaminants such as benzene, toluene, ethylbenzene, and xylenes (BTEX), chlorobenzene, and dichlorobenzenes. Thus, the selected remedy includes the removal of an additional 1.4 million cy (relative to Honeywell's proposal) from the ILWD, which:

- Reduces the average contaminant concentrations in sediments/wastes remaining under the cap.
- Allows for the placement of a thicker cap, as necessary, to protect human health and the environment (see response to Frequent Comment #6, above).
- Provides an adequate water depth to allow for the establishment of a productive habitat after capping.
- Allows for erosion protection of the cap.

The selected remedy also includes dredging, if necessary, to address geotechnical concerns, including the evidence of historical failures (i.e., underwater slumping or "landslides") associated with the ILWD to ensure long-term stability of the cap.

The selected remedy includes NAPL (containing chlorinated benzenes and other contaminants) removal in the causeway area of SMU 2 based on evidence from on-shore data, which suggest that the removal would need to extend to approximately 30 ft (9 m) in depth. Honeywell limits its NAPL removal proposal to the deepest sediment core in this area, which is 13 ft (4 m) in depth. Thus, the remedy would result in the removal of up to an additional 234,000 cy of material from SMU 2, relative to Honeywell's proposal.

3. No Loss of Lake Surface Area

While Honeywell's proposal would result in the loss of 6 acres of lake surface area (by filling in 6 acres of the lake), NYSDEC and EPA's selected remedy would not result in the loss of any lake surface area and would be in line with New York's water resources laws, while still remaining cost effective, among other factors, under the balancing criteria of CERCLA.

Frequent Comment #12: There have been many years of study, and the lake cleanup should begin as soon as possible to accelerate the return of this lake to a valuable resource and asset to the community. Some commentors also indicated that the NYSDEC plan is also appropriate in that

[7] The additional removal of hot spots in the ILWD is based on areas which would exceed maximum contaminant threshold concentrations derived assuming an upwelling rate of 6 cm/yr instead of the 2 cm/yr used in Honeywell's recommended alternative. See response to Technical Comment #9.

it includes long-term monitoring programs such as inspection and repairs of the cap in the lake and at the SCA.
(Comments R-3.2, L-2.1, L-3.1, L-3.3, G-4.1, G-6.12, G-7.1, G-7.4, G-11.13, H-1.13, P-2.1, P-10.1, P-36.1, P-40.1, P-46.1, P-56.1, O-2.1, O-4.1, O-5.1, O-6.1, O-6.3, O-6.6, O-7.1, O-8.9, O-10.6, O-12.1, O-16.1, O-20.1, O-24.1, O-25.1)

Response to Frequent Comment #12: Onondaga Lake has been studied for many years, as NYSDEC, Honeywell, various institutions, and other interested parties have attempted to understand this complex system. Knowing what is contaminating the lake, where it is coming from, where the contaminants are, and what their effects are is a difficult and critical process. An understanding of the contamination and its effects is crucial to protect the community and the environment. While NYSDEC and EPA believe the selected remedy should be implemented as soon as possible, further investigatory and planning work will be needed as part of remedial design, including data collection and design document preparation, before the final lake cleanup takes place.

Sampling and other forms of long-term monitoring (e.g., inspection and repairs of the cap in the lake, air and groundwater monitoring at and near the SCA) will take place during implementation of the selected remedy, and will continue indefinitely to ensure the health of the community, the lake, and the environment. Monitoring programs will be adaptable so that they can change depending on the progress of the lake remediation or the results of new findings.

Frequent Comment #13: We hope that Honeywell will agree to implement the NYSDEC preferred remedy. What is Honeywell's position on this? If they do not, will the taxpayers be paying for the remediation? If Honeywell implements the remedy and the project goals are still not met, can Honeywell walk away from the project? If the project goals are still not met after Honeywell completes the remediation and/or Honeywell does not follow through on the project, what would be the next steps with respect to cleaning up the lake?
(Comments L-3.4, P-4.5, P-29.3, O-6.4)

Response to Frequent Comment #13: While NYSDEC cannot speak for Honeywell at this time with respect to their position on the remediation of Onondaga Lake, NYSDEC will continue to work with Honeywell in an effort to expedite the remediation of Onondaga Lake in a manner that is protective of human health and the environment and is not a burden on taxpayers. The obligation of remediating Onondaga Lake continues with remedial action monitoring after the initial remediation (e.g., dredging, capping) has been completed. The purpose of the remedial action monitoring is to ensure the continued effectiveness of the remediation and to take corrective measures (e.g., repair damage to cap). See also response to Frequent Comment #8.

Frequent Comment #14: The lake should be restored to its original natural conditions and functions and the remediation should use solutions that are ecologically sustainable and not rely on costly technologies.
(Comments G-1.3, G-1.6, G-3.16, P-31.2, P-51.1)

Response to Frequent Comment #14: The selected remedy was developed to selectively isolate most of the contamination in the lake without causing long-term disturbances to the lake and while allowing the lake to restore its natural functions. The complete removal of all the contaminants to levels below the mean PECQ of 1 or effects range-low (ER-L) values would involve removing 12 to 20 million cy of material just from the littoral zone, and the removal of all the contaminated profundal zone sediment would be on a similar scale. The feasibility of this removal is questionable, and would require among other things either significantly larger disposal sites or a technology which would remove the contaminants so that the dredged spoils could be used in a beneficial manner.

Given the mix of contaminants present in lake sediments (e.g., metals, chlorinated benzenes, BTEX, PCBs, polycyclic aromatic hydrocarbons [PAHs]) and their wide range of physicochemical characteristics (e.g., volatility, partitioning, solubility, susceptibility to chemical or biological degradation, density), it would be difficult and/or infeasible to treat these spoils. Therefore, the FS report and the Proposed Plan concentrated on technologies and practices that would most effectively protect human and ecological health by eliminating the releases/exposure of these contaminants.

It is anticipated that the remedial actions will be completed within four years of their start. The primary remedial action in the littoral zone of the lake will be capping, with dredging to address several issues relating to the effectiveness and placement of the cap. The cap will be placed relatively quickly and will be designed to isolate the contaminants from the environment and allow a natural benthic community to develop. After the dredged sediments are pumped to and disposed of at the SCA, the area will be capped and made available for reuse. Once the SCA is capped, the cost and maintenance will be relatively modest, consisting primarily of monitoring.

The treatment of the supernatant is also anticipated to be completed within a relatively short time frame (i.e., within four years of the start of remedial activities in the lake). The operation of the groundwater barrier wall and collection system with respect to limiting groundwater flow towards Onondaga Lake will need to be maintained in perpetuity and the treatment of collected groundwater will likely need to be maintained until such time as the concentration of contaminants in the groundwater is no longer of concern. The remediation of the profundal zone is based primarily on MNR and oxygenation of the hypolimnion. As discussed in the FS report (primarily in Appendix N), MNR was determined to be an appropriate remedial approach for the profundal zone based on the available data, which show that current sedimentation rates are burying the more contaminated profundal sediments with cleaner material. The oxygenation program uses a relatively modest expenditure to increase the oxygen levels in the lake. This will in turn allow the natural processes in the lake to control the production of methylmercury and dissolved forms of mercury, and may allow a benthic/hypolimnetic community to redevelop. Once the lake ecosystem begins to be restored, the technological efforts to return Onondaga Lake to its prior function should be reduced by assistance from natural processes. Additional contingency measures (e.g., additional thin-layer capping) will be implemented in profundal areas that do not achieve acceptable goals (e.g., achieving the mercury BSQV of 0.8 mg/kg, achieving PRGs for fish) during the 10-year MNR period or sooner, if data indicate this goal will not be achieved as anticipated. See also response to Frequent Comment #6.

Frequent Comment #15: The lake should be clean enough to support both a warm-water and a cold-water fishery.
(Comments G-1.9, O-26.1, O-26.2, O-26.3)

Response to Frequent Comment #15: The focus of a CERCLA-based remediation is to address releases of hazardous substances consistent with the NCP. There are programs, such as those administered by the Onondaga Lake Partnership (OLP), to improve fisheries in the lake that are unrelated to NYSDEC and EPA's program for addressing hazardous substances in the lake under CERCLA. Nonetheless, changes that may take place in the lake due to the remediation, as well as the long-term monitoring program, may provide additional information for the OLP to assess the feasibility of fishery improvements under other programs. During the remedial design, there will be coordination with the OLP, to the extent appropriate, consistent with CERCLA and the NCP.

Frequent Comment #16: NYSDEC rejected Honeywell's mercury fate and transport model in 1998 for a variety of reasons. A contaminant fate and transport model for mercury and organic contaminants should be developed based on a comprehensive monitoring program and should be an integral part of the rehabilitation efforts. The model should be used to help answer important questions such as how much lower will concentrations of contaminants in fish be following remediation. The modeling effort could be performed outside of the Superfund process by independent parties not related to Honeywell and NYSDEC. This would not delay the remediation. (Comments G-4.2, G-4.5, G-4.7, G-11.19, H-1.2, P-10.2, P-17.6, O-7.5, O-9.1, O-9.2, O-20.3)

Response to Frequent Comment #16: At the outset of this project, NYSDEC anticipated that a comprehensive mechanistic model would be developed during the RI/FS process to describe mercury behavior and mass. During this process NYSDEC determined that the model developed by Honeywell was not reliable as a predictive tool for assessing the impact of various remedial scenarios on mercury in Onondaga Lake. At that time (1998), NYSDEC decided to end the modeling process and proceed with collection of additional sediment, water, and biota data, along with development of a simpler mass balance approach for the summer stratified period in order to complete the RI report. Even with the simpler approach, the mercury mass balances presented by Honeywell in its RI report did not identify sources for the majority of the mercury inputs to the lake. NYSDEC rejected Honeywell's document and, after collecting additional information on mercury cycling, NYSDEC rewrote the RI report in 2002. NYSDEC's RI report presents the results of the simplified mass balance approach and identifies the major sources and sinks of mercury in the lake system and their relative importance. A summary of the results of this mass balance is presented in the response to Technical Comment #14. The FS process used models for specific issues in the lake where such modeling is sufficiently reliable, including groundwater movement, isolation capping, and MNR.

To further examine the potential changes in fish concentrations after implementation of the selected remedy, an assessment of the potential concentrations of methylmercury in the media that the fish would be exposed to (water and food) after remediation was conducted during development of the Proposed Plan. The assessment (see response to Technical Comment #16) indicated that the exposure of fish to methylmercury in the water may be reduced by more than half (54 to 64 percent) following remediation. Exposure to methylmercury via the littoral (near shore) zone food chain may be reduced from less than 10 percent for SMU 5 to 86 percent for SMU 1. Exposure to methylmercury via the pelagic (deep water) zone food chain may be reduced by 26 to 96 percent. Thus, it is reasonable to expect to see significant, noticeable reductions in the mercury concentrations in the fish of Onondaga Lake (especially pelagic fish) following source control and lake remediation. If the selected remedy does not at least achieve the range of fish tissue PRGs specified in the ROD, the remedy will be reevaluated at a minimum as part of the five-year review under CERCLA, and could be addressed through a modification of the ROD.

It is possible that refinements of these estimates based on the length of exposure time and the relative importance of individual routes of exposure to various species of fish could be made with a more complex mechanistic model; however, it is unlikely that the final conclusion – that it is reasonable to expect to see a significant reduction in the concentrations of contaminants in fish as a result of the remediation within a relatively short period of time (i.e., less than 10 years after remediation) – would be changed. As additional data are acquired, NYSDEC will consider whether it is appropriate to develop or refine fate and transport models for the site. If such models are developed or refined, they will be used, as appropriate, to optimize the remedial design as implementation proceeds.

Frequent Comment #17: Many of the key decisions will be made during the remedial design stage. There should be transparency and citizen participation throughout the design and implementation process. Also, a citizens advisory committee (CAC) should be established. Direct public participation and meetings will be needed on the siting and design of the SCA. This should include a 90-day public comment period for the review of designs and related environmental impact statement for the SCA. The CAC should include concerned citizens and groups, as well as key stakeholders and research institutions to discuss the design and monitoring activities.
(Comments L-1.8, L-2.1, G-6.3, G-6.4, G-7.3, G-9.1, G-10.3, G-11.20, P-4.4, P-33.4, P-36.5, P-37.3, P-37.4, P-37.5, O-1.5, O-7.6, O-17.3, O-21.1)

Response to Frequent Comment #17: NYSDEC will conduct an extensive public outreach program during the remedial design and construction phases. These activities are anticipated to include the holding of public meetings and the distribution of fact sheets, etc., on a periodic basis, as well as at key stages of the project, such as during the siting and design of the SCA. The objective of the outreach program will be to update the public on the project status, as well as to solicit public comment. The concept of a CAC will be evaluated by NYSDEC and EPA following issuance of the ROD.

Frequent Comment #18: There should be opportunities for land development near the lake. There should also be more parkland and a recreational trail (but no commercial-type development) around the lakeshore.
(Comments L-3.2, P-7.1, P-20.1, P-22.2, P-23.1, P-24.1, P-29.5, P-38.1, P-41.1, O-6.2, O-8.1, O-8.8)

Response to Frequent Comment #18: Onondaga Lake is a tremendous resource to the surrounding community. NYSDEC will make every effort to ensure that remedial activities associated with Onondaga Lake and the surrounding areas support the beneficial uses of these areas by the local community.

Frequent Comment #19: There should be a group or staff of people to monitor the lake, such as a “lake keeper” staff. Efforts should be made to recruit and train local community members for jobs related to restoration of the lake. Such positions can be in conjunction with local universities and include volunteers and interns. The lake should serve as an educational resource for the community.
(Comments G-1.7, G-1.8, G-6.11, G-10.3, P-19.1, P-19.3, O-17.4)

Response to Frequent Comment #19: The ROD is the means of documenting the selection of the remedy. The issues raised concerning the community participation in the implementation of the remedy cannot be resolved at this time.

Frequent Comment #20: The goals and objectives of the remediation should be clearly defined, as well as the time frame to meet those goals. The community, NYSDEC, and other parties should identify their vision for the future of the lake, including the cleanup of industrial contamination in the

lake and at the subsites, further improvements at Metro, lake habitat restoration, etc. This should be included in the plan.
(Comments G-3.10, G-11.15, P-29.2, P-29.6, P-29.7, O-7.2, O-8.1, O-9.1, O-18.5)

Response to Frequent Comment #20: As was stated at the public meetings and in the Proposed Plan, NYSDEC, in conjunction with the New York State Department of Health (NYSDOH) and EPA, identified site-specific objectives and goals for the Onondaga Lake remediation that are protective of human health and the environment. It is difficult for NYSDEC to commit to specific start and end dates for the various elements of this work (e.g., design, construction, monitoring), since there are many issues to address before work begins or can be deemed complete. Public outreach and involvement will continue throughout this process. Should there be a need to modify design or construction activities as a result of public concerns, the time frame would change. General time frames for the remedial work are included in the ROD.

The ROD outlines what NYSDEC and EPA believe is the most appropriate remedial approach. The ROD and federal law (CERCLA) do not dictate how a community should use a site (in this case, Onondaga Lake). While the community's vision can be developed outside of the state and federal regulatory process, NYSDEC is willing to work with community representatives to coordinate local visions or plans.

Many of the upland sites are privately owned. While remediation may restrict future use, it does not mandate how privately owned property must be used. Additionally, the ROD states that habitat restoration will be evaluated on a lakewide basis during the remedial design.

Metro improvements are well underway and, when completed, will be state of the art. Continued monitoring and maintenance will evaluate compliance with water quality standards and protection of the lake with respect to Metro's discharge.

Frequent Comment #21: Has NYSDEC or Honeywell determined how much the value of properties near the SCA will change?
(Comments P-11.4, P-28.2, P-33.3)

Response to Frequent Comment #21: NYSDEC has not determined whether the value of properties near the SCA would change nor is NYSDEC aware that Honeywell has conducted such an evaluation. However, NYSDEC would take the necessary steps such that any impacts to the surrounding community would be minimized. During design and construction of the SCA, NYSDEC will make every effort to ensure that, following remediation, the area will be available for future uses that are beneficial to the community.

TECHNICALLY DETAILED COMMENTS AND RESPONSES

Technically detailed comments were typically asked by only one commentor, and so are not included as frequent comments, which were typically asked by multiple parties. Note that the Comment and Response Index (Attachment 2 of this Responsiveness Summary) contains responses to individual comments, or references to frequent or technically detailed comments, as appropriate. Technically detailed comments are typically those for which the response is relatively lengthy; designation of a comment as a "technical comment" (TC) is not meant to imply that it necessarily warrants a more thorough response, or that frequent or individual comments aren't also technical in nature. If a specific comment is considered to need a detailed technical response, the response in the Comment and Response Index will indicate to “see response to Technical Comment #1” (or other appropriate comment number).

Technical Comment #1: Oxygenation is experimental; its ecological and recreational use ramifications are not known; it is not inexpensive; and it requires constant long-term operation and maintenance. Why is it included as part of the preferred remedy, rather than increasing the amount of thin-layer capping or isolation capping in the profundal zone. What supplemental remedies will be proposed if it is technically impracticable or does not work?

Response to Technical Comment #1: The selected remedy calls for phased thin-layer capping, oxygenation, and MNR to remediate the profundal zone and hypolimnion of the lake. Oxygenation was selected as part of the remedy because it provides a cost-efficient method (relative to full removal of profundal sediments exceeding the cleanup criteria) to significantly reduce the amount of mercury methylation and associated mercury exposure in the lake.

Active hypolimnetic oxygenation is a widely used technology to maintain oxygen resources in eutrophic lakes and ponds. Many of these programs have been active for years; in fact, oxygenation has been used in the U.S. for over 150 years. More recently, hypolimnetic oxygenation was begun at Lake Amish in Alberta in 1988 (Aku et al., 1997) and at Irondequoit Bay, NY (Monroe County Department of Health, 2002) in 1993. Both of these lakes, as well as others, have been studied extensively to assess various changes to their ecosystems. While there are specific components that will likely be unique to Onondaga Lake, the science of oxygenation is not new or experimental, and there are not likely to be major unforeseen problems that would preclude it from being a long-term solution.

Oxygenation of the lake’s hypolimnion would be conducted in phases, with the initial phase (a pilot study) evaluating the effectiveness associated with implementation of oxygenation. The selected remedy includes implementation of an oxygenation pilot study prior to full-scale implementation because the exact way in which the lake ecosystem will be altered by oxygenation is not known. However, maintaining oxic conditions is a very effective method of eliminating the production of methylmercury in the water column in the lake.

A pilot study will be performed to evaluate the potential effectiveness of oxygenation at reducing the formation of methylmercury in the water column, while preserving the normal cycle of stratification within the lake. An additional factor which will be considered during the design of the pilot study will be the effectiveness of oxygenation at reducing fish tissue methylmercury concentrations. If supported by the pilot study results, the pilot study will be followed by full-scale implementation of oxygenation in SMU 8. Furthermore, potential impacts of oxygenation on the lake system will be evaluated during the pilot study and/or the remedial design of the full-scale oxygenation system.

Technical Comment #2: What evidence supports the design thickness of the sediment cap as being able to preclude contaminant migration? Methylation of mercury will still occur under the cap and can still be transported through the sand and gravel material of the cap and enter the water column.

Response to Technical Comment #2: The sediment cap proposed for Onondaga Lake consists of three layers which have different purposes and material requirements. These layers, from bottom to the top, include:

- An isolation layer, which will be designed to prevent or limit vertical chemical migration.

- An armor layer, which will be designed to protect the isolation layer from erosional processes such as waves, ice scour, and propeller wash. This armor (erosion) layer will be included where needed and at the appropriate depth.

- A habitat/bioturbation layer, which will be designed to provide habitat for benthic macroinvertebrates and allow for bioturbation processes without exposure to contaminated sediment or disruption of the isolation layer material. The specific thickness(es) and type(s) of substrate material to be used for the habitat layer will be determined during remedial design as part of the comprehensive lakewide habitat restoration plan.

Many of the sediment caps currently in place at other sites are composed of sand, the material proposed for use in the isolation layer of the sediment caps for Onondaga Lake. As discussed in the Onondaga Lake FS report, some of these projects where sand caps have been used include the West Eagle Harbor/Wyckoff Island site in Washington and Soda Lake in Wyoming, among many others (Hazardous Substance Research Centers [HSRC], 2005). The armor layer, which will likely consist of gravel, will serve to protect the isolation (sand) layer rather than inhibit chemical transport.

As discussed in detail in Appendix H of the FS report, design of the isolation layer was based on a model described in the EPA/US Army Corps of Engineers (USACE) guidance for in-situ subaqueous capping (Palermo et al., 1998). The model was used to evaluate the migration of contaminants through the isolation layer of the sediment cap and incorporates both advection and diffusion/dispersion as transport mechanisms. The thickness of the isolation layer in the cap is a component of the model that influences chemical transport and was chosen for each SMU to ensure that there would be no predicted exceedances of the cleanup criteria in the habitat layer. Because of the limitations of computer modeling and other factors associated with cap construction, a 50 percent buffer or safety layer will be added during cap construction. The thickness of the overall cap is thereby increased by a thickness equal to 50 percent of the thickness of the chemical isolation layer. As part of the remedial design, a decision will be made as to what portion of the buffer layer will be considered part of the habitat restoration layer. The remaining portion of the buffer layer will be added to the modeled chemical isolation layer to represent the actual chemical isolation layer portion of the cap. Furthermore, an additional layer will be placed below the isolation layer to address possible mixing with underlying sediment and uneven placement.

Modeling efforts indicate that the proposed material (at the thicknesses specified in the FS report following hot spot removal, where needed) will be effective at preventing chemical migration beyond the isolation layer of the cap. The cap model was used to determine the appropriate thickness of the isolation layer in each littoral zone SMU and whether sediment removal is necessary in areas of elevated concentrations and/or high upwelling rates so that the cleanup criteria are not exceeded for over 1,000 years at the top of the cap. Frequent monitoring will occur during and after placement of the cap to ensure that it is effective at isolating the contaminated sediment over the long term.

Methylation of mercury is primarily carried out by sulfate-reducing bacteria that thrive under anoxic conditions. Under oxic conditions, mercury primarily demethylates; that is, the methyl group is removed from mercury, reverting it back to an inorganic form. Unlike the profundal sediments, which have anoxic water above them during the stratified period, the littoral sediments always have oxygenated water above and likely are oxygenated some distance into the sediments. While it is possible that methylation may take place deep in the littoral sediments, data from the RI report do not indicate that significant amounts of methylmercury are transported across the sediment-water interface in the littoral zone. This is reflected in the water column data where the methylmercury concentrations in the oxygenated epilimnion are typically very low (less than 1 nanogram per liter [ng/L]). This is also reflected in the benthic macroinvertebrates from the littoral zone where, except for SMU 1, the concentrations of methylmercury are uniformly low (10 to 20 micrograms per kilogram [µg/kg] for chironomids).[8]

The proposed cap, including the isolation and habitat layers, is expected to encourage higher rates of bioturbation and bioirrigation, which would cause the habitat layer to be even more oxygenated. The cap will be comprised of clean materials and will be conducive to benthic communities. Once it is in place, the potential for methylmercury to be released from the littoral sediments below the cap to the water column above the cap will be significantly less than current conditions.

Technical Comment #3: Information on the contamination in the wetlands near the mouths of Ley Creek (Wetland SYW-12) and Harbor Brook (Wetland SYW-19) should be provided. These areas should be remediated and restored as valuable wetland habitat.

Response to Technical Comment #3: Contamination at Wetlands SYW-12, located between the mouths of Ley and Onondaga Creeks, and SYW-19, at the mouths of Harbor Brook and the East Flume, as well as two other wetlands adjacent to the lake (Wetlands SYW-6 and SYW-10), was documented in the Onondaga Lake RI report and evaluated with respect to human health and ecological risks in the HHRA and BERA. Sediment was sampled at four locations from two depth intervals (i.e., 0 to 0.5 ft and 0.5 to 1 ft [0 to 15 cm and 15 to 30 cm]) in each of these four wetlands in August 2000. Wetland SYW-19, in particular, was determined to be severely contaminated and requires further investigations, as stated in Section 5.4 of the RI report:

> "*Due to the extensive contamination in Wetland SYW-19...this wetland area is undergoing further investigation as part of the Preliminary Site Assessment (PSA) and RI for the Wastebed B/Harbor Brook site*."

During the Onondaga Lake RI, the maximum detection of total mercury in wetlands (60.2 mg/kg) was found near the mouth of Harbor Brook in Wetland SYW-19, and total mercury concentrations in this wetland were significantly higher than values reported for the other wetland stations. The maximum detections of dichlorobenzenes, hexachlorobenzene, phenol, and PAHs were also seen in Wetland SYW-19.

Elevated concentrations of PCBs, chromium, and cadmium were detected in Wetland SYW-12 (as discussed in Chapter 5 of the RI report), and will be further addressed as part of the Wastebed B/Harbor Brook RI/FS. Wetland SYW-12 has undergone numerous modifications over the years. At one time there was a pier adjacent to the mouth of Ley Creek. A harbor was cut into the shore, linking the lake with the railroad tracks where the mouth of Onondaga Creek used to be, immediately in front of what is now the Carousel Center. Also, a review of aerial photographs (as

[8] The average methylmercury concentration (79 µg/kg) in SMU 1 chironomids is almost an order-of-magnitude greater than for any other area of the lake. See also response to Technical Comment #16.

presented in Chapter 4 of the RI report) suggests that this wetland was disturbed and filled at various times. Borings collected by Onondaga County in 2003 indicated that a layer of “tar like material” is found throughout most of the wetland at depths of about 4 to 10 ft (1 to 3 m).

The Wastebed B/Harbor Brook RI/FS will determine if Wetlands SYW-12 and SYW-19 need to be remediated and, if so, the extent of the remediation. If remediation is determined to be necessary, then wetland restoration plans will be developed during remedial design. It is likely that those plans would include strategies for improving habitat beyond the existing conditions in those areas requiring remediation where poor habitats currently exist.

Technical Comment #4: The effectiveness of the groundwater remediation along the lakeshore is critical to the success of the preferred remedy. A scenario for which the barrier walls are found to be ineffective should have been evaluated.

Response to Technical Comment #4: Currently, design and effectiveness of the sediment cap in SMUs 1, 2, and 7 depend on the success of a groundwater barrier wall and collection system to significantly reduce the upwelling rate to 2 cm/year or less within these SMUs. This barrier wall and collection system is also needed along SMUs 1 and 2 to control the releases of contaminants via migration of contaminated groundwater from the Semet Residue Ponds, Willis Avenue, and Wastebed B/Harbor Brook sites to the lake.

In addition, the selected remedy includes dredging to remove material in the hot spot areas of the ILWD to a depth of 3.3 ft (1 m) below the initial 6.6 ft (2 m) [on average] dredge cut for a total estimated removal depth of 10 ft (3 m) within the hot spot areas of the ILWD. The hot spots are defined as those wastes/sediments that contain select CPOIs (based on their presence at significantly elevated concentrations in the ILWD materials and/or the compounds for which the cap model was most sensitive) above threshold concentrations. The purpose of the hot spot removal is to improve capping effectiveness. The hot spot threshold concentrations that would trigger the additional dredging are as follows:

- Benzene – 208 mg/kg.
- Chlorobenzene – 114 mg/kg.
- Dichlorobenzenes – 90 mg/kg.
- Naphthalene – 20,573 mg/kg.
- Xylene – 142 mg/kg.
- Ethylbenzene – 1,655 mg/kg.
- Toluene – 2,626 mg/kg.
- Mercury – 2,924 mg/kg.

The above concentrations were developed using the cap model developed by Honeywell and represent the maximum concentrations that could be present in the wastes/sediments and not cause failure of a cap with a 2.5-ft-thick isolation layer assuming an upwelling rate of 2.4 inches/year (6 cm/year). Capping effectiveness is related to cap thickness, contaminant concentrations below the cap, and the upwelling rate (rate at which groundwater flows up through the capped sediments/wastes). With regard to the upwelling rate, Honeywell’s cap model predicts that the cap would be effective based on an assumed upwelling rate of 0.8 inches/year (2 cm/year). This assumption relies upon the proper construction/operation of a hydraulic control system which would be installed (as part of the Wastebed B/Harbor Brook IRM) along the lakeshore adjacent to SMU 1. While the capping model assumes an upwelling rate of 0.8 inches/year (2 cm/year), the hot spot threshold concentrations were developed by NYSDEC by assuming a higher (2.4

inches/year [6 cm/year]) upwelling rate. See response to Technical Comment #9 for additional information related to this higher upwelling rate.

The use of a higher upwelling rate in the development of these values resulted in lower (more conservative) hot spot threshold concentrations than would be developed by assuming lower (e.g., 0.8 inches/year [2 cm/year] or 1.6 inches/year [4 cm/year]) upwelling rates. The use of these threshold concentrations for identifying hot spots within the ILWD provides a method for increasing the effectiveness of capping at the site. As refined cap modeling would be performed during remedial design, it is possible that these concentrations may be modified. However, the hot spot threshold concentrations would need to be based on an assumed upwelling rate of 2.4 inches/year (6 cm/year).

Based on the evaluations performed during the RI/FS process and as a part of the design of the IRMs, it is expected that the groundwater barrier wall and collection system will be effective in significantly reducing the groundwater upwelling rates and in controlling contaminant releases from the upland sites. However, if the groundwater barrier wall and collection system is shown to not be effective based on data generated from the planned monitoring program, additional remedial activities would be considered and selected as appropriate pursuant to state and federal Superfund laws and regulations. These would likely include modifications to the design and/or operation of the barrier/collection system, the placement of additional capping materials, or the removal of additional contaminated sediments.

Technical Comment #5: The effects range-median (ER-M) or probable effect level (PEL) values (or an average of these values) should be selected as reasonable indicators of acute toxicity rather than the probable effect concentrations (PECs). Clarify if the sediment effect concentrations (SECs) for the organic contaminants were normalized to organic carbon content. Also, the PECs do not include any margin of safety for chronic toxicity.

Response to Technical Comment #5: One of the RAOs identified in the ROD is to be protective of fish and wildlife by eliminating or reducing existing and potential future adverse ecological effects on fish and wildlife resources and to be protective of human health by eliminating or reducing potential risks to humans. To address this RAO, areas of sediment were selected for inclusion in the remedial alternatives based on various site-specific criteria as part of the Onondaga Lake FS report.

The mean PECQ approach was proposed by Honeywell as one of the criteria to use for determining remedial areas. The mean PECQ is a single unitless index that accounts for both the presence and concentrations of multiple contaminants in sediment samples. NYSDEC evaluated and refined the mean PECQ approach proposed by Honeywell prior to inclusion in the FS report and Proposed Plan.

In order to select a value that would be protective of aquatic life in Onondaga Lake, NYSDEC carefully evaluated the benthic toxicity tests in the RI/FS process and developed site-specific SECs using these data sets. The use of a geometrically averaged PEC was developed from the site-specific SECs as a consensus-based value based on methodologies published in the literature (e.g., MacDonald et al., 2000; Ingersoll et al., 2000). As discussed in Chapter 9 of the Onondaga Lake BERA, the use of any one of the five individual SECs alone will always present interpretation issues, as follows:

> "*Based on the results of the SEC evaluations described above, it can be concluded that no one of the methodologies employed accurately describe or predict threshold concentrations of toxicity in Onondaga Lake sediments, nor can any one methodology accurately attribute the toxicity observed to any single contaminant. These values cannot be absolute because of the exposure of organisms to a complex mixture of metals and other contaminants which make it difficult to attribute the toxicity to any particular contaminant. However, collective evaluation through a strength-of-evidence approach does provide useful information*."

During NYSDEC's review of the mean PECQ methodology, the PEC for each contaminant was compared to the other initial SECs, as well as to an alternative PEC based on only the ER-M and the PEL. As can be seen in TC Tables 1 and 2 (in the "Tables" section of this RS), the PEC, based on all five SECs, is at least as protective (lower) than the ER-M, the PEL, or the alternative PEC (mean of ER-M and PEL). In 42 out of 47 cases, the PEC was more protective (lower) than the ER-M/PEL averaged value. In three out of 47 cases, the PEC was less protective (greater) than the ER-M/PEL averaged value. In two out of the 47 cases, the PEC was equal to the ER-M/PEL averaged value. Thus, the use of the ER-M/PEL averaged value was analyzed and determined to be less protective of the environment. On that basis, the ER-M/PEL average was rejected in favor of the PEC approach for identifying areas to be remediated. Also, see response to the NRRB's recommendation #5 (Attachment 1 of this RS).

The concentrations of organic contaminants were not normalized to organic carbon, consistent with the discussion in MacDonald et al. (2000), which stated that use of a dry-weight-normalized basis "*predicted sediment toxicity as well or better than organic carbon-normalized SQGs* [sediment quality guidelines] *in field collected sediments*." Thus, the Onondaga Lake SEC/PEC values for the organics are on a dry-weight basis.

The ROD discusses the basis for selecting a mean PECQ of 1 for inclusion in the cleanup criteria for the lake. Additional discussion of chronic toxicity and of why the mean PECQ criterion selected for use for the lake was determined to be protective of aquatic invertebrates is included in the response to Technical Comment #7.

Technical Comment #6: The Proposed Plan indicates that only 23 of the 46 CPOIs were used in the calculation of mean PECQs. It is unclear why some contaminants were retained and others were not. A more conservative approach based on all 46 CPOIs should be used.

Response to Technical Comment #6: A number of contaminants were removed from the mean PECQ analysis to increase the predictive power of the mean PECQ methodology. This is discussed in detail below.

During the development of the FS report (Appendix J), NYSDEC reviewed the mean PECQ methodology to assess whether the mean PECQ was predictive of toxicity as measured in the 1992 data and to optimize the methodology by the use of different variations as suggested in the literature. This review included an assessment of each of the individual contaminants, different endpoints, and use of independent methods of assessment. As the comment notes, half of the original 46 contaminants or CPOIs were removed from the mean PECQ calculations; however, this was done to improve the predictive power of the methodology. Some of these deletions were obvious choices. For example, the PECQs of manganese and dibenzofuran (see figures in Appendix J of the FS report) did not show any relationship with chironomid mortality, nor would they be expected to, based on literature toxicology data. Keeping such contaminants in the PECQ calculations would have the effect of obscuring the relationship between the mean PECQ and toxicity. Removing them from the PECQ calculation makes the calculation a more accurate and powerful predictor of areas that require remediation because only those parameters which actually have a toxic effect on a lakewide basis at this site were assessed.

In addition to contaminants that did not show any relationship with chironomid mortality based on both Onondaga Lake toxicity testing and the relevant literature, other contaminants did not exhibit a relationship between PECQ and mortality based on toxicity testing even though toxicity might be expected based on the literature. Examples of these contaminants include cadmium and pesticides. Finally, some of these contaminants appeared to have some marginal relationship to mortality, such as toluene and chlorobenzene.

To resolve whether these individual contaminants had a true influence (statistically significant) on invertebrate mortality on a lakewide basis, a Multiple Analysis of Variance (MANOVA) was conducted. The derivation of the SECs and the assessment of the individual PECQs looked at each contaminant individually, as if only that contaminant was contributing to the toxicity in the samples. The MANOVA examined the influence of all of the independent variables (the concentrations of the contaminants) on the dependent variables (chironomid and amphipod mortality) and established whether there is a statistically significant relationship between each contaminant and mortality.

Note that the MANOVA used the concentrations of contaminants directly, and that this analysis was therefore independent of the SEC methodology. The information from this MANOVA analysis was used in the selection of the final list of contaminants in the mean PECQ analysis, which included only those contaminants that had a statistically significant relationship to mortality on a lakewide basis. As noted above, this allowed the mean PECQ methodology to have a greater predictive ability than if it also used contaminants whose concentrations were not associated with toxicity in a manner that was statistically significant. A summary of the analysis is provided below.

Multiple Analysis of Variance for Chironomid and Amphipod Mortality Rates and Chemical Concentrations in Onondaga Lake

MANOVA models can be used to look at a series of dependent variables as they are influenced by one or more independent factors.

The mortality rates for chironomids and amphipods were measured at 79 stations in 1992 and at 15 stations in 2000 (see Chapter 9 of the BERA report). The MANOVA analyses were done using the following contaminants of concerns (COCs):

- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Zinc
- Benzene
- Toluene
- Ethylbenzene
- Xylene (Total)
- Chlorobenzene
- Dichlorobenzenes (Sum)

- Trichlorobenzenes (Sum)
- Total PAHs (16 compounds or naphthalene and sum of other PAHs)
- PCBs (Sum of Aroclors 1248, 1254, and 1260)

Other COCs (antimony, arsenic, manganese, selenium, silver, vanadium, hexachlorobenzene, dibenzofuran, phenol, chlordane [sum], and DDT and metabolites) were not included since these COCs were not analyzed in many of the 1992 samples and, for some (e.g., manganese, hexachlorobenzene), were not expected to be contributing to acute toxicity in the lake. In the MANOVA modeling, the dependent variables are the mortality rates of chironomids and amphipods and the independent variables are the concentrations of the COCs.

MANOVA is used to evaluate the effects of independent variables on multiple dependent variables. The main purpose of using a MANOVA for this assessment was to evaluate the lack of difference for a set of dependent variables as a criterion for reducing a set of independent variables to a smaller, more easily modeled number of variables and to identify the independent variables that influence a set of dependent variables the most.

Statistical software was used to perform the MANOVA. The widely accepted significance level (alpha [α]) chosen was 5 percent ($\alpha = 0.05$). The output of the MANOVA includes the F-test values and p-values for each COC. The COCs with p-values less than alpha are considered to have significant contribution to the mortality rates. These COCs are included in the mortality model.

In addition to the MANOVA analysis, a stepwise regression analysis was performed for the mortality rates of chironomids and amphipods separately. Similar to the MANOVA, the stepwise regression method is used to study the effect of the independent variables (the COCs) on the mortality rates. The difference between the stepwise regression and the MANOVA is that the stepwise regression can only take one dependent variable (mortality rate) at a time. In other words, there is no interaction between the two dependent variables (chironomid and amphipod mortality rates). In many ecological or biological studies, the dependent variables often have strong actual or potential interactions that are addressed by using the MANOVA analysis.

For Onondaga Lake, a total of 12 different models were developed using both MANOVA and stepwise regression, including four MANOVA models and eight stepwise regression models. The four MANOVA models were based on either the 1992 data alone or the 1992 and 2000 data combined. For each data set, concentrations of total PAHs and naphthalene plus the remaining PAHs were modeled separately. The four models for the chironomid and four models for the amphipod assessments in the stepwise regression analysis included these same variations. Based on this quantitative assessment, the COCs that were statistically significant across the 12 MANOVA and stepwise regression models were mercury, ethylbenzene, xylene, chlorobenzene, dichlorobenzenes, trichlorobenzenes, naphthalene, other PAHs (15 compounds), and total PCBs. The fact that these 23 COCs had a statistically significant relationship supported NYSDEC's decision to retain them.

The purpose of removing contaminants from the mean PECQ analysis was not to reduce the number or complexity of the calculations, but rather to increase the predictive power of the mean PECQ methodology. In addition to the mean PECQ analysis, NYSDEC also assessed the lakewide data for each individual contaminant of the initial 46 to determine whether the use of the final form of the mean PECQ caused any contamination in the lake to be overlooked. This assessment resulted in the inclusion of the localized area of the lake associated with Station S48 (which has high mortality and high benzene concentrations) for remediation (see Section 2.7 of the FS).

Technical Comment #7: The mean PECQ methodology does not explicitly address chronic toxicity and the mean PECQ threshold of 1 does not appear to be adequate for the protection of benthic organisms. A mean PECQ threshold of 0.3, which will result in additional areas requiring remediation, may be adequate.

Response to Technical Comment #7: Figures J.14 and J.15 in Appendix F of the Onondaga Lake FS report show a general trend of increasing mortality with increasing mean PECQ values. However, the correlation is relatively weak (r^2 values of about 0.5 for chironomid mortality and about 0.6 for amphipod mortality), and the statistical significance has not been established. It is difficult to quantitatively associate any level of biological or toxicological response with any particular mean PECQ value. Therefore, NYSDEC decided to use the mean PECQ as an integrated hazard quotient (HQ). An HQ is defined as a risk threshold divided by the expected exposure level. When the HQ is less than 1, the level of exposure does not exceed the corresponding risk threshold, and harm is not anticipated. The mean PECQ of 1 is the point at which, on average, risk thresholds for COPCs specifically derived from acute toxicity studies conducted within Onondaga Lake are not exceeded. Figures J.14 and J.15 show that some mortality to chironomids and amphipods does occur below the mean PECQ of 1. However, the low coefficient of determination (r^2) value for the relationships suggests that this apparent toxicity cannot be explained by the mean PECQ/mortality relationship, and could result from other factors.

Integration of toxicity data into the mean PECQ provides a single index for identification and demarcation of areas to be remediated. This process is more efficient than attempting to develop as many as 46 individual maps of Onondaga Lake (potentially one for each COPC) and overlaying these maps to identify and delineate areas to be remediated. When the areas of the lake that exceed a mean PECQ of 1 and a mercury PEC of 2.2 mg/kg are compared to locations where toxicity tests were conducted, it becomes apparent that these site-specific cleanup values address nearly every sample location where acute toxicity in laboratory testing was observed.

Chronic toxicity is not explicitly addressed by the mean PECQ methodology, and it is possible that, following remediation, areas will remain in the lake where chronic toxicity to benthic organisms could occur. However, the areas of the lake to be remediated based on the mean PECQ of 1 and the mercury PEC of 2.2 mg/kg will be dredged and/or capped, and the cap material will be clean substrate, thus eliminating the potential for chronic toxicity in those areas.

The Onondaga Lake BERA discussed two components of the RI that were relevant to chronic toxicity – the benthic macroinvertebrate community analyses conducted in 1992 and 2000 and the chronic sediment toxicity testing conducted in 2000. The benthic macroinvertebrate community analyses provide an indirect measure of the occurrence of chronic toxicity at the population and community levels. The chronic sediment toxicity testing done in 2000 was purposefully limited to a small number (i.e., 15) of stations in the lake with the specific objective of observing whether or not the results of the 42-day chronic toxicity tests were significantly more sensitive than the results of the 10-day acute toxicity tests conducted in 1992. There was never an intent to use these chronic data to derive SECs for cleanup criteria.

Those two components of the RI, as described in the BERA, would not be useful for developing chronic SECs for two reasons:

- First, the calculations used to develop the SECs underlying the PECQ require that a certain proportion of the macroinvertebrate sampling stations be unimpaired. The BERA analysis found that benthic communities at every station in the lake were impaired to some degree when compared to the reference lake (Otisco Lake), which is in a rural setting.

- Second, the variability of the data from the limited number of chronic toxicity tests conducted in 2000 was even greater than that for the 1992 acute toxicity testing. This is expected due to the nature of the chronic toxicity testing (e.g., longer term, more sensitive endpoints). Given the relatively weak correlation found between acute sediment toxicity and the mean PECQ, it is apparent that the data from the 2000 chronic toxicity tests are too variable to attempt development of chronic SECs.

There are numerous possible causes for the benthic community to be impacted throughout the lake. Onondaga Lake has been subjected to numerous environmental insults over the past 100 years, including the impacts of urbanization, discharges from numerous industries and agricultural activities, wastewater treatment discharges, and runoff from road surfaces. It would be difficult to identify areas where chronic toxicity was occurring solely as a result of specific contaminants from past industrial discharges of hazardous wastes/substances as opposed to areas where chronic toxicity was occurring as a result of some other cause or process (e.g., anoxic conditions, temperature, substrate, light). It can be noted, however, that most of the littoral zone stations which were classified in the BERA to be moderately or severely impaired (based on the benthic community data) are within the areas to be remediated based on the mean PECQ of 1 and the mercury PEC cleanup values.

Technical Comment #8: Most of the sediment data in SMU 1 were collected within the top 2 m. The limited data at depths greater than 2 m cannot be considered representative of conditions over the 84-acre area of SMU 1.

Response to Technical Comment #8: The selected remedy includes the dredging (to a maximum depth of 3 m) in areas identified as hot spots in which select contaminants exceed threshold concentrations. The purpose of the additional removal is to improve the reliability of capping in this area. As stated in the ROD, the threshold concentrations may be modified during remedial design as a result of refined cap modeling. Most of the sediment data were collected within the top 2 m. However, there are data from cores that extend below a depth of 2 m in and near the ILWD which indicate that elevated concentrations of select CPOIs (including samples whose concentrations exceed the cap threshold values for xylenes and dichlorobenzenes) exist at or below a depth of 2 m. It is for this reason that the remedial design will include an extensive sediment coring program in the ILWD to better define the horizontal and vertical extent and nature of the contamination. The results of this program will be used to identify the areas in which hot spot removal between depths of 2 and 3 m is warranted.

Technical Comment #9: Honeywell believes that the depth of removal and associated cap design (thickness) in its recommended alternative is sufficiently protective since many conservative assumptions were used in its cap model. In addition, Honeywell believes that its remedy for SMU 1, rather than the preferred remedy, is a more appropriate balance of the statutory and regulatory criteria governing remedy selection.

Response to Technical Comment #9: NYSDEC proposed dredging and capping as remedial measures in SMU 1 (see pages 74 to 76 in the Proposed Plan). Although NYSDEC utilized the capping model developed by Honeywell, NYSDEC did not consider Honeywell's inputs to the model mentioned in the comment to be overly conservative, as Honeywell suggests. For example, Honeywell indicated that its model was conservative since it used the highest concentrations of each contaminant, regardless of what depth it was found at in a particular SMU. However, the highest concentrations of contaminants were typically found in the upper layers (in the upper 1 to 3 m) of the waste/sediment in SMU 1. Thus, the use of the worst-case sediment concentrations in the model was reasonable, rather than conservative, since, in actuality, the highest concentrations for most contaminants were detected in the region that would be in contact with the cap. Therefore, NYSDEC developed threshold concentrations for identifying hot spots within the ILWD to provide a method for increasing the effectiveness of capping at the site. Another example is that for the more mobile contaminants that were of most concern with respect to capping effectiveness (chlorobenzene, dichlorobenzenes, BTEX), there were no reliable site-specific data regarding porewater concentration or partitioning coefficients. Where this was the case, the use of literature-based values for partition coefficients is reasonable, but not conservative, because those values represent the best (but not biased) estimate for those parameters.

Finally, Honeywell's use of an upwelling velocity (the rate at which groundwater flows up through the capped sediments/wastes) of 2 cm/yr was based on a groundwater model prediction of a future condition. While NYSDEC does not dispute the groundwater model construction and calibration within the upland areas, the model has not been calibrated or validated by comparing the predicted upwelling rates to measured values within the lake sediments. Unfortunately, Honeywell's attempts to collect usable upwelling rates in the ILWD were not successful. Thus, based on additional analyses performed prior to the issuance of the Proposed Plan (as discussed in more detail below), NYSDEC used a more conservative upwelling rate (6 cm/yr) to develop sediment cap threshold values (CTVs) that represent the maximum concentrations that could be present in the wastes/sediments and not cause failure of a cap with a 2.5-ft isolation layer. The development of CTVs based on this higher upwelling rate is intended to improve the reliability of capping.

Capping effectiveness is related to cap thickness, contaminant concentrations below the cap, and the upwelling rate. Generally, under conditions with high upwelling rates, advection becomes the dominant mechanism of contaminant transport, and changes in other factors (i.e., contaminant concentrations and cap thickness) have less of an effect on cap effectiveness. NYSDEC used the value of 6 cm/yr for the upwelling velocity as a reasonable measure of conservancy (a factor of 3 greater than the value predicted by Honeywell). This value was determined through the additional analysis illustrated by the predicted values presented in TC Figure 1 (in the "Figures" section of this RS), which shows the CTVs for benzene, chlorobenzene, dichlorobenzenes, and xylenes (the compounds to which the model design was most sensitive) at upwelling rates ranging from 2 to 20 cm/yr. As shown on this figure, the CTVs decrease significantly as upwelling velocities increase from 2 cm/yr to about 6 cm/yr for a 2.5-ft isolation layer. Above approximately 8 to 10 cm/yr, there is less of a change in the CTVs with increasing upwelling velocities. Thus, the upwelling rate of 6 cm/yr was used as a conservative measure to address the uncertainty of the groundwater model.

In regard to a comparison between NYSDEC and Honeywell's remedies for SMU 1, the selected remedy, as supported and stated in detail in the Proposed Plan and this ROD:

- Is more permanent and reliable.
- Provides greater long-term effectiveness and cap reliability.
- Provides a better balance of tradeoffs with respect to the evaluation criteria.

Technical Comment #10: The mercury in the profundal zone (SMU 8) sediments is the primary source of methylmercury; however, there is almost no remedial action planned for the sediments in SMU 8.

Response to Technical Comment #10: The lake was divided into eight SMUs based on the nature and extent of contamination and the physical/chemical/limnological characteristics of each SMU. The profundal zone (SMU 8) includes certain critical characteristics that guided the selection of remedial alternatives. The boundary between the littoral zone and the profundal zone was defined in the RI report as the 9-m water depth contour, which is the typical depth of the thermocline. The vast differences in the limnological processes and chemistry as they relate to COCs, especially mercury, between the epilimnion and the hypolimnion were the basis for this definition. There are certainly other ways to define the littoral/profundal zone boundary (e.g., light penetration, sediment type, macrophyte distribution), but the thermocline was determined by NYSDEC (as documented in Section 3.7 of the RI report) to be the most important in terms of contaminant transport and fate.

As described in Chapter 3 of the RI report, the epilimnion is oxic, rapidly and extensively mixed, and contains the bulk of the biota in the lake. The littoral sediments are subjected to wind-driven wave resuspension and extensive bioturbation, and contain unique hot spots of contaminants. These hot spots are found in areas of Honeywell wastes which were deposited under artificial depositional regimes and are now erosional. In contrast, the hypolimnion/profundal zone is a depositional zone with little mixing of the water column and which currently has few, if any, benthic organisms based on limited data from the RI. Also, fish would not be expected to inhabit the hypolimnion during anoxic periods.

Since the littoral sediments represent an ongoing source of contamination due to the extensive deposits and the very active processes causing releases in these erosional zones, dredging and isolation capping were selected for the littoral SMUs. On the other hand, the profundal zone contains sediments that are very stable where highly contaminated sediments from historical depositions are being covered by less-contaminated sediments. Thus, full removal (dredging) of contaminated sediments from SMU 8 was not included in any of the alternatives in the Proposed Plan. Isolation capping was also not included in the alternatives for SMU 8 due to the stable nature of the profundal sediments and the minimal groundwater upwelling velocities in the deep portion of the lake. Based on the analyses and models prepared by Honeywell for the FS report, it was determined by NYSDEC that thin-layer capping in areas that exceed a mean PECQ of 1, oxygenation, and MNR is the most appropriate approach for attaining the RAOs in the profundal sediments and hypolimnion, as documented in the Proposed Plan and this ROD. As discussed in Appendix N of the FS report, inclusion of MNR in an overall remedy for large contaminated sediments sites is consistent with EPA guidance.

MNR modeling conducted by Honeywell based on high-resolution cores indicated that this process will reduce the surface sediment (those sediments which could provide habitat for a benthic community in deep waters, or up to a 10-cm depth) concentrations to levels below the mercury PEC within the MNR period of 10 years, as long as the starting concentration is below 6.7 mg/kg. During the MNR period, concentrations of mercury at the surface of the entire profundal zone are expected to decline to the PEC within a reasonable time frame (10 years) following remediation (based on modeling conducted in the FS report using the 1992 0 to 2 cm data). However, since this model only addressed mercury, the mean PECQ of 1 (based on 23 CPOIs) was applied to the profundal zone to select areas for thin-layer capping. The selected remedy includes thin-layer capping over approximately 150 acres of the profundal zone. The amount of thin-layer capping needed in the profundal zone will be reassessed based on additional data to be collected during pre-design.

Technical Comment #11: There are many things that could go wrong with the controls proposed for the SCA. The commentor identifies several such problems, including possible failure of the pumping system and associated piping.

Response to Technical Comment #11: Reasonable steps can be taken to avoid problems and to control the consequences of those that may occur. Good design practice calls for the implementation of a wide array of monitoring systems that can detect both potential system upsets and releases of contaminants to the environment. Considerable care will be taken during remedial design to specify the use of the most reliable dredging and materials handling equipment and to require that the operation of that equipment be closely monitored. The SCA will be constructed in accordance with applicable laws, regulations, and guidance, which directly address these issues.

There are several techniques available to limit or avoid the discharge of sediment slurry during dredging and pumping operations. In similar circumstances, pressure sensors have been placed along the route of the fluid pipelines to detect pressure changes. Should a section of line fail, pressure would noticeably drop and fluid pumping would be halted until the problem had been corrected. Thus, the quantity of material that could be discharged from a line failure would be limited and could readily be recovered by various means.

Another approach that has been taken when contaminated slurry is being pumped is to use a double-walled piping system, which was used in the cost estimates in Appendix F of the FS report and in the cost estimate for the selected remedy. In this case, slurry released from the inner pipe would be captured by the second or outer line and would not be discharged to the environment. While there is a low probability of pipeline failure, steps would be taken to minimize slurry release in the event of failure. The potential use of these techniques will be evaluated during remedial design.

With respect to air quality, air monitoring will occur throughout project implementation. Monitoring equipment will be placed at various locations including the dredging site, the SCA, and possibly other locations. The monitoring data will be used to determine if operations are proceeding as anticipated or if modifications and corrective actions are necessary.

Technical Comment #12: The mapping methodology employed by TAMS [for NYSDEC] in the RI report has, in all likelihood, led to distortions in the predicted distribution of contaminants shown in the FS report. This has resulted in underestimates of mercury, chlorinated benzenes, BTEX, and possibly other contaminants in the profundal zone. Our [ASLF's] sediment maps show that these chemicals permeate sediments located beyond the rather artificial 9-m boundary used to separate the profundal and littoral zones. In fact, many maps in the FS report (which were taken from the RI report) support this same conclusion.

SMU 1 should be expanded into the deeper waters of the lake so as to include this contamination. These highly contaminated sediments should be subject to the same dredging and capping remedial approach as the other sediments in the ILWD. SMU 7 and SMU 2 should be reexamined in this light.

Response to Technical Comment #12: The contaminant distribution maps presented in Chapter 5 of the RI report (which did utilize the 9-m contour as a boundary) agree well with the maps included in Appendix B of ASLF's comment letter, which indicate elevated concentrations of contaminants in the top 30 cm of the profundal zone immediately adjacent to the ILWD. The maps in the RI report were meant to assist in the evaluation of the contaminant distribution, transport, and fate and to present contaminant distributions for all CPOIs, not only for the surface sediments but also for deep sediments down to 8 m (the vertical extent of the RI data).

In Appendix I of the RI report, a different method of portraying the data (i.e., kriging) was presented for mercury contamination, which also used the 9-m contour as a boundary and showed elevated mercury concentrations in the profundal zone in the south end of the basin (see also response to Comment G-11.36 in the Comment and Response Index). Honeywell's FS report used a simpler method (i.e., Thiessen polygons) of presenting the chemical distribution data for the purpose of estimating volumes. During its review of the FS report, NYSDEC assessed the suitability of the Thiessen polygon method by comparing the areas and volumes presented in the FS report with estimates based on the mapping presented in the RI report and determined that the volume estimates were adequate for the purposes of the FS report.

NYSDEC is aware that contamination extends from the ILWD past the 9-m boundary into SMU 8. As noted in the response to Technical Comment #10, the boundaries of the SMUs were drawn based on several factors, including whether the area is above or below the thermocline in the summer stratified period. The differences between the epilimnion and hypolimnion in terms of settling, resuspension, and water chemistry make the 9-m contour a reasonable boundary, as is discussed in more detail in Chapters 3 and 5 of the RI report. Because NYSDEC is aware of this contaminant distribution in SMU 8, the selected remedy includes thin-layer capping in the area adjacent to the ILWD based on exceedances of the mean PECQ of 1. Furthermore, the suitability of thin-layer capping at the base of the ILWD in SMU 8 will be further evaluated during remedial design and remedy implementation based on the additional data to be collected. If extremely high concentrations of contaminants are found in this area, additional remedial measures will be considered.

Technical Comment #13: Treatment of the sediments should be required to separate out highly contaminated material. Soil washing technologies, which have been demonstrated on sediments in Saginaw Bay, among other places, could be a very effective way to separate the calcareous Solvay waste from the NAPL which occurs in and near the ILWD. Another potential benefit of soil washing lies in its ability to separate sand from fine-grained silts and clays. In the case of Onondaga Lake, this technology could potentially be used to generate clean capping material, while reducing the amount of sediments being disposed of in the SCA. In our examination of boring logs from the lake (Stations S329 to S334), ASLF has noted that considerable sand deposits exist within the lake.

Response to Technical Comment #13: Although soil washing was an effective treatment for use at Saginaw Bay, it cannot be inferred that it would be as effective a treatment for the Onondaga Lake sediments. Pilot studies would be needed to assess the efficacy of soil washing as a treatment technology for the lake sediments; to date, no such studies have been conducted. This technology was evaluated in the Onondaga Lake FS report (Parsons, 2004), but was determined to not be viable, since it can be difficult to implement due to complex treatment requirements for extraction fluid, lack of full-scale applications to date, and lack of commercial availability.

A number of factors should be considered when evaluating the possibility of processing contaminated sediments. As suggested by the comment, sediment grain size is an important variable since coarse-grained sediment can be expected to be relatively free of contamination in comparison to fine-grained material. As mentioned in the comment, the boring logs (which are general field descriptions and are not quantitative) for two locations – Stations S329 and S330 – do indicate that the material collected there is predominantly sandy (and, thus, coarse-grained). Based on contamination levels from the RI data, these two stations would not be targeted for remediation.

An assessment of the laboratory analysis for particle size determination presented in the RI report shows that the sediments in the 8-m cores from stations within the ILWD (Stations S309 to S315) typically exhibit a low sand fraction, with over 90 percent fine-grained material (silt and clay, less than 0.075 mm). These cores, which are likely to be more representative of the material that would be targeted for removal than would Stations S329 and S330, suggest that size separation of dredged sediments is not likely to be efficient or even feasible. Thus, should a washing technology be considered for lake sediments, it can be expected that little or no benefit would be obtained by utilizing a size-separation technology ahead of the treatment system. Based on our research, Saginaw Bay contaminants were PCBs and other industrial organics that were adsorbed, at least in part, to native sediments with a greater variety of grain sizes than found in Onondaga Lake.

Another factor that will influence the viability of applying soil-washing methods to Onondaga Lake sediment is that the targeted material has highly variable physical and contamination characteristics as a result of the many manufacturing processes that took place at the former Honeywell facilities along the lake. Soil washing systems perform best when the incoming contaminated material exhibits consistent properties (note, however, that there is limited experience with this technology, although its application has been increasing). This enables the designers to optimize the treatment process for the specific material that would be processed. The variability of Onondaga Lake sediments would make it difficult to design a single well-defined processing system to handle all targeted material. Thus, soil washing probably does not have general applicability to Onondaga Lake sediments and is therefore not part of the selected remedy. See also response to Comment O-18.2.

Technical Comment #14: The observation (reflected in the mercury mass balance for the water column of Onondaga Lake as presented in Tables 6-20 to 6-25 of the RI report) that the measured losses of mercury exceed the measured inputs of mercury by a large extent suggests that there is not an adequate understanding of the sources of mercury to the lake.

Response to Technical Comment #14: As discussed in the RI report, the mercury mass balance for the water column of Onondaga Lake, based on sources and sinks identified in Honeywell's 1992 RI/FS work plan, was incomplete, as the sources of roughly 75 percent of the mercury input was not accounted for. As described in the RI report (Sections 6.1.1.5 and 6.1.3), NYSDEC obtained supplemental information that identified additional sources of mercury (i.e., profundal sediments and the ILWD) that account for the gaps in the total mercury mass balance for the stratified period and provide for an understanding of sources of mercury to the lake.

The mass balance for total mercury for the stratified period, based on the analyses conducted for the RI and subsequent refinements of the resuspension fluxes (see response to Technical Comment #17, below), is presented in TC Table 3 below.[9]

TC Table 3 Summary of Lake Mass Balance for Stratified Period for Total Mercury

Sources (g)			**Sinks (g)**	
Epilimnetic Sources	External Sources	3,360	Settling to Lake Bottom	10,700
	Wind-Induced Resuspension	6,300	Outflow	660
	Diffusion: Littoral Zone	72	Volatilization	46
Hypolimnetic Sources	Diffusion: Profundal Zone	43		
	Particle Exchange: Ebullition	880		
Total Sources		~10,700	Total Sinks	~11,400

The selected remedy (along with remediation of the upland subsites, including impacted tributaries) will address the RAOs and PRGs both directly and indirectly by reducing the external inputs to the lake, reducing and isolating the contaminant inventories in the lake, and by eliminating or reducing internal processes (e.g., methylation in the anoxic waters, resuspension of contaminated wastes/sediments) in the lake. The predicted reductions (on the order of 90 percent) in inputs and inventories are expected to reduce the exposures and uptake of contaminants in humans and wildlife in a manner that is protective and consistent with the NCP.

Technical Comment #15: Although there has been a marked decrease in mercury loading to the lake since the early 1970s, there has been no corresponding change in fish mercury concentrations. One might speculate that total mercury loads to the lake do not regulate mercury levels in fish, but rather that these levels are regulated by the very high rate of methylmercury production. The RI/FS did not determine if the supply of methylmercury to fish largely occurs in the hypolimnion, as opposed to the littoral sediments. It is not clear how the reduction in total mercury loads or control of methylation in the hypolimnion will address mercury concentrations in fish.

Response to Technical Comment #15:

Sediment Concentrations and Potential Reductions in Mercury

Contaminant concentrations in sediments throughout the lake will be significantly reduced by the following:

---

9 TC Table 3 is based on a presentation by Gbondo-Tugbawa et al. (2005) at the Third International Conference on the Remediation of Contaminated Sediments, New Orleans, LA. This table is similar to Table 6-20 in the RI report, which presented the mercury mass balance for the stratified period based on the sources and sinks as per the 1992 work plan. Table 6-20 was updated to include mercury loading supplied by wind-driven resuspension and methane ebullition, as reflected in TC Table 3. In the RI report these additional loads were discussed in the text and in other tables and figures, but were not included in the formal mass balance table because they were not part of the original sampling programs in 1992. The RI report presented a range of mercury loads from resuspension (2,000 to 20,000 g); however, subsequent to the completion of the RI report, a more refined analysis (Gbondo-Tugbawa et al., 2005) of the meteorological data allowed for the determination of the more precise value of 6,300 g.

- Reduction of external inputs, which will result in a reduction in future inventories and concentrations in the lake.

- Removal and capping of littoral sediments requiring remediation, which will result in a direct reduction in inventories and concentrations.

- Implementation of thin-layer capping and MNR in the profundal zone.

These actions will either remove or isolate (by capping) 89 to 99 percent of the various contaminant inventories in the lake (see FS report Table 5.3). This will cause the lakewide surface area-weighted average mercury concentration in the sediments to be reduced by 67 percent (from about 2.9 to 1.0 mg/kg, assuming that the profundal sediments only reach a concentration of about 1.2 mg/kg as predicted by the MNR model presented in the FS report), with the littoral zone being reduced by 86 percent (from about 3.5 to 0.5 mg/kg) (see FS report Tables I.24 and I.26).

This reduction in surface sediment concentrations for mercury and other CPOIs will immediately reduce impacts to the benthic community due to direct-contact toxicity. For bioaccumulative CPOIs, such as PCBs and hexachlorobenzene, the reduction in concentration is expected to directly reduce the uptake of these contaminants by the benthic community.

The uptake of mercury from the sediments by the benthic community (which is a food source for fish) is highly dependent on the production and subsequent increased concentrations of methylmercury in sediment and porewater. The ratio of methylmercury to total mercury in sediments is dependent on mercury concentration in a logarithmic manner (Krabbenhoft et al., 1999), in which the most direct relationship occurs in sediments with low total mercury concentrations (less than 1 to 2 mg/kg). At higher concentrations of total mercury, the influence of total mercury concentrations on methylmercury concentrations is not as strong (i.e., little additional methylmercury is evidently produced with increasing total mercury [Krabbenhoft et al., 1999]). The selected remedy will significantly reduce the total mercury concentrations in the surface sediments of areas to be remediated to very low concentrations (i.e., predicted to be 0.2 mg/kg or less at the top of the cap). This would reduce the total mercury concentrations to the level (i.e., less than 1 to 2 mg/kg) in which there is a strong relationship with methylmercury; therefore, a decrease in the methylmercury concentrations would be expected.

The removal and capping of sediments and the reduction of external inputs, in addition to oxygenation, will indirectly address surface water contamination. The three major sources of total mercury to the water column of the lake are the following:

- External upland sources (i.e., the Honeywell subsites and the tributaries draining those sites).

- Resuspension of littoral zone sediments/wastes (especially in the ILWD).

- Releases from the profundal sediments via both diffusion and ebullition.

The remediation of external sources is expected to eliminate or reduce total mercury loads from the upland sources resulting in a 70 percent decrease in total mercury loading to the lake (see Tables N.2 and N.3 in Appendix N of the FS report). The remediation in SMUs 1 to 7 would virtually eliminate resuspension as a source in the littoral zone from areas containing mercury at concentrations greater than the mercury PEC (i.e., 2.2 mg/kg). The RI report indicates that releases from the profundal sediments are a significant source of total mercury to the water column, based on the 1992 mercury mass balance which suggests that the downward mercury flux on settling particles increases by 30 percent in the hypolimnion relative to the downward flux from the epilimnion. It was concluded that this is at least partially due to ebullition of methane from the sediments facilitating the migration of mercury both by directly carrying sediments into the water column and by increasing the rate of diffusion. As presented by UFI at the Onondaga Lake Scientific Forum in 2004, the rate of ebullition from the sediment has dropped by a factor of about six since 1992, suggesting that this source of mercury to the water column has already dropped substantially. Thus, based on reduction of external and internal sources of mercury to the lake, a reduction in total mercury concentrations in the water column is expected (see Appendix I of the FS report).

The oxygenation component of the remediation is expected to have two additional benefits. The first is the reduction in total and dissolved mercury concentrations. Based on the data for the 1992 stratified period and 1999 fall turnover, it is evident that under the anoxic conditions of the stratified period, the concentrations of dissolved and total mercury increase substantially. However, when that water is oxygenated during other times of the year, chemical processes take place which rapidly strip this mercury out of the system (see RI report Figures 5-142 and 5-143). Thus, oxygenation of the hypolimnion is also expected to reduce the total mercury concentration in the water column. The second benefit of oxygenation is the elimination of methylation that occurs under anoxic conditions in the hypolimnion.

Fish Mercury Concentrations

A major factor in the uptake of mercury by biota is the methylation that takes place under anoxic conditions. Hypolimnetic dissolved oxygen (DO) is generally depleted from summer to early fall due to cultural eutrophication (Owens and Effler, 1996). Prior to 1987, the lake regularly failed to turn over in the spring due to salinity stratification (Owens and Effler, 1996). The water inputs from the surrounding tributaries tended to plunge into the hypolimnion due to their high salinity and caused a significant saline stratification. The failure of the lake to turn over exacerbated the depletion of the DO in the hypolimnion (Owens and Effler, 1996). Turnover resumed after the Honeywell Main Plant closed in 1986, although saline inputs (e.g., from the wastebeds) continue to enter the lake. However, exactly how these changes affect methylmercury cycling and exposures has not been fully defined. For example, while a lack of turnover may maximize the conditions for methylation in the hypolimnion, it may also limit the amount of exposure in the epilimnion that occurs from releases caused by the approach of turnover.

A comparison of the annual average mercury concentrations in smallmouth bass (the species with the most extensive sampling record) with the mercury profile in the 1996 high-resolution sediment core collected during the RI from the southern basin (which serves as a surrogate for the gross total mercury load to the lake) provides some insight (as discussed below) into the relationship between sediment and fish (see TC Figure 2 in the Figures section of this RS). (It should be noted that the dates associated with this 1996 core, as shown in TC Figure 2, are rough estimates since assigning exact years of deposition to the slices of sediment cores is somewhat subjective. This is because each slice does not necessarily represent a single year that can be directly compared to the fish data, but instead represents a variable length of time depending on the thickness of the interval sampled, the sediment flux rate at the time that the sediment was deposited, and the amount of compaction that has occurred in the sediments, as well as the thickness of the slice analyzed.) The history of Honeywell's discharges of mercury to the lake system is discussed in Chapter 4 of the RI report. It should be noted that the fish data presented in the figures for this response are shown as annual averages and do not account for differences in fish size. However, normalizing mercury concentrations to fish length does not change the relationships discussed below.

As shown in TC Figure 2, there was a substantial decrease in mercury concentrations in fish and sediment after mercury controls were installed at Honeywell's facilities in 1970. When the Willis Avenue plant closed in 1977, a second decrease in mercury concentrations occurred in both fish and sediment. However, from 1979 to 1981, average mercury concentrations in fish increased from 0.7 to 1.2 mg/kg. Concentrations also increased slightly in sediment during this period, possibly coincident with the transfer of the Bridge Street plant from Allied Chemical to LCP.

From 1980 to 1986, Honeywell diverted its wastebed overflows from the lake to Metro in an experimental attempt to use the ionic wastes to precipitate out phosphorus. While this diversion of the overflow appeared to cause a drop in the total mercury inputs into the lake (as seen in the core profiles), it appears to have continuously increased the inputs of methylmercury to the epilimnion, since it is known that methylation of mercury occurs in the sewage treatment plant (McAlear, 1996). This likely resulted in decreases in mercury flux to the sediments, but an increase in average mercury in fish levels occurred at the same time.

In the late 1980s, a brief but sharp increase in the fish and sediment mercury concentrations occurred between the time that the Main Plant shut down in 1986 (reducing the solids flux and the effects of salinity on the turnover regime) and the time that the Bridge Street plant shut down in 1988 (reducing the mercury load to the lake), as discussed by Rowell (1992) and cited in Chapter 6 of the RI report. After the 1988 closure of the Bridge Street plant, the mercury concentrations in both fish and sediments dropped. After 1990, the mercury concentrations in fish have generally reverted to the levels seen in the late 1970s, with some minor perturbations in both sediment and fish concentrations.

These patterns suggest that both processes (loading of total mercury and methylation) play a role in the uptake of methylmercury in fish. Thus, the selected remedy was developed to address the sources of both total mercury and methylation. When average mercury in fish and sediment are directly compared, using the data from 1974 to 1996 (TC Figure 3), a linear relationship is suggested for Onondaga Lake. This relationship supports the use of the BSQV, which was derived using a direct empirical relationship between mercury concentrations in fish and sediment.

However, the plot in TC Figure 3 does not suggest a particularly strong relationship between total mercury loading and mercury concentrations in fish. This result would be expected because of the inherent uncertainty in the dating of the high-resolution sediment core mentioned above. In addition, mercury uptake is most directly affected by the amount of methylmercury that the fish are exposed to, not the total mercury concentrations in sediments. An example of the way in which these two processes may not always move in the same direction is the period in the early 1980s when Honeywell waste was diverted through the Metro plant. This diversion likely resulted in increased methylmercury loads while also reducing the total mercury load to the lake.

If the fish and sediment data shown in TC Figure 2 are separated into three distinct periods of Honeywell operations (1974 to 1979, prior to diversion to Metro; 1980 to 1986, during diversion to Metro; and post-1986, after closure of the Main Plant), three distinct relationships are suggested despite the relatively small data sets (TC Figure 4). In the 1970s, there is a weak but positive relationship between total mercury loading (as represented by the sediment concentrations in the 1996 profundal core) and fish mercury concentrations during a time when turnover is impaired.

During the early 1980s, there was no apparent relationship between total mercury loading and fish mercury concentrations. However, concentrations of mercury in fish were higher than they were during the 1970s. Turnover was still impaired, but a significant amount of total mercury from Honeywell's diversion of overflow was being removed at Metro, thus resulting in lower total mercury loads to the lake, although the methylmercury load to the epilimnion was increasing. This suggests that the impact of the diversion to Metro during this period was great enough to overwhelm the apparent relationship between total mercury loading and fish mercury concentrations that was seen in the 1970s.

After Honeywell ceased operations at the Main Plant in 1986, the lake was in a more typical stratification regime and a stronger apparent relationship between total mercury loading and mercury concentrations in fish was seen. During this time, concentrations of mercury in fish were higher in comparison to the sediment concentrations than were seen in previous years. This suggests that exposures of fish to methylmercury may have increased during this time, even when the total mercury loading (as represented by the 1996 high-resolution profundal sediment core) was consistent with the 1970s levels. TC Figure 4 highlights the complexity of the system as total loading and methylation interact and also shows that both processes can play a role in the uptake of mercury in fish.

Technical Comment #16: A basic understanding of mercury inputs and transformations is lacking, such that stakeholders cannot be assured that the remediation program will be successful (e.g., reductions in mercury concentrations in fish). How will it be possible for NYSDEC, as stewards of this resource, to communicate to stakeholders how the lake will respond to remediation activities? The development of a well-tested and credible model that also addresses the fate and transport of selected components of the organic contaminants would go a long way in demonstrating this understanding and guiding the rehabilitation effort.

Response to Technical Comment #16: Analyses performed for the RI/FS, based on data collected during the RI/FS, provide for an understanding of mercury inputs and transformations. This understanding was used to develop the RAOs and PRGs upon which the selected remedy is based. More important than gross mercury loading to the lake in terms of uptake in biota (e.g., fish) is the fact that total mercury is methylated in the lake under anoxic conditions. Methylmercury is much more easily taken up from the environment and more strongly accumulated in biota than non-organic forms of mercury. The following is an assessment of fish exposure to methylmercury and how remediation is expected to reduce those exposures. The primary routes of exposure for fish are directly from the water column and through the food chain.

Water Column Mercury Concentrations

High rates of methylation occur in the anoxic hypolimnion, which appears to be the dominant source of methylmercury to the water column. The reduction of the total mercury loads to the lake and oxygenation of the hypolimnion are expected to substantially reduce this source of methylmercury to the system and significantly reduce the concentration of methylmercury throughout the water column. The RI report estimated that hypolimnetic methylation contributed approximately 230 g during the stratified period in 1992, representing more than half of the total methylmercury budget for Onondaga Lake (see RI report Table 6-23). While this methylmercury production occurs in the hypolimnion, it is not considered isolated from the rest of the lake. In the mass balance for the epilimnion during the 1992 stratified period, it was estimated that 110 g of methylmercury (about 43 percent of the epilimnion's budget) cross the thermocline from the hypolimnion into the epilimnion. While the mass balance approach is an important way to assess sources, a more direct measure of the exposure to the biota and the possible changes that will occur with oxygenation can be seen in the actual water column methylmercury concentrations.

During the first phase of the RI, water samples were collected by Honeywell once a month from April to December of 1992 at the north and south deep basin stations either at depths of 3, 9, and 15 m or at depths of 0, 3, 6, 9, 12, 15, and 18 m. In April, the lake was still completely mixed from spring turnover and was well oxygenated throughout the water column (see TC Figures 5 and 6 in the Figures section of this RS), with total methylmercury concentrations ranging from 0.31 to 0.36 ng/L. Summer stratification was established by May 25, and oxygen concentrations were already depressed in the hypolimnion and were at or very close to anoxia at 18 m. In May, average methylmercury concentrations ranged from 0.19 to 0.35 ng/L in the well-mixed and oxygenated epilimnion. However, methylmercury in the hypolimnion started at 0.35 ng/L at 12 m, increased to 0.69 ng/L at 15 m, and finally peaked at 1.86 ng/L at 18 m. This suggests that the effects of anoxia/methylation in the water column were already being seen in May.

In the summer stratification period, hypolimnetic methylmercury concentrations were elevated to a maximum of about 12 ng/L, with an average for the period of about 4 to 6 ng/L. At the same time, low concentrations on the order of 0.3 ng/L were detected at depths of 0 and 6 m in the epilimnion. Of particular note are the epilimnetic data from the 9-m depth, which is at the bottom of the oxygenated epilimnion but just above the thermocline. As can be seen in TC Figure 6, concentrations of methylmercury at 9 m during the summer (ranging from 0.49 to 1.02 ng/L with an average of 0.71 ng/L) were about twice those seen in the upper waters of the epilimnion during this period. With the onset of fall turnover, the methylmercury-rich hypolimnetic waters mixed with the epilimnetic water and produced concentrations of methylmercury between 1 and 2 ng/L throughout the water column into December.

During the second phase of the RI, Honeywell collected additional samples to further assess the importance of fall turnover in mercury (and methylmercury) fate and transport. The sampling started during the stratified period in September 1999 and continued through the turnover process into December (see RI report Figures 5-143 and 5-145). In September 1999, the average total methylmercury concentration in the surface water (0 m depth) was 0.98 ng/L, roughly three times that of 1992. The average methylmercury concentration of 2.4 ng/L (0 m depth) from October to December reflects the rise during the turnover process and is greater than the concentrations seen in 1992.

In 2000, on an approximately biweekly basis, Sharpe (2004) collected epilimnetic (0 m depth) and hypolimnetic (12, 15, and 18 m depths) water samples for methylmercury analyses. These data exhibit a pattern similar to the 1992 data. In April and early May 2000, very low concentrations (less than 0.1 ng/L) of methylmercury were detected at the 0 m depth, with slightly higher concentrations (mean of 0.25 ng/L) during the stratified period, and a rise to about 1 ng/L during turnover.

In late July 2000, water samples were collected by Honeywell from just above the sediment-water interface in both the profundal and littoral zones. The samples from the profundal zone had methylmercury concentrations ranging from 1.93 to 3.84 ng/L, which is consistent with the hypolimnetic water column data collected in 1992 and 2000. The littoral zone samples were from locations in the Ninemile Creek delta and the ILWD subject to resuspension. In the Ninemile Creek delta, the methylmercury concentration (0.214 ng/L) was consistent with the well-oxygenated epilimnion. The samples from the ILWD contained higher concentrations (0.405 to 0.827 ng/L) than are typically seen in the epilimnion prior to turnover, which was likely due to resuspended contaminated material. It is expected that these elevated concentrations would be for the most part eliminated with the partial removal and capping proposed in the ILWD.

Fish Exposure to Mercury

Based on the water column data presented above, an assessment can be made of the exposure of fish to methylmercury in the water column and how that exposure may be affected by the remedial program. The data from the spring turnover, when the entire water column is well oxygenated, give the best insight into the effects that oxygenation of the hypolimnion will have on the methylmercury regime in the water column. During this time, only very low concentrations (less than or equal to 0.3 ng/L) of methylmercury are seen in the water column. In 1992, these same concentrations of methylmercury are seen in the surface (0 to 6 m) water throughout the summer stratified period. If the entire water column of the lake is kept oxic by the remedial program, it would be expected that the water column methylmercury concentrations would be maintained at these low levels.

Currently, methylmercury builds up in the hypolimnion during the stratified period, which lasts roughly four months of the year. This methylmercury increase starts concurrent with the decline in oxygen levels in May. A concentration of 1.8 ng/L of methylmercury was seen at 18 m in May 1992, when hypolimnetic oxygen levels ranged from 0.5 to 4.1 mg/L. During this time (at the beginning of the stratified period in May 1992), it is reasonable to assume that there were no fish in the hypolimnion, since most of the hypolimnion exhibited DO levels less than 4 mg/L, which is less than the NYSDEC average daily DO standard for fish propagation and survival (5 mg/L).

Although fish are not likely to be exposed directly to hypolimnetic waters during the stratified period, there is evidence that methylmercury from the hypolimnion is crossing the thermocline into the epilimnion, where fish are expected to be. At the 9 m water depth at the bottom of the epilimnion during the stratified period, fish can be exposed to methylmercury concentrations that are at least twice the concentrations seen throughout the water column during the spring turnover period and in the top of the epilimnion during the stratified period. It is likely that littoral zone fish (smallmouth and largemouth bass, bluegill, catfish) are not subject to this exposure since the more desirable habitat (macrophyte beds) for these species is restricted to depths of less than 6 m in Onondaga Lake, while more pelagic fish (walleye and white perch) are likely to be exposed to this additional dose of methylmercury near the thermocline. Walleye (a top predator) have the highest concentrations of mercury in the lake, and white perch (a planktivore) have mercury concentrations substantially higher than littoral-zone fish with a similar trophic level (bluegill) and often have higher concentrations than top-trophic-level littoral predators (bass). It is expected that oxygenation of the lake would reduce this exposure to methylmercury crossing the thermocline by at least 50 percent to concentrations consistent with spring turnover levels.

During fall turnover, the hypolimnetic waters, with their elevated mercury and methylmercury concentrations, are mixed with the epilimnetic waters, resulting in methylmercury concentrations that are about three to five times higher than during spring turnover. These elevated concentrations are found throughout the lake and typically persist for at least three months (from the onset of turnover [mixing] in the beginning of October until sampling ended in December), and affect all fish species. It is expected that remediation will reduce these exposures by a factor of 3 to 6 to levels that are similar to spring turnover conditions.

A potential change in the exposure of littoral- and pelagic-zone fish to water-column methylmercury is presented below in TC Tables 4 and 5, respectively, based on the RI data collected from April to December 1992. Samples were collected at two locations (north and south deep basins) once a month. In the tables, the year is divided into three periods of four months. The spring turnover period is represented by a single set of samples (April), the summer stratified period in 1992 is represented by five sets of samples (May to September), and the fall turnover period is represented by three sets of samples (October to December). There are no samples from the winter stratified period. While the tables below are based on the 1992 RI data, data from water sampling in 2000 (Sharpe, 2004) reflect similar trends, with low concentrations in the upper epilimnion in spring and summer with an increase during the approach to fall turnover.

TC Table 4 Exposure of Littoral Zone Fish to Water Column Methylmercury

Time Period (Percent of year)	Current Concentrations[1]	Weighted Concentration[1, 2]	Weighted Concentration Due to Remediation[1, 3]	Percent Reduction
Spring (33.3%)	0.3	0.1	0.1	0
Summer (33.3%)	0.3	0.1	0.1	0
Fall (33.3%)	1.4	0.47	0.1	78 %
Weighted Average Concentration	N/A	0.67	0.3	55 %
Notes: [1] All units are in ng/L. [2] Concentration times percent of year. [3] Predicted concentration following remediation (0.3 ng/L) for all seasons times percent of year.				

TC Table 5 Exposure of Pelagic Zone Fish to Water Column Methylmercury

Time Period (Percent of year)	Current Concentrations[1]	Weighted Concentration[1, 2]	Weighted Concentration Due to Remediation[1, 3]	Percent Reduction
Spring (33.3%)	0.3	0.1	0.1	0
Summer (33.3%)	0.7	0.23	0.1	57%
Fall (33.3%)	1.4	0.47	0.1	78%
Weighted Average Concentration	N/A	0.80	0.3	62%
Notes: [1] All units are in ng/L. [2] Concentration times percent of year. [3] Predicted concentration following remediation (0.3 ng/L) for all seasons times percent of year.				

Uptake of Mercury Through the Ingestion of Benthic Macroinvertebrates

The lower levels of the aquatic-based food chain include the benthic macroinvertebrates in the littoral zone and the zooplankton in the pelagic/profundal zone.

As discussed in Chapter 2 of the RI report and Chapter 7 of the BERA report, macroinvertebrate samples were collected in 1992 and 2000 from various locations in the lake (see Figures 7-5 and 7-9 of the BERA report). SWACs for total mercury and average methylmercury concentrations in the surface (0 to 15 cm) sediments for each SMU are presented in TC Table 6 below. SWACs were not calculated for methylmercury due to the significantly smaller data set as compared to mercury.

TC Table 6 Total Mercury SWACs and Average Methylmercury Concentrations for Surface Sediments by SMU

SMU	Current Mercury SWAC (mg/kg)	Average Methylmercury Concentration (µg/kg)
1	20.49	20.5
2	2.88	6.4
3	1.36	2.1
4	2.10	4.2
5	0.77	3.1
6	2.54	8.6
7	9.32	12.2
8	2.61	22.5
Littoral Zone (SMUs 1 – 7)	3.59	13.2

The combined 1992 and 2000 data for methylmercury concentrations in chironomids for SMUs 1 through 7 are shown on TC Figure 7. The average methylmercury concentration (79 µg/kg) in SMU 1 chironomids is almost an order-of-magnitude greater than for any other area of the lake. The chironomids in the rest of the littoral SMUs all have similar lower concentrations (5 to 20 µg/kg, with an average of 10.8 µg/kg) and are all elevated above the non-detect levels seen in Otisco Lake, which is the reference lake for the Onondaga Lake project.

Implementation of the selected remedy will substantially reduce the sediment SWACs for total mercury in SMUs 1, 2, 3, 4, 6, and 7 as a result of the use of clean fill for capping materials (the SWAC for SMU 5 will not be substantially reduced since the selected remedy includes limited [approximately 10 percent of the total area of the SMU] remediation in this SMU). For the benthivorous fish that primarily reside in the southern corner of the lake, it can be expected that exposure to methylmercury through the food chain will be reduced by as much as an order of magnitude following remediation. This is based on the assumption that concentrations of methylmercury in SMU 1 chironomids will be reduced from the current average in SMU 1 (79 µg/kg) to the average concentration in the other littoral zone SMUs (10.8 µg/kg) (a reduction of 86 percent) or less. SMU 1 represents about 8 percent of the area of the littoral zone of the lake and contains significantly greater chironomid methylmercury concentrations than the rest of the littoral zone (see TC Figure 7). For those fish that range over the entire littoral zone, it can be expected that exposure to methylmercury in the littoral food chain would also be reduced, but to a lesser extent.

Zooplankton Mercury Concentrations

Zooplankton samples were collected in May (spring), August (summer), and November (fall) of 1992. The results are presented in TC Table 7 below.

TC Table 7 Zooplankton Data from 1992

Season	Station	Methylmercury Concentration (µg/kg)	
		Assemblage	Daphnids
Spring	W1	32	NC
	W2	41	NC
Summer	W1	33	220
	W2	26	300
Fall	W1	81	230
	W2	65	250
Notes: Data taken from 1993 PTI report. NC = not collected.			

Two types of samples were collected, as follows:

- **Assemblages** were bulk samples of the materials in the collection net, which included large numbers of smaller copepods and larger species, and possibly other material such as large colonial phytoplankton and daphnids.

- **Daphnids** were collected by sorting the bulk samples in the field. Twenty individual *Daphnia* sp. were collected for each sample.

The assemblage sampling indicates that methylmercury concentrations were relatively stable between spring and summer collections, with average concentrations of 36.5 and 29.5 µg/kg, respectively. The methylmercury concentrations increased by about a factor of two during the fall turnover (average of 73 µg/kg), showing a clear response to the increase in epilimnetic water concentrations of methylmercury. It can be noted that these assemblage concentrations are three to seven times greater than the concentrations seen in most of the littoral zone benthic invertebrates (chironomids) and that concentrations in the fall samples approach the SMU 1 methylmercury results for macroinvertebrates.

The daphnid sampling indicates that the methylmercury concentrations are stable from summer to fall, with average concentrations of 260 and 240 µg/kg, respectively. (Note that a daphnid sample could not be collected in the spring.) This lack of change in the methylmercury body burdens indicates that the daphnids are not affected by the increase in epilimnetic water concentrations at fall turnover and suggests that their exposure does not change across the summer stratified and fall turnover periods. It can also be noted that these concentrations are roughly eight times greater than the assemblage concentrations, 25 times greater than the macroinvertebrate methylmercury concentrations seen in the littoral zone outside of SMU 1, and about three times greater than the average SMU 1 macroinvertebrate methylmercury results.

An important pattern seen in the zooplankton results is that the daphnids have substantially greater concentrations of methylmercury than the assemblages. There are a few possible explanations for this. The first is that the assemblage samples were bulk samples and were not sorted. It is possible that other material with lower concentrations of methylmercury (e.g., phytoplankton) may have been included in the sample, causing dilution. However, this would imply that the majority of the sample was something other than zooplankton.

The second possibility is that there are ecological differences between daphnids and the smaller copepods. In particular, it is well documented that daphnids migrate vertically on a diurnal basis, moving into deeper water during the day to avoid predation by planktivorous fish (e.g., white perch) that selectively feed on these large zooplankton (Wetzel, 1983). While there is evidence that the smaller zooplankton also migrate, they do not appear to do so nearly to the same extent as daphnids. Thus, it is believed that the daphnids spend a majority of their time at the very bottom of the epilimnion or in the thermocline, where the methylmercury concentrations are elevated throughout the summer, while the smaller copepods are primarily in the upper epilimnion where the methylmercury concentrations remain at the spring turnover concentrations of around 0.2 to 0.3 ng/L. This concept is supported by the fact that while the assemblage concentrations rise during the fall turnover, reflecting the increase in epilimnetic water concentrations, the daphnid concentrations do not. This suggests that the daphnids are exposed to elevated concentrations throughout the summer and fall. A third possible reason for some of the differences seen is that the larger daphnids may have different feeding habits, which affects the amount and type of food that is processed. Another possibility is that *Daphnia* ssp. may simply concentrate more mercury than other species just as some fish species concentrate more than others do (reasons may be based on food, environmental factors, or internal biological makeup). There is at least one laboratory experiment which shows that *Daphnia mendotae* accumulated more monomethylmercury under certain conditions than did either of two copepod species which were also tested (Pickhardt et al., 2004).

Based on the patterns in the zooplankton results, an assessment of the exposure of fish to methylmercury from the littoral food chain and how the remedial program will affect this exposure can be made. Zooplankton present a much larger potential exposure to methylmercury through the food chain than the littoral benthic macroinvertebrates do because they occupy a larger area of the lake and have concentrations at least three times higher than the methylmercury concentrations in the littoral benthic macroinvertebrates. However, it should be recognized that fish that feed on zooplankton (e.g., white perch, bluegill) preferentially select the large individuals (e.g., daphnids), which have concentrations about 25 times higher than the littoral benthic macroinvertebrates outside of SMU 1. The concept that the daphnids are continually exposed to elevated concentrations of methylmercury in the water column throughout the summer and fall, resulting in highly elevated methylmercury body burdens, and are preferentially selected as prey at the bottom of the pelagic food chain is reflected in the fish data. The white perch, which feed predominantly in the pelagic zone on zooplankton, have higher concentrations of mercury than the trophic-level-equivalent species in the littoral zone (bluegill). The top predator of the pelagic zone (walleye, which feed on other pelagic fish such as white perch) consistently have the highest mercury concentrations in the lake (see TC Figure 8).

Reductions in total mercury loads to the hypolimnion and oxygenation of the hypolimnion to eliminate methylation of mercury in the water column are expected to greatly reduce or eliminate this exposure of zooplankton to water column methylmercury to levels at or below the spring turnover concentrations of 0.2 to 0.3 ng/L. This should cause the concentrations of methylmercury in all zooplankton to drop to around 30 to 40 µg/kg, which corresponds to zooplankton concentrations during spring turnover (see TC Tables 8 and 10 below), and possibly to drop to around 10 µg/kg, which corresponds to the concentrations seen in benthic macroinvertebrates outside of SMU 1 (see TC Tables 9 and 11 below). These scenarios represent potential drops in methylmercury exposure through the pelagic food chain of between 26 and 96 percent.

TC Table 8 Reductions in Methylmercury Concentrations in the Assemblage Zooplankton if Fall Concentrations are Reduced to Spring Concentrations of 36.5 µg/kg

Time Period (Percent of Year)	1992 Concentrations in Zooplankton[1]	Weighted Concentration[1, 2]	Weighted Concentration Due to Remediation[1, 3]	Percent Reduction
Spring (33.3%)	36.5	12.1	12.1	0
Summer (33.3%)	29.5	9.8	9.8	0
Fall (33.3%)	73	24.3	12.1	50%
Total (100%)	N/A	46.2	34	26%

Notes: [1] All units are in µg/kg.
[2] Concentration times percentage of year.
[3] Assumes spring and summer concentrations will not change but that concentrations during fall turnover will decrease to spring levels (36.5 µg/kg) or less.

TC Table 9 Reductions in Methylmercury Concentrations in the Assemblage Zooplankton if Concentrations are Reduced to Littoral Chironomid Levels of 10.8 µg/kg

Time Period (Percent of Year)	1992 Concentrations in Zooplankton[1]	Weighted Concentration[1, 2]	Weighted Concentration Due to Remediation[1, 3]	Percent Reduction
Spring (33.3%)	36.5	12.2	3.6	70%
Summer (33.3%)	29.5	9.8	3.6	63%
Fall (33.3%)	73	24.3	3.6	85%
Total (100%)	N/A	46.3	10.8	77%

Notes: [1] All units are in µg/kg.
[2] Concentration times percentage of year.
[3] Assumes concentrations for all seasons will decrease to levels in littoral chironomids outside of SMU 1 of 10.8 µg/kg.

TC Table 10 Reductions in Methylmercury Concentrations in the Daphnid Zooplankton if Concentrations are Reduced to Assemblage Spring Concentrations of 36.5 µg/kg

Time Period (Percent of Year)	1992 Concentrations in Zooplankton[1]	Weighted Concentration[1, 2]	Weighted Concentration Due to Remediation[1, 3]	Percent Reduction
Spring (N/A)	N/A	N/A	N/A	N/A
Summer (50%)	260	130	18.2	86%
Fall (50%)	240	120	18.2	85%
Total (100%)	N/A	250	36.5	85%

Notes: [1] All units are in µg/kg.
[2] Concentration times percentage of year.
[3] Assumes summer and fall concentrations will decrease to spring assemblage levels (36.5 µg/kg) or less.

TC Table 11 Reductions in Methylmercury Concentrations in the Daphnid Zooplankton if Concentrations are Reduced to Littoral Chironomid Levels of 10.8 µg/kg

Time Period (Percent of year)	1992 Concentrations in Zooplankton[1]	Weighted Concentration[1, 2]	Weighted Concentration Due to Remediation[1,3]	Percent Reduction
Spring (N/A)	N/A	N/A	N/A	N/A
Summer (50%)	260	130	5.4	96%
Fall (50%)	240	120	5.4	96%
Total (100%)	N/A	250	10.8	96%

Notes: [1] All units are in µg/kg.
[2] Concentration times percentage of year.
[3] Assumes concentrations in summer and fall will decrease to levels in littoral chironomids outside of SMU 1 of 10.8 µg/kg.

Profundal Benthic Macroinvertebrates

Based on limited data from the RI, a benthic community does not currently exist in the profundal zone of Onondaga Lake due to the summer anoxia. Following remediation, it is expected that the concentrations of total mercury in the profundal surface sediments will decline (predicted to be 1 mg/kg or less) due to MNR and concentrations of methylmercury in the overlying water will decrease to low levels (0.3 ng/L) due to reduced loads and oxygenation. While the desired concentration of DO in the hypolimnion for the remedy will be determined in design, a benthic community may develop in the profundal zone in response to oxygenation. If so, this benthic community would represent an additional route of exposure to methylmercury for fish in the lake.

It is expected that conditions in the profundal zone following remediation will be similar to conditions in much of the littoral zone (e.g., relatively low mercury concentrations [SWAC of about 1 mg/kg or less], relatively high oxygen concentrations). Thus, it is reasonable to assume that these benthic organisms would have methylmercury concentrations similar to those of the littoral zone macroinvertebrates. It is acknowledged that the degree to which the overlying water (hypolimnion) and the surface (bioturbation zone) sediments can be kept oxygenated, thereby preventing mercury methylation, will need to be further evaluated during design.

Conclusions

To further examine the potential changes in fish concentrations after implementation of the selected remedy, an assessment of the potential concentrations of methylmercury in the media that the fish would be exposed to (water and food) after remediation was conducted during development of the Proposed Plan and ROD. The assessment indicated that exposure of fish to methylmercury in the water may be reduced by more than half (54 to 64 percent) following remediation. Exposure to methylmercury via the littoral (near shore) zone food chain may be reduced from less than 10 percent for SMU 5 to 86 percent for SMU 1. Exposure to methylmercury via the pelagic (deep water) zone food chain may be reduced by 26 to 96 percent. Thus, it is reasonable to expect to see significant, noticeable reductions in the mercury concentrations in the fish of Onondaga Lake (especially pelagic fish) following source control and lake remediation. If the selected remedy does not at least achieve the range of fish tissue PRGs specified in the ROD, the remedy will be reevaluated at a minimum as part of the five-year review under CERCLA, and could be addressed through a modification of the ROD.

It is possible that refinements of these estimates based on the length of exposure time and the relative importance of individual routes of exposure to various species of fish could be made with a more complex mechanistic model; however, it is unlikely that the final conclusion – that it is reasonable to expect to see a significant reduction in the concentrations of contaminants in fish as a result of the remediation within a relatively short period of time (i.e., less than 10 years after remediation) – would be changed. As additional data are acquired, NYSDEC will consider whether it is appropriate to develop or refine fate and transport models for the site. If such models are developed or refined, they will be used, as appropriate, to optimize the remedial design as implementation proceeds.

Technical Comment #17: The potential for resuspension of the ILWD to be a significant source of mercury (and other contaminants) to the lake has been established, but the magnitude has not. This would have required application of appropriate quantitative tools (models). The profundal sediments as a major source of mercury also lacks quantification.

Response to Technical Comment #17: As discussed in the RI report, an assessment of the potential for resuspension of the ILWD to act as a source of mercury to the lake was initiated by NYSDEC in the fall of 2001 with a sampling/monitoring program. This program confirmed an increase in total mercury concentrations in the water column above the ILWD during wind-induced resuspension, and the transport of those elevated concentrations farther out into the rest of the lake. This program also established a relationship between wind speed and direction and turbidity (a surrogate for resuspended waste/sediments).

This information was utilized in a simple model in which the water column above the ILWD was idealized as a completely mixed tank, and used the following site-specific information: the relationship between total suspended solids and turbidity, the relationship between wind speed and turbidity, the meteorological data for the years 2001 to 2003, and the relationship between wind speed and current speed. The RI report presented a range of potential total mercury loads from the ILWD during the stratified period (2,000 to 20,000 g). A refined estimate based on further analysis of the meteorological data suggested a load of 6,300 g of total mercury to the water column of the lake from resuspended ILWD sediments (Gbondo-Tugbawa et al., 2005), which agrees well with the mass balance developed in the RI report. (See also response to Technical Comment #14 and associated TC Table 3.) Certainly a more sophisticated hydrodynamic model would yield an estimate with less uncertainty, and the RI report was clear on the limitations of this estimate, but NYSDEC considered these estimates to be sufficient to identify the resuspension of the ILWD to be a source of total mercury on the same scale as all of the external loads to the lake.

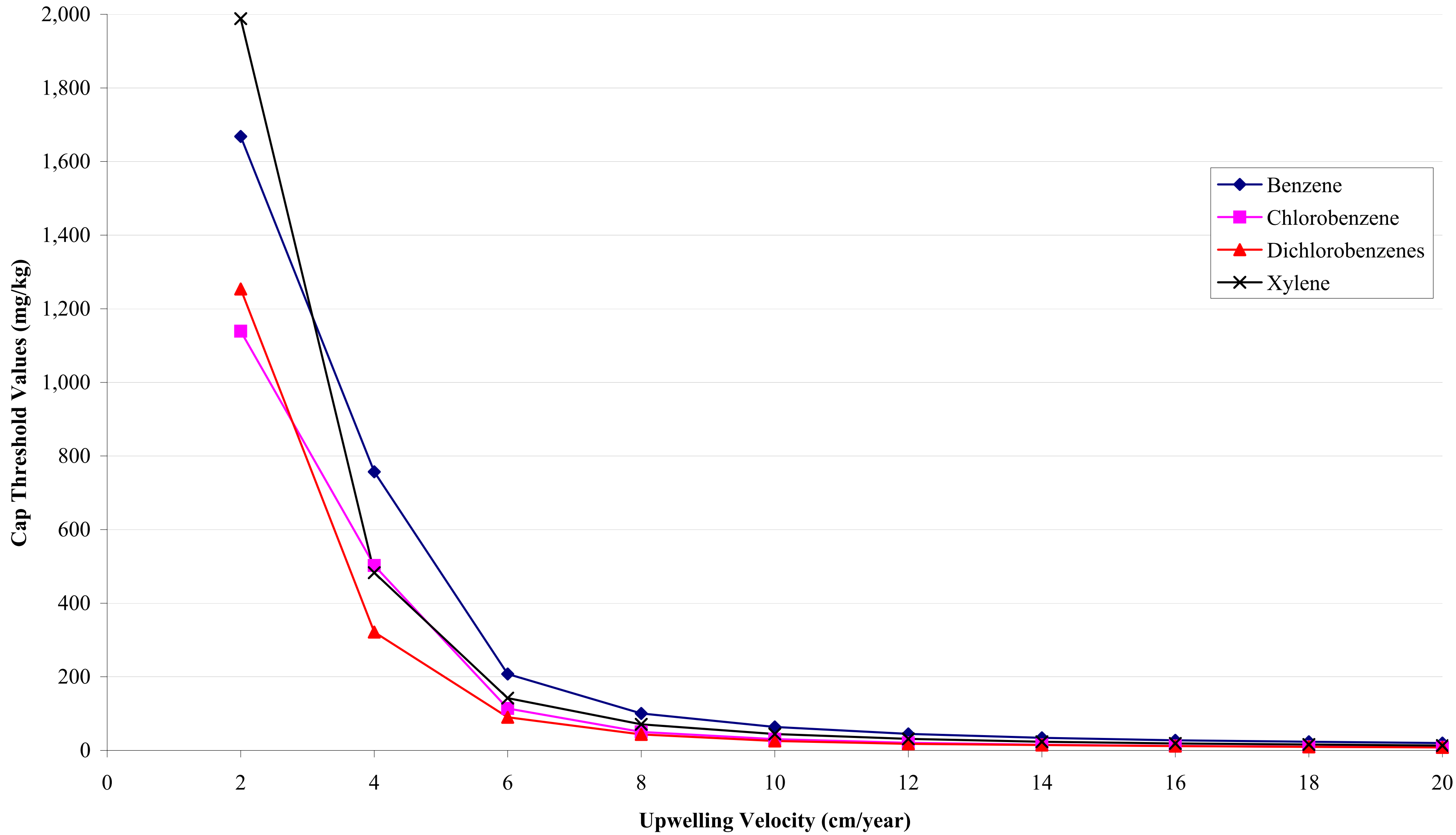
As discussed in the RI report, the sediment trap data clearly and consistently show an increase in particle-bound mercury across the hypolimnion, indicating a source below the thermocline. The RI report proposed that ebullition of methane gas likely acted as a mechanism for transferring total mercury associated with particles from the large mercury reservoir in the sediments across the sediment-water interface into the water column. Ebullition is often cited as a dominant transfer mechanism across the sediment-water interface, but it appears that only a few studies have actually documented this. Ohle (1958) and Matinvesi (1995) both qualitatively described the transport of sediments by the convection currents created by the rising methane bubbles, while Service Environmental & Engineering (2002) quantified the rate of particle transport. Martens and Klump (1980) and Martens et al. (1980) quantified the increase in diffusional transport caused by ebullition. As discussed in the RI report, the ebullition rate in Onondaga Lake (as estimated by Addess, 1990) is comparable (and is actually higher) than that cited in the St. Louis River by Service Environmental & Engineering. The RI report used the average particle transport rate from Service Environmental & Engineering (2002) and the average mercury concentration in the top 30 cm of the profundal sediments to estimate the mass of total mercury transported by this mechanism during the stratified period (880 g). Note that if the range of particle transport rates from Service Environmental & Engineering were used, the range of estimated transport rates from the profundal sediments to the water column in Onondaga Lake would be about 500 to 1,300 g of total mercury. These values, along with the increased diffusion, agree well with the mass balance presented in the RI report.

The current understanding of the magnitude of both of these sources of mercury, as well as all of the other sources and sinks of mercury to the lake, is sufficient for remedy selection. The magnitude of these sources and sinks may be confirmed, if warranted, as part of either the pre-design sampling or baseline monitoring programs. As additional data are acquired, NYSDEC will consider whether it is appropriate to develop or refine fate and transport models for the site. If such models are developed or refined, they will be used, as appropriate, to optimize the remedial design as implementation proceeds.

RESPONSIVENESS SUMMARY

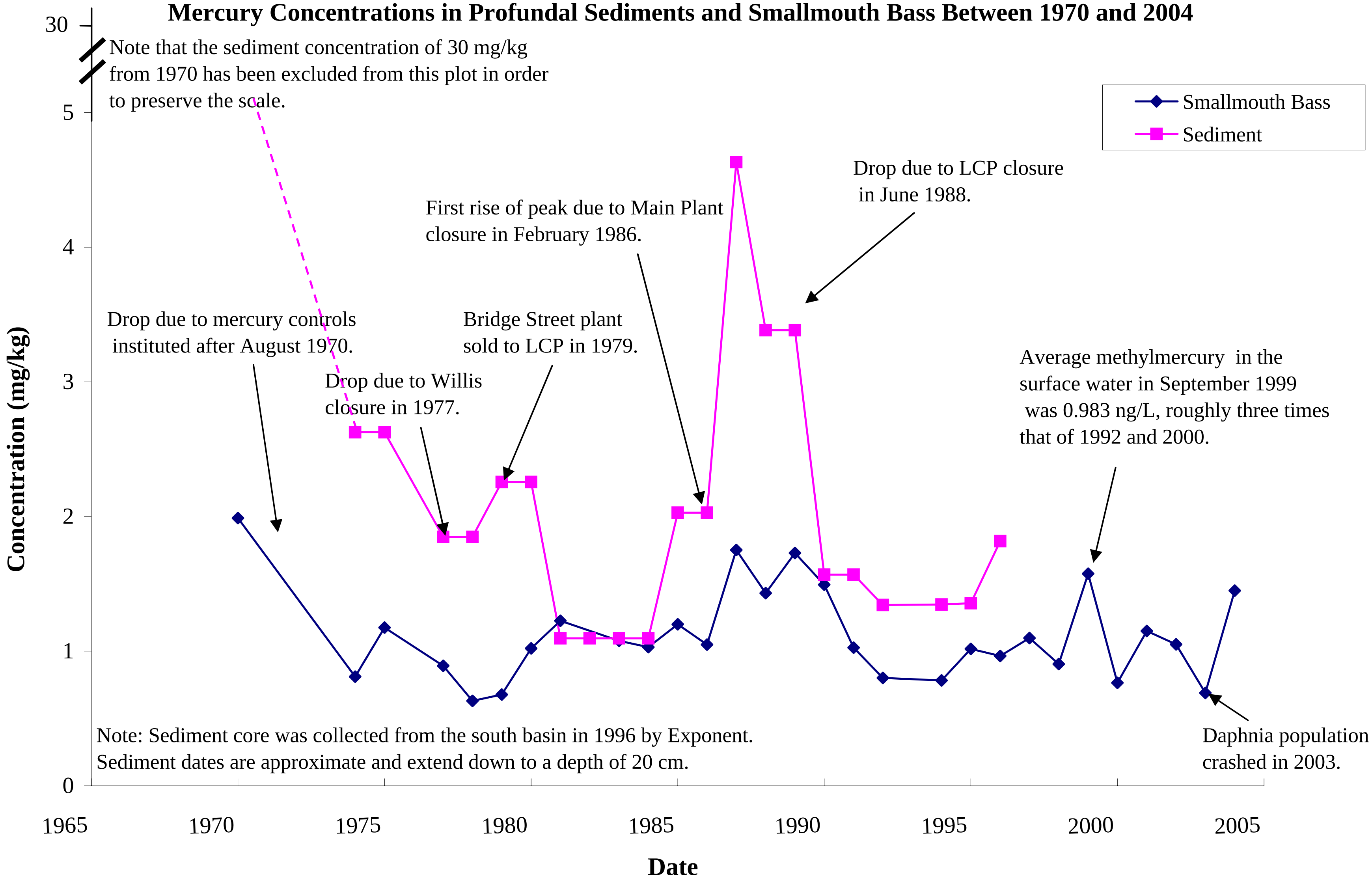
FIGURES

TC Figure 1
Sediment Cap Threshold Values vs. Upwelling Velocity for Benzene, Chlorobenzene, Dichlorobenzenes, and Xylene with a 2.5 Foot Isolation Layer

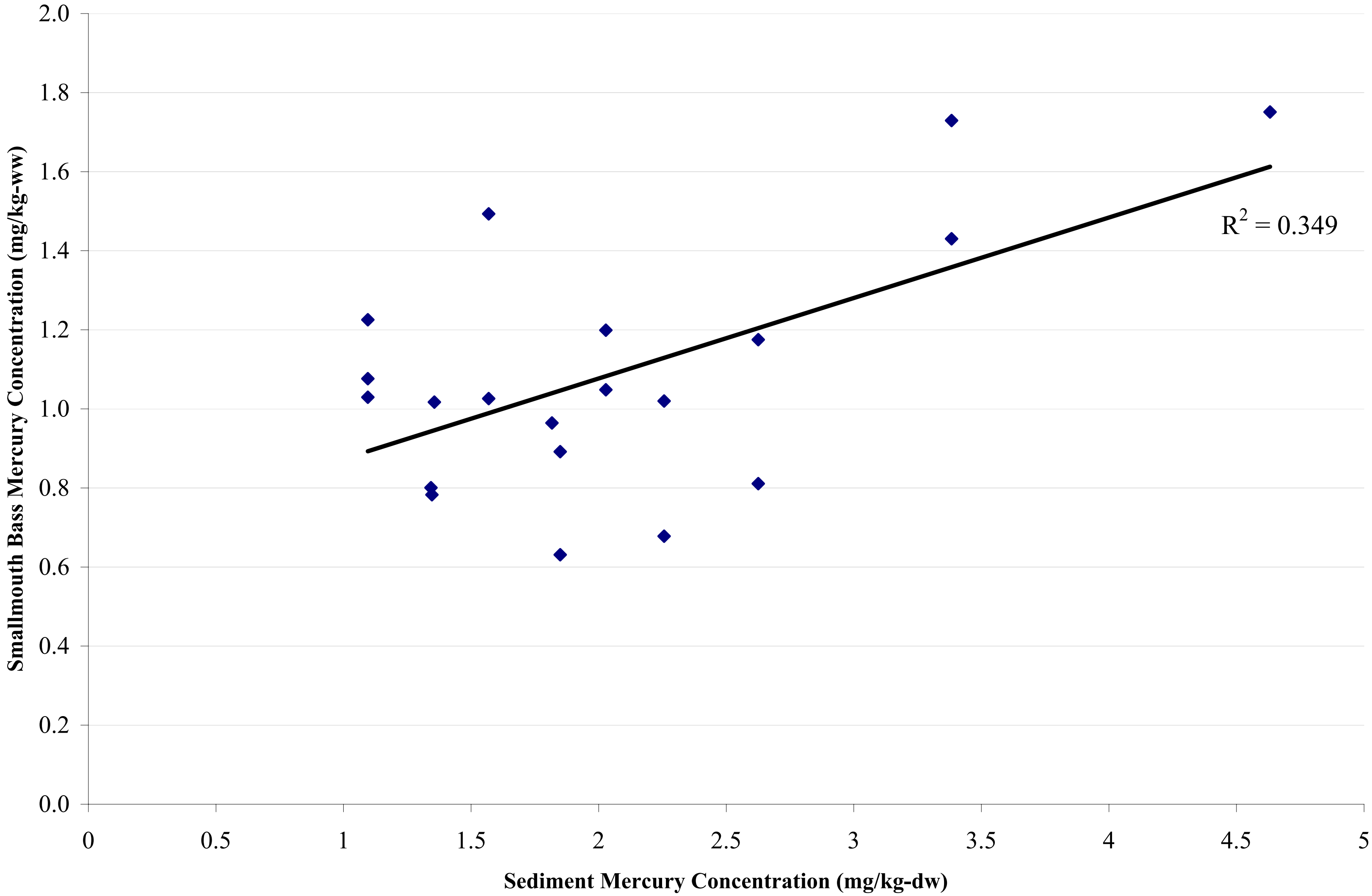


TC Figure 2

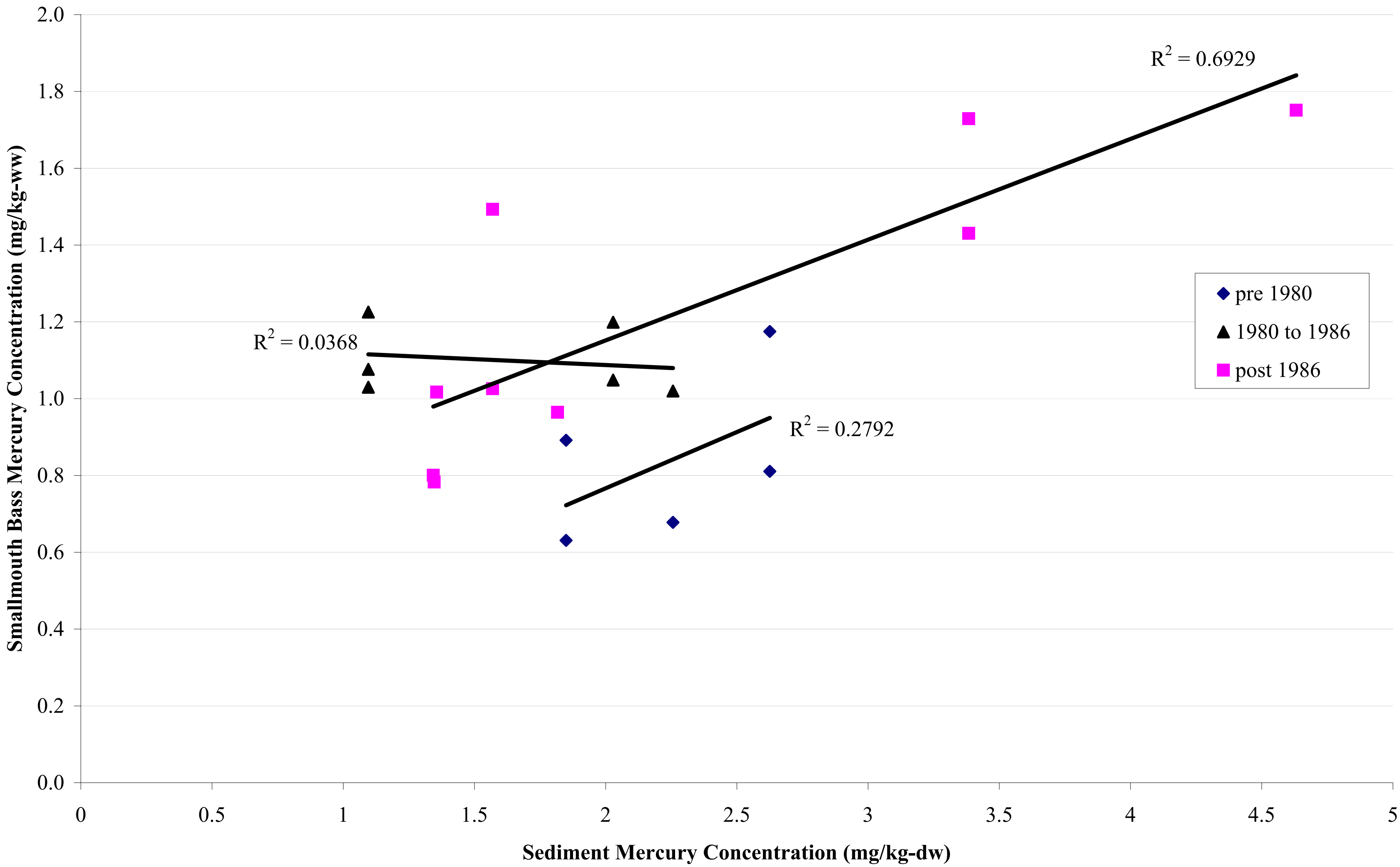
Mercury Concentrations in Profundal Sediments and Smallmouth Bass Between 1970 and 2004



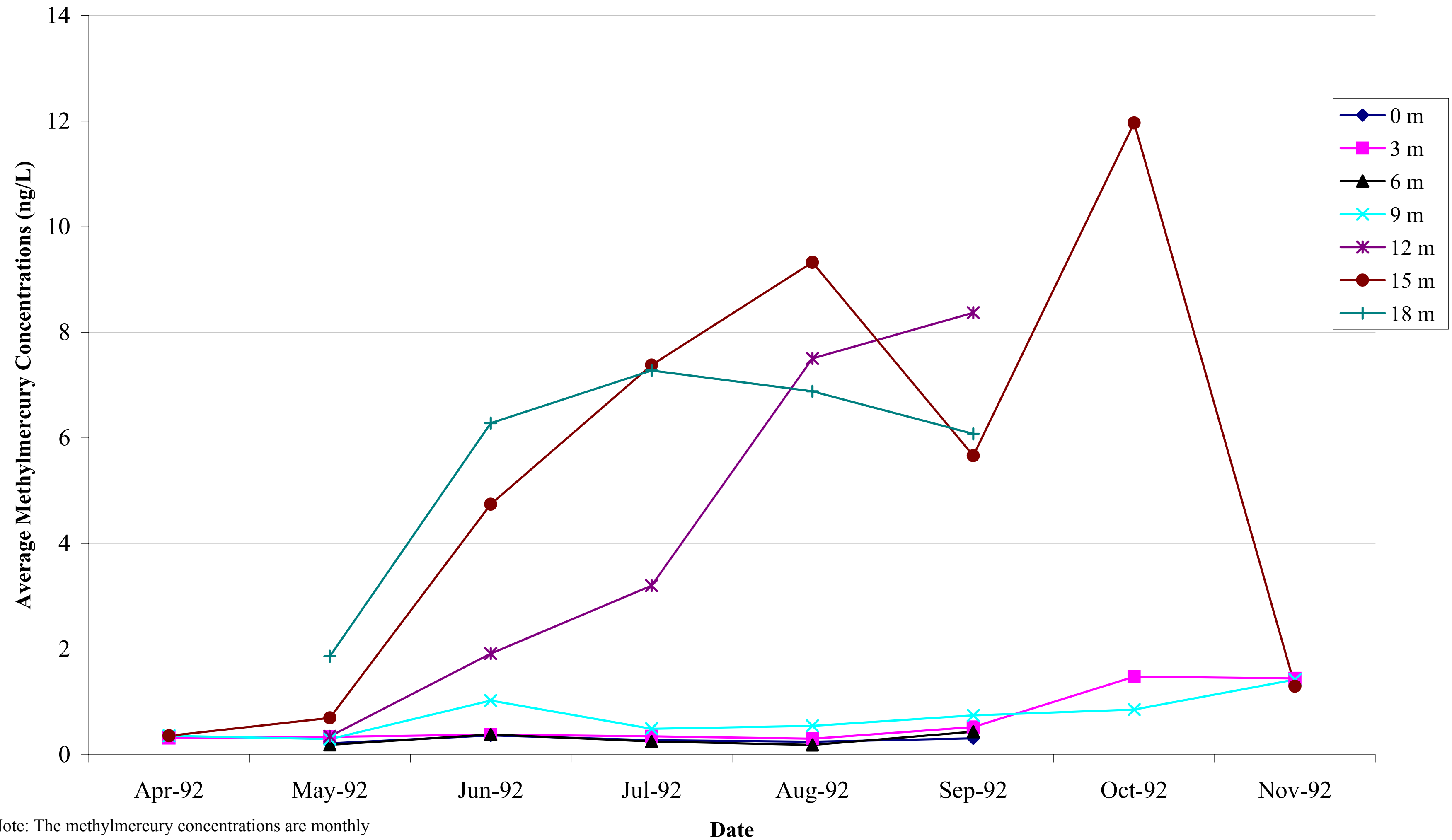
TC Figure 3
Mercury in Smallmouth Bass vs. Mercury in Sediment



TC Figure 4
Mercury in Smallmouth Bass vs. Mercury in Sediment by Era

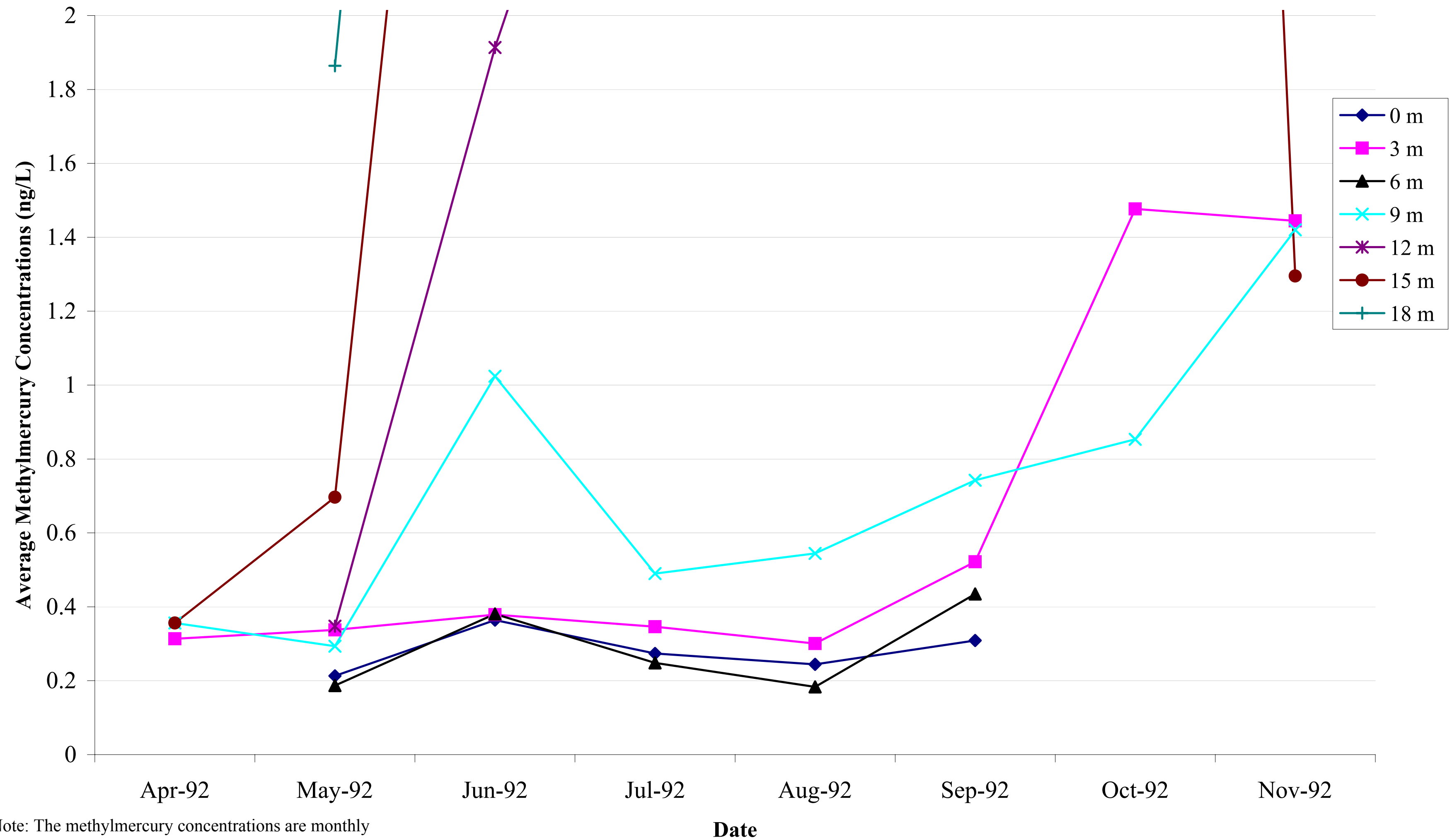


TC Figure 5
Temporal Trends of Methylmercury in Surface Water at Depths from 0 to 18 Meters



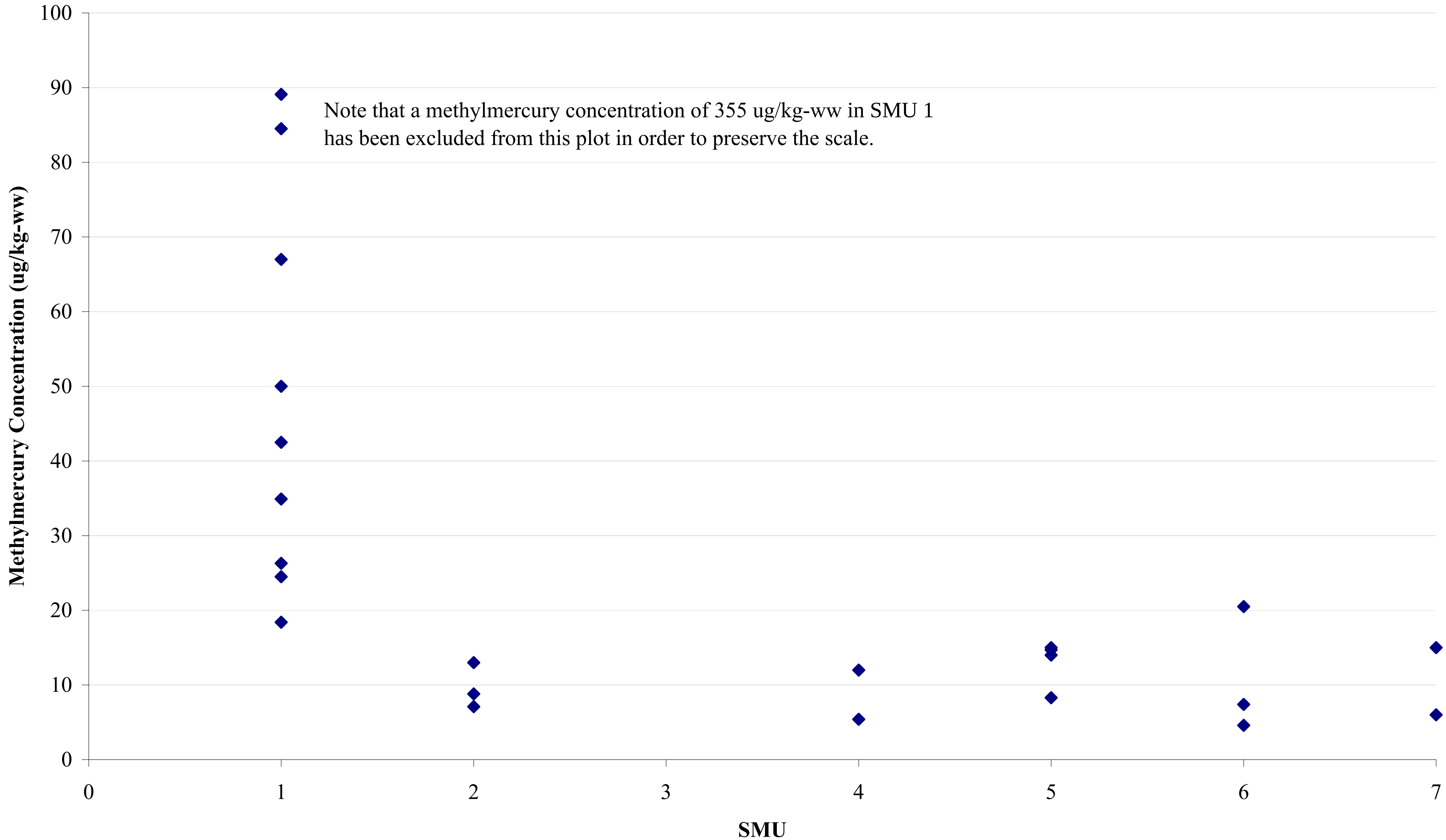
Note: The methylmercury concentrations are monthly averages from the north and south deep basin stations.

TC Figure 6
Temporal Trends of Methylmercury in Surface Water at Depths from 0 to 18 Meters Excluding the High Hypolimnion Values

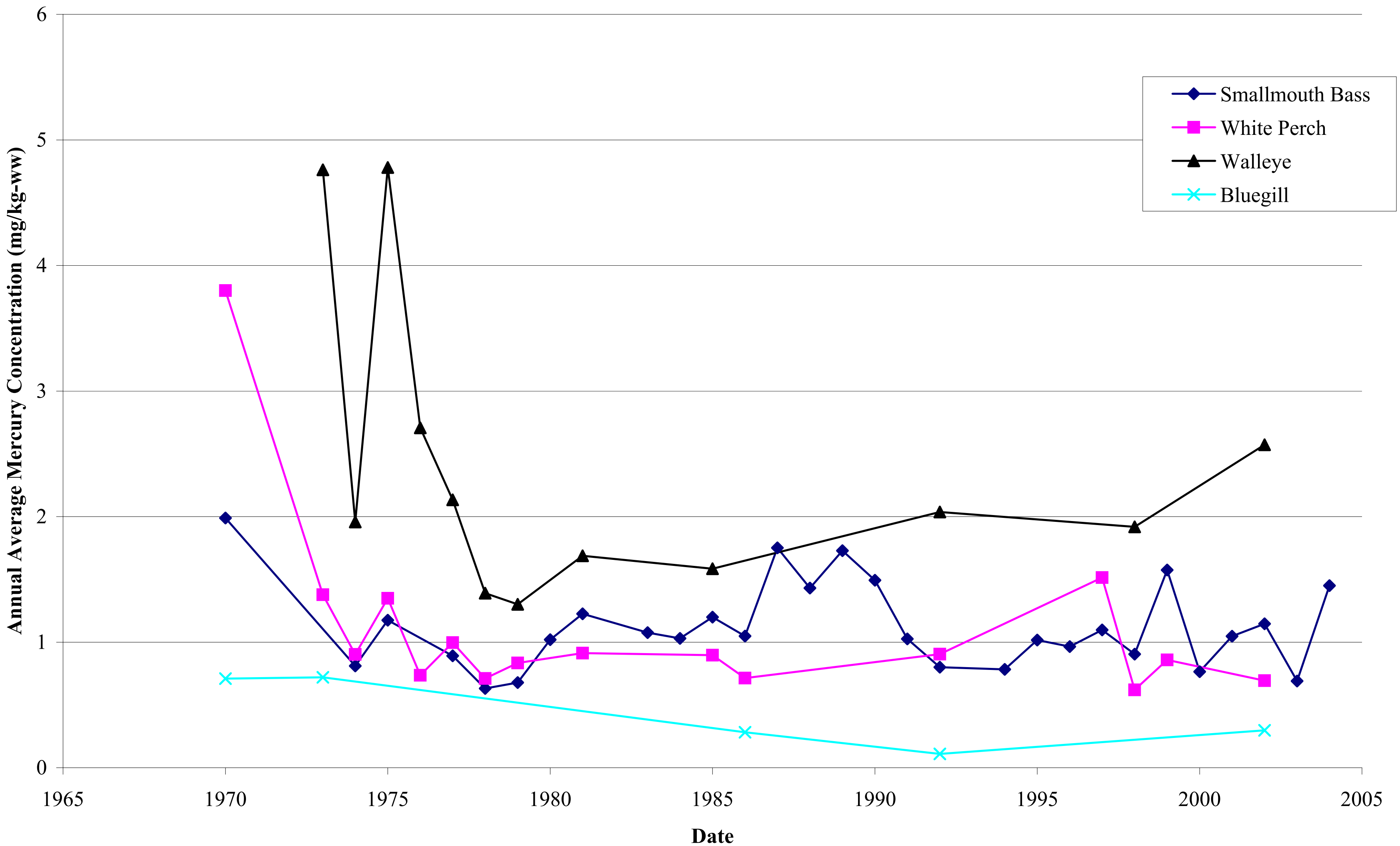


Note: The methylmercury concentrations are monthly averages from the north and south deep basin stations.

TC Figure 7
Methylmercury Concentrations in Chironomids from 1992 and 2000 in SMUs 1 through 7



TC Figure 8
Mercury Concentrations in Fish Fillets from 1970 to 2004



RESPONSIVENESS SUMMARY

TABLES

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
State						
S-1	Christensen	Joan K.	Member of Assembly, State Assembly of New York	2/17/05	Written	S-1.1
Onondaga Nation						
N-1	Heath, Esq.	Joseph J.	General Counsel for Onondaga Nation	2/8/05	Written	N-1.1 – N-1.7
Regional						
R-1	Coburn	David	Director, County of Onondaga, Executive Department, Office of the Environment	2/25/05	Written	R-1.1 – R-1.6
R-2	Rapp, Mrs.		Onondaga County Legislature	2/1/05	Written	R-2.1
R-3	Rivette	Barbara S.	Chair, Onondaga County Council on Environmental Health	2/23/05	Written	R-3.1 – R-3.8
Local						
L-1	Coogan	Mary Ann	Supervisor, Town of Camillus	2/9/05	Written	L-1.1 – L-1.12
L-2	Czaplicki	E. Robert	Supervisor, Town of Geddes	1/12/05	Written	L-2.1 – L-2.2
L-3	Warner	Deborah	Director of Government Affairs, Greater Syracuse Chamber of Commerce	1/12/05	Written	L-3.1 – L.3-5

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
Groups and Associations						
G-1	Breen	Ríobart É.	Executive Director, Anam Duan Franciscan Ecology Center	2/25/05	Written	G-1.1 – G-1.11
G-2	Burton	Cara	Director, Solvay Public Library	2/24/05	Written (letter to editor)	G-2.1
G-3	Daley	Douglas J. (and students)	Associate Professor, SUNY ESF	3/1/05	E-mail	G-3.1 – G-3.20
G-4	Effler, PhD and Driscoll, PhD	Steven W. and Charles T.	Director of Research, Upstate Freshwater Institute and University Professor of Environmental Systems Engineering, Syracuse University	3/1/05	Written	G-4.1 – G-4.22
G-5	Glance	Dereth	Program Coordinator, Citizens Campaign for the Environment	11/29/04	Written	G-5.1
G-6	Glance	Dereth	Program Coordinator, Citizens Campaign for the Environment	3/1/05	Written	G-6.1 – G-6.12
G-7	Loew	Martha Holly	Chair, Sierra Club, Iroquois Group	3/1/05	E-mail	G-7.1 – G-7.4
G-8	Long, MD	Robert E.	Onondaga Audubon Society, Inc.	2/16/05	Written	G-8.1
G-9	Murphy and Ringler	Cornelius and Neil H.	President and Chair, Faculty of Environmental & Forest Biology, SUNY ESF	2/25/05	Written	G-9.1 – G-9.3
G-10	Ringler	Neil H.	Distinguished Teaching Professor and Chair, Faculty of Environmental and Forest Biology, SUNY College of Environmental Science and Forestry	2/25/05	Written	G-10.1 – G-10.3
G-11	Sage	Samuel H.	President, Atlantic States Legal Foundation, Inc.	2/25/05	Written	G-11.1 – G-11.39

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
Honeywell						
H-1	Wickersham	David L.	Director, Remediation & Evaluation Services, Honeywell	2/28/05	Written	H-1.1 – H-1.16
Public Comments						
P-1	Bardeen	Joan E.		1/7/05	E-mail	P-1.1 – P-1.2
P-2	Bonner	David J.		1/7/05	E-mail	P-2.1
P-3	Bragman	Howard		1/12/05	Written (at Jan. meeting)	P-3.1 – P-3.2
P-4	Ciampi	Nancy		1/12/05	Written	P-4.1 – P.4-5
P-5	Comerford	Katherine J.		1/20/05	E-mail	P-5.1
P-6	Coughenour	Charles		12/15/04	E-mail	P-6.1 – P-6.3
P-7	Cram	Kenneth H.		2/19/05	Written	P-7.1
P-8	Cucci	JoAnn		1/12/05	Written (at Jan. meeting)	P-8.1
P-9	Eidt	Roger B.		1/9/05	Fax (to Steven Eidt @ DEC)	P-9.1 – P-9.2
P-10	Gibbs, Jr.	John S.		1/31/05	Written	P-10.1 – P-10.3
P-11	Haley	Kevin and Donna		2/23/05	E-mail	P-11.1 – P-11.4
P-12	Hanson	Bill	Manager, US Business Development, Great Lakes Dredge & Dock Company	11/30/04	E-mail	P-12.1
P-13	Johnson	Dallas		1/12/05	Written (at Jan. meeting)	P-13.1
P-14	Jones	Charles G.		2/12/05	E-mail	P-14.1 – P-14.2
P-15	Klink	P. Garry	Onondaga Yacht Club	1/12/05	Written (at Jan. meeting)	P-15.1 – P-15.3

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
P-16	Lange	J. Andrew		12/16/04	Written	P-16.1 – P-16.6
P-17	Lange	J. Andrew		1/12/05	Written	P-17.1 – P-17.6
P-18	Lathrop	Arnold W.		2/12/05	E-mail	P-18.1 – P-18.2
P-19	Law	Thomas E.		1/6/05	Written (at Jan. meeting)	P-19.1 – P-19.3
P-20	Lightcap	Richard J.		2/18/05	Written	P-20.1
P-21	Marquardt	Robert		1/8/05	Written	P-21.1 – P-21.3
P-22	Mazur	Allan		1/7/05	E-mail	P-22.1 – P-22.2
P-23	Mazur	Allan		2/22/05	E-mail	P-23.1
P-24	McGraw	Ashley (petition)	Ashley McGraw Architects PC	2/25/05	Fax	P-24.1
P-25	Monostory	Les		1/12/05	Written	P-25.1 – P-25.3
P-26	Motto	Barb		12/14/04	E-mail	P-26.1
P-27	Murphy	Michael		1/18/05	E-mail	P-27.1 – P-27.2
P-28	Murray	Susan and John		2/28/05	Written	P-28.1 – P-28.3
P-29	Myers	Temple W. and Mary A.		1/7/05	E-mail	P-29.1 – P-29.9
P-30	Nowak	Michael P.		2/22/05	Written	P-30.1
P-31	Orzell	Daniel L.		1/12/05	Written (at Jan. meeting)	P-31.1 – P-31.2
P-32	Poncha	Rusi		2/26/05	Written	P-32.1 – P-32.2
P-33	Procopio	Garrie		2/18/05	Written	P-33.1 – P-33.5
P-34	Procopio	Garrie		2/19/05	E-mail	P-34.1

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
P-35	Procopio	Garrie		2/19/05	E-mail	P-35.1
P-36	Rhoads	T.		1/12/05	Written (at Jan. meeting)	P-36.1 – P-36.5
P-37	Rhoads	T.		1/14/05	Written	P-37.1 – P-37.7
P-38	Russell	Sandra		2/18/05	Written	P-38.1
P-39	Ryder	Jesse		2/3/05	E-mail	P-39.1
P-40	Sanford	W. (petition)		2/23/05	Written	P-40.1
P-41	Schoenwald	Donald L.		2/22/05	Written	P-41.1
P-42	Spizuoco	Bill		3/4/05	E-mail	P-42.1
P-43	Tyler, PE	James H.		2/18/05	E-mail	P-43.1
P-44	Valenti, Jr.	Richard D.		12/8/04	E-mail	P-44.1
P-45	Webster	Deborah		3/1/05	E-mail	P-45.1 – P-45.2
P-46	Weller, PE	Dennis G.	President, Structural Associates, Inc.	2/4/05	Written	P-46.1
P-47	Woollis	Pam		2/16/05	Written (at 2/16 meeting)	P-47.1
Oral Comments (from transcript of 1/12 public meeting only)						
O-1	Pirro	Nick	Onondaga County Executive	1/12/05	Spoken	O-1.1 – O-1.8
O-2	Sweetland	Dale	Onondaga County Legislative Chairman	1/12/05	Spoken	O-2.1
O-3	Corbett	James	Onondaga County Legislator	1/12/05	Spoken	O-3.1 – O-3.2
O-4	Ward	Marlene	Mayor, Village of Liverpool	1/12/05	Spoken	O-4.1
O-5	Czaplicki	Bob	Supervisor, Town of Geddes	1/12/05	Spoken	O-5.1
O-6	Warner	Deborah	Greater Syracuse Chamber of Commerce	1/12/05	Spoken	O-6.1 – O-6.6
O-7	Sage	Sam	President, Atlantic States Legal Foundation	1/12/05	Spoken	O-7.1 – O-7.8

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
O-8	Holstein	Chuckie	FOCUS Greater Syracuse	1/12/05	Spoken	O-8.1 – O-8.9
O-9	Ohl	Clyde		1/12/05	Spoken	O-9.1 – O-9.3
O-10	Freedman	Jeffrey	Onondaga Yacht Club	1/12/05	Spoken	O-10.1 – O-10.6
O-11	Kochan	Nick	Village of Liverpool Planning Board Chairman	1/12/05	Spoken	O-11.1 – O-11.3
O-12	Chapman	David	Mountain Eagle Management	1/12/05	Spoken	O-12.1 – O-12.2
O-13	Bragman	Howard		1/12/05	Spoken	O-13.1 – O-13.2
O-14	Monostory	Les	President, Onondaga County Federation of Sportsmen's Clubs	1/12/05	Spoken	O-14.1 – O-14.2
O-15	Kaczmar, PhD	Swiatoslav		1/12/05	Spoken	O-15.1 – O-15.2
O-16	Fulmer	Sharon		1/12/05	Spoken	O-16.1 – O-16.2
O-17	Glance	Dereth	Central New York Program Coordinator, Citizens Campaign for the Environment	1/12/05	Spoken	O-17.1 – O-17.4
O-18	Hughes	Don	Technical Advisor to ASLF	1/12/05	Spoken	O-18.1 – O-18.5
O-19	Eckel	Sarah		1/12/05	Spoken	O-19.1
O-20	Effler	Steve	Director of Research, Upstate Freshwater Institute	1/12/05	Spoken	O-20.1 – O-20.4
O-21	Ciampi	Nancy		1/12/05	Spoken	O-21.1
O-22	Pedemonti	Peter		1/12/05	Spoken	O-22.1
O-23	Arnold	David		1/12/05	Spoken	O-23.1
O-24	Mossotti	Sherry		1/12/05	Spoken	O-24.1
O-25	Brown	Terry	Chairman/CEO, O'Brien & Gere	1/12/05	Spoken	O-25.1 – O-25.2

RS Table 1 – Onondaga Lake Responsiveness Summary
Comment Directory – Initial Comment Period through March 1, 2005

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
O-26	Monostory	Les	Co-chair, Fisheries Subcommittee of the Onondaga Lake Partnership; Vice-president of Central New York Chapter of the Izaak Walton League	1/12/05	Spoken	O-26.1 – O-26.3

RS Table 2 – Onondaga Lake Responsiveness Summary
Comment Directory – Second Comment Period

Letter Code	Last Name	First Name	Affiliation	Date Submitted	Form Submitted	Individual Comments
Honeywell						
H-2	Wickersham	David L.	Director, Remediation & Evaluation Services, Honeywell	4/29/05	Written	H-2.1 – H-2.5
H-3	Milch	Thomas H.	Arnold & Porter (legal counsel to Honeywell)	6/24/05	Written	H-3.1
Public Comments						
P-48	Anna-Fey	June		4/27/05	Written	P-48.1
P-49	Balboa	Alex		3/30/05	E-mail	P-49.1
P-50	Cappel	Sallie		3/12/05	E-mail	P-50.1
P-51	Cope Savage	Joan		4/29/05	E-mail	P-51.1
P-52	Hammond, MD	Susan P.		4/27/05	Written	P-52.1 – P-52.12
P-53	Lange	J. Andrew		4/2/05	Written	P-53.1 – P-53.7
P-54	Mager	Andy		4/29/05	E-mail	P-54.1
P-55	Markert	Alan		4/13/05	E-mail	P-55.1
P-56	Melvin	Alice C.		4/14/05	E-mail	P-56.1

TC Table 1. Onondaga Lake Sediment Effect Concentrations for Metals

	ER-L	TEL	ER-M	PEL	AET	PEC	ER-M and PEL Average
Metals (mg/kg)							
Antimony	3.10	4.00	3.10	4.30	NC	3.60	3.70
Arsenic	0.90	1.29	4.40	3.55	4.30	2.40	3.98
Cadmium	0.94	1.42	2.10	3.11	8.60	2.40	2.61
Chromium	17.6	29.3	47.9	67.3	195	50.3	57.6
Copper	12.3	19.1	40.7	48.3	83.7	32.9	44.5
Lead	9.68	13.3	56.9	57.6	116	34.5	57.3
Manganese	197	231	280	295	445	278	288
Mercury	0.51	0.99	2.80	2.84	13.0	2.20	2.82
Nickel	5.22	8.37	20.9	25.8	50.0	16.4	23.4
Selenium	0.42	0.40	0.60	0.68	0.94	0.58	0.64
Silver	0.82	0.90	1.20	1.42	2.70	1.28	1.31
Vanadium	2.70	3.40	6.00	8.30	12.2	5.60	7.15
Zinc	37.9	56.7	94.6	120	218	88.0	107

Notes:

- All concentrations are in dry weight.

AET - apparent effects threshold

ER-L - effects range-low

ER-M - effects range-median

NC - value was not calculated because of an insufficient number of detected observations or data points

PEC - probable effect concentration

PEL - probable effect level

TEL - threshold effect level

TC Table 2. Onondaga Lake Sediment Effect Concentrations for Organic Contaminants

	ER-L	TEL	ER-M	PEL	AET	PEC	ER-M and PEL Average
Organic Compounds							
BTEX Compounds (mg/kg)							
Benzene	27.3	42.4	42	299	5,300	150	171
Ethylbenzene	142	206	657	657	13.3	176	657
Toluene	13.1	15.9	27.5	50.3	443	41.8	38.9
Xylene isomers (total)	153	367	1,640	997	606	561	1,319
Chlorinated Benzenes (mg/kg)							
Chlorobenzene	64.4	48.3	580	799	10,000	428	690
Dichlorobenzene Sum	21.5	44.2	773	765	1,373	239	769
Trichlorobenzene sum	186	209	930	482	287	347	706
Hexachlorobenzene	7.16	8.9	28	23.6	28	16.4	25.8
Polychlorinated Biphenyls (mg/kg)							
Aroclor 1016	99.0	104	135	135	90	111	135
Aroclor 1248	82	98.7	300	307	470	204	304
Aroclor 1254	68.5	73.5	82.5	79.7	77	76.1	81.1
Aroclor 1260	80.0	115	240	221	240	164	231
Total PCBs	136	151	400	382	710	295	391
PAH Compounds (mg/kg)							
Naphthalene	340	471	1,400	1,380	2,100	917	1,390
Acenaphthene	469	478	1,200	1,030	1,700	861	1,115
Fluorene	55.2	66.9	305	327	3,500	264	316
Phenanthrene	92.2	135	480	491	16,000	543	486
Anthracene	33.0	49.6	210	249	4,400	207	230
Fluoranthene	140	483	1,400	2,482	26,000	1,436	1,941
Pyrene	114	238	650	795	NC	344	723
Benz[a]anthracene	60.7	118	415	451	NC	192	433
Chrysene	100	172	440	541	NC	253	491
Benzo[b]fluoranthene	63.1	80.9	240	253	1,100	908	247
Benzo[a]pyrene	62.8	98.2	210	355	NC	146	283
Indeno[1,2,3-cd]pyrene	58.8	102.0	370	503	NC	183	437
Dibenz[a,h]anthracene	49.4	67.7	180	218	730	157	199
Benzo[ghi]perylene	228	307	1,300	1,170	2,700	780	1,235
Acenaphthylene	507	673	1,850	1,970	3,000	1,301	1,910
Benzo[k]fluoranthene	63.1	80.9	240	253	1,100	203	247
Dibenzofuran	340	295	340	561	NC	372	451
Total PAHs	605	1,559	9,023	9,299	92,330	5,925	9,161
Other SVOCs (mg/kg)							
Phenol	45	45	45	45	45	45	45
Pesticides (mg/kg)							
DDT and Metabolites (Sum)	47	23.7	47	26.6	16.3	29.6	36.8
Chlordane isomers (Sum)	NC	5.1	NC	5.1	NC	5.1	5.1

Notes:

- All concentrations are in dry weight.

AET - apparent effects threshold

ER-L - effects range-low

ER-M - effects range-median

NC - value was not calculated because of an insufficient number of detected observations or data points

PEC - probable effect concentration

PEL - probable effect level

TEL - threshold effect level

RESPONSIVENESS SUMMARY

ATTACHMENT 1

National Remedy Review Board Recommendations
and
NYSDEC and EPA's Responses

RESPONSIVENESS SUMMARY

ATTACHMENT 2

Comment and Response Index

RESPONSIVENESS SUMMARY

ATTACHMENT 3

Letters Submitted During the Public Comment Period