# QUALITY ASSURANCE PROJECT PLAN
# FOR THE
# HUDSON RIVER PCBs SITE

## Design Support Sediment Sampling and Analysis Program

October 1, 2002
(Revision 4)

Prepared for:

**General Electric Company**
Corporate Environmental Programs
Albany, New York

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In Conjunction with:
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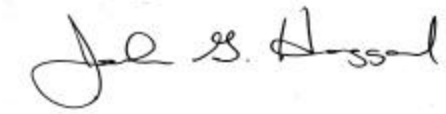
Liverpool, New York

# A. PROJECT MANAGEMENT

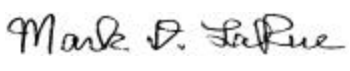
## A1 Title Page and Approvals

**QUALITY ASSURANCE PROJECT PLAN FOR MONITORING FOR THE DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM**

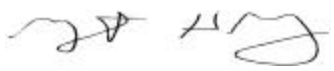


**John Haggard** **Date: October 1, 2002**
**GE Project Manager**

**John Connolly** **Date: October 1, 2002**
**Project Manager**



**Mark LaRue** **Date: October 1, 2002**
**Field Sampling Manager**



**Margaret Murphy** **Date: October 1, 2002**
**Field Sampling Manager**

**David R. Blye** **Date: October 1, 2002**
**QA Program Manager**

# TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES



## APPENDICES

## APPENDICES (Cont.)

## A3 Distribution List

| Name | Agency or Company |
|---|---|
| John Haggard | General Electric Company |
| Bob Gibson | General Electric Company |
| John Connolly | Quantitative Environmental Analysis, LLC |
| Mark LaRue | Quantitative Environmental Analysis, LLC |
| David R. Blye | Environmental Standards, Inc. |
| Bob Wagner | Northeast Analytical, Inc. |
| Steve Grant | Accutest Laboratories |
| Chris Couch | CT&E Laboratories |
| Don Nazzario | Lancaster Laboratories, Inc. |
| Veronica Bortot | STL Pittsburgh |
| Carl Ambruster | STL Edison |
| Jeannine McCrumb | STL Burlington |
| Matt Burns | Paradigm Analytical Laboratories, Inc. |
| Marty Keller | Teledyne Brown Engineering, Inc. |
| Stephen Montagna | Blasland, Bouck & Lee, Inc. |
| Other Contractors | To be determined |
| Distribution per AOC | Paragraph 44 of AOC |

## A4 Project/Task Organization

The General Electric Company (GE) will maintain overall technical responsibility for conducting the Design Support Sediment Sampling and Analysis Program (SSAP). The organizational structure for the SSAP is illustrated in Figure A-1.

### A4.1 Project Management

Overall Project Manager

John Haggard/Bob Gibson, General Electric Company (GE)

Responsibilities and duties of the GE Project Managers include the following:

- Define project objectives and establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- review and analyze overall task performance with respect to planned requirements and authorizations;
- approve reports prior to their submission to USEPA Region II; and
- represent GE at public meetings.

Project Manager

John Connolly, Quantitative Environmental Analysis, LLC (QEA)

The QEA Project Manager is directly responsible for activities performed by QEA personnel associated with the project. Other responsibilities include:

- Provide overall direction and management of QEA activities as defined in the SSAP;
- provide QA management of all aspects of the project within the responsibility of QEA;
- final review of all documents prepared by QEA; and
- represent project team at public meetings.

Data Production Manager and QA Program Manager

David R. Blye, Environmental Standards, Inc.

The Data Production Manager will oversee all quality assurance aspects of the project. Specific tasks include:

- Review of data compliance with the QAPP;
- oversight of all data verification and validation;
- coordinate analytical laboratory schedules;
- maintain the QAPP; and
- review data quality objectives, set assessment criteria and conduct assessments to determine compliance.

Field Sampling Managers

Mark LaRue and Margaret Murphy, Quantitative Environmental Analysis, LLC

All field activities will be managed by the Field Sampling Managers. Responsibilities include:

- manage field staff;
- supervise Site Coordinator and Sample Collection Coordinator;
- coordinate sample collection and field laboratory schedules;
- oversee ordering and delivery of supplies;

- coordinate and manage all subcontractors;
- monitor program progress relative to schedule and determine corrective actions necessary to maintain schedule;
- review/approve the type of field equipment used and ensure that procedures are followed to achieve the DQOs;
- review field notebooks/logs with respect to completeness, consistency, and accuracy; and
- prepare routine progress reports, including a summary of field activities and field audit results.

Site Coordinators

Martin Hennessey and Sean McNamara, Quantitative Environmental Analysis, LLC

The Site Coordinators are responsible for day-to-day supervision of all site activities. Specific responsibilities include:

- Primary contact with Agency oversight team;
- oversee all activities in the field laboratory including field data log in, COC generation, core segmentation, sample labeling, cooler packing;
- coordinate sample collection and field laboratory schedules; and
- report any deviations from protocol to the Field Sampling Manager.

Site Health and Safety Coordinator

Kip Score, Saratoga Safety

The Site Health and Safety Coordinator is responsible for enforcement of the OSHA standards (29 CFR 1910.120) regarding Health and Safety concerns. Specific responsibilities include:

- Ensure compliance with all Health and Safety Plan (HASP) procedures during performance of field work activities;
- conduct daily health and safety/subcontractor coordination meetings;
- report any deviations from HASP to Site Coordinator

Engineering Data Coordinator

Steve Montagna, Blasland, Bouck & Lee, Inc.

The data generated in this project will be used to design the selected remedy. The Engineering Data Design Liaison is responsible for insuring that the data collected fulfills the needs of the engineering designers. Responsibilities include:

- Review routine progress reports, including a summary of field activities and field audit results; and
- recommend program modifications needed to maximize data usability for design.

## A4.2 Project Execution

Sediment Core Collection and Sediment Probing

Quantitative Environmental Analysis, LLC

Blasland, Bouck & Lee, Inc.

Atlantic Testing Laboratories, Ltd.

The field personnel conducting sediment core collection and sediment probing have the following responsibilities:

- Collect core samples at pre-determined sites according to the core collection SOP (Appendix 1);
- maintain field logs;
- run a daily check of the Global Positioning System (GPS) by checking a point with known coordinates; and
- deliver field logs and sediment cores to field laboratory facility at the end of each day.

Sediment Core Processing (Field Laboratory)

Quantitative Environmental Analysis, LLC

Blasland, Bouck & Lee, Inc.

QEA will provide oversight to a Blasland, Bouck & Lee, Inc. Specific responsibilities of the personnel processing cores include:

- enter field notes into electronic database;
- section sediment cores;
- homogenize core sections;
- place samples of homogenized sediment in sample containers;
- prepare sample containers for shipping; and
- maintain chain of custody documentation.

Geophysical Surveys

Quantitative Environmental Analysis, LLC

Ocean Surveys, Inc.

QEA will provide oversight to contractors conducting bathymetric surveys, side-scan sonar (SSS) surveys and sub-bottom profiling tests. Contractor responsibilities include:

- Conduct measurements of water depth at pre-determined sites according to the bathymetric survey SOP (Appendix 2)
- conduct side-scan sonar survey throughout the Upper River according to side scan sonar SOP (Appendix 17)
- conduct tests of sub-bottom acoustic and electromagnetic surveying equipment according to the sub-bottom profiling test SOP (Appendix 3)
- maintain field logs; and
- run a daily check of the Global Positioning System (GPS) by checking a point with known coordinates.

Project QA/QC Officer

Kathleen Finnegan, Environmental Standards, Inc.

- The Project QA/QC officer has the following responsibilities:
- Receipt of data packages from laboratories;
- review laboratory data packages;
- coordinate field QA/QC activities with Field Sampling Manager;
- review field reports;
- review audit reports;
- prepare interim Quality Assurance Reviews; and
- prepare final Quality Assurance Reviews.

Analytical Measurements on Sediment Samples

Northeast Analytical, Inc. (Schenectady, New York).

Axys Analytical Services, LTD (Sydney, British Columbia, Canada).

Accutest Laboratories (Dayton, New Jersey).

CT&E Environmental Services, Inc. (Charleston, West Virginia).

Lancaster Laboratories, Inc. (Lancaster, Pennsylvania).

STL Pittsburgh (Pittsburgh, Pennsylvania).

STL Burlington (Burlington, Vermont).

STL Edison (Edison, New Jersey).

Paradigm Analytical Laboratories, Inc. (Wilmington, North Carolina).

Teledyne Brown Engineering, Inc. (Knoxville, Tennessee).

The specific analyses each of the above laboratories will perform is identified in Section B4.

Responsibilities and duties of the analytical laboratories include the following:

- Perform analytical procedures;
- report the data to the database manager in the required format and within required turn-around times; and
- strictly adhere to all protocols in the QAPP and contact the QA Program Manager prior in advance of any protocol deviations.

Coordination of Analytical Laboratories

Kathleen Finnegan, Environmental Standards, Inc.

Responsibilities include:

- Communicate daily with the analytical laboratories;
- ensure that laboratories can meet their time commitments, otherwise direct samples to another laboratory; and
- resolve laboratories questions/concerns about SOP details.

Data Production and Database Development and Maintenance

Jennifer Besa, Environmental Standards, Inc.

Responsibilities include:

- Electronic QA checks on data packages;
- electronic data verification;
- population of the project database;
- QA checks on database; and
- distribution of database.

Data Validation

Staff Quality Assurance Chemists, Environmental Standards, Inc.

Responsibilities include:

- Validate data on a timely basis to facilitate incorporation of qualifiers into the database.

## A5 Problem Statement and Background

To achieve the objectives of the selected remedy, it is necessary to enhance our understanding of the distribution of PCB mass and concentration in the river sediments. Current understanding rests on historic data, the most comprehensive of which was collected from the Thompson Island Pool in 1984. Within the Thompson Island Pool, the boundaries of the areas targeted for dredging are reasonably well documented, but whether these boundaries are appropriate today is an open question. Outside of the Thompson Island Pool, the historic data are sparse and dredging boundaries that would achieve the objectives of the selected remedy are not well defined.

The sediment sampling project was conceived in the Feasibility Study (FS) as a means to reduce the uncertainty that currently exists regarding the delineation of dredging targets necessary to achieve the objectives of the selected remedy. The conceptual program described in the FS was used as a starting point for the design of a sediment characterization program that would achieve the objective of accurately defining sediment cut lines. USEPA guidance (USEPA 2001) also was considered during the design of the sediment characterization project.

The data collected in the sediment characterization program, combined with the criteria for remediation provided in the ROD, will be used to:

- establish the horizontal and vertical distribution of PCBs in sediment;
- refine estimates of PCB mass distribution in sediment;
- delineate the areas of the sediment bed that will be targeted for removal and the depths of sediment to be removed in each area; and
- document sediment, chemical, and physical properties important for the design of dredging, treatment, and disposal.

## A6 Project/Task Description

### A6.1 Description of Work to be Performed

The project entails the collection, processing and characterization of sediment cores from areas that historic data indicate contain sufficient PCB mass to be targeted for dredging and areas that have a reasonable probability of having sufficient PCB mass to be targeted for dredging. The areas falling in the first category have been termed Target Areas and total 493 acres. The areas falling in the second category have been termed Areas to be Screened. About 190 acres in Section 1 (the portion not classified as Target Areas) have been classified as Areas to be Screened. The historic data in Sections 2 and 3 are too sparse to determine Areas to be Screened. Bed mapping by side scan sonar will be used to make this determination. Fine grained deposits identified by the side scan sonar survey in River Sections 2 and 3 that are not already Target Areas and are 50,000 $ft^2$ or more will be identified as Areas to be Screened by sediment coring. In addition, sediment cores will be taken from other sediment types if information obtained from

work conducted in River Section 1 demonstrates in conjunction with the existing sediment data that these sediment types may exceed the respective MPA thresholds. The number of additional sediment cores in these sediment types in River Sections 2 and 3 will not exceed a total of five hundred (500).

Sediment samples will be collected and analyzed for grain size in 2002 to confirm side scan sonar data. Sample locations will be selected from areas which, based on input from the geophysical contractor and USEPA, need further definition/confirmation of grain size. In each River Section, approximately 150 shallow core samples will be collected using push-core techniques, for a total of 450 samples. The top one (1) inch of each core will be submitted for grain size analysis (sieve method) in accordance with the method specified in the SOP (Appendix 10). These 450 sediment samples are separate from the 5% of the sediment samples to be analyzed for geotechnical parameters including, grain size, discussed below.

About 3,300 cores will be taken in the Target Areas in Sections 1, 2, and 3. Areas to be Screened will be sampled at a density of 4 cores per acre. Additional cores will be taken in Areas to be Screened if the generated data are insufficient to meet defined statistical tolerances.

The sediment cores will be sectioned in a nearby on-shore field laboratory and the sections will be sent to analytical laboratories for measurement of total PCBs using Aroclor quantification and moisture content. Bulk density measurements will be made in the analytical laboratory on the top 2 inch core segment; the remainder of the cores will be analyzed for bulk density via field measurements. A portion of the samples will also be analyzed for homolog PCBs in order to

establish the relationship between Aroclor-based Total PCB concentrations and Tri+ PCB concentrations as described in Section A7.

The surface sections of all cores will also be analyzed for total organic carbon (TOC) and $^{137}$Cs. A sub-set of the deeper core sections from approximately 2% of the cores will be analyzed for RCRA metals and dioxins/furans. These deeper sections will be chosen from sections located immediately below the deepest core section containing PCBs at a Tri+ concentration exceeding 1 ppm (see B1.4.2.1). Candidate sections will be identified after the PCB analyses have been completed. Additionally, approximately 5% of the core segments will be submitted for geotechnical parameters, including grain size distribution, Atterberg Limit, specific gravity, TOC, and USCS Classification. The choice of cores for these parameters will be based on the criterion that the range of sediment types be subjected to geotechnical testing. Visual characterization using the Unified Soil Classification System (USCS) will be the basis for defining the range of sediment types and choosing the cores for testing.

The PCB data will be used to establish the depth below which PCBs (Tri+) are not detected. This interface will define the depth of contamination for removal purposes. The PCB data, in combination with the bulk density data will be used to compute the PCB MPA of each core. The MPA statistic will be used in Sections 1 and 2 to define the areas of sediment that will be targeted for removal (*i.e.*, dredging targets). It will be used in River Section 3, along with the vertical distribution of PCB concentration and the $^{137}$Cs concentration in the surficial sediments to define dredging targets. The ROD has set the Tri+ PCB MPA targets in River Sections 1 and 2 at 3 g/m$^2$ and 10 g/m$^2$, respectively. The Section 2 MPA criterion will also be applied in Section 3 as a first screen. Sediments that meet or exceed the criterion will be examined to

determine whether the PCBs are being effectively sequestered by burial. This examination will involve whether surficial sediment $^{137}Cs$ levels are indicative of old or new sediments and the extent to which peak PCB concentrations have been buried. Final determination of dredging targets will be made during remedial design and will consider geotechnical characteristics of the sediment, river hydrography, sediment type and the capabilities of dredging equipment in addition to the sediment cut lines developed from the PCB data.

The RCRA metals and dioxin/furan data will be used to estimate the surface sediment metal and dioxin/furan concentrations likely to exist after dredging. This data will be used to provide information to assist in the remedial design.

The results of the geotechnical analyses will be used to assess the overall dredge-ability of the sediment, including selecting dredging equipment, developing estimates of dredge production rates, and assisting in the design of the sediment transport, processing and disposal aspects of the project.

Twenty cores will be selected at random from each of the three river sections for disposal characterization. This portion of the project is intended as a screening analysis to identify the types of sampling and treatment to be required when final sediment characterization is made for disposal purposes. A composite sample will be prepared from each core by mixing aliquots obtained from each core segment. The resulting 60 samples will be analyzed for RCRA hazardous waste characteristics and concentrations (TCLP metals and organics, and ignitability) and high-resolution dioxins/furans.

During sediment coring, the river bottom will be manually probed at every location to assess sediment thickness, degree of compaction, presence of subgrade cobbles, gravel, sand and/or rock, to the extent practicable. This information will be used to help define the makeup and integrity of geotechnical conditions below soft sediment for assessing anchoring, spud setting, and installation of other structures deemed necessary during remedial design. It will also be used to define areas where more detailed sub-bottom characterization will be needed as part of remedial design.

In addition to the side scan sonar study to map the sediment bed, a bathymetric survey will be conducted to refine our understanding of the river hydrography in River Sections 2 and 3 (The hydrography of River Section 1 was measured in the fall of 2001 by conducting 361 bank-to-bank bathymetry transects). Water depths will be measured along bank-to-bank transects spaced at 300-ft. intervals throughout River Section 2. The transect frequency will be increased to every 100 feet in the vicinity of Target Areas. A similar program will be conducted in River Section 3, although the spacing outside of the Target Areas will be 1000 feet. The resulting sediment bed elevation data is necessary for various aspects of remedial design.

### A6.2 Schedule

The sampling program is currently planned for two field seasons (approximately September to November of 2002 and May to November of 2003). The project schedule is presented in Figure A-3. Sampling in the first field season will focus on River Section 1 and *Hot Spots* 33, 34 and 35 in River Section 2. River Section 3 and the remainder of River Sections 1 and 2 will be sampled during the second field season at locations selected based on the results of the

geophysical surveys performed during the first field season. Bathymetric studies in the landcut between the TIP and Reach 6 will be conducted in the first field season (2002) and in River Sections 2 and 3 in the second (2003) field season.

The schedule is triggered by the effective date of the AOC. Specific calendar dates will depend on time frames for USEPA review and approval of submitted documents and the total number of cores to be collected. The side scan sonar survey will be timed during the field season in a manner that minimizes any difficulties posed by the presence of submerged aquatic vegetation. In areas where submerged aquatic vegetation is present, the side scan sonar survey and the associated confirmatory sediment sampling for grain size analysis and will be completed in 2002 if practical. The program is currently planned to be completed in two field seasons as follows:

1. 2002 Field Season. The target core collection rate is 60 cores per working day (Monday through Friday). The total number of cores planned to be taken during the 2002 season assumes that significant delays are not encountered, *e.g.*, as a result of delays associated with unsafe river work conditions. As specified in Figure A-3, work will terminate on November 1 or such later date as is agreed to by GE and USEPA (with the exception of the work in the Lock 6 land cut, which will be conducted in the winter of 2002). If the sediment cores targeted for collection in 2002 cannot be collected by the end of the field season, these locations will be added to the 2003 field season.

2. 2003 Field Season. The number of cores that will need to be collected in 2003 will be defined after the side scan sonar data are collected and interpreted and the MPA results from River Section 1 are evaluated. Again, the target production rate will be 60 cores per

working day. The 2003 field season may include cores targeted for collection in 2002 that could not be collected by the end of the 2002 field season due to time constraints. Collection will continue until the end of the field season -- *i.e.*, October 31st or such later date as is agreed to by GE and US EPA.

## A7 Quality Objectives and Criteria

### A7.1 Data Quality Objectives

Design and implementation of the remedy specified in the ROD requires the following information about conditions in the river:

- the horizontal and vertical boundaries of the dredging program;
- the river hydrography;
- the locations of obstacles to operation of dredging equipment;
- the geotechnical properties of the sediment that affect the choice of dredging equipment, dredging rate, and the transport, processing and disposal of dredged sediments;
- the structural properties of the strata below the soft sediments relevant to support of anchoring systems for the dredging and containment infrastructure;
- the concentration of pollutants other than PCBs that affect processing and disposal of dredged sediments;
- the pollutant concentration in sub-bottom sediments that would be uncovered by the dredging; and
- the characteristics of habitat areas that will be disrupted by the program.

The project is intended to provide most of this information. For some categories the project will provide all of the necessary data, for others it will provide screening data to support preliminary design and decisions about the necessity and scope of more focused sampling. It will not attempt to characterize habitat areas (a separate program is being developed for habitat assessment). The data quality objectives (DQOs) are described below and summarized in Table A-1.

### A7.1.1 Boundaries of the Dredging Program

The selected remedy (REM 3/10/Select) includes the following components (ROD at page 94):

- Removal of sediments based primarily on a mass per unit area (MPA) of 3 $g/m^2$ Tri+PCBs or greater (approximately 1.56 million cubic yards of sediments) from River Section 1;
- Removal of sediments based primarily on an MPA of 10 $g/m^2$ Tri+ PCBs or greater (approximately 0.58 million cubic yards of sediments) from River Section 2;
- Removal of selected sediments with high concentrations of PCBs and high erosional potential (NYSDEC *Hot Spots* 36, 37, and the southern portion of 39) (approximately 0.51 million cubic yards) from River Section 3;
- Dredging of the navigation channel, as necessary, to implement the remedy and to avoid hindering canal traffic during implementation. Approximately 341,000 cubic yards of sediments will be removed from the navigation channel (included in volume estimates in the first three components, above); and
- Removal of all PCB-contaminated sediments within areas targeted for remediation, with an anticipated residual of approximately 1 mg/kg Tri+ PCBs (prior to backfilling).

Areas of sediment targeted for remediation were selected based on the potential for those areas to contribute PCBs to the water column and fish through the food chain. The delineation of the target areas considered a number of factors, primarily the inventory of PCBs in the sediment, but also surface sediment concentrations, sediment texture, bathymetry and depth at which the PCB contamination is found. Areas where 12 inches or greater of relatively clean sediment exist were eliminated from consideration. Target areas were defined as approximately 50,000 square feet (a little over an acre) or greater, due to practical limitations on the number of separate remediation zones that could be accommodated for a project of this size (ROD at pp. 54-55). "EPA identified certain select areas in River Section 3 for remediation, specifically NYSDEC *Hot Spots* 36, 37, and the southern portion of *Hot Spot* 39, based on PCB inventory and signs of potential loss of PCB inventory to the water column or uptake by biota" (ROD at pp. 55-56).

To comply with the ROD it is necessary to identify sediments fitting the various criteria. Four DQOs have been derived from this requirement: 1) identify sediments where MPA meets or exceeds the specified thresholds; 2) identify the potential of River Section 3 sediments with MPA meeting or exceeding 10 $g/m^2$ Tri+ PCBs to be a significant source of PCBs to the water column and fish because of erodability or lack of burial; 3) identify navigational channel areas that must be deepened to implement the remedy; and 4) identify the depth of sediments containing detectable Tri+ PCBs in all sediment deposits targeted for removal.

### A7.1.2 River Hydrography

River hydrography impacts the choice of dredging equipment and containment infrastructure, the extent of dredging to facilitate navigation, and the extent of backfill needed after dredging.

Different dredging equipment may be required in shallow water and backfilling may not be appropriate or desired in shallow water areas because of habitat considerations. River hydrography data will be collected to meet two DQOs: 1) identify the bathymetric contours; and 2) identify regions of the navigational channel that must be deepened for remedy implementation. River velocity information may also be important for remedial design, but does not fall under the scope of this project.

### A7.1.3 Locations of Obstacles to Operation of the Dredging Equipment

Boulders and large debris will interfere with dredging and may have to be removed prior to dredging. If the PCB-containing soft sediments extend down to a consolidated hard bottom, the dredge will not have an opportunity to overbite into clean sediment and contaminated sediments are likely to remain after dredging. Mapping of hard bottom and the locations of boulders and large debris will assist in choosing and sequencing equipment and in decisions about the need and efficacy of dredging to remove residual contaminated sediments. Two DQOs have been established: 1) establish the depth of soft sediment and determine whether PCBs are present in the soft sediments abutting hard bottom; and 2) identify locations where boulders and debris are present in sediments that will be targeted for removal.

### A7.1.4 Geotechnical Properties of the Sediments

The types of equipment best suited for removing sediment, transporting it to the sediment handling facilities and dewatering it depends on certain sediment properties. These properties vary between fine and coarse sediments and from location to location. The extent of this

variability must be known to optimize the design of a data collection program. Sampling is proposed with the DQO of determining the variability of geotechnical properties to support determination of the need for a more comprehensive field investigation.

### A7.1.5 Structural Properties of the Underlying Strata

Anchoring, spud setting, and installation of other structures deemed necessary during remedial design will be impacted by the geotechnical characteristics of the geologic strata underlying the soft sediments. A limited understanding of these sub-bottom conditions is necessary for preliminary design of the remedy and to determine whether variability is great enough to warrant a detailed field investigation. The DQO is to screen the makeup and integrity of the geologic strata to support a decision regarding the necessity of a detailed investigation.

### A7.1.6 Pollutants other than PCBs in Dredged Sediments

Regulations require that dredge material be analyzed for certain chemical characteristics to determine the appropriate method of disposal. The method of disposal affects various aspects of the remedial design and data are needed to anticipate the chemical characteristics of the dredged material. The DQO is to collect chemical characterization data for preliminary assessment of dredge material disposal options. Included in this DQO is a determination of what types of sediment (*i.e.*, coarse versus fine, upstream versus downstream) are likely to qualify for each disposal option. These data would provide a basis for a more comprehensive sampling program for disposal characterization.

### A7.1.7 Pollutant Concentrations in Uncovered Sediments

The buried sediments uncovered by dredging may contain pollutants other than PCBs. Knowledge of the presence of these pollutants and their concentrations is needed to make decisions regarding design of the remedy. The DQO is to collect sufficient data to identify the suite of other pollutants present in sediments underlying the PCB-containing sediments and the range of concentrations present.

## A7.2 Measurement Performance Criteria

Measurement performance criteria describe how the DQOs will be satisfied. For each DQO, the types of measurements to be conducted are introduced and their performance requirements are discussed. The analytical data generated for the SSAP will be evaluated based on QA/QC criteria as described in Sections A7.3, B5, D1 and D2 and the Quantitative Data Quality Objectives summarized in Tables A-1, B-6a – B-6j and B-7a – B-7n. Only data qualified as "rejected" (flagged with an R or UR) will be omitted from data analyses as these data are considered by data validation guidance unusable for either quantitative or qualitative purposes.

### A7.2.1 Identify Sediments Where MPA Meets or Exceeds the Specified Thresholds

This DQO requires determination of the PCB MPA in sediments that have a reasonable probability of having an MPA meeting or exceeding the thresholds defined in the ROD. Based on the FS and the goals of the selected remedy, candidate sediments include all sediments in

River Section 1 (Thompson Island Pool) and finer sediments in River Sections 2 and 3. Measurements of sediment type that accurately distinguish cohesive (fine), non-cohesive (coarse) and sediments in between in River Sections 2 and 3 are required. These measurements, the historical PCB data, the USEPA 1992 side scan survey and the results of sampling conducted in River Section 1 during this program should be integrated to provide the most accurate assessment of which sediments in River Sections 2 and 3 have a reasonable probability of having an MPA meeting or exceeding the thresholds defined in the ROD. The referenced historical PCB data are those data generated in the Low-Resolution Core (LRC) Study (USEPA, 1998). This study used sampling protocols consistent with those proposed here and yielded estimates of MPA in sediments from the three river sections. The data quality acceptance criteria applied in the LRC study and the evaluation of data usability (USEPA, 1998) support the use of this data in conjunction with the new data to be generated in this program. The relative MPA levels found in the three river sections for particular sediment types (as represented by various measures of grain size) may provide a means to anticipate MPA in River Sections 2 and 3 from the MPA found in particular sediment types in River Section 1.

Once the sampling domain is established, the soft sediment column must be sampled so that the mass of PCBs present in the sediments at any location can be determined. This requires a coring technique capable of penetrating the soft sediments to hard bottom. The PCB concentrations, bulk density and moisture content of the cored sediments must be measured to provide the data for calculation of MPA. The MPA of each core segment is calculated from the product of the length of the core section (cm), PCB concentration (ug/g dry), the bulk density (g total/$cm^3$) and the solids content (i.e., 1 - moisture content; g dry/g total). The MPA of the core is calculated by

summing the MPA values of the core segments. An example of this calculation can be found in Figure 10-1 of the ROD (USEPA, 2002).

Sufficient core samples are needed to accurately define the spatial nature of MPA so that boundaries at the ROD MPA thresholds may be defined. Boundaries will be developed by spatial interpolation between samples. Such interpolation requires that sample spacing not exceed the distance over which the MPAs of neighboring samples are correlated. GE conducted a variogram analysis of PCB concentrations from closely spaced samples (*i.e.*, about 10-foot separation) taken in 1990 from four areas of the Thompson Island Pool and found correlation extended about 300 feet along channel and 50 feet cross-channel. USEPA took an alternative approach in the FS and used the statistical properties of the 1984 data set to calculate that 40 samples are needed to provide a log mean (median) MPA that has upper 95% confidence limit no greater than 1.5 times the log mean. USEPA applied this performance requirement to a 5-acre plot, producing a sampling density of 40 cores per 5-acre plot (8 cores per acre), which is satisfied by sampling on a triangular grid with 80-foot spacing. This spacing assures spatial continuity between neighboring samples in the along-channel direction and potentially in the cross-channel direction, and has been adopted for the project. Sampling will be conducted in two phases to provide an opportunity to determine if coarser grid spacing can satisfy the measurement performance criteria. In areas targeted for dredging, the 80-foot triangular grid will be sampled, but a 160-foot triangular grid will be sampled in areas to be screened and in the navigational channel. The resulting data will be analyzed to determine whether the performance criteria have been satisfied. If not, additional samples will be collected in the areas to be screened and the navigational channel to fill in the 80-foot grid. The analysis will be performed using a standard geostatistical approach, as described below.

The analysis will involve separating the sampled area into subreaches, or segments, and developing experimental and model variograms for each segment. The segmentation developed in the kriging analysis performed by EPA and reported in the DEIR (EPA 1997) will be used as a starting point and modified as necessary based on new information. Segmentation will be guided by the geophysical information generated by side scan sonar and sub-bottom profiling, as well as the PCB concentration and MPA results. Segments will be divided at bends in the River, *i.e.*, each segment will be relatively straight so extrapolation around bends is not necessary. In addition, segments will be delineated so as to minimize along-river gradients in mean PCB concentration and MPA (mean stationarity). Finally, to the extent possible, separate segments will be delimited for the 80-foot and the 160-foot data. The goal is to develop segments in which sampling and sediment characteristics are relatively homogeneous and PCB concentrations and MPA show some spatial congruity. To minimize discontinuities at segment boundaries, segments will be overlapped for a distance greater than or equal to the range of the fitted variogram model (see below), that is, the distance over which spatial correlation is observed.

EPA (1997) determined that variograms of total PCB mass in the Upper Hudson River tend to be anisotropic, that is, sensitive to the direction in which they are calculated. The major axis generally appeared to follow the axis of river flow. Therefore, experimental variograms will likely be developed in both the along-flow and across-flow directions. Final decisions concerning the inclusion and direction of anisotropy will be made following initial exploratory analysis of the data (*e.g.*, posting of the data, calculation of basic statistics).

The experimental semivariances will be modeled using ARCGIS version 8.2. Two variogram models commonly used are the exponential and spherical models. Based on the analysis conducted by EPA (1997), it is likely that an exponential model will be fit to the experimental

semivariances; however the spherical model will be considered as well. As discussed above, PCB MPA in the Upper Hudson River tends to be distributed anisotropically; therefore it may be necessary to use some combination of these two models to appropriately model the anisotropic semivariances. A nugget may also need to be included depending on the experimental semivariances.

Sampling density will be judged sufficient for development of interpolated boundaries of PCB concentration and MPA if the variogram demonstrates spatial correlation at the scale of the sampling density. Specifically, the range of the model variogram must be greater than the sample spacing (160 feet). Satisfaction of this condition indicates that PCB masses at locations up to 160 feet apart are correlated. Since the interpolated boundaries will lie *between* data points, they will be considerably closer than 160 feet to individual data points at any location (at most on the order of 80 feet). Thus, this condition ensures that the correlation between data points and interpolated boundaries will actually be greater than the correlation observed at 160 feet, and therefore that the data will provide the information necessary to reasonably estimate the boundaries. It should be noted that if a sampling location is abandoned, which will occur if there is insufficient sediment to obtain a sample, the sample spacing will in some cases be greater than 160 feet. Generation of the variogram will be insensitive to this fact unless the number of abandoned locations is a significant fraction of the number of stations within the subreach for which the variogram is being developed. In any event, the judgment of data sufficiency will be made based on the existence of spatial correlation within the data set. If no correlation is obtained because of the presence of abandoned stations, more refined sampling may be required.

Should more refined sampling be required, the second round of sediment sampling for the screening areas will be designed and the results interpreted taking into account a number of factors, including the PCB MPA results, the variograms based on the 160-foot data, the side scan sonar and sub-bottom profiling, the PCB concentration and organic carbon data, as well as other information such as minimum dredge area sizes.

Accurate interpolation of dredging boundaries requires that the location of each sample be specified accurately. The error should be less than 1 foot to prevent significant contribution to interpolation error.

PCBs will be measured using a method that generates Aroclor equivalent concentrations as well as a Total PCB concentration. Additional information regarding this method can be found in Section B4 and the Standard Operating Procedures (SOPs) included as Appendices 5-7. The use of an Aroclor methodology is necessitated by the number of analyses required to meet the project objectives; insufficient laboratory capacity exists for any other methodology. Homolog PCBs will be measured on a subset of the samples to provide a means to develop a relationship between the Aroclor equivalent concentrations and the Tri+ PCB metric used in the ROD to specify thresholds. Additional information regarding this method can be found in Section B4 and the SOPs included as Appendices 6-8. The paired homolog and Aroclor measurements will be used to develop a regression model relating Aroclor concentrations of a sample (*i.e.*, concentrations of Aroclors 1221, 1242 and 1254) to the Tri+ PCB concentration of the sample. A fraction of each Aroclor concentration is attributable to Tri+ PCBs and the Tri+ PCB concentration will be calculated by multiplying each Aroclor concentration by the appropriate fraction and summing the results, as shown in Equation 1.

Tri+ PCB = a(Aroclor 1221) + b(Aroclor 1242) + c(Aroclor 1254)

The values and confidence limits for the Aroclor fractions (i.e., the coefficients a, b and c in Equation 1) will be estimated by regression of a data set of matched Tri+ PCB and Aroclor concentrations. This data set will be composed of all of the paired Tri+ PCB and Aroclor concentrations (native samples and Performance Evaluation samples). Data rejected by the verification/validation process will be excluded. Because it is possible that the various laboratories applying Method 8082 will have unique relationships between Tri+ PCB concentration and their reported Aroclor concentrations, laboratory-specific regression equations will be developed. The data from individual laboratories will be pooled and a new regression equation calculated, if there is not statistically-significant difference between the regression coefficients. The statistical test to be applied to test the null hypothesis that the regression coefficients are equal across laboratories will be determined upon review of the data and the regression equations.

It is also possible that the coefficients in Equation 1 will depend on particular characteristics of the sample such as location, sediment type or total PCB concentration. Such dependencies will be searched for by studying the residuals of the regression analysis. If residuals are found to co-vary with location, sediment type or total PCB concentration, the data set will be partitioned appropriately and new regression equations will be developed.

The development of the regression equations and the estimation of Tri+ PCB concentrations will occur after all of the 2002 data are received. Any decisions regarding additional sampling based on data from 2002 will be reviewed once all the data are in and appropriate adjustments made.

The equations will be updated after all of the 2003 data are received and new estimates of Tri+ PCB concentrations may be developed. The process for development of the regression equations is displayed in Figure A-4. The proposed regression model(s) will be submitted to EPA for review and approval after the completion of each field season.

### A7.2.2 Identify River Section 3 Sediments With PCB Tri+ Inventory >= 10 $g/m^2$ and Either the Potential for Loss of PCBs to the Water Column or for PCB Uptake by Biota due to Erosion or Inadequate Burial

Areas of sediment in River Section 3 that are 50,000 $ft^2$ or greater and have an MPA of 10 $g/m^2$ Tri+ of PCB or more will be further evaluated to identify areas with a potential for PCB loss to the water column or potential for PCB biouptake due to erosion or inadequate burial.

### A7.2.3 Identify Navigational Channel Areas That Must Be Deepened for Remedy Implementation

The selected remedy includes dredging of the navigational channel where necessary to implement the remedy. USEPA targeted sediments (in the FS) based on depth measurements reported by the New York State (NYS) Canal Corporation The precision of these measurements will be evaluated by collecting depth soundings along transects that traverse the navigational channel at 100-ft intervals in River Section 1 (completed in fall 2001), 300-ft intervals in River Section 2 and 1000-ft intervals in River Section 3. These results will be compared to the NYS Canal Corporation data. If the depth measurements at similar locations are within 6 inches to a foot of each other, the Canal Corporation data will be used to interpolate between bathymetric

transects. If the difference in depth is greater than 1ft, the need for additional data will be evaluated. The depth soundings need to be collected with sufficient density to identify the boundaries of the navigational channel and the water depth in the channel. This requires measurements at intervals of about 2 feet along each transect. Given the 2-ft sampling interval, the horizontal location of the soundings must be measured with accuracy of 1 to 2 inches.

### A7.2.4 Identify Depth of PCB-Containing Sediments in Sediments Targeted for Removal

The depth of sediment that will be removed in targeted areas will be defined as the depth below which Tri+ PCBs are not detected. The measurements of PCBs in the sediment must resolve the location of this interface with an accuracy consistent with the ability to control the vertical cut of the dredging equipment. Current dredging equipment has a practical accuracy of about 6 inches.

### A7.2.5 Identify Bathymetric Contours

Location of bathymetric contours will be determined from sediment bed elevation data collected during bathymetric surveys in River Sections 1, 2 and 3. The location of the contours may affect the volume of sediments to be removed by various types of dredging equipment and the scheduling and cost of the dredging project. Accurate identification of the contours is necessary for remedial design. Boundaries will be developed by spatial interpolation between measurements of water depth. Such interpolation requires that sample spacing not exceed the distance over which the depths of neighboring samples are correlated. Depths are highly correlated along channel and less so across channel. For this reason, across channel sampling

needs to be done at a frequency of a few feet, whereas along channel sampling can be done at a frequency of several hundred feet. This is accomplished by sampling along cross-channel transects. Bathymetric (*i.e.*, water depth) data have been collected along transects spaced at approximately 100-foot intervals in Thompson Island Pool (River Section 1). This bathymetric survey was conducted during fall of 2001 and fulfilled the measurement performance criteria. Bathymetric data will be collected along transects that are spaced at 100-foot or 300-foot intervals in River Section 2. For River Section 3, bathymetric transects will be spaced at 100-foot or 1000-foot intervals. The depth measurement and the coordinates of each measurement must have an error no greater than a few inches. The 2001 survey had an accuracy of ± 1 and ± 3 cm for horizontal and vertical positioning, respectively.

Bathymetric data for all transects will be entered into a GIS database prior to analysis. Analysis of the data and generation of maps depicting bathymetric contours in River Sections 1, 2 and 3 will be accomplished using geostatistical methods such as kriging.

### A7.2.6 Establish Depth of Soft Sediment and Determine Whether PCBs are Present in Soft Sediments Abutting Hard Bottom

This DQO will be achieved using PCB concentration and sub-bottom characterization data. The location of the hard bottom, or equivalently the thickness of soft sediment, will be determined by manual probing at sediment core sampling locations following procedures outlined in the SOP included as Appendix 4. The probing must be able to distinguish between materials that can be removed by the dredging equipment (sediment) and materials that cannot be removed (hard bottom). The person(s) performing the probing will be trained by QEA staff who will

demonstrate the amount of resistance to be interpreted as hard bottom. This method requires the use of professional judgement. Total PCB concentration data at each sampling location will be used to determine the depth in the sediment bed below which PCBs are not detected. The distance between this depth and the soft sediment thickness will be determined at each sampling location.

### A7.2.7 Identify Locations Where Boulders and Debris are Present in Sediments Targeted for Removal

The locations of boulders and large debris will be identified using two data sources. First, physical information and observations at sediment sampling locations will be collected during PCB core collection and manual probing. This information will be used to determine sampling locations where boulders and large debris were observed. Second, side scan sonar surveys will be conducted in River Sections 1, 2 and 3. Large objects, such as boulders and debris, may be discernible in the side scan sonar images. The locations of these large objects on the side scan sonar images will be determined.

Information from both data sources will be combined to identify locations of boulders and large debris. These locations will be incorporated into a GIS database and maps will be generated that identify the locations of boulders and large debris in River Sections 1, 2 and 3. These maps will be used to determine whether additional data need to be collected to further quantify boulders and debris for purposes of remedial design.

### A7.2.8 Determine Variability of Geotechnical Properties to Support Design of a Detailed Field Investigation

Geotechnical properties that will be evaluated include: grain size distribution, Atterberg limit, specific gravity, bulk density, water content, total organic carbon, and Unified Soil Classification System (USCS) classification. These data will be obtained from analyses of 5% of the sediment sampling cores collected for PCB evaluation.

The geotechnical data must be collected over the range of sediment types present in the river, including fine sediment and coarse sediment. The delineation between fine and coarse sediment type will be based on the results of side scan sonar data analysis in River Sections 1, 2 and 3. The variability and predictability of geotechnical properties must be established to determine the need for a more detailed field investigation. This involves investigation of the relationship between the geotechnical properties and other measurements that are to be made on all of the sediment cores collected to establish dredging boundaries. These include bulk density, moisture content and visual characterization using the USCS. If the geotechnical properties are highly variable and poorly predicted from the properties measured at high density, a more detailed field study will be developed as part of remedial design.

### A7.2.9 Screen Makeup and Integrity of Geologic Strata to Support Decision Regarding Necessity of a Detailed Investigation

A screening level assessment of the makeup and integrity of the geologic strata underlying the soft sediment in River Sections 1, 2 and 3 will be completed in this DQO. Data and information from the manual probing of soft sediments during the collection of sediment core samples (see Section A7.2.6) will be used in this screening level assessment. Additional information about the underlying geologic strata may be provided by the sub-bottom profiling study; the reliability of the data is uncertain at this time, but will be determined during testing of the sub-bottom profiling equipment and techniques.

These data and information will be used to examine the spatial variability of the underlying strata and develop a limited understanding of its makeup and integrity. If the underlying strata vary spatially and that variability is poorly delineated by the screening samples, a more detailed field study will be developed as part of remedial design.

### A7.2.10 Collect Data for Preliminary Design of Disposal Options and to identify the Types of Sediment Likely to Qualify for Each Option

The DQO requires sufficient data to provide a basis for a comprehensive sampling program for disposal characterization. The sampling program must include a sufficiently broad list of chemicals to support evaluation of RCRA hazardous waste characteristics. The number of samples and precision of measurement must be sufficient to characterize spatial variability, in

order to form the basis for development of a more comprehensive sampling plan for disposal characterization. Sufficient samples should also be collected to evaluate correlation between concentrations of individual chemicals and sediment type, location with the river reach, and PCB mass and concentration.

To achieve these ends, twenty cores should be selected from sediments targeted for removal in each of the three river sections. Within each river section, the cores should encompass a range of sediment types, to be measured as grain size. As sediments will be homogenized upon dredging, for each core, analyses should be performed on a composite of samples from all core sections. The analyte list should be broad enough to permit decision-making with regards to disposal. Therefore, each disposal characterization sample should be analyzed for RCRA hazardous waste characteristics and concentrations (specifically, TCLP metals and organics, reactivity, ignitability) and high-resolution dioxins/furans. Table A-2 lists the regulatory criteria, test methods, and CFR citations that will be used to determine whether sediments may be classified as hazardous waste under the regulatory authority of RCRA or TSCA.

Chemical and criteria data will be summarized for disposal characterization samples taken in each river section. This summary will include information on the type and quantity of listed chemicals found at each sampling location; the range, mean, and variance of listed chemicals in the river section, and the percentage of characterization samples that exceeded the regulatory limits in Table A-2. This information, in conjunction with other information gathered during the SSAP, will be used by the remedial design team to determine the extent of testing that will be required for sediment disposal characterization during the sediment dredging program and the types of facilities that may be necessary to process such sediments. The actual determination of

the extent of sediments classified as hazardous waste will be done during the remedial dredging program and is beyond the scope of this QAPP.

#### A7.2.11 Collect Sufficient Data to Identify Other Pollutants in Sediments Underlying PCB-Containing Sediments and Range of Concentrations Present

The DQO requires sufficient data to characterize the concentrations of other pollutants that will remain following dredging, in order to support decisions during design of the remedy. Towards this end, a sufficient number of samples must be collected to characterize average and range of contaminant levels for each target area. This can be achieved by analyzing 2% of the total number of sample cores. Within each target area, the cores should be selected randomly. In each core, the core segment immediately below the deepest segment in which PCBs were measured at greater than 1 ppm should be analyzed. Core selection for these analyses must await the results of PCB analysis of the core segments. The list of analytes should be broad enough to support decision-making during remedial design and will consist of RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium) and dioxins/furans.

### A7.3 PARCC and Sensitivity - Definitions and Equations

Data quality and quantity are measured by comparison of resulting data with established acceptable limits for data precision, accuracy, representativeness, comparability and completeness (PARCC) and sensitivity. Data outside PARCC/sensitivity QA objectives will be evaluated, according to Section B5 and the Quantitative Data Quality Objectives (Tables B-6a through B-6j and Tables B-7a through B-7n) of this document, and the criteria contained in the

specified analytical methods, to determine what, if any, aspects of the data can be defensibly used to meet the project objectives.

### A7.3.1 Precision

Precision criteria for each analysis method to be used for the SSAP are summarized on Tables B-7a through B-7n. Precision measures the reproducibility of data or measurements under specific conditions. Precision is a quantitative measure of the variability of a group of data compared to their average value. Precision is usually stated in terms of relative percent difference (RPD) or percent relative standard deviation (%RSD). Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, RPD will be used in this project. For a series of measurements, %RSD will be used. The total precision of a series of measurements can be related by the additive nature of the variances. Equations for RPD and %RSD are presented below:

$$RPD = \frac{|D1 - D2|}{(D1 + D2)/2} \times 100\%$$

Where:

D1 and D2 = the two replicate values

$$\%RSD = S/x \times 100\%; \text{ and } S = \frac{\sqrt{\left(\sum_{I=1}^{n} \frac{(x_i - x)^2}{n-1}\right)}}{x}$$

Where:

| | | |
|---|---|---|
| S | = | standard deviation |
| $x_i$ | = | each observed value |
| x | = | the arithmetic mean of all observed values |
| *n* | = | total number of values |

### A7.3.2 Accuracy

Accuracy criteria for each analysis method to be used for the SSAP are summarized on Tables B-7a through B-7n. Accuracy measures the bias in a measurement system that may result from sampling or analytical error. Sources of error that may contribute to poor accuracy are:

- Laboratory error,
- Sampling inconsistency,
- Field and/or laboratory contamination,
- Handling,
- Matrix interference, and
- Preservation.

Equipment blanks, as well as matrix spike QC samples, Performance Evaluation (PE) samples and Laboratory Control Spikes (LCSs), will be used to measure accuracy for project samples.

Matrix spike analysis is not required for the Total PCB as Aroclor or Total PCB as homologs methods. Section B5 provides further information on the methods where matrix spike analysis will be performed. Accuracy is calculated using the equation below:

$$\%R = \frac{SSR - SR}{SA} = 100$$

Where:

| | | |
|---|---|---|
| %R | = | % recovery |
| SSR | = | spike sample result |
| SR | = | sample result |
| SA | = | amount of spike added to sample |

### A7.3.3 Representativeness

Representativeness criteria for each analysis method to be used for the SSAP are summarized on Tables B-7a through B-7n. Representativeness expresses the degree to which sample data represent the characteristics of the media or matrix from which they are collected. Samples that are considered representative are properly collected to accurately characterize the nature and extent of contamination at a general sample location. Representativeness will be measured by using standardized collection methods (*e.g.*, sampling, handling, and preserving) and analytical laboratory analytical methods. Section A7.2. provides measurement performance criteria that sample data will be evaluated against to determine if samples are representative.

### A7.3.4 Comparability

Comparability criteria for each analysis method to be used for the SSAP are summarized on Tables B-7a through B-7n. Comparability expresses the confidence with which one data set can be compared with another data set from a different phase or from a different program. Comparability involves a composite of the above parameters as well as design factors such as sampling and analytical protocols. An acceptable level of comparability will be accomplished through the consistent use of accepted analytical and sampling methods.

### A7.3.5 Completeness

Completeness criteria for each analysis method to be used for the SSAP are summarized on Tables B-7a through B-7n. Completeness is defined as the percentage of data that is judged to be valid to achieve the objectives of the investigation compared to the total amount of data. Deficiencies in the data may be due to sampling techniques, poor accuracy, precision, or laboratory error. While the deficiencies may affect certain aspects of the data, usable data may still be extracted from applicable samples. An evaluation of completeness necessarily involves an evaluation of the impact of missing data on the ability of the project to achieve its goals. The goal for completeness is 95% as listed on Tables B-7a through B-7n. The equation used for completeness is presented below:

$$C\,(\%) = \frac{D}{P \times n} \times 100$$

Where:

| | | |
|---|---|---|
| D | = | number of confident quantifications |
| P | = | number of analytical parameters per sample requested for analysis |
| n | = | number of samples requested for analysis |

As indicated previously, assessment of completeness alone does not provide a comprehensive evaluation of data quality. Therefore, the percentage of usable and unusable data will also be calculated through use of the database by the following equations:

% Usable Data = #Unqualified Positive + #U + #U* + #JN + #J + #UJ [+ #MPC for Dioxins/Dibenzofurans]/Total Number of Results

% Unusable Data = #R + #UR/Total Number of Results

Separate % Completeness, % Usable Data, and % Unusable Data calculations will be performed for the project data. The definitions for the qualifier codes U, U*, J, UJ, MPC, R and UR are presented in Section D.2.1.2.

### A7.3.6 Sensitivity

Sensitivity is defined as the ability to achieve the project-required reporting limits as defined in Tables B-6a through b-6j. The method detection limits (MDLs) are also summarized on Tables B-6a through B-6j. Project action limit goals (PALGs) are not listed on Tables B-6a through B-6j as PAGLs have not been provided to GE by USEPA for the SSAP.

## A8 Special Training/Certification

Field personnel will adhere to the procedures specified in the site-specific health and safety plan (HASP), including having met the following requirements prior to the commencement of sampling:

A training course of at least 40 hours that meets the requirements specified in 29 CFR Part 1910.120(e) on safety and health at hazardous waste operations; and a refresher course of at least 8 hours that meets the requirements of 29 CFR Part 1910.120(e) on safety and health at hazardous waste operations within the last 12 months.

The Site Health and Safety Coordinator will be responsible for ensuring that field personnel for each participating organization have current health and safety training prior to commencement of field sample collection activities. The health and safety training records will be maintained as discussed in the HASP.

No other specialized training is anticipated for this project. Field personnel performing sample collection and measurement activities will be properly trained in equipment use and procedures necessary for each task prior to entering the field. Each contractor/consultant will employ their internal processes/procedures for establishing that personnel are adequately experienced in the duties they are expected to carry out and are receiving any needed training. Training courses or workshops on specific equipment, techniques or procedures shall all be documented. The requirements of this QAPP will be reviewed by management and field personnel of each participating organization to ensure that persons with appropriate credential and experience are

assigned to the tasks to be performed. It will be the responsibility of the Field Sampling Manager to ensure that field personnel understand and comply with the applicable QAPP requirements for their individual tasks.

Personnel who are responsible for performing laboratory analyses will be properly trained by the laboratory director or her/his designee to conduct the various laboratory analyses described in this QAPP. The laboratories participating in this project will have training programs that are equivalent to those requirements in the National Environmental Laboratory Accreditation Conference (NELAC/NELAP) standards, Section 5.0 Quality Systems. The laboratory shall have sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned functions. Data verification and validation will be under the direction of the QA Program Manager who is experienced with the production, reporting, verification and validation of analytical data.

## A9 Documentation and Records

This QAPP will be distributed to each contractor responsible in the collection, generation and interpretation of field and analytical data. The QA Program Manager will be responsible for ensuring that necessary changes occur to keep the QAPP up to date with actual practices. The QA Program Manager will ensure that a distribution list of QAPP recipient organizations or individuals is maintained such that revisions and updates can be distributed. The document control format used in this QAPP will identify the QAPP revision number and revision date. A QAPP revision history will be maintained that identifies each revision and a summary of the

revision. This revision history will be incorporated into this section of the QAPP in any subsequent issues of the revised or updated QAPP.

- Revision 0, May 3, 2002. This version was the initial document submitted to US EPA Region 2 for review and comment.

- Revision 1, August 2, 2002. Revision 1 incorporates changes to the QAPP to make it consistent with the final Hudson River PCBs Site Design Support Sediment Sampling and Analysis Program Field Sampling Plan (QEA/Environmental Standards, July 2002) and to address US EPA comments to the QAPP Revision 0.

- Revision 2, September 9, 2002. Revision 2 addresses US EPA comments to the August 2, 2002, QAPP Revision 1.

- Revision 3, September 26, 2002. Revision 3 addresses US EPA comments to the September 9, 2002, QAPP Revision 2.

- Revision 4, Octobe 1, 2002. Revision 4 addresses US EPA comments to the September 26, 2002, QAPP Revision 3.

Analytical data for this project will be reported in both an Electronic Data Deliverable (EDD) and analytical data package. The EDD will be generated by the participating laboratories and will be used by the data management contractor to facilitate loading the analytical data into the project database. The EDD specification is included as Appendix 42.

Analytical data packages will be prepared by the laboratories according to the procedures described in the SOP "Data Package Deliverable" (SOP DPSOP) which is included in Appendix 9. Data packages will be provided by the laboratory in an Adobe® Acrobat® .pdf electronic format for all analyses. The .pdf electronic data package will be delivered to the QA Program Manager for distribution to the data validators. A summary of results (described as Level A deliverables in SOP DPSOP) will be provided to the data management contractor and other necessary contractors for use in checking the project analytical database against hard copy results or other preliminary evaluation.

All TCLP analytical data generated by the laboratories will be reported as µg/L (organics) or mg/L (metals). All sediment sample analytical data generated by the laboratories will be reported as mg/kg (organics except dioxins/dibenzofurans and radiological data). Dioxin/dibenzofuran sediment sample analytical data will be reported as pg/g. Radiological sediment sample data will be reported as pCi/g. Results between the laboratory method detection limit (MDL) and the reporting limit (RL) will be reported by the laboratories as quantitative estimates ("J" qualifier code). Additionally, sediment sample data will be reported on a dry-weight basis. Data retained in the project database may be converted to units other than those reported by the laboratories. Sample results will not be corrected for contamination found in laboratory blanks.

Appropriate records will be maintained to provide adequate documentation of the entire data generation process, including field sampling and laboratory analysis. Field sampling records will include maintaining field logs and sample chain of custody documentation. Sample field log and chain of custody forms are presented in Figures A-6 and A-7, respectively. Field QA/QC

samples will be identified by a unique identifier in the field log and also by a separate field in the sample Chain-of-Custody forms.

The final evidence file will be the central repository for documents that constitute evidence relevant to sampling and analysis activities as described in this QAPP and the FSP. GE and the various consultants/contractors are custodians of and will maintain the contents of the evidence files for the sediment sampling and analysis program, including all relevant records, correspondence, reports, logs, data, field records, pictures, subcontractor reports, analytical data, and data reviews.

The final evidence file will include where generated:

- field records;
- field data and data deliverables;
- photographs;
- drawings;
- coring logs;
- laboratory data deliverables;
- data validation reports;
- field and laboratory audit reports,
- progress reports, QA reports; and
- custody documentation.

# B. DATA ACQUISITION

## B1 Sampling Process Design

The SSAP consists of four components: side scan sonar survey, sub-bottom profiling, bathymetric survey and sediment characterization. The experimental design for each of these components is provided in the sub-sections below.

### B1.1 Side Scan Sonar Survey

Side scan sonar surveys will be conducted throughout all three River Sections in accordance with the Standard Operating Procedure (SOP) presented as Appendix 17. The goal is to develop a map of sediment types. Based on the expectation that PCB concentrations and inventory are correlated with sediment type (previous studies have shown a correlation between the grain size distribution and PCB concentration [USEPA, 1997]), the boundaries between sediment types that are defined by side scan sonar will be used with the MPA data in developing MPA contours. The details of how sediment type will be incorporated in the spatial interpolation of MPA will be determined during data analysis.

### B1.2 Sub-Bottom Profiling

In portions of the site, the interfaces between geologic strata may provide information useful in delineating sediment to be dredged. The side scan sonar survey (Section B1.1) will provide one means to estimate the boundaries between sediment types. Other geophysical techniques,

specifically sub-bottom profiling, can image the subsurface geology using acoustic and/or electromagnetic signals. The utility of these techniques is not assured and depends on various properties of the sediment. These techniques are currently being applied in the Lower Hudson River.

Sub-bottom profiling will be tested during the 2002 field season in selected portions of River Section 1 (*i.e.*, the Thompson Island Pool) and River Section 2 (in the vicinity of NYSDEC Hotspots 33, 34, or 35). Both River Sections will be used for testing because of potential differences in stratigraphy attributable to differences in the origin of the sediments (*i.e.*, both catastrophic and long-term deposition in River Section 1 versus primarily long-term deposition in River Section 2). The areas in which sub-bottom profiling will be tested are scheduled for sediment coring during the 2002 field season. Coring in the areas subject to the sub-bottom profiling tests will be performed as soon as practicable after the testing is completed.

### B1.3 Bathymetric Survey

Bathymetric data exist for River Section 1 from a survey conducted for GE in the Fall of 2001 (Figure B-1). Bathymetric surveys will be performed in River Sections 2 and 3 during the second field season (2003) after the side scan sonar data have been collected and interpreted. The bathymetric SOP is presented in Appendix 2. The transect spacing is based on professional judgment and previous experience at other sites. If data gaps are identified during subsequent design activities, additional data will be obtained.

The 2001 River Section 1 bathymetric data are currently being processed for inclusion into the project database. These data will be used for the remedial design, subject to confirmation of the data from the side scan sonar survey, which also provides bathymetric data. The surveys were conducted for GE by Ocean Surveys, Inc. (OSI) along 361 bank-to-bank transects spaced at approximately 100-ft. intervals throughout the Thompson Island Pool (River Section 1). Approximately 277 data points were obtained along each transect, resulting in a typical spacing of 2 feet between soundings. To maintain horizontal and vertical control for this work, OSI used an on-board GPS that received signal corrections from a shore-based unit. The reported accuracy for this system was +/-1 cm for horizontal positioning, and +/-3 cm for vertical positioning.

The horizontal positioning data were transmitted in real-time to an on-board vessel tracking system that was capable of displaying significant features such as the river shoreline, navigational aids, target transects for data collection, and the position of the vessel in relation to these features. This enabled the helmsman to maneuver the vessel to follow each transect laterally across the river, and collect water depth data using an Innerspace Model 448 digital depth sounder. The water depth data were used to calculate an elevation of the riverbed. These elevations were in reference to the elevation of a shore-based benchmark. This system accounted for variability in water elevation that occurred as a result of upstream hydroelectric and canal operations.

Bathymetric data will be collected in River Section 2 along bank-to-bank transects spaced at 300-ft. intervals. The transect frequency will be increased to every 100 feet in the areas identified for sediment sampling by side scan sonar (if 50,000 $ft^2$ or more) and areas identified for

navigational dredging. This increased transect density will extend approximately 500 feet upstream and downstream of these areas. The approximate location of the data collection transects in River Section 2 are presented in Figure B-1; however, additional transects will be included in any areas identified for sediment sampling during the side scan sonar survey.

Bathymetric data will be collected in River Section 3 along bank-to-bank sampling transects generally spaced 1000 feet apart. The transect frequency will be increased to every 100 feet in areas identified for sediment sampling by side scan sonar (if 50,000 $ft^2$ or more) and areas identified for navigational dredging. This increased transect density will extend approximately 500 feet upstream and 500 feet downstream of these areas. The approximate locations of the data collection transects in River Section 3 are presented in Figure B-1; however, additional transects will be included in any areas identified for sediment sampling during the side scan sonar survey.

### B1.4 Sediment Characterization

The sediment core collection program was designed to collect the information necessary to characterize the extent and depth of sediment areas to be dredged (*i.e.,* estimate PCB mass per unit area of riverbed). A subset of the samples collected under this program will be subject to additional testing to provide supporting information needed for other aspects of the remedial design (*e.g.*, equipment types, sediment handling facilities, *etc.*). This additional testing includes geotechnical characterization, sub-bottom characterization, and preliminary disposal characterization. The sediment sampling program is planned for two field seasons (approximately September to November of 2002 and May to November of 2003). Sampling in

the first field season will focus on River Section 1 and *Hot Spots* 33, 34 and 35 of River Section 2. River Section 3 and the remainder of River Sections 1 and 2 will be sampled during the second field season at locations based on the results of the geophysical surveys performed during the first field season.

### B1.4.1 Sediment Sample Locations

Sample locations within the three River Sections will be selected to provide the data necessary for delineating the horizontal distribution of PCBs in the sediment. This will be accomplished by overlaying a triangular grid with a spacing of 80 feet between nodes over a map of the riverbed for River Sections 1, 2 and 3 that is referenced to a geographical coordinate system (*e.g.*, NAD 83). Core sample locations will be selected from these grid nodes at varying densities, as described below. Sampling will begin at the upstream end of each section and proceed downstream.

Sediment cores will be collected in two phases in River Section 1 during 2002. The first phase of sampling will involve collecting sediment cores at every grid node (80-ft. spacing) in the defined Target Areas (except in those portions of the Target Areas that fall into the navigational channel, which will be sampled at a grid node spacing of 160 ft.) and at a grid node spacing of 160 feet in the Areas to be Screened (remainder of River Section 1). Sediment cores will be collected in the Lock 6 land cut (upstream of the Thompson Island Dam Guard Gate) at a 160-foot grid spacing. PCB data obtained from the Areas to be Screened will be evaluated on an as-received basis to identify areas where the data are insufficient to meet the project objectives.

The second phase of sampling will be performed to address data gaps, and will involve collection of sediment cores within selected areas at the grid nodes located between the nodes already sampled. This will result in samples being collected at a grid node spacing of 80 feet in these selected areas. Sediment core locations for River Section 1 are presented in Figures B-2a through B-2e, and example horizontal coordinates for each core location are presented in Table B-1. During field activities, northing and easting coordinates for each sediment core location will be downloaded electronically into the field GPS system on each sampling vessel and used to guide the vessels into position. It is unlikely that it will be possible to collect sediment cores in the areas of River Section 1 that were identified as being rocky during previous geophysical surveys; however, these conditions will be confirmed by probing at the grid nodes during the field sampling activities. Cores will be collected at all targeted grid nodes where conditions permit.

The portion of the Lock 6 land cut between the Thompson Island Dam Guard Gate and Lock 6 will be investigated during the off-season (winter 2002) when this portion of the channel is drained. Geophysical investigations may or may not be conducted in the land cut. The channel will be inspected visually for sediment types and surveyed using conventional surveying techniques to identify areas where water depths may be less than required for navigation to support completion of the project. If areas of fine-grained sediment with an areal extent of 50,000 $ft^2$ or more are identified or areas where navigation may be impeded due to insufficient water depth are identified, these areas will be sampled using push core techniques on 160-foot grid spacing.

With the exception of Hot Spots 33, 34, and 35 and adjacent areas of fine-grained sediment, the sediment core locations in River Section 2 will be determined after the side scan sonar survey is completed and the data are interpreted to delineate sediment types. Both the 1992 and the 2002 side scan surveys will be considered in identifying areas for sampling. Sediment core locations for Hot Spots 33, 34, and 35 and areas of adjacent fine-grained sediment have been selected based on existing side scan sonar data. Sediment core locations in these areas are presented in Figure B-2f.

The side scan sonar survey data to be collected in River Section 3 will be used to distinguish among sediment types.

In both River Sections 2 and 3, areas that are not designated as Target Areas will be designated as Areas to the Screened if they are fine-grained sediments that abut Target Areas or have an areal extent of 50,000 $ft^2$ or more. In addition, if information obtained from work conducted in River Sections 1 and 2 demonstrate that other sediment types may exceed the respective MPA thresholds, sampling of those sediment types will be conducted. The number of sediment cores to be taken from these other sediment types in River Sections 2 and 3 will not exceed a total of five hundred (500).

Core samples will be collected at grid nodes in Target Areas (80-ft. spacing), and Areas to be Screened (160-ft. spacing). Sampling will also be conducted within areas selected in River Sections 2 and 3 in the FS (USEPA 2000a) for navigational dredging, where sediment core samples will be collected at every other grid node (160-ft. node spacing). The Supplemental FSP that will be prepared upon completion of the 2002 field activities (and related data evaluation

activities) will specify the sediment core locations in River Sections 2 and 3 that will be sampled in 2003.

River Section 3 sampling will occur before River Section 2 sampling in 2003. A portion of the cores for River Section 3 will be sectioned more finely than those in River Sections 1 and 2 to address the "select" criteria identified in the ROD. For Target Areas, two thirds of the cores will be segmented in the same manner applied in River Sections 1 and 2. The remaining cores will be segmented in six-inch increments (see Figure B-3). In Areas to be Screened, the segmentation approach will be the same as proposed for Sections 1 and 2. If the results of these samples indicate that a MPA threshold of 10 $g/m^2$ has been exceeded, the finer segmentation approach will be implemented on half of the remaining 80-ft. grid nodes as described above. The Supplemental FSP will specify the sediment core locations for River Section 3.

### B1.4.2 Sediment Sample Analyses

As described above, the collection of sediment samples will be used to characterize the horizontal and vertical distribution of PCBs in the sediment and assist in the delineation of areas that will be targeted for sediment removal. A subset of the sediment samples collected for PCB characterization purposes will be subject to additional testing including geotechnical characterization, sub-bottom characterization and preliminary disposal characterization. The data to be generated for each of these components are discussed below. Summaries of the sediment sampling program for River Section 1, 2, and 3 are provided in Tables B-2, B-3, and B-4.

#### B1.4.2.1 Chemical Analysis of Sediments

The procedures for collecting, handling and segmenting the sediment cores are provided in Section B2.4. A homogenized sediment sample from each core segment will be analyzed for PCBs using the project-specific PCB Aroclor method presented in Appendix 5. The PCB extraction procedures are defined in Appendices 6 and 7. Additional analyses will be performed in accordance with the methods summarized in Tables B-6a to B-6j and presented in SOPs included as Appendices 10-29. These analyses include moisture content in each core segment. The top 2-inch segment also will be analyzed for a radionuclide ($^{137}Cs$), bulk density and Total Organic Carbon. Volume requirements are sufficient from the three inch diameter core to provide the necessary sample volume to conduct the analyses. Bulk density will be determined for the remaining core segment samples in the field laboratory according to the procedure described in the SOP for core processing (Appendix 1). Container requirements are summarized in Table B-5. In the first two weeks, an estimated 3000 environmental sediment samples will be analyzed for Aroclor PCBs and these other parameters (60 cores per day x 10 days = 600 cores x 5 samples per core = 3000 samples).

A project-specific method for homolog PCB analysis (USEPA Method 680 – Appendix 8) will be performed on 400 positive (i.e., not non-detect) sediment sample extracts in the first two weeks[1] (apportioned among the labs performing the Aroclor analyses based on their rate of analysis); this amounts to about 13% of the Aroclor samples. Thereafter, homolog

[1] As used herein, the "first two weeks" shall refer to the first two weeks of the sampling program or the first 3000 samples (150 SDGs with a SDG containing approximately 20 field sediment samples), whichever is greater.

analysis will be reduced to 4% of the Aroclor samples per lab (not less than 350 positive Aroclor analyses, apportioned among the labs based on their rate of analysis). The subset of sample extracts being analyzed for homologs will span the same range of PCB concentrations as the subset being analyzed for Aroclors. The homolog sample extracts will be selected from sample delivery groups (SDGs) that have satisfied the performance evaluation (PE) criteria for Aroclors (as described in Section C1.2.1.1). Figure B-1a provides a flow diagram that summarizes homolog PCB sample analysis selection.

Additionally, approximately 2% of the total number of cores (selected randomly from core segments immediately below the deepest segment in which PCBs were measured at greater than 1 ppm) will be analyzed for RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium) and high resolution dioxins/furans. The 1 ppm criterion has been selected to provide an indication of sediments that may be present at the bed surface after dredging; however, the PCB concentration used to define dredging cut lines will be established during remedial design. Figure B-1b provides a flow diagram that summarizes dioxin/furan and RCRA metals sample analysis selection. The samples for RCRA metals and high resolution dioxins/furans will be selected for analysis after completion of the PCB analysis. The storage of these samples is discussed in Section B3.2. Selection of the samples meeting the above criteria will be done on a weekly to biweekly (frequently enough that holding times are not compromised for metal or dioxins/furans) basis by querying the database for samples that are the deepest segment of a core that have PCB concentration levels at 1 ppm or less. 2 % of these samples will be randomly selected using a random number generator and submitted to the appropriate laboratory as described in section B3.2.

### B1.4.2.2 Geotechnical Characterization

A portion of the sediment samples collected during the sediment characterization program will be analyzed for geotechnical parameters to characterize the physical properties of the sediment. Consistent with the U.S. Army Corps of Engineers (USACE) guidance, the results of these analyses will be used to assess the overall dredge-ability of the sediment, including selecting dredging equipment, developing estimates of dredge production rates, and assisting in the design of the sediment transport, processing and disposal aspects of the project (USACE 1983, USACE 1986).

Approximately 5% of the sediment samples (~1350 samples) will be selected for geotechnical testing by a qualified geotechnical field technician. The selection of samples for geotechnical testing will be based on visual characterization using the Unified Soil Classification System (USCS) during sediment sample processing (Section B2.4.1). The samples will be selected in manner that will result in the evaluation of a range of sediment types. Depending on the results of the visual characterization, additional samples may be required for geotechnical characterization. If deemed appropriate based on review of the data received and the needs of the design effort, additional measurements and testing will be conducted as part of a subsequent sampling effort, as further described in the RD Work Plan (BBL 2002). Once the sediment samples for geotechnical testing are obtained, each sample will be subjected to analysis for the following parameters:

| Parameter | Method | Appendix |
|---|---|---|
| Grain Size (sieve and hydrometer as appropriate) | ASTM D422 and D1140 | 10 |
| Atterberg Limit | ASTM D4318-00 | 11 |
| Specific Gravity | ASTM D854-001 | 12 |
| Total Organic Carbon | Lloyd Kahn | 15 |
| USCS Classification | ASTM D2487 | 16 |

#### B1.4.2.3 Sub-bottom Characterization

Sub-bottom characterization will be performed on a limited basis as part of the SSAP to help define the geotechnical conditions below soft sediment. The sub-bottom characterization will include probing of the river bottom and will be performed in conjunction with the sample collection procedures presented in Section B2.4.1. During the collection of sediment cores, the sediment at each sampling location will be probed by manually advancing a probing rod into the sediment to assess sediment thickness, degree of compaction, presence of subgrade cobbles, gravel, sand, and/or rock, to the extent practicable (Appendix 4). The probing will generally be done 3 to 5 ft. away from the target sample location to avoid disturbing the sediment prior to core sample collection. Physical information and observations obtained by the initial manual advancement and subsequent vibra-coring of each of the sediment core tubes described in Section B2.4.1 for collection of sediments will also be valuable in assessing sub-bottom characteristics. A profile of subgrade conditions will be developed by combining field data, probing results, and the geotechnical characterization of sediment samples.

Physical information and observations obtained by the initial manual advancement and subsequent vibra-coring of each of the sediment core tubes described in Section B2.4.1 for collection of sediments will also be valuable in assessing sub-bottom characteristics. Profiles of sub-grade conditions will be developed by combining field data, probing results, and the geotechnical characterization of sediment samples.

#### B1.4.2.4 Preliminary Disposal Characterization

Sediment samples will be used to determine sediment characteristics that may affect acceptance for disposal in landfill facilities. This portion of the program is not intended to fully characterize sediment for disposal; however, these data will be obtained on a preliminary basis to identify what types of sampling and treatment may be required when final characterization is made for disposal purposes. Samples prepared for disposal characterization will be full core composites rather than core segments to better reflect the effects of the dredging process, because the dredging operations will tend to mix sediments as they are removed from the river.

Twenty cores will be selected at random from each of the three River Sections for preliminary disposal characterization. A length-weighted composite sample will be prepared from each core by mixing aliquots obtained from each core segment. The resulting 60 samples will be submitted for RCRA hazardous waste characteristics and concentrations (TCLP metals and organics, and ignitability), and high-resolution dioxins/furans (Appendices 21-28).

## B2 Sampling Methods

### B2.1 Side Scan Sonar Survey

Side scan sonar survey procedures will follow the SOP in Appendix 17. Acoustic imagery will be obtained along longitudinal survey lines parallel to the course of the river. Bank-to-bank side scan survey coverage will be obtained by running multiple survey lines with overlapping coverage. The surveys will be conducted using a high resolution, dual frequency, side scan sonar system. Manual probing, visual characterization of sediments during the survey, and confirmatory sampling of grain size will be conducted to ground-truth the remote sensing data. Sediment samples will be collected and analyzed for grain size. Sample locations will be selected from areas which, based on input from the geophysical contractor and USEPA, need further definition/confirmation of grain size. In each River Section, approximately 150 shallow core samples will be collected using push-core techniques, for a total of 450 samples. The top one (1) inch of each core will be submitted for grain size analysis (sieve method) in accordance with the method specified in the SOP included as Appendix 10.

The acoustic imagery will be processed and interpreted to represent graphically the physical characteristics of the riverbed (*i.e.*, sediment type or rock). These data will be used to assist in identifying the areas to be sampled, as discussed in Section B1.4.

### B2.2 Sub-bottom Profiling

Testing will be conducted according to the SOPs attached as Appendix 3 in 5 to 10 acre plots in which stratification is expected based on historical data. Sonar and ground penetrating radar will

be applied along 3-4 transects that overlay lines of sediment cores planned for or previously collected in the 2002 field season. Transects will be sampled multiple times using different acoustic and electromagnetic frequencies. The choice of frequencies will be determined based on real-time assessment of the reflected signal.

Sub-bottom acoustic and electromagnetic data will be interpreted using the stratigraphy observed in sediment cores as confirmatory data. The ability of the techniques to identify interfaces between strata accurately will be assessed and recommendations for potential use in Year 2 (*i.e.*, the 2003 field season) will be presented in the Supplemental FSP for USEPA review and approval. The specific equipment and procedures to be used in the sub-bottom profiling test will be chosen after consultation with experts in sub-bottom profiling of shallow soft-bottom river sediments. A separate Sub-Bottom Profiling Test Work Plan and associated QAPP will be developed and submitted to USEPA for review and approval in accordance with the schedule in the SSAP.

### B2.3 Bathymetric Survey

The bathymetric surveys will be conducted from the water surface following the SOP presented in Appendix 2. During the surveys, horizontal and vertical control of the vessel will be maintained through the use of an on-board global positioning system (GPS) that receives signal corrections from a shore-based unit. The expected accuracy for this system is +/- 1 cm for horizontal positioning, and +/-3 cm for vertical positioning.

The horizontal positioning data will be transmitted in real-time to an on-board vessel tracking system that is capable of displaying significant features such as the river shoreline, navigational aids, target transects for data collection, and the position of the vessel in relation to these features. This will allow the helmsman to maneuver the vessel to follow each transect laterally across the river, and collect water depth data using a digital depth sounder. The water depth data will be used to calculate the elevation of the riverbed, in reference to the elevation of a shore-based benchmark. Variability in water elevation that occurs as a result of upstream hydroelectric and canal operations will be accounted for. The data collected during this survey will be used for design support purposes.

## B2.4 Sediment Characterization

The collection and processing of sediment samples collected as part of the sediment characterization will follow the SOPs included as Appendices 1 and 18, respectively, and are summarized below. Vessels utilized for this program will be equipped with real-time kinematic differential global positioning systems capable of ±1 cm horizontal accuracy. Adequate shore-based control points to operate this system will be established. This positioning system will provide data to onboard GPS receivers that will guide vessels to pre-programmed coordinates for each core sample location. Once in position, vessels will be held in position with spuds and/or anchors, and sample collection will commence.

### B2.4.1 Sediment Characterization Core Collection and Processing

The procedures for collecting the sediment cores will follow the SOP presented as Appendix 1. Prior to attempting to collect a core, probing will be conducted in an area adjacent to the target

sample location (*i.e.*, 3 – 5 ft. away) to avoid disturbing the sediment in the vicinity where the core will be taken. The procedures for probing the sediment are described in the SOP presented as Appendix 4. The probing will identify the general characteristics of the sediment (*i.e.*, approximate depth and texture). This information will be used to evaluate whether a core can be obtained, and what type of core tube material should be used. Cores will be collected by manually advancing a sample collection tube into the sediment until significant resistance is encountered. At each location, the core tubes will be advanced further into the sediment with the aid of vibra-coring equipment, which will allow for a greater depth of penetration. In cohesive (*i.e.*, fine-grained) sediments, the cores will be collected in 3-in. outside diameter transparent polycarbonate (Lexan®) tubes. In non-cohesive (*i.e.*, coarse-grained) sediments, the cores will be collected using aluminum tubes. Once the vibra-coring equipment is no longer able to penetrate the sediment, cores will be pulled from the sediments, and the length of the recovered core sample estimated.

Core recovery in the polycarbonate tubes will be measured directly. In the aluminum tubes, the core recovery will be estimated by tapping the outside of the core tube with a small hammer and correlating the location of the change in sound with the sediment water interface. The recovery will be defined as the distance from the bottom of the core tube to the top of the sediment retained in the core tube.

If the recovery is less than 60% of the depth of penetration, the sediment in the core tube will be discarded (contained on the vessel for proper disposal). Up to three attempts at vibra-core collection will be made to obtain an acceptable core. Between attempts, the core tube will be rinsed with river water until all sediment is visibly removed. If the third vibra-coring attempt is

unacceptable based on recovery alone, it will be flagged but still used as a sample for that location. If sediment probing indicates a sediment depth of less than 6 inches over a hard substrate, only one vibracore attempt will be made. If a minimum of 60 percent recovery is not achieved, a ponar grab sample will be collected. Grab samples will be sent to NEA for analyses which will include a laboratory measurement of bulk density. A minimum distance of 1 ft. will be maintained between the locations of attempted core samples. If an acceptable core cannot be collected within 10 feet of the node location, the attempts at collecting the core and the conditions preventing the collection will be recorded on the field log, and the location will be abandoned.

If a sampling location is abandoned it will be considered a null location with sediments too shallow to be dredged and therefore MPA will not be mapped over it. Side scan sonar information will be used to determine the extent of the null area.

Upon collection of an acceptable core, the core will be capped, sealed, and labeled. Core tubes will be labeled by writing directly on the core tube using a permanent marker. The labeling will include the core identification number, date, and time. In addition, an arrow will be drawn on the core to indicate the core top. All other field data will be recorded in the field log (Figure A-6), as described in the Core Collection SOP (Appendix 1). The capped cores will be maintained in a vertical position and stored on ice in a storage rack kept in the dark until they are submitted to the field processing facility at the end of each day and cut into segments the following day.

Processing of the sediment cores into analytical samples will follow the SOP presented as Appendix 18. The field processing facility will be equipped to process approximately 60

sediment cores per day. This will require multiple "assembly lines," each consisting of an area for supporting and cutting the core tubes, homogenizing (*i.e.*, mixing) the sediment and placing it into sample containers, and a system for producing labels for the sample containers and maintaining records, including chain of custody forms. Additionally, decontamination facilities that include adequate ventilation, new and spent solvent storage facilities, and liquid and solid PCB waste storage facilities will be required.

When a sediment core arrives at the field processing facility, field notes prepared by the sampling personnel will accompany it. A sample custodian will enter this information into a database. This database will be used to compile information as the sample processing proceeds, and will be capable of producing chain of custody forms that will accompany processed samples to off-site analytical laboratories. Additionally, this database will be formatted in a manner that will facilitate entry of analytical data electronically as it is received from the laboratories.

The initial step will be to weigh the core tube. The weight of the core tube, the tube caps, sediment and water will be used to calculate an initial estimate of the sediment bulk density. Cores will be transported with the water head space to minimize disturbance with the top core layer. The next step will be removal of the cap on the top of the core. Any standing water above the sediment will be siphoned off once the fines have settled. The length of the recovered core will then be measured, and the outside of the core tube will be marked to identify where the core tube will be cut into segments. The marking procedure will include placing arrows on each segment to indicate the upper end. The segmentation scheme has been designed to provide, among other things, information required to define the boundary between the PCB-containing sediments and any underlying clean sediments. Additionally, the top 2 inches of sediment in

each core will form a section to provide information useful to determining the erodibility of sediments in River Section 3 and in the assessment of baseline PCB levels in surface sediments. The length of the core segments will vary from core to core, depending on the total length of the recovered core. The core segmentation approach is presented in Figure B-3. For cores with a sample recovery of 2 ft. or less, the upper segment will be 2 in., the next segment will extend from 2-6 in., with the remainder of the core cut into 6-in. segments. For cores with a sample recovery greater than 2 ft., but less than 3 ft., the upper segment will be 2-in. long; the next segment will extend from 2–12 in., with the remainder of the core cut into 6-in. segments. For cores with a sample recovery exceeding 3 ft., the upper segment will be 2-in. long; the next segment will extend from 2–24 in., with the remainder of the core cut into 6-in. segments. Material at the very bottom of the core, typically the last 2 inches, will be discarded and not used as sample to avoid sediments entrained during the coring process. The last (bottom) sample segment of each core will typically be less than 6-in. long. These segments will be submitted for analysis if they are at least 1 in. in length. If less than 1 in., this material will be combined with the segment above it, and the total length of the bottom core will be recorded.

Prior to extruding the sediment from the core tubing, the core tube will be cut into segments (vibratory saw for polycarbonate tubing, pipe cutter for aluminum tubing). Therefore, the sediment will only be extruded from the section of the core tubing that corresponds to the sample that will be mixed and analyzed. As the core tube is cut, the portion of the tube above and below the cut will be supported. When the core tube is cut through, the core segment will be separated from the rest of the core with a stainless steel broad knife. The sediment will then be removed from the core tube segment with a stainless steel spatula, placed in a stainless steel bowl, and thoroughly homogenized prior to placing the sample into an appropriate sample container. The

mixing bowl to be used for each core segment will be tared prior to placing the sediment into the bowl so an accurate weight can be recorded for bulk density calculation. Equipment that is reused (cutting tools, broad knife, spatula, bowls) will be decontaminated prior to reuse in accordance with the procedures specified in Section B2.4.2.

A brief description of the physical characteristics of each core segment will be recorded in the field database. These characteristics will include the general soil type (fine sand, coarse sand, gravel, silt, clay, and organic/other matter such as wood chips), presence of observable biota, odor, and color. Each core segment will be examined visually to identify changes in sediment characteristics as it is extruded from the core tubing. If changes in stratigraphy are observed within a core segment, then the nature and approximate length of the various layers will be noted in the field database. If any objects of cultural significance are observed during the core processing, they will be noted in the field database and separated from the sediment and stored at the field processing facility for subsequent inspection by a qualified geomorphologist or archaeologist.

Sample volumes and corresponding container specifications are provided in Table B-5. Samples will be chilled to 4°C and kept in the dark until they are relinquished to the analytical laboratory. All reusable materials that come into contact with the sediment will be decontaminated in accordance with the procedures specified in Section B2.4.2. Disposable equipment and residual materials will be properly contained for proper disposal.

GE will archive the remaining portion of each sediment sample collected and analyzed by GE pursuant to the Consent Order in one 4-ounce storage jar. The purpose of such archiving is to

ensure that the data needs to be served by the sediment samples for the design and implementation of EPA's remedy have been satisfied. Subsequent analysis of the archived samples may be necessary if, for example, there are problems with the quality of the data obtained from the initial analysis, or if data gaps relating to the above goal are identified by GE or USEPA, or if additional data are needed to characterize sediments for disposal. However, GE's obligation to archive samples shall not obligate GE under this Consent Order to conduct any analyses beyond those required by the Consent Order and the Sediment Field Sampling Plan.

GE will continue to archive the samples from each year of field investigations until such time as USEPA has approved the delineation of areas to be dredged. Thereafter, USEPA will have the option of obtaining some or all of the archived samples pursuant to Paragraph 58 of the Consent Order. All parties reserve whatever rights they have under applicable law with respect to such samples, including (but not limited to) GE's right to challenge any analysis of such samples conducted by EPA (subject to Paragraph 62 of the Consent Order) or by any third party. These archiving obligations will not abrogate or otherwise affect any rights or obligations of either GE or the Trustees for Natural Resources with respect to such samples.

Samples for engineering parameters will be obtained from a subset of the sediment core segments in accordance with SOPs presented in the Appendices 10-16. The engineering data samples will be prepared by placing a portion of the homogenized sediment from the core segments into appropriate containers, as specified in Table B-5. The containers for PCB analysis will be filled before the containers for engineering parameters are filled. If the sample volume is insufficient to perform the engineering data analyses, additional sample volume will be obtained by forming a composite sample using a portion of an adjacent homogenized core segment. As a

last resort, sample collection for engineering data may be abandoned for that segment, although this will be minimized to reduce any potential for bias. The core segments used to form the composite and proportions thereof will be described in the project database.

Samples for preliminary disposal characterization will be obtained from a subset of the sediment cores in accordance with the SOPs presented in Appendices 21-28. The samples will be prepared by homogenizing the sediment from each core segment in a single core separately, and then forming a composite sample containing homogenized sediment from each of the segments in the core. The composite sample will be placed in containers, stored and analyzed appropriately, as specified in the SOPs included as Appendices 21-28 and Table B-5.

### B2.4.2 Decontamination Procedures

All non-disposable equipment that comes in contact with sediment will be decontaminated prior to reuse in accordance with the procedures specified herein. These procedures include:

- wash with laboratory grade detergent;
- rinse with distilled water;
- rinse with acetone and allow to dry (contain rinsate for appropriate disposal);
- rinse with hexane and allow to dry (contain rinsate for appropriate disposal); and
- rinse with distilled water.

Although decontamination of equipment used for inorganic analyses (e.g. RCRA metals) usually involves nitric acid, for several reasons, it will not be used here. Its use on the sampling vessel poses a handling hazard. It would have to be used in the decontamination of non-disposable

laboratory equipment used to process thousands of sediment samples even though less than 200 of these samples would be analyzed for Total RCRA metals (selection of the samples will not occur until after completion of the Total PCBs as Aroclor analysis). The decontamination procedures outlined above will remove most of any metal contamination. Finally, field blanks will provide a direct check on the significance of any metal contamination.

Residual sediment core segments and decontamination fluids (generated in the field processing facility and on the sampling vessels) will be stored in an appropriately designed storage facility at the field processing facility prior to shipment for off-site disposal in accordance with applicable regulations. Decontamination facilities for new and spent solvent storage, and solid PCB waste storage will be required.

Disposable materials that come into contact with sediment such as personal protective equipment will also be stored at the field processing facility prior to appropriate off-site disposal as PCB-containing waste. Used core tube sections will be disposed of as PCB waste.

## B3 Sample Handling and Custody Requirements

### B3.1 Field Activities Sample Custody

As described in Section 2.2.5 of the FSP, upon collection of an acceptable sediment core (see Appendix 1 for the SOP on core collection) the core will be capped, sealed and labeled. The capped cores will be maintained in a vertical position aboard the sampling vessel until the end of the day when they are submitted to the field processing facility and cut into segments. Core

sample processing will follow the SOP presented in Appendix 18. The field lab will process up to 60 sediment cores a day, or approximately 300 samples.

The primary objective of sample custody procedures is to create an accurate written record which can be used to trace the possession and handling of samples from the moment of their collection, through analysis, until their final disposition.

A sample (or sample container) will be considered under custody if:

- It is in the Field Sampling Manager's (or his designate's) possession,
- It is in the Field Sampling Manager's (or his designate's) view, after being in the Field Sampling Manager's (or his designate's) possession,
- It was in the Field Sampling Manager's (or his designate's) possession and the Field Sampling Manager (or his designate's) locked it up, or
- It is placed in a designated secure area by the individual who is maintaining custody.

A field log (Figure A-6) will be used to document custody of the sediment cores from the time they are collected until the cores are delivered to the field sample processing laboratory. Custody of the sediment cores will be transferred by the core collection personnel to the Core Processing Contractor by a release and acceptance signature as indicated on the field log (Figure A-6). The field log transfer of the sediment cores will terminate transfer of the sediment cores to the processing laboratory where sample custody will begin. A copy of the field log forms will be maintained on file at the sediment sample processing laboratory. Custody for samples collected

from sediment sample core processing will be maintained by the Core Processing Contractor or the field personnel collecting the samples. The Processing Lab Coordinator or field personnel are responsible for documenting each sample transfer and maintaining custody of samples until they are shipped or delivered by courier to the laboratory or archived or disposed.

All necessary sample containers will be shipped or delivered by laboratory courier to the sediment sample processing facility and received by the Core Processing Contractor or field personnel. Sample containers meeting EPA cleaning requirements may be purchased by GE and shipped directly to the site due to the volume of sample containers needed. Under this condition, certificates of analysis documenting the bottle cleanliness will be filed at the sample processing facility. Sample container and preservation requirements are presented in Table B-5. The laboratory(ies) or bottle vendor will deliver containers on a periodic basis to the facility such that an adequate supply of sample containers exists for several days. A laboratory supplied and initialed Chain-of-Custody will be used to document preparation and delivery of sample containers to the site. The Core Processing Contractor will terminate this container delivery Chain-of-Custody upon receipt at the site and copies will be filed in the sample processing laboratory records. Sample containers needed for a specific sampling task will then be relinquished by Core Processing Contractor (or designate) to the sampling team after verifying the integrity of the containers and confirming that the proper bottles have been assigned for the task to be conducted.

After a given sample has been prepared, a self-adhesive, waterproof label will be affixed to each container. An example label is provided in Figure B-4. At a minimum, the sample label will contain:

- Field sample identification number,
- Date and time collected,
- Custodian's initials, and
- Analytical category.

The analytical categories include AROCLOR, RADNUC, GEOTEC, DISPOSAL or ARCHIVE. The categories were chosen based on the fact those samples in different categories will go to different laboratories for analysis. For example, the sample labeled AROCLOR may also have moisture content, bulk density and TOC performed on it, but the same laboratory will do all analyses.

Immediately after sample preparation and labeling, each sample container designated for analysis will be sealed into a plastic bag and placed into an insulated cooler with "wet ice" or icepacks (for samples requiring temperature preservation) and appropriate packing materials for shipment to the laboratory.

A field Chain-of-Custody record will accompany the samples to their destination. An example of the field Chain-of-Custody records is provided in Figure A-7. Field Chain-of-Custody records may be prepared either using a computerized sample tracking and Chain-of-Custody program that will be integral to the project database or via hand or preprinted Chain-of-Custody forms. The sampling personnel will properly relinquish the samples on the field Chain-of-Custody record. These record forms will be sealed in a plastic bag to protect them against moisture. The temperature of a temperature bottle blank will be monitored to ensure all samples requiring

temperature preservation are within 4°± 2° Celsius (C), as required, prior to leaving the site. Temperature blanks will consist of bottles filled with distilled or tap water. The shipping coolers will then be sealed utilizing custody seals that will be initialed by the Core Processing Contractor or designate. All sample coolers will be delivered to the analytical laboratory by either direct courier or 24-hour delivery courier (*i.e.*, Federal Express) at the end of each day's sample processing activities.

### B3.2 Laboratory Receipt and Custody

Once samples are received at the laboratory, the field Chain-of-Custody record is completed and signed by the individual Laboratory Sample Custodian. The Laboratory Sample Custodian will check the sample bottle labels against the corresponding information listed on the field Chain-of-Custody records and note any discrepancies. Additionally, the laboratory sample receipt personnel will note any damaged or missing sample containers. The laboratory personnel will check chemical preservation for sample analyses that require addition of acid or base by recording the pH of each sample container during the sample login process. This information will be recorded on the field Chain-of-Custody record and/or in a separate logbook. The temperature of the temperature bottle blank included in each cooler of samples requiring temperature preservation will also be recorded at the time of sample receipt by the laboratory personnel. This temperature will also be measured on the field Chain-of-Custody record and/or in a separate logbook. Any discrepancies in sample identifications, sample analysis information, any indication that samples are missing upon receipt at the laboratory, or any indication that samples not received at the correct pH or temperature (4°± 2°C) will be communicated to the QA

Program Manager and Field Sampling Manager within 24 hours of sample receipt so that appropriate corrective action can be determined and implemented.

After the sample receipt information is checked and recorded, sample analysis information will be entered into the individual Laboratory Information Management System (LIMS) (or equivalent). Each sample will be provided a unique laboratory identification number and the analysis tests requested on the Chain-of-Custody records entered into the LIMS. After the required information has been entered into the LIMS, the Laboratory Sample Custodian will initiate an internal laboratory Chain-of-Custody. The internal Chain-of-Custody will document the transfer of samples from the storage location to the analyst for analysis and subsequently through final disposition at the laboratory. At a minimum, the internal Chain-of-Custody will include client identification, laboratory sample number, sample matrix, signatures for relinquishing and receiving samples or sample extracts or digestates, and reasons for the change in custody (procedure to be performed).

Samples for sediment characterization, geotechnical characterization and preliminary disposal characterization will be contained in separate jars (Table B-5). Sediment characterization samples to be analyzed for total RCRA metals and dioxins/dibenzofurans will be delivered to one of the primary total PCB analytical laboratories and then subsequently transferred to the laboratory performing the dioxin/dibenzofuran or total RCRA metals analyses. Selection of the sample segment to be analyzed for dioxin/dibenzofurans or total RCRA metals will be determined after the total PCB results are evaluated (refer to Figure B-1b).

The laboratory that performed the total PCB analysis will deliver the retained original sample under chain-of-custody to the designated laboratory. The total PCB laboratory will initiate a new Chain-of-Custody record for delivery of the sample to the appropriate laboratory and will also include copies of the original Chain-of-Custody Record delivered with the samples. The receiving laboratory for total RCRA metals or dioxins/dibenzofurans will include the transfer Chain-of-Custody Records in the final data package.

All completed field and laboratory Chain-of-Custody records will be provided in the laboratory analysis data package as part of the required deliverable report.

Samples will be stored in secure, limited access areas in an environment that maintains any required temperature preservation noted in Table B-5. According to Table B-5, samples for most analyses are required to be refrigerated at a temperature of 4° ± 2° C. The temperature of the refrigerators or freezers used to store samples will be monitored by the project laboratories according to their internal standard operating procedures. Samples which do not require temperature preservation will be stored at room temperature. Disposal of unused raw sample volumes, sample extracts, and sample digestates will be in accordance with each laboratory's waste management procedures. Disposal of raw samples will occur after 14 days from the date the analysis report (full data package) was issued.

### B3.3 Extract and Sample Archive Procedures

Sample extracts will be held (frozen at<-10°C) from each year of field investigations until such time as USEPA has approved the delineation of areas to be dredged. GE will archive the

remaining portion of each sediment sample collected and analyzed by GE pursuant to the Consent Order in one 4-ounce storage jar. The purpose of such archiving is to ensure that the data needs to be served by the sediment samples for the design and implementation of EPA's remedy have been satisfied. Subsequent analysis of the archived samples may be necessary if, for example, there are problems with the quality of the data obtained from the initial analysis, or if data gaps relating to the above goal are identified by GE or USEPA, or if additional data are needed to characterize sediments for disposal. However, GE's obligation to archive samples shall not obligate GE under this Consent Order to conduct any analyses beyond those required by the Consent Order and the Sediment Field Sampling Plan.

GE will continue to archive the samples from each year of field investigations until such time as USEPA has approved the delineation of areas to be dredged. Thereafter, USEPA will have the option of obtaining some or all of the archived samples pursuant to Paragraph 58 of the Consent Order. All parties reserve whatever rights they have under applicable law with respect to such samples, including (but not limited to) GE's right to challenge any analysis of such samples conducted by EPA (subject to Paragraph 62 of the Consent Order) or by any third party. These archiving obligations will not abrogate or otherwise affect any rights or obligations of either GE or the Trustees for Natural Resources with respect to such samples.

Archived samples will be stored frozen in a clean and controlled manner at a temperature of <-10°C. Daily temperature measurements will be taken and recorded at the storage location using a NIST calibrated thermometer to document proper temperature preservation. A label identical to that placed on the original sample will be used to identify the archive sample.

## B4 Analytical Procedures

The Hudson River Design Support Sediment Sampling and Analysis Program will involve the analysis of sediment samples for chemical parameters and/or geotechnical characterization. The justification and rationale for the selected analyses are presented in Section A7.

The following laboratories will provide analytical services for the SSAP:

- Northeast Analytical, Inc. (NEA, Schenectady, New York) will perform Total PCBs as Aroclors, Total PCBs as homologs, bulk density, TOC and moisture content analysis. NEA will be responsible for analysis of the top 2" core segment sample for each core.,
- Axys Analytical Services, LTD (Sydney, British Columbia, Canada) will provide independent confirmation Total PCB as homologs analysis of the PE extracts,
- Accutest Laboratories (Dayton, New Jersey) will perform Total PCBs as Aroclor and moisture content analysis,
- CT&E Environmental Services, Inc. (Charleston, West Virginia) will perform Total PCBs as Aroclor and moisture content analysis,
- Lancaster Laboratories, Inc. (Lancaster, Pennsylvania) will perform Total PCBs as Aroclor and moisture content analysis,
- STL Pittsburgh (Pittsburgh, Pennsylvania) will perform Total PCBs as Aroclor, moisture content analysis, TCLP analyses, ignitability, and total RCRA metals,
- STL Burlington (Burlington, Vermont) will perform the geotechnical testing analysis,
- STL Edison (Edison, New Jersey) will perform Total PCBs as Aroclor and moisture content analysis as a backup laboratory,

- Paradigm Analytical Laboratories, Inc. (Wilmington, North Carolina) will perform the dioxin/dibenzofuran analysis, and
- Teledyne Brown Engineering, Inc. (Knoxville, Tennessee) will provide the radionuclide analysis.

### B4.1 Chemical Analysis Procedures

The chemical analyses to be performed collectively for sediment samples include the Target Compound List (TCL) Aroclors and Total PCBs; PCB homologs as Total PCBs; Toxicity Characteristic Leaching procedure (TCLP) volatile organic compounds, TCLP semivolatile organic compounds, TCLP pesticides, TCLP herbicides, and TCLP metals; ignitability, polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs or dioxins/dibenzofurans) total homologs and 17 2,3,7,8-chlorine containing toxic isomers); total RCRA metals; $^{137}$Cesium, total organic carbon (TOC), bulk density, and moisture content.

The Total PCBs as Aroclors analyses may potentially be performed at any of the project laboratories identified above to perform this analysis, depending on the pace of the field program and the laboratory's capacity at the time of the sampling event. This managed capacity will minimize potential analysis problems due to overburdening at any one laboratory. As such, the comparability of the analytical data between the project laboratories for these analyses was of paramount importance. Therefore, the project team developed analytical standard operating procedures (SOPs) for these analyses that provided a common procedure for use at all project laboratories. These jointly developed SOPs provide for common QC procedures, acceptance

criteria and corrective actions so that comparable data can be produced for these analyses since samples will be dispersed to multiple facilities.

NEA will perform all paired PCB homolog analyses. The GEHR8082 PCB analysis extracts associated with compliant PE analysis results will be shipped under Chain-of-Custody to NEA for PCB homolog analysis using GEHR680 (see Figure B-1a). STL Pittsburgh will perform the TCLP volatile organic compounds, TCLP semivolatile organic compounds, TCLP pesticides, TCLP herbicides, TCLP metals, ignitability and total RCRA metals analyses. Paradigm Analytical Laboratories, Inc. will perform the PCDD/PCDF (dioxin/dibenzofuran) analyses. Teledyne Brown Engineering, Inc. will perform the $^{137}$Cesium analysis.
The procedures that will be used to analyze samples for chemical parameters are summarized below:

- GE Hudson River Design Support Sediment Sampling and Analysis Program Standard Operating Procedure for the extraction and cleanup of sediment/solid samples for Polychlorinated Biphenyl (PCB) analysis using the Soxhlet extraction technique by SW-846 Method 3540C for subsequent analysis by SW-846 Method 8082. (GE SOP GEHR 3540C – Appendix 7)

- GE Hudson River Design Support Sediment Sampling and Analysis Program Standard Operating Procedure for the extraction and cleanup of sediment/solid samples for Polychlorinated Biphenyl (PCB) analysis using the pressurized fluid extraction technique as per SW-846 Method 3545 for subsequent analysis by SW-846 Method 8082. (GE SOP GEHR3545 – Appendix 6)

- GE Hudson River Design Support Sediment Sampling and Analysis Program Standard Operation Procedure for Polychlorinated Biphenyls by SW-846 8082. (GE SOP GEHR8082, to be used for TCL Aroclor and total PCB analysis – Appendix 5)

- GE Hudson River Design Support Sediment Sampling and Analysis Program Standard Operation Procedure for the Determination of PCBs in Sediment by Gas Chromatography/Mass Spectrometry by EPA Method 680 (GE SOP GEHR680), to be used for PCB homolog and total PCB analysis – Appendix 8)

- GE Hudson River Design Support Sediment Sampling and Analysis Program Standard Operation Procedure for Total Organic Carbon by Lloyd Kahn (Appendix 15)

- $^{137}$Cesium determination in sediment/solid by gamma ray spectroscopy (Appendix 20)

- TCLP preparation by SW-846 Method 1311 (Appendix 21)

- Volatiles Analysis of TCLP Leachates by SW-846 Method 8260B (Appendix 22)

- Semivolatiles Analysis of TCLP Leachates by SW-846 Method 3510C/3520C/8270C (Appendix 23)

- Pesticides Analysis of TCLP Leachates by SW-846 Method 3510C/3520C/8081A (Appendix 24)

- Herbicides Analysis of TCLP Leachates by SW-846 Method 8151A (Appendix 25)

- Metals Analysis of TCLP Leachates by SW-846 Method 3010A/6010B/7470A (Appendix 26)

- Ignitability by SW-846 Chapter 7 (Appendix 27)

- PCDD/PCDF Analysis of sediment/solids by EPA Method 1613B (Appendix 28)

- Metals Analysis of sediment/solid samples by SW-846 Methods 6010B/7471A (Appendix 29)

- Bulk Density (ASTM D4531-86, modified, Appendix 13)

- Water Content (EPA Method 160.3, as defined in the Total PCB extraction SOPs provided in Appendix 6 and Appendix 7)

The above procedures are based upon the methods summarized in "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods," November 1986, SW-846 Third Edition, and updates, as applicable; US EPA Office of Water Methods, ASTM International and the US Army Corp of Engineers.

The reporting limits for the project parameters are summarized on Tables B-6a – B-6j. It should be noted that the reporting limits listed in Tables B-6a – B-6j may not always be achievable due

to matrix effects, necessary dilution of the sample, and/or interferences. Additionally, the sediment/solid samples will be reported on a dry-weight basis. The reporting limits listed in Tables B-6a – B-6j for sediment/solid sample matrices are based on dry-weight.

The analytical procedures to extract and analyze Aroclors and Total PCBs by SOP GEHR8082 (Appendix 5) are project specific improvements to the guidance provided in SW-846 Method 8082. For example, SW-846 Method 8082 indicates initial calibration of the gas chromatograph using a five standard concentration levels of Aroclor 1016 and Aroclor 1260. The GE project specific method GEHR8082 initial calibration consists of five standard levels of the Aroclors known to be the predominant Aroclors or suspected Aroclors to be detected based on historical data (Aroclor 1221, Aroclor 1242 and Aroclor 1254). Method GEHR8082 requires a single level standard to be analyzed for the remaining Aroclors (Aroclor 1016, Aroclor 1232, Aroclor 1248 and Aroclor 1260) at or below the reporting limit of 200 ug/Kg. Additionally, if Aroclor 1016, Aroclor 1232, Aroclor 1248 or Aroclor 1260 are qualitatively identified in a sample based on pattern recognition to the reporting limits standard, the gas chromatograph system is required to have a complete five concentration level calibration and the sample extract reanalyzed for quantitative reporting. In addition to the example just presented, ambiguities in the SW-846 Method 8082 guidance have been eliminated by defining specific QC acceptance criteria, corrective actions and reporting procedures in the project specific method GEHR8082. A summary for quick reference of the analytical QC frequency, acceptance criteria and corrective action is provided in “Summary Table GEHR8082” included in SOP GEHR8082 (Appendix 5) for quick reference.

The homolog and total PCB analysis method, SOP GEHR680, is based upon the standard EPA Method 680. This analytical technique will be used to determine homolog distributions and total PCBs for use in developing the Tri+PCBs to total PCBs as Aroclors relationship.

### B4.2 Geotechnical Characterization Analysis Procedures

Samples selected for geotechnical characterization will be analyzed for grain size distribution, Atterberg Limits, specific gravity, and USCS classification as necessary to obtain geotechnical information on the sediments collected during field activities. STL Burlington will perform the geotechnical testing services.

The procedures that will be used to perform geotechnical characterization are summarized below:

- Grain Size Distribution (sieve and hydrometer as appropriate) by ASTM Methods D422 and D1140 (Appendix 10)
- Atterberg Limit by ASTM Method D4318-00 (Appendix 11)
- Specific Gravity by ASTM Method D854-001 (Appendix 12)
- USCS Classification by ASTM D2487 (Appendix 16)

The above procedures are based upon the methods summarized in "ASTM International Annual Book of Standards."

## B5 Quality Control Requirements

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. The intended use of data, analytical measurements and the availability of resources are an integral part in development of the DQOs. DQOs define the total uncertainty in the data that is acceptable for each specific activity during the sampling events. This uncertainty includes both sampling error and analytical instrument error. Ideally, the prospect of zero uncertainty is the intent; however, the variables associated with the collection process (field and laboratory) inherently contribute to the uncertainty of the data. The overall quality assurance objective is to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. In order to achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness will be specified. The overall objectives and requirements for this project have been established to assure a high degree of confidence in the data obtained. The DQO Tables, Reference Limit and Evaluation Tables, and Measurement Performance Criteria Tables are found in Tables A-1, B-6a – B-6j and B-7a – B-7n.

### B5.1 Field QA/QC Samples

QA/QC samples will be collected in the field to allow evaluation of data quality. Field QA/QC samples include equipment blanks, duplicate samples, matrix spike samples and matrix spike duplicate samples. During the SSAP, USEPA intends to split sediment samples with GE and analyze them for PCBs. The types and frequency of QA/QC samples to be collected for each

parameter are described below. QA/QC samples prepared in the laboratory include method blanks, laboratory control spikes, and temperature blanks. Field quality control checks used during this investigation will include the following:

Split Sample Analysis

During the SSAP, USEPA intends to split sediment samples with GE and analyze them for PCBs. GE will analyze its portion of split samples (up to 100 analyses) for both Aroclor (Appendix 5) and homologs by USEPA Method 680 (Appendix 8). For the split samples in which GE performs analysis by USEPA Method 680 (Appendix 8), USEPA will analyze its portion of the split sample utilizing an analytical method that is consistent with the method given in Appendix 8. The precision goal for these split sample results is 25% (median) within each River Section and within 75% on an individual basis. If the median RPD within any River Section is greater than 25%, GE will take appropriate corrective action in accordance with the corrective action process outlined in Section C1.3.

Equipment Blanks

The purpose of analyzing equipment blanks is to demonstrate that sampling procedures do not result in contamination of the environmental samples and to evaluate the effectiveness of the decontamination of field equipment performed by field personnel. For organics and TOC samples with solid matrix, equipment blanks will be prepared by processing a sample of laboratory grade sand (sodium sulfate may be substituted depending on laboratory preference) in the same manner that environmental samples including placement in new core sample tubing, removal, mixing, and placing in containers. Equipment blanks will not be collected for TCLP

metals, total RCRA metals or $^{137}$Cesium analysis because a contaminant-free solid blank matrix does not readily exist. Additionally, an equipment blank for total RCRA metals analysis would have to be collected on each core since sample segments for this analysis will not be selected until after receipt of the Total PCBs as Aroclor analysis, which is not practical with the number of cores involved with the SSAP. Equipment blanks will be collected at the rate of 5% of the total number of environmental samples. If compounds/analytes of interest are detected at levels greater than the reporting limit for the parameter the sampling crew should be notified so that the source of contamination can be identified (if possible) and corrective measures taken prior to the next sampling event. If the concentration in the associated samples (cores taken on same day) is less than 5 times the value in the equipment blank, the results for the environmental samples may be affected by contamination and should be qualified (see Section D).

Field Duplicates

The purpose of analyzing field duplicates is to demonstrate the precision of sampling and analytical processes. Field duplicates will be prepared in the field laboratory at the rate of 5% of the total number of environmental samples and will consist of two aliquots from the same segment of a sediment core (after homogenization). The analysis of a duplicate sample precludes that analytes are to be found at appreciable levels in samples. The relative percent difference (RPD) of the two measurements on the sample is calculated by the following equation:

$$RPD = (DUP1-DUP2)/AVG \times 100\%$$

Where: DUP1 = the greater of the measured values

DUP2 = the lesser of the measured values

AVG = average of the two analyses

Note: One half the RL is used in the calculation if the analyte is "not-detected".

Precision criteria are listed in the Tables B-7a – B-7n. If the RPD of sediment field duplicate results is greater than the QC acceptance criteria, the environmental results for the field duplicate pair will be qualified as estimated. The field laboratory crew processing the sediment cores should be notified so that the source of sampling variability can be identified (if possible) and corrective action taken.

Matrix Spikes and Matrix Spike Duplicates

The purpose of analyzing matrix spikes (MS) and matrix spike duplicates (MSDs) is to assess analytical accuracy and recovery of analytes of interest in a particular sample matrix. Laboratory duplicates (LDs) are typically substituted for MSDs for inorganic and wet chemistry analyses. Matrix spike and matrix spike duplicate samples are not required for every analysis under the SSAP. Specifically, MS and or MSD are required as defined below.

1. Aroclors and Total PCBs by SOP GEHR8082: MS and MSDs not required by US EPA for the SSAP.
2. PCB Homologs by SOP GEHR680: MS and MSDs not required by US EPA for the SSAP.
3. TCLP Analyses: MS required but MSD/Laboratory Duplicate not required based on US EPA SW-846 Method 1311.
4. Dioxins/Dibenzofurans – MS and MSD not required based on US EPA Method 1613B.

5. $^{137}$Cesium – MS and MSD not required due to the inability to verify isotope distribution in the sample. MS and MSDs are not performed by radionuclide testing laboratories.
6. TOC: MS and Laboratory Duplicate required.
7. Ignitability, Bulk Density and Moisture Content: Laboratory duplicate required.

MSs/MSDs/LDs will be analyzed at the rate of one pair per sample batch (up to 20 samples) for non-PCB analyses. Each MS/MSD will consist of an aliquot of laboratory-fortified environmental sample. Preferably a sample of low level concentration should be used so that the spike level is of sufficient concentration over the background level of the chosen sample. Spike concentrations are given in the analytical SOPs presented in Appendices 5-8, 15, and 19-29. The MS and MSD are extracted and analyzed following procedures used for actual sample analysis. The percent recovery of the MS/MSD is calculated by the following equation:

$$\%REC = (A-B)/T \times 100\%$$

Where: A = concentration of analyte in the spike sample aliquot

B = background concentration of compound or analyte in the unspiked sample aliquot

T = known true value of the spike concentration

Matrix spike recovery information is used to assess the long-term accuracy of a method. Percent recovery and precision criteria are listed in Tables B-7a – B-7n. If the percent recovery or the precision between the MS and MSD is outside the limits, all calculations should be checked and the data should be qualified (see Section D).

An additional requirement for this project is to prepare MS/MSD samples that contain all target compounds/analytes of interest so that method performance information is obtained for all analytes. The addition of known concentrations of compounds/analytes into the sample also monitors extraction/digestion efficiency.

Performance Evaluation (PE) Samples

PE samples will be used as an accuracy performance measure for samples to be analyzed for PCBs by GEHR8082 and GEHR680. Details of the PE program are described in Section C1.2.1.

## B5.2 Laboratory QA/QC Procedures

Method Blanks

The purpose of analyzing method blanks is to demonstrate that the analytical procedures do not result in sample contamination from the laboratory solvents, reagents, or glassware used in processing the samples. Method blanks will be prepared and analyzed by the contract laboratory at a rate of at least one per analytical batch. Method blanks will consist of laboratory-prepared blank water processed along with the batch of environmental samples including all manipulations performed on actual samples. The method blank should be prepared and analyzed before analysis of the associated environmental samples. If the result for a single method blank is greater than the reporting limit the source of contamination should be corrected, and the associated samples should be reanalyzed. If reanalysis is not possible, the laboratory should flag the associated data and note the deviation in the case narrative.

Laboratory Control Spikes

The purpose of analyzing laboratory control samples is to demonstrate the accuracy of the analytical method. Laboratory control spikes (LCSs) will be analyzed at the rate of one per sample batch (up to 20 samples). Laboratory control spikes consist of laboratory-fortified method blanks. The accuracy criteria are listed in Tables B-7a – B-7n. If the recovery is outside this range, the analytical process is not being performed adequately for that analyte. The sample batch must be re-processed and the LCS reanalyzed. If reanalysis is not possible, the associated sample results should be quantified as low or high biased. The percent recovery of the LCS is calculated by the following equation:

$$\%REC = (A-B)/T \times 100\%$$

Where: A = concentration of analyte in the spike sample aliquot

B = background concentration of compound or analyte in the unspiked sample aliquot

T = known true value of the spike concentration

Temperature Blanks

The purpose of preparing temperature blanks and sending the temperature blanks in the sample coolers on location is to enable the laboratory to monitor the temperature of the coolers (and samples) upon receipt at the laboratory. A temperature blank will be provided in each cooler sent from the laboratory to the field.

Instrument level QC performed by the laboratory and the frequencies for these measures is presented in the applicable laboratory SOP which are included in Appendices 5-8, 10-16, and 19-29.

## B6 Equipment/Instrumentation Testing, Inspection, and Maintenance

### B6.1 Field Equipment

Equipment failure will be minimized by inspecting all field equipment to assure that it is operational and by performing appropriate preventive maintenance activities. Field sampling equipment and associated support equipment will be inspected prior to collecting each sample and any necessary repairs will be made prior to decontaminating and reusing the equipment. Routine daily maintenance procedures of field equipment to be conducted in the field will include:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment and measurement systems,
- Storage of equipment away from the elements,
- Daily inspections of sampling equipment and measurement systems for possible problems (*e.g.*, damage or weak batteries),
- Check instrument calibrations as described in Section B7 of the QAPP, and
- Charging battery packs for equipment when not in use.

Field equipment maintenance will be documented in the applicable field logs. Specific equipment that will be inspected/tested includes:

- The Global Positioning System (GPS) on each sampling vessel and the geophysical testing equipment will be maintained in accordance with the manufacturer's recommendations.
- Instrumentation used to collect geophysical data will be maintained in accordance with the manufacturer's recommendations.
- Vibracoring equipment will be inspected daily to ensure they are in proper working condition and maintained in accordance with manufacturer's recommendations.
- Sampling vessels will be inspected daily and maintained in good working order.

Spare parts and supplies will be stored in the field or processing laboratory facility to minimize downtime. These items include, but are not limited to, the following:

- Appropriately-sized batteries,
- Extra sample containers and preservatives,
- Extra sample coolers, packing material, and ice,
- Sufficient supply of decontamination solvents (acetone and hexane)
- Tubing cutters
- Broad taping knives
- Distilled water

- Additional supply of health and safety equipment (*i.e.*, respirator cartridges, boots, gloves, Tyvek®, *etc.*),
- Core tubing cut in appropriate lengths will be available on site in sufficient quantity to supply field personnel for several days, and
- Additional equipment, as necessary, for the field tasks.

## B6.2 Laboratory Instrumentation

The primary goals of the project laboratory's preventative maintenance programs will be to prevent instrument and equipment failure as much as possible and to minimize instrument down time when failure occurs. The laboratory(ies) will maintain a complete inventory of replacement parts needed for preventive maintenance and spare parts that routinely need replacement (*e.g.*, septa, gauges, sources, detectors, *etc.*). Implementation and documentation of the preventative maintenance program will be primarily the responsibility of the technical group using the instrumentation according to the individual laboratory preventative maintenance policies in their respective Laboratory Quality Manual. If an instrument fails, the problem will be diagnosed as quickly as possible, and either replacement parts will be ordered or a service call will be placed to the manufacturer. If instrument failure impedes sample analysis, the QA Program Manger will be notified promptly so that appropriate corrective action and sample capacity management can occur. All preventative maintenance and maintenance performed as corrective action will be documented by the group leader, analyst, or contracted service representative who performed the procedure and the documentation will be maintained at the individual laboratory.

## B7 Calibration Procedures and Frequency

### B7.1 Field Instruments and Calibration

It is expected that field measurements and equipment will include, but may not be limited to, Global Positioning System (GPS) readings, geophysical testing, and vibracore sediment core collection. The Global Positioning System (GPS) on each sampling vessel will have a daily check on a point with known coordinates. Geophysical testing equipment will be calibrated and maintained in accordance with the manufacturer's recommendations. The operation of vibracoring equipment will be measured against criteria provided by the manufacturer. If these criteria are not met, appropriate adjustments/modifications will be made.

To ensure that field measurements completed during field data collection have been collected with properly calibrated instruments, field personnel will follow the procedures described by the manufacturer's recommendation and as described below.

In general, field instruments will be calibrated prior to use and the instrument calibration checked after the final use on each day. Personnel performing instrument calibrations shall be trained in its proper operation and calibration. Equipment will be maintained and repaired in accordance with manufacturer's specifications (Section B6). In addition, prior to use, each major piece of equipment will be cleaned, decontaminated, checked for damage, and repaired, if needed. Field calibration activities will be noted in a field log notebook that will include, at a minimum, the following:

- Entries to the instrument logbooks shall be made at least once daily whenever the instrument is in use.
- Calibration records shall include:
  - Calibrator's name,
  - Instrument name/model,
  - Date/time of calibration,
  - Standard(s) used and source,
  - Temperature (if it influences the measurement),
  - Results of calibration (raw data and summary), and
  - Corrective actions taken.

### B7.2 Laboratory Analytical Instrumentation and Calibrations

Calibration of laboratory analytical instrumentation is required for the generation of appropriate data to meet project data quality objectives. Detailed calibration procedures, calibration frequency and acceptance criteria are specified in the analytical method SOPs (Appendices 5-8, 10-16, and 19-29). Each laboratory contracted for this project will be responsible for the proper calibration and maintenance of laboratory analytical equipment. Calibration activities performed will be documented in the analytical data package (see Section A9) and will be available for review during internal and external laboratory audits.

In general, reference standards used will "bracket" the expected concentration of the samples. At a minimum, this generally will require the use of three to five different standard concentration levels that are used to demonstrate the instrument's linear range in quantitation. Calibration of

an instrument must be performed prior to the analysis of any sample and then at periodic intervals (continuing calibration) during the sample analyses to verify that the instrument is still calibrated. Sample concentrations are often outside the instruments linear range and, therefore, need to be diluted and reanalyzed. The analytical SOPs (Appendices 5-8, 10-16, and 19-29) also provide the calibration acceptance criteria and corrective actions to be employed if the acceptance criteria are not met (*i.e.*, recalibration, *etc.*).

### B7.2.1 Standard and Standards Records

Standards used by laboratories are described in the laboratory analytical methods (Appendices 5-8, 10-16, and 19-29). Laboratory standards will not be used if there are indications of physical deterioration (such as discoloration), or if the shelf life of the standard (as established by the manufacturer) is exceeded. Appropriate records of laboratory standards will be maintained in the laboratory, including the following:

- name and source,
- date received,
- lot number or manufacturer's tracking number,
- stock and initial concentration calculations, and
- storage requirements and storage location.

## B8 Inspection/Acceptance Requirements of Supplies and Consumables

Only supplies and consumables that are of adequate quality to sustain confidence in the sample collection, processing, and laboratory analyses will be used for this project. Where no independent assurance of the quality of outside supplies is available, procedures to ensure that the quality of the purchased materials are consistent with the overall project technical and quality criteria will be established. Purchased supplies and consumables will not be used until they have been inspected, calibrated or otherwise verified to ensure compliance with any standard specifications relevant to all calibrations or tests being performed for the project. Records of all supplies and consumables used for the project will be maintained.

### B8.1 Inspection and Acceptance Testing of Supplies and Consumables

Inspections or acceptance testing will be documented, including the procedures to be followed (including acceptance criteria and testing method), the individuals responsible, frequency of evaluation, and handling and storage conditions. The established procedures must enable project personnel to verify, prior to use, that critical supplies and consumables meet relevant project quality objectives. Supplies and consumables used during sample collection and processing will be inspected on an as-received basis. In the analytical laboratories, each analyst verifying the quality of reagents/standards must be qualified to perform the associated instrumental analysis so that they can calibrate the instrument, use the data system to set up sequences, perform calculations, and interpret the data.

## B8.2 Documentation and Tracking of Supplies and Consumables

Records for purchases and receipt of supplies and consumables for sample collection and processing activities will be maintained in the field processing facility. Return of damaged or inappropriate materials to the suppliers will also be documented.

Documented procedures shall exist at each project laboratory for the purchase, receipt, handling/storage, and tracking of supplies and consumables used for the technical operations. The established procedures must enable project personnel to ensure that supplies and consumables that have not been tested, have expired, or do not meet acceptance criteria are not used for the project. All laboratory personnel performing reagent/standard preparation must have demonstrated proficiency that they understand the dilutions, preparations, and documentation required after training with a qualified person.

Each project laboratory shall retain records for all standards, reagents and media including the manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if supplied), the date of receipt, recommended storage conditions, and an expiration date after which the material shall not be used unless its reliability is verified by the laboratory. The original containers (such as provided by the manufacturer or vendor) shall be labeled with a unique identifier that links the containers to the aforementioned records, the date opened, and the expiration/reevaluation date.

Records shall be maintained on reagent and standard preparation. These records shall indicate traceability to the purchased stocks or neat compounds, reference to the method of preparation, date of preparation, expiration date and preparer's initials. All containers of prepared reagents

and standards must bear a unique identifier and expiration/ reevaluation date and be linked to the aforementioned records. Labels that indicate the following information are to be used for reagents and standards:

- Unique Identifier (notebook reference indicating where the reagent preparation is documented),
- Name of the material,
- Concentration,
- Date prepared,
- Storage Conditions, and
- Expiration/reevaluation date.

## B9 Data Acquisition Requirements (Non-Direct Measurements)

One previously collected set of data will be used in this project. This data set provides hydrographic (bathymetry) measurements for the Thompson Island Pool. The data were collected in fall 2001 and are not part of the Administrative Record for the site. Ocean Surveys, Inc. (OSI), under contract to GE, measured water depths at about 2-ft intervals along 361 bank-to-bank transects spaced at approximately 100-ft intervals throughout the Thompson Island Pool.

Approximately 277 data points were collected along each transect. To maintain horizontal and vertical control for this work, OSI used an on-board global positioning system (GPS) that received signal corrections from a shore-based unit. The reported accuracy for this system was +/- 1 cm for horizontal positioning, and +/- 3 cm for vertical positioning.

The data conform to the Measurement Performance Criteria listed in Section A7. The entire Thompson Island Pool was sampled so that the data set satisfies the spatial domain requirements of the DQOs.

## B10 Data Management

The following subsections present an overview of the project information management system. This includes the field sample data collection process, the required specifications of the electronic data deliverable (EDD) and delivery of the EDD file, definitions of the EDD loading and evaluation phases, definitions of the electronic data verification software, and the storage, review, and retrieval of analytical data.

To support the storage, evaluation, and retrieval of analytical results, a commercially available client/server based relational database management system has been implemented. All data used for analysis, presentation, and reporting on the project are stored in a central electronic database that is available over the internet via a web interface. Specialized application modules, outlined below, are used for automated data collection, data evaluation, and data integration:

- **FIELD SAMPLE DATA COLLECTION SYSTEM** – Software that automates collection of field data. The system captures, manages, and maintains field data information including electronic Chain-of-Custody creation, sample ID creation, bottle label creation, and data export files containing information regarding the samples and sampling activities.

- **LABORATORY DATA CHECKER –** Custom software designed to automate checking of the electronic deliverables. EDDs submitted to the data management system will automatically undergo the checking process allowing immediate feedback, in the form of a report, to the data generator if errors are encountered. The laboratory data checker (LDC) assists in ensuring data reliability by checking EDDs against several criteria including valid values, data types, and format. A more detailed list of checks is provided in Section B10.2.1.

- **DATA VERIFICATION MODULE –** A custom-designed software module developed by Environmental Standards, Inc. used to facilitate the data evaluation process. The automated data verification module (DVM) will verify analytical data submitted by the laboratory in EDD form, will review the data against the performance specifications provided for the project, will evaluate data, will produce exception reports, and will load qualified results to the permanent database.

### B10.1 Purpose/Background

The information management system production will occur in the following sequence. Figures B-5 and B-6 illustrate the data flow process. All field-generated data will be entered into a field database via custom-designed forms developed in Microsoft® Access®. This software will facilitate data entry and management of the collected field data for the project. These forms were developed primarily to limit the possibility of data entry/transcription errors, both at the time of core collection and during sample processing in the field lab. Valid value lists have been defined for each of the data fields thereby restricting possible entries made by the user. Additionally, several features have been programmed to occur automatically (*e.g.*, field sample ID's are created based on the core ID and section depth information), further limiting the possibility of user error. Tables B-8 and B-9 present a summary of the information that will be collected at the time of coring and during sample processing in the field lab, respectively.

The data entry forms discussed above will be used on the sampling vessels at the time of core collection, and during sample processing in the field lab. The forms will be uploaded to laptop computers located on the sampling vessels. As a precaution, sampling crews will be required to print hard copy field logs at regular intervals to limit the possibility of losing data due to power loss or computer failure. In case of inclement weather, when the use of a computer may not be possible, data collected in the field will be recorded on hard copy field logs (using water proof paper) and later entered into the field database.

Data collected on the sampling vessels will be transferred electronically to the field lab where additional information will be entered into the field database. After all necessary information

has been entered into the field database, sample labels and Chain-of-Custody reports are generated automatically.

Two electronic exports will be automatically created from the field database and emailed to a specific address at Environmental Standards in a specified format, as described in Appendix 42, for inclusion in the project database. The export containing core data collected for the day will be sent at the end of each day of core collection and a second export regarding the samples will be sent at the end of each day of core processing. Each file will go into an upload directory on the server which will process the file, check for valid values, required fields, and correct format, and then input the file into the data management system.

Analytical laboratories will email EDDs in the 4-file format described in Appendix 42 to Environmental Standards for loading into the data management system. The EDDs will undergo checks to verify that the EDD adheres to GE's structural requirements, that the valid values used by the laboratory are in accordance with GE's standards, and that 10% of each laboratory's electronic data loaded for the day compares with the hard copy without error. Upon completion of these checks and loading of the data to the data management system, the draft version of the data will be immediately available for review via the web interface to authorized users. The automated data verification process and data validation will be performed as described in Section D of the QAPP. The resulting approved data will then be available to the appropriate project team members for review and/or inclusion in reports via the web interface.

### B10.2 Data Recording

As discussed above, the field sample data collection software will require data entry by the field teams. The software's data entry forms include valid value pick lists for the required fields to avoid incorrect data entry. In addition, several data fields will be populated automatically by the program to further reduce entry/transcription errors. Figure B-7 is the data entry form that will be used during core collection to enter core-specific information into the field database. Figure B-8 is the data entry form that will be used in the field lab to record information generated during core processing. Table B-8 and Table B-9 indicate the data collected during the sediment core collection and sample processing in the field lab.

The electronic exports of the field data are automatically generated to match specific file requirements. Upon submittal of the files to the data management system, further checks occur by the system for valid values, population of required fields, and correct file formatting. If any errors are detected on any of the levels, the file is rejected and an email is sent to the data generator alerting them of data errors. An error log detailing the errors is included in the email to allow corrections.

#### B10.2.1 Laboratory Data Checker Specifications

Laboratory EDDs will be submitted to the LDC before import to the system to be checked against pre-specified criteria ensuring data reliability and consistency. EDDs submitted to the data management system will automatically undergo the checking process allowing immediate

feedback, in the form of a report, to the data generator if errors are encountered. A detailed list of checks is provided:

1. File Format
   - number of fields specified for the file
   - field widths
   - data types

2. Valid Values
   - adherence to valid values as specified for the GE Hudson River Project (provided in Table B-10) for all fields where required

3. Dates
   - field sample collection date (sample_date) is earlier than sent_to_lab_date
   - sample_date is earlier than analysis_date
   - leachate_date and prep_date are earlier than analysis_date

4. Required Tests
   - tests delivered in the analytical data match the tests requested in the field sample data deliverable

5. Reportable Results
   - every analyte for a test (as specified by the method) performed on a sample must have exactly one reportable result; therefore, if five Aroclors are specified for a

PCB method and it is run at a dilution, each of the five Aroclors may have only one reportable result chosen from the multiple runs

6. U Qualifier
   - there should be a U lab qualifier if and only if the result_value is null

7. Parent Samples
   - samples requiring a parent sample (determined by sample_type_code) identify the sample that was the source of this sample
   - identified parent sample exists in the database

8. Column Number
   - if any two column chromatography test results are reported, there must be corresponding one column test results present

9. Orphans and Links
   - every field and lab sample is linked to test data
   - every test has result data
   - every result has batch data
   - checks are made in reverse – batch data links to results, result data links to tests, and test data links to samples

10. Duplicate Rows
    - the combination of values in each primary key is unique within each file

- the sample_delivery_group of an analytical deliverable does not already exist in the database

11. Required Fields
    - fields designated as required in the EDD specification are populated
    - QC fields required, based on sample type and result type, are correctly populated; the tables below illustrate the checked requirements

Required Fields by sample type (sample_type_code**) for result_type_code = TRG (target compounds)

| | **sample_type_code** | | | |
|---|---|---|---|---|
| **Required Fields** | **MS** | **LCS** | **LR** | **FD** |
| PARENT_SAMPLE_CODE | X | | X | X |
| QC_ORIGINAL_CONC | X | | | |
| QC_SPIKE_ADDED | X | X | | |
| QC_SPIKE_MEASURED | X | X | | |
| QC_SPIKE_RECOVERY | X | X | | |
| QC_DUP_ORIGINAL_CONC | | | X | |
| QC_DUP_SPIKE_ADDED | | | | |
| QC_DUP_SPIKE_MEASURED | | | X | |
| QC_DUP_SPIKE_RECOVERY | | | | |
| QC_RPD | | | X | X |

| | sample_type_code | | | |
|---|---|---|---|---|
| **Required Fields** | **MS** | **LCS** | **LR** | **FD** |
| QC_RPD_CL | | | X | X |
| QC_LCL | X | X | X | X |
| QC_UCL | X | X | X | X |
| QC_SPIKE_STATUS | X | X | | |
| QC_DUP_SPIKE_STATUS | | | | |
| QC_RPD_STATUS | | | X | X |

Required Fields by sample type (sample_type_code) for result_type_code = SUR (surrogate)

| | sample_type_code | | | |
|---|---|---|---|---|
| **Required Fields** | **MS** | **LCS** | **LR** | **FD** |
| PARENT_SAMPLE_CODE | | | | |
| QC_ORIGINAL_CONC | | | | |
| QC_SPIKE_ADDED | X | X | X | X |
| QC_SPIKE_MEASURED | X | X | X | X |
| QC_SPIKE_RECOVERY | X | X | X | X |
| QC_DUP_ORIGINAL_CONC | | | | |
| QC_DUP_SPIKE_ADDED | | | | |
| QC_DUP_SPIKE_MEASURED | | | | |
| QC_DUP_SPIKE_RECOVERY | | | | |
| QC_RPD | | | | |

| | sample_type_code | | | |
|---|---|---|---|---|
| **Required Fields** | **MS** | **LCS** | **LR** | **FD** |
| QC_RPD_CL | | | | |
| QC_LCL | X | X | X | X |
| QC_UCL | X | X | X | X |
| QC_SPIKE_STATUS | X | X | X | X |
| QC_DUP_SPIKE_STATUS | | | | |
| QC_RPD_STATUS | | | | |

**Note:

MS = matrix spike

LCS = laboratory control sample

LR = lab replicate

FD = field duplicate

If any of the above criteria are not met, the file is returned to the data generator via email along with an error report detailing the errors to allow corrections.

### B10.2.2 LDC Testing Methodology

A systematic approach was developed to test the software and to make any necessary code changes to rectify problems identified during testing. Test electronic data deliverables were generated based upon the GE project specifications and operated upon in a local environment. Environmental Standards personnel were responsible for generating the test data and changing

the necessary data fields to result in specific criteria failures. The altered data sets were then run through the LDC and reviewed.

The test data sets were developed to encompass the multiple sample and result types, methods, and test types to allow data dependent criteria testing. The error reports were compared with expected error results and any necessary code changes were made. Each identified error was then corrected and the test data was run through the LDC until a "clean" report was produced.

### B10.3 Data Validation

The data validation process is described in Section D2.1 of this QAPP.

#### B10.3.1 Automated Data Verification Process Overview

The automated DVM process is described in Section D.2.2 of this QAPP.

#### B10.3.2 Required Fields for Automated Verification Process

The DVM process requires additional fields that are not required for EDD loading. These fields are conditionally required for various sample types and are indicated in the EDD in the summary table below:

| EDD File | EDD Field | Required For | DVM |
|---|---|---|---|
| Sample | parent_sample_code | Spiked Samples and Duplicate/Replicate Samples | ensures proper parent sample flagging |
| Field Sample | sample_date | all field samples | to determine times for hold samples |
| | sample_time | all field samples | to determine times for hold samples |
| | cooler_id | all field samples | to batch field samples |
| Test | sample_receipt_date | all field samples | to determine times for hold samples |
| | sample_receipt_time | all field samples | to determine times for hold samples |
| | prep_date | all samples that require prepping | to determine times for hold samples |
| | prep_time | all samples that require prepping | to determine times for hold samples |
| | leachate_date | all leached samples | to determine times for hold samples |
| | leachate_time | all leached samples | to determine times for hold samples |

| EDD File | EDD Field | Required For | DVM |
|---|---|---|---|
| Result | result_value | all samples that are not ND | set usability flags |
| | result_unit | all applicable | set usability flags |
| | detection_limit_unit | all applicable | set usability flags |
| | qc_original_concentration | MS samples | set usability flags |
| | qc_spike_added | MS samples, Surrogate compounds, LCS samples | set usability flags |
| | qc_spike_measured | MS samples, Surrogate compounds, LCS samples | set usability flags |
| | qc_spike_recovery | MS samples, Surrogate compounds, LCS samples | set usability flags |
| | qc_dup_original concentration | LR samples | set usability flags |
| | qc_dup_spike_measured | LR samples | set usability flags |
| | qc_dup_spike_recovery | Surrogate compounds | set usability flags |
| | qc_RPD | all applicable | set usability flags |

| EDD File | EDD Field | Required For | DVM |
|---|---|---|---|
| | qc_spike_lcl | Spiked samples, Surrogate compounds, LCS samples | set usability flags |
| | qc_spike_ucl | Spiked samples, Surrogate compounds, LCS samples | set usability flags |
| | qc_rpd_cl | Duplicate samples | set usability flags |

### B10.3.3 Control Limits for Automated Verification Process

In addition to the need for the correct population of fields, it is necessary to identify a list of control limits to be used when running DVM. The areas requiring limits for the GE Hudson River Project are as follows:

1. Upper and lower accuracy limits by fraction (solid and water) for:
    - Matrix Spike
    - Laboratory Control Spike

2. Reject limits by fraction (solid and water) for:
    - Matrix Spike
    - Laboratory Control Spike

3. Relative Percent Difference (RPD) limits by fraction (solid and water) for:
    - Field Duplicate
    - Laboratory Replicate (Laboratory Duplicate)

4. Upper and lower surrogate recovery limits for any method which requires surrogate analytes be analyzed

5. Order of flag severity

6. Holding times for all analytes for the following stages:
    - from collection date to leachate date
    - from collection date to extraction date
    - from collection date to analysis date
    - from collection date to analysis preserved date
    - from leachate date to extraction date
    - from leachate date to analysis date
    - from extraction date to analysis date

### B10.3.3.1 GE Hudson River Project QC Limits

**MS-SEDIMENT AND LEACHATE (ACCURACY)**

| FRACTION | LOW | HIGH | REJECT |
|---|---|---|---|
| RCRA AND TCLP METAL | 75 | 125 | 30 |
| TCLP VOA | 70 | 130 | 30 |
| TCLP SVOA | 50 | 135 | 10 |
| PCB | NA | NA | NA |
| PCB Homologs | NA | NA | NA |
| DIOXIN/FURAN | NA | NA | NA |
| TCLP PEST | 50 | 135 | 10 |
| TCLP HERBICIDE | 50 | 135 | 10 |
| TOC | 75 | 125 | 30 |

**FD/LR-SEDIMENT (PRECISION)**

| FRACTION | RPD |
|---|---|
| RCRA AND TCLP METAL | 40 |
| TCLP VOA | 40 |
| TCLP SVOA | 40 |
| PCB | 40 |
| PCB Homologs | 40 |
| DIOXIN/FURAN | 40 |
| TCLP PEST | 40 |
| TCLP HERBICIDE | 40 |
| TOC | 40 |

**LCS-SEDIMENT AND LEACHATE (ACCURACY)**

| FRACTION | LOW | HIGH | REJECT |
|---|---|---|---|
| RCRA METAL | 70 | 130 | 30 |
| TCLP METAL | 80 | 120 | 50 |
| TCLP VOA | 70 | 130 | 30 |
| TCLP SVOA | 50 | 135 | 10 |
| PCB | 60 | 140 | 10 |
| PCB Homologs | 60 | 140 | 10 |
| DIOXIN/FURAN | NA | NA | * |
| TCLP PEST | 50 | 135 | 10 |
| TCLP HERBICIDE | 50 | 135 | 10 |
| TOC | 75 | 125 | 30 |

MS = Matrix Spike
FD = Field Duplicate
LR = Lab Replicate
LCS = Laboratory Control Sample

*See Appendix 28 for Dioxin/Furan LCS limits. Compounds with recoveries outside of acceptance limits (biased high or low) will result in the rejection of these compounds in the associated project samples.

#### B10.3.3.2 Environmental Standards Flag Severity Order

1. U* (due to blank contamination)
2. UR (Non-Detection with Rejected Detection Limit), R (Rejected result)
3. J (estimated), UJ (Non-Detection with Estimated Detection Limit)
4. U (non-detect)
5. Unflagged

Definitions of qualifier codes are provided in Section D2.1.2.

### B10.3.4 Criteria for Automated Verification

The criteria for automated verification are as described in the QC limit tables above in Section B10.3.3.1, the data validation SOPs in this QAPP and the evaluation process described in Section D.2.1.

The following evaluation procedures account for potential data evaluation out-of-criteria situations:

- Samples analyzed outside of holding time criteria will be qualified as estimated or rejected (in the event of gross exceedance).
- Samples with surrogate recoveries greater than or less than the project control limits as specified in the Analytical Method Tables will have all values greater than the sample reporting limit qualified as estimated.

- Samples with surrogate recoveries below the project control limits but greater than or equal to 10% will have all non-detected values qualified as estimated.

- Samples with surrogate recoveries below 10% will have non-detected results rejected.

- Samples for organic analysis with MS recoveries or relative percent differences (RPDs) outside of project control limits will have the specific out-of-criteria compound result(s) in the associated unspiked sample qualified. Qualification for matrix spike analyses follows the QC rules used for surrogates using the associated Reject QC Limit.

- The unspiked compounds detected in the MS and field sample (for organic analysis) will be evaluated for Relative Standard Deviation (RSD). If the RSD exceeds 20% for aqueous samples or 40% for solid samples, the unspiked compounds in the field sample will be estimated.

- LCS samples with recoveries outside of criteria will have all samples in the same prep batch qualified following the same rules as for surrogates using the associated Reject QC Limit.

- Inorganic MS samples with recoveries outside of criteria will have all samples of the same matrix on the Chain-of-Custody qualified following the same rules as for surrogates using the associated Reject QC Limit.

- Laboratory duplicates with inorganic analytes out of RPD criteria will have the analyte values greater than the sample reporting limit qualified as estimated in all

similar matrix samples in the same lab prep batch on the Chain-of-Custody using the associated Reject QC Limit.

- Field duplicate analytes with out-of-criteria RPDs will have the analyte values greater than the sample reporting limit estimated in only the field duplicate and its associated sample.

### B10.3.5 DVM Testing Methodology

A systematic approach was developed to test the software module and to make any necessary code changes to rectify problems identified during testing. Test data sets were generated based upon the GE project specifications and operated upon in a local environment. Environmental Standards QA personnel were responsible for obtaining the test data and changing the necessary data fields to result in specific data qualification. The altered data sets were then run through DVM and reviewed.

Each individual qualification process has defined boundary conditions that must be exceeded in order for each unique data qualification to occur. In general, boundary conditions were set that would allow for the following:

- Data within the criteria that would result in no qualification
- Data exactly equal to the criterion that would result in no qualification unless the criterion is defined as "$\leq$" or "$\geq$"
- Data that exceeded the criteria that would result in qualification

Additionally, multiple analysis fractions (*e.g.*, volatiles, metals, Aroclors) were included in the testing scheme to represent fraction-specific conditions. A test data set was developed to meet each of the boundary conditions identified for each individual qualification process. Environmental Standards then tested each qualification process on an individual basis so that it could be easily verified if problems or inappropriate qualification had occurred. The data qualification flag assigned by the software module was then compared to the expected data qualification flag and any code changes made, if necessary. At completion of the individual qualification process testing, the fully integrated testing of all processes was performed to ensure that final application of a data qualifier flag had occurred according to the qualifier hierarchy.

### B10.4 Data Transformation

Data transformation is expected to consist of transferring test results from one unit to another unit of measure (*e.g.*, mg/Kg to ug/Kg). This will be accomplished within the database so that transcription error does not occur. The number of significant figures will be that of the original value regardless of any data transformations so that results will not be rounded or truncated.

### B10.5 Data Transmittal

The field and laboratory electronic data deliverables will be sent to the project information management system for processing via email. Once the files have been processed by the system, they are archived on the server to retain the original data files.

An electronic data export will be provided to the EPA on a monthly basis, as defined in the Administrative Order on Consent. The export will contain the most recent version of the data at the time of file creation. Any changes to data in the database will therefore be present in the export provided to EPA. Changes and/or updates to the project data will be documented by two methods. Data verification and validation changes will be detailed in the DVM and validation reports. Other significant changes to the database will be documented in corrective action memorandum as described in Section C1.3.

### B10.6 Data Reduction

Data reduction is addressed in Section D1.7.

### B10.7 Data Analysis

Analysis of data to determine dredge cuts or other information pertinent to remedial design will be conducted during the remedial design phase of this project.

### B10.8 Data Tracking

The flow of data through the information management system includes loading, verification, and validation (if performed). Each step is date/time stamped in the system when completed. The status of the data at any given moment is made available through the web-interface to authorized users. Users will see the status as “loaded”, “verified”, “validated”, or “final”. A status of

"final" indicates that all steps in the process are completed and the data is ready for analysis/reporting.

### B10.9 Data Storage and Retrieval

The information management system is a commercially available client/server based relational database system allowing concurrent connections of multiple users. An Oracle 8.0 database provides a central repository for all of the project data. Multiple users can connect to the system from their workstations over the internet via a web interface. Basic workstation requirements are:

- Pentium or faster PC (Pentium II recommended)
- 32 MB RAM, 60 MB of free hard disk space
- compatible with Windows 95/98, and Windows NT/2000.

The data management system is highly secure with firewall protection along with many layers of user authentication. Within the system itself, security administration allows users to be assigned to a group with various permissions set controlling what each user can access. User access to data in the database, reports, table administration, and many other features are all controlled. The project manager will be required to provide a list of approved users for the system and define user groups with associated security levels. In addition, backups of the database are run daily to ensure data preservation.

Backups of the data will be retained as defined in the Administrative Order on Consent.

Retrieval of the data can be accomplished through the web interface. Approved users can download the data to their computers for use in a spreadsheet, run customized reports, process customized queries, or simply review the data through an "explorer-like" window. Additionally, customized data exports will be supplied to the appropriate project team members. A seamless data flow is set up so that the EDDs are delivered to a specific email address, automatically checked and loaded, and a customized export of the data is automatically emailed out to the designated recipient.

# C. ASSESSMENT AND OVERSIGHT

## C1 Assessments and Response Actions

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits.

### C1.1 Field System Audits

#### C1.1.1 Internal Field System Audits

##### C1.1.1.1 Internal Field System Audit Responsibilities

Internal audits of field activities including sampling and field measurements will be conducted by the Field Sampling Manager. These audits will verify that all established procedures are being followed.

##### C1.1.1.2 Internal Field System Audit Frequency

An internal field audit will be conducted at least once at the beginning of the sediment sample collection activities during the 2002 and 2003 field seasons to ensure the sampling crews employ consistent procedures. The Field Sampling Manager may add additional internal field audits as

deemed necessary based on routine observation of sample collection and processing activities. Additionally, the Field Sampling Manager may request the QA Program Manager to schedule an external audit to be performed to document corrective action.

#### C1.1.1.3 Internal Field System Audit Procedures

The internal field audit will include examination of field sampling records, field instrument operating records, sample collection, handling, processing and packaging in compliance with the established procedures, maintenance of QA procedures, Chain-of-Custody, *etc.* Follow-up audits will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the program. The audit will involve review of field measurement records, instrumentation calibration records, and sample documentation. The findings resulting from the internal audit will be summarized by the Field Sampling Manager and provided to the QA Program Manager so that necessary corrective action can be monitored from initiation to closure.

### C1.1.2 External On-Site Field System Audits

#### C1.1.2.1 External On-Site Field System Responsibilities

Audits of the field sample collection procedures and sample processing laboratory procedures used during the course of the sediment sampling program will be conducted by Environmental Standards Project Field Auditors. The purpose of the audits will be to document the quality of the field procedures and to verify that the field procedures as described in the FSP, QAPP, and SOPs are being followed by the subcontractors.

### C1.1.2.2 External On-Site Field System Audit Frequency

The on-site field audit frequency for the 2002 field season will be two (2) audits with one being conducted at the beginning of the field season and the second audit being performed at the end of the field season. Two audits will be performed during the 2002 field season since the duration of the season is short (approximately four to five weeks). Three (3) on-site field system audits will be performed during the 2003 field season. An initial audit will be conducted at the beginning of the 2003 field sample collection schedule such that corrective action, if necessary, can be initiated as early in the program as possible. The second and third audits will be performed approximately at the mid-point and at the end of the 2003 sample collection program.

### C1.1.2.3 External On-Site Field System Audit Procedures

Each audit is proposed to be two (2) days in duration. The first day will focus on the field sample collection and the second day will focus on the sample processing facility. The audit will include, at a minimum, an evaluation of field documentation records, decontamination procedures, sampling/field procedures, sample packaging and shipment procedures, Chain-of-Custody procedures, quality assurance/quality control sample collection procedures, and adherence to health and safety/personal protective equipment procedures. The field audits will be conducted according to the SOP "Performance and Reporting of Field Audits" presented in Appendix 30. Specific elements of the on-site field operations audit to be performed by the Environmental Standards Project Field Auditor include the verification of:

- Completeness and accuracy of sample Chain-of-Custody forms including documentation of times, dates, transaction descriptions, and signatures,

- Completeness and accuracy of sample identification labels including notation of time, date, location, type of sample, person collecting sample, preservation method used, and type of testing required,

- Completeness and accuracy of field notebooks or records including documentation of times, dates, subcontractor names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of field measurements, soil logs, and any problems encountered during sampling,

- Adherence to health and safety guidelines outlined in the Project Health and Safety Plan (HASP), including wearing of proper personal protective equipment (PPE),

- Adherence to decontamination procedures outlined in Section B2.7 of this QAPP including proper decontamination of sediment core sampling and processing equipment, and

- Adherence to sample collection, preparation, preservation, and storage procedures.

The Environmental Standards Project Field Auditor will develop an audit checklist as described in the field audit SOP to aid in performing each evaluation. The field audit findings will be discussed

with the field personnel at the conclusion of the audit and subsequently summarized in an audit report. A copy of each audit report will be submitted to the EPA RPM, the GE Project Manager, the QA Program Manager and the contractor that was audited. The audit report will present major findings and recommended corrective actions necessary to resolve quality control deficiencies.

## C1.2 Laboratory Performance and System Audits

### C1.2.1 Performance Audits

#### C1.2.1.1 Inter-Laboratory Comparison Performance Audits

Since more than one laboratory facility may be involved in the PCB analytical program to support the SSAP, an inter-laboratory comparison study will be completed prior to the commencement of the analysis of sediment core samples. This evaluation will include a comparison of the data and data packaging produced by various laboratories and is described in detail below. Sediment samples from the Upper Hudson River at 4 different locations and one matrix matched performance evaluation (PE) sample in the 30-40 ppm range will be used to provide a range of PCB concentrations. Sufficient sample volumes have been collected to allow homogenization and splitting of the samples to supply an adequate number of samples to each prospective laboratory. The laboratories will be instructed to analyze the samples for PCBs by the Aroclor method (Appendix 5, SOP GEHR8082), and to provide electronic data packages in accordance with specifications in Appendix 9 (SOP DPSOP). The resulting data and data packages will be compared among laboratories for consistency and adherence to the packaging requirements. The data assessment will include comparing both total PCB concentration and

PCB composition (to the extent possible using the Aroclor PCB methodology). These samples will also be analyzed by an independent laboratory for homologs by the GC/MS SIM (EPA Method 680) to determine the comparability of the Aroclor and homolog results by the two different methods. Acceptance criteria will be established for each analytical method using the results of the interlab comparison study.

Sediment samples collected from the Hudson River are being used for preparing PE samples for use in both the inter-laboratory study and for on-going performance monitoring during the sediment sampling program. Figure C-1 provides a flow diagram of the initial PCB PE acceptance limit generation. Figure C-2 provides a flow diagram of the inter-laboratory comparison study PE analysis. Table C-1 summarizes the analyses to be performed to set PE acceptance limits for each of the five (5) PE samples prior to the inter-laboratory study. Four (4) Hudson River PE samples have been developed with approximate concentrations of 1-3 ppm, 13 ppm, 169 ppm and 749 ppm. In order to develop initial acceptance criteria for each of the 4 PEs, 3 separate jars from each PE will be obtained during the sub-sampling step. One jar will be collected at the beginning, the middle and the end of the sub-sampling step. Additionally, the matrix-matched PE (a less than mesh size 70 clean soil spiked at approximately 30-40 ppm with 1221 and 1242 at a 3:1 ratio) will also be prepared and 3 separate jars sent for acceptance limit generation. This will produce 3 sample jars for each of the 4 Hudson River concentration levels (3 X 4 = 12 total jars) plus 3 sample jars of the matrix-matched PE. The 15 PE jars will be sent to Northeast Analytical (NEA) for extraction and analysis as follows. Each PE will be extracted by the methods included in Appendix 6 or 7. The extracts will be analyzed by the EPA-approved Total PCB as Aroclor Method GEHR8082 (Appendix 5) and EPA 680 GC/MS SIM method (Appendix 8). A laboratory other than NEA will further analyze the same extracts by the EPA

680 GC/MS SIM method (Appendix 8). The independent laboratory has been identified as Axys Analytical Services, LTD of Sydney, British Columbia, Canada.

The specific number of analyses to be done by NEA on the 3 jars per PE level will be as follows. A single analysis will be done on each of the Jar 1 and Jar 2 samples. Three (3) analyses will be done on the Jar 3 sample. This will generate 5 analyses for each of the 5 PEs. The mean and variance of the results from the Jar 3 analyses will be compared to the Jar 1 and Jar 2 results using a *t* –Test. If the inter-analysis results are comparable at the 95% confidence interval, then the PE matrix will be considered homogeneous. The acceptance limits for each PE will be calculated using the 95% confidence interval of the five (5) results. If the inter-analysis results are not comparable at the 95% confidence interval, then the PE(s) will be re-homogenized and the process repeated.

Further, as previously mentioned, a laboratory independent of the GE SSAP will be selected to analyze each PE extract by the EPA 680 GC/MS SIM method (Appendix 8). The results of the five (5) analyses determined by NEA for each of the five (5) PEs will be compared to the five (5) analysis results determined by the independent laboratory for each of the five (5) PEs. A *t*-test will be used to determine if the two sets of data are significantly different. If no significant difference is determined, then NEA's and the independent laboratory's results will be combined to account for inter-laboratory variability, and the combined results will be used to generate the initial PE acceptance limits as described above. If the two sets of data for any of the five (5) PEs are significantly different, then corrective action will be undertaken to determine if an analytical problem exists that has biased one set of data compared to the other. This investigation will primarily involve manual validation of both NEA's and the independent laboratory's GEHR680

analysis results to determine if quantitative or qualitative errors are present that explain the difference between the two sets of results. If errors are identified, then they will be corrected and the *t*-test repeated. If errors are identified that can not be corrected, than an outlier test (Grubbs or Dixon) will be performed on the applicable PE set (5 NEA results and 5 independent laboratory results). Results that were identified as outliers will be discarded, and the remaining results combined to generate the acceptance limits at the 95% confidence interval. If no errors are identified or if the *t*-test test is repeated after correcting previously identified errors, then the results from both NEA and the independent laboratory for the individual PE(s) in question will be combined to generate the acceptance limits at the 95% confidence interval. Again, this combination of results will account for inter-laboratory variability.

During the inter-laboratory study, 3 aliquots from each of the 4 PE concentrations and 1 aliquot of the matrix-matched PE will be analyzed by each laboratory participating in the program (current estimate is 10 laboratories). Figure C-2 provides a flow diagram of the inter-laboratory comparison study PE analysis. Table C-2 summarizes the analyses to be performed for each of the five (5) PE samples during the inter-laboratory study assuming 10 laboratories participate in the bidding process. These samples will be analyzed using the total PCB by Aroclor method (GEHR8082). PE acceptance criteria for on-going performance monitoring will be updated for the Aroclor PCB method (GEHR8082) using the results of the inter-laboratory comparison study.

The ability of candidate laboratories to analyze Hudson River sediment samples for Total PCBs as Aroclors by GEHR8082 will be determined by comparing the results of the laboratories' analyses of each PE sample against the results obtained by NEA from the prior analyses of these

same PE samples conducted to determine the initial PE acceptance limits (herein referred to as the pre-study). Both accuracy and precision will be evaluated by testing the null hypotheses that a candidate laboratory's Aroclor and Total PCB concentrations have the same mean (accuracy) and variance (precision) as the pre-study.

The pre-study results will be used to establish initial estimates of the mean and variance for measurements of each of the five (5) PE samples. The mean and variance of the three (3) results obtained by a candidate laboratory's single analyses of three (3) jars of the PE sample will be computed and two statistical tests conducted.

The first test will evaluate the null hypothesis that the candidate laboratory's results and the pre-study results have the same variance. This test will evaluate whether the candidate laboratory is able to achieve the precision achieved in the pre-study. It consists of computing an F statistic as follows:

$$\mathbf{F_s} = \frac{\mathbf{s}_1^2}{\mathbf{s}_2^2}$$

where $s^2$ is the variance and the subscripts1 and 2 designate the candidate laboratory and the pre-study, respectively. $F_s$ will be compared to the critical F value at the $95^{th}$ percentile with degrees of freedom $\nu_1 = n_1 - 1$ and $\nu_2 = n_2 - 1$, where n is the number of samples. If $F_s$ exceeds the critical value, the candidate laboratory's results will be determined to be significantly less precise than the pre-study results.

The second test will evaluate the null hypothesis that the candidate laboratory's results and the pre-study results have the same mean. This test will evaluate whether the candidate laboratory was able to achieve satisfactory accuracy. For those results that do not fail the F test, a *t*-test will be used to make a determination as to whether a real difference exists between the means of the candidate laboratory results and the pre-study results. The *t* statistic is:

$$t_s = \frac{\overline{\mathbf{Y}}_1 - \overline{\mathbf{Y}}_2}{\sqrt{\left[\frac{(\mathbf{n}_1 - 1)\mathbf{s}_1^2 + (\mathbf{n}_2 - 1)\mathbf{s}_2^2}{\mathbf{n}_1 + \mathbf{n}_2 - 2}\right]\left(\frac{\mathbf{n}_1 + \mathbf{n}_2}{\mathbf{n}_1 \mathbf{n}_2}\right)}}$$

where $\overline{\mathbf{Y}}$ is the mean, and as before, $s^2$ is the variance, n is the number of samples and the subscripts 1 and 2 designate the candidate laboratory and the pre-study. $t_s$ will be compared to the critical *t* value at the $95^{th}$ percentile with $n_1+n_2-2$ degrees of freedom (two-tailed test).

The data from those laboratories for which the *t*-test does not reveal a significant difference from the pre-study results will be accepted into the population of valid results. Then a new mean and variance for the PE sample will be computed from the pooled data and both the F test and the *t*-test will be repeated. The F test will be used to reevaluate the acceptance of the remaining laboratory variances. Any results that exhibit a variance significantly different from the variance of the pooled data will be rejected. If the mean of the results from any of the remaining laboratories previously judged to produce means different from the pre-study means is not significantly different from the mean of the pooled population, that laboratory's data will be accepted. The process will be repeated until no additional laboratory's data are accepted into the

pooled data set. Final acceptance limits at the 95% and 99% confidence intervals will then be computed from the pooled data.

### C1.2.1.2 Performance Evaluation Audits During the Project

PE samples will be submitted to each subcontractor laboratory performing the PCB Aroclor analysis by SOP GEHR8082 (Appendix 5) and the PCB homolog analysis by SOP GEHR680 (Appendix 8) as a measure to assess accuracy during the course of the project. Figure C-3 provides a flow diagram that summarizes the GEHR8082 and GEHR680 PE sample analysis during the SSAP. Additionally, as requested by USEPA, the validation strategy for the PCB Aroclor and PCB homolog analyses is linked to the laboratory results of on-going Performance Evaluation (PE) sample analysis (see Section D). For the labs running Aroclor analysis, the frequency of PE samples shall be one per day for the first two weeks (e.g., 5 labs x 10 days = 50 PE samples). Thereafter, the frequency shall be one PE sample per lab per day for each lab performing satisfactorily. The lab(s) running homolog analysis shall analyze the extracts of 12 PE samples in the first two weeks (i.e., 3 at each of the 4 PCB concentration levels). Thereafter, the frequency shall be one per every two SDGs or one PE per day, whichever is more frequent, for each lab performing satisfactorily.

The PEs will be retained aliquots of the Hudson River sediment samples used in the inter-laboratory comparison study (Section C.1.2.1.1). The PT firm will prepare, retain and store (4°± 2°C) sufficient sediment for use during the program. Additionally, the PT firm will be directed

by the QA Program Manager to subsample, pack and ship the retained Hudson River PE (from one concentration level) for delivery to the sample processing laboratory field personnel. Instructions will be developed for the sample processing laboratory field personnel to label the samples for submission as single blind to the participating analytical laboratories. The analytical results for the PE sample results will be summarized and compared to acceptance limits developed during the inter-laboratory comparison study, and appropriate corrective action or validation taken if analytical problems are detected.

The database will store the PE acceptance limits to be used during the SSAP for both GEHR8082 and GEHR680 analysis. PE samples will be coded in the EDD so that when SDGs containing PE results are submitted by the laboratory(ies) to the database, an automated report can be generated to summarize the PE accuracy performance. Figure C-4 presents an example of the PE sample result pass/fail summary report. Samples associated with failing PE results will be identified so that they SDGs can be submitted to the ESI chemist for validation.

### C1.2.2 Laboratory System Audits

#### C1.2.2.1 Internal Laboratory System Audits

Each individual laboratory QA Manager performing analytical testing services for this project will performs periodic internal systems audits to evaluate laboratory operations and quality control procedures in accordance with their individual Laboratory Quality Manual. These audits are intended to serve two purposes: 1) to ensure that the laboratories are complying with the procedures defined in laboratory manuals and contracts; and 2) to determine any sample flow or

analytical problems. Internal audits performed by the participating laboratories during the time GE sample analyses are being performed may be requested by QA Program Manager as necessary to review associated QA/QC issues relevant to this project.

#### C1.2.2.2 External Laboratory System Audits

##### C1.2.2.2.1 External Laboratory System Audit Responsibilities

An audit of the laboratory procedures used during the course of the sediment sample collection program will be conducted by Data Validators under direction of the QA Program Manager.

##### C1.2.2.2.2 External Laboratory System Audit Frequency

One laboratory audit will be performed of each subcontractor laboratory that provides analytical chemistry testing services for PCB Aroclors, PCB congeners and TOC. Laboratories providing dioxin/furan, TCLP and $^{137}Cs$ analysis will not be independently audited due to the small numbers of samples to be analyzed for these parameters and project-specific SOPs will not be necessary since one laboratory is expected to provide testing for each of these analyses. The audits will be conducted at a time period when actual sample analyses are being conducted. Additionally, the audits will be performed early in the program to ensure that corrective action can be initiated promptly if problems are encountered. Future audits may be performed if deemed necessary by the QA Program Manager in consultation with the GE Project Manager.

#### C1.2.2.2.3 External Laboratory System Audit Procedures

Environmental Standards project personnel will initiate frequent communications with each project laboratory to discuss and address real-time corrective action of QA/QC issues (if any) encountered by the laboratories. Additionally, Environmental Standards will provide routine feedback to the laboratories resulting from data verification and validation efforts. The purpose of the external laboratory audits will be to document the quality of the laboratory analysis procedures and to verify that the procedures as described in the FSP, QAPP and SOPs are being followed by the participating laboratories. The audits of the laboratories will be conducted according to the procedures described in "Performance and Reporting of Analytical Laboratory Audits" presented in Appendix 31. The following general areas will be evaluated during the laboratory audits to be performed by Environmental Standards project personnel:

- Organization and Personnel,
- Sample Receipt and Storage Area,
- Sample Preparation Area,
- Sample Analysis Instrumentation,
- Documentation,
- Quality Control Manual and Project-Specific SOPs, and
- Data Handling.

The laboratory audit findings will be discussed with the audited laboratory personnel at the conclusion of the audit and subsequently summarized in an audit report. A copy of each audit

report will be submitted to the EPA RPM, the GE Project Manager, and the audited laboratory. The audit report will present major findings and recommended corrective actions, if necessary, to resolve quality control deficiencies.

### C1.3 Corrective Action

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or poor QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented will be documented in the regular quality assurance reports to management (Section C2). Corrective action will only be implemented after approval by the GE Project Manager or his designee. If immediate corrective action is required, approvals secured by telephone from the GE Project Manager should be documented in a memorandum. Written corrective action will be documented using a format equivalent to the example provided in Figure C-5.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the GE Project Manager, who in turn will notify the US EPA Project Coordinator. If the problem is analytical in nature, information on the problem will be promptly communicated to the US EPA Program Manager. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established QC procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. The Project Manager, or his designee, will issue a nonconformance report for each nonconformance condition.

### C1.3.1 Field Corrective Action

Corrective action in the field may be initiated when the sample network or rationale is changed (*i.e.*, more/less samples, sampling locations other than those specified in the FSP, *etc.*), or when sampling procedures and/or field analytical procedures require modification, *etc.*, due to unexpected conditions. In general, the field team (GE Project Manager, Project Manager, QA Program Manager, Field Sampling Manager, Site Coordinator or sampling technicians) may identify the need for corrective action. The field staff, in consultation with the Project Manager and GE Project Manager, will recommend a corrective action. The GE Project Manager will approve the corrective measure that will be implemented by the field team. It will be the responsibility of the Field Sampling Manager to ensure the corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (*i.e.*, additional sediment samples) using existing and approved procedures in the FSP and QAPP, corrective action approved by the Field Sampling Manager will be documented. If corrective actions resulting in fewer samples (or analytical fractions), alternate locations, *etc.*, keep project quality assurance objectives from being achieved, it will be necessary that all levels of project management, including the GE Project Manager, Project Manager, and the US EPA Project Coordinator concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The QA Program Manager will identify deficiencies and recommended corrective action to GE Project Manager and Project Manager. The Field Sampling Manager and field team will perform implementation of corrective actions. Corrective action will be documented in quality assurance reports to the entire project management team.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, the GE Project Manager or US EPA Project Coordinator may stop work.

### C1.3.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during, and after initial analyses. Each laboratory's corrective action procedures are provided in the SOPs provided in Appendices 5-8, 10-16, and 19-29. The submitted SOPs specify the majority of the conditions during or after analysis that automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, or automatic reinjection/reanalysis when certain QC criteria are not met. Furthermore, a number of conditions, such as broken sample containers, multiple phases, low/high pH readings, and potentially high concentration samples, may be identified during sample log-in or just prior to analysis. Following consultation with laboratory analysts, it may be necessary for the laboratory QA Officer to approve the implementation of corrective action.

A member of the laboratory technical staff will identify the need for corrective action. The laboratory QA Officer, in consultation with members of the technical staff, will approve the required corrective action to be implemented by designated members of the laboratory technical staff. The laboratory QA Officer will also ensure implementation and documentation of the corrective action. If the nonconformance causes project objectives not to be achieved, it will be necessary to inform the QA Program Manager who must concur with the corrective action.

Corrective actions that are performed prior to release of the data from the laboratory will be documented in a laboratory corrective action log and in the narrative data report sent from the laboratory to the Environmental Standards data validator. If corrective action does not rectify the situation, the laboratory will contact the QA Program Manager prior to release of the data.

### C1.3.3 Corrective Action During Data Validation and Data Assessment

The need for corrective action may be identified during the data verification, data validation or data assessment process. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

As previously stated in Section A7.3.5, the percent completeness will be used to determine whether the data quality meets the objectives for the project. If the completeness objectives are not met for individual parameters, the QA Program Manager will review the reasons for the invalid data with the GE Project Manager. Depending on the ability to mobilize the field team, the reasons for the incomplete data (*e.g.*, holding time exceeded), and the effect of the incomplete data on the accomplishment of the project objectives, additional samples may be

collected and analyzed. An evaluation will also be conducted if a sample does not generate data for a parameter category (*e.g.*, PCB congeners, total RCRA metals). Such a data gap could result from sample container breakage or sample loss during analysis. If GE determines that the missing results are critical to accomplishing the work plan objectives, additional sampling will be conducted to obtain the missing data. The GE Project Manager and Project Manager will be responsible for approving the implementation of corrective action, including resampling, during data assessment. The QA Program Manager will document all corrective actions of this type.

## C2 Reports to Management

Monthly progress reports submitted to the US EPA are required by the Administrative Order on Consent (AOC). These progress reports will contain a summary of key quality assurance and quality control activities that occurred during the reporting period. The QA portion of the monthly progress reports will be the responsibility of the QA Program Manager and will provide a status report on the accuracy, precision, and completeness of the data as well as the results of the performance and system audits, and corrective action needed or taken during the project.

### C2.1 Contents of the QA Section of the Monthly Reports

The QA section of the monthly progress reports will contain results of field and laboratory audits performed during the reporting period, information generated during the reporting period reflecting on the achievement of specific DQOs (including data validation and assessment results), and a summary of corrective action that was implemented and the corrective action's immediate results on the project. The status of analytical, data verification and data validation tasks will be summarized

for the project with respect to the project schedule. In addition, whenever necessary, updates on training provided, changes in key personnel, and anticipated problems in the field or laboratory for the coming reporting period that could bear on data quality along with proposed solutions will be reported. Furthermore, detailed references to QAPP modifications will also be highlighted. QAPP modifications will be reviewed and approved by the EPA RPM. Monthly progress reports will be prepared in written, final format by the GE Project Manager or his designee. To the extent possible, assessment of the project should also be performed on the basis of available QC data and overall results in relation to originally targeted objectives.

### C2.2 Frequency of QA Reports

The QA reports will be prepared as part of the monthly progress report required by the AOC and will be delivered to recipients by the 15$^{th}$ day of every month. The reports will continue without interruption until the project has been completed.

In the event of an emergency, or in case it is essential to implement corrective action immediately, QA reports can be made by telephone to the appropriate individuals, as identified in the Corrective Action sections of this QAPP. These events and their resolution will be addressed thoroughly in the next issue of the monthly progress report.

## C2.3 Individual Receiving/Reviewing QA Reports

Those individuals identified in the AOC, paragraph 34, will receive copies of the monthly report containing the summary of QA activities. Additional project team members will receive the monthly progress report as deemed appropriate by the GE Project Manager.

# D. DATA VALIDATION AND USABILITY

The QA procedures that will occur after data collection are described in this section.

## D1 Data Review, Verification and Validation

The field, laboratory, and data management activities described in the FSP and this QAPP will be reviewed to assess whether these activities were performed in a manner that is appropriate for accomplishing the project objectives. This assessment will include electronic verification of the data, followed by data validation. Verification of the data is performed to determine whether the data have been generated in accordance with the procedures identified in the FSP and QAPP. Data validation involves identifying the technical usability of the data for making decisions pertaining to satisfying the project objectives identified in Section A7.

### D1.1 Review of Sampling Design

The ability of the collected samples to conform to the sampling design specifications in Section B1 of the QAPP and Section 1 of the FSP will be reviewed by the GE Project Manager, Sampling Program Manger and Field Sampling Manager on a real-time basis during each field sampling season (2002 and 2003). Those samples that deviate from the sampling design and the impact to project objectives, if any, will be discussed in the final report prepared at the end of each field season (2002 and 2003).

## D1.2 Review of Sample Collection Procedures

The sample collection procedures employed by the various collection contractors will be reviewed on a routine basis during each field season (2002 and 2003) to confirm that the samples are collected in accordance with the FSP (Section 2) and Section B2 of this QAPP. This review will note unacceptable departures, if any, from sample collection procedures in the FSP or QAPP and identify sample data (analytical or field) that should be excluded from incorporation into the project database or data evaluation process. The external field audits will necessarily enable the data quality to be assessed with regard to the sample collection and field operations. In addition, the Field Sampling Manager or his designee will review project logbooks or records on a routine basis during sampling activities.

To assure that all field data are collected accurately and correctly, field audit(s) as described in Section C1.1 will be performed during sample collection to document that the appropriate procedures are being followed with respect to sample (and QC sample) collection. These audits will include a thorough review of the field books and standard data collection forms used by the project personnel to ensure that tasks are performed as specified in the FSP and QAPP.

The evaluation (data review) of equipment blanks and other field QC samples will provide definitive indications of the data quality. If a problem arises, it should be able to be isolated via the complete sample tracking and documentation procedures that will be performed. If such a problem does arise, corrective action can be instituted and documented. If data are compromised due to a problem, appropriate data qualifications will be used to identify the data.

The labeling and identification of samples will also be reviewed to ensure samples properly represent the location they were intended to represent. It is expected that labeling errors will be minimal due to use of standardized labeling schemes and valid value checking in the project database.

### D1.3 Review of Sample Handling

The handling, preservation and storage of samples collected during the sampling program will be monitored on an on-going basis. The field audits described in Section C1.1 will provide documentation on proper handling of samples during collection and processing at the field processing laboratory facility. These audits will be reviewed by the Sampling Program Manger and Field Sampling Manager to determine if sample representativeness was maintained during collection and processing. Additionally, the project laboratories will document sample receipt including proper containers and preservation at the time samples are logged into their individual laboratory. The sample receipt records (a required data package deliverable) as well as Chain-of-Custody documentation will be routinely assessed by the data validators during data validation. Sample handling, storage, or preservation problems identified during data validation will result in appropriate qualification of data to warn the data user to data quality deficiencies.

### D1.4 Review of Analytical Procedures

The use of the proper analytical procedures described in Section B4 of the QAPP will be reviewed primarily through the data verification and data validation methods discussed in

Section D2 of this QAPP. Qualification of data that does not conform to criteria is also discussed in Section D2 of this QAPP.

Confirmation that samples were analyzed for the proper analyses will be performed through tracking mechanisms in the project analytical database. The tracking mechanisms will determine if samples submitted for analysis actually had the analyses performed. If analyses that were identified to be performed were not actually performed (due to loss of sample or improper log in at the laboratory, *etc.*) then a determination should have been made at the time the missing data was discovered and appropriate corrective action documented. The GE Project Manager, Project Manager and Field Sampling Manager will review the impact of incomplete analyses and identify impacts to the project objectives, if any, in the final project report for each field season (2002 and 2003).

### D1.5 Review of Quality Control

The review of quality control checks described in Section B5 of the QAPP will be reviewed primarily through the data verification and data validation methods discussed in Section D2 of this QAPP. Qualification of data that does not conform to criteria is also discussed in Section D2 of this QAPP.

### D1.6 Review of Calibration

The review of calibration of instruments and equipment described in Section B7 of the QAPP will be reviewed primarily through the data verification and data validation methods discussed in Section D2 of this QAPP. Qualification of data that does not conform to criteria is also discussed in Section D2 of this QAPP.

The Field Sampling Manager will review records of field equipment calibration and identify any impacts to non-analytical data that may exist.

### D1.7 Data Reduction and Processing

Data generated through field activities or by laboratory operations shall be reduced and validated prior to reporting. The field contractor or laboratory shall not disseminate data until it has been subjected to these reduction and internal validation procedures that are summarized in subsections below:

#### D1.7.1 Data Reduction

Data reduction involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements, and calculations. Data reduction occurs with:

- The FSP and QAPP through sample locations and naming conventions;
- The field sampling process through use of field logs and field measurements;

- Communications with the laboratory in sample analysis requests;
- Field operations with collection, preservation, and Chain-of-Custody documentation;
- Laboratory operations with sample receipt and handling, sample preparation and analysis, collation of raw data, and generation of laboratory results; and
- Post-laboratory operations with collation of analytical results in a format suitable for documents such as reports, maps, and trend plots.

Data reduction steps include field operations, laboratory operations, and report preparation operations.

Specific QC measures developed to ensure accuracy throughout the data reduction process is described throughout this QAPP.

#### D1.7.1.1 Field Data Reduction Procedures

Sediment Sampling

Field data will be recorded manually on a field log sheet at the time of core collection. These data will include:

- date ,
- time,
- sample I.D.,
- horizontal coordinates (northing, easting),

- water depth,
- depth of core tube penetration,
- approximate length of recovered sediment,
- field observations (probing results), .and
- additional information as defined in the EDD specification (Appendix 42) in the Core Data Import Format will be recorded in the field database.

If errors are made on the field logs, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. The field logs will be provided to the sample custodian at the field processing facility at the end of each day. The field data will then be entered into the field database. Upon completion of transcribing the field data into electronic format, the Field Sampling Manager or his designee will proof the forms to determine whether the field crew has made any transcription errors. Corrections will be made as appropriate to the electronic data.

Geophysical Surveys

Data acquired during the geophysical surveys will be generated by specialized instrumentation and stored electronically on a real-time basis in on-board computers. Proper calibration of instrumentation (Section B7) will facilitate the collection of accurate data. The electronic files will be backed up daily to minimize the potential for the loss of a significant amount of data. The geophysical survey contractor will be responsible for processing and interpreting the geophysical data upon completion of the field survey.

### D1.7.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures will be followed according to the following protocol. Raw analytical data will be recorded in the individual laboratory's Laboratory Information Management System (LIMS) (or equivalent) and tabular summary tables will be generated. Other pertinent information, such as the sample identification number, the analytical method used, the name of the analyst, the date of analysis, and matrix sampled will also be recorded in LIMS. At a minimum, reagent concentrations, instrument settings, and raw data will be retained by hard copy and laboratory notebooks, which shall be signed and dated by the analyst. Copies of any instrument printouts (such as gas chromatograms) will be maintained on file. Periodic review of raw data and of the computerized records by the laboratory personnel will occur prior to final data reporting according to each laboratory's Laboratory Quality Manual. As previously stated, complete copies of laboratory data will be provided according to the requirements in Section A9.

For this project, the equations that will be employed in reducing data are presented in the laboratory SOPs, which have been included in Appendices 5-8, 10-16, and 19-29 to this QAPP. (In addition, several of these equations, expressing analytical accuracy and precision have been presented in Sections A7.3 and B5 of this QAPP.) Such formulae make pertinent allowance for matrix type. The laboratory technical staff will check all calculations. Errors will be noted, and corrections will be made. The original notations will be crossed out legibly. Analytical results for sediment samples shall be calculated and reported on a dry-weight basis.

Quality control data (*e.g.*, laboratory duplicate results, surrogate recoveries, matrix spike recoveries, and matrix spike duplicate recoveries) will be compared to the acceptance criteria.

Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the laboratory Quality Assurance Officer for review. Unacceptable data shall be appropriately qualified in the project report. Case narratives will be prepared which will include information concerning data that was outside acceptance limits and any other anomalous conditions encountered during sample analysis. After the laboratory Quality Assurance Officer approves these data, the data are considered ready for release to the GE project team.

### D1.7.2 Identification and Treatment of Outliers

Outliers are unusually large or unusually small values in a population of observations. Outliers may be the result of a variety of circumstances (field or laboratory related), including any of the following:

- Sampling artifact,
- Sample integrity problem,
- Sample identification incorrectly transcribed in the field or laboratory,
- Unique conditions,
- Faulty or defective instruments,
- Inaccurate reading of meters,
- Errors in recording of data,
- Calculation errors, or
- Analytical errors.

Procedures for the identification of outliers will be followed at both the analytical stage and at the ensuing data reduction stage.

Outliers in laboratory data can arise from errors in analysis or from site-specific conditions that are out of the control of the laboratory. Errors in the laboratory are most often detected in the data review and validation process. In the event that quality control processes detect a suspected outlier not identified during data verification or validation, the suspect data will be subjected to appropriate statistically outlier testing. Outliers will be reported, but may not be used for evaluation purposes.

The QA Program Manager will identify outliers at the data reduction stage. When any particular value is suspected to be an outlier, the following steps will be taken:

- Other data from the same sample will be checked to see if they are also anomalous.

- The QA Program Manager will seek input from any individuals involved in generating the anomalous value as to possible causes. This will include questioning the field crew and the analyst(s).

    - Field crew - If samplers demonstrate standard competency in the sampling procedure used at the time the sample with the anomalous value was obtained, then sampling errors will be dismissed as a possible cause of the outlier.

- Analyst(s) - The analyst(s) will be asked to examine his/her notes and calculations and, if possible, to rerun the sample for the specific parameter in question. Results of any samples rerun outside holding time will be used for comparative purposes.

Rejection of any suspect data or outlier will only be done by the GE Project Manager and Project Manager in conjunction with the QA Program Manager. The GE Project Manager, Project Manager and the QA Program Manager will reject the data as an unacceptable outlier if:

- A problem with equipment or an incorrect procedure used during the sampling event is identified, or

- The rerun by the analyst generates a value that significantly differs from the value being examined.

### D1.7.3 Data Processing

Data will be processed from verified or validated data for use in making final decisions. It is expected that summary tables, maps and charts of verified and validated data will be prepared by various project team members. Data that is processed will be checked by an individual knowledgeable about the data type being compiled who will perform a reasonable (minimum of 10%) check of the final tabulated information to ensure transcription errors have not occurred. Further checks of the tabulated data will occur if problems are encountered or if a systematic problem is detected in the process. Systematic problems will be identified and corrected prior to processing the data again.

## D2 Validation and Verification Methods

Electronic data verification and data validation (where necessary) are conducted after samples have been taken and analyzed. Verification and validation are the "report card" at the end of data collection and analysis; they provide an understanding of the data quality. The response to data verification and data validation is critical. If correctable data quality issues are discovered, the findings must be immediately provided to the appropriate data generator such as the field samplers or laboratories so that appropriate corrective action can be taken to prevent the problem from recurring. The data verification program utilizes the information contained in the laboratory Electronic Data Deliverables (EDDs) and can provide information on data quality very quickly after the data generation. The more traditional data validation occurs after the formal laboratory reports are submitted and, although important to document data validity, does not provide timely feed back to a program that generates thousands of results per week from field samples. In a program of this magnitude and duration, there is ample opportunity to correct problems by use of the QA program elements described in the QAPP, by providing real-time feed back, and by taking corrective action.

Sample analysis and batch quality control results will be delivered in an EDD (refer to QAPP Section A9) for batch loading into the project database. Analytical results for all samples will also be provided in a full data package (refer to QAPP Section A9) in a scanned electronic media (Adobe® Acrobat® .pdf).

The usability of the analytical data will be assessed by using a tiered approach. Data will initially undergo an electronic data verification, which provides the first test of the quality of the

results. This automated process assesses data usability by evaluating batch quality control results. The term verification is used because criteria-based checking of the laboratory-reported QC results against the limits defined in the QAPP is used to qualify data. Full data validation, *i.e.*, manual qualitative and quantitative checking, will be performed on the PCB analytical results that are subject to question and on a subset of the other analytical results. This "tiered" data review strategy is consistent with several innovative validation approaches suggested by US EPA Regions for large-scale analytical programs ("*Region I, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses," (July 1996, revised December 1996); "Innovative Approaches to Data Validation," (Region III June 1995))*.

Automated electronic data verification will be performed on 100% of the total PCB, homolog PCB, TCLP, total RCRA metals, TOC and dioxin/furan data using the batch quality control results provided by the laboratories in the EDD. The specific measures evaluated during verification and the associated criteria are discussed in QAPP Section D.2.2. They include:

- Holding times;
- Accuracy (by evaluating laboratory control sample (LCS) recovery, matrix spike/matrix spike duplicate (MS/MSD) recoveries (except for PCBs), and Performance Evaluation (PE) sample results);
- Precision (by evaluating laboratory duplicate results);
- Field duplicate sample precision;
- Blank contamination (laboratory method blanks and field generated blanks);
- Surrogate compound recoveries; and
- Percent solids for solid matrices.

This electronic verification process will provide an understanding of the data quality based on those QC indicators that have the most influence on qualification of data. The electronic verification process will operate in an automated process so that the quality of the data can be determined soon after the laboratory reports it. In contrast, manual validation findings will not be available for three to four weeks after the data package is submitted by the laboratory because of the length of time professional validation takes. The use of electronic verification process can ultimately be "truthed" against the full data validation findings.

Full data validation will be performed on the PCB analytical data whose accuracy is open to question and on a subset of the other analytical data in accordance with the procedures defined in the QAPP Section D2.1. As requested by USEPA, the validation strategy for the PCB Aroclor and PCB homolog analyses is linked to the laboratory results of on-going Performance Evaluation (PE) sample analysis. The validation strategy for the remaining analyses is linked to the project DQOs.

### D2.1 Data Validation

Data validation is the process of verifying that qualitative and quantitative information generated relative to a given sample is complete and accurate. Data validation procedures shall be performed for both field and laboratory operations as described below:

#### D2.1.1 Procedures Used to Evaluate Field Data

Procedures to evaluate field data for this program primarily include reviewing field logbooks to check for transcription errors by the field crewmembers. These procedures are performed to

ensure that field measurements and various quality control analyses were properly performed and documented. The field data documented includes data generated during measurement of field parameters, observations, results of any quality control sample analyses, and field instrument calibrations. This task will be the responsibility of the Field Sampling Manager or designee, who will otherwise not participate in making any of the field measurements or in adding notes, data, or other information to the logbook or record form.

### D2.1.2 Procedures to Validate Laboratory Data

The PCB analyses will be subject to data validation in accordance with the following strategy:

- Total PCBs as Aroclors by SW-846 Method 8082 (SOP GEHR8082)
  1. PE samples for analysis of total PCBs as Aroclors by the SOP GEHR 8082 will be submitted to laboratories during the course of each sampling field season. For the laboratories running Aroclor analysis, the frequency of PE samples shall be one per day for the first two weeks (*e.g.*, 5 labs x 10 days = 50 PE samples). Thereafter, the frequency shall be one PE sample per laboratory per day for each laboratory performing satisfactorily. PE sample results will be compared to the acceptance criteria that will be based on the 95% confidence limit of the mean value of the PE results determined during the initial acceptance criteria generation. The 95% confidence acceptance limits for total PCBs as Aroclors will be updated after the inter-laboratory study is complete as described above. This more robust set of 95% confidence acceptance limits will be used for the on-going PE analysis during the SSAP.

  2. Validation of total PCBs as Aroclor will be performed if the result of the PE sample analysis fails. If a PE result falls outside the 95% confidence acceptance limits, but

inside the 99% confidence acceptance limits, then all samples will be validated that were analyzed in the SDG associated with the failing PE. If a PE result falls outside the 99% confidence acceptance limits, then all samples analyzed the day of the associated failing PE will be validated.

- PCB Homologs by EPA Method 680 (SOP GEHR680 – Appendix 8)
  1. Twelve PEs will be analyzed for PCB Homologs by EPA Method 680 (SOP GEHR8680 – Exhibit B) (three from each of the four Hudson River PE concentrations levels) during the first two weeks of the field season. For the remainder of the program, PE's for EPA Method 680 (SOP GEHR680 – Appendix 8) will be analyzed at a rate of one per every two SDGs or one PE per day, whichever is more frequent, for each lab performing satisfactorily.. PE sample results will be compared to the acceptance criteria that will based on the 95% confidence limit of the mean value of the PE results determined during the initial acceptance criteria generation.

  2. Validation of PCB Homologs will be performed if the result of the PE sample analysis fails. If a PE result falls outside the 95% confidence acceptance limits, then all samples will be validated that were analyzed in the SDG associated with the failing PE.

For the other (non-PCB) analyses, data validation will be performed on a subset of the analytical results in accordance with the following frequencies:

- TOC by Lloyd Kahn

Validation of two (2) SDGs selected randomly from TOC data from each project laboratory will occur during each of the 2002 and 2003 field seasons in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- Dioxins/Furans by EPA Method 1613B

  Validation of one (1) SDG selected randomly from dioxin/furan data from each project laboratory will occur during each of the 2002 and 2003 field seasons in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- RCRA Metals by SW-846 Method 6010B/7471A

  Validation of one (1) SDG selected randomly of total RCRA metals data from each project laboratory will occur during each of the 2002 and 2003 field seasons in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- TCLP Volatiles by SW-846 Method 1311/8260B

  Validation of two (2) samples selected randomly from TCLP volatiles data from each River Section will be performed in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- TCLP Semivolatiles SW-846 Method 1311/8270C

  Validation of two (2) samples selected randomly from TCLP semivolatiles data from each River Section will be performed in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- TCLP Pesticides SW-846 Method 1311/8081A

  Validation of two (2) samples selected randomly from TCLP pesticides data from each River Section will occur in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- TCLP Herbicides SW-846 Method 1311/8151A

  Validation of two (2) samples selected randomly from TCLP herbicides data from each River Section will occur in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

- TCLP Metals SW-846 Method 6010B/7470A

  Validation of two (2) samples selected randomly from TCLP metals data from each River Section will occur during each of the 2002 and 2003 field seasons in order to provide confirmation that the project laboratories are performing the analyses according to the requirements in the FSP and QAPP.

Independent validation of geotechnical parameters, $^{137}Cs$ and ignitability analysis data will not occur.

The data validation strategy is based upon the fact that 100% verification of the key analytical data will occur, the quantity of samples to be collected, and the ruggedness of the overall QA program. The QA program incorporates many measures to monitor QA at various points during the course of the project including: pre-qualification of the laboratories (see QAPP Section C1.2.1), EDDs and data packages will be provided by project laboratories as part of the pre-sampling inter-laboratory evaluation so that these deliverables can be reviewed prior to initiation of sample collection to confirm adherence to project analytical and reporting protocols; PEs (see QAPP Section C1.2.1.2), common analytical SOPs for key parameters, field audits (see QAPP Section C1.1), laboratory audits (see QAPP Section C1.2.2) and electronic data verification (see QAPP Section D2.2). These monitoring elements, together with the validation of analytical data (where necessary) as described above and in QAPP Section D2.1, will provide an overall assurance of the data quality.

The validation results will be compared to the results of the electronic verification for the same data set to provide an indication of the accuracy of the electronic verification process. If verification or validation identifies deficiencies in data quality, the source of the deficiencies will be investigated and corrective action will be taken (QAPP Section C1.3). Additional data may be validated if deemed necessary by the GE Project Manager and QA Program Manager as part of the corrective action process. However, no more than 200 samples will be validated per week.

Qualification of data resulting from the electronic verification or validation processes will be reflected by assigning the appropriate qualifier code to the sample result in the project database.

Due to the uncertainty of the ultimate validation volume for total PCBs as Aroclors and PCB homologs, the Data Summary Report to be provided to USEPA for each year of sampling will be submitted either 90 days following completion of field activities or 30 days following completion of any required PCB data validation, whichever is later, as provided in Exhibit F to the FSP.

The validation of the laboratory data will be performed with guidance from the Region II, Standard Operating Procedures for the Validation of Organic and Inorganic Data Acquired Using SW-846 Method (various SOPs and issue dates), *"US EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*," (October 1999), and the *"US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*," (February 1994). These documents which provide most of the criteria by which data are accepted or rejected were used as a basis in developing the data validation SOPs as listed below:

- DV8260B – Validation of Volatile Organic Data Generated by SW-846 Method 8260B,
- DV8270C – Validation of Semivolatile Organic Compound Data Generated by SW-846 Method 8270C,
- DV8081A – Validation of Organochlorine Pesticide Data Generated by SW-846 Method 8081A,
- DV8151A – Validation of Herbicide Data Generated by SW-846 Method 8151A,
- DV8082 – Validation of PCB (Aroclor) Data Generated by SW-846 Method 8082,
- DV680 – Validation of PCB (Homolog) Data Generated by GEHR680,
- DV1613B – Validation of Polychlorinated Dibenzo-*p*-dioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data Generated by Method 1613B,
- DV6010B – Validation of Metals Data Generated by SW-846 Method 6010B,

- DV74707471-Validation of Mercury Data Generated by SW-846 Methods 7470A/7471A, and
- DVTOC – Validation of TOC Data Generated by the Lloyd Kahn Procedure.

These data validation SOPs have been provided in Appendices 32-41 to this QAPP and will provide the specific criteria used to validate the data for each analytical parameter for the project. Full validation will include an evaluation of documented QA/QC measures through a review of tabulated QC summary forms and raw instrument data. Based on the results of the validation, full validation may be performed for additional data if deemed necessary by the GE Project Manager and Sediment Sampling Manager in conjunction with the QA Program Manager.

A preliminary review will be performed to verify that necessary paperwork (*e.g.,* Chain-of-Custody records, analytical reports, and laboratory personnel signatures) and deliverables (as specified in FSP and QAPP) for the analyses are present. At a minimum, deliverables will include sample Chain-of-Custody records, a detailed case narrative, analytical results, calibration summaries, QC summaries, and supporting raw data from instrument printouts as specified in Section A9 of this QAPP. The QA Program Manager will contact a project laboratory to request the correction of certain deficiencies prior to the submittal of the Quality Assurance Review, if such corrections are necessary for a full evaluation of the usability of the data. Such correctable deficiencies may include missing data deliverables or calculation errors that would take a significant amount of the staff reviewer's time to correct. In addition, the QA Program Manager may contact a project laboratory to request the correction of all correctable deficiencies prior to the submittal of the Quality Assurance Review, if time allows. Any laboratory resubmittals as a

result of such requests will be discussed in the appropriate "Comments" section of the Quality Assurance Review.

A detailed review will be performed by the QA Program Manager or staff reviewer of to independently verify compliance to the required analytical protocols and to determine the qualitative and quantitative reliability of the data as the data are presented. Full validation will include a detailed review and interpretation of data generated by the laboratory. The primary tools that will be used by experienced data review chemists will be guidance documents, established (contractual) criteria, the data validation SOPs provided in Appendices 32-41 to the QAPP, and professional judgment.

Based upon the review of the analytical data, a Quality Assurance Review will be prepared which will summarize the qualitative and quantitative reliability of the analytical data. During the course of the data review, a full organic, inorganic, and general chemistry support documentation package will be prepared from the deliverables provided by the laboratory; this support documentation will provide backup information that will accompany all qualifying statements presented in the quality assurance review. Table D-1 provides a summary of the Quality Assurance Review report format and details the information contained in the support documentation packages.

Based upon the quality assurance review of the analytical data, specific codes will be placed next to results in the database to provide and indication of the quantitative and qualitative reliability of the results. These defined qualifier codes will serve as an indication of qualitative and quantitative reliability. The data qualifier codes and definitions will be as follows:

U - The compound/analyte was analyzed for, but was not detected above the reported sample quantitation/detection limit.

U* - This compound/analyte should be considered "not detected" since it was detected in a blank at a similar level.

J - Quantitation is approximate (estimated) due to limitations identified during the quality assurance review (data validation).

N - The analysis indicates that there is presumptive evidence to make a "tentative identification" of this compound/analyte.

R - Unusable (rejected) result – compound/analyte may or may not be present in this sample.

UR - Unusable "not-detected" result; compound may or may not be present in this sample.

UJ - This compound/analyte was not detected, but the quantitation/detection limit is probably higher than reported due to a low bias identified during the quality assurance review.

EMPC - Estimated Maximum Possible Concentration; chromatographic peaks are present in the expected retention time window, but, the peaks do not meet all of the conditions

required for a positive identification. The reported result represents the estimated maximum possible concentration if the PCDD or PCDF was present.

Once the review has been completed, the QA Program Manager will submit the report and data tables to the GE Project Manger and appropriate team members. The approved quality assurance review will be signed and dated by the QA Program Manager.

### D2.2 Procedures for Data Verification

Automated electronic data verification will be performed on 100% of the total PCB, PCB homolog, TCLP, total RCRA metals, TOC and dioxin/furan data using the batch quality control results provided by the laboratories in the EDD. The quantitative criteria (limits) used for data verification will be consistent with the data validation quantitative criteria (limits) for the same evaluation processes. The automated data evaluation process provides consistent evaluation and qualification (flagging) of data. To accomplish the data verification process, the system completes the following phases:

Phase 1: Contamination

- Method Blank Evaluation – Determine whether the source of positive results in the field sample is attributable to laboratory processing.
- Equipment Blank Evaluation – Determine whether the source of positive results in the field sample detection is attributable to field processing.

Phase 2: Holding Times

- Holding Time Evaluation – Check whether holding times meet, slightly exceed, or grossly exceed acceptance criteria.

Phase 3: Accuracy

- Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Evaluation – Spiked field sample recoveries for the MS and MSD are compared to the acceptance criteria range.

- Laboratory Control Sample (LCS) – Spiked compound recoveries are compared to the acceptance criteria range.

Phase 4: Precision

- Laboratory Duplicate Evaluation – The relative percent differences between MS and MSD recoveries or precision between a field sample and its laboratory duplicate (if performed) are compared to the acceptance criteria.

- Field Duplicate Evaluation – Check whether the precision between a field sample and its field duplicate meet project criteria.

Phase 5: Surrogates

- Surrogate Evaluation (organics only) – Surrogate recoveries are compared to the acceptance criteria ranges.

Phase 6: Percent Solids

- Percent Solids Evaluation – Check whether the field sample percent solids meet project criteria.

The following evaluation procedures account for potential data verification out-of-criteria situations:

- Samples analyzed outside of holding time criteria will be qualified as estimated or rejected (in the event of gross exceedance).
- Samples with surrogate recoveries greater than or less than the project acceptance criteria ranges will have values greater than the sample reporting limit qualified as estimated.
- Samples with surrogate recoveries below the project control limits but greater than or equal to 10% will have all non-detected values qualified as estimated.
- Samples with surrogate recoveries below 10% will have non-detected results qualified unusable.
- Samples for organic analysis with MS and/or MSD recoveries (except PCBs) or relative percent differences (RPDs) outside of project control limits will have the specific out-of-criteria compound result(s) in the associated unspiked sample qualified. Qualification for matrix spike analyses follows the QC rules used for surrogates.

- LCS samples with recoveries outside of criteria will have all samples in the same preparation batch qualified following the same rules as for surrogates.

- Inorganic MS samples with recoveries outside of criteria will have samples of the same matrix in the associated batch qualified following the same rules as for surrogates.

- Laboratory duplicates with inorganic analytes out of RPD criteria will have the analyte values greater than the sample reporting limit qualified as estimated in similar matrix samples in the associated batch.

- Field duplicate analytes with out-of-criteria RPDs will have the analyte values greater than the sample reporting limit estimated in only the field duplicate and its associated sample.

A summary report detailing the out-of-control criteria and the associated sample data that are qualified is generated at the end of the data verification process. The electronic data verification qualifiers will be posted to the project analytical database. Qualifier codes will be identical to those identified above in Section D2.1.2. Data will move from an "unverified" to "verified" state in the project analytical database at the conclusion of the data verification process. Sample data that is selected for full validation will have the verification process report evaluated to provide a check on the data verification process logic.

## D3 Reconciliation with Data Quality Objectives

The QA Program Manager in conjunction with Overall Project Manager and Project Manager will determine whether field and analytical data or data sets do not meet the requirements necessary for decision making. The results of measurements will be compared to the DQO requirements set forth in this QAPP. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. Much of the data generated by this program will be used to develop graphic representations of the vertical and horizontal distribution of PCBs and sediment bed type which will be used to delineate the areas of the river bed to be dredged. The DQOs will be considered to be satisfied if the data are sufficient (based on the accuracy of the data and the quality of the graphic representations) to define the distribution of PCBs in sediment in a manner that is acceptable for delineating areas for dredging. Additionally, the DQOs will be considered to be satisfied if sufficient geotechnical information exists to complete the design of structures and support facilities required for the project. Data that do not meet the data users needs will be identified and appropriately noted in the project database so the decision-makers are aware of its limitation.

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