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OTHER: 253338
SDMS DocID 253338

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US ARMY CORPS
OF ENGINEERS
New England District

Contract No. DACW33-01-D-0004
Delivery Order No. 01
March 2005

FINAL WORK PLAN DOCUMENTS

Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP) Addendum 3 and Health and Safety Plan (HASP)

Task RI-13 Lyman Mill Pond Sediment Investigation

Centredale Manor Restoration Project Superfund Site North Providence, Rhode Island

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FIELD SAMPLING PLAN

Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Task RI-13
Lyman Mill Pond Sediment Investigation

CONTRACT NO. DACW33-01-D-0004
DELIVERY ORDER NO. 01

Submitted to:

Department of the Army
U.S. Army Corps of Engineers
New England Division

March 2005

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TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
1.1 Objectives 1-1
1.1.1 Site Description 1-1
1.2 Overview of Field Activities 1-2

2.0 PROJECT ORGANIZATION AND SITE MANAGEMENT 2-1
2.1 Project Organization 2-1
2.1.1 Personnel Responsibilities 2-1
2.1.2 Schedule 2-1
2.2 Site Control 2-1
2.2.1 Site Access 2-1
2.2.1.1 Field Office/Command Post 2-1
2.2.1.2 Site Security/Control 2-1

3.0 FIELD SAMPLING ACTIVITIES 3-1
3.1 Mobilization/Demobilization 3-1
3.2 Sample Collection 3-2
3.2.1 Sediment Core Sampling 3-2
3.2.2 Packaging and Shipment of Samples 3-2
3.3 Field Investigation Documentation 3-3
3.3.1 Logbooks 3-3
3.3.1.1 Site Master Log 3-3
3.3.1.2 Field Logs 3-3
3.3.2 Sample Documentation 3-4
3.3.3 Sample Location Identification System 3-4
3.3.4 Field Electronic Data Deliverable 3-5
3.3.5 Field Summary Report 3-5
3.4 Quality Control Samples 3-5
3.5 Chain of Custody Procedures 3-6
3.6 Equipment Decontamination 3-6
3.6.1 Decontamination Procedures 3-6
3.7 Control and Disposal of Investigation-Derived Waste (IDW) 3-7
3.7.1 Drum Labeling 3-7
3.7.2 Analytical Requirements for Waste Characterization 3-7
3.7.3 Transportation and Disposal 3-7
3.7.4 Hazardous Waste Manifesting Compliance 3-7

4.0 REFERENCES 4-1

TABLES

Table 1. Core Collection and Processing Estimated Field Schedule
Table 2. Standard Operating Procedures
Table 3. Sample Container, Sample Size, Preservation Requirements, Holding Times and Analytical Laboratories
Table 4. Target Sample Locations in Lyman Mill Pond

US EPA ARCHIVE DOCUMENT

FIGURES

Figure 1. Lyman Mill (RI-13C) Field Sampling Organization Chart
Figure 2. Lyman Mill Pond Sampling Locations

APPENDICES

Appendix A: Data Quality Objectives for Lyman Mill Pond
Appendix B: Standard Operating Procedures (SOPs)
Appendix C: Field Forms
Appendix D: Field Electronic Data Deliverable Requirements

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (USEPA) Region I and U.S. Army Corps of Engineers (USACE) New England District are conducting additional characterization of the Centredale Manor Restoration Project (CMRP) Superfund site located in North Providence, Rhode Island. This work is being conducted to fill data gaps in support of the remedial investigation/feasibility study (RI/FS). This Field Sampling Plan (FSP) describes data collection activities required to complete sediment collections in Lyman Mill Pond under task RI-13C.

This FSP is divided into four sections. Section 1.0 presents background information and states the objectives of the field activities. Section 2.0 describes the components of general site management and Section 3.0 presents the specifics of the field data collection activities. References are provided in Section 4.0, and other supporting information is provided in the appendices.

A Quality Assurance Project Plan (QAPP) Addendum 3 has also been prepared for these activities and is provided as a separate document (Battelle, 2005a). The FSP and QAPP Addendum 3 comprise the Sampling and Analysis Plan (SAP) for the investigation. An updated Site Health and Safety Plan (HASP) (Battelle, 2005b) has also been prepared to support the field investigation and subsequent data analyses. Additional project documents prepared to support recent site investigations include the Data Management Plan (DMP; Battelle, 2004a) and Site Management Plan (SMP; Battelle, 2002).

1.1 Objectives

The *Remedial Investigation* (Battelle, 2004b) identified that the spatial coverage for sediment samples in Lyman Mill Pond is insufficient for mapping the horizontal and vertical distribution of dioxin and other compounds of concern with sufficient resolution for developing remedial alternatives. Additional data collection is required to fill this data gap. Data quality objectives (DQOs) for Lyman Mill Pond are presented in Appendix A; this FSP addresses the following field activity identified from the DQO process:

- Collection of sediment cores from the Lyman Mill Pond to better define the horizontal and vertical distribution of dioxin/furan contamination and screen for the presence of other contaminants, including polychlorinated biphenyls (PCBs as Aroclor), pesticides, polycyclic aromatic hydrocarbons (PAH), and metals.
- Collection of sediment cores from the Lyman Mill Pond for radiometric dating to better define estimated sedimentation rates and identify the sediment depth associated with the onset of waste-related activities at the site; identify any relationships between sediment depth, age and dioxin concentration; and estimate the rate of sediment accumulation in depositional areas.
- Collection of data for selected geotechnical parameters to support the development of remedial alternatives.

Additional data may be collected below Lyman Mill Dam in a future phase of the project.

1.1.1 Site Description

The study area for the CMRP site includes the 3-mile reach of the Woonasquatucket River from the Route 44 bridge immediately upstream of the Brook Village apartment complex, downstream to the former Dyerville Dam. From north to south, this reach of the river has four dammed impoundments:

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Allendale Pond, Lyman Mill Pond, Manton Pond, and Dyerville Pond (only pilings remain of the former Dyerville Dam). These impoundments are connected by free-flowing channel reaches below each dam. The main part of the site is located at 2072 and 2074 Smith Street in North Providence, Rhode Island, and is currently occupied by the Brook Village and Centredale Manor apartment complex. The site history, conceptual site model (CSM) and a summary of previous investigations at the site are provided in the *Remedial Investigation* (Battelle, 2004b).

1.2 Overview of Field Activities

The field activities described in this FSP include the following:

- Mobilization/demobilization;
- Collection of sediment core samples from Lyman Mill Pond;
- Sediment core processing; and
- Disposal of Investigation Derived Waste (IDW).

Details of the sampling program are described in Section 3.0.

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2.0 PROJECT ORGANIZATION AND SITE MANAGEMENT

This section presents the project organization and site management considerations for the CMRP site RI/FS field activities.

2.1 Project Organization

This section describes the project organization and schedule, including responsibilities of the personnel involved in performing the field activities. Key project personnel and their responsibilities are outlined below.

2.1.1 Personnel Responsibilities

The project organization structure is presented in Figure 1. The Battelle field personnel conducting the work outlined in this FSP will consist of a Field Operations Leader (FOL), Site Safety Officer (SSO), and field scientists. The team under the direction of the FOL will perform the field work. The FOL will report directly to the Battelle RI/FS Task Manager.

Responsibilities of the FOL include supervising field operations; ensuring that the procedures specified in the FSP are properly implemented; maintaining daily sampling and shipping schedules; and reporting to the RI/FS Task Manager on a regular basis regarding sampling status and progress of the field activities.

The FOL has been appointed as the SSO for this project. The SSO will assist in implementing the Health and Safety Plan (Battelle, 2005b). The SSO will report directly to the Battelle Health and Safety Officer on any health and safety issues. The SSO/FOL will also report any hazards, injuries, or decisions to stop work to the Battelle RI/FS Task Manager.

2.1.2 Schedule

All fieldwork is separated by activity. The estimated schedule for the investigation is shown in Table 1.

2.2 Site Control

The following subsections contain information regarding the control of activities at the site. Site information is also contained in the SMP Update (Battelle, 2002).

2.2.1 Site Access

No site access issues are anticipated.

2.2.1.1 Field Office/Command Post

No single field support location will be established for this investigation as field crews will operate primarily out of support vehicles. The support vehicles will be located in a non-obtrusive area near to the locations being sampled on a given day.

2.2.1.2 Site Security/Control

Battelle will not control access to the study area, and will only control access to active sampling locations. As directed by the FOL, all removable equipment will be locked in support vehicles and secured at the end of each working day.

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3.0 FIELD SAMPLING ACTIVITIES

The field sampling activities consist of the following subtasks:

- Mobilization/demobilization;
- Sample collection;
- Field investigation documentation;
- Chain-of-custody procedures;
- Sediment core processing;
- Decontamination procedures, and
- Control and disposal of Investigation Derived Waste (IDW).

Each of these tasks and the specific activities are described below.

3.1 Mobilization/Demobilization

Prior to beginning any field work, all field team members will review the Statement of Work (SOW), this FSP, the QAPP Addendum 3, the HASP, and all applicable Standard Operating Procedures (SOPs) identified in Section 3.2 and provided in Appendix B of this FSP. In addition, the RI/FS Task Manager, the SSO, the FOL, and field scientists will hold a field team orientation meeting prior to beginning the fieldwork to familiarize personnel with the scope of the field activities. All field team members will receive a copy of all of the documents listed above prior to the orientation meeting. A record of the fieldwork orientation meeting will be maintained in the project file.

Equipment mobilization may include, but not necessarily be limited to, transporting and preparing the following equipment:

- Sampling and shipping equipment;
- Health and safety equipment;
- Decontamination equipment;
- Subcontractor equipment (to be conducted by the subcontractor).

The FOL will coordinate the mobilization. The FOL will be responsible for mobilizing and demobilizing the equipment and personnel necessary to perform the work outlined in the specification, including obtaining any permits required by federal, state, and local authorities. The FOL will also coordinate any equipment purchases necessary to conduct the field investigation and transportation of equipment to the site as needed.

At the completion of field work, the FOL will coordinate the demobilization, which includes the removal of all sampling equipment, IDW, and any other investigation-related materials from the site. A subcontractor will be procured for IDW disposal. Once the procurement process has been completed, a "Notice to Proceed" will be issued to the selected subcontractor to initiate IDW removal as required.

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3.2 Sample Collection

3.2.1 Sediment Core Sampling

Sediment core samples will be collected from 10 sample locations in Lyman Mill Pond (Figure 2 and Table 4) as described in the Coring Methodology (Appendix B, Reference #S-19). For this investigation, vibracoring methods will be used because gravel may be encountered at sample locations in the southern area of Lyman Mill Pond, and one consistent coring method is preferred for the study area. Further, this method is consistent with the approach used for the May 2003 investigation at Allendale and Lyman Mill Ponds.

Sample locations were selected using a systematic sampling approach, with minor judgment-based modifications as described in Appendix A. Sample locations were selected to provide approximately equally-spaced coverage throughout the pond in areas where no data are available. Systematic, equally-spaced sampling assures complete coverage of the pond area, and will provide optimal data for determining the precision associated with the contour maps.

At each of the ten locations a vibracore sample will be collected to characterize the distribution of dioxin/furan contamination and screen for the presence of other site-related contaminants; PCBs, pesticides, PAH, metals and selected geotechnical parameters (i.e., percent solids, water content, grain size and Atterberg Limits). Samples for potential geotechnical analysis will be selected after all cores have been processed to ensure that all sediment types are represented; sample selection will be mutually agreed upon by USEPA, USACE and Battelle. At 5 of the 10 sites an additional core will be collected for radiometric dating. Core penetration depths of four feet will be targeted. Where practical, longer cores will be collected.

SOPs that apply to sediment core sampling procedures are listed in Table 2. Copies of all SOPs are provided in Appendix B. Sampling stations will be surveyed in advance using a differential Global Positioning System (dGPS) following SOP 3-118-02. All sample locations will be referenced to the Rhode Island State Plane Coordinate System (NAD 83).

After collection, sediment cores will be transported (stored cold in the vertical position) to U.S. EPA AED laboratory in Narragansett, Rhode Island for processing. Processing will be conducted by USACE ERDC and Battelle staff, and is described in the Coring Methodology (Appendix B, Reference # S-19). Sub-samples from each core will be collected as detailed in Table 3. Sample container requirements, holding times, and preservation requirements are also summarized in Table 3. After core processing is complete, sub-samples will be transported to Battelle Duxbury and then shipped to participating laboratories for the required testing.

3.2.2 Packaging and Shipment of Samples

Samples will be shipped to participating laboratories following Battelle SOP No. 5-210-03, *Packaging and Shipping of Samples* (Appendix B). Briefly, the FOL or designee will pack the samples securely in a cooler with bubble wrap and blue ice or crushed ice to achieve the proper temperature. Each cooler will contain a cooler temp blank, which will be comprised of a bottle of sand and labeled in the same manner. The cooler should have at least one inch of bubble wrap placed on the bottom of the cooler and the samples should be wrapped in bubble wrap if breakable or crushable containers are used. The samples will be packed tightly and not be able to move freely in the cooler; they must be secure. An upper weight limit of 70 pounds per cooler is suggested. All paper work is signed, the original custody form

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(Appendix C-2) is placed in a zip-lock bag with a cover letter, and taped to the top of the cooler to avoid moisture.

A cover letter accompanying the samples should include

- the name of the Battelle technical contact (i.e., Deirdre Dahlen);
- a statement about the number of coolers being shipped;
- a reference to the appropriate document (i.e., QAPP Addendum 3); and
- a request that the receiving laboratory return the signed custody forms to Battelle (i.e., Deirdre Dahlen).

When one sample shipment is contained in multiple coolers, the custody forms should be copied, placed in zip-lock bags, and attached to the inside top of each cooler. Copies should be clearly labeled as such and they should indicate which samples are contained in each cooler. The individual coolers should be numbered 1 of 3, 2 of 3, etc. In addition, the Federal Express (or other transporter) label should be completed to indicate the cooler number and total number of coolers in the shipment (1 of 3, 2 of 3, etc.). Each cooler shipped by Federal Express receives a unique tracking number. Shipping over national holidays and weekend deliveries should be avoided whenever possible.

3.3 Field Investigation Documentation

Field documentation requirements are described below.

3.3.1 Logbooks

Logbooks will be maintained throughout the field investigation. The site master log, field logbooks, and field equipment logbooks are briefly described below.

3.3.1.1 Site Master Log

The site master log (Appendix C-3) is the primary field investigation document to be maintained by the FOL. Its primary purpose is to contain within one document the actual field data or references to other field documents that contain a specific description of every activity that has occurred in the field on any given day. Any administrative occurrences, conditions, or activities that have affected the fieldwork will also be recorded. A copy of these reports will be sent to the site managers at the conclusion of the field program. Daily Calibration Data Sheets (Appendix C-4) will be filed as part of the Master Log as well (see Section 3.3.1.3 for details regarding calibration of the field equipment).

3.3.1.2 Field Logs

The field team will maintain separate field logs, as necessary. All entries will be in permanent ink with changes initialed and dated. In general, these logs will contain specific details supporting the tasks performed by the person maintaining the field log. Information to be recorded in the field logs or on supporting field data forms shall include, but not be limited to the following:

- name and title of author, date and time of entry, and physical/environmental conditions during the field activity;
- name and titles of field crew, including subcontractors;
- name and titles of site visitors, and time on and off site;
- documentation of health and safety activities;
- sampled media designation (i.e., sediment core);

- sample collection method (i.e., grab or composite);
- number and volume of samples taken;
- description of sampling points;
- date and time of collection;
- sample identification numbers;
- references for maps and photographs of the sampling sites;
- field observations;
- field measurements made (i.e. Water Depth);
- decontamination procedures;
- instrument calibration; and
- weather conditions.

3.3.2 Sample Documentation

Sediment core sample log sheets will be completed for each sample collected. Example field forms used to document sample collection activities (e.g., sediment core logs) are provided in Appendix C. Information recorded will include sample identification, analytes, depth sampled, date and time collected, and other pertinent information. Chain-of-custody (COC) forms will be maintained in a file and copies will be sent to the site managers on a weekly basis when analytical samples are being shipped. Consistent with the May 2003 investigation, each sediment core will be visually described and photo-documented by USACE ERDC.

3.3.3 Sample Location Identification System

Each analytical sample collected from the study area will be assigned a unique sample location tracking number. Consistent with previous investigations, the sample location tracking number will consist of a four- to five-segment, alpha-numeric code that identifies the area, sample medium, specific sample location identifier, sample event, sample depth or the quality control (QC) sample designation, if appropriate. Any other pertinent information regarding sample identification will be recorded in the field logbooks or on sample log sheets.

The alpha-numeric coding to be used in the sample location numbering system is explained in the following diagram and the subsequent definitions:

AAA - AA - NNNN - NN

Where "A" represents an alpha character and "N" represents a numeric character.

1. The three alpha character group identifies the area investigated (e.g., "LPX" for Lyman Mill Pond). The character group is as follows:

   LPX – Lyman Mill Pond

   The two alpha character group identifies the matrix sampled as follows:

   SD – Sediment

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2. A four numeric character group describing a unique location number identified sequentially. Data collected will use a "4500" series.

3. A two digit round number for that station number "01" for the first sample collected from that location, and "02" for the second sample collected from that location, etc. For example, the sample identifier, LPX-SD-4501-01 represents a sediment core sample collected from the Lyman Mill Pond at location 4501, and it was the first sediment sample collected at that location. The '-NN' code will not be used if only one core is collected at each location.

Sample IDs assigned to sub-samples collected from each core are described in Battelle (2005a). Briefly, sub-samples collected from processed cores will be assigned a unique sample ID based on the sediment core ID and the depth interval collected, as follows:

AAA - AA - NNNN – NNNN-NNNN

Where 'AAA-AA-NNNN' is the sediment core ID and 'NNNN-NNNN' designates the depth interval sampled in feet. For example, LPX-SD-4501-0000-0005 represents a sediment core sample collected from the Lyman Mill Pond at location 4501, and it was sub-sampled between 0 and 0.05 feet.

3.3.4 Field Electronic Data Deliverable

The field team will be responsible for generating an electronic data deliverable (EDD) that summarizes all sample collection data. The field EDD must be prepared in accordance with the requirements of the DMP (Battelle, 2004a). The field EDD will be loaded into the project database. Field EDD specifications and an example EDD are provided in Appendix D.

All data in the field EDD should be formatted as values (no formulas). There should not be any blank rows, hidden columns and hidden rows in the file. The first line of each file will be the column header. The column names are the same as the database field names and must exactly match the spelling provided in Appendix D. Field formats should be reviewed carefully prior to submitting the EDD to Battelle. A field reported as *Null* cannot have spaces or returns. A number field must be reported with a number or *Null*. For example, if a text value, such as "N/A" or a space, is reported in a number field, the data will not be acceptable to the database and the EDD will be rejected.

3.3.5 Field Summary Report

A field summary report is not a required deliverable for this investigation. However, a summary of field activities, including a chronology of events, narrative description of field conditions, tabulated sample collection information (i.e., the field EDD), and a summary of any problems encountered, deviations, and corrective actions will be documented by the FOL and later included in the chemistry data report, which is a required deliverable for this investigation.

3.4 Quality Control Samples

The field QC samples that will be collected or generated during the field sampling activities are described below. A detailed discussion of the objectives, procedures, and collection rates for each type of QC sample is provided in the QAPP Addendum 3 (Battelle, 2005a).

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3.5 Chain of Custody Procedures

Samples collected at the site will be held under Chain of Custody (SOP 6-040-01 and Appendix C-2). COC procedures will be used to ensure that:

- All necessary samples are collected for all scheduled analyses;
- The correct samples are analyzed for requested analyses and traceable to their records;
- Samples are protected from loss and identified if damaged;
- Alteration of samples (e.g., filtration and preservation) is documented;
- A forensic record of sample integrity is established; and
- Sample security is maintained.

COC protocol to be followed by sampling personnel involves the following steps:

- Documenting procedures used and reagents added to samples during sample preparation and preservation;
- Recording sample site identification, field sample number, and specific sample collection procedures on the appropriate forms;
- Using sample labels which contain all information necessary for effective sample tracking; and
- Completing standard field data record forms to establish sample custody in the field before sample shipment.

The COC record is used to document sample-handling information (i.e., sample location, sample identification, and number of containers corresponding to each sample number). The following information is recorded on the COC record (Appendix C-2):

- Project reference;
- Site identification code, sample identification code, date of collection, time of collection, number and type of sample containers for each analysis, preservation methods, site type, total number of containers for each sample, and sample depth;
- Names of the sampler(s) and the person shipping the samples; and
- Date and time that the samples were delivered for shipping.

3.6 Equipment Decontamination

This section provides guidelines for decontamination of equipment used during the field investigation. All decontamination activities will be conducted within an established area and will be performed under the supervision of the FOL. Personnel decontamination issues are discussed in the HASP.

3.6.1 Decontamination Procedures

All non-disposable sampling and testing equipment that comes in contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points, as described below:

- Brush to remove gross contamination;
- Potable water and detergent (e.g., Alconox or Liquinox) wash and scrub with brush;
- Rinse with potable water;
- Rinse with DI water (analyte free);

- Air dry (to the extent practical) on aluminum foil or in a strainer; and
- Wrap in aluminum foil for transport (or if not being used immediately).

3.7 Control and Disposal of Investigation-Derived Waste (IDW)

Solid Investigation-Derived Waste (IDW) will include excess sample material and personal protective equipment (i.e., nitrile gloves, booties). Minimal excess sample material is expected during this effort, as core samples will be fully contained in liners. A labeled drum will be placed in a secure location on site near the Lyman Mill Pond for disposal of IDW. Battelle's sub-contractor, ONYX Environmental, will be responsible for the transportation and disposal of the solid IDW (dioxin bearing, non-F027 listed waste). Decontamination in the field will occur for all sampling equipment such as Vibracore barrels, cutter heads, and core catchers.

3.7.1 Drum Labeling

Investigation-derived waste will be generated during the sediment core sampling and equipment decontamination activities. After the material is drummed and the lid secured, the drum will be marked using a waterproof indelible ink marker; an example follows:

- IDW-CM-01 – (IDW – Centredale Manor – Drum #01)
- Date first accumulated: e.g., 3/30/05
- Source(s) of material: Sample ID#
- Volume and type of total material

3.7.2 Analytical Requirements for Waste Characterization

No testing of the IDW is required for this sampling event. The waste profile from previous testing at the site will be used to determine waste disposal methods

3.7.3 Transportation and Disposal

It is anticipated that the drums of solid waste will remain on site until all planned sample collection activities for the site are complete (summer 2005). A licensed hazardous waste transportation and disposal subcontractor (ONYX Environmental Services, LLC) has been contracted to transport and dispose of any non-hazardous and hazardous waste streams generated during the investigation.

3.7.4 Hazardous Waste Manifesting Compliance

The transportation and disposal subcontractor for each shipment of IDW leaving the site will prepare one hazardous waste manifest.

Manifests will be completed for all hazardous wastes disposed off site, and signed by Battelle's Hazardous Waste Coordinator "On Behalf of EPA". At no time does Battelle or its subcontractors assume ownership of the IDW.

Copies of all documentation of control and disposal of IDW generated by the project will be provided to the USEPA. Copies will also be maintained in the project file located at the Battelle Duxbury, Massachusetts office.

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4.0 REFERENCES

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Battelle, 2005a. *Addendum 3 to Tasks 19-22 QAPP, Centredale Manor Restoration Project Superfund Site Baseline Risk Assessment, Initial Project Planning and Support.* January.

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TABLES

Table 1. Core Collection and Processing Estimated Field Schedule

Activity	Working Days	Est. Start Date	Est. Finish Date
Notice to Proceed	1	12/2/04	12/2/04
Kickoff meeting	1	03/15/05	03/15/05
Field preparation	11	03/15/05	03/29/05
Core Collections (including mob/demob)	3	03/30/05	04/01/05
Sediment core Processing	5	04/04/05	04/08/05

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Table 2. Standard Operating Procedures[1]

Reference Number	Title, Revision Date and/or Number	Originating Organization
3-118-02	Northstar 952XDW Differential GPS Navigation System, 1/28/04	Battelle
5-114-05	The Storage and Disposal of Chemical Waste, 12/11/98	Battelle
5-210-03	Packaging and Shipping of Samples 4/4/01	Battelle
6-040-01	Sample Receipt, Custody, and Handling in the Field, 4/4/02	Battelle
S-19 (a)	Coring Methodology	EPA ERTC/REAC (modified by Battelle 3/05)

[1] Sampling SOPs provided in Appendix B.

(a) Not a Battelle SOP; reference number corresponds to number assigned in the QAPP Addendum 3 (Battelle, 2005a).

Table 3. Sample Container, Sample Size, Preservation Requirements, Holding Times and Analytical Laboratories

Medium/ Matrix	Analytical Parameter	Minimum Sample Volume	Container	Preservation Requirements (a)	Maximum Holding Time	Laboratory for Shipping
Sediment	Dioxin/Furan and Percent Moisture	½ full	125 mL pre-cleaned jar	Cold (4±2°C)	1-year	Henry Pham Battelle Columbus 505 King Avenue Columbus, OH 43201 (614) 424-7849
	PCB Aroclor/ Pesticide, PAH and Percent Moisture	½ full	125 mL pre-cleaned jar	Cold (4±2°C)	14-d [1-year if frozen (b)]	Jeff Newell Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781) 952-5270
	Pb-210, Percent Moisture	¾ full	125 mL pre-cleaned jar	Ambient	30-d	Pat Marshall Teledyne Brown 2508 Quality Lane Knoxville, TN 37931 (865) 934-0379
	Metals (c) , Percent Moisture	¾ full	125 mL pre-cleaned jar	Cold (4±2°C)	Metals: 6-mo Hg: 28-d	Shirley Ng Mitkem Corporation 175 Metro Center Blvd. Warwick, RI 02886-1755 (401) 732-3400
	MeHg, Hg, Percent Moisture	½ full	125 mL pre-cleaned jar	Frozen (-20°C)	28-d	Carolynn Suslick Battelle MSL 1529 Sequim Bay Rd. Sequim, WA 98382 (360) 681-3624
	Geotechnical (d)	½ full	1-L (32-oz) pre-cleaned jar	Cold (4±2°C)	28-d	Ken Davis Applied Marine Sciences 502 North Highway 3 League City, TX 77573 (281) 554-7272

(a) Samples will be kept chilled in the field and preserved (cold, frozen) as noted above for shipment to participating laboratories.

(b) EMAP Estuaries 1992 Virginian Province Quality Assurance Project Plan.

(c) Target metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc.

(d) Analyses will vary from sample to sample, but will generally include Water Content/Percent Solids, Grain Size and Atterberg Limits.

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Table 4. Target Sample Locations in Lyman Mill Pond

Station ID	EASTING	NORTHING	Additional core collection for Radioisotopes
LPX-SD-4501	333988.07	275774.46	
LPX-SD-4502	334088.42	276025.34	X
LPX-SD-4503	333904.44	276217.04	X
LPX-SD-4504	333683.15	276649.32	
LPX-SD-4505	333831.11	276736.8	X
LPX-SD-4506	333692.16	277040.43	
LPX-SD-4507	333878.71	277365.93	X
LPX-SD-4508	334029.21	277266.87	
LPX-SD-4509	333501.75	277422.54	X
LPX-SD-4510	333272.74	277805.93	

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FIGURES

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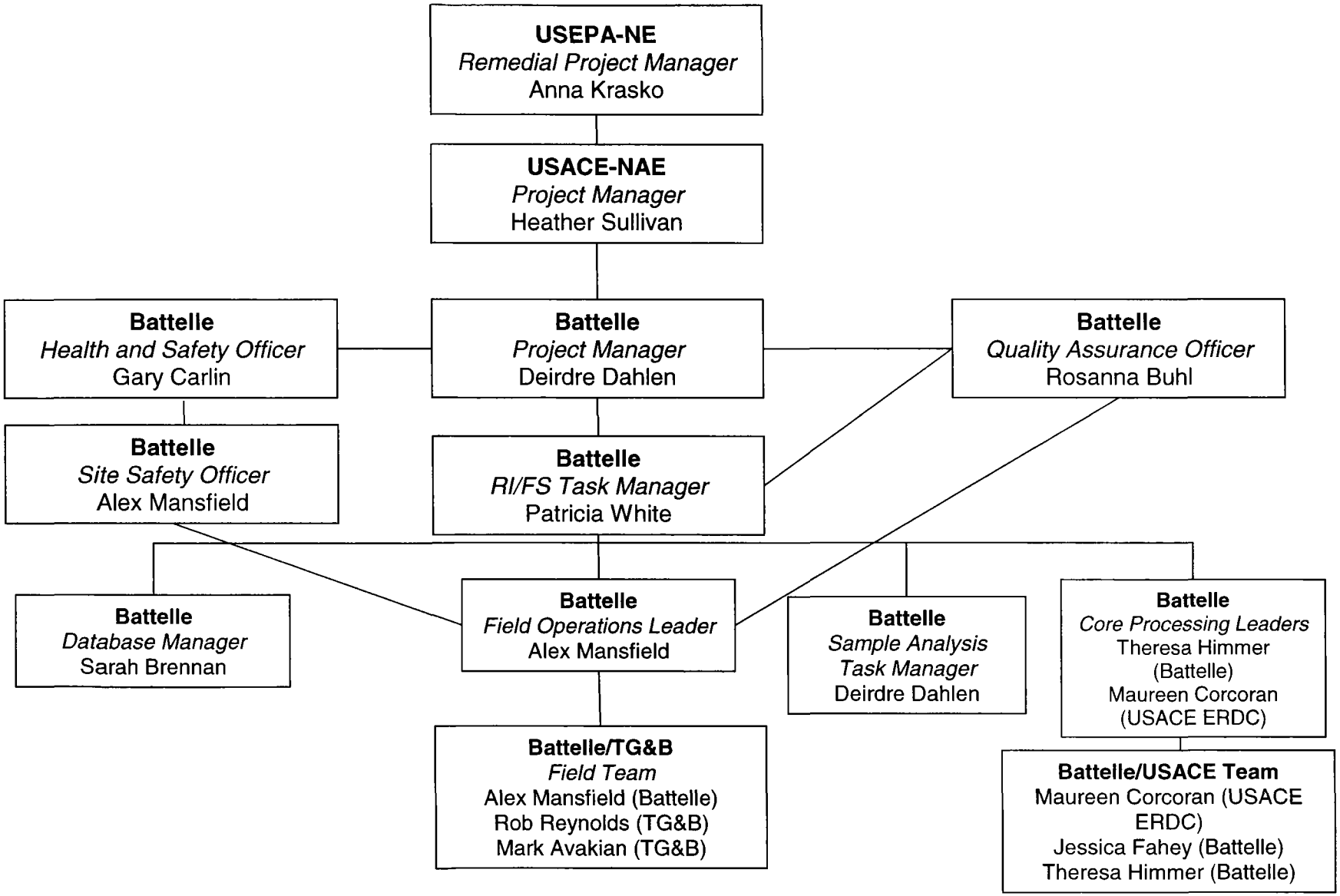


Figure 1. Lyman Mill (RI-13C) Field Sampling Organization Chart

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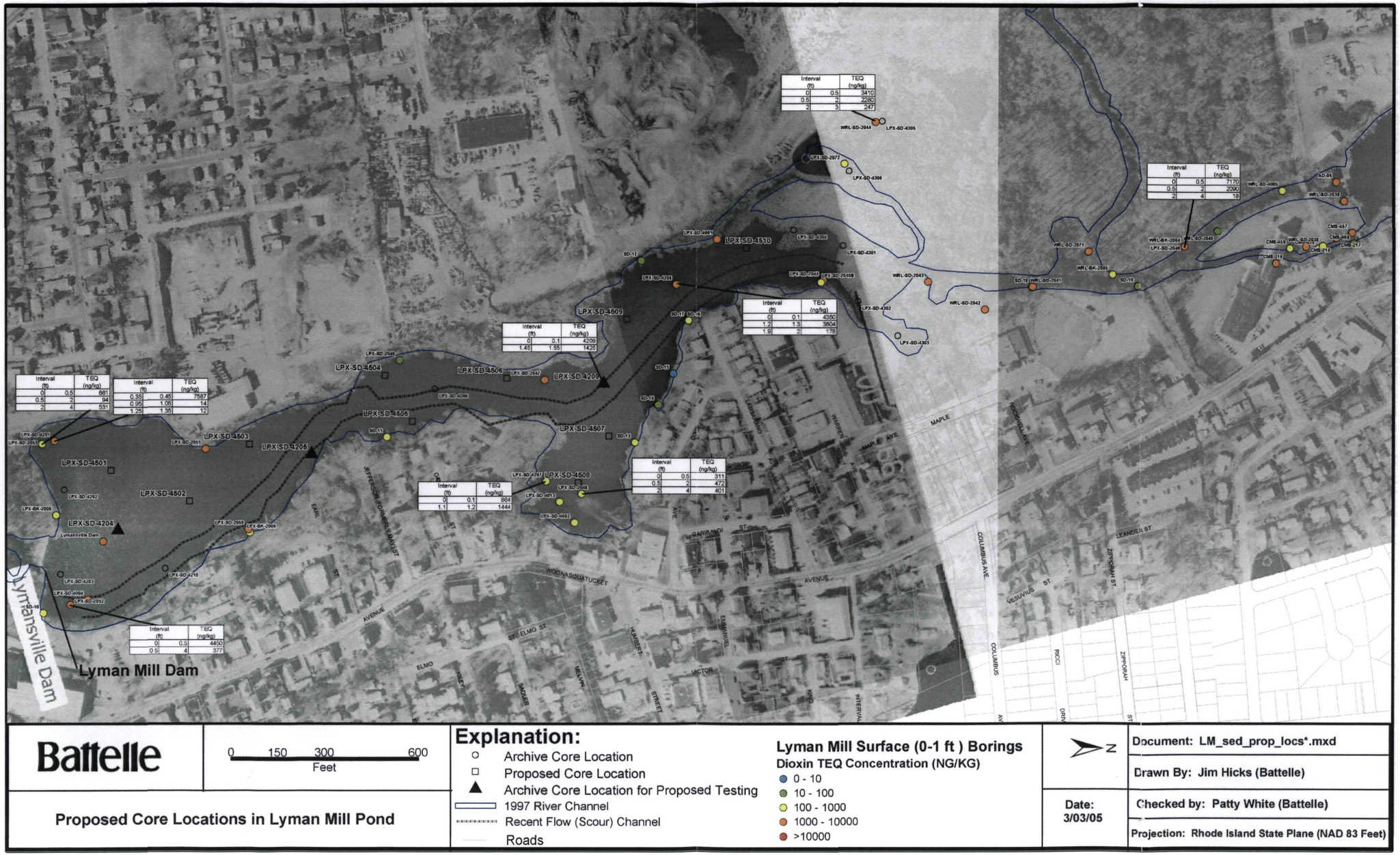


Figure 2. Lyman Mill Pond Sampling Locations

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APPENDIX A

Data Quality Objectives for Lyman Mill Pond

Data Quality Objectives for Sediment Core Collection in Lyman Mill Pond [a]

STEP 1: State the Problem

Sediment chemistry data were collected from Lyman Mill Pond from 1998 to 2003; however, the existing data are inadequate for delineating the horizontal and vertical extent of dioxin contamination with sufficient resolution for developing remedial alternatives for consideration in the Feasibility Study (FS). In addition, the spatial distribution of other contaminants of concern (COCs) in Lyman Mill Pond surface sediments is unknown. Additional data are needed to better define the horizontal distribution of dioxin in surface sediments so that the pond can be subdivided (stratified) as appropriate based on level of contamination. The vertical extent of dioxin contamination must be better defined to provide more reliable estimates of sediment volume to be addressed in the FS, and support the development of remedial alternatives. Because the pond sediments appear to be relatively stable, the existing data will be combined with newly-collected data to provide an overall interpretation of contaminant distribution in the pond. Important aspects of the conceptual site model (CSM) for Lyman Mill Pond that influence the proposed data collection effort are as follows:

- Dioxin concentrations in surface sediments throughout Lyman Mill Pond exceed upstream reference concentrations. Dioxin is more widespread and present at higher concentrations relative to reference than other COCs in Lyman Mill Pond.
- The vertical extent of dioxin contamination based on existing data appears to be approximately 2 ft below mudline, although it appears to be shallower in some areas.
- Dioxin concentrations are relatively low in coarse-grained sediments (i.e., sand and gravel).
- It is expected that preliminary remediation goals (PRGs) for sediment will not be organic carbon normalized; instead, they will be developed to apply to a range of TOC values. Existing TOC data are considered to be sufficiently representative of all Lyman Mill Pond sediment of a similar sediment type.

Radioisotope data for Allendale Pond sediment cores were used to establish the 1940 time horizon (below which site-related contamination does not appear to occur). A similar approach potentially can be applied to Lyman Mill Pond. Radioisotope profiles were obtained from one May 2003 sediment core from Lyman Mill Pond; additional cores will verify the results from the initial core. Data for geotechnical parameters will also be collected to support remedial design. The CSM for the CMRP site, including a description of the sources of contamination, release mechanisms, and transport pathways is provided in the draft Remedial Investigation (RI) report (Battelle, 2004).

STEP 2: Identify the Decision

The primary purpose of the data collected in this study is to characterize Lyman Mill Pond using a series of estimates rather than to make decisions. These estimates will answer the following questions:

1. What is the horizontal distribution of dioxin in Lyman Mill Pond surface sediments, and how do the concentrations compare to the PRGs?
2. What is the vertical extent of dioxin contamination in various areas of the pond?
3. What is the horizontal distribution of other COCs in Lyman Mill Pond surface sediments?
4. What is the net sediment accumulation rate in the pond?
5. What are the grain size distribution, Atterberg Limits, and percent solid characteristics of various sediment types?

STEP 3: Identify Inputs to the Decision

1. Existing and proposed data on the horizontal and vertical distribution of dioxin and other COCs in sediment.
2. Sediment accumulation rate based on radioisotope data (^{210}Pb).
3. Information on sediment type, stratigraphy, and geotechnical parameters to support remedial design.
4. PRGs.

Data Quality Objectives (continued)

STEP 4: Define the Study Boundaries

The study area is bounded by Lyman Mill Dam on the south, the banks of the pond on the east and west, and the forested wetland and inlet channel to the pond on the north. The vertical limit of the study area (i.e., coring depth) is 4 ft, which is expected to be well below the level of site-related contamination. The temporal boundaries of the study are 1998-2005 because the newly-acquired data will be combined with existing data to create composite maps of contaminant distribution.

STEP 5: Develop a Decision Rule

Because no decisions will be made per se, there are no decisions rules. Rather, as noted in Step 2, several sets of estimates will be made. These estimates are as follows:

1. Horizontal Distribution of Dioxin: The horizontal distribution of dioxin within the boundaries of Lyman Pond will be estimated using contour plots. The contour plots will be based on a combination of new and existing data. One contour plot will be drawn for each depth at which samples are collected or analyzed. The dioxin levels shown in these contour plots will be compared to PRGs (which are in the process of development) to determine where and to what degree PRGs are exceeded. In addition to the contour plots, the precision of the concentration estimates shown in the contour plots will be estimated. Dioxin concentration contours and precision estimates will be obtained using kriging methods.
2. Vertical Extent of Dioxin: The contour plots for horizontal dioxin distribution will also be used to evaluate the vertical extent of dioxin across Lyman Mill Pond.
3. Horizontal Distribution of Other COCs: The horizontal distributions of other COCs within the boundaries of Lyman Pond will be presented graphically as bubble plots (data density is not expected to be sufficient for contouring). Confidence intervals for concentrations of other COCs will not be determined.
4. Sediment Accumulation Rate: The sediment accumulation rate will be estimated using the radioisotope data collected. The estimates will include confidence intervals developed using the methods described in the Final Sediment Stability Technical Memorandum (QEA, 2004).
5. Geotechnical Parameters: The grain size distribution, Atterberg Limits, and percent solid characteristics of the various sediment types will be estimated using appropriate data collected. No confidence intervals for these parameters will be obtained.

STEP 6: Evaluate Decision Errors

As described above, several estimates will be obtained from this study, along with related estimates of precision or confidence intervals (i.e., estimates of uncertainty) for dioxin concentration and sediment accumulation rate. The level of uncertainty is related to the number of observations that are collected, with smaller confidence intervals and greater precision being obtained when a larger number of samples is collected. The uncertainty estimates also depend on the underlying variability in the data. In general, characterization studies are designed so that the width of the confidence intervals or the precision of the estimates meet given constraints, which requires a combination of minimizing the errors and collecting a large enough number of samples. For this study, the number of samples to be analyzed was determined based on available resources. Therefore, precision estimates will be obtained for each of the dioxin contour plots, and confidence intervals will be obtained for sediment accumulation rate. Uncertainty estimates will not be obtained for concentrations of other COCs or geotechnical parameters (grain size distribution, Atterberg Limits, or percent solids).

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Data Quality Objectives (continued)

STEP 7: Optimize the Design for Obtaining Data

Sediment Chemistry Cores

A systematic sampling approach, with minor judgment-based modifications, was used to determine sampling locations. Sample locations were selected to provide approximately equally-spaced coverage throughout the pond in areas where no data are available. Systematic, equally-spaced sampling assures complete coverage of the pond area, and will provide optimal data for determining the precision associated with the contour maps. The judgment-based modifications noted below were taken into account when selecting proposed core locations:

- Where possible, archived samples from the May 2003 sediment coring effort were selected for analysis.
  - Core LPX-SD-4204 will provide data on the vertical extent of dioxin in the south-central part of the pond, in the vicinity of the sample "Lyman Mill Dam."
  - Core LPX-SD-4205 will provide data on the east side of the channel in an area where no previous data are available.
  - Core LPX-SD-4209 has existing data for surface and mid-depth sample intervals, but no data for depths of greater than 2 ft are available in this part of the pond. Therefore, a deeper archive sample (2.4-2.5 ft) from this core will be analyzed.
- Areas where the soft sediment thickness appears to be less than approximately 2 ft based on the 2002 geophysical survey were avoided.

If the field crew is unable to access a particular core location, then the core should be collected as close to the proposed location as possible in order to maintain approximately equally-spaced data points for contaminant concentration mapping.

Three samples will be collected for dioxin/furan analysis from each of ten new core locations: one surface sample (0-0.5 ft), one mid-depth sample (approximately 1.2-1.3 ft below the surface), and one deep sample that is expected to be below the level of site-related contamination (approximately 2.4-2.5 ft below the mudline). One archive sample will be collected from deeper in the core (3.0 – 3.5 ft) in the event that the deep sample from any core shows evidence of dioxin contamination. The surface sample from each of the ten cores will also be analyzed for other COCs (PCBs, pesticides, PAHs, metals). Proposed sample locations are shown in Figure 2, and a sample summary is provided in Table A. In addition, archived samples from three cores collected in May 2003 also will be analyzed as shown in Table A.

Radioisotope Cores

Five cores will be collected for ^{210}Pb (Table A); three to five cores will be analyzed for ^{210}Pb, with sufficient number of subsamples to determine a vertical profile. The sample intervals will be selected by the project geologist based on the CSM and lithology observed in the cores. Sediment accumulation rates and associated confidence intervals will be developed following the methods described in the final Sediment Stability Technical Memorandum (QEA, 2004).

Geotechnical Analysis

Five samples will undergo analysis of grain size and Atterberg Limits, and fifteen samples will be tested for percent solids/water content. Samples for potential geotechnical analysis will be collected from the surface and mid-depth intervals from each sediment core, and the samples to be submitted to the laboratories will be selected after all cores have been processed to ensure that all sediment types are represented.

(a) Based on EPA's seven step DQO process (*Guidance for the Data Quality Objectives Process.* EPA QA G-4. EPA/600/R-96/055. August 2000.)

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Table A. Sample Summary for Sediment Core Collection in Lyman Mill Pond

Station ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals	Radioisotopes	Archive
New Stations [(a)]					
LPX-SD-4501	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4502	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4503	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4504	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4505	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4506	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4507	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4508	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4509	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4510	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X

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Table A. (continued)

Station ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals	Radioisotopes	Archive
May 2003 Stations (archived samples)					
LPX-SD-4204	0.0 – 0.1 1.1 – 1.2 2.35 – 2.45	X X X	Combined 0.0 – 0.1 and 0.3 – 0.4 ft samples	-	-
LPX-SD-4205	0.0 – 0.1 1.3 – 1.4 2.4 – 2.5	X X X	Combined 0.0 – 0.1 and 0.4 – 0.5 ft samples	-	-
LPX-SD-4209	2.4 – 2.5	X	-	-	-

(a) Samples for potential geotechnical analysis will be collected from the surface and mid-depth intervals from every core and selected for analysis after all core processing is complete.

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APPENDIX B

Standard Operating Procedures (SOPs)

Battelle
Applied Coastal and Environmental Services
Standard Operating Procedure

for

NORTHSTAR 952XDW DIFFERENTIAL GPS NAVIGATION SYSTEM

Summary of changes in this version: The Northstar model is updated from 941X to 952DW throughout the SOP. The accuracy is changed from 2-5 meters to 1-5 meters. Automated switching between GPS, DGPS and WAAS is described.

1.0 APPLICATION

The objective of this document is to define the standard operating procedures (SOP) for the operation of the Northstar 952XDW Differential Global Positioning System (DGPS) navigation system. Also included in this SOP are the procedures for recording navigational information during discrete sampling events. The Northstar navigation system collects and displays GPS data to obtain positional information with an accuracy of 1 – 5 meters (depending on the military's use of selective availability). To obtain high accuracy positional data, the system uses Differential GPS information to automatically obtain Latitude/Longitude position. If for any reason the DGPS data is not available, the system will automatically resort to GPS navigation mode with an accuracy between 30 – 100 meters.

The Northstar navigation system can be interfaced with Battelle's data acquisition software **NAVSAM** (Attachment 3). With this system, digitized charts can be accessed to display coastlines, depth contours, aids to navigation, planned stations, waypoints, and the vessel's trackline and position. The color video display provides positional and heading information for the helmsman for station keeping during sampling operations. The computer can be used as an electronic logbook for recording position data during sediment sampling. Refer to the software and operations manual for **NAVSAM** and SOP No. 6-029-01, Sample Tracking Using NAVSAM Software, for preparation and use of the **NAVSAM** system.

NOTE: When this SOP is being used, the Northstar reference manual for the 952XDW-DGPS must be available.

2.0 CALIBRATION

The Northstar 952XDW DGPS is incapable of undergoing a calibration that increases its ability to attain more accurate geographic information. The integrity of the unit is assured instead by conducting a comparison measurement of a known position at a specific location versus the position location by the GPS unit. Ensuring the accuracy of the data collected by the instrument will be considered sufficient for maintaining the integrity of the measurement. The difference between the actual position and that of the GPS unit should be determined to verify the accuracy of the position. If the Northstar 952XDW fails to attain a reading that is within 5 meters of the actual position while in differential mode, the manual should be consulted for possible sources of error and the reference position verified. Verification of Northstar operation must be documented in the survey logbook.

3.0 OPERATION

3.1 EQUIPMENT

The Northstar 952XDW DGPS navigation system includes the following items:

- Northstar 952XDW DGPS Receiver Unit (GRU) – the primary source of position data
- GPS Antenna
- Beacon receiver Antenna Coupling Unit (ACU)
- 25-ft coaxial cable for ACU
- 10-ft interface cable
- 10-ft power cable
- Northstar Reference Manual

3.2 INSTALLATION

The Northstar navigation system is to be installed aboard the survey vessel by a qualified factory service technician. If using the **NAVSAM** data acquisition software, it is to be installed per BOSS software manual.

3.3 BASIC NAVIGATION

To display the coordinates of the current position, press the button marked POSITION. A screen is displayed showing the position coordinates (displayed as latitude and longitude), Coarse-Over-Ground (COG) and Speed-Over Ground (SOG). In the center of the screen, the datum currently in use is displayed. The datum describes the reference of the chart currently in use. Applying the datum corrects for any position differences between the chart and the GPS coordinate system. In the upper right corner of the screen is an indicator that shows whether DGPS corrections are in use. The DGPS indicator is a large letter "D."

When DGPS is active, position measurements are accurate to about 1 – 5 meters, speed measurements accurate to about 0.1 knots, and COG measurements accurate to about 0.5 degrees. DGPS corrections remove errors caused by Selective Availability (a complex formula of data encryption that can be turned on or off by the Department of Defense at any time) and the atmosphere, and provide an accuracy exceeding that obtained by military users of the GPS system. The 952 automatically switches between GPS, DGPS or WAAS when in the default "Auto" mode to select the most accurate source for the vessel's position. When DGPS represents the strongest signal, the letter "D" will be displayed in the upper right portion of the 952 GPS Position Screen. When in WAAS mode, the letter "W" will be displayed. WAAS consists of approximately 25 ground reference stations positioned across the United States that monitor GPS satellite data. Two master stations, located on either coast, collect data from the reference stations and create a GPS correction message. This correction accounts for GPS satellite orbit and clock drift plus signal delays caused by atmosphere and ionosphere. The corrected differential message is then broadcast through one or two geostationary satellites, or satellites with a fixed position over the equator. The information is compatible with the basic GPS signal structure, which means any WAAS-enabled GPS receiver can read the signal.

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The color chart screen is a "north-up" display, and provides an overall view of the surrounding area and all nearby waypoints. A Navionics map chip can be inserted into the map port on the front of the unit. This chip allows quick upload of various navigational charts. A different chip can be used for different areas of the world. Press the POSITION key to show the position plotted relative to the current route, track history, and nearby waypoints on the chart. The image of the boat displayed on the screen points in the direction of the COG. This position may be different from the vessel heading. The boat image shows actual direction of travel over the bottom, not the direction the boat is heading. Press the ZOOM IN or ZOOM OUT menu keys to see more or less of the area in the center of the screen. Press the CENTER Menu key to move the plotted area so that the boat is at the center of the screen.

To enter waypoints, press the WAYPTS/ROUTES key. Press the WAYPT LIST menu key and then ADD menu key. To store a waypoint permanently in the memory, first assign it a name. The name can be from 1 to 6 characters long and it must differ by at least one character from any other waypoint name in the memory. Enter up to 16 characters of descriptive information for the waypoint on the line below the name. Waypoints are entered as latitude/longitude coordinates.

Waypoints can be displayed be pressing the WAYPTS/ROUTES function key, then the WAYPT LIST menu key to display the waypoint lists. To change any information about a waypoint stored in memory, press the WAYPTS/ROUTES key, then the WAYPT LIST menu to display a list of waypoint. Use the up and down keys to point to the desired waypoint, then press the EDIT menu key. Name, description, coordinates and/or warning radius of the waypoint may be changed.

To navigate to a waypoint already stored in memory, press WAYPTS/ROUTES function key and then the WAYPT LIST menu key. Use the up and down cursor arrow keys to move the large arrow on the left of the screen to point to the desired waypoint. Press the GO TO menu key and then ENTER. The screen will automatically switch to the STEER display to show information for navigating to this waypoint.

4.0 MAINTENANCE

All routine and non-routine maintenance must be performed by either Northstar or an authorized dealer. Maintenance performed on any component of the navigation system must be recorded in the Maintenance Log (Attachment 1). It is the responsibility of the operator to ensure that all maintenance and maintenance records are kept up-to-date. This includes shipboard maintenance and replacement of any parts. Non-shipboard maintenance is the responsibility of the Field Logistics and Operations Group (FLOG).

4.1 SCHEDULED MAINTENANCE

The estimated life of the Northstar 952XDW internal memory module is seven to ten years. However, to ensure trouble-free operation, the memory module should be replaced every seven years with an exact replacement. The memory module replacement is to be performed by the factory.

4.2 ROUTINE MAINTENANCE

Any maintenance should be referred to Northstar or an authorized dealer. Be sure to keep the unit covered while not in use to prevent sun and spray damage.

4.3 SPECIAL MAINTENANCE

Any service problems should be referred to Northstar or an authorized dealer.

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5.0 TRAINING

Users of the Northstar 952XDW DGPS Navigation system must read this SOP and Sections 1, 19, and 25 of the NSRM and demonstrate the correct use of the system while under the supervision of physical oceanography supervisor. Upon successful completion of training, a Certificate of Training (Attachment 2) will be issued. The original certificate will be submitted to the QA Unit.

6.0 SAFETY

6.1 GROUNDING OF THE SYSTEM

1. The ground cable must be at least 16 gauge for up to 15 feet and at least 14 gauge over 15 feet. Do not share the Northstar 952XDW ground wire with any other equipment.
2. Insufficient grounding of the equipment would result in an accumulation of static charges. This condition could not only result in damage to the equipment, but it could also lead to serious injury to anyone handling the system. It is extremely important that the system be adequately grounded.

6.2 CHECKING FOR BREAKS IN THE WIRING

Visually check all wires, cables, connectors, etc., for breaks, corrosion, or any other damage. Replace the damage part immediately to avoid injury to persons using and operating around the equipment.

6.3 OPERATING, MAINTAINING, AND SERVICING THE SYSTEM

Installation, maintenance, or servicing procedures will be performed by a qualified factory service technician.

ATTACHMENTS

Attachment 1. Battelle Applied Coastal and Environmental Services Maintenance Log
Attachment 2. Battelle Battelle Applied Coastal and Environmental Services Certificate of Training
Attachment 3. Positional Calibration using the NAVSAM Data Acquisition Software

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APPROVALS

Author		12-23-03
Technical Review		1/13/04
Quality Systems Manager		12-23-03
Resource Manager	Signature	1-28-04 Date

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ATTACHMENT 1

Battelle
Applied Coastal and Environmental Services

MAINTENANCE LOG

SOP No. 3-118-02

SOP Title: NORTHSTAR 952XDW DGPS NAVIGATION SYSTEM

DATE/OPERATOR	SERVICE PERFORMED

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ATTACHMENT 2

Battelle
Applied Coastal and Environmental Services

CERTIFICATE OF TRAINING

SOP No. 3-118-02

SOP Title: NORTHSTAR 952XDW DGPS NAVIGATION SYSTEM

Trainee: _____

Instructor: _____

Date SOP Read: _____

Date BOSS Hardware Manual Read: _____

Date BOSS **NAVSAM** Manual Read: _____

Approval: _____

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ATTACHMENT 3

Positional Calibration using the NAVSAM Data Acquisition Software.

SOP No. 3-118-02
SOP Title: NORTHSTAR 952XDW DGPS NAVIGATION SYSTEM

When the Northstar navigation system is to be used in conjunction with the **NAVSAM** data acquisition software and the BOSS instrumentation system, calibration of the navigation system can be accomplished using the software. This is possible because many of the manual calibration procedures explained in this attachment are embedding in the **NAVSAM** code. The procedures explained in this section provide a stepwise method to check the accuracy of the navigation system using the menu driven **NAVSAM** data acquisition software.

Positional calibration for the Navigation System is performed using the NAVSAM Data Acquisition software according to SOP No. 5-274 "Survey Setup for the Battelle Ocean Sampling System" and the NAVSAM Manual.

Initial Navigation Readings

After it has been determined that the **NAVSAM** software is operating properly (Section 2.0 in the **NAVSAM** manual), power the navigation system to acquiring GPS data. Then follow the menu driven steps below to obtain the initial navigation readings.

1. Select *Calibration* Menu.
2. Then select the *Navigation* calibration option.
3. The averaged latitude and longitude (using 30 values) and respective standard deviation is then calculated.
4. Print screen and place printout in the survey log book.

Absolute Position

Using a NOAA navigation chart (1/40000 scale or larger) determine the absolute position of the vessel while recording the following information:

1. The navigational chart being used (for example NOAA chart 13253 Plymouth, Kingston, and Duxbury Harbors, Scale 1:20,000 North American Datum 1983). Record as: 13253, 1983.
2. The absolute position to the resolution of the chart. Example: dd, mm, ss North, -dd, mm, ss West.
3. Jitter 0.003.
4. Factor 0.000.
5. Enter initials.
6. Print screen and place printout in the survey log book.

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Positional and Maximum Allowable Offset

The **NAVSAM** software calculates both the positional and the maximum allowable offsets using the absolute position value (determined using the NOAA navigational chart), and the positional jitter value as input. To enter these values into the software follow the steps listed below (refer to Section 4.0 in the **NAVSAM** manual). The first two steps should have already been completed (as describe above) to obtain the initial navigation readings.

1. Go to the *Survey Setup* menu and choose the *Calibration* option.
2. In *Calibration* sub-menu, go to the *Navigation* function.
3. While in *Navigation*, the software will prompt the user to enter the absolute position and jitter. Print screen and place printout in the survey log book.

If the positional offset is less than the maximum allowable offset, the offset may be used as input into the navigation system to correct the positional data output. If the maximum allowable offset is larger than the positional offset, no correction is required (refer to **NAVSAM** manual).

Offset Correction

If the reported position is outside of jitter range of the calibration site, an offset is to be applied to the reported position of the vessel when discrete samples are obtained. The **NAVSAM** software will automatically apply the offset to the position data.

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ORIGINAL

Battelle Duxbury Operations
Standard Operating Procedure

for

THE STORAGE AND DISPOSAL OF CHEMICAL WASTE

Summary of changes in this version: A section describing disposal of samples and sample extracts has been added.

1.0 OBJECTIVE

The purpose of these procedures is to provide a protocol for the handling, transport, storage, and disposal of chemical and hazardous wastes generated by this facility that is in compliance with the regulations as defined by the Massachusetts Department of Environmental Protection (DEP), Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA).

These procedures are implemented in order to reduce the risks to personnel associated with the handling of hazardous or toxic substances and to prevent contamination of the environment.

2.0 PREPARATION

The purchase, maintenance, and use of the supplies and equipment listed below are the responsibility of the designated Hazardous Waste Handlers for the individual sections generating the wastes. They are used only for the collection and transport of hazardous wastes, and should be transported to the Hazardous Waste Storage Shed, for drum introduction, within three days after the container is full. They should never remain in the Hazardous Waste Storage Shed for any period of time.

- 5-gallon safety cans for organic solvents and combustible wastes
- 5-gallon plastic or metal buckets with lids for solids

The following supplies must be kept in the waste storage area at all times. They are the responsibility of the Hazardous Waste Coordinator (HWC).

Waste Storage and Disposal Containers

- 30- or 55-gallon drums for solid and liquid wastes, including 30 gallon plastic drums for solids, and sealed top drums with screw-plug openings for liquids. As for liquid storage, steel (6D) drums will be used in the storage of solvent waste. For aqueous organic and acid waste, polylined (17E) drums will be used for storage.

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Transferring Equipment

- Plastic safety funnels with brass screens and vents
- Hand pump/siphon with Teflon or tygon tubing
- Tools: screwdriver, drum plug wrench, and brass pliers
- Drum dolly

Personal Protective Equipment

- Disposable Tyvex coveralls and/or lab coats
- Disposable Tyvex hoods
- Full Face Respirator
- Disposable plastic gloves (nitrile or butyl rubber, or Viton)
- Respirator and cartridges [consult Environment, Safety, and Health (ES&H) Officer]
- Shoe covers (Rubber or Tyvek)

Spill Cleanup Equipment and Supplies

- Spill absorbent (Vermiculite or Speedidry)
- Broom, foxtail and dustpan
- Shovel
- Paper towels
- 85-gallon overpack drum
- Stoppers
- Putty
- Teak plugs
- Togglebolt & rubber ball
- Manual drum pump

Labels and Logs

A supply of labels and log sheets that are referred to in this SOP are kept in the room adjacent to the Hazardous Waste Storage Shed. Additional ones may be obtained from the HWC.

3.0 SAMPLE DISPOSAL

Sample disposal occurs for three sample phases: the original sample, the extracted sample, and the sample extract. The following list explains the procedure for disposal of each type of sample.

1. The unextracted original sample is held in the appropriate storage area until approval for disposal is granted. At that time, the samples are removed from storage and the Hazardous Waste coordinator is contacted and advised of the level of contamination in the sample. The

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Hazardous Waste Coordinator will then assist the Project manager in deciding whether the sample is "clean" or must be discarded in a hazardous waste stream.

2. The disposal of extracted samples is into the appropriate waste stream.
   - Aqueous samples: disposed into aqueous waste
   - Sediment samples: disposed into solid waste
   - Tissue samples: disposed into solid waste
   - Oil samples: disposed into solvent waste

3. All sample extracts are disposed into the solvent waste stream.

The disposal of foreign samples is described in SOP 5-269.

4.0 PROCEDURES

Only the designated Hazardous Waste Handlers and the HWC may carry out procedures described in this section.

4.1 Collection

Liquid waste (solvents and flammables) generated in the labs must be collected in 5-gallon safety cans (satellite containers). Care must be taken not to mix substances that will react with each other. If there is any question concerning compatibility, the HWC or the ES&H Officer should be contacted prior to taking action. A record of the type, relative amount, and hazard associated with each substance added must be kept on the hazardous waste tag (Attachment 1). This card must be attached to the satellite container. Waste may be temporarily stored, if properly labeled, in a fume hood prior to satellite container introduction. The waste contents in these temporary storage containers must be introduced into an approved satellite container by the end of every working day. All satellite container waste must be emptied into the appropriate storage container within three days after the satellite container has been declared full.

In the Main Lab, preservative solutions (formalin and alcohols) are collected in a 55-gallon drum piped to the transfer sink. A hazardous waste tag (Attachment 1) must be filled out and attached to the container. Once the collection container is full, it must be taken to the Hazardous Waste Storage Shed by an assigned and trained Hazardous Waste Handler. Upon arrival at the shed, the container must be immediately secured and labeled to indicate the introduction date and type of waste.

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4.2 Transport To The Disposal Area

Transportation of hazardous waste is carried out by assigned Hazardous Waste Handlers only. Personal Protective Equipment as described in Section 2.0 is worn during transport and disposal. Satellite containers are transported from the lab to a truck using either dollies or carts. The truck collects the containers from each building and brings them to the to Hazardous Waste Storage Shed.

4.3 Transfer Into Storage Drums

In the Hazardous Waste Storage Shed, the waste handler locates a storage drum labeled IN USE for the type of material being transferred. The waste handler then introduces the hazardous chemical into the appropriate 30 or 55-gallon drum.

Once a drum is filled, the bung caps are secured tightly and the drum is moved from the transfer area to the storage area of the waste shed. The drum must then be grounded, the date must be placed on a preprinted DOT aprroved hazardous waste label, and the IN USE tag is removed, leaving the FULL tag in place. This drum must be manifested and shipped off site within 180 days of the date the drum is full.

The next empty drum is labeled with the following: an IN USE and FULL tag, a drum ID number, profile description (used Satellite Hazardous Waste tag), and a Hazard placard, if applicable (e.g. corrosive placard on acid waste), in preparation for waste introduction. The empty drum must be grounded before the addition of any materials.

4.3.1 Liquid Waste

Liquid waste is transferred into an air-tight, 55-gallon, screw-cap drum. If a new drum is started, the larger cap is unscrewed with the drum plug wrench. The safety vent is screwed in and the cap tightened by hand.

An IN USE drum has the small cap and safety vent in place with a yellow plastic funnel on top of the drum ready for use. The cap should only be secured hand-tight. The small cap is unscrewed and the cap vented. The funnel is placed into the hole that contained the cap and the waste transferred from the satellite container into the 55-gallon drum by pouring. If the satellite container is too awkward to transfer by pouring, the hand pump should be inserted into the satellite container and the waste pumped into the storage drum.

After the collection container is emptied, the screen in the funnel is checked to be sure that it is not clogged with solids. If there is an accumulation of solids, the screen is removed and the contents dumped into the solid waste drum. The screen is replaced, the drum capped, and the small cap secured in place on the drum. Any spillage that may occur during the transfer is cleaned up immediately as follows:

- The spill is covered with absorbent and allowed to sit for at least five minutes.

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- The spill material is swept up using a broom and dustpan and discarded as a solid into the solid waste drum.

The transfer is recorded on the waste transfer log (Attachment 2) on the desk in the Hazardous Waste office.

4.3.2 Solid Waste

Solid waste is transferred into an air-tight, 30 gallon open top drum. The lid is removed from the collection container and the contents dumped into the storage drum. Once the transfer has been completed, the lid and sealing ring are replaced on the storage drum. After the lid has been restored the drum must be grounded. The transfer also is recorded on the waste transfer log, and this log is placed on the desk for reference.

4.4 Storage Of Hazardous Waste

The waste storage area at the facility is for temporary storage only. As a small quantity generator, we are not permitted to hold hazardous waste past 180 days after the holding drum is full.

The area is to be clearly identified by a sign that reads DANGER - UNAUTHORIZED PERSONNEL KEEP OUT, as required by 40 CFR 264.14. The area must have a solid concrete floor and a surrounding lip that will retain any waste resulting from spills or leakage.

Only containers authorized by the U.S. DOT may be used for storage. All containers, equipment, and supplies must be clearly labeled and easily accessible. The storage area must be well ventilated to prevent buildup of toxic or hazardous vapors.

A Waste Profile Sheet is maintained by the HWC for each type of waste generated. If a different type, or one of unknown composition is started, an Analysis and/or Profile Sheet must be filled out (Attachment 3) by the HWC. Once the profile sheet has been filled out, a sample of the waste stream will need to be sent for analysis. Once the stream has been approved and registered with the transporter the final profile sheet will be stored in the hazardous waste shed by HWC.

4.5 Inspections

Inspections of the area and its contents are carried out by the HWC no less than every seven days. The results are recorded on the hazardous waste storage area inspection log, (Attachments 4 and 5). The main points covered during the inspection are

- Integrity of the confinement area –- ensuring that there are no cracks or breakage in the walls or floor that could result in leakage from the area in the event of an accidental spill or leaking drum

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- Integrity of the storage drums — ensuring that there are no cracks or holes in the storage drums that could result in leakage of liquids or a release of fumes from highly volatile compounds

- Ensuring that all materials are in acceptable storage and transport containers

- Ensuring that there is easy access to all storage containers; that transfer, cleanup, and emergency supplies and equipment are on hand in their proper places and are in working order; and that the general cleanliness of the area meets compliance standards.

- Ensuring that all labels and records are correctly filled out and up to date. All discrepancies are recorded on a Waste Storage Remedial Action Form (Attachment 6) that is filled out by the inspector.

All records are collected by the HWC and kept in the Hazardous Waste File. These weekly inspection reports are kept on file and a copy is submitted to the ES&H Officer.

4.6 Shipping Of Waste

Shipping is the responsibility of the HWC. A shipment of any accumulated waste must be completed within a maximum of 180 days from the time the storage drum is full. New storage/shipping containers will be delivered at the time of pick up.

The schedule for the transport and disposal of the waste must be arranged through Clean Harbors, Inc., 85 Quincy Avenue, Braintree, Massachusetts 01284. A uniform hazardous Waste Manifest, EPA Form 8700-22, must be filled out and accompany each shipment.

Copies 6 and 7 of the Manifest are sent to the Massachusetts DEP by the HWC once the shipment is made. Within 35 days of the shipment, a copy of the final deposition of the waste must be received from the BOS broker, Clean Harbors. If this is not received, it must be tracked down. If not returned within 45 days, Battelle must file a report with the DEP.

5.0 CALCULATIONS

There are no calculations associated with this procedure.

6.0 QUALITY CONTROL

The quality control procedures for hazardous waste handling include the conduct of inspections (Section 3.5) and personnel training (Section 6.2).

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7.0 TRAINING

7.1 Personnel Responsibilities

The responsibilities of the personnel involved with waste control are outlined in Section 6.1.1 - 7.1.3.

7.1.1 ES&H Officer

The ES&H Officer is responsible for ensuring that the BOS Duxbury facility operates in accordance with internal, State, and Federal regulations as they relate to the environment, safety, and health. The ES&H Officer is responsible for

- Developing training programs relative to job safety, health, and the proper handling of chemical and laboratory wastes
- Monitoring the activities of the HWC and Hazardous Waste Handlers
- Performing routine inspections of the department facilities, including the hazardous waste areas
- Making recommendations to upgrade safety, health, and environmental compliance-related deficiencies
- Informing department personnel of recent developments in the above areas which may affect operations

In addition, the ES&H Officer for the Duxbury facility coordinates departmental operations with the Health, Safety, and Environmental Departments at the Battelle Columbus Division Laboratories.

7.1.2 Hazardous Waste Coordinator

The HWC is responsible for overseeing the operation of the waste storage area at the Duxbury facilities and arranging for waste to be disposed of off site in accordance with Massachusetts Hazardous Waste Regulations (310 CMR 30.000). The responsibilities of the HWC include

- Packaging and labeling of containers
- Arranging for waste removal
- Maintaining manifest records and tracking the manifest until its signed and returned
- Conducting weekly inspections of the waste area

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- Ensuring that the proper waste-handling materials and personal protective equipment are available and adequate (e.g., gloves, coveralls, goggles, respirators and cartridges, boots, funnels, pumps, etc.)

- Maintaining emergency spill response equipment

In addition, the HWC has primary responsibility for overseeing the collection and transfer of waste by the department waste handlers. Waste generated by other departments in the laboratory is labeled, picked up in their area by designated Waste Handlers, transferred to the waste storage area, and transferred into drums.

The HWC reports directly to his/her Section Manager, but is responsible for notifying the ES&H Officer at the Duxbury facility and the Environmental Compliance Officer at Battelle Columbus Laboratories of any problems encountered. In addition, the HWC keeps them informed of ongoing activities.

7.1.3 Hazardous Waste Handlers

The Hazardous Waste Handlers are responsible for monitoring the proper storage of wastes generated by their associated departments and the transfer of these materials to the Hazardous Waste Storage Area. Specific responsibilities include

- Inspection of waste collection containers
- Labeling and pickup of wastes
- Transfer of wastes into proper storage containers
- Recording and reporting of these activities to the HWC
- Provisions of assistance with regards to spill response and emergency procedures
- Documentation of any accidental spills and remedial action taken

7.2 TRAINING

The HWC and HW Handlers must successfully complete a 40-hour HAZWOP training course conducted by a certified facility or a Certified Environmental Compliance Officer selected by Battelle Columbus Laboratories and must be familiar with the contents of this SOP. The hazards and risks associated with these tasks, and the safety procedures that must be followed to prevent these hazards are explained. In addition to personal safety and cleanup, emergency actions are defined and demonstrated. After reading the SOP and attending a demonstration of all that is involved, the trainee receives a Certificate of Training (Attachment 7). Original certificates are kept in the QA office training files.

8.0 SAFETY

In addition to the safety precautions previously mentioned involving handling, transferring, and minor spill management, the *Battelle Ocean Sciences Emergency Contingency Plan*, which

addresses large spill situations, has been issued to all staff and filed with the Duxbury Fire Department and the Massachusetts Board of Health. In addition, an Emergency Chemical Spill Response Guide is posted in the Hazardous Waste Storage Shed.

9.0 ATTACHMENTS

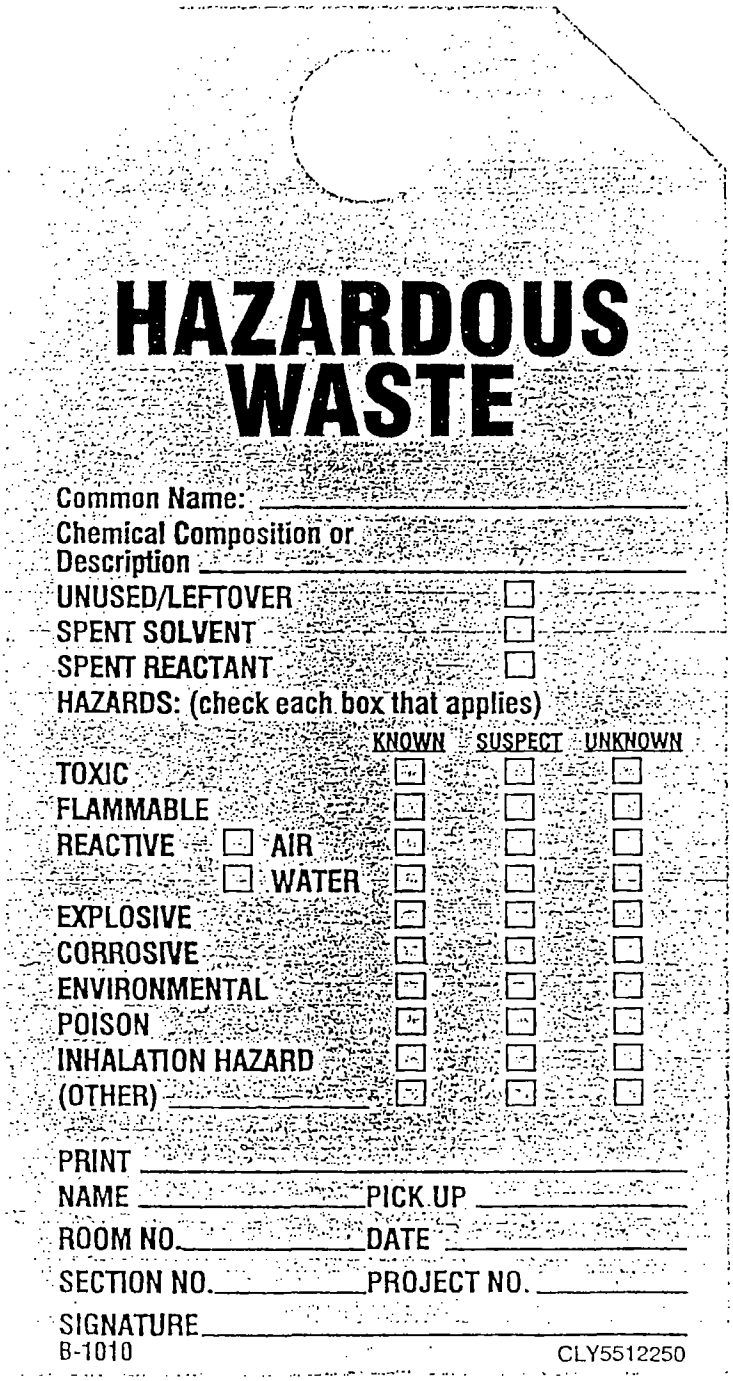
Attachment 1. Example of Hazardous Waste Card
Attachment 2. Example of Waste Transfer Log
Attachment 3. Example of Waste Profile Sheet
Attachment 4. Example of Waste Area Inspection Log (Side 1)
Attachment 5. Example of Waste Area Inspection Log (Side 2)
Attachment 6. Example of Waste Storage Remedial Action Form
Attachment 7. Example of Certificate of Training

APPROVALS

Author Approval	Robert Smith J.	12·9·98
Technical Manager	Robert Smith J.	12·9·98
QA Coordinator	Donna Burke	12-10-98
Vice President Battelle Duxbury Operations	Name	12/11/98 Date

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Attachment 1
Example of Hazardous Waste Card



HAZARDOUS WASTE

Common Name: _____

Chemical Composition or Description _____

UNUSED/LEFTOVER ☐

SPENT SOLVENT ☐

SPENT REACTANT ☐

HAZARDS: (check each box that applies)

	KNOWN	SUSPECT	UNKNOWN
TOXIC	☐	☐	☐
FLAMMABLE	☐	☐	☐
REACTIVE ☐ AIR	☐	☐	☐
☐ WATER	☐	☐	☐
EXPLOSIVE	☐	☐	☐
CORROSIVE	☐	☐	☐
ENVIRONMENTAL	☐	☐	☐
POISON	☐	☐	☐
INHALATION HAZARD	☐	☐	☐
(OTHER) _____	☐	☐	☐

PRINT _____

NAME _____ PICK UP _____

ROOM NO. _____ DATE _____

SECTION NO. _____ PROJECT NO. _____

SIGNATURE _____

B-1010 CLY5512250

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Attachment 2

Example of Waste Transfer Log

Date	Drum No.	Waste Composition	Volume	Technician

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Attachment 3

Example of Waste Profile Sheet

Clean Harbors

WASTE MATERIAL PROFILE SHEET

BATTELLE

Profile Sheet Number: 7414 R 295797

A GENERAL INFORMATION

GENERATOR NAME: Battelle Ocean Sciences
CUSTOMER NAME (IF DIFFERENT FROM GENERATOR)
FACILITY ADDRESS: 398 Washington St.
CUSTOMER CONTACT:
Duxbury, MA 02332
CUSTOMER PHONE:
GENERATOR USEPA I.D. MAD016191314
TECHNICAL CONTACT: Judith Scanlon TITLE: Safety Officer PHONE: (617) 934-0571
NAME OF WASTE: Aqueous organic waste
PROCESS GENERATING WASTE: Solvent/water rinse for laboratory glassware

B PHYSICAL CHARACTERISTICS OF WASTE

DESCRIPTION AND COLOR: light green liquid

ODOR: ☐ NONE ☐ MILD ☒ STRONG — DESCRIBE: Solvent/sweet

PHYSICAL STATE @ 70° F: ☐ SOLID ☐ SEMI SOLID ☐ LIQUID WITH SLUDGE ☒ LIQUID ☐ POWDER

LAYERS: ☐ SINGLE PHASED ☐ BILAYERED ☐ MULTILAYERED ☐ N/A

FREE LIQUID: ☒ YES ☐ NO — VOLUME: 100%

pH: ☐ <2 ☒ 2-5 ☐ 5-9 ☐ 9-12.5 ☐ >12.5 ☐ EXACT ☐ N/A

SPECIFIC GRAVITY: ☐ <1 ☐ 1-1.0 ☐ 1.0 ☐ 1.0-1.2 ☐ 1.2-1.4 ☐ 1.4-1.8 ☐ >1.8 ☐ EXACT

FLASH POINT (°F): ☐ <70 ☐ 70-100 ☐ 101-139 ☐ 140-200 ☐ >200 ☐ NO FLASH ☐ EXACT

C CHEMICAL COMPOSITION (TOTALS MUST ADD TO 100%) *

Acetone	80 %
Methanol	5 %
Water	15 %
	%
	%
	%
	%
	%
	%

*RANGES ARE PERMISSIBLE, BUT MUST BE NARROW

D METALS ☐ TOTAL (PPM) ☐ EPA EXTRACTION PROCEDURE (mg/L)

ARSENIC (As)		SELENIUM (Se)	
BARIUM (Ba)		SILVER (Ag)	
CADMIUM (Cd)	N/A	COPPER (Cu)	
CHROMIUM (Cr)		NICKEL (Ni)	
MERCURY (Hg)		ZINC (Zn)	
LEAD (Pb)		TIN (Sn)	
CHROMIUM-HEX (Cr+6)		OTHER	

E OTHER COMPONENTS - TOTAL (PPM)

CYANIDES	N/A	PCB'S	N/A
SULFIDES		PHENOLICS	

F SHIPPING INFORMATION

D.O.T. HAZARDOUS MATERIAL? ☐ YES ☐ NO
PROPER D.O.T. SHIPPING NAME: RQ Hazardous Waste, Liquid, N.O.S.
D.O.T. HAZARD CLASS: ORM-E
UN/NA I.D. NO.: NA 9189 (F003) R.Q.
SHIPMENT METHOD: ☐ BULK LIQUID ☐ BULK SOLID ☐ DRUM (SIZE) 55g
ANTICIPATED VOLUME: 550 GALS CUBIC YARDS
10 DRUMS OTHER
PER: ☐ ONE TIME ☐ WEEK ☐ MONTH ☐ QUARTER ☒ YEAR ☐

G HAZARDOUS CHARACTERISTICS

REACTIVITY: ☐ NONE ☐ PYROPHORIC ☐ SHOCK SENSITIVE ☐ EXPLOSIVE ☐ WATER REACTIVE ☐ OTHER

OTHER HAZARDOUS CHARACTERISTICS:
☐ NONE ☐ RADIOACTIVE ☐ ETIOLOGICAL ☐ PESTICIDE MANUFACTURING WASTE ☐ OTHER

USEPA HAZARDOUS WASTE? ☒ YES ☐ NO
USEPA NUMBER(S): F003
STATE HAZARDOUS WASTE? ☐ YES ☐ NO
STATE NUMBER(S):

H SPECIAL HANDLING INFORMATION/OTHER COMMENTS

☐ ADDITIONAL PAGE(S) ATTACHED

I HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS COMPLETE AND ACCURATE AND THAT ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

AUTHORIZED SIGNATURE: Judith Scanlon TITLE DATE

JUN 10'93 15:58 No.022 P.06

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Attachment 4
Example of Waste Area Inspection Log (Side 1)

Battelle Duxbury Operations
Waste Storage Area Inspection Log

INVENTORY:

Drum No.	Accumulation Date	Status			Identification
		E	U	F	

Comments:

_____

_____

_____

_____

_____

Date: _____ Inspector: _____

Reviewed By: _____ Date: _____

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Attachment 5

Example of Waste Area Inspection Log (Side 2)

CONTAINERS:

1. Are all containers closed or sealed properly? Y_____ N_____
2. Are all the containers leak-free? Y_____ N_____
3. Do any containers show outward signs of damage or corrosion? Y_____ N_____
4. Are all drums clearly numbered? Y_____ N_____
5. Are all drums clearly labeled as to the contents? Y_____ N_____
6. Are all drums properly labeled as to EMPTY, IN USE or FULL? Y_____ N_____

AREA:

7. Are all warning signs in place? Y_____ N_____
8. Is the floor free from severe cracks? Y_____ N_____
9. Are there any cracks or damage to the sidewalls? Y_____ N_____
10. Is the WASTE TRANSFER FILE in order? Y_____ N_____
11. Are extra labels and tags available? Y_____ N_____

SAFETY:

12. Is the pad free from standing water? Y_____ N_____
13. Is the fire extinguisher present and full? Y_____ N_____
14. Is the spill control equipment present? Y_____ N_____
15. Is the transfer equipment present and in working order? Y_____ N_____
16. Is there adequate free space between the drums? Y_____ N_____
    to allow proper inspection and access?

Date: _____ Inspector _____

Comments: _____

_____

_____

_____

_____

_____

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Attachment 6

Example of Waste Storage Remedial Action Form

TYPE OF DISCREPANCY:

(A separate form should be filled out for each discrepancy.)

☐ COLLECTION CONTAINERS ☐ STORAGE CONTAINERS
☐ STORAGE AREA ☐ SAFETY
☐ TRANSFER EQUIPMENT ☐ DOCUMENTATION

DESCRIPTION OF DISCREPANCY DATE: _____

_____

_____

_____

_____

_____

_____

DATE: _____ REPORTED BY: _____

CORRECTIVE ACTION: _____

_____

_____

_____

_____

_____

_____

_____

_____

IMPLEMENTED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

US EPA ARCHIVE DOCUMENT

Attachment 7

BATTELLE DUXBURY OPERATIONS
CERTIFICATE OF TRAINING

FOR

SOP No. _____

TITLE _____

_____

_____

TRAINEE _____

INSTRUCTOR _____

DATE SOP READ _____

DATE OF COMPLETION
OF PROFICIENCY TEST _____

APPROVED BY _____ **DATE** _____

US EPA ARCHIVE DOCUMENT

Battelle Duxbury Operations
Standard Operating Procedure

For

PACKAGING AND SHIPPING OF SAMPLES

Summary of changes in this version: An attachment that provides instructions for field personnel, additonal information for sample packaging and shipping, and a training section are added.

1.0 OBJECTIVE

The purpose of this SOP is to define the procedures, responsibilities, and documentation associated with the packaging and shipping of samples.

2.0 RESPONSIBILITIES

The sample custodian or designee is responsible for the proper packaging and shipping of samples from the laboratory. The Project Managers are responsible for informing the sample custodian or designee as to when and where the samples or sample containers are going to be shipped. The project manager or designee is responsible for contacting the recipient of the material to be shipped to notify them of a pending delivery.

3.0 EQUIPMENT

Field Pack Equipment
Coolers
Bubble Wrap
Teflon Tape
Black Ball Point Pens **NO "SHARPIES"**
Blank custody forms
Proper Jars for sampling
Packaging Tape
Chain-of-custody (COC) Seals

Sample Transmittal Equipment
Coolers
Bubble Wrap
Sample Transmittal Forms
Samples
Cover Letter
Zip Lock Bag

4.0 PREPARTION

4.1 Cooler Preparation

Coolers should be washed inside and outside with soap and warm water to avoid any possible contamination of the samples. The coolers should have two sturdy handles, a working top, and be in good shape. Do not use any coolers that are damaged or are contaminated.

4.2 Cooler Labeling

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It is critical that cooler labels are secured to the cooler to ensure that samples are not lost.

- The shipping label (typically Fed Ex) should be permanently attached to the cooler lid, NOT the cooler handle. In order to ensure that the label doesn't fall off, scrub the cooler lid and rinse with a solvent (e.g., methanol). Stick the label on the lid and tape over it with packing tape.
- In addition to the shipping label, a full label with the recipient's name and address as well as the sender's name and address should be attached to the outside of the cooler.
- The sample custody form should include the full addresses of the recipient and the shipping organizations, as well as a contact name at each organization.

5.0 PROCEDURE

There are two types of shipping performed by the sample custodian or designee. The most common is Sample Transmittal or sample transfer, this occurs when the laboratory custodian ships samples to an outside contractor. The second type of shipping is the preparation and shipment of "Field Packs."

5.1 Shipping Samples

The sample custodian or designee packs the samples securely in a cooler with bubble wrap and adds blue ice or crushed ice to achieve the proper temperature and to ensure that the samples stay at a constant temperature for their entire trip. The cooler should have at least one inch of bubble wrap placed on the bottom of the cooler and the samples should be wrapped in bubble wrap if breakable or crushable containers are used. Cubitainers are soft plastic and are easily punctured. Cubitainers should not be packaged with anything that has sharp edges. The samples must be packed tightly and not be able to move freely in the cooler; they must be secure. An upper weight limit of 70 pounds per cooler is suggested. All paper work is signed, the original custody form is placed in a zip lock bag with a cover letter, and taped to the top of the cooler to avoid moisture.

Cover letter accompanying samples should include

- the name of the Battelle technical contact;
- a statement about the number of coolers being shipped;
- a description of the work to be performed or a reference to the appropriate document (e.g., contract, QAPP); and
- a request that the receiving laboratory return the signed custody forms.

When one sample shipment is contained in multiple coolers, the custody forms should be copied, placed in Zip-lock bags, and attached to the inside top of each cooler[1]. Copies should be clearly labeled as such and they should indicate which samples are contained in each cooler. The individual coolers should be numbered 1 of 3, 2 of 3, etc. In addition, the Federal Express (or other transporter) label should be completed to indicate the cooler number and total number of coolers in the shipment (1 of 3, 2 of 3, etc.). Each cooler shipped by Federal Express receives a unique tracking number. Copies of all paper work associated with a sample shipment are stored in the custody form logbook for tracking purposes. (Note that it is Battelle policy that all cover letters receive one-over-one approval).

Shipping over national holidays should be avoided whenever possible.

---

[1] Some projects may require that a separate, cooler-specific custody form be prepared to inventory the contents of each cooler. This requirement should be communicated to the sample custodian by the project manager.

5.2 Shipping Field Packs

The second form of shipping is a "field pack." In this type of shipping the empty jars and coolers are sent to clients for sampling in the field. They might consist of just an empty cooler or include a complete kit of PC (certified) grade jars, pens, packing tape, bubble wrap, Teflon tape, custody forms and warm blue ice to be frozen in the field. This type of packaging needs to be secured in the same manner as actual samples (described above). Field packs must be accompanied by Attachment 1, which describes sampling and documentation requirements for field personnel to ensure the integrity of the samples.

If the sample jars are shipped from Battelle, the certificate which comes with the jars certifying that they are precleaned must be maintained in the Sample Jar Logbook. The custodian notes the jar lot on the sample custody forms that are shipped to the client. If the sample jars are drop-shipped directly to the field then Battelle is not responsible for retaining the jar certificates unless they are shipped to Battelle with the samples. The handling of the cleaning certificate should be specified in the cover letter. The project manager should specify whether the cleaning certificate should be returned to Battelle or maintained with the field records.

6.0 TRAINING

The sample custodian is normally responsible for the shipment of samples off-site. Therefore, the sample custodian and alternates must receive training in this SOPs. Another individual may perform the activities described in this SOP under the supervision of the sample custodian or another trained staff member. A person who is being trained to ship samples from Battelle must first read this SOP. The person may then perform specific tasks under the supervision of a qualified instructor. A certificate of training (Attachment 2) is issued upon completion of training and provided to the Quality Assurance Unit.

ATTACHMENTS

Attachment 1 Instructions for field sampling teams
Attachment 2 Certificate of training

APPROVALS

Author	Joanna Bunk	4-02-01
Laboratory Supervisor	[signature]	4·3·01
Quality Systems Manager	Joanna Bunk	4-4-01
Analytical Services and Field Operations Resource Manager	[signature]	4/3/2001
	Name	Date

Attachment 1
Instructions For Field Sampling Teams (Page 1 of 3)

RESPONSIBILITIES
The person collecting the samples (sample collector) is responsible for

- Collect and preserve samples in accordance with approved procedures, as specified in the project specifications or the attached guidance
- Collect sufficient sample for the intended analyses
- Adjust the pH to < 2 if the sample is intended for volatile organics analysis (and also adding sodium thiosulfate if total residual chlorine is present)
- Assign a sample number or code at the time of collection that uniquely identifies that sample
- Label each sample container with the sample number, project identification, date of collection, collector's initials, and storage requirements (room temperature, frozen, chilled). Labeling system must be water resistant and use indelible ink. Sharpies cannot be used for VOA samples.
- Document sample collection (location, date and time of collection, collector's name), sample type (matrix), preservation, and any special remarks on the custody form
- Collect samples into proper sample containers (see table below)
- Package samples for shipment in a manner that minimizes the risk of breaks and leaks and to ensure that the samples are maintained at the appropriate temperature
- Complete and sign the custody form completely, accurately, and legibly
- Enclose the custody form in a sealed plastic bag, and attach the bag to the inner top of the cooler
- Ensure integrity of the samples by sealing or locking the shipping container(s) and applying custody tape (if required)
- Arrange timely transportation of samples to the laboratory; identify on the shipping label the name of the person to whom the samples should be delivered
- Ship samples with ample time to meet holding time requirements and ample volume for the intended analyses
- Call the laboratory to notify the laboratory that the samples have been shipped and when they will arrive

If the samples show signs of damage or contamination, contact the sampling team project manager immediately to determine if samples should be re-collected. Compromised samples must be segregated and shipped separately to avoid potential cross-contamination.

DECONTAMINATION
All sampling equipment should be thoroughly decontaminated prior to the field sampling efforts. The employer of the sample collector is responsible for this training and for documenting the decontamination procedures. Decontamination must be appropriate for the types of samples and intended analysis.

SHIPPING REQUIREMENTS
It is Battelle policy that samples are not received outside of regular business hours unless the project manager has made specific arrangements with the laboratory manager and the sample custodian in advance.

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Attachment 1
Instructions For Field Sampling Teams (Page 2 of 3)

REJECTION OF SAMPLES

It may be necessary for Battelle to reject samples if any of the following conditions are noted upon receipt:

- The integrity of the samples is compromised (leaks, cracks, grossly contaminated container exteriors or shipping cooler interiors, obvious odors, etc.)
- The identity of the container cannot be verified
- The proper preservation of the container cannot be established
- VOC vials contain bubbles of sizes greater than 1% of the vial volume
- Incomplete sample custody forms: the sample collector or the intended analysis is not documented, or the custody forms are not signed and dated by the person who relinquished the samples
- Samples are designated for VOA analysis but no VOA trip blank is provided.

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Attachment 1
Instructions For Field Sampling Teams (Page 3 of 3)

HOLDING TIMES AND CONDITIONS

The employer of the field sampling team is responsible for determining, documenting, and communicating to the field sampling team the holding times required for the intended analysis. In the absence of other instructions, the attached criteria should be applied.

Compound Class	Containers (Volume)	Preservation		Holding Time
		Temperature	Other	
WATER (1 L except TBT 2 L)				
Pesticides and PCBs	Glass with Teflon lined caps	Cool 4°C ±2°C	pH 5-9 if held longer than 72 hours	7 days
SVOA, TPH or Fingerprinting	Glass with Teflon lined caps	Cool 4°C ±2°C	Store in dark	7 days
VOA	Glass with Teflon lined caps	Cool 4°C ±2°C	pH<2 Headspace ≤1% of sample No bubbles	14 days
TBT	Polycarbonate Teflon lined caps	Freeze ≤20°C		90 days
Metals	Teflon	Cool 4°C ±2°C	Acidify with 0.2% nitric acid < 2pH	28 days (Hg) 6 months (Other metals)
SEDIMENT OR SOIL (50 g)				
Pesticides and PCBs	Glass with Teflon lined caps	Cool 4°C ±2°C or Frozen <20°C		14 days 1 year
SVOA or TBT	Glass with Teflon lined caps	Cool 4°C ±2°C or Frozen <20°C		14 days 1 year
VOA, TPH, or Fingerprinting	Glass with Teflon lined caps	Cool 4°C ±2°C		14 days
Metals	Polystyrene or Glass with Teflon lined caps	Cool 4°C ±2°C		28 days (Hg) 6 months (Other metals)
TISSUE (50 g)				
All classes	Glass with Teflon lined cap or for organic analysis solvent-rinsed foil	Freeze ≤20°C		1 year

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Attachment 2

RECORD OF TRAINING
For
SOP No. 5-210-03
Packaging of Samples for Shipment

The above mentioned SOP is relevant to your work. Your signature below signifies that you have read and understand the requirements associated with this procedure.

Trainee

Instructor

Date SOP read and understood

Comments:

Approval_____ Date_____

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Battelle Duxbury Operations
Standard Operating Procedures
for

SAMPLE RECEIPT, CUSTODY, AND HANDLING IN THE FIELD

1.0 OBJECTIVE

Sample control is a vital aspect of any environmental monitoring program that generates data that may be used for regulatory purposes or as evidence in a court of law. Additionally, the complexity of many environmental sampling programs, which may involve the collection and analysis of samples of various media from different sites to be analyzed for several parameters, makes a sample control system essential. In 2002, Battelle Duxbury Operations identified the need for a Field Sample Custodian. The purpose of this standard operating procedure (SOP) is to delineate sample custody procedures and responsibilities related to field operations. SOP 6-010 defines the sample custody procedures related to the analytical chemistry laboratory. These SOPs define the procedures, organizational responsibilities, and documentation requirements associated with the field and laboratory sample control system.

This SOP introduces a new position at Battelle Duxbury Operations: Field Sample Custodian. This person is a member of the Field Section and is responsible for receiving samples collected in the field. The Field Sample Custodian may later relinquish custody of samples to the Laboratory Sample Custodian, if samples are designated for analysis of Organic compounds or if aliquoting or compositing will be performed by Duxbury's analytical laboratory.

2.0 DEFINITIONS

Custody Records — The administrative records associated with the possession history of each sample from the time of collection, through analysis, to final disposal.

Chain-of-Custody Records — The administrative records associated with the physical possession and/or storage history of each individual sample from the purchase and preparation of each sample container and sampling apparatus to the final analytical result and sample disposal.

Legal or Evidentiary Chain of Custody (COC) – A special type of sample custody which requires that the physical possession, transport and storage of a sample be documented in writing. The records must account for all periods of time from sample container acquisition through sample disposal.

Sample control — The formal system designed to provide sufficient information to reconstruct the history of each sample, including collection, shipment, receipt and distribution within the laboratory, analysis, storage or disposal, and data reporting.

Sample custody — Samples are considered to be in a person's custody if

- The samples are in a person's actual possession;
- The samples are in a person's view after being in that person's possession;

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- The samples were in a person's possession and then were locked or sealed up to prevent tampering; or,
- The samples are in a secure area

3.0 RESPONSIBILITIES

Sample Collector — The sample collector is responsible for ensuring that samples can be tracked to their point of origin and that the integrity of the samples is maintained during collection. The person collecting the samples is responsible for

- Collecting and preserving samples in accordance with approved procedures, as specified in the project-specific plan and SOPs;
- Adjusting the pH of water samples to < 2 if the sample is intended for volatile organics analysis (and also adding sodium thiosulfate if total residual chlorine is present);
- Collecting a VOA blank when samples are collected for analysis;
- Assigning a number or code at the time of collection that uniquely identifies each sample. This may be a sample ID assigned by NAVSAM or a unique number that is a concatenation of the survey ID (AAB, AAC) and a sequential non-repeating number (001, 002)

  e.g., AAB-001

- Labeling each sample container with the project number, unique sample number, sampling location or description, container number (e.g. 1 of 3), project identification, collection date and time, and the collector's initials;

  Optional labeling information includes: project title, storage requirements (room temperature, frozen, chilled), collection method, field replicate number, depth interval, sample coordinates, sieve size, etc. The inclusion of additional label information is project-specific and should be defined in the project QAPP.

- Labeling the top and bottom of samples that must remain upright and for cores that have been cut for storage, the depth; and,
- Documenting sample collection information on a Station Log form. At a minimum this must include:
  - -Date and time
  - -Location
  - -Project
  - -Sample ID
  - -Number of sample containers
  - -Brief sample description
  - -Initials of collector(s)

Chief Scientist — The Chief Scientist is responsible for sample custody in the field. All samples collected during a survey are in the custody of the Chief Scientist until the samples are relinquished from the boat. The responsibilities of the Chief Scientist include:

- Ensuring that samples are colleted according to the Quality Assurance Project Plan (QAPP) or

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Sampling and Analysis Plan (SAP), including appropriate handling, labeling, and equipment decontamination;

- Ensuring that all samples collected during a survey are stored according to the storage requirements defined in the survey plan, and in a location that is secure[1];
- Recording the Field Sample ID and description on a Sample Custody Form (Attachments 1 or 2) that provides a complete inventory of every sample that is off-loaded during a survey;
- Formally relinquishing the samples by signing and dating the Relinquished By portion of the custody form. This signature documents that the Chief Scientist has verified the existence and sample ID of every sample on the form;
- Ensuring integrity of the samples by sealing or locking the shipping container(s) and applying custody tape (if required);
- Relinquishing samples to the Field Sample Custodian or directly to a laboratory representative who receives the samples by signing the Received By portion of the custody form;
- Documenting sample preservation on the Station Log form or on the custody form;
- Packaging samples for shipment from the ship to shore in a manner that minimizes the risk of breaks and leaks and ensures that the samples are maintained at the appropriate temperature;

  The QAPP or Field Sampling Plan should be referenced for the proper sample preservation in the field. In general,

  - Sediment cores shall remain upright at all times during transportation and storage
  - Cores and associated water samples shall remain at 4°C ±2°C at all times during transportation and storage
  - Tissue samples shall be frozen as soon as possible after collection unless the QAPP/SAP specifies alternative storage requirements.
- Arranging timely transportation of samples to the laboratory (ies), including identifying on the shipping label the name of the person to whom the samples should be delivered. For samples being delivered to Battelle, this will be the Field Sample Custodian; and,
- Notify the Sample Custodian(s) of pending sample delivery or shipment.

The Field Sample Custodian receives samples that are collected by Battelle's Field team. The Field Sample Custodian is not involved in direct transfers from the boat to a subcontractor laboratory, these transfers are the responsibility of the Chief Scientist. The responsibilities of the Field Sample Custodian include:

- Receiving samples, verifying that each sample listed on the custody form has been received (for details see Section 4.1);
- Completing and signing the custody records accurately and legibly;
- Completing a sample receipt form (Attachment 3);
- Maintaining records of sample receipt, release, and shipment (including a copy of the bill of lading) in the Field Custodian Logbook;
- Packaging samples for shipment to off-site analytical laboratories in a manner that minimizes the risk of breaks and leaks and ensures that the samples are maintained at the appropriate temperature;
- Notifying each receiving laboratory that samples have been shipped and ensuring that each laboratory returns a fax'd copy of the completed custody forms within 24 hours after receipt;

[1] Sample securing during a survey is defined as: samples are stored coolers or refrigeration/freezer units that can be directly supervised by the Chief Scientist and that are locked-up at the end of each survey day. Lock-up can include: placing sample storage units in a locked area of the survey vessel, storage van, or hotel/motel room.

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- Distributing completed custody forms according to Section 4.1.5;
- Arranging for the return of shipping coolers to the client or shipper, if appropriate; and,
- Communicating sample custody problems to the appropriate project or task manager and implementing corrective action as directed (Section 4.8).

Alternate Custodians — The Sample Custodians are responsible for assisting the Field Sample Custodian and for performing the above tasks in the absence of the Field Sample Custodian.

Project Manager — The Project Manager is responsible for

- preparing a survey plan that clearly defines the samples to be collected, types of sample containers, the required holding times and storage conditions, any sample splits or processing to be performed, and the contact name, shipping address, and telephone number of each analytical laboratory, including a clear description of where each sample or sample aliquot will be shipped;
- preparing a cover letter to accompany the samples;
- communicating the potential presence of total residual chlorine (if applicable);
- communicating sample custody-related problems to the client; and,
- defining and overseeing implementation of any needed corrective action to the sample custodian and laboratory manager.

Field Manager — The Field Manager is responsible for designating the Field Sample Custodian and the Alternate Sample Custodian for each survey and for ensuring that these individuals are trained to perform the tasks specified in this SOP.

4.0 PROCEDURES

4.1 SAMPLE RECEIPT

Samples arriving at Duxbury are delivered to the Field Sample Custodian and stored in the appropriate sample storage location as soon as possible. The original sample custody forms should be transmitted with the samples to the laboratory. The Field Coordinator will designate this location, which should be identified in the survey plan. The Field Sample Custodian is notified immediately.

The sample custodian must review and document the receipt of the samples by completing a project-specific Sample Receipt Form (Attachment 3) for samples received each day. As part of sample receipt,

- The custodian should record the temperature of each cooler to document whether or not the samples were maintained at the appropriate temperature (frozen, cool, or room temperature) during shipment. The temperature of a cooler blank (if available), melt water, or the external temperature of the sample containers should be measured and documented. (Thermometers or probes are never inserted into a sample container);
- In general, shipping containers should only be opened under a vented hood unless the character of the samples is known to be innocuous;

- The Sample Custodian formally receives the samples after inventorying the samples vs. the custody forms, by signing and dating the Received By portion of the custody form. This signature documents that the sample custodian has custody of each sample listed on the form;
- The Field Sample Custodian must determine whether the sample condition upon receipt is acceptable. That is, that the sample temperatures are appropriate for the intended analysis; and that sample integrity is acceptable (no broken or cracked jars or lids). The QAPP or field sampling plan will define acceptable sample handling and holding times. If sample containers, preservation, or delivery do not meet the QAPP/SAP criteria then the sample custodian must notify the project manager who in turn must notify the client (section 4.8); and,
- Samples should be stored in the appropriate storage location until samples are released to the appropriate analytical laboratory.

It is Battelle policy that samples are not received outside of regular business hours unless the project manager has made specific arrangements with the sample custodian in advance. Samples received at Duxbury outside of normal business hours are placed in an appropriate, secure storage location at the required temperature and are formally released to the Field Sample Custodian during the next routine business day, unless other arrangement are made.

4.1.1 Sample Acceptance/Rejection Criteria

Under some circumstances Battelle will place itself at risk by accepting samples for analysis if data are generated from samples that do not meet chain of custody or handling requirements (Section 4.1.1). Battelle may currently analyze samples for the following regulatory programs

- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation and Liability Act (Superfund) (CERCLA)
- Clean Water Act (CWA)

It is the responsibility of the project manager to specify in the QAPP that project samples are being analyzed for compliance monitoring. In these cases samples could be rejected if:

- The integrity of the samples is compromised (leaks, cracks, grossly contaminated container exteriors or shipping cooler interiors, obvious odors, etc.);
- The identity of the container cannot be verified;
- The proper preservation of the container cannot be established;
- VOC vials contain bubbles of sizes greater than 1% of the vial volume;
- Sample custody forms are incomplete (the sample collector is not documented or the custody forms are not signed and dated by the person who relinquished the samples);
- The sample collector did not relinquish the samples; and,
- Samples are designated for VOA analysis but no VOA trip blank is provided.

If the sample custodian identifies any of the above conditions the project manager must be notified (Section 4.8).

It is the responsibility of the Field Sample Custodian to ensure that any conditions that compromise sample integrity are recorded on the Sample Receipt Form. The Sample Custodian will notify the Project Manager and Laboratory Manager in writing (Attachment 4) of sample receipt, condition, and problems (e.g., breakage, leakage, missing samples, excessive temperatures). Upon completion of sample

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inspection, the Sample Custodian formally acknowledges receipt of the samples by signing, dating, and noting the current time on the sample transmittal form(s).

4.1.2 Documentation

Documentation of sample custody includes the sample custody forms, any additional records of transmittal (e.g., letter), a copy of the air bill (if applicable), and the Sample Receipt form. There records are maintained by the Field Sample Custodian in the Field Custody Logbook.

Sample custody forms are initiated in the field and are shipped with the samples to the analytical laboratories. Copies of these records are distributed to the Field Custody Logbook, the Chief Scientist (for the Survey logbook), and the project or task manager. Each laboratory should send a fax'd copy of the custody forms back to the sample custodian within 24 hours to document the receipt of samples and for early identification of sample loss or breakage. The original custody forms are returned to the project manager/task leader as part of the final data report. The originals are maintained in the project files. If Battelle's Duxbury laboratory is analyzing samples, the laboratory custodian should return the original custody forms to the project manager or task leader once the samples have been logged in. A copy of the completed custody forms will be maintained in the Custody Logbook.

The condition of the samples, integrity of the custody seals, discrepancies between sample labels and transmittal forms, and unusual events or deviations from the project work plan or SOPs are documented in detail on a Sample Receipt Form (Attachment 3). Any problems are also recorded on the original custody forms, if present.

4.2 SAMPLE STORAGE

Upon completion of sample log-in procedures, samples are transferred to a secure location for storage until transfer to the analytical laboratory. This location may be a room, refrigerator, or freezer, depending on the storage requirements of the samples, but must be an area that can be locked from the outside. This storage location is documented on the Sample Receipt form. Only the sample custodian will have keys to these controlled-access areas. He will maintain spare keys that will be signed in and out by the Chief Scientist if access to the controlled areas is required for sample storage outside of normal working hours.

The following storage requirements are applied to samples received at Battelle unless otherwise specified in the QAPP: tissue and sediment samples: ≤20°C; water samples: 4±2°C. Samples collected for compliance monitoring according to EPA regulatory methods are stored according to the conditions specified in Attachment 5; storage conditions should be specified in the QAPP.

Samples that are to be analyzed for volatile organic compounds must be stored in a separate storage location from the samples being analyzed for semi-volatile organic compounds.

4.3 INITIAL SAMPLE PROCESSING AND SAMPLE IDS

The compositing or aliquoting of samples prior to shipment to analytical laboratories is documented on the appropriate processing forms. Sample Split or Compositing forms are maintained in the Survey Logbook in a section entitled "Initial Processing. Split samples retain their original Field Sample identification number. Composited samples will be assigned a new, unique identification field number using the same format defined in Section 3.0.

If samples are aliquotted for several analyses, a suffix is added to the Field Sample IDs to distinguish the analysis type. The project QAPP should define the protocol codes.

4.4 SHIPMENT OF SAMPLES

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Distribution of samples from the field team to the laboratories for analyses is documented on the original sample custody form, which is shipped with the sample to the laboratory. (The preparation of field kits, custody of sample containers, and sample packing procedures are defined in SOP 5-210). Basically,

- each sample on the custody form must be accounted for during packing;
- the samples must be packed such that temperatures requirements are maintained and that samples are protected from breaks or leaks;
- appropriate transportation is arranged; and,
- original custody forms are included with the samples shipment.

The project manager should generate a cover letter to accompany the samples. It should identify the project, the intended analysis, the project quality control requirements, and the delivery and reporting schedule. Custody forms and the cover letter are placed in a sealed plastic bag and taped to the top lid of the freezer. A *copy* custody forms, the cover letter, and the bill of lading should be retained for tracking purposes in the Survey Log (Section 4.1.2).

4.5 CLIENT NOTIFICATION

The project manager must be notified immediately if problems are noted during sample receipt and log-in so that corrective action may be initiated. The sample custodian should communicate directly with the project manager if discrepancies between sample labels and custody forms are noted or if samples are missing. The project manager should communicate problems (e.g., holding time exceedences, preservation issues, incomplete or improper custody records – see Section 4.1.3) to the client, as needed. This notification and the clients directions for corrective action is documented on the Corrective Action form (Attachment 4). It must be specifically documented if the client approves analysis of the samples. All corrective action is communicated to the sample custodian or laboratory manager in writing.

4.6 SAMPLE ARCHIVAL AND DISPOSAL

Unused portions of field samples remain in the custody of the sample custodian. The decision to archive "extra" sample should be made by the client and the Project Manager when the project is initiated. Sample disposition and the length of storage should be defined in the project plan. In the absence of other directives, unexpended samples that are maintained under proper storage conditions archived for six months after the delivery of the final data. Unless otherwise specified by the client, the samples will be discarded in the proper waste stream after this period. Samples not maintained at appropriate temperatures are likely unsuitable for analysis and are held only until chemical analysis is complete so that the samples may be discarded in the appropriate waste stream. The project manager will be notified prior to the disposal of samples.

Sample disposal should be initiated by the project manager, who contacts the Field Sample Custodian once the results of analysis are known. The appropriate handling and disposal procedures for sample and sample extract are discussed in SOP 5-114.

5.0 SAFETY

Sample handling must always assume that samples are potentially "contaminated." Therefore, sample shipping containers are always opened in a vented fume hood, and personnel protective equipment is worn when unpacking samples (safety glasses, lab coat, and gloves).

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Occasionally, samples are received broken. Because the potential hazard may be unknown all spills must be treated as if the material is hazardous. Clean-up materials should be maintained in the sample custody room. These consist of

absorbent (e.g., speedi-dry)
dust pan and brush
glass disposal container
heavy-duty gloves
paper towels
plastic bags
solid waste stream container

The hazardous waste coordinator should be contacted to determine the proper disposal procedures for spilled sample. In general, water samples are absorbed into chemical absorbent; sediment, soil, or tissues are placed in heavy-duty plastic bags. These are both disposed of in the laboratory's solid waste stream. Broken glass containers are placed in the glass disposal container.

6.0 TRAINING

A person who is being trained as a sample custodian must first read this SOP. The person may then perform specific tasks under the supervision of a qualified instructor (Sample Custodian). Tasks performed by the trainee are reviewed and co-signed by the Laboratory Sample Custodian until it has been established that the trainee is able to perform these tasks without supervision. A certificate of training (Attachment 6) is issued upon completion of training and provided to the Quality Assurance Unit.

ATTACHMENTS

1. Battelle Standard Chain-of-Custody form
2. NavSam® Chain-of-custody Form
3. Sample Receipt Form
4. Sample Custody Corrective Action Form
5. Sample Handling Requirements
6. Certificate of Training

APPROVALS

Author	Joan Kuhl	4-3-02
Field Coordinator	Lynda M. Shaw	4-5-02
Quality Systems Manager	Joan Kuhl	4-3-02
Field Manager	Wayne R. Tull	4/4/02
	Name	Date

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ATTACHMENT 1
Battelle Duxbury Operations
Standard Chain-of-custody Form

Battelle
... Putting Technology To Work

Chain of Custody

Proj. No	Proj. Name

SAMPLERS: Signature

DATE	TIME	BATTELLE ID	CLIENT ID	SAMPLE DESCRIPTION	ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"										
					PEST	PCB	TPH FINGERPRINT	PAH	VOA	TBT	METALS	OTHER	ACIDIFIED	PRESERVED	Total Number of Containers

Relinquished by:	Date/Time	Received by:	Date/Time
Relinquished by:	Date/Time	Received by:	Date/Time

Comments:

1. Completed by field collector.
2. Completed by laboratory sample custodian.
3. Completed by chief scientist or designated field-based custodian.
4. Completed by person receiving samples from the field.
5. Completed by person receiving samples from 4 above.

ORIGINAL

ATTACHMENT 2
Battelle Duxbury Operations
NavSam® Chain-of-custody Form

MWRA Harbor and Outfall Monitoring Program
Contract No. S274
Chain-of-Custody Form

Today's Date : 6/9/98 8:09:07 AM

Chain-of-Custody # : WN985-BS-0146
Survey ID : WN985
Analysis ID : BS
Analysis Description : Biogenic silica

Laboratory : Chesapeake Biological Laboratory
Nutrient Analytical Services
Box 38
Solomons MD 20688
Dr. Carl Zimmerman
410-326-7252 (Phone) 410-326-7209 (Fax)

Bottle ID :	Bottle ID :	Sampling Date :	Station ID :	Ck 1	Ck 2	Ck 3	Ck 4
[redacted]	WN98500BBS1	5/1/98 8:13:44 AM	N04	☐	☐	☐	☐
[redacted]	WN98500BBS2	5/1/98 8:13:44 AM	N04	☐	☐	☐	☐
[redacted]	WN98500DBS1	5/1/98 8:16:38 AM	N04	☐	☐	☐	☐
[redacted]	WN98500DBS2	5/1/98 8:16:38 AM	N04	☐	☐	☐	☐
[redacted]	WN98500FBS1	5/1/98 8:18:46 AM	N04	☐	☐	☐	☐
[redacted]	WN98500FBS2	5/1/98 8:18:46 AM	N04	☐	☐	☐	☐
[redacted]	WN985030BS1	5/1/98 10:22:29 AM	N18	☐	☐	☐	☐
[redacted]	WN985030BS2	5/1/98 10:22:29 AM	N18	☐	☐	☐	☐
[redacted]	WN985032BS1	5/1/98 10:25:17 AM	N18	☐	☐	☐	☐
[redacted]	WN985032BS2	5/1/98 10:25:17 AM	N18	☐	☐	☐	☐
[redacted]	WN985034BS1	5/1/98 10:27:04 AM	N18	☐	☐	☐	☐
[redacted]	WN985034BS2	5/1/98 10:27:04 AM	N18	☐	☐	☐	☐
[redacted]	WN985059BS1	5/1/98 12:11:34 PM	N10	☐	☐	☐	☐
[redacted]	WN985059BS2	5/1/98 12:11:34 PM	N10	☐	☐	☐	☐
[redacted]	WN98505BBS1	5/1/98 12:13:53 PM	N10	☐	☐	☐	☐
[redacted]	WN98505BBS2	5/1/98 12:13:53 PM	N10	☐	☐	☐	☐
[redacted]	WN98505DBS1	5/1/98 12:16:18 PM	N10	☐	☐	☐	☐
[redacted]	WN98505DBS2	5/1/98 12:16:18 PM	N10	☐	☐	☐	☐

Shipping Condition - Room Temperature: _____ Cold(ice): _____ Frozen(dry ice): _____
Received Condition - Room Temperature: _____ Cold(ice): _____ Frozen(dry ice): _____

Relinquished By / Date / Time / Company / Transport-Airbill #	Received By / Date / Time / Company

1. Completed by chief scientist or designee prior to removing samples from the field. Cooler is sealed with custody tape at this time.
2. Completed by person receiving samples from the field.
3. Completed by person receiving samples from 2 above.

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ATTACHMENT 3
Battelle Duxbury Operations
Sample Receipt Form

Project Number: _____ Client: _____
Received by: _____ Date/Time Received: _____
No. of Shipping Containers _____ _

SHIPMENT

Method of Delivery: _____ Commercial Carrier (Air bill No. _____)
_____ Hand Delivered
_____ US Mail (RPS No. _____)

COC Forms: _____ Shipped with samples _____No forms

Cooler(s)\Box(es) were sealed with: _____ Tape _____ Custody Seals_____(Other specify)
Were the seals intact for each shipping container?_____Yes_____No_____NA
If NO, see Sample Custody Corrective Action Form

SAMPLES

Sample Labels: _____ Sample labels agree with COC forms
_____ Discrepancies (see Sample Custody Corrective Action Form)*

Container Seals: _____ Tape _____ Custody Seals_____(Other specify)
_____ Seals intact for each shipping container
_____ Seal broken (list impacted samples):

Condition of Samples: _____ Sample containers intact
_____ Sample containers broken/leaking (see Sample Custody Corrective Action Form)*

Temperature upon receipt (°C): _____Temperature blank used _____Yes____No
(Note: If temperature upon receipt differs from required conditions, list impacted samples):

Samples Preserved? ___Yes ___No ____Describe:

Storage Location: _____

Additional Comments:

Samples logged in by: _____ Date/Time: _____
* Must also be noted on the C-O-C.

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ATTACHMENT 4
Battelle Duxbury Operations
Sample Custody Corrective Action Form

Project Number _____ Client _____

Description of Problem (continue on back, if needed):

The sample custodian must contact the project manager on the day that problems are identified. If the project manager is not in the office the laboratory manager must be notified.

Documentation of project manager notification:

Sample Custodian: _____ _____
Signature Date

Project Manager _____ _____
Signature Date

Documentation of client notification (to be completed by project manager):

On _____ I contacted _____ at _____
Date Name of client contact Name of client organization

Results of communication with client (Describe any corrective action directed by the client):

RETURN THIS ORIGINAL TO THE SAMPLE CUSTODIAN. THE SAMPLE CUSTODIAN WILL PROVIDE COPIES TO THOSE ON THE ORIGINAL SAMPLE CUSTODY DISTRIBUTION LIST.

Date that this form was received by the custodian:_____

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ATTACHMENT 5
Sample Handling Requirements

WATER

Compound Class	Containers	Preservation		Holding Time
		Temperature	Other	
PESTICIDES[1]	Glass with Teflon lined caps	Cool 4°C ±2°C	pH 5-9 if held longer than 72 hours Store in dark	7 days until extraction, 40 days after extraction
PCBs[1]				
PAH[1]			Store in dark	
Other SVOA • Haloethers • Phthalate Esters • Nitroaromatics • Isophorones • Nitrosamines				
TPH or FINGERPRINT				
VOA[1]			pH<2 Headspace ≤1% of sample	14 days
TBT		Freeze ≤20°C		90 days

[1]If Residual Chlorine is present in the sample it must be treated with sodium thiosulfate.

SEDIMENT/SOIL

Compound Class	Containers	Preservation		Holding Time
		Temperature	Other	
PESTICIDES **PCBS**	Glass with Teflon lined caps	Cool 4°C ± 2°C		14 days until extraction, 40 days after extraction
PAH **SVOA**		Freeze ≤20°C		1 Year
VOA		Cool 4°C ± 2°C		14 days
TPH or FINGERPRINT		Cool 4°C ± 2°C		14 days until extraction, 40 days after extraction
TBT		Freeze ≤20°C		1 Year

TISSUE

All tissue samples are stored frozen (≤20°C). Unless specified in the QAPP, tissue samples are frozen in the field in pre-cleaned glass jars or Teflon® bags. For some projects, plastic bags or aluminum foil may be acceptable.

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ATTACHMENT 6
Battelle Duxbury Operations
Certificate of Training

SOP No. 6-040

SOP Title: **SAMPLE RECEIPT, CUSTODY, AND HANDLING IN THE FIELD**

Trainee_____

Instructor_____

SOP Read:_____ _____
Signature Date

Date Training Completed:_____

The above mentioned trainee has satisfactorily completed the training requirements associated with this SOP. Supporting documentation (if applicable) is attached.

Comments:

Approval: _____ _____
Signature Date

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CORING METHODOLOGY (Reference # S-19)
U.S. EPA ERTC/REAC, As Modified by Battelle
March 2005

INTRODUCTION

Sediment cores may be collected via a variety of sampling methods, including vibracoring, push coring, and hammer coring, among others. For this investigation, vibracoring methods will be used because gravel may be encountered at sample locations in the southern area of Lyman Mill Pond, and one consistent coring method is preferred for the study area. Further, this method is consistent with the approach used for the May 2003 investigation at Allendale and Lyman Mill Ponds.

POSITIONING VESSEL

1. Sample locations will be selected prior to commencement of the survey. Each sample station will be located using real-time differential global positioning system (dGPS).
2. The survey vessel will anchor as close to each target coordinate as possible.
3. After the vessel is anchored at the target location, actual sample locations will be identified by using data provided by real-time dGPS unit on the survey vessel immediately prior to collection of the sample.
4. If the position is unacceptable, the vessel position is adjusted and the position rechecked.
5. Once the survey vessel is anchored in an acceptable position, core samples will be collected. All non-dedicated equipment that may potentially come in contact with the sediments will be decontaminated between sample locations as specified below.
6. At the end of the sampling day, the data loaded in the dGPS units are checked to verify the existence of all locations in which data were collected. Sampling locations will be plotted onto a master chart as the samples are collected and checked with the dGPS data as a further verification that the correct locations and sampling schedule are being followed, and as a visual reference of the progress of the survey.

SAMPLING PROCEDURES

Decontamination of Equipment

Decontamination of non-dedicated sampling equipment (i.e., the polybutyrate core tube liners, aluminum or steel core tubes, and the core nose and catcher assemblies) will be performed prior to sampling and between each sample location. Visible sediment from outside the core barrel and on the vibracore unit will be removed with pressurized water and a brush. After all visible contamination has been removed, surfaces that will come in contact with the sediments will be rinsed with distilled water and then acetone. After the acetone has evaporated, all equipment will be wrapped with aluminum foil. All waste materials will be contained during decontamination and transferred to appropriate drums for disposal.

Collection of the Sediment Cores

Separate cores will be collected for radiodating (^{210}Pb) and physical/chemical testing; 5 for radiodating and 10 for physical/chemical testing.

1. Obtain water depth (depth to top of sediment), using either an onboard dual frequency fathometer (if dual frequency fathometer indicates two surfaces, use the lower of the two surface depths) or with a leadline. Calculate required penetration depth.
2. The plastic covering and aluminum foil at the top of the core barrel and liner will be removed. The core barrel will be inserted into the head of the vibracorer as it lies horizontally on the deck and secured in the vibracore.
3. The operator will slowly winch the vibracorer into its deployment orientation.
4. The vibracorer will then be then slowly lowered into the water by the deployment equipment.
5. As the vibracorer approaches the sediments, the motor will be turned on. The vibracorer is then allowed to slowly penetrate the sediments.
6. On completion of the required penetration, or upon vibracore refusal, the motor will be turned off and the vibracorer slowly raised. The actual vibracore penetration depth is recorded.
7. Clean the vibracorer and coring assembly by hosing down the equipment with water prior to being brought on board. Care should be taken not to direct water into the open end of the core barrel.
8. The vibracorer will then be returned to its deck storage location and the core nose will be immediately sealed by placing a plastic cap over the open end. The core will be carefully unbolted and taken to the core extraction area.
9. The core liner will be extracted from the core barrel and vibracoring recovery (e.g., total sediment core footage) will be measured using a tape measure and recorded to the nearest 0.1 foot.
10. Evaluate whether core penetration and recovery are acceptable.
11. If the recovery is acceptable, record this as the "primary" core and move the sample vessel a few feet prior to collecting any duplicate cores, if needed.
12. For each core collected record all pertinent information (as summarized below) in a field log book.
13. The core tubes will be capped and stored upright until transfer to the support launch for return to the sample processing area. The top of the core tube will be cut at the core sediment surface prior to capping. After capping, the top and bottom ends will be marked. Tubes will be transported to the processing facility by the support launch and will be maintained in an upright position wrapped in a cooling vest (sheets of iced gel) or stored in a refrigerated truck.

Procedures for Unacceptable Sediment Core Recovery

1. If the penetration depth or recovery ratio (total sediment core footage divided by penetration depth) are unacceptable for the specified chemical analyses, the location of the sampling vessel will be shifted a few feet to collect a second sample.
2. Establish the new location and record GPS coordinates of actual sample location.
3. Collect a vibracore at the adjusted location.
4. A maximum of two vibracores will be collected. If none of the cores meet the penetration or percent recovery ratio objectives, the longer of the two recovered cores will be selected as the primary core for analysis.

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Core Processing

As noted above, separate cores will be collected for radiodating and physical/chemical testing.

1. Cores will be stored until processing in a vertical position at 4 degrees Celsius (°C). Cores will be maintained under custody of Battelle until transferred to U.S. EPA AED laboratory in Narragansett, Rhode Island, where custody will be transferred either to a representative from the AED laboratory (i.e., William Nelson or Barbara Bergen) or to the processing team (Battelle and USACE ERDC).
2. Process areas at AED should be designated for handling hazardous materials. All personnel in the processing area, must be dressed in appropriate health and safety gear as specified in a site specific health and safety plan (HASP).
3. Remove top core cap for each core liner, and assess whether core lengths are to be processed as cohesive or non-cohesive sediments.
4. Gently remove overlying water either by a siphoning technique or cutting a small opening in the core just above the water layer and gently squeezing the core to remove the water. After overlying water is removed, replace the core cap.
5. Cores will be placed horizontally on the processing table.
6. Use the circular saw (or alternate clean, cutting device) to make longitudinal cuts through the core liner.
7. Place the core on a clean processing table and cut cores in half longitudinally.
8. Where the topmost material appears to be comprised of unconsolidated (ooze) material, a V-trough will be used to contain the sample such that the surface six inches are contained for subsequent subsampling.
9. The smear zone will be removed by scraping approximately 1/4 inch of exposed sediment. Dispose of this material as specified below.
10. The sediment cores will be visually described (core log attached) in a field log book and photo-documented. This will be the responsibility of USACE ERDC.
11. **Cores for Radioisotope Testing.** 5 cores will be collected for ^{210}Pb (Table 1). Cores selected for radioisotope testing will depend on the type of sediment recovered, and may vary based on sediment type, depth of core, and spatial distribution of vibracores. USACE ERDC will make the determination whether a core is deemed suitable for radiodating testing. The sample intervals will be selected by the project geologist based on the Conceptual Site Model (CSM) and lithology observed in the cores. A sufficient number of subsamples will be collected to establish a vertical profile.
12. **Cores for Chemical and Geotechnical Testing.** All cores will be analyzed for chemical and geotechnical parameters. Sub-samples will be collected from surface, mid-depth and deep intervals (Table 1); material will be collected from both sides of the core to ensure sufficient volume for testing (Table 2). Selection of these sections may be modified at the discretion of project geologist based upon the stratigraphy observed in the cores. Sub-samples for testing (Table 1) will be collected as follows
    a. ***Dioxin/furan*** – Three samples will be collected for dioxin/furan analysis from each core: one surface sample (0-0.5 ft), one mid-depth sample (approximately 1.2-1.3 ft below the surface), and one deep sample that is expected to be below the level of site-related contamination (approximately 2.4-2.5 ft below the mudline).
    b. ***Chemistry*** – The surface sample (0-0.5 ft) from each core will also be analyzed for other COCs (PCBs, pesticides, PAHs, metals).
    c. ***Geochemistry*** – Five samples will undergo analysis of grain size and Atterberg Limits, and fifteen samples will be tested for percent solids/water content. Samples for potential geotechnical analysis will be collected from the surface and mid-depth intervals from each sediment core, and the samples to be submitted to the laboratories will be selected after all cores have been processed to ensure that all sediment types are represented

d. ***Archive*** – One archive sample will be collected from deeper in the core (3.0 – 3.5 ft) in the event that the deep sample from any core shows evidence of dioxin contamination.

13. Sub-samples for radioisotope, chemical and geotechnical testing, as well as archives, will be removed from the core and placed in a decontaminated or dedicated container. The sample will be homogenized, labeled with unique sample ID (below) and the date recorded on the label.

Each analytical sub-sample will be assigned a unique sample ID, which will consist of a four- to five-segment, alpha-numeric code that identifies the area, sample medium, specific sample location identifier, sample event and sample depth, as follows

AAA - AA - NNNN – NNNN-NNNN

Sediment Core ID Core Sub-Sample ID

- The AAA-AA-NNNN represents the ID assigned to the sediment core, where the three alpha character group (AAA) identifies the area investigated (e.g., "LPX" for Lyman Mill Pond); the two alpha character group (AA) identifies the matrix sampled (e.g., "SD" for sediment); and the four numeric character group (NNNN) describes a unique location number identified sequentially (e.g., sediment cores collected using the "4500" series). Example: LPX-SD-4501.

- The NNNN-NNNN represents the ID assigned to the processed sediment core and identifies the depth interval that was sub-sampled for testing. The four numeric character group (NNNN-NNNN) describes the depth interval in feet collected (e.g., 0000-0050).

  Example: LPX-SD-4501-0000-0050

  represents a sediment core sample collected from Lyman Mill Pond at location 4501, which was sub-sampled between 0 and 0.05 feet.

14. All sub-samples will be maintained under chain of custody; sub-samples for radiodating will be maintained at ambient temperatures; sub-samples for mercury and methyl mercury analysis at Battelle Sequim will be maintained frozen (-20°C); and all remaining sub-samples (dioxin/furan, PCB/Pest/PAH, metals and geotechnical) will be maintained cold (4°±2°C).
15. All unused sediment material and solid investigative derived waste (IDW), such as PPE and core liners, will be placed in a 55-gallon drum(s) for temporary storage. Battelle's sub-contractor, ONYX Environmental, will be responsible for the transportation and disposal of the solid IDW (dioxin bearing, non-F027 listed waste. Solid IDW will be retrieved by ONYX Environmental at the completion of all data collection activities (spring/summer 2005).
16. The work area will be decontaminated prior to the start of processing for the next core.

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Table 1. Sample Summary for Sediment Core Collection in Lyman Mill Pond.

Station ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals	Radioisotopes	Archive
New Stations [(a)]					
LPX-SD-4501	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4502	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4503	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4504	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4505	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4506	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4507	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4508	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4509	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4510	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X

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Table 2. Sample Container, Sample Size, Preservation Requirements, Holding Times and Analytical Laboratories.

Analytical Parameter	Minimum Sample Volume	Containers	Preservation Requirements (a)	Maximum Holding Time (preparation/ analysis)	Laboratory for Shipping
Radiodating Cores					
Pb-210	¾ full	125 mL pre-cleaned jar	Ambient	30-d	Pat Marshall Teledyne Brown 2508 Quality Lane Knoxville, TN 37931 (865) 934- 0382
Chemistry and Geotechnical Cores					
Dioxin/Furan	½ full (or 20-g wet)	125 mL pre-cleaned jar	Cold (4±2°C)	1-year	Henry Pham Battelle Columbus 505 King Avenue Columbus, OH 43201 (614) 424-7849
PCB Aroclor/ Pesticide	½ full (or 50-g wet)	125 m pre-cleaned jar	Cold (4±2°C)	14-d [1-year if frozen (b)]	Jeff Newell Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781) 952-5270
Metals (Hg, MeHg)	½ full (or 20-g wet)	125 mL pre-cleaned jar	Frozen (-20°C)	28-d	Carolynn Suslick Battelle MSL 1529 Sequim Bay Rd. Sequim, WA 98382 (360) 681-3624
Metals	½ full	125 mL pre-cleaned jar	Cold (4±2°C)	6-mo (28-d for Hg)	Shirley Ng Mitkem Corporation 175 Metro Center Boulevard Warwick, RI 02886-1755 (401) 732-3400
Geotechnical	½ full	1-L pre-cleaned jar	Cold (4±2°C)	28-d	Ken Davis Applied Marine Sciences 502 North Highway 3 League City, TX 77573 (281) 554-7272
Archive	½ full	250 m pre-cleaned jar	Cold (4±2°C)	1-year	Jeff Newell Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781) 952-5270

DOCUMENTATION

Field notes will also be kept during sampling activities. The following information will be recorded in a bound field logbook:

- Names of personnel on the vessel(s)
- Vessel Name
- Weather and tidal conditions
- Date and time of sampling
- Location and sample station number

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- Vibracore Location Number
- Vibracore Number
- Measured Water Depth
- Vibracore Penetration & Recovery Table
- Calibration information

EQUIPMENT LISTS

Survey Vessel

- Dual frequency fathometer or lead line with 0.1' markings.
- Plastic sheeting
- Permanent marker or grease pencil
- Vibracore assembly and deployment equipment (e.g., Aframes, winches, generator)
- Decontaminated polybutyrate (e.g., Lexan) core liners, fully assembled with decontaminated stainless steel core noses and core catchers
- Cooling vests, or equivalent
- Assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- Field logbooks
- Appropriate decontamination equipment
- Tape measure
- Submersible pump and hose
- DGPS with external antennae
- Core extrusion table
- Hacksaw and spare blades
- Core caps
- Tape for securing core caps
- Appropriate personal health and safety equipment
- Appropriate decontamination equipment

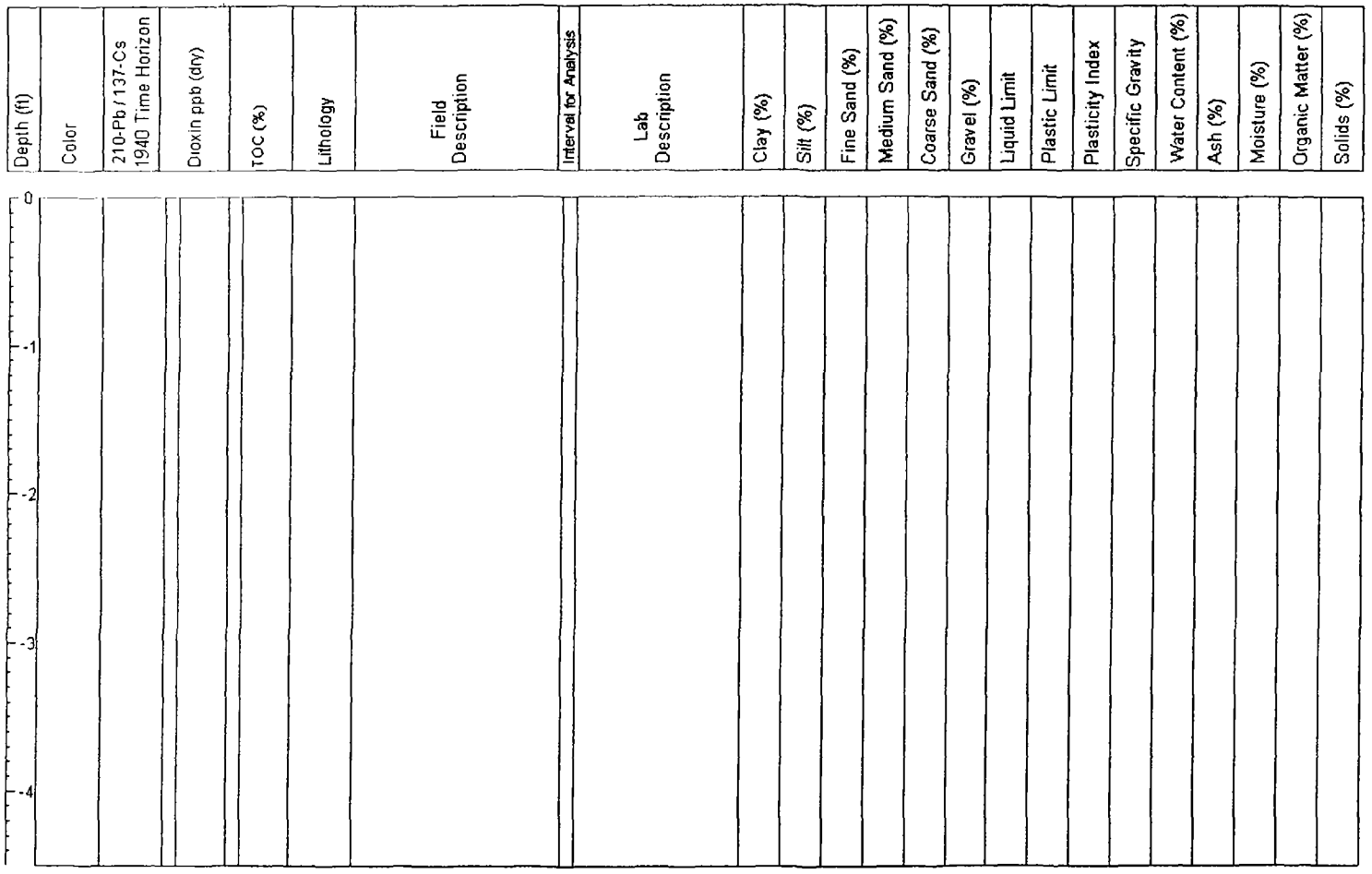
Core Processing Laboratory

- Core processing table
- Processing laboratory notebook and associated coring documentation
- Tape measure
- Hacksaw and spare blades
- Core caps
- Sampling equipment: disposal knives and spoons
- Refrigerator, at 4°C for sample storage/archive
- Freezer
- Sample Glassware (e.g., containers)
- Samples labels and labeling tape
- Appropriate waste disposal equipment
- Appropriate personal health and safety equipment
- Appropriate decontamination equipment

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PROJECT NAME: Centredale Manor Restoration Project
LOCATION: Woonasquatucket River, North Providence, RI
BORING NUMBER:
LOCATION (lat/long):

DATE:
TOTAL DEPTH:



Example Core Log. (Lab description and results will reported as data are available)

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APPENDIX C

Field Forms

Field Station Log

Coring Field Log Lyman Mill, USACE Centredale Manor, RI Project # G487002-RI13C1		
Sample ID:	Sampled by:	
Site:	Date:	
Reduced Sounding (MLW from chart): Sounding:	Location Method ___dGPS ___ Loran ___ Depth ___Ranges/Bearing	
Sea State: Weather:	Sampler Type: ___Vibra Core ___Gravity Corer ___Push Tube ___ Water Sampler ___ Other (specify)	
Coordinates Latitude: Longitude:	Penetration Depth: Recovery Depth:	Time:
Coordinates Latitude: Longitude:	Penetration Depth: Recovery Depth:	Time:
Coordinates Latitude: Longitude:	Penetration Depth: Recovery Depth:	Time:
Coordinates Latitude: Longitude:	Penetration Depth: Recovery Depth:	Time:
Coordinates Latitude: Longitude:	Penetration Depth: Recovery Depth:	Time:
Coordinates Latitude: Longitude:	Penetration Depth: Recovery Depth:	Time:
Material Description:	Notes:	

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Battelle
... Putting Technology To Work

Chain of Custody

Proj. No	Proj. Name
SAMPLERS: Signature	

DATE	TIME	BATTELLE ID	CLIENT ID	SAMPLE DESCRIPTION	ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"										
					PEST	PCB	TPH FINGERPRINT	PAH	VOA	TBT	METALS	OTHER	ACIDIFIED	PRESERVED	Total Number of Containers

Relinquished by:	Date/Time	Received by:	Date/Time
Relinquished by:	Date/Time	Received by:	Date/Time

Comments:

ORIGINAL

Chain of Custody Form

Site Master Log

Site Master Log Lyman Mill Pond Sediment Investigation Project # G487002-RI13C1		
Date:	**Vessel:**	
Personnel:		

Time:	**Activities:**

GPS CALIBRATION FORM

BATTELLE DUXBURY OPERATIONS
397 Washington St., Duxbury, MA 02332
(781) 934-0571 Fax (781) 934-2124

Survey: **Lyman Mill Pond Sediment Investigation**
Area or Site Name: **Lyman Mill Pond, Centredale , RI**
Project Title: **Centredale Manor Restoration Project**

Superfund Site

Check GPS at Established Benchmark at Survey start, prior to sample collection
Check GPS at least one reference checkpoint at beginning of each day.

Established Benchmark Name _____ *Established by* _____
Benchmark Location

Units and Datum	*Northing / Latitude*	*Easting / Longitude*
State Plane NAD 83 (Ft)		
State Plane NAD 27 (Ft)		
Lat Long NAD 83 (Decimal Minutes)		
Lat Long NAD 83 (Deg, min, sec)		

*Comments*_____
GPS Reference Checkpoint Name _____

Reference Checkpoint 1 Location

Units and Datum	*Northing / Latitude*	*Easting / Longitude*
State Plane NAD 83 (Ft)		
State Plane NAD 27 (Ft)		
Lat Long NAD 83 (Decimal Minutes)		
Lat Long NAD 83 (Deg, min, sec)		

Date/Time _____ *Vessel* _____

Unit Make/Model _____

Benchmark or Reference Checkpoint (circle one) Name _____

Established coordinates from table _____

Measured coordinates _____

Difference _____feet _____meters _____ Within 100 meters? Yes/No

If no, check operation, re-measure, or replace unit and repeat calibration check.

Benchmark or Reference Checkpoint (circle one) Name _____

Date/Time _____ Vessel _____

Unit Make/Model _____

Measured coordinates _____

Difference _____feet _____meters _____ Within 100 meters? Yes/No

If no, check operation, re-measure, or replace unit and repeat calibration check.

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APPENDIX D

Field Electronic Data Deliverable Requirements

Table D-1. Electronic Data Deliverable Requirements for Field Data.

Field Name	Definition
NSAMPLE	Sample ID from sample custody records
FIELD_QC_TYPE	Normal = not a QC sample; DU = field duplicate, RB = rinsate blank, PE = performance evaluation sample; TB = trip blank.
SACODE	"Normal" = not duplicated, "Dup1" = duplicated, "Dup2" = duplicate
SAMP_DATE	Collection date from custody records; Format DD-MON-YY.
MATRIX	Soil or groundwater
SPECIES	Not applicable for RI/FS; leave as NULL in EDD
TISSUETYPE	Not applicable for RI/FS; leave as NULL in EDD
BORING	Sample location (several nsamples will have the same boring ID; e.g. soil samples collected from the same location at different depths).
NORTHING	State plane coordinate (NAD 1983) of boring.
EASTING	State plane coordinate (NAD 1983) of boring.
ELEVATION	In feet (NGVD 1929).
TOP	Top of sample interval in feet. Applicable to soil samples.
BOTTOM	Bottom of sample interval in feet. Applicable to soil samples.
DEPCODE	"a" = surface, "b" = subsurface.
OU	Not applicable for RI/FS; leave as NULL in EDD
AOC	Not applicable for RI/FS; leave as NULL in EDD
DATEAPPENDED	Leave as NULL in EDD.
DATASOURCE	Battelle
SUBMATRIX	Leave as NULL in EDD.
FILTERED	"Unfiltered" for RI/FS groundwater samples.
MATRIX_GENERAL	Leave as NULL in EDD
WRECEPTOR	Leave as NULL in EDD

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Table D-2. Example Field EDD

SACODE	SAMP_DATE	BORING	NORTHING	EASTING	ELEVATION	TOP	BOTTOM	DEPCODE	DATASOURCE
DUP1	2/17/1999	CMS-001	282652.562	331496.151	0	0	0.25	A	IT
DUP2	2/17/1999	CMS-001	282652.562	331496.151	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-002	282561.114	331509.087	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-003	282453.252	331510.447	0	0	0.25	A	IT
DUP1	2/17/1999	CMS-004	282361.637	331526.270	0	0	0.25	A	IT
DUP2	2/17/1999	CMS-004	282361.637	331526.270	0	0	0.25	A	IT
DUP1	2/17/1999	CMS-005	282258.112	331530.864	0	0	0.25	A	IT
DUP2	2/17/1999	CMS-005	282258.112	331530.864	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-006	282159.182	331531.801	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-007	282058.635	331534.945	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-008	281958.088	331540.900	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-009	281854.820	331544.134	0	0	0.25	A	IT
NORMAL	2/17/1999	CMS-010	281757.250	331555.363	0	0	0.25	A	IT

1.0 TITLE AND APPROVAL PAGE (EPA WORKSHEET #1)

Site Name/Project Name: *Centredale Manor Restoration Project Superfund Site Baseline Risk Assessment, Initial Project Planning and Support*
Site Location: *Centredale Manor, Lyman Mill Pond, North Providence, Rhode Island*

Document Title: *Centredale Manor Tasks 19–22 Quality Assurance Project Plan – Addendum 3*

Lead Organization (Agency, State, Tribe, Federal Facility, PRP, or Grantee): *Battelle*

Preparer's Name and Organizational Affiliation: *Deirdre Dahlen/Battelle*

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Preparation Date (Day/Month/Year): 03/10/2005

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Signature/Date
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Printed Name/Organization

Investigative Organization's Project QA Officer: Rosanna Buhl March 10, 2005
Signature/Date
Rosanna Buhl/Battelle 03/10/2005
Printed Name/Organization

Lead Organization's Project Manager: Deirdre Dahlen March 10, 2005
Signature/Date
Deirdre Dahlen/Battelle 03/10/2005
Printed Name/Organization

Approval Signature:
Signature/Date
Andy Beliveau/ QA Officer
Printed Name/Title
EPA Region 1
Approval Authority

Other Approval Signatures:
Signature/Date
Heather Sullivan/USACE NAE Project Officer
Printed Name/Title

Document Control Number: *Not applicable.*

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2.0 CONTENTS AND DOCUMENTATION FORMAT

2.1 Table of Contents

EPA-NE QAPP Worksheet #	Title	Page Number
1	Title and Approval Page	1
2	Contents and Document Format	2
#2a	EPA-NE QAPP Worksheet	7
#3	Distribution List	11
#4	Project Personnel Sign-Off Sheet	12
#5a	Project Organization Chart	15
#5b	Communication Pathways	16
#6	Personnel Responsibilities and Qualifications Table	17
#7	Special Personnel Training Requirements Table	NA
#8a	Project Planning Meetings	20
#8b	Problem Definition/Site History and Background	28
#9a	Project Description and Schedule	35
#9b	Target Analytes and Detection Limits	47
#9c	Field and Quality Control Sample Summary Table	56
#9d	Analytical Services Table	57
#10	Project Schedule Timeline Table	58
#11a	Project Quality Objectives/Decision Statements	59
#11b	Measurement Performance Criteria Tables	62
#12a	Sampling Design and Rationale	68
#12b	Sampling Locations, Sampling and Analysis Method/SOP Requirements Table	69
#13	Project Sampling SOP Reference Table	76
#14	Field Sampling Equipment Calibration Table	77
#15	Field Equipment Maintenance, Testing and Inspection Table	78
#16	Sample Handling, Tracking and Custody Requirements	79
#17	Field Analytical Method/SOP Reference Table	NA
#18	Field Analytical Instrument Calibration Table	81
#19	Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table	82
#20	Fixed Laboratory Analytical Method/SOP Reference Table	83

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #	Title	Page Number
#21	Fixed Laboratory Instrument Maintenance and Calibration Table	89
#22a	Field Sampling QC Table	92
#23a	Field Analytical QC Sample Table	NA
#23b	Field Analytical QC Sample Table Cont.	NA
#24a	Fixed Laboratory Analytical QC Sample Table	98
#24b	Fixed Laboratory Analytical QC Sample Table Cont.	107
#25	Non-direct Measurements Criteria and Limitations Table	NA
#26	Project Documentation and Records Table	114
#27a	Assessment and Response Actions	115
#27b	Project Assessment Table	116
#27c	Project Assessment Plan	117
#28	QA Management Reports Table	123
#29a	Data Verification Process	124
#29b	Data Validation Summary Table	125
#29c	Data Validation Modifications	126
#30	Data Usability Assessment	127

NA, Not applicable.

ATTACHMENTS

(Attachments A through G applicable to the May 23, 2001 QAPP)
H Resumes 131
I Electronic Data Deliverable (EDD) Specifications 169
J Definition of Raw Data 173
K Pertinent Fixed Laboratory SOPs ..... not paginated

FIGURES

Figure 1. Project Organizational Chart 15
Figure 2. Lyman Mill Pond Boring Locations 34
Figure 3. Preliminary Data Review Decision Tree 130

TABLES

Table 1. Sampling Summary for Sediment Core Collection in Lyman Mill Pond 32
Table 2. Sampling Locations, Numbers of Samples, Required Analytical Parameters, and Performing Laboratories 35
Table 3. Sample Type, Storage and Holding Time Requirements for Chemical Parameters 36
Table 4. Data Reporting Qualifiers 46

GLOSSARY OF TERMS

Term	Definition	Term	Definition
Types of plans/documents		*Sampling Locations*	
FSP	Field sampling plan	LPX	Lyman Mill Pond
QAPP	Quality assurance project plan (also referred to as sampling and analysis plan, SAP)		
SOP	Standard Operating Procedure		
SOW	Statement of Work	*Laboratories*	
		AMS	Applied Marine Sciences, Inc.
Sample Types		BATD	Battelle Duxbury
SE	Sediment	BCO	Battelle Columbus
		MSL	Battelle Marine Sciences Laboratory
Analytical Terms		Mitkem	Mitkem Corporation
CC	Continuing calibration	Teledyne	Teledyne Brown Engineering
CCV	Continuing calibration verification		
COPC	Chemicals of potential concern	*Analytical Terms (cont)*	
CVAA	Cold vapor atomic absorption	HPLC	High performance liquid chromatography
CVAF	Cold vapor atomic fluorescence	IC	Initial calibration
DCM	Dichloromethane (also referred to as methylene chloride)	ICP/AES	Inductively coupled plasma/atomic emission spectroscopy
DUP	Laboratory (analytical) sample duplicate	ICP/MS	Inductively coupled plasma/mass spectrometry
EDD	Electronic data deliverable	ICP/OES	Inductively coupled plasma/optical emission spectroscopy
EMDL	Estimated method detection limit	ICV	Initial calibration verification
FIAS	Flow- injection atomic spectroscopy	ICS	Independent control standard
GC/ECD	Gas chromatography/electron capture detection	LCS	Laboratory control sample
GC/HRMS	Gas chromatography/high resolution mass spectrometry	MB	Method blank
GC/MS	Gas chromatography/mass spectrometry	MDL	Method detection limits
GPC	Gel permeation chromatography	MeHg	Methyl mercury
Hg	Mercury	MPC	Measurement performance criteria

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GLOSSARY OF TERMS (cont)

Term	Definition	Term	Definition
Analytical Terms (cont)			
MS	Matrix spike	QL	Quantitation limit
MSD	Matrix spike duplicate	RIS	Recovery internal standard
OPR	Ongoing precision and recovery	RPD	Relative percent difference
PAH	Polycyclic aromatic hydrocarbons	RRF	Relative response factor
PCB	Polychlorinated biphenyls	RSD	Relative standard deviation
PB	Procedural blank	SIS	Surrogate internal standard
PD	Percent difference	SRM	Standard reference material
QC	Quality control		

****

This is a Project-Specific Quality Assurance Project Plan.

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EPA-NE QAPP Worksheet #2

Site Name/Project Name: Centredale Manor
Site Location: Centredale Manor, Lyman Mill Pond, North Providence, Rhode Island
Site Number/Code: 016P
Operable Unit:
Contractor Name: Battelle
Contractor Number: DACW33-01-D-0004
Contract Title: Centredale Manor Restoration Project Superfund Site
Work Assignment Number: Delivery Order #01
Anticipated date of QAPP Implementation: March 2005

1. Identify Guidance used to prepare QAPP: *Region I, EPA-NE Compendium QAPP Guidance, Draft Final September 1998*

2. Identify EPA Program: *Superfund*

3. Identify approval entity: *EPA-NE or State: U.S. Army Corps of Engineers, New England Division and EPA-NE* or other entity:

4. Indicate whether the QAPP is a generic program QAPP or a project-specific QAPP. (underline one)

5. List dates of scoping meetings that were held: September 21, 2004

6. List title of QAPP documents and approval dates written for previous site work, if applicable:

Title	Approval Date
Sampling and Analysis Plan Woonasquatucket River Sediment Investigation, Centredale Manor Site, North Providence, Rhode Island. (prepared by Tetra Tech NUS, Inc.)	September 1999
Task 15 QAPP, Centredale Manor Restoration Project Superfund Site Baseline Risk Assessment, Initial Project Planning and Support (prepared by Battelle)	November 2000
Tasks 19-22 QAPP, Centredale Manor Restoration Project Superfund Site Baseline Risk Assessment, Initial Project Planning and Support (prepared by Battelle)	May 2001
Addendum to Tasks 19-22 QAPP, Centredale Manor Restoration Project Superfund Site Baseline Risk Assessment, Initial Project Planning and Support (prepared by Battelle)	September 2002
Addendum 2 to Tasks 19-22 QAPP, Centredale Manor Restoration Project Superfund Site Baseline Risk Assessment, Initial Project Planning and Support (prepared by USEPA Region 1)	April 2003

7. List organizational partners (stakeholders) and connection with EPA and/or State:
U.S. Army Corps of Engineers, New England District

EPA Region I

State of Rhode Island

8. List data users:
U.S. Army Corps of Engineers, New England District

EPA Region I

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable the project, then circle the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below:
EPA-NE QAPP Worksheet #7 - No special training required
EPA-NE QAPP Worksheet #17 – not applicable
EPA-NE QAPP Worksheet #22b – no field QC (e.g., rinsate blanks or field duplicates)
EPA-NE QAPP Worksheet #23a and #23b – No applicable QC samples associated with field screening analyses
EPA-NE QAPP Worksheet #25 – Evaluation of historical data for usability described in Harding (2001)[1] and Battelle (2002a)[2]

[1] Harding 2001. Final Work Plan for the Human Health and Ecological Risk Assessment for the Centredale Manor Restoration Project Superfund Site. March 15, 2001.

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EPA-NE QAPP Worksheet # 2a

Bold QAPP Elements, Worksheets and/or Required Information that are not applicable to the project and provide an explanation on EPA-NE QAPP Worksheet #2, Item 9.

REQUIRED EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS		EPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Project Management and Objectives				
A1	1.0	Title and Approval Page	1	- Title and Approval Page
A2	2.0 2.1 2.2 2.3 2.4	Table of Contents and Document Format Table of Contents Document Control Format Document Control Numbering System EPA-NE QAPP Worksheet #2	2	- Table of Contents - EPA-NE QAPP Worksheet
A3	3.0	Distribution List and Project Personnel Sign-off Sheet	3 4	- Distribution List - Project Personnel Sign-off Sheet
A4, A8	4.0 4.1 4.2 4.2.1 4.3 4.4	Project Organization Project Organizational Chart Communication Pathways Modifications to Approved QAPP Personnel Responsibilities and Qualifications Special Training Requirements/ Certification	5a 5b 6 7	- Organizational Chart - Communication Pathways - Personnel Responsibilities and ~~Qualifications Table~~ - **Special Personnel Training Requirements Table**
A5	5.0 5.1 5.2	Project Planning/Project Definition Project Planning Meetings Problem Definition/Site History and Background	8a 8b	- Project Scoping Meeting Attendance Sheet with Agenda and other Project Planning Meeting Documentation - Problem Definition/Site History and Background - EPA-NE DQO Summary Form - Site Maps (historical and present)
A6	6.0 6.1 6.2	Project Description and Schedule Project Overview Project Schedule	9a 9b 9c 9d 10	- Project Description - Contaminants of Concern and Other Target Analytes Table - Field and Quality Control Sample Summary Table - Analytical Services Table - System Designs - Project Schedule Timeline Table
A7	7.0 7.1 7.2	Project Quality Objectives and Measurement Performance Criteria Project Quality Objectives Measurement Performance Criteria	11a 11b	- Project Quality Objectives/Decision Statements - Measurement Performance Criteria Table

[2] Battelle 2002a. Summary of Data Needs for the Centredale Manor Restoration Superfund Site RI/FS. February 25, 2002.

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EPA-NE QAPP Worksheet # 2a (continued)

REQUIRED EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Measurement/Data Acquisition			
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	12a 12b	- Sampling Design and Rationale - Sampling Locations, Sampling and Analysis Method/SOP Requirements Table - Sample Location Map
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers	13 12b 14 15	- Sampling SOPs Project Sampling SOP Reference Table - Sampling Container, Volumes and Preservation Table - Field Sampling Equipment Calibration Table Cleaning and Decontamination SOPs - Field Equipment Maintenance, Testing and Inspection Table
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	16	- Sample Handling, Tracking and Custody SOPs - Sample Handling Flow Diagram - Sample Container Label (Sample Tag) - Chain-of-Custody Form and Seal
B4, B6, B7, B8	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	17 18 19	- Field Analytical Methods/SOPs - Field Analytical Method/SOP Reference Table - ~~Field Analytical Instrument Calibration~~ Table - Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table

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EPA-NE QAPP Worksheet # 2a (continued)

REQUIRED EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NE QAPP Worksheet #	REQUIRED INFORMATION
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration 12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies	 20 21	- Fixed Laboratory Analytical Methods/SOPs - Fixed Laboratory Analytical Method/SOP Reference Table - Fixed Laboratory Instrument Maintenance and Calibration Table
B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	 22a 22b **23a** **23b** 24a 24b	**Sampling** ~~- Field Sampling QC Table~~ ~~- Field Sampling QC Table cont.~~ **Analytical** - **Field Analytical QC Sample Table** - **Field Analytical QC Sample Table cont.** - **Field Screening/Confirmatory Analysis Decision Tree** - Fixed Laboratory Analytical QC Sample Table - Fixed Laboratory Analytical QC Sample ~~Table cont.~~
B9	14.0 Data Acquisition Requirements	**25**	- **Non-Direct Measurements Criteria and Limitations Table**
A9, B10	15.0 Documentation, Records and Data Management 15.1 Project Documentation and Records 15.2 Field Analysis Data Packa Deliverables 15.3 Fixed Laboratory Data Package Deliverables 15.4 Data Reporting Formats 15.5 Data Handling and Management 15.6 Data Tracking and Control	26	- Project Documentation and Records Table - Data Management SOPs
Assessment/Oversight			
C1	16.0 Assessments and Response Actions 16.1 Planned Assessments 16.2 Assessment Findings and Corrective Action Responses 16.3 Additional QAPP Non-Conformances	27a 27b 27c	- Assessment and Response Actions - Project Assessment Table - Project Assessment Plan - Audit Checklists
C2	17.0 QA Management Reports	28	- QA Management Reports Table

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EPA-NE QAPP Worksheet # 2a (continued)

REQUIRED EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Data Validation and Usability			
D1	18.0 Verification and Validation Requirements		- Validation Criteria Documents *
D2	19.0 Verification and Validation Procedures	29a 29b 29c	- Data Evaluation Process - Data Validation Summary Table - Data Validation Modifications
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	- Data Usability Assessment

* Include Data Validation Criteria Document as an attachment to the QAPP if Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses will not be used for validating project data.

Note: Required project-specific information should be provided in tabular format, as much as practicable. However, sufficient written discussion in text format should accompany these tables. Certain sections, by their nature, will require more written discussion than others. In particular, Section 8.0 should provide an in-depth explanation of the sampling design rationale and Sections 18-20 should describe the procedures and criteria that will be used to verify, validate and assess data usability.

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EPA-NE QAPP Worksheet #3 - Rev. 10/99

Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Document Control Number
Heather Sullivan	Project Manager	U.S. Army Corps of Engineers, New England District	978-318-8543	NA
Beverly Lawrence	RI/FS Technical Lead	U.S. Army Corps of Engineers, New England District	978-318-8512	NA
David DuLong	Chief Engineering/ Planning Division	U.S. Army Corps of Engineers, New England District	978-318-8500	NA
Maureen Corcoran	Geomorphologist	U.S. Army Corps of Engineers, Waterways Experiment Station (WES)	601-634-3334	NA
Anna Krasko	Remedial Project Manager	EPA Region I	617-918-1232	NA
Cornell Rosiu	Work Assignment Manager	EPA Region I	617-918-1345	NA
Andy Beliveau	QA Officer	EPA Region I	617-918-8607	NA
William Nelson	Technical Advisor	EPA Atlantic Ecology Division (AED)	401-782-3053	NA
Lisa Lefkovitz	Program Manager	Battelle Duxbury	781-952-5254	NA
Deirdre Dahlen	Project Manager	Battelle Duxbury	781-952-5253	NA
Patty White	RI/FS Task Manager	Battelle Duxbury	781-952-5279	NA
Rosanna Buhl	Project QA Coordinator	Battelle Duxbury	781-952-5309	NA
Alex Mansfield	Field Manager	Battelle Duxbury	781-952-5329	NA
Karen Tracy	Dioxin/Furan Task Leader	Battelle Columbus	614-424-4028	NA
Brenda Lasorsa	Hg and MeHg Task Leader	Battelle Marine Sciences Laboratory (MSL)	360-681-3650	NA
Evan Philo	Metals Task Leader	Mitkem Corporation	401-732-3400	NA
Rebecca Charles	Pb-210 Task Leader	Teledyne Brown Engineering Environmental Services	865-934-0379	NA
Ken Davis	Geotechnical Task Leader	Applied Marine Sciences, Inc.	281-554-7272	NA

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EPA-NE QAPP Worksheet #4 - Rev. 10/99

Project Personnel Sign-Off Sheet

Organization: Battelle Duxbury

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Lisa Lefkovitz	Program Manager	781-952-5254			
Deirdre Dahlen	Project Manager	781-952-5253			
Patty White	RI/FS Task Manager	781-952-5279			
Rosanna Buhl	Project QA Coordinator	781-952-5309			
Alex Mansfield	Field Manager	781-952-5329			
William Steinhauer	Laboratory Manager	781-952-5319			
Jeff Newell	Laboratory Sample Custodian	781-952-5270			
Bob Lizotte	PCB/Pesticide and PAH Analysis Supervisor	781-952-5235			
Jon Thorn	Sample Preparation Supervisor; LIMS Manager	781-952-5271			

Organization: Battelle Columbus

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Karen Tracy	Dioxin/Furan Task Leader	614-424-4028			
Zachary J. Willenberg	QA Officer	614-424-5795			
Mary E. Schrock	Laboratory Manager	614-424-4976			
Mark F. Misita	Sample Preparation Chemist	614-424-7884			
Henry H. Pham	Sample Preparation Chemist and Sample Custodian	614-424-7849			
Susan Winnard	Sample Preparation Chemist	614-424-4365			
Wesley H. Baxter	Sample Preparation Chemist	614-424-7849			
Betsy Thompson	GC/HRMS Analyst	614-424-3884			
Joseph E. Tabor	GC/HRMS Analyst	614-424-5130			

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EPA-NE QAPP Worksheet #4 (continued) - Rev. 10/99

Project Personnel Sign-Off Sheet

Organization: Battelle Marine Sciences Laboratory (MSL)

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Brenda Lasorsa	Hg and MeHg Task Leader	360-681-3650			
Janet Cloutier	QA Officer	360-681-4550			
Carolynn Suslick	Sample Custodian	360-681-3624			
Rebecca Wood	Total Hg, Sample Preparation Chemist	360-681-3675			
Jordana Wood	MeHg, Sample Preparation Chemist and Analyst	360-681-3622			
Laurie Niewolny	MeHg Analyst	360-681-3689			
Mary Ann Deuth	Total Hg, Analyst	360-681-4572			

Organization: Mitkem Corporation.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Evan Philo	Metals Task Leader	401-732-3400			
Reinier Courant	QA Officer	401-732-3400			
Shirley Ng	Sample Custodian	401-732-3400			
Karolina Badura	Sample Preparation Chemist and Metals Analyst	401-732-3400			
Ruth Smith	Sample Preparation Chemist	401-732-3400			
Joanna Sadlek	Metals Analyst	401-732-3400			

EPA-NE QAPP Worksheet #4 (continued) - Rev. 10/99

Project Personnel Sign-Off Sheet

Organization: Teledyne Brown Engineering – Environmental Services

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Rebecca Charles	Task Leader, Radionuclide Analysis	865-934-0379			
William Meyer	QA Manager	256-726-1234			
Pat Marshall	Sample Custodian	865-934- 0382			
Marty Webb	Production Manager	865-934-0375			
Lauren Larson	Gamma Spectroscopist	865-934-0390			

Organization: Applied Marine Sciences, Inc.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read	QAPP Acceptable as Written
Ken Davis	Geotechnical Task Leader; Sample Custodian	281-554-7272			
Mike Seymour	QC Manager	281-554-7272			
Amy Nichols	Analyst	281-554-7272			

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EPA-NE QAPP Worksheet #5a - Rev. 10/99

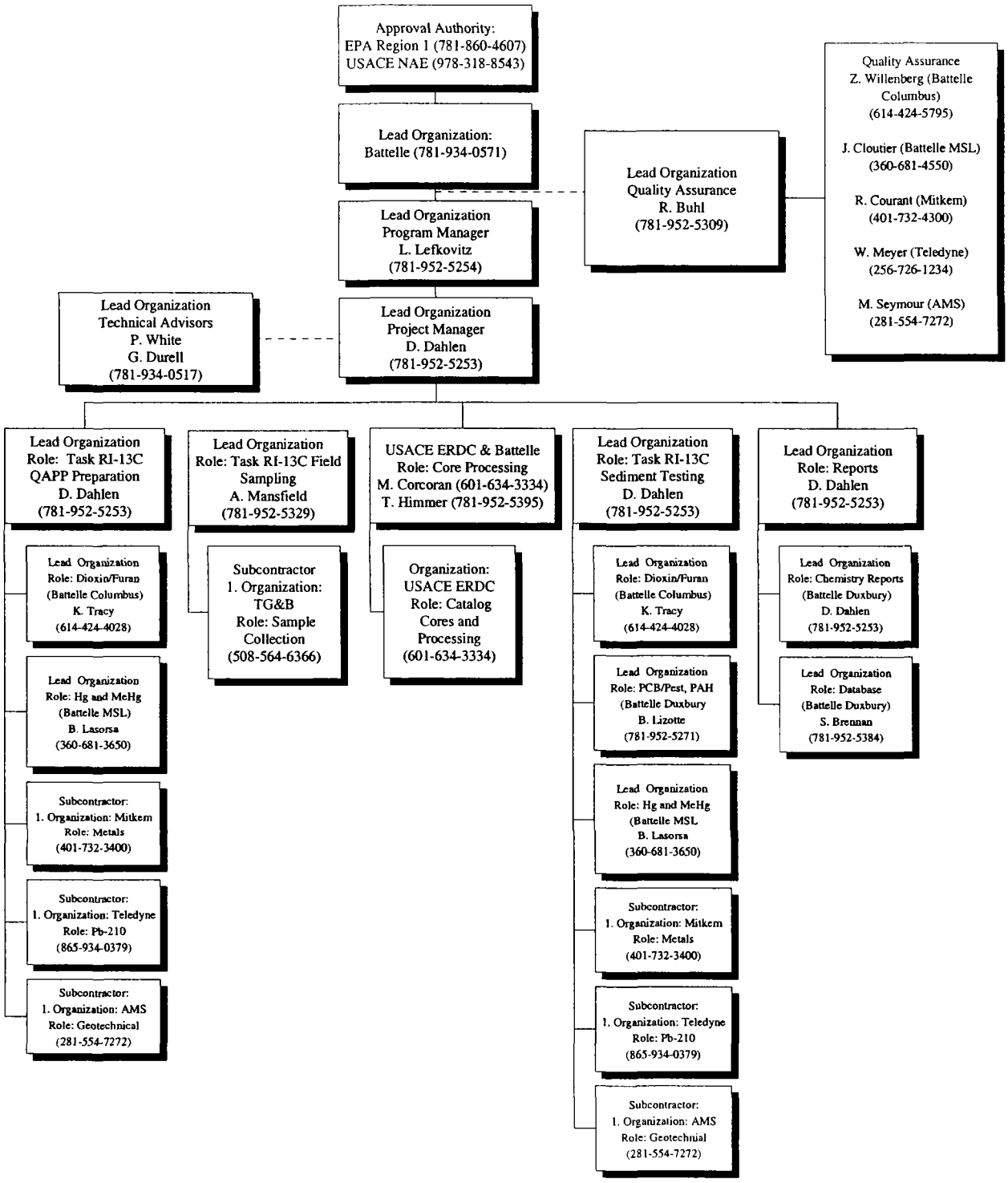


Figure 1. Project Organizational Chart.

EPA-NE QAPP Worksheet #5b - Rev. 10/99

Communication Pathways

Communication pathways will follow the project organization chart (Figure 1). Ms. Heather Sullivan is the USACE NAE Project Manager. Ms. Deirdre Dahlen is Battelle's Project Manager and is responsible for the technical oversight, overall quality and conduct of the project. Ms. Dahlen will be the primary contact with the USACE NAE Project Manager. Ms. Dahlen will ensure that the objectives of the project are met within budget and on schedule. Ms. Patty White will serve as the Remedial Investigation (RI)/Feasibility Study (FS) Task Manager. Task Managers/Leaders responsible for field sampling and analysis activities will report directly to Ms. Dahlen.

Ms. Rosanna Buhl will serve as Battelle's Program Quality Assurance (QA) Officer, and is responsible for identifying areas for corrective action, coordinating the QA activities such as systems and data audits, and preparing reports to management for this project. She will be assisted by the QA Officers/Managers at each of the participating laboratories.

As indicated in Figure 1, Task Leaders have been assigned for each of the major project tasks (*e.g.*, QAPP Preparation). The Task Leaders will serve as the point of contact and will direct task activities and monitor task performance to ensure adherence to technical standards, budget, and schedule. They also will be responsible for apprising Ms. Dahlen of progress and notifying her of any significant problems or delays.

The need for corrective action may be identified during analysis, during QA reviews, or during management reviews. EPA Worksheets #21 and #24a define the corrective action(s) options for quality control data and calibration exceedences. Corrective action implemented in response to QA audits is documented as part of the analyst's response to the audit. Battelle SOP 4-035 describes Battelle Duxbury's formal Corrective Action program. All internal corrective action is followed up by the QA Officer. Corrective action related to changes in scope, analytical techniques, or financial variances are formally communicated to Ms. Sullivan by Ms. Dahlen.

All communications will be conducted using electronic mail, phone, telefaxes, and/or reports.

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EPA-NE QAPP Worksheet #6 - Rev. 10/99

Personnel Responsibilities and Qualifications Table

Name (a)	Organizational Affiliation	Responsibilities	Location of Personnel Resumes, if not included	Education and Experience Qualifications
Deirdre Dahlen	Battelle Duxbury	Responsible for the technical oversight of field and sampling program, preparing QAPP Addendum, overall quality and conduct of the project for lead organization		Supplied with May 23, 2001 QAPP
Rosanna Buhl	Battelle Duxbury	Coordinates QA/QC activities performed for lead organization (Battelle Duxbury)		As above
Patty White	Battelle Duxbury	Oversee RI/FS		As above
Alex Mansfield	Battelle Duxbury	Responsible for managing field sampling program and preparing field project documents (e.g., FSP).		Attached
Theresa Himmer	Battelle Duxbury	Core processing		Attached
Jessica Fahey	Battelle Duxbury	Core processing		Attached
William Steinhauer	Battelle Duxbury	Manager of Organics Laboratory		Supplied with May 23, 2001 QAPP
Jeff Newell	Battelle Duxbury	Responsible for laboratory custody of samples	Not available[1]	Roxbury Latin School, 1988-1993; UMASS Boston, Environmental Science 1998-present Electrician Apprentice, 1996-1999; Battelle – 2003-present, (Sample Custodian since July 2003)
Jon Thorn	Battelle Duxbury	Oversee sample preparation and LIMS reporting		Supplied with May 23, 2001 QAPP
Bob Lizotte	Battelle Duxbury	Oversee analysis of environmental samples for Chlorinated Pesticide/PCB Aroclors; and preparation of data packages for internal review		Attached

EPA-NE QAPP Worksheet #6 - Rev. 10/99

Personnel Responsibilities and Qualifications Table

Name (a)	Organizational Affiliation	Responsibilities	Location of Personnel Resumes, if not included	Education and Experience Qualifications
Karen Tracy	Battelle Columbus	Responsible for assisting with QAPP preparation; overseeing technical conduct of dioxin/furan analyses: and prepare and validate final tables and submit data package(s) to QA for data audit		Supplied with May 23, 2001 QAPP
Zachary J. Willenberg	Battelle Columbus	Oversee QA/QC activities performed for Battelle Columbus; audit data		Documented with September 27, 2002 QAPP Addendum
Mary E. Schrock	Battelle Columbus	Dioxin Laboratory Manager		Supplied with May 23, 2001 QAPP
Henry Pham	Battelle Columbus	Responsible for sample preparation and laboratory custody of samples		As above
Mark Misita	Battelle Columbus	Responsible for sample preparation for dioxin/furan analyses; assist with analysis of the samples by HRGC/HRMS		As above
Susan Winnard	Battelle Columbus	Responsible for sample preparation for dioxin/furan HRMS analyses		As above
Wesley H. Baxter	Battelle Columbus	Responsible for sample preparation for dioxin/furan HRMS analyses		Documented with September 27, 2002 QAPP Addendum
Betsy Thompson	Battelle Columbus	Analyze environmental samples for dioxin/furan by HRGC/HRMS		Attached
Joseph E. Tabor	Battelle Columbus	Analyze environmental samples for dioxin/furan by HRGC/HRMS		Supplied with May 23, 2001 QAPP
Brenda Lasorsa	Battelle Marine Sciences Laboratory (MSL)	Responsible for assisting with QAPP preparation; overseeing technical conduct of Hg and MeHg analyses		Attached
Janet Cloutier	Battelle MSL	Oversee project QA/QC activities; audit technical systems and data		Attached
Carolynn Suslick	Battelle MSL	Responsible for laboratory custody of samples		Supplied with May 23, 2001 QAPP
Rebecca Wood	Battelle MSL	Prepare environmental samples for total mercury analysis		Attached
Jordana Wood	Battelle MSL	Analyze environmental samples for methyl mercury		Attached
Laurie Niewolny	Battelle MSL	Analyze environmental samples for methyl mercury		Attached
Mary Ann Deuth	Battelle MSL	Analyze environmental samples for total mercury		Attached

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EPA-NE QAPP Worksheet #6 - Rev. 10/99

Personnel Responsibilities and Qualifications Table

Name (a)	Organizational Affiliation	Responsibilities	Location of Personnel Resumes, if not included	Education and Experience Qualifications
Evan Philo	Mitkem Corporation	Responsible for assisting with QAPP preparation; overseeing technical conduct of metals analyses: and prepare final metals report		Attached
Reinier Courant	Mitkem Corporation	Responsible for quality assurance review of metals data		Attached
Shirley Ng	Mitkem Corporation	Responsible for sample receipt, login and custody		Attached
Karolina Badura	Mitkem Corporation	Analyze environmental samples for metals		Attached
Ruth Smith	Mitkem Corporation	Prepare environmental samples for metals analysis		Attached
Joanna Sadlek	Mitkem Corporation	Analyze environmental samples for metals		Attached
Rebecca Charles	Teledyne Brown Engineering Environmental Services (TBE-ES)	Project Manager Radionuclide Analysis	NA	Documented with April 2003 QAPP Addendum #2 (prepared by USEPA)
William Meyer	TBE-ES	QA Manager	NA	Attached
Pat Marshall	TBE-ES	Sample Custodian	NA	Documented with April 2003 QAPP Addendum #2 (prepared by USEPA)
Marty Webb	TBE-ES	Production Manager	NA	As above
Lauren Larson	TBE-ES	Gamma Spectroscopist	NA	As above
Ken Davis	Applied Marine Sciences	Responsible for technical oversight of geotechnical analyses and data reporting		Supplied with May 23, 2001 QAPP
Mike Seymour	Applied Marine Sciences	QC Manager		Attached
Amy Nichols	Applied Marine Sciences	Analyst		As above

(a) If the individual identified here is not available at the time of project commencement, then alternate staff – with comparable training – will perform project work.
[1] Resume not available. Education summarized in next column.

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EPA-NE QAPP Worksheet #8a - Rev. 10/99

Project Planning Meetings

EPA Regulation Program: RCRA FIFRA TSCA CERCLA DW CWA CAA (underline one)	**Site Name**: Centredale Manor
Program (Brownfields, NPDES, etc.): Superfund	**Site Location**: North Providence, Rhode Island
Project Date(s) of Sampling: September, 2004	**CERCLA Site/Spill Identifier No.**: 016P
Project Manager: Deirdre Dahlen	**Operable Unit**:
	Other Site Number/Code: 016P
	Phase: ERA SA/SI Pre-RI RI (phase I, etc.) FS RD RA post-RA (underline one)
	Other phase:

Date of Meeting: September 21, 2004
Meeting Location: A Technical Project Planning Meeting for the Centredale Manor Restoration Project was held at the Corps of Engineers New England District offices. Meeting attendees are listed below.

Name	Project Role	Affiliation	Phone #	e-Mail Address
Anna Krasko	RPM	EPA New England	617-918-1232	krasko.anna@epa.gov
Andy Beliveau	QA Chemist	EPA New England	617-918-8607	beliveau.andy@epa.gov
Michael Jasinski	Manager	EPA New England	617-918-1352	jasinski.mike@epa.gov
Cornell Rosiu	Work Assignment Manager	EPA	617-918-1345	rosiu.cornell@epa.gov
Chau Vu	HH Risk Assessor	EPA New England	617-918-1446	vu.chau@epa.gov
Laureen Borochaner	PM	USACE-NAE	978-318-8802	laureen.a.borochaner@usace.army.mil
Heather Sullivan	PM	USACE-NAE	978-318-8543	heather.l.sullivan@usace.army.mil
Mark Geib		USACE-NAE		
Beverly Lawrence	RI/FS Technical Lead	USACE-NAE	978-318-8512	beverly.e.lawrence@usace.army.mil
Mark Otis		USACE-NAE		
Rose Schmidt	Geologist	USACE-NAE	978-318-8345	rosemary.a.schmidt@usace.army.mil
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EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Purpose. A meeting for the Centredale Manor Restoration Project Superfund Site was held on September 21, 2004 at the USACE NAE offices in Concord, MA. The purpose of the meeting was to discuss conceptual remedial alternatives for contaminated media at the site. The process of developing alternatives for detailed evaluation in the Feasibility Study (FS) will be a collaborative effort between the agencies, potentially responsible parties (PRPs), and the public, thereby ensuring that all concerns are addressed wherever feasible. These minutes are a compilation of notes taken during the meeting by Battelle staff. Action items are summarized at the end of these minutes. A list of attendees is provided above.

After introductions and opening comments, Battelle presented an overview of the project that summarized the site history, actions taken at the site, investigations performed and next steps. Next, Battelle provided a presentation on the FS scoping approach, with examples of possible remedial alternatives for consideration at the site.

Meeting Minutes.

FS Scoping Approach
A presentation handout describing the four elements of the FS scoping approach was provided at the meeting. The FS will follow CERCLA guidance, and satisfy the guidelines in USEPA's *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites.* Major discussion points are summarized below.

1) **Refine the Conceptual Site Model** – the CSM will be refined throughout the FS, until there is sufficient certainty to make decisions regarding the preferred alternative(s). Contaminant sources and release mechanisms will be evaluated, and contaminated media, exposure routes and receptors identified.
    a. While some subsurface anomalies have been detected at the site, there is no clear evidence (from bore logs) that primary contaminant sources (e.g., buried drums) still remain at the site, at least in any large quantity.
    b. One possible ongoing secondary source of dioxin contamination to the Woonasquatucket River that may need to be controlled is the discharge of contaminated groundwater to the river adjacent to the Brook Village parking lot. The dioxin concentration in groundwater samples collected in this area decreased from 2001 to 2002, but still remained high compared to values measured in nearby wells. Findings indicate that the plume of groundwater contamination is not widespread; but appears to be localized within the area adjacent to the Brook Village parking lot. Additional sampling and analysis may be warranted to evaluate if the dioxin contamination is continuing to decline, and to verify whether dioxin is discharging to the river in PCE-contaminated groundwater.
    c. Secondary sources of contamination also include contaminated sediments. Release mechanisms can include erosion, resuspension, and downstream transport of contaminated sediments; and dioxin flux from the sediment bed under non-resuspending conditions. An initial dioxin mass balance (Sediment Stability Study Draft Technical Memorandum, August 2004) showed no net downstream (of Lyman Mill Dam) transport of dioxin under non-resuspending conditions. Additional data collection is planned to verify the initial assessment.

       A hydrodynamic model has been developed for Allendale and Lyman Mill Ponds (Sediment Stability Study Technical Memorandum, August 2004). The model was used to predict areas of potential scour (order of magnitude estimates) in a 100-yr flood for Allendale and Lyman Mill Ponds. Areas of potential scour are much greater for Lyman Mill Pond.

       The last 100-year flood (~1,600 cfs flow) was reported in 1998, and most major flood events have occurred since 1970. There have been no major floods since the reconstruction of Allendale Dam.

EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Minutes (cont).

Additional data collections (e.g., site-specific data on sediment strength) are planned to refine the hydrodynamic model and reduce uncertainties associated with the model results. This will not be complete in time for the draft Remedial Investigation (RI) report. Instead, these data will be incorporated into the FS.

The hydrodynamic model will not predict sediment deposition, although it can be used to qualitatively identify areas of likely deposition. A more complex sediment transport model would be needed to predict areas of sediment deposition.

d. Horizontal and Vertical Extent of Contamination – Data collected between 1999 and 2003 have been used to assess the horizontal extent of contamination in Allendale and Lyman Mill Ponds. Data collected in May 2003, which targeted depositional areas, have been used to assess the vertical extent of contamination in both ponds.

Allendale Pond – the majority of surface sediment (0-1 ft) is contaminated with dioxin at levels above background (i.e., average concentration of approximately 30 ppt measured at Greystone Mill Pond). Sediment core data show that dioxin contamination is generally above background levels in the upper 1½ ft.

Lyman Mill Pond – There are far less data available for Lyman Mill Pond (compared to Allendale Pond), and data can not be contoured as a result. The lack of sufficient sample density at Lyman Mill is a probable data gap. Among the areas sampled in Lyman Mill Pond, most surface sediments (0-1 ft) contain dioxin at levels above background. Limited sediment core data suggest that dioxin contamination in Lyman Mill Pond extends slightly deeper (~ 2 ft) compared to Allendale Pond. Sediment cores collected at Lyman Mill Pond contained a gelatinous, highly organic material in the upper 2 ft (and sometimes deeper). USACE ERDC has prepared a map showing the distribution and thickness of this gelatinous layer.

Additional discussion points included:

- Presentation of the contaminant data. For example, should 2,3,7,8-TCDD data be presented as opposed to dioxin TEQ? Additionally, the dioxin contaminant maps need to clearly distinguish how the concentrations in each pond compare to background levels. Also, preparation of a HCX distribution map will be considered as HCX may be a tracer directly related to historical site activities.
- Pre- and post-dam breach sediment data should be compared, although there are far less post-breach data available. The FS should emphasize that the Allendale Dam was first breached in 1991, and therefore data from the 1999-2003 investigations can all be considered "post-breach" data.
- Sediment contaminant maps presented in the FS will be refined based on additional data collection and evaluation (e.g., oxbow area contaminant data, geomorphology of sediment bed).

e. Exposure routes and receptors – the baseline human health risk assessment (BHHRA; completed August 2004) shows that the primary exposure pathway driving risk is fish consumption. The draft baseline ecological risk assessment (BERA) showed that the primary exposure pathway to ecological receptors is bioaccumulation and consumption of contaminated prey. Further, risk to aquatic life is primarily associated with depositional areas of the pond, indicating that the depositional areas should be the focus of future cleanup.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Minutes (cont).

2) **Define the risk management goals** – are defined in terms of Remedial Action Objectives (RAOs) and Preliminary Remediation Goals (PRGs). RAOs are descriptive statements regarding what we hope to achieve for the site. Example RAOs are summarized in the meeting handout. PRGs are based on a food chain risk, i.e., safe sediment concentrations (back calculated) that will reduce contaminant levels in fish to an acceptable level. Draft human health PRGs have been derived (July 2004), and preliminary results indicate that human health PRGs for sediment are likely to be below upstream background concentrations. Derivation of ecological PRGs for sediment is planned. The draft PRG report is scheduled for November 2004. Cleanup levels will be formulated using PRGs as a starting point and taking into consideration site-specific modifying factors such as technical feasibility. PRGs and cleanup levels will be documented in the FS.

   Group discussions focused on the procedure for establishing PRGs for source area soils (EPA to send letter to RIDEM outlining request). Additional clarification is required regarding which parts of the aquifer are classified by RIDEM as GB vs. GA.

3) **Identify and screen risk management alternatives** – guiding principals for identifying and screening alternatives are summarized in the meeting handout. The focus will be on risk management, with the overall goal of removing contaminants from the food chain. A combination of approaches is commonly used for effective risk management, and a phased approach will be considered. A phased approach will allow for the opportunity to determine if the system is responding as expected following cleanup.
   a. Institutional controls (IC) – not likely to be screened out unless an IC is recognized to be ineffective.
   b. Dredging – not likely to be screened out
   c. In-situ capping – not likely to be screened out, although there are concerns with flood storage capacity. In-situ capping needs to be below water level, and care should be taken to minimize raising the elevation of shallow area.
   d. Monitoring natural recovery – not likely to be screened out, although a natural recovery trend has not yet been observed at this site (secondary source control measures in the form of interim soil caps have been in place for less than 5 years).

   Group discussions focused on the need to research who owns the dams and ponds; this task should be completed prior to identifying alternatives. Further, the condition of the dams should be investigated and documented.

4) **Fill data gaps** – identified data gaps need to be filled prior to developing remedial alternative(s). Possible data gaps discussed by the group include:
   a. Innovative methods (i.e., SPMDs or polyethylene disks) could be used to determine whether dioxin is being discharged to the river in groundwater in the vicinity of the Brook Village Parking lot. If dioxin does not appear to be entering the river at this point, then additional secondary source control measures may not be required. Another groundwater sample also could be collected from Well MW-05S to verify the decreasing trend in dioxin concentration. If additional source control in this area appears warranted, then additional soil boring data may be required to better define the extent.
   b. Additional surface water sample data collected under non-resuspending conditions may be required to supplement the initial assessment of dioxin mass balance for Allendale and Lyman Mill Ponds.
   c. Additional site-specific data will be collected to reduce uncertainties associated with the hydrodynamic model (site-specific erosion properties for sediment, sediment bed type, stage height and current velocity data).
   d. Additional sample data are required to better define the horizontal and vertical extent of contamination at Lyman Mill Pond (and possibly areas downstream). (USACE ERDC suggests collecting deeper cores at Lyman Mill Pond compared to cores taken during May 2003 investigation).
   e. Research ownership of dams and ponds.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Minutes (cont).

f. Research condition of the dams.

Following the discussion of the FS Scoping Approach, a handout summarizing possible remedial alternatives for 1) source area soils, 2) source area groundwater, and 3) river/pond sediments was provided to the group to facilitate discussions.

Possible Remedial Alternatives – Source Area Soils, Groundwater, and River/Pond Sediments
It is assumed that the FS will adopt a phased approach, with the source area, Allendale Pond, and Lyman Mill Pond addressed initially. Areas downstream of Lyman Mill Dam will be addressed in a later phase. Possible remedial alternatives were listed in a table, with an initial assessment of the feasibility of each alternative, advantages, disadvantages, technical approach for evaluation, and potential data gaps. The most significant discussion points for each medium are summarized below.

1) **Source Area Soils**
   a. "No action" is not listed in the table but will be included in the FS.
   b. Convert interim soil caps and parking lots to permanent caps – If interim caps #1 and #2 are converted to permanent caps, then the caps will need to be augmented to be protective. There is some concern about the current state of the caps (i.e., geotextile), and engineering requirements for permanent caps need to be established (e.g. 2 ft of cover with geotextile underlay). This presumes that leaching is not a significant concern. The source area soil technical memorandum (July 2004) indicates that leaching to groundwater is not significant, except at Well MW-05S (in the Brook Village parking lot).

      An initial evaluation of the integrity of the caps has been performed, and some deficiencies were found. The evaluation also assessed what would need to be done to make the caps permanent. Sufficient information is available to cost out this alternative.

      The tailrace cap (Cap #3) was designed to be protective and should not need to be augmented.

   c. Excavation – highest contaminant concentrations are in surface soils and contamination is fairly widespread; concentrations > 1 ppb dioxin TEQ were also measured in areas under the parking lots. Excavation would present short-term health risks and residents would likely need to be relocated temporarily. Excavation is risky in that additional sources of waste (e.g., buried drums) may be discovered during excavation. The excavation alternative should be screened out early in the process, as opposed to carrying it through the detailed FS evaluation.

Additional discussion points included:

- There are some very small areas in the source area that are not covered, either by parking lots or caps. These areas are too small in extent to pose a health risk.
- Locations of all active utilities need to be identified and documented. Depending on location, water lines could be encased so as to guarantee no exposure to contaminants. Brook Village and Centredale Manor management should be contacted to assess their capacity to maintain and manage institutional controls.
- Potential vapor intrusion into the buildings needs to be addressed. EPA believes this was discussed in the BHHRA, although risk was not calculated. Indoor air samples have been collected.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Minutes (cont).

2) **Source Area Groundwater**
   a. "No action" is a possible remedial alternative, with follow-up monitoring.
   b. Remove source in the event that we confirm that dioxin is entering the river at this point – excavate area with NAPL, as this is assumed to be the mechanism by which dioxin is mobilized. Potential data gap – may need soil borings to define the extent of the source of contamination in vicinity of MW-05S.
   c. Hydraulic barrier – potentially effective in restricting contaminant migration into the river, but does not remove the source of contaminants.
   d. In-situ – potential in situ treatment technologies should be included in the screening process.

3) **Pond and River Sediment** – One important question is whether the dams will remain in place as part of the remedy, or be modified and/or removed. Some parties are in favor of controlled dam removal and returning the river to circa 1700's conditions. This would result in a loss of flood storage, however, and additional data are needed to better understand how the hydrodynamic system would change and how sediments behind the dams would be remobilized. Also, would only Allendale and Lyman Mill Dams be removed, or would all dams located further downstream also be removed? The public prefers that the dams stay in place; however, the dams need work to be part of a remedy. Also, institutional controls would be needed to ensure that the dams are maintained properly, and at present there is no enforcement program in Rhode Island to direct owners to maintain the dams. The same set of possible remedial alternatives is applicable; however, the design would vary depending upon whether the dam stay in place or not. The preferred alternative may also include a contingency remedy that could be implemented at a later date, should the dams be removed.

   Possible remedial alternatives for pond and river sediment are summarized in the meeting handout and include:

   a. Monitored Natural Recovery (MNR) – this alternative is reliant on contaminated sediment being buried by cleaner sediment. This alternative is frequently used in combination with other approaches. Site conditions at Centredale may not correspond with generally accepted conditions needed for MNR. Further, the interim protective caps have only been in place for a couple of years and sufficient time has not elapsed to demonstrate that MNR is occurring at the site.
   b. In-situ – currently there are no field-demonstrated in-situ treatment technologies for dioxin contaminated sediments.
   c. Thin-layer capping – could be used in conjunction with partial removal
   d. Isolation (thick-layer) capping. Many innovative technologies are available (SITE program fact sheet is available).
   e. Removal by dry excavation or dredging – water levels would need to be lowered for dry excavation. The sluice gates at Lyman Mill are not operable, but Allendale Dam may be used to lower water levels in both ponds. Dry excavation is preferable in the fall to control odors – narrow construction window. Targeted removal is less ecologically destructive compared to complete removal. Alternatively, dredging to remove the top 1-ft of contaminated sediment everywhere would eliminate majority of contamination at the site. Thin layer capping could be used to minimize residuals. Hot spot removal is also an option.
   f. Removal and onsite upland confinement – this is not a preferred alternative given that onsite capacity may be insufficient. More important, placing contaminated sediments over the existing interim caps is not sensitive to the public's concerns. Should the caps be extended into the river channel, then this alternative would warrant further consideration.
   g. Removal and onsite nearshore confinement – As with upland confinement, there are limited areas for nearshore confinement. The oxbow area (also referred to as forested wetland) is not preferred as a confinement area, as it is a wetland with future recreation use. Also, the oxbow area is located within the floodplain. Effects on river bed morphology must be taken into account.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Minutes (cont).

h. Removal and onsite confinement in one or more CAD cells – Excavate to remove clean sediment and bury contaminated sediment; lower cost alternative. However, may have to do exploratory borings to confirm depth of bedrock.
i. Removal and offsite hazardous waste landfill disposal – removal costs should be evaluated assuming disposal as F-listed waste
j. Removal and offsite incineration – as above
k. Combination alternative – Given the lack of onsite capacity for confinement, a combination alternative (e.g., capping and dredging) is likely to be more feasible. Will need institutional controls to prevent future dredging. Also need fishing advisories until it can be demonstrated that sediment and tissue concentrations have decreased to acceptable levels.

Additional discussion points included:

- Both ponds will be evaluated, but risk management approach may not be the same;
- Will also need an alternative for the oxbow area;
- Urban runoff is a source of PAH contamination to the area, but this is not site-related;
- Should decide how many alternatives will be carried through detailed FS evaluation. Combination alternatives can be carried through the FS.
- A second screening to narrow down alternatives is likely;
- Physical characteristics of the ponds will control what approaches can be implemented and where; and
- USACE ERDC should remain involved to assess changes to the river channel characteristics.

The team agreed that additional data collection to fill identified data gaps was needed to support the FS. A Work Plan will be prepared to address these data gaps.

Action Items

A list of identified action items is provided below. There was no formal discussion regarding which organizations would be responsible for each of the identified action items. As a result, the list below represents a preliminary assignment of action items.

USACE

- Research ownership of the Allendale and Lyman Mill Ponds, and associated dams;
- Document condition of the Allendale and Lyman Mill Dams;
- Research layout at site of utility lines;
- Coordinate with Battelle to fill identified data gaps
  a. Collect additional data from the river near Well MW-05S to confirm whether dioxin is discharging to the river; collect a groundwater sample from Well MW-05S to confirm whether dioxin concentrations in groundwater are continuing to decline;
  b. Collect additional surface water data under non-resuspending conditions to verify initial dioxin mass balance in the river;
  c. Collect site-specific data to reduce uncertainties associated with the hydrodynamic model (sediment erosion properties, sediment bed type, stage height, and current velocities); and
  d. Collect sediment sample data at Lyman Mill Pond to better define the horizontal and vertical extent of contamination; RIDEM requested that additional data collections also be considered Manton Pond.

RIDEM

- Clarify which parts of the aquifer at the site are classified as GB vs. GA.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #8a - Rev. 10/99 (continued)
Project Planning Meetings

Meeting Minutes (cont).

USEPA

- Assess capacity for Brook Village and Centredale management to maintain and manage ICs
- Confirm that vapor intrusion into the buildings in not a concern, and whether buildings have basements; and
- Send a letter to RIDEM regarding ARARs for source area soils

Battelle

- Coordinate with USACE to fill identified data gaps (see above);
- Recommend sampling design for Lyman Mill Pond; and consider what samples should be tested for (e.g., dioxin only, or full suite of contaminants); and
- Compare pre- and post-dam breach sediment data for Allendale and Lyman Mill Ponds.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #8b - Rev. 10/99

Problem Definition/Site History and Background

Site History and Background[3]

The Centredale Manor Site is a multi-unit apartment complex that houses elderly and handicapped adults. It is located at 2074 Smith Street (Route 44) in Centredale, a village of North Providence, Rhode Island. The Centredale Manor apartment building and adjacent apartment building known as "Brook Village," are located on the site of the former Metro-Atlantic Chemical Corporation, which operated from the 1940s to the 1970s in a former mill complex on the site. The Woonasquatucket River follows the west boundary of the site. The remains of a raceway for the former mill complex are present on the eastern boundary of the site.

Historical records of Metro Atlantic Chemical researched by Weston (March 1999) indicate that the site manufactured hexachlorophene and that there were shipments of trichlorophenols to the site. The mill complex was destroyed by fire in the late 1970's and the apartment buildings were constructed in 1982. During construction of the apartment buildings 400 drums and 6,000 cubic yards of contaminated soil were removed from the site. Labels indicated that the drums contained caustics, halogenated solvents, PCBs, and inks.

A study conducted in June 1996 by the EPA Narragansett Laboratories and the Providence Urban Initiative Program (EPA, 1996) determined that elevated levels of dioxin were present in fish collected from the River. A subsequent study of the Woonasquatucket River conducted by the USEPA OEME in June 1998 found elevated concentrations of dioxin and polychlorinated biphenyls (PCBs) in sediments in portions of the river and impoundments adjacent to the downstream of Centredale Manor (EPA, July 1998). Soil and sediment sampling conducted by EPA START personnel in September 1998 found dioxin at concentrations up to 10.1 ppb in sediments collected directly behind the Allendale dam that had a water depth of at least six feet (Weston, March 1999). Allendale Pond was an impoundment located immediately downstream of the Centredale Manor Site. The impoundments dam breached in 1991 exposing the sediments. Further sampling conducted in February 1999 on the Centredale Manor property also found elevated concentrations of dioxin in soils and sediment. Additional historical information on the Centredale Manor Site is available in the Expanded Site Inspection Report, prepared by Weston (March, 1999).

Contaminants of concern include dioxin, 1,2,4,5,7,8-hexachloroxanthene (HCX), 2,3,6,7-tetrachloroxanthene (TCX) and PCBs.

QAPP Addendum 3

This QAPP Addendum 3 is based on Battelle Centredale Manor Tasks 19-22 QAPP – Addendum (09/27/02) and USEPA QAPP Addendum 2 (04/28/03). All QAPP elements for this project are detailed in this document.

[3] Site history and background taken verbatim from the *Sampling and Analysis Plan Woonasquatucket River Sediment Investigation, Centredale Manor Site North Providence, Rhode Island* (Tetra Tech, 1999). Note – references cited in Tetra Tech SAP not available.

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EPA-NE QAPP Worksheet #8b – Rev. 10/99 (cont)

Problem Definition/Site History and Background

General Objectives

The purpose of this study is to collect sediment samples from selected locations in Lyman Mill Pond (Figure 2). Samples will be analyzed for parameters identified in EPA-NE QAPP Worksheet #9a to support the Remedial Investigation (RI)/Feasibility Study (FS). The objective is to determine the nature and extent of contamination of the pond sediments by locating the layer of sediment corresponding to the time when the largest amounts of dioxin entered the river. An additional objective is to determine which layers of sediment do not contain significant amounts of dioxin. The information will also be used to determine which layers need to be removed, if necessary, and what are the physical characteristics of the layers to be removed.

The project will consist of sampling in the Lyman Mill Pond. Samples will be collected from various depth intervals, and sub-sets of samples will be analyzed for for dioxin/furan, PCB Aroclor, chlorinated pesticides, polycyclic aromatic hydrocarbons (PAH), metals (including Hg), methyl mercury, Pb-210, grain size distribution, Atterberg Limits, percent solids and water content.

Data Quality Objectives

The Overall DQO for this project is to generate data of sufficient quality to define where the dioxin contamination is located in sediments laterally and vertically so that decisions can be made about the remedial alternatives that would be undertaken in the clean up of the site.

Data Quality Objectives (DQOs) for sediment core collection in Lyman Mill Pond are based based on EPA's seven step DQO process (*Guidance for the Data Quality Objectives Process*. EPA QA G-4. EPA/600/R-96/055. August 2000), as follows:

STEP 1: State the Problem

Sediment chemistry data were collected from Lyman Mill Pond from 1998 to 2003; however, the existing data are inadequate for delineating the horizontal and vertical extent of dioxin contamination with sufficient resolution for developing remedial alternatives for consideration in the Feasibility Study (FS). In addition, the spatial distribution of other contaminants of concern (COCs) in Lyman Mill Pond surface sediments is unknown. Additional data are needed to better define the horizontal distribution of dioxin in surface sediments so that the pond can be subdivided (stratified) as appropriate based on level of contamination. The vertical extent of dioxin contamination must be better defined to provide more reliable estimates of sediment volume to be addressed in the FS, and support the development of remedial alternatives. Because the pond sediments appear to be relatively stable, the existing data will be combined with newly-collected data to provide an overall interpretation of contaminant distribution in the pond. Important aspects of the conceptual site model (CSM) for Lyman Mill Pond that influence the proposed data collection effort are as follows:

- Dioxin concentrations in surface sediments throughout Lyman Mill Pond exceed upstream reference concentrations. Dioxin is more widespread and present at higher concentrations relative to reference than other COCs in Lyman Mill Pond.
- The vertical extent of dioxin contamination based on existing data appears to be approximately 2 ft below mudline, although it appears to be shallower in some areas.
- Dioxin concentrations are relatively low in coarse-grained sediments (i.e., sand and gravel).
- It is expected that preliminary remediation goals (PRGs) for sediment will not be organic carbon normalized; instead, they will be developed to apply to a range of TOC values. Existing TOC data are considered to be sufficiently representative of all Lyman Mill Pond sediment of a similar sediment type.

EPA-NE QAPP Worksheet #8b – Rev. 10/99 (cont)

Problem Definition/Site History and Background

STEP 1: State the Problem (cont)

Radioisotope data for Allendale Pond sediment cores were used to establish the 1940 time horizon (below which site-related contamination does not appear to occur). A similar approach potentially can be applied to Lyman Mill Pond. Radioisotope profiles were obtained from one May 2003 sediment core from Lyman Mill Pond; additional cores will verify the results from the initial core. Data for geotechnical parameters will also be collected to support remedial design. The CSM for the CMRP site, including a description of the sources of contamination, release mechanisms, and transport pathways is provided in the draft Remedial Investigation (RI) report (Battelle, 2004).

STEP 2: Identify the Decision

The primary purpose of the data collected in this study is to characterize Lyman Mill Pond using a series of estimates rather than to make decisions. These estimates will answer the following questions:

1. What is the horizontal distribution of dioxin in Lyman Mill Pond surface sediments, and how do the concentrations compare to the PRGs?
2. What is the vertical extent of dioxin contamination in various areas of the pond?
3. What is the horizontal distribution of other COCs in Lyman Mill Pond surface sediments?
4. What is the net sediment accumulation rate in the pond?
5. What are the grain size distribution, Atterberg Limits, and percent solid characteristics of various sediment types?

STEP 3: Identify Inputs to the Decision

1. Existing and proposed data on the horizontal and vertical distribution of dioxin and other COCs in sediment.
2. Sediment accumulation rate based on radioisotope data (^{210}Pb).
3. Information on sediment type, stratigraphy, and geotechnical parameters to support remedial design.
4. PRGs.

STEP 4: Define the Study Boundaries

The study area is bounded by Lyman Mill Dam on the south, the banks of the pond on the east and west, and the forested wetland and inlet channel to the pond on the north. The vertical limit of the study area (i.e., coring depth) is 4 ft, which is expected to be well below the level of site-related contamination. The temporal boundaries of the study are 1998-2005 because the newly-acquired data will be combined with existing data to create composite maps of contaminant distribution.

STEP 5: Develop a Decision Rule

Because no decisions will be made per se, there are no decisions rules. Rather, as noted in Step 2, several sets of estimates will be made. These estimates are as follows:

1. Horizontal Distribution of Dioxin: The horizontal distribution of dioxin within the boundaries of Lyman Pond will be estimated using contour plots. The contour plots will be based on a combination of new and existing data. One contour plot will be drawn for each depth at which samples are collected or analyzed. The dioxin levels shown in these contour plots will be compared to PRGs (which are in the process of development) to determine where and to what degree PRGs are exceeded. In addition to the contour plots, the precision of the concentration estimates shown in the contour plots will be estimated. Dioxin concentration contours and precision estimates will be obtained using kriging methods.
2. Vertical Extent of Dioxin: The contour plots for horizontal dioxin distribution will also be used to evaluate the vertical extent of dioxin across Lyman Mill Pond.
3. Horizontal Distribution of Other COCs: The horizontal distributions of other COCs within the boundaries of Lyman Pond will be presented graphically as bubble plots (data density is not expected to be sufficient for contouring). Confidence intervals for concentrations of other COCs will not be determined.
4. Sediment Accumulation Rate: The sediment accumulation rate will be estimated using the radioisotope data collected. The estimates will include confidence intervals developed using the methods described in the Final Sediment Stability Technical Memorandum (QEA, 2004).
5. Geotechnical Parameters: The grain size distribution, Atterberg Limits, and percent solid characteristics of the various sediment types will be estimated using appropriate data collected. No confidence intervals for these parameters will be obtained.

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EPA-NE QAPP Worksheet #8b – Rev. 10/99 (cont)

Problem Definition/Site History and Background

STEP 6: Evaluate Decision Errors

As described above, several estimates will be obtained from this study, along with related estimates of precision or confidence intervals (i.e., estimates of uncertainty) for dioxin concentration and sediment accumulation rate. The level of uncertainty is related to the number of observations that are collected, with smaller confidence intervals and greater precision being obtained when a larger number of samples are collected. The uncertainty estimates also depend on the underlying variability in the data. In general, characterization studies are designed so that the width of the confidence intervals or the precision of the estimates meet given constraints, which requires a combination of minimizing the errors and collecting a large enough number of samples. For this study, the number of samples to be analyzed was determined based on available resources. Therefore, precision estimates will be obtained for each of the dioxin contour plots, and confidence intervals will be obtained for sediment accumulation rate. Uncertainty estimates will not be obtained for concentrations of other COCs or geotechnical parameters (grain size distribution, Atterberg Limits, or percent solids).

STEP 7: Optimize the Design for Obtaining Data

Sediment Chemistry Cores

A systematic sampling approach, with minor judgment-based modifications, was used to determine sampling locations. Sample locations were selected to provide approximately equally-spaced coverage throughout the pond in areas where no data are available. Systematic, equally-spaced sampling assures complete coverage of the pond area, and will provide optimal data for determining the precision associated with the contour maps. The judgment-based modifications noted below were taken into account when selecting proposed core locations:

- Where possible, archived samples from the May 2003 sediment coring effort were selected for analysis.
  - Core LPX-SD-4204 will provide data on the vertical extent of dioxin in the south-central part of the pond, in the vicinity of the sample "Lymansville Dam."
  - Core LPX-SD-4205 will provide data on the east side of the channel in an area where no previous data are available.
  - Core LPX-SD-4209 has existing data for surface and mid-depth sample intervals, but no data for depths of greater than 2 ft are available in this part of the pond. Therefore, a deeper archive sample (2.4-2.5 ft) from this core will be analyzed.
- Areas where the soft sediment thickness appears to be less than approximately 2 ft based on the 2002 geophysical survey were avoided.

If the field crew is unable to access a particular core location, then the core should be collected as close to the proposed location as possible in order to maintain approximately equally-spaced data points for contaminant concentration mapping.

Three samples will be collected for dioxin/furan analysis from each of ten new core locations: one surface sample (0-0.5 ft), one mid-depth sample (approximately 1.2-1.3 ft below the surface), and one deep sample that is expected to be below the level of site-related contamination (approximately 2.4-2.5 ft below the mudline). One archive sample will be collected from deeper in the core (3.0 – 3.5 ft) in the event that the deep sample from any core shows evidence of dioxin contamination. The surface sample from each of the ten cores will also be analyzed for other COCs (PCBs, pesticides, PAHs, metals). Proposed sample locations are shown in Figure 2, and a sample summary is provided in Table 1. In addition, archived samples from three cores collected in May 2003 also will be analyzed as shown in Table 1.

Radioisotope Cores

Five cores will be collected for ^{210}Pb (Table 1); three to five cores will be analyzed for ^{210}Pb, with sufficient number of subsamples to determine a vertical profile. The sample intervals will be selected by the project geologist based on the CSM and stratigraphy observed in the cores. Sediment accumulation rates and associated confidence intervals will be developed following the methods described in the final Sediment Stability Technical Memorandum (QEA, 2004).

EPA-NE QAPP Worksheet #8b – Rev. 10/99 (cont)

Problem Definition/Site History and Background

STEP 7: Optimize the Design for Obtaining Data (cont)

Geotechnical Analysis
Five samples will undergo analysis of grain size and Atterberg Limits, and fifteen samples will be tested for percent solids/water content. Samples for potential geotechnical analysis will be collected from the surface and mid-depth intervals from each sediment core, and the samples to be submitted to the laboratories will be selected after all cores have been processed to ensure that all sediment types are represented.

Table 1. Sample Summary for Sediment Core Collection in Lyman Mill Pond

Station ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals	Radioisotopes	Archive
New Stations [(a)]					
LPX-SD-4501	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4502	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4503	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4504	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4505	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4506	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4507	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4508	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X

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EPA-NE QAPP Worksheet #8b – Rev. 10/99 (cont)

Problem Definition/Site History and Background

Table 1. (cont)

Station ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals	Radioisotopes	Archive
New Stations [(a)]					
LPX-SD-4509	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4510	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
May 2003 Stations (archived samples)					
LPX-SD-4204	0.0 – 0.1	X	Combined 0.0 –	-	-
	1.1 – 1.2	X	0.1 and 0.3 –		
	2.35 – 2.45	X	0.4 ft samples		
LPX-SD-4205	0.0 – 0.1	X	Combined 0.0 –	-	-
	1.3 – 1.4	X	0.1 and 0.4 –		
	2.4 – 2.5	X	0.5 ft samples		
LPX-SD-4209	2.4 – 2.5	X	-	-	-

(a) Samples for potential geotechnical analysis will be collected from the surface and mid-depth intervals from every core and selected for analysis after all core processing is complete.

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EPA-NE QAPP Worksheet #8b – Rev. 10/99 (cont)

Problem Definition/Site History and Background

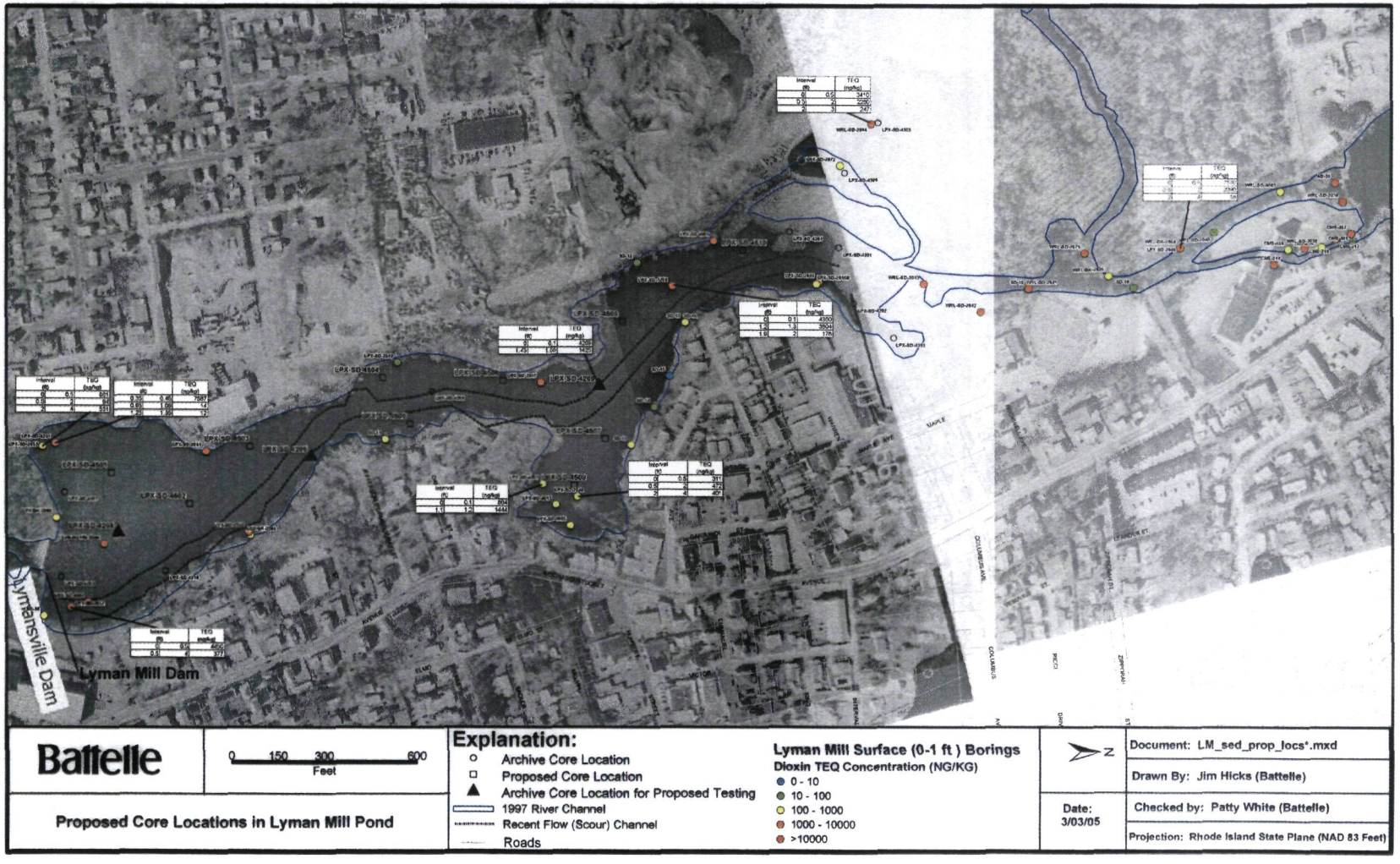


Figure 2. Lyman Mill Pond Boring Locations. (provided as 11by17 map in Field Sampling Plan)

EPA-NE QAPP Worksheet #9a - Rev. 10/99

Project Description and Schedule

Sampling Tasks:
Samples will be collected from a Dioxin superfund site. ***Unused sample*** *will be disposed of as dioxin-bearing, non F-027 waste.*

Field sampling activities, including sampling locations and collection techniques, are discussed in detail in the Field Sampling Plan (Battelle, 2005[1]); a general overview of sampling activities is also described in EPA-NE QAPP Worksheet #12a. Briefly, sediment core samples from multiple sampling locations located in Lyman Mill Pon (Figure 2), will be collected for physical and chemical testing (Tables 1 and 2). Additional details regarding sample collection are provided in EPA-NE QAPP Worksheets #9c and #12b.

Table 2. Sampling Locations, Numbers of Samples, Required Analytical Parameters, and Performing Laboratories

Sample Matrix	Sampling Locations	Total Number of Study Samples (a)	Analysis Parameters	Performing Laboratory
Lyman Mill Pond Sediment Cores	Approximately 15	37 (3/core * 10 cores; plus 7 archive (b))	Dioxin/Furan and Percent Moisture	Battelle Columbus
		12 (1/core * 10 cores; plus 2 archive (b))	PCB Aroclor, Pesticides, PAH and Percent Moisture	Battelle Duxbury
		12 (1/core * 10 cores; plus 2 archive (b))	Hg, MeHg and Percent Moisture	Battelle Sequim
		12 (1/core * 10 cores; plus 2 archive (b))	Metals (c) and Percent Moisture	Mitkem Corporation
		30 (d) (~10/core * 3 cores)	Pb-210 and Percent Moisture	Teledyne Brown
		15	Geotechnical (e)	Applied Marine Sciences, Inc.
		~10	Archive (f)	Battelle Duxbury

(a) Additional samples may be collected; sample numbers referenced indicate the number of samples authorized for sample analysis.
(b) Selected archive samples from May 2003 investigation; see EPA-NE QAPP Worksheet 9c.
(c) Target metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc.
(d) Five cores will be collected; three to five cores will be analyzed for ^{210}Pb, with sufficient number of subsamples to determine a vertical profile. Total number of analyses authorized is 30 samples.
(e) Analyses may vary by sample, but will generally include 15 samples for percent solids and water content and 5 samples for grain size distribtution and Atterberg Limits.
(f) One archive sample will be collected from deeper in the core (3.0 – 3.5 ft) in the event that the deep sample from any core shows evidence of dioxin contamination.

Sample Storage and Holding Times for Chemical Analyses:
All samples will be shipped by overnight carrier on ice from the field to participating laboratories. Upon arrival at the laboratory, samples will be logged into laboratory's sample tracking system and the laboratory will maintain possession of the original sample custody logs that accompany the samples. Samples will be prepared for physical and chemical testing within specified holding times (Table 3).

[1] Battelle 2005. Field Sampling Plan, Centredale Manor Restoration Project Superfund Site, Task RI-13 Lyman Mill Pond Sediment Investigation. January.

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Table 3. Sample Type, Storage and Holding Time Requirements for Chemical Parameters

Sample Type	Field Storage Conditions	Laboratory Storage Conditions	Holding Times
Sediment	Cold (<6 °C)	Frozen (at, or below, –20 °C)	Dioxins/Furans: 1 year
			PCB, Pesticide, PAH: 1 year (a) (40 days for extracts)
			Hg and MeHg: 28 d (60-d for digestate)
		Refrigerated (at approximately 4±2 °C)	Metals: 6-mo (60-d for digestate)
			Geotechnical: 28 d
		Ambient	^{210}Pb: not determined

(a) EPA, 1992. EMAP Estuaries 1992 Virginian Province Quality Assurance Project Plan.

Sample Disposition – As noted above, samples will be collected from a Dioxin superfund site and unused sample will be disposed as dioxin-bearing, non-F027 waste.

Core Processing Tasks:
Sediment cores will be transported from the field to the U.S. EPA AED laboratory in Narragansett, Rhode Island, where cores will be processed and sub-samples collected for radioisotope, chemical and geotechnical testing. Details regarding core processing are described in *Draft Coring Methodology* (U.S. EPA ERT/REAC, 2003), as modified by Battelle (see Attachment K, SOP S-19).

Sediment Analysis Tasks:
Sediment core samples will be tested for dioxin/furans, PCB Aroclors, chlorinated pesticides, PAH, metals, Hg, MeHg, Pb-210 activity, geotechnical parameters and moisture content (Tables 1 and 2). Definitive data will be produced for each analytical task.

All analytical tasks will be performed in a fixed laboratory following standard operating procedures (SOPs). SOPs were provided previously (Battelle, 2001; Battelle, 2002; USEPA, 2003)[2]. SOPs for new analytical parameters and/or laboratories that did not participate in previous investigations (e.g., Mitkem Corporation) are provided with this QAPP Addendum (Attachment K). General descriptions of analytical methods are described below.

Moisture Content
Moisture content will be determined by each participating laboratory following standard operating procedures. NOTE – samples designated for organic and metals analysis that contain low solids content (<30% solids) must be pre-treated to remove excess water before using sample material for extraction and analysis. See discussion below for how to handle low solids content samples.

[2] Battelle 2001. Tasks 19-22 QAPP Field Sampling, Chemical and Toxicity Testing. May 23, 2001. 509 pgs + app.
Battelle 2002. Tasks 19-22 QAPP Addendum. September 27, 2002. 218 pgs + app.
USEPA 2003. Tasks 19-22 QAPP Addendum 2. April 28, 2003. 58 pgs.

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a – Rev. 10/99 (continued)

Project Description and Schedule

At Battelle Duxbury, moisture determination will be performed following SOP 5-192. Briefly, 1 to 5-g of well-mixed soil is weighed into a pre-weighed, pre-baked, aluminum weighing pan. The pan is placed in a drying oven and dried overnight at ca. 105 °C. After approximately 24 h, the pan is removed from the drying oven and allowed to cool at room temperature for at least 30 min. The pan is reweighed and percent moisture determined as defined in Section 4.0 of the SOP.

Soil samples with percent solids <30%
Samples with <30% solids will be centrifuged to remove excess water. Briefly, approximately 100 g of well-mixed soil will be centrifuged for approximately 2 minutes at 1,000 RPMs. The overlying water will be decanted and discarded. The remaining soil will be mixed well and an aliquot (10 to 30 g) removed for extraction following Battelle SOP 5-192. An additional aliquot will be removed for dry weight determination. Sample results will be reported on dry weight basis.

Dioxin/Furan (Battelle Columbus)
Sediment samples (Tables 1 and 2) will be extracted and analyzed for the seventeen 2,3,7,8-substituted PCDD/PCDF following the general procedures in EPA Method 1613, Revision B, as described in Battelle Columbus SOPs ASAT.II-001-02 and ASAT.II-002-02 with modifications noted below.

Approximately 1- 10 g (wet weight) of each sediment sample will be spiked with isotopically labeled analogs of fifteen of the seventeen 2,3,7,8-substituted PCDD/PCDF. Samples will be extracted with methylene chloride by an Accelerated Solvent Extraction (ASE) procedure (SOP ASAT.II-009-00). Alternatively, samples may be extracted with methylene chloride (or toluene) in a Soxhlet apparatus for a minimum of sixteen hours. The entire extract will be put through cleanup (acid and base partitioning) for those analytes.

All extracts for PCDD/PCDF analysis will be spiked with $^{37}Cl_4$-2,3,7,8-TCDD cleanup standard, partitioned against acid solutions, and processed through acid/base silica, alumina, and carbon Celite columns. Extracts will be spiked with $^{13}C_{12}$-1,2,3,4-TCDD/$^{13}C_{12}$-1,2,3,7,8,9-HxCDD recovery standard and concentrated to a final volume of 20 µL.

Sample extracts will be analyzed by high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) in the selected ion monitoring mode (SIM) at a resolution of approximately 10,000. Initial analysis for PCDD/PCDF will be on a DB-5 or equivalent column. Because 2,3,7,8-TCDF is not completely separated from all of the other TCDF isomers on the DB-5 column, second column confirmation of 2,3,7,8-TCDF levels above the lowest calibration level in the initial analysis will be carried out on a DB-Dioxin or DB-225 column. All analytes will be quantified by isotope dilution or by the method of internal standards using surrogate compounds.

Concentrations of the seventeen 2,3,7,8-substituted PCDD/PCDF in sediment will be reported on a dry weight basis. Total concentrations of dioxins and furans in a given level of chlorination will be calculated by summing the concentrations of all isomers identified within the level of chlorination, including both 2,3,7,8-substituted and non-2,3,7,8-substituted isomers.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a – Rev. 10/99 (continued)

Project Description and Schedule

2,3,7,8-TCDD Toxic Equivalents (TEQ) values will be determined in the database, using final, validated data. The TEQ values will be calculated by multiplying concentrations for each isomer by its Toxicity Equivalency Factor (TEF). The TEQs for each isomer detected within a sample will be summed to report a total TEQ value for each sample. The TEF values used will be based on the ESAT (1998)[3].

PCB Aroclor, Chlorinated Pesticides and Polycyclic Aromatic Hydrocarbons (Battelle Duxbury)
Sediment samples (Tables 1 and 2) will be extracted for PCB Aroclor, chlorinated pesticides and PAH following Battelle Duxbury SOP 5-192. This method was developed by Battelle in support of NOAA's National Status and Trends Mussel Watch Project (Peven and Uhler, 1993a). Briefly, approximately 10 to 30 g of wet sediment material will be weighed into an extraction vessel and spiked with the surrogate internal standard (SIS) compounds. Next, the sample will be extracted three times with 100 mL dichloromethane (DCM) using shaker techniques. After each extraction, the sample will be centrifuged, and the solvent extract decanted into a receiving vessel. The combined extract will be dried over sodium sulfate, concentrated to approximately 2 to 3 mLs using Kuderna-Danish and nitrogen evaporation techniques. Sample extracts will be dried over anhydrous sodium sulfate, reduced in volume and cleaned using activated copper, alumina column and high-performance liquid chromatography (HPLC) cleanup The post-HPLC extract will be concentrated under nitrogen to approximately 1 mL, fortified with recovery internal standards (RIS) that are used for quantification, and split for PCB Aroclor/chlorinated pesticide and PAH analyses by GC/ECD and GC/MS, respectively. The extract for GC/ECD analysis will be solvent exchanged into hexane prior to analysis.

GC/ECD Analysis — PCB Aroclors and chlorinated pesticides will be analyzed by GC/ECD (Hewlett Packard 6890 Series GC) using a 60-m DB5 column and hydrogen as the carrier gas. A minimum of a five-point calibration curve will be used for pesticide analysis ranging from approximately 0.001 to 0.15 mg/mL. A single point calibration at approximately 0.1 mg/mL will be used for Technical Chlordane and at approximately 2 mg/mL for PCB Aroclors analysis. And a single point calibration at approximately 0.1mg/mL will be used for Toxaphene analysis

Aroclor will be determined as the most predominant Aroclor formulation, or mixture of two major Aroclor formulations. If, based on the review of the data, it appears that the PCB composition of the samples is dominated by one Aroclor, then that formulation will be used for quantitation. If the PCB composition appears to be primarily a combination of two Aroclor formulations (*e.g.*, Aroclors 1248/1254), then a standard of those mixtures will be analyzed and used for quantitation and data reporting.

GC/MS Analysis — PAH will be analyzed by GC/MS in the SIM mode using a 60-m DB5 column and a Hewlett Packard 5972 (or 5973) detector (Battelle SOP 5-157).

Concentrations for all target analytes will be determined by the method of internal standard, using RISs for quantification. Sample results will be reported on a dry weight basis. Total PCB will be calculated as the sum of the detected Aroclors. *Totals calculations will be determined by the **database** using final, validated data.*

[3] The TEF values used by ESAT are the ones published in Environmental Health Perspectives, volume 106, Number 12, December 1998, "Toxic Equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife."

EPA-NE QAPP Worksheet #9a – Rev. 10/99 (continued)

Project Description and Schedule

Mercury (Hg) and Methyl Mercury (MeHg) (Battelle Marine Sciences Laboratory (MSL))
Total Mercury in Sediments by Cold Vapor Atomic Absorption (CVAA) (Modified EPA 245.5). This method is applicable to the determination, in sub-part per million, of total mercury in acid-digested sediment samples. The modification of EPA 245.5 is regarding the digestion where the MSL no longer uses the potassium permanganate (source of mercury contamination) and uses a modified Texas A&M University (TAMU) digestion using nitric, perchloric, and hydrofluoric acids as developed for the NOAA Status and Trends Program. Alternatively, sediments can be digested using the aqua regia digestion described in the Appendix to EPA Method 1631. This method uses a CVAA technique. The National Institute of Standards and Technology (NIST) certified reference materials for mercury in sediment (1944 or 2704), matrix spikes, duplicate samples, blank spikes, and blanks are routinely analyzed for quality control. The MSL's current detection limit for total mercury in sediment is 0.00432 ug/g as Hg or 0.00432 parts per million on a normal 0.2 gram sample

Methylmercury in Sediment by Cold Vapor Atomic Fluorescence (EPA Method 1630 - Draft). The MSL has the capability to analyze sediment samples for trace levels of methylmercury. The MSL uses EPA Method 1630 - Draft (after Bloom, 1989) for the determination of methylmercury in a wide range of liquid and solid matrices. This CVAF technique, based upon emission of 254 nm radiation by excited Hg° atoms in an inert gas stream, was largely developed at the MSL and has been used routinely since 1989. Sediment samples are extracted into methylene chloride then back-extracted into water using Teflon vessels, as well. Sediments are processed wet but at the time of preparation, percent moisture data is calculated on a sub-sample. An ethylating agent is then added to the aqueous sample to form a volatile methyl-ethylmercury derivative, and then the derivative is purged onto graphitized carbon traps as a means of preconcentration and interference removal. The mercury species are then separated using isothermal chromatography, broken down to elemental mercury by means of pyrolysis, and detected using a CVAF detector as described in Bloom and Fitzgerald (1988). The certified reference material for sediment (IAEA-405), matrix spikes, duplicate samples, and blanks are routinely analyzed for quality control. The current MSL detection limit in sediment for a typical 0.5 g sample is 0.0538 ng/g (0.0538 part per billion).

Metals (Mitkem Corporation)
Sediment samples will be analyzed for 19 metals, aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), vanadium (V) and zinc (Zn) according to Method SW6010B. Prior to analysis samples are undergo an acid and hydrogen peroxide digestion procedure. During analysis, the samples are converted to an aerosol and transported through the hot zone of the argon plasma where they absorb energy. As the metals pass into relatively cooler zones, they release this energy at element specific wavelengths. These spectra are dispersed and measured to determine relative amount of metals present.

Sediment samples will be analyzed for mercury (Hg) according to Method SW7471. Prior to analysis, samples will undergo an aqua regia and potassium permanganate digestion procedure. During analysis, the mercury ions formed during digestion are reduced to the elemental state and aerated into a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance is measured at 253.7 nm and is a function of mercury concentration.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a – Rev. 10/99 (continued)
Project Description and Schedule

The concentrations of the target metals are reported to the client in either ug/L or mg/kg concentrations depending on the sample matrix. Solid or sediment samples are reported on a dry weight basis and have their analytical concentrations (value in digestate) adjusted based on the amount of sample used and the percent moisture of the samples.

Pb-210 Age Dating (Teledyne Brown Engineering)
The Pb-210 activity of soils and sediments is determined radiochemically by separating the daughter product Bi-210 and assaying its beta activity. The method measures the Pb-210 fraction from which Bi-210 may be dissolved by leaching with hot hydrochloric acid (activity in the interior of mineral grains may be excluded).

Stable lead and bismuth carriers are added to the dried sample and it is leached with hot 6N hydrochloric acid. The sample is then filtered and the filtrate is evaporated, oxidized with nitric acid, and finally dissolved in 1.8N hydrochloric acid. The solution is passed through an ion exchange column. Lead is eluted first with 9N hydrochloric acid and with deionized water, then, bismuth is eluted with 2N sulfuric acid. The bismuth is precipitated as the oxychloride and is collected by vacuum filtration on a 1-inch glass fiber disc. The bismuth yield is determined gravimetrically. The filter disc is mounted on a nylon planchet and covered with 3 mg/cm^2 aluminum absorber for beta assay in a low level, gas-flow proportional counter. The Pb-210 concentration is then calculated and reported in pCi/g.

Geotechnical (Applied Marine Sciences, Inc.)
Sediment samples will be analyzed for a series of geotechnical parameters including grain size distribution, Atterberg Limits, percent solids and water content.

Grain Size – Sediment samples will be tested for grain size distribution following ASTM Method D422. This method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 74μm (retained on the No. 200 sieve) is determined by sieving,while the distribution of particle sizes smaller than 74μm is determined using a hydrometer to secure the necessary data.

Each sample is homogenized using a stainless steel spatula. Separate grain size and water content aliquots are secured. The grain size aliquot is treated with 30% hydrogen peroxide to remove organic matter, and dispersed in a solution of sodium hexametaphosphate. The course-grained fraction (>74μm) is separated

from the fine-grained fraction (<74μm) by sieving the sample through a No.200 sieve. The portion remaining on the No. 200 sieve is washed into a beaker and dried. This dried fraction is sorted through a series of nested sieves to provide the distribution of course-grained particles.

The fraction passing the No. 200 sieve is washed into a hydrometer cylinder and brought to volume. The sample is stirred and hydrometer readings are taken at 2, 5, 15, 60, 250, and 1440 minute intervals. The resulting data are combined with the sieve data to generate a grain size distribution curve. Percent, gravel and sand values may be calculated directly from the sieve data, while the silt and clay values are read from the graph.

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Atterberg Limits – Sediment samples will be tested for Atterberg Limits following ASTM Method D4318, *Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*. Briefly, samples will be analyzed for plastic limit, liquid limit, and plasticity index using the multipoint, wet sample preparation procedure. The sample will be processed to remove material retained on the No. 40 sieve. The liquid limit will be determined over a range of water contents, the data will be plotted from which the liquid limit is determined. The plastic limit will be determined by drying the sample to the point where a 3.2 mm thread crumbles. The plasticity index will be calculated as the difference between the liquid limit and the plastic limit.

Percent Solids and Water Content – Sediment samples will be tested for percent solids and water content following ASTM Method D2974 and D2216, respectively.

Quality Control Tasks:
A routine set of fixed laboratory quality control (QC) samples will accompany every set of samples processed and analyzed for this project. The type and frequency of fixed laboratory QC samples are defined in EPA-NE QAPP Worksheet #24a. *MS, MSD and DUP samples must be prepared from Centredale project samples.*

In general, batch QC samples for chemical testing include:

- one procedural/method blank (PB, MB)
- one laboratory control sample (LCS)
- one matrix spike/matrix spike duplicate set (MS/MSD)
- one standard reference material (SRM), where available
- multiple surrogate internal standards (SIS) per sample
- one laboratory (analytical) sample duplicate (DUP) (^{210}Pb and geotechnical only)

For PCB/Pesticide, two laboratory control samples (LCS) will be prepared with each analytical batch of samples.

1) LCS#1 – will be spiked with a universal matrix spike solution that includes chlorinated pesticides, individual PCB congeners[4] (18 congeners), and PAH. (This same solution will also be used to fortify the matrix spike (MS) and matrix spike duplicate (MSD) QC samples)
2) LCS#2 – will be fortified with an alternative MS solution that contains Aroclor 1016 and Aroclor 1260 only. The second LCS will be used to demonstrate data quality in terms of accuracy for PCBs as Aroclors (as opposed to congeners.)

Secondary Data:
Not applicable.

[4] PCB congener analysis is not required for this study. PCB congeners are simply being fortified into the LCS because the laboratory universal MS solution contains PCB congeners along with the target pesticides required for this study. LCS secovery data will only be reported for the target pesticides, not PCB congeners. Aroclor recovery data will be reported for the second LCS.

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Data Management Tasks:
The dioxin/furan data generated by GC/HRMS will be acquired on a Alpha station personal work station 600AU using VG OPUS and OPUSquan software. GC/HRMS data files will be transferred electronically to a PC so that the data can be incorporated into an electronic database or spreadsheets for final quantification and tabular result presentation.

PCB Aroclor, chlorinated pesticide and PAH data will be acquired using the Agilent Technologies Chemstation acquisition software and reduced using the Enviroquant software. Result files are then transferred directly into the Battelle Laboratory Information Management System (LIMS) for final table generation.

Mercury and methyl mercury data are acquired electronically with hardcopy reports and data are electronically transferred to a spreadsheet.

Metals data (Mitkem Corporation) are taken directly from the analytical software database and converted into Comma Separated Value (CSV) format files. These files are uploaded into LIMS. Once in the LIMS, the instrument data is adjusted for preparatory weights/dilutions and any can be reported in a number of different reporting formats based on client needs.

Geotechnical data are generally acquired on instrument software and downloaded to spreadsheets, or alternatively hand entered (e.g, grain size).

The appropriate analyst/data manager assigned to the project team will perform all data reduction. The final reduction of analytical chemistry data will account for the size of the processed sample and dilution factors. Data provided by participating laboratories will be requested in an electronic data deliverable (EDD).

Electronic Data Deliverable – Final laboratory data will be reported in an EDD, using a normalized Excel spreadsheet (Excel 97 or higher). EDD specifications are summarized in Attachment I, and detailed in the Data Management Plan (Battelle, 2004).

Laboratory results reported in the EDD will include:

- Sediment results on a dry weight basis
- Blank results – reported on a concentration basis
- Internal standard results (e.g., SISs, labeled PCDD/PCDF) – recovery reported as whole numbers.
- MS, MSD and LCS results – recovery of target parameters reported whole numbers.
- SRM results – percent difference reported to one decimal place

Supplemental QC results that will be reported in the project file, but not in the EDD, will include:

- The relative percent difference (RPD) between the MS and MSD results – reported to one decimal place.
- The RPD of the duplicate sample analysis – reported to one decimal place.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Chemistry reports will also include a QA/QC narrative that define the QC criteria that were to be met along with results that were achieved. QA/AC narratives are further described in EPA-NE QAPP Worksheet #9a, Data Usability Assessment Tasks.

Documentation and Records:
The core samples will be delivered under Chain-of-Custody from the sampling site to EPA AED, Narragansett. The core samples will be logged immediately after sampling and delivery to EPA AED. USACE ERDC will be responsible for logging the cores and preparing the core logs. Battelle and USACE ERDC will be responsible for core processing. Battelle will be responsible for shipping samples to participating laboratories under additional Chain-of-Custody. For purposes of documentation, a copy of the original Chain-of-Custody from the core samples should accompany any additional sub-sample Chain-of-Custody. All unused core sub-samples will be archived at Battelle for a period of 6-mo, at which time Battelle will contact USACE for approval to dispose of the unused samples.

Documentation associated with laboratory analyses will include sample receipt and log-in records, sample processing logs, sample preparation records, analytical instrument printouts, equipment logs, or recorded electronically in the Laboratory Information Management System (LIMS). Initially, all data will be recorded either (1) electronically onto a computer storage media from laboratory systems or (2) manually into laboratory notebooks or on established data forms. All notes will be written in ink, or electronically in LIMS. Corrections to hand-entered data will be initialed, dated and justified. Complete forms, laboratory notebooks, or other forms of hand-entered data will be signed and dated by the individual entering the data. It will be the responsibility of the Laboratory Manager and/or Task Leader to ensure that all data entries and hand calculations are verified. Sample preparation laboratory records will be maintained in bound laboratory record books. In addition to these documentation procedures, sample logs associated with field and laboratory custody and tracking will be maintained in project files.

Data Packages:
Analytical Task Leaders will prepare a project-specific data package (project records). All packages will receive secondary review either by another analyst or the laboratory supervisor. In addition, a minimum 10% of the data packages (100% for Battelle Columbus, Battelle MSL and AMS) will be submitted to the Quality Assurance Unit (QAU) for an independent Quality Assurance review.

Data packages are considered a deliverable and will be maintained by the laboratory. Data package format may vary by laboratory, however, each data package (except Pb-210 activity and geotechnical) must contain the pertinent raw data elements (Attachment J) necessary for third party validation. Data packages for Pb-210 activity and geotechnical will follow standard laboratory report formats for those laboratories.

One copy of each HRMS data package, including raw data, will be submitted to EPA-NE for Tier III validation. One copy of all other analytical data packages, except Pb-210 activity and geotechnical, will be submitted to Environmental Standards for Tier II validation. Pb-210 activity and geotechnical data will not receive third party validation.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Assessment/Audit Tasks:
Quality assurance encompasses all planned and systematic activities necessary to assure management that the products generated and the services performed by Battelle meet the quality standards established in this Analysis Plan. The primary mechanism for accomplishing this goal is audits. Audits refer to the formal assessment of conformance to the QA Program and its effectiveness. During an audit, the agreement with QA policy documents (*e.g.,* SOPs) is evaluated, deficiencies are identified, and corrective action is taken. Ideally, audits also serve to increase awareness and understanding of QA policies and procedures. Ms. Rosanna Buhl is Battelle's QA Officer and is responsible for identifying areas for corrective action, coordinating the QA activities such as systems and data audits, and preparing reports to management for this project. QA Officers at participating laboratories will be responsible for coordinating and performing QA activities at participating laboratories. The identity of auditors and their qualification are presented in EPA-NE QAPP Worksheet #6. The following QA audits are planned for this project.

- A technical system (initiation) audit is conducted as part of the review of this QAPP Addendum to (1) ensure that the delivery order scope and all required elements are addressed adequately, (2) verify that all required SOPs are approved and current, and (3) to verify that all participants have the required qualifications and documented training to perform their assigned tasks.
- Performance audits are independent checks of routinely obtained data. One Standard Reference Material (SRM) will be incorporated into each batch of applicable chemistry samples to assess the accuracy and precision with which target analytes of known concentration are recovered from a representative matrix. Acceptance criteria are presented in EPA-NAE QAPP Worksheets #24a and #24b.

Data reports, submitted to USACE NAE, will be verified by the appropriate Laboratory Analyst and Laboratory Supervisor and validated by the Project Manager. The Quality Assurance Unit (QAU) will conduct independent audits on a minimum of 10% of the data reports (see Battelle SOP 6-027). These audits will reconstruct representative data from each sample based on sample processing records, instrument calibration factors (*e.g.,* response factors) and output (*e.g.,* area counts), and sample manipulations and spiking. Samples will be tracked from receipt and processing through analysis and reporting to ensure that the reported data are accurate, complete, and traceable.

Participating laboratories are responsible for reporting results of QA audits to the appropriate analytical Task Leader, Laboratory Manager, and/or the Laboratory Project Manager (EPA-NE QAPP Worksheet #27b). Each laboratory is responsible for ensuring that audit reports are responded to and appropriate corrective action implemented and documented in the project file, and approved by management. Audit reports at Battelle will define any errors, deficiencies, or deviations from the QAPP. The responsible analyst documents the corrective action on the audit report and submits the audit report to the Project Manager for review and approval. Battelle audit reports are available for review at the respective facility.

Data reports, submitted to USACE NAE, will receive a review by a senior scientist and the Quality Assurance Unit.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Data Verification and Validation Tasks:
Data validation discussed in this QAPP describes what Battelle and other participating laboratories will perform internally. Data validation is the responsibility of those immediately responsible for overseeing and/or performing analyses, data entry, data reduction, and data reporting. The data validator will verify final report tables for accuracy and completeness (*i.e.,* calculation, manual entries). Battelle's procedures for data validation and review activities are described in SOPs 6-027 (Battelle Duxbury), SOPs ASAT.II-003 and ASAT.II-010 (Battelle Columbus), and MSL-Q-005 (Battelle MSL).

A series of reviews by technical personnel will be implemented to ensure that the data generated for this project meet the data quality objectives. These reviews will include the following activities.

- Data and related project records will be reviewed by laboratory personnel at the end of each working day to ensure that analytical activities are completely and adequately documented.
- The Task Leaders will be responsible for reviewing analytical results and supporting documentation. The results of QC sample analyses will be compared to pre-established criteria as a measure of data acceptability.
- All hand-entered or transcribed data will be 100% validated.
- All calculations performed manually will be checked for accuracy. Calculations performed by software will be checked at a frequency sufficient to verify their accuracy.

All data will be validated to ensure that the measurement performance criteria (MPCs) described in EPA-NE QAPP Worksheet #11b have been met, instrument calibration and maintenance requirements also specified in EPA-NE QAPP Worksheet #21 have been met, and that the data are complete, accurate, and traceable.

All data that do not meet the listed MPCs will be submitted to the Project Manager, or her designee, for review and assessment of the potential impact of the results. Affected samples may be reanalyzed at the

Project Manager's, or her designee, discretion. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (Table 4), and the rationale for accepting the analysis will be thoroughly documented.

Third Party Validation — PCDD/PCDF HRMS data will receive Tier III validation by EPA-NE. All other analytical chemistry data packages (excluding Pb-210 and geotechnical) will receive Tier II validation by Environmental Standards.

EPA-NE QAPP Worksheet #9a - Rev. 10/99 (continued)

Project Description and Schedule

Table 4. Data Reporting Qualifiers

Data Qualifier[1]	Definition	Data Qualifier[1]	Definition
J	Detected at a concentration above the method detection limit (MDL) and below the reporting and/or quantitation limit (RL or QL)[2]; *see Worksheet #9b*	B	Analyte detected in the laboratory blank; concentration found in study samples is less than the blank action level (*see EPA-NE QAPP Worksheets #11b*).
U	Not detected, or detected at a level below the detection limit (MDL, QL or RL) reported, *see Worksheet #9b*	~	QC value outside the accuracy or precision criteria goal (EPA-NE QAPP Worksheet #11b) – but meets contingency criteria.
#	Result from second column confirmation analysis	&	QC value outside the accuracy or precision criteria goal (EPA-NE QAPP Worksheet #11b).
T	Holding time exceeded	X	Estimated, due to lack of a compound specific response factor
E	Estimate; significant matrix interference.		

[1] Qualifiers, and their definitions will be included in the analytical report.
[2] Detection Limits (MDLs, EDLs, RLs, QLs) are defined in EPA-NE QAPP Worksheet #9b; Achieved detection limits will be reported with the data.

Data Usability Assessment Tasks:

The review of quality control data is a critical step in the data validation process because quality control data that are within the QAPP acceptance criteria indicate that the sample processing and analysis systems are in control. Quality control data will be evaluated for usability as described in Figure 3 (EPA-NE QAPP Worksheet #30). EPA-NE QAPP Worksheet #24a describes the type of quality control samples that will be analyzed with each analytical batch and corrective action for out-of-control quality control data and instrumentation calibrations. All quality control data that do not meet the measurement performance criteria will be flagged (Table 4) and brought to the attention of the Task Leader and the Project Manager, who will determine the appropriate corrective action (*e.g.*, reanalysis or data reported with qualifiers).

QA/QC narratives will present quality control criteria and the quality control results. They will be prepared for each analytical batch and will describe any MPC exceedances and what, if any, impact they may have on the overall data.

Further data usability will be performed by the data validators, who will perform a Tier II (all chemistry data excluding HRMS data) or Tier III (all HRMS data) validation of the data following USEPA Region 1 guidelines.

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9b - Rev. 10/99

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Dioxin/Furan
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-23

Analyte	CAS Number	Project Action HH Goal* (pg/g dry weight)	Project Action ECO Goal* (pg/g dry weight)	Analytical Method[1]		Achievable Laboratory Limits (DRY WT – pg/g)	
				MDLs	Method QLs[2]	MDLs[3]	RLs[3]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	0.0684	0.008	NA	2	0.59	1.0
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	0.587	0.057	As above	2	0.49	1.0
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	0.0821	0.009	As above	10	2.2	5.0
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	4.11	0.467	As above	10	0.70	5.0
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	0.0747	0.008	As above	10	1.9	5.0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	2.05	0.233	As above	10	1.3	5.0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	4.11	0.467	As above	10	2.46	5.0
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	4.11	0.467	As above	10	2.5	5.0
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	1.37	0.156	As above	10	2.3	5.0
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.05	0.233	As above	10	1.2	5.0
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	1.37	0.156	As above	10	2.1	5.0
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	1.37	0.156	As above	10	2.1	5.0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	205	23.3	As above	10	1.3	5.0
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	2050	233	As above	10	2.0	5.0
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	41.1	4.67	As above	10	2.4	5.0
Octachlorodibenzo-p-dioxin	3268-87-9	41100	4670	As above	20	3.7	10
Octachlorodibenzofuran	39001-02-0	137000	15600	As above	20	8.0	10
Total HpCDD	37871-00-4	NA	NA	As above	NA	NA	NA
Total HpCDF	38998-75-3	As above	As above	As above	NA	NA	NA
Total HxCDD	34465-46-8	As above	As above	As above	NA	NA	NA
Total HxCDF	55684-94-1	As above	As above	As above	NA	NA	NA
Total PeCDD	36088-22-9	As above	As above	As above	NA	NA	NA
Total PeCDF	30402-15-4	As above	As above	As above	NA	NA	NA
Total TCDD	41903-57-5	As above	As above	As above	NA	NA	NA
Total TCDF	55722-27-5	As above	As above	As above	NA	NA	NA
Actual data will be evaluated against Estimated Detection Limits (EDLs); see EPA-NE Worksheet #30. Values detected at a level below the EDL will be J flagged; Non-detects will be reported as the EDL and U flagged.							

[1] Method 1613B.
[2] Analytical method MDLs and RLs documented in validated methods. These limits are based on a sample size of 10 g wet weight and an average sample % dry weight of 50% to give a final sample size of 5 g dry weight.
[3] Achievable MDLs and RLs are limits that an individual laboratory can achieve when performing a specific analytical method. These limits are based on an average sample size of 5 g dry weight. The MDL values are from a seven replicate MDL study performed in 2004 (using Automated Solvent Extraction technique); and the RL values are based on the lowest calibration standard, sample size (10g wet weight and an average sample % dry weight of 50% to give a final sample size of 5 g dry weight, and extract volume 20µL).

* Recommended detection limits.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Chlorinated Pesticides and PCB Aroclors
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP: L-9

Analyte	CAS Number	Project Action HH Goal* (ng/g dry weight)	Project Action ECO Goal* (ng/g dry weight)	Analytical Method[1]		Achievable Laboratory Limits (DRY WT – ng/g)	
				MDLs	Method Practical QLs (wet wt – ng/g)	MDLs[2]	RLs[3]
4,4'-DDD	50-29-3	0.52	Not available	Not available	Not available	0.128	0.67
4,4'-DDE	72-54-8	0.367	As above	As above	As above	0.083	0.67
4,4'-DDT	72-55-9	1.69	0.52	As above	As above	0.076	0.67
Aldrin	309-00-2	0.101	Not available	As above	As above	0.070	0.67
alpha-BHC	319-84-6	0.0587	As above	As above	As above	0.076	0.67
alpha-Chlordane	5103-71-9	0.575 **	1260 **	As above	As above	0.071	0.67
beta-BHC	319-85-7	0.205	Not available	As above	As above	0.066	0.67
delta-BHC	319-86-8	7.92	As above	As above	As above	0.081	0.67
Dieldrin	60-57-1	0.00903	4	As above	As above	0.082	0.67
Endosulfan I	959-98-8	44.9	Not available	As above	As above	0.086	0.67
Endosulfan II	33213-65-9	44.9	As above	As above	As above	0.083	0.67
Endosulfan Sulfate	1031-07-8	44.9	As above	As above	As above	0.099	0.67
Endrin	72-20-8	6.5	As above	As above	As above	0.083	0.67
Endrin Aldehyde	7421-93-4	6.5	As above	As above	As above	0.111	0.67
Endrin Ketone	53494-70-5	6.5	As above	As above	As above	0.084	0.67
gamma-BHC	58-89-9	0.284	As above	As above	As above	0.072	0.67
gamma-Chlordane	5103-74-2	0.575 **	1260 **	As above	As above	0.063	0.67
Heptachlor	76-44-8	0.214	As above	As above	As above	0.078	0.67
Heptachlor Epoxide	1024-57-3	0.106	As above	As above	As above	0.070	0.67
Methoxychlor	72-43-5	361	Not available	As above	As above	0.113	0.67
Technical chlordane	57-74-9	Not available	As above	As above	As above	Not available	15 [a]
Toxaphene	8001-35-2	As above	As above	As above	As above	As above	15 [a]

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Chlorinated Pesticides and PCB Aroclors
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP: L-9

Analyte	CAS Number	Project Action HH Goal* (ng/g dry weight)	Project Action ECO Goal* (ng/g dry weight)	Analytical Method[1]		Achievable Laboratory Limits (DRY WT – ng/g)	
				MDLs	Method Practical QLs (wet wt – ng/g)	MDLs[2]	RLs[3]
Aroclor-1016	12674-11-2	12.6	447	Not available	Not available	Not available	15 [a]
Aroclor-1221	1104-28-2	12.6	447	As above	As above	As above	15 [a]
Aroclor-1232	11141-16-5	12.6	447	As above	As above	As above	15 [a]
Aroclor-1242	53469-21-9	12.6	447	As above	As above	As above	15 [a]
Aroclor-1248	12672-29-6	12.6	447	As above	As above	As above	15 [a]
Aroclor-1254	11097-69-1	12.6	447	As above	As above	As above	15 [a]
Aroclor-1260	11096-82-5	12.6	447	As above	As above	As above	15 [a]
Aroclor-1268	11100-14-4	12.6	447	As above	As above	As above	15 [a]

Data will be evaluated against sample specific MDLs (YR2003) and RLs; see EPA-NE Worksheet #30. Non-detects, or values detected at a level below the sample specific MDL, will be reported as the sample specific MDL and U flagged. Values detected above the sample specific MDL and below the sample specific RL will be reported and J flagged.

[1] MDLs and RLs are not cited in EPA methods 8081 or 8082.
[2] Achievable MDLs are from a seven replicate MDL study (in sediment) and are based on a sample size of 20-g average sample size (dry). MDLs for some compounds are not available.
[3] RLs determined from the low calibration standard and adjusted for sample processing volumes and factors.
RL = [(low calibration std., 0.001 to 0.004 ng/µL) * (pre-injection volume, 1000 µL) * (dilution factor, 1.67)] / (Sample dry wt., approximately 10-g). Actual RLs will vary depending upon sample processing factors; actual RLs will be reported with the data.
[a] A single point calibration at approximately 0.1 mg/mL will be used for analysis of Technical Chlordane and Toxaphene; a single point calibration at approximately 2 mg/mL will be used for analysis of PCB Aroclors. PCB Aroclor RLs are derived from the low calibration standard of Aroclor 1016 and Aroclor 1260.

* Recommended detection limits.

** Recommended detection limit for Chlordane used for both alpha- and gamma-chlordane.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: PAH
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP: L-10

Analyte[a]	CAS Number	Project Action HH Goal* (ng/g dry weight)	Project Action ECO Goal* (ng/g dry weight)	Analytical Method[1]		Achievable Laboratory Limits (DRY WT – ng/g)	
				MDLs	Method Estimated QLs (wet wt – ng/g)	MDLs[2]	RLs[3]
Biphenyl	92-52-4	Not available	Not available	Not applicable	Not applicable	0.064	0.84
2-Methylnaphthalene	91-57-6	1130	10700	As above	As above	0.018	0.84
Acenaphthene	83-32-9	3380	3010	As above	As above	0.064	0.84
Acenaphthylene	208-96-8	3380	3010	As above	As above	0.030	0.84
Anthracene	120-12-7	16900	3010	As above	As above	0.041	0.84
Benzaldehyde	100-52-7	Not available	Not available	As above	As above	Not available	0.84
Benz[a]anthracene	56-55-3	1.8	3010	As above	As above	0.083	0.84
Benzo[a]pyrene	50-32-8	0.18	3010	As above	As above	0.103	0.84
Benzo[b]fluoranthene	205-99-2	1.8	3010	As above	As above	0.077	0.84
Benzo[g,h,i]perylene	191-24-2	1690	3010	As above	As above	0.029	0.84
Benzo[k]fluoranthene	207-08-9	18	3010	As above	As above	0.119	0.84
Chrysene	218-01-9	180	3010	As above	As above	0.063	0.84
Dibenz[a,h]anthracene	53-70-3	0.18	548000	As above	As above	0.043	0.84
Dibenzofuran	132-64-9	3290	Not available	As above	As above	0.027	0.84
Fluoranthene	206-44-0	2260	4790	As above	As above	0.101	0.84
Fluorene	86-73-7	2260	121000	As above	As above	0.041	0.84
Indeno[1,2,3-cd]pyrene	193-39-5	1.8	3010	As above	As above	0.032	0.84
Naphthalene	91-20-3	1130	3010	As above	As above	0.088	0.84
Phenanthrene	85-01-8	1690	329000	As above	As above	0.055	0.84
Pyrene	129-00-0	1690	87700	As above	As above	0.105	0.84

Data will be evaluated against sample specific MDLs (YR2003) and RLs; see EPA-NE Worksheet #30. Non-detects, or values detected at a level below the sample specific MDL, will be reported as the sample specific MDL and U flagged. Values detected above the sample specific MDL and below the sample specific RL will be reported and J flagged.

[1] Method 8270C is full scan method; Battelle will analyze samples by SIM; therefore EPA method MDLs/RLs are not applicable.
[2] Achievable MDLs are from a seven replicate MDL study and are based on a sample size of 32.6-g average sample size (dry). MDLs for some compounds are not available.
[3] RLs determined from the low calibration standard and adjusted for sample processing volumes and factors.
RL = [(low calibration std., 0.005 ng/µL) * (pre-injection volume, 1000 µL) * (dilution factor, 1.67)] / (Sample dry wt., 10-g).
Actual RLs will vary depending upon sample processing factors – actual RLs will be reported with the data.
[4] Bolded PAHs represent the EPA 16 PAH priority pollutants.
* Recommended detection limits.

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SO
Analytical Parameter: Mercury and Methyl Mercury
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: 1631c/L-41 (Hg); Bloom (1989)/L-40 (MeHg)

Analyte	CAS Number	Project Action HH Goal* (µg/g dry weight)	Project Action ECO Goal* (µg/g dry weight)	Analytical Method[1]		Achievable Laboratory Limits (µg/g Dry Wt)	
				MDLs	Method QLs	MDLs[2]	QLs[2]
Mercury	7439-97-6	0.000727	As above	NA	NA	0.000019	0.00006
Methyl Mercury	22967-92-6	0.000242	0.001	NA	NA	0.0000538	0.00017

Data will be evaluated against Laboratory Achieved MDLs and QLs; see EPA-NE Worksheet #30. Non-detects, or values detected at a level below the MDL, will be reported as the QL and U flagged. Values detected above the MDL and below the QL will be reported and J flagged. Undetected metals (based on the instrument detection limit) will be reported as the QL and U flagged.

NA – Not available.
[1] Method Bloom (1989).
[2] Achievable MDLs are from a seven replicate MDL study conducted in 2005 and are based on a sample size of approx. 0.2 g dry for Hg and 0.5 g dry for MeHg. QLs are based on 3.18 × the achievable laboratory MDL.

* Recommended detection limits.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Metals
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP: SW6010B/L-119 (ICP/OES); SW7471/L-120 (FIMS 100) for Hg

Analyte	CAS Number	Project Action HH Goal* (µg/g dry weight)	Project Action ECO Goal* (µg/g dry weight)	Analytical Method[1] (µg/L)		Achievable Laboratory Limits (DRY WT - µg/g)	
				MDLs[2]	Method QLs[3]	MDLs[3]	QLs
Aluminum	7429-90-5	549	Not available	Not available	30	0.34	10
Antimony	7440-36-0	0.329	As above	As above	21	0.056	1
Arsenic	7440-38-2	0.097	As above	As above	35	0.076	1
Barium	7440-39-3	384	As above	As above	0.87	0.13	10
Beryllium	7440-41-7	1.65	As above	As above	0.18	0.0061	0.25
Cadmium	7440-43-9	0.0294	As above	As above	2.3	0.0055	0.25
Chromium (total) [4]	7440-47-3	0.772 **	As above	As above	4.7	0..14	1
Cobalt	7440-48-4	7.41	As above	As above	4.7	0.022	2.5
Copper	7440-50-8	9.56	As above	As above	3.6	0.21	1.5
Iron	7439-89-6	Not available	As above	As above	4.1	0.87	10
Lead	7439-92-1	0.396	As above	As above	28	0.041	0.5
Manganese	7439-96-5	288	As above	As above	20	0.067	2.5
Mercury	7439-97-6	0.000727	As above	As above	Not available	0.007	0.033
Molybdenum	13939-06-5	Not available	As above	As above	5.3	0.86	1
Nickel	7440-02-0	3.58	As above	As above	10	0.026	2.5
Selenium	7782-49-2	0.271	As above	As above	50	0.067	1.5
Silver	7440-22-4	1.37	As above	As above	4.7	0.019	1.5
Thallium	7440-28-0	0.00165	As above	As above	27	0.079	1
Vanadium	7440-62-2	2.22	As above	As above	5	0.021	2.5
Zinc	7440-66-6	6.86	As above	As above	1.2	0.056	2.5

Data will be evaluated against Laboratory Achieved MDLs and QLs; see EPA-NE Worksheet #30. Non-detects, or values detected at a level below the MDL, will be reported as the MDL and U flagged. Values detected above the MDL and below the QL will be reported and J flagged. Undetected metals (based on the instrument detection limit) will be reported as the MDL and U flagged.

NA – Not available.
[1] Methods SW6010B (ICP/OES) and SW7471 (FIMS 100 for Hg).
[2] The estimated instrument detection limits shown are provided as a guide for an instrument limit and are based on specific wavelengths specified by the method (SW6010B). The actual method detection limits (MDLs) are sample dependent and may vary as the sample matrix varies..
[3] Achievable MDLs are from a seven replicate MDL study conducted in 2004 and are based on a sample size of 1.0 g dry weight.
[4] Project Action HH Goal is for hexavalent chromium; however, the project samples will be analyzed for total chromium.

* Recommended detection limits.

** Cr VI

EPA-NE QAPP Worksheet #9b - Rev. 04/03 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Pb-210 Activity
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP: L-112

Analyte	CAS Number	Project Action HH Goal* (dry weight)	Project Action ECO Goal* (dry weight)	Analytical Method		Achievable Laboratory Limits (DRY WT-pCi/g)
				MDLs	Method QLs	MDC[1]
Pb-210	NA	NA	NA	NA	NA	0.1

NA – Not available/applicable.

[1] Minimum Detectable Concentration (MDCs) based on typical sample volumes, efficiencies and count times. Actual data will be evaluated against posteriori MDC. Achieved MDCs will be reported with the study data.

* Recommended detection limits.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Geotechnical
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP[1]: L-46 (grain size); L-117 (Atterberg Limits); L-118 (percent solids); and L-47 (water content)

Analyte	CAS Number	Project Action HH Goal* (dry weight)	Project Action ECO Goal* (dry weight)	Analytical Method[1]		Achievable Laboratory Limits (DRY WT - %)	
				MDLs	Method QLs	MDLs	RLs[2]
Percent Gravel	Not available	Not applicable	Not applicable	NA	NA	NA	0.01
Percent Coarse Sand	As above	As above	As above	NA	NA	NA	0.01
Percent Medium Sand	As above	As above	As above	NA	NA	NA	0.01
Percent Fine Sand	As above	As above	As above	NA	NA	NA	0.01
Percent Silt	As above	As above	As above	NA	NA	NA	0.01
Percent Clay	As above	As above	As above	NA	NA	NA	0.01
Grain Size Distribution Curve	As above	As above	As above	NA	NA	NA	NA
Liquid Limit	As above	As above	As above	NA	NA	NA	1
Plastic Limit	As above	As above	As above	NA	NA	NA	1
Plasticity Index	As above	As above	As above	NA	NA	NA	1
Percent Solids	As above	As above	As above	NA	NA	NA	0.01
Water Content	As above	As above	As above	NA	NA	NA	1

Data will be evaluated against Laboratory Achieved RLs. Values detected at a level below the RL will be J flagged; Non-detects will be reported as the RL and U flagged.

NA – Not available/applicable.

[1]ASTM D422 (grain size), D4318 (Atterberg Limits), D2974 (percent solids) and D2216 (water content).

[2] The reporting limit (RL) for sieve fraction is 0.01%; for the fine fraction (hydrometer analysis) readings are taken at 0.5 gram intervals and reported at 0.01%. Note that a weight percent less than 0.01% can be measured gravimetrically, but it has no relevance in characterizing the sediment type.

* Recommended detection limits.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9b - Rev. 10/99 (continued)

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Medium/Matrix: Sediment
Region I Matrix Code (from EPA-NE DQO Summary Form): SE
Analytical Parameter: Moisture
Concentration Level: Low
Field Analytical or Fixed Laboratory Method/SOP: L-13

Analyte	CAS Number	Project Action HH Goal (ng/g dry weight)	Project Action ECO Goal (ng/g dry weight)	Analytical Method		Achievable Laboratory Limits (WET WT)	
				MDLs	Method QLs	MDLs	RLs[1]
Moisture	Not available	Not applicable	Not applicable	Not applicable	Not applicable	Not available	0.03%

[1] RLs determined from the maximum sensitivity of the balance and adjusted for sample processing volumes.
RL =[(maximum sensitivity of the balance, 0.01 g) / (Sample wet wt., 30-g)] *100%.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #9c - Rev. 10/99

Field and Quality Control Sample Summary Table

Medium/ Matrix	Analytical Parameter	Conc. Level	Analytical Method/ SOP Reference[1]	No. of Sampling Locations[2]	No. of Field Dup Pairs	Organic		Inorganic		No. of Trip Blanks	No. of Bottle Blanks	No. of Equip. Blanks[3]	No. of SRM or PE Samples[4]	Total No. of Samples to Lab[5]
						No. of MS	No. of MSD	No. of MS	No. of MSD					
Sediment	Dioxin/ Furan (a)	Low	1613B/L-23	10 cores (~3 samples per core; = 30 samples)	0	1 MS/MSD set per analytical batch (b)		0	0	0	0	0	1 SRM per analytical batch	37 (c)
Sediment	PCB/Pest/ PAH (a)	Low	NS&T/L-9 NS&T/L-10	10 cores (~1 sample per core; = 10 samples)	0	1 MS/MSD set per analytical batch (b)		0	0	0	0	0	1 SRM per analytical batch	12 (c)
Soil	Hg, MeHg (a)	Low	1631c/L-41 Bloom/ L-40	10 cores (~1 sample per core; = 10 samples)	0	0	0	1 MS/MSD set per analytical batch (b)		0	0	0	1 SRM per analytical batch	12 (c)
Sediment	Metals (a)	Low	6010B/L-119 7471/L-120	10 cores (~1 sample per core; = 10 samples)	0	0	0	1 MS/MSD set per analytical batch (b)		0	0	0	1 SRM per analytical batch	12 (c)
Sediment	Pb-210 (a)	Low	TBE-2015/L-112	~3 cores (~10 samples per core; = 30 samples)	0	0	0	1 MS and 1 lab DUP per analytical batch (b)		0	0	0	0	30
Soil	Geotech-nical	Low	ASTM D422/L-46 D4318/L-117 D2974/L-118 D2216/L-47	10 cores (surface and mid-depth intervals)	0	0	0	0	0	0	0	0	0	15 (auth-orized)

[1] Complete SOP references in EPA-NE QAPP Worksheet #20.
[2] Number reported here represents the number of sampling locations – not the total number of samples that will be collected. Multiple samples will be collected at each sampling location; see EPA-NE QAPP Worksheets #9a and #12b.
[3] Rinsate blank only.
[4] SRM samples will not be collected in the field – instead these are fixed laboratory analytical QC samples supplied by a certified agency and prepared in the laboratory to demonstrate comparability.
[5] Total number of samples to the lab only represents total numbers of samples **collected in the field and shipped to the participating lab**. This includes authentic (study) samples and field QC samples (*e.g.*, field duplicates). Total number of samples to the lab does **not** include fixed laboratory QC samples (*e.g.*, MS/MSD, SRM). In this case, aliquots of sample will be used from an authentic sample to prepare the fixed laboratory QC sample – separate and distinct samples will not be collected to satisfy the fixed laboratory QC sample requirements. Fixed laboratory QC sample (*e.g.*, MS/MSD) types and frequency are defined in EPA-NE QAPP Worksheet #11b or 24.
(a) Moisture content determined at participating laboratories in conjunction with each laboratory's specific analysis.
(b) Analytical batch contains 20 or fewer authentic samples.
(c)Archived samples from the May 2003 investigation will also be used for chemical testing, and will include:

Boring ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals
LPX-SD-4204	0.0 – 0.1; 1.1 – 1.2; and 2.35 – 2.45	X (3 samples)	Combined 0.0 – 0.1 and 0.3 – 0.4 ft samples
LPX-SD-4205	0.0 – 0.1; 1.3 – 1.4; and 2.4 – 2.5	X (3 samples)	Combined 0.0 – 0.1 and 0.4 – 0.5 ft samples
LPX-SD-4209	2.4 – 2.5	X	-

EPA-NE QAPP Worksheet #9d - Rev. 10/99

Analytical Services Table

Medium/ Matrix	Analytical Parameter	Concentration Level	Analytical Method/SOP[1]	Data Package Turnaround Time [2]	Laboratory/Organization (Name and Address: Contact Person and Telephone Number)	Backup Laboratory/ Organization (Name and Address: Contact Person and Telephone Number)
Sediment	Dioxin/ Furan (a)	Low	1613B/L-23	60 days	Karen Tracy Battelle Columbus 505 King Avenue Columbus, OH 43201 (614) 424-4028	Backup GC/HRMS system available at Battelle Columbus
Sediment	PCB Aroclors/ Pesticide (a)	Low	NS&T/L-9	30 days	Deirdre Dahlen Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781-934-0571)	Backup GC/ECD systems available at Battelle Duxbury
Sediment	PAH (a)	Low	NS&T/L-10	30 days	Deirdre Dahlen Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781-934-0571)	Backup GC/MS systems available at Battelle Duxbury
Sediment	Hg, MeHg (a)	Low	1631c/L-41 Bloom/L-40	30 days	Brenda Lasorsa Battelle MSL 1529 Sequim Bay Rd. Sequim, WA 98382 (360) 681-3650	Backup CVAF System at MSL
Sediment	Metals (a)	Low	SW6010B/ L-119 SW7471/L-120	30 days	Evan Philo Mitkem Corporation 175 Metro Center Blvd. Warwick, RI 02886-1755 (401) 732-3400	Backup ICP/OES and CVAF at Battelle MSL
Sediment	Pb-210 (a)	Low	TBE-2015/ L-112	30 days	Rebecca Charles Teledyne Brown Engineering – Environmental Services 2508 Quality Lane Knoxville, TN 37931 (865) 934-0379	Battelle MSL 1529 Sequim Bay Rd. Sequim, WA 98382 (360) 681-3604
Sediment	Geotech-nical (b)	Low	(b)	30 days	Ken Davis Applied Marine Sciences 502 North Highway 3 League City, TX 77573 (281) 554-7272	GeoPlan Associates 30 Mann St. Hingham, MA 02043 (616) 740-1340

[1] Specify appropriate reference number/letter from the Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17) and from the Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

[2] Data Package Turnaround Time may increase should large numbers of samples (e.g., >40) be received for analysis.

(a) Percent moisture will also be determined; sample results will be reported on a dry weight basis.

(b) Geotechnical parameters may vary by sample, and generally include Grain Size (ASTM D422/L-46); Atterberg Limits (ASTM D4318/L-117) Percent Solids (ASTM D2974/L-118) and Water Content (ASTM D2216/L-47).

EPA-NE QAPP Worksheet #10 - Rev. 10/99

Project Schedule Timeline Table

Activities	Dates (MM/DD/YY) [a]		Deliverable	Deliverable Due Date
	Anticipated Date(s) of Initiation	Anticipated Date of Completion		
QAPP Addendum Preparation				
QAPP Preparation	December 7, 2004	January 17, 2005	QAPP	January 21, 2005
USACE/USEPA Review	January 21, 2005	February 14, 2005		
Field Sampling[1,2]				
Sediment Core Collections	March 30, 2005	April 1, 2005	NA	NA
Core Processing	April 4, 2005	April 8, 2005		
Sample Shipment	April 11, 2005	April 11, 2005		
Sample Analysis[2]				
Physical and Chemical Testing	April 12, 2005	May 25, 2005	Data Report	November 18, 2005 [3]
Prepare Study Files	May 26, 2005	June 1, 2005		
Third Party Validation (Tier II/III)	June 2, 2005	July 26, 2005		
Load Final, Validated Data & QA Review	July 28, 2005	August 10, 2005		
Letter Data Report [3]	October 20, 2005	November 2, 2005		
Internal Review	November 3, 2005	November 9, 2005		
Revise Letter Data Report	November 10, 2005	November 16, 2005		
Submit Letter Data Report	November 18, 2005	November 18, 2005		

[a] If due date falls on a weekend then the deliverable will be submitted on the following Monday.
[1] Start date based on receiving Notice to Proceed by November 29, 2004
[2] Participating laboratories will be responsible for sample custody and data quality control through validation process.
[3] One combined data report will be prepared, including results from various data collection activities (i.e., surface water, sediment, SPMD). As a result, the delivery schedule is based on the availability of final, validated data from the last data collection activity (SPMD study scheduled for June 2005).
N/A Not applicable.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #11a - Rev. 10/99

Project Quality Objectives/Decision Statements

Project Quality Objectives:
The project quality objectives for physical and chemical testing is to generate data of a quality to be used for the RI/FS. The data needed for the RI/FS must be definitive data of very high quality (tight measurement performance criteria. Sensitivity requirements for selected parameters (e.g., geotechnical) have not been defined.

Project quality objectives and measurement performance criteria for physical and chemical testing are defined below.

Measurement Performance Criteria:
Method performance criteria (MPC) chosen to ensure that the definitive data will be of high quality are defined by analysis parameter in EPA-NE QAPP Worksheet #11b.

Data quality may be defined in terms of accuracy, precision, representativeness, completeness, comparability, and sensitivity.

- *Accuracy* is the agreement between an observed value and an accepted value. Analytical accuracy is monitored for analytical chemistry measurements as specified in EPA Worksheet #11b.

  Applicable samples: LCS, MS, MSD, SRM, SIS (each sample).
  Applicable analyses:
  - ⇒ Dioxin/Furan
  - ⇒ PCB Aroclors/Pesticide (No SRM or MS/MSD for Aroclors)
  - ⇒ PAH
  - ⇒ Metals (SIS not applicable; at Mitkem, the SRM will be a "Priority Pollutant/CLP™ Inorganic Soil" from Environemntal Resource Associates)
  - ⇒ MeHg (SIS not applicable; no LCS)
  - ⇒ Pb-210 (LCS, MS, and DUP only)
  - ⇒ Geotechnical (DUP only)

- *Precision* is defined as the degree of reproducibility among individual measurements of the same property, obtained under similar conditions. Measures of analytical precision will be determined in all phases of the program.

  Applicable samples: MS/MSD, DUP.
  Applicable analyses:
  - ⇒ Dioxin/Furan (no DUP)
  - ⇒ Pesticide (No Dup)
  - ⇒ PAH (no DUP)
  - ⇒ Metals (no DUP)
  - ⇒ MeHg (no DUP)
  - ⇒ Pb-210 (no MSD)
  - ⇒ Geotechnical (DUP only)

EPA-NE QAPP Worksheet #11a - Rev. 10/99 (continued)

Project Quality Objectives/Decision Statements

- *Representativeness* is the degree to which data accurately and precisely represent a characteristic of a population. Representativeness is addressed primarily in the sample design, through the selection of sampling sites and procedures that reflect the project goals and environment being sampled. It is ensured by the proper handling, homogenizing, compositing, and storage of samples and analysis within the specified holding times so that the material analyzed reflects the material collected as accurately as possible.

  Applicable analyses: Dioxins/Furans, PCB Aroclors, Chlorinated Pesticides, PAH, Metals, Hg, MeHg, Pb-210 activity, Geotechnical and Percent Moisture.

- *Completeness* is defined as the amount of data collected as compared to the amount that is needed to make valid decisions. 100% completeness is targeted for all analyses. Study objectives will not be compromised if 95% of the analytes are reported.

  Applicable analyses: Dioxins/Furans, PCB Aroclors, Chlorinated Pesticides, PAH, Metals, Hg, MeHg, Pb-210 activity, Geotechnical and Percent Moisture.

- *Comparability* is the measure of the confidence with which one data set can be compared to another. Comparability can be measured using split samples, comparing data to historical, or as will be done for this project – by using established laboratory methods that are comparable to other low-level methods and by analyzing Standard Reference Material (SRM) samples, as available. Using SRMs from batch to batch of samples throughout this project shows how data compares at the concentration of the SRM.

  Applicable samples: SRM
  Applicable analyses:
  ⇒ Dioxin/Furan
  ⇒ Pesticides
  ⇒ PAH
  ⇒ Metals (at Mitkem, the SRM will be a "Priority Pollutant/CLP™ Inorganic Soil" from Environemntal Resource Associates)
  ⇒ Hg, MeHg

- *Sensitivity* is the capability of methodology or instrumentation to discriminate among measurement responses for quantitative differences or a parameter of interest. Sensitivity expressed as the detection limits is presented in (EPA Worksheet #9b).

  Applicable analyses: Dioxins/Furans, PCB Aroclors, Chlorinated Pesticides, PAH, Metals, Hg, MeHg, Pb-210 activity and Geotechnical.

- *Quantitation Limits*. Recommended project action goals are documented in EPA-NE QAPP Worksheet #9b. These are recommended detection limits, not **required** limits.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #11a - Rev. 10/99 (continued)

Project Quality Objectives/Decision Statements

All deviations from protocols described in this QAPP will be documented and approved by the Project Manager and discussed in the final report. All data that do not meet the listed MPCs will be submitted to the Project Manager, or her designee, for review and assessment of the potential impact of the results.

Affected samples may be reanalyzed at the Project Manager's discretion. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a, Data Verification and Validation Tasks), and the rationale for accepting the analysis will be thoroughly documented.

The calculation of quality control statistics is summarized in EPA-NE QAPP Worksheet #30.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #11b - Rev. 10/99

Measurement Performance Criteria Table

Medium/ Matrix	Sediment
Analytical Parameter	Dioxin/Furan
Concentration Level	Low

QC results are evaluated against the measurement performance criteria (MPC) and all data that do not meet the listed MPCs will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rational for accepting the analysis thoroughly documented in the QA/QC narrative.

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)[3]	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
S-17, S-19	1613B/ L-23	Accuracy	<5× MDL, or associated samples >5× blank values (>10× blank values for OCDD, OCDF and totals)	Blank	A
			PD≤30% from certified values (for certified values >5× MDL)	Standard Reference Material	A
			Within Method 1613 Table 6 OPR requirements for LCS 50-120% R for MS/MSD (Analyte concentration in MS/MSD must be >5× background concentration to be used for data quality assessment)	Laboratory Control Sample; Matrix Spike/Spike Duplicate	A
			25-150% R	Internal Standards	A
		Precision	Not Required	Laboratory (Analytical) Sample Duplicates	A
			RPD≤30% (Using R data; Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)	MS/MSD	A
		Comparability	See SRM above	Intercomparison exercises (*e.g.*, SRM analyses), follow defined SOPs	A

MDL = Method Detection Limit; PD = Percent Difference; R = Recovery; RPD = Relative Percent Difference
[1] Reference SOP Number from EPA-NE QAPP Worksheet #13.
[2] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.
[3] Data Quality Indicators (a.k.a. PARCC parameters, *i.e.*, precision, accuracy/bias, sensitivity, data completeness, comparability)

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #11b - Rev. 10/99

Measurement Performance Criteria Table

Medium/ Matrix	Sediment
Analytical Parameter	PCB, Pesticide and PAH
Concentration Level	Low

QC results are evaluated against the measurement performance criteria (MPC) and all data that do not meet the listed MPCs will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rational for accepting the analysis thoroughly documented in the QA/QC narrative.

Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)[3]**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
S-17, S-19	NS&T/L-9 (PCB/Pest) & NS&T/L-10 (PAH)	Accuracy	< sample-specific RL, or associated samples >5× blank values	Blank	A
			PD≤30% from a range of certified values (using surrogate corrected data; certified concentration in SRM must be >RL)	Standard Reference Material (*no SRM for Aroclor*)	A
			90% of analytes meet the following: 40-120% R (Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)	Laboratory Control Sample; Matrix Spike/Spike Duplicate	A
			40-125% R	Surrogates	A
		Precision	Not required	Laboratory (Analytical) Sample Duplicates	A
			RPD≤30% for at least 90% of analytes (Using R data; Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)	MS/MSD	A
		Comparability	See SRM above	Intercomparison exercises (*e.g.*, SRM analyses), follow defined SOPs	A

RL = Reporting Limit; PD = Percent Difference; R = Recovery; RPD = Relative Percent Difference

[1]Reference SOP Number from EPA-NE QAPP Worksheet #13.
[2] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.
[3] Data Quality Indicators (a.k.a. PARCC parameters, *i.e.*, precision, accuracy/bias, sensitivity, data completeness, comparability).

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #11b - Rev. 10/99

Measurement Performance Criteria Table

Medium/ Matrix	Sediment
Analytical Parameter	Hg, MeHg
Concentration Level	Low

QC results are evaluated against the measurement performance criteria (MPC) and all data that do not meet the listed MPCs will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rational for accepting the analysis thoroughly documented in the QA/QC narrative.

Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)[3]**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
S-17, S-19	1631c/L-41 Bloom (1989)/L-40	Accuracy	<5× MDL, or associated samples >5× blank values	Blank	A
			PD ≤ 25% from certified values (for certified values >5× MDL)	Standard Reference Material	A
			70-130 % R (Analyte concentration in MS/MSD must be >5× background concentration to be used for data quality assessment)	Matrix Spike/Spike Duplicate *(no applicable LCS for MeHg)*	A
			Not applicable	Surrogates	A
		Precision	Not required	Laboratory (Analytical) Sample Duplicates	A
			RPD≤30% (Using R data; Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)	MS/MSD	A
		Comparability	See SRM above	Intercomparison exercises (*e.g.*, SRM analyses), follow defined SOPs	A

MDL = Method Detection Limit; PD = Percent Difference; R = Recovery; RPD = Relative Percent Difference.

[1]Reference SOP Number from EPA-NE QAPP Worksheet #13.
[2] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.
[3] Data Quality Indicators (a.k.a. PARCC parameters, *i.e.*, precision, accuracy/bias, sensitivity, data completeness, comparability).

EPA-NE QAPP Worksheet #11b - Rev. 10/99

Measurement Performance Criteria Table

Medium/ Matrix	Sediment
Analytical Parameter	Metals
Concentration Level	Low

QC results are evaluated against the measurement performance criteria (MPC) and all data that do not meet the listed MPCs will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rational for accepting the analysis thoroughly documented in the QA/QC narrative.

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)[3]	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
S-17, S-19	SW6010B/ L-119 SW7471/L-120	Accuracy	<RL, or associated samples >10× blank values (a)	Blank	A
			Within Manufacturer Specified Performance Acceptance Limits (for certified values >5× MDL)	Standard Reference Material	A
			70-130 % R (Analyte concentration in MS/MSD must be >5× background concentration to be used for data quality assessment)	Laboratory Control Sample; Matrix Spike/Spike Duplicate	A
			Not applicable	Surrogates	A
		Precision	Not required	Laboratory (Analytical) Sample Duplicates	A
			RPD≤30% (Using R data; Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)	MS/MSD	A
		Comparability	See SRM above	Intercomparison exercises (*e.g.*, SRM analyses), follow defined SOPs	A

RL = Reporting Limit; MDL = Method Detection Limit; PD = Percent Difference; R = Recovery; RPD = Relative Percent Difference.

(a) RL is set at or above lowest calibration standard many MDL's are 20-100 times lower than the RL which is why the 5× MDL criteria is not used.

[1]Reference SOP Number from EPA-NE QAPP Worksheet #13.
[2] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.
[3] Data Quality Indicators (a.k.a. PARCC parameters, *i.e.*, precision, accuracy/bias, sensitivity, data completeness, comparability).

EPA-NE QAPP Worksheet #11b - Rev. 04/03 (continued)

Measurement Performance Criteria Table

Medium/ Matrix	Sediment
Analytical Parameter	Pb-210
Concentration Level	Low

QC results are evaluated against the measurement performance criteria (MPC) and all data that do not meet the listed MPCs will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rational for accepting the analysis thoroughly documented in the QA/QC narrative.

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)[3]	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
S-17, S-19	TBE-2015/ L-112	Accuracy	< Sample-specific MDC, or associated samples >5× blank values	Blank	A
			Not applicable – *No SRM or PE available*	Standard Reference Material	A
			Analytes meet the following: 70-130% R	Laboratory Control Sample	A
			60-140% R (Concentration of spiked analytes in MS must be >5× background concentrations to be used for data quality assessment)	Matrix Spike	A
		Precision	RPD≤50% (Analytes detected at level >5× MDC)	Laboratory (Analytical) Sample Duplicates	A
			Not Applicable (MS only)	MS/MSD	A
		Comparability	Not applicable, see SRM above	Intercomparison exercises (*e.g.*, SRM analyses)	A

RL = Reporting Limit; R = Recovery; MDC = Minimum Detectable Concentration; RPD = Relative Percent Difference
[1] Reference SOP Number from EPA-NE QAPP Worksheet #13.
[2] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.
[3] Data Quality Indicators (a.k.a. PARCC parameters, *i.e.*, precision, accuracy/bias, sensitivity, data completeness, comparability).

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #11b - Rev. 10/99

Measurement Performance Criteria Table

Medium/ Matrix	Sediment
Analytical Parameter	Geotechnical (a)
Concentration Level	Low

QC results are evaluated against the measurement performance criteria (MPC) and all data that do not meet the listed MPCs will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rational for accepting the analysis thoroughly documented in the QA/QC narrative.

Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)[3]**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
S-17, S-19	ASTM D422/ L-46 ASTM D4318/L-117 ASTM D2974/L-118 ASTM D2216/L-47	Accuracy	Not applicable	Blank	A
			Not applicable – *No SRM for geotechnical parameters*	Standard Reference Material	A
			Not applicable	Laboratory Control Sample; Matrix Spike/Spike Duplicate	A
			Not applicable	Surrogates	A
		Precision	RPD ≤ 50% (for analytes detected at level > 10× MDL)	Laboratory (Analytical) Sample Duplicates	A
			Not applicable	MS/MSD	A
		Comparability	See SRM above	Intercomparison exercises (*e.g.*, SRM analyses), follow defined SOPs	A

MDL = Method Detection Limit; RPD = Relative Percent Difference.

(a) Geotechnical parameters include Grain Size by ASTM D422; Atterberg Limits by ASTM D4318; Percent Solids by ASTM D2974; and Water Content by ASTM D2216.

[1] Reference SOP Number from EPA-NE QAPP Worksheet #13.

[2] Reference analytical method/SOP Number from EPA-NE QAPP Worksheet #20.

[3] Data Quality Indicators (a.k.a. PARCC parameters, *i.e.*, precision, accuracy/bias, sensitivity, data completeness, comparability).

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #12a - Rev. 10/99

Sampling Design and Rational

The Field Sampling Plan (FSP) has been prepared for these activities and is provided as a separate document (Battelle, 2005[5]) to this QAPP Addendum. The FSP and QAPP addendum comprise the Sampling and Analysis Plan (SAP) for the investigation.

This FSP is divided into four sections. Section 1.0 presents background information and states the objectives of the field activities. Section 2.0 describes the components of general site management and Section 3.0 presents the specifics of the field data collection activities. References are provided in Section 4.0, and other supporting information is provided in the appendices.

The field sampling activities consist of the following subtasks:

- Mobilization/demobilization;
- Sample collection;
- Field investigation documentation;
- Chain-of-custody procedures;
- Decontamination procedures, and
- Control and disposal of Investigation Derived Waste (IDW).

Each of these tasks and the specific data collection activities are described in the FSP (Battelle, 2005).

[5] Battelle, 2005. Field Sampling Plan, Centredale Manor Restoration Project Superfund Site, Lyman Mill Pond Sediment Investigation. January.

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EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)
Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4501 LPX-SD-4502 LPX-SD-4503 LPX-SD-4504 LPX-SD-4505 LPX-SD-4506 LPX-SD-4507 LPX-SD-4508 LPX-SD-4509 LPX-SD-4510	Sediment Cores	To be determ-ined	Dioxin/Furan	Low	Approximately 3 samples will be analyzed from each sediment core. Samples will be collected from 3 depth intervals, including: surface (0.0-0.5 ft); mid-depth (1.2-1.3 ft); and deep (2.4-2.5 ft) intervals.	S-17, S-19	L-23	½ full	125 mL pre-cleaned jar	Cold (<6°C)	1 year

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.
[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

US EPA ARCHIVE DOCUMENT

EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)

Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4501	Sediment Cores	To be determ-ined	PCB Aroclor, Pesticide and PAH	Low	Approximately 1 sample, collected from the surface depth interval (0.0-0.5 ft), will be analyzed from each sediment core.	S-17, S-19	Moisture L-13; PCB Aroclor/ Pesticide L-9; PAH L-10	½ full	125 mL pre-cleaned jar	Cold (<6°C)	Organics: 1-year if frozen (EPA, 1992)
	LPX-SD-4502											
	LPX-SD-4503											
	LPX-SD-4504											
	LPX-SD-4505											
	LPX-SD-4506											
	LPX-SD-4507											
	LPX-SD-4508											
	LPX-SD-4509											
	LPX-SD-4510											

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.
[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

US EPA ARCHIVE DOCUMENT

EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)

Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4501	Sediment Cores	To be determ-ined	Hg and MeHg	Low	Approximately 1 sample, collected from the surface depth interval (0.0-0.5 ft), will be analyzed from each sediment core.	S-17, S-19	Hg L-41 MeHg L-40	½ full	125 mL pre-cleaned jar	Frozen	28-d
	LPX-SD-4502											
	LPX-SD-4503											
	LPX-SD-4504											
	LPX-SD-4505											
	LPX-SD-4506											
	LPX-SD-4507											
	LPX-SD-4508											
	LPX-SD-4509											
	LPX-SD-4510											

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.

[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

US EPA ARCHIVE DOCUMENT

EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)

Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4501	Sediment Cores	To be determ-ined	Metals	Low	Approximately 1 sample, collected from the surface depth interval (0.0-0.5 ft), will be analyzed from each sediment core.	S-17, S-19	L-119 L-120	½ full	125 mL pre-cleaned jar	Cold (<6°C)	6-mo (28-d Hg)
	LPX-SD-4502											
	LPX-SD-4503											
	LPX-SD-4504											
	LPX-SD-4505											
	LPX-SD-4506											
	LPX-SD-4507											
	LPX-SD-4508											
	LPX-SD-4509											
	LPX-SD-4510											

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.
[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

US EPA ARCHIVE DOCUMENT

EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)

Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4502	Sediment Cores	To be determ-ined	Pb-210	Low	5 cores will be collected; 3-5 cores will be analyzed, with sufficient number of subsamples to determine a vertical profile. 30 analyses are authorized. Sample intervals will be selected by the project geologist based on the CSM and stratigraphy	S-17, S-19	L-112	3/4 full	125 mL pre-cleaned jar	Ambient	30 d
	LPX-SD-4503											
	LPX-SD-4505											
	LPX-SD-4507											
	LPX-SD-4509											

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.
[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

US EPA ARCHIVE DOCUMENT

EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)

Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4501 LPX-SD-4502 LPX-SD-4503 LPX-SD-4504 LPX-SD-4505 LPX-SD-4506 LPX-SD-4507 LPX-SD-4508 LPX-SD-4509 LPX-SD-4510	Sediment Cores	To be determ-ined	Geotechnical (parameters may vary by sample, but will generally include percent solids, water content, grain size and Atterberg Limits)	Low	5 samples will be analyzed for grain size and Atterberg Limits; 15 samples will be analyzed for percent solids and water content. Samples for potential geotechnical analysis will be collected from the surface (0.0-0.5 ft) and mid-depth intervals from each core.	S-17, S-19	Grain Size L-46 Atterberg Limits L-117 Percent Solids L-118 Water Content L-47	½ full	1 L pre-cleaned glass jar	Cold (<6°C)	28-d

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EPA-NE QAP P Worksheet #12b - Rev. 10/99 (continued)
Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location [1]	Location ID Number	Medium/ Matrix	Depth (Units)	Analytical Parameter	Conc Level	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[2]	Analytical Method/ SOP[2]	Minimum Sample Volume [3]	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Lyman Mill Pond	LPX-SD-4501	Sediment Cores	To be determ-ined	Archive	Low	1 Archive sample will be collected from deeper in the core (3.0-3.5 ft) in the event that the deep sample (2.4-2.5 ft) from any core shows evidence of dioxin contamination	S-17, S-19	Archive	½ full	125 mL pre-cleaned jar	Frozen	N/A
	LPX-SD-4502											
	LPX-SD-4503											
	LPX-SD-4504											
	LPX-SD-4505											
	LPX-SD-4506											
	LPX-SD-4507											
	LPX-SD-4508											
	LPX-SD-4509											
	LPX-SD-4510											

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.
[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

[1] All field sampling locations are critical; see Field Sampling Plan for specific locations.
[2] See the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).
[3] Sample volume listed for all parameters is sufficient to allow extra material for preparation of Fixed Laboratory quality control (QC) samples.

EPA-NE QAPP Worksheet #13 - Rev. 10/99

Project Sampling SOP Reference Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Identification	Modified for Project Work Y or N	Comments[1]
S-17	Soil Sampling Appendix E – Visual Identification of Soil Samples EM 1110-1-1906 (9/30/96)	Battelle and USACE WES	Core log, core slicing equipment	N	Provided with QAPP Addendum #2 (USEPA, 2003)
S-19	Coring Methodology U.S. EPA ERTC/REAC (March 2003), As Modified by Battelle (March 2005)	ERTC/REAC	Vibracore and penetrometer assembly, decontaminated Lexan core liners, core caps, GPS	N	Attachment
S-20	Northstar 952XDW Differential GPS Navigation System (Battelle SOP 3-118-02)	Battelle	GPS unit	N	See FSP
S-21	Packaging and Shipment of Samples (Battelle SOP 5-210-03)	As above	Coolers, tape, blue Ice, wet ice, ziplock bags, custody forms	N	See FSP
S-22	Sample Receipt, Custody, and Handling (Battelle SOP 6-010-11)	As above	varies	N	
S-23	Sample Receipt, Custody, and Handling in the Field (Battelle SOP 6-040-01)	As above	varies	N	

[1] Sampling SOPs provided in Field Sampling Plan (Battelle, 2005).

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #14 - Rev. 10/99

Field Sampling Equipment Calibration Table

Equipment	Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference*
Vibracore	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

* Specify appropriate reference letter/number from the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13).

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #15 - Rev. 10/99

Field Equipment Maintenance, Testing and Inspection Table

Sampling Equipment/ Instrument	Maintenance Activity	Testing Activity	Inspection Activity	Responsible Person	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
Vibracore	Cleaning	NA	Visual inspection	Alex Mansfield (Battelle) Robert Reynolds and Mark Avakian (TG&B)	Prior to use and after each use	Decon. completed	Re-Clean	NA
Core Slicing Equipment	Cleaning	NA	Visual inspection	Theresa Himmer (Battelle)	Prior to use and after each use	Decon. completed	Re-Clean	NA

NA = Not applicable.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #16 - Rev. 10/99

Sample Handling, Tracking and Custody Requirements

SAMPLE COLLECTION, PACKAGING AND SHIPMENT
Sample Collection: Alex Mansfield (Battelle), Robert Reynolds (TG&B) and Mark Avakian (TG&B) – sediment cores
Sample Packing: Alex Mansfield (Battelle) – transport of sediment cores to EPA AED
Coordination of Shipment: Alex Mansfield and Jessica Fahey (Battelle) – sediment cores and processed cores
Type of Shipment (Courier): Same day transfer to EPA-AED, Narragansett using Battelle vehicle; Overnight Carrier for delivery of sediment sub-samples (processed sediment cores) from Battelle to participating laboratories.
SAMPLE RECEIPT AND ANALYSIS
Responsible Organization: Battelle Columbus (receive samples for Dioxin/Furan analysis) Battelle Duxbury (receive samples for PCB Aroclors, pesticide and PAH analyses) Battelle MSL (receive samples for Hg and MeHg analyses) Mitkem Corporation (receive samples for metals analyses) Teledyne Brown (receive samples for Pb-210 activity analyses) Applied Marine Sciences (receive samples for geotechnial analyses)
Sample Receipt: Henry Pham, Sample Custodian Battelle Columbus Jeff Newell, Sample Custodian Battelle Duxbury Carolynn Suslick, Sample Custodian Battelle MSL Shirley Ng, Sample Custodian Mitkem Corporation Pat Marshall, Sample Custodian Teledyne Brown Ken Davis, Sample Custodian Applied Marine Sciences, Inc
Sample Custody and Storage: Henry Pham Sample Custodian Battelle Columbus Jeff Newell, Sample Custodian Battelle Duxbury Carolynn Suslick, Sample Custodian Battelle MSL Shirley Ng, Sample Custodian Mitkem Corporation Pat Marshall, Sample Custodian Teledyne Brown Ken Davis, Sample Custodian Applied Marine Sciences, Inc
Sample Preparation: Mark Misita, Henry Pham and Susan Winnard (assisted by Wesley Baxter), Dioxin/Furan at Battelle Columbus Jon Thorn (assisted by sample prep staff), PCB Aroclor, pesticide, PAH, and percent moisture at Battelle Duxbury Mary Ann Deuth and Brenda Lasorsa, Hg and MeHg at Battelle MSL Karolina Badura and Ruth Smith, Metals at Mitkem Corporation Lauren Larson, Pb-210 at Teledyne Brown Ken Davis, TOC and Grain Size Applied Marine Sciences **Laboratory QC samples defined on EPA-NE QAPP Worksheet #24a must be prepared with the Study Samples. MS, MSD and laboratory duplicate samples must be prepared from Centredale project samples.**

EPA-NE QAPP Worksheet #16 - Rev. 10/99 (continued)

Sample Handling, Tracking and Custody Requirements

Sample Determinative Analysis: Joe Tabor (assisted by Betsy Thompson), Dioxin/Furan at Battelle Columbus Bob Lizotte (assisted by GC and GC/MS analysts), PCB Aroclor, pesticides and PAH at Battelle Duxbury Mary Ann Deuth and Brenda Lasorsa, Hg and MeHg at Battelle MSL Joanna Sadlek, Karolina Badura, Metals at Mitkem Corporation Lauren Larson, Pb-210 at Teledyne Brown Ken Davis, TOC and Grain Size Applied Marine Sciences
SAMPLE ARCHIVAL
Field Sample Storage (No. of days from sample collection): Varies by parameter and matrix for chemical analyses – see Worksheet #9a (Table 2)
Sample Extract/Digestate Storage (No. of days from extraction/digestion): varies by parameter and matrix for chemical analysis– see Worksheet #9a (Table 2)
SAMPLE DISPOSAL
Responsible Organization: Each participating laboratory is responsible for disposal of samples received for required analyses
Responsible Personnel: Project Manager and Sample Custodian

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #18 - Rev. 10/99

Field Analytical Instrument Calibration Table

Instrument	Activity	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference
GPS	Determine coordinates of sampling locations	daily	100m	Replace instrument	Battelle sampling personnel	S-20

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #19 - Rev. 10/99

Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table

Instrument	Maintenance Activity	Testing Activity	Inspection Activity	Responsible Person	Frequency	Acceptance Criteria	Corrective Action	Method/ SOP Reference
GPS	N/A	N/A	Visual inspection	As above	Daily	Equipment in working order	Replacement device obtained	S-20

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EPA-NE QAPP Worksheet #20 - Rev. 10/99

Fixed Laboratory Analytical Method/SOP Reference Table

Ref Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive[1] or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrmt	Mod for Project Work Y or N
L-1	Battelle Duxbury	Use of the Cahn Model 25 and Cahn Model 28 Electrobalances (SOP 3-004)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-2	Battelle Duxbury	Operation and Maintenance of Hewlett-Packard 5970B, 5972A and 5973A Gas Chromatograph/Mass Selective Detector (GC/MSD) using Hewlett-Packard Software (SOP 3-092)	Definitive	NA	PAH	GC/MS	N
L-3	Battelle Duxbury	Operation and Maintenance of Gas Chromatographs (SOP 3-116)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-4	Battelle Duxbury	Analytical Instrument Data Acquisition Using the Labsystems X-Chrome Data System (SOP 3-132)	Definitive	NA	Pest/PCB	GC/ECD	N
L-5	Battelle Duxbury	Use of Electronic Balances (SOP 3-160)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-6	Battelle Duxbury	Quality Assurance Facilities Inspections (SOP 4-009)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-7	Battelle Duxbury	Quality Assurance Audits of Reported Data (SOP 4-015)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-8	Battelle Duxbury	Non-Conformance and Corrective Action (SOP 4-035)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-9	Battelle Duxbury	Identification and Quantification of Polychlorinated Biphenyls (By Congener and Aroclor) and Chlorinated Pesticides by Gas Chromatography/Electron Capture Detection (SOP 5-128)	Definitive	NS&T Methods	Pest/PCB	GC/ECD	N
L-10	Battelle Duxbury	Identification and Quantification of Polynuclear Aromatic Hydrocarbons by Gas Chromatography/Mass Spectrometry (SOP 5-157)	Definitive	NS&T Methods	PAH	GC/MS	N
L-11	Not assigned						
L-12	Battelle Duxbury	HPLC Cleanup of Samples for Semivolatile Organic Pollutants (SOP 5-191)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #20 - Rev. 10/99

Fixed Laboratory Analytical Method/SOP Reference Table

Ref Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive[1] or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrmt	Mod for Project Work Y or N
L-13	Battelle Duxbury	Soil/Sediment Extraction for Trace Level Semi-Volatile Organic Contaminant Analysis (SOP 5-192)	Definitive	NA	PAH, Pest/PCB, Moisture	GC/MS and GC/ECD	N
L-14	Not assigned						
L-15	Battelle Duxbury	Cleaning of Organic Chemistry Labware (SOP 5-216)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-16	Battelle Duxbury	Chemistry Laboratory Sample Identification (SOP 6-007)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-17	Battelle Duxbury	Sample Receipt, Custody and Handling (SOP 6-010)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-18	Battelle Duxbury	Documentation Procedures in the Gas Chromatography/Mass Spectrometry (GC/MS) Facility (SOP 6-011)	Definitive	NA	PAH	GC/MS	N
L-19	Battelle Duxbury	Data Recording (SOP 6-017)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-20	Battelle Duxbury	Laboratory Verification and Validation of Analytical Data (SOP 6-027)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-21	Battelle Duxbury	Preparation of Analytical Control Charts (SOP 7-028)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-22	Battelle Duxbury	Preparation, Analysis, and Reporting Quality Control Data in the Chemistry Laboratory (SOP 7-029)	Definitive	NA	PAH and Pest/PCB	GC/MS and GC/ECD	N
L-23	Battelle Columbus	The Analysis of Polychlorinated Dibenzo-p-dioxin/Polychlorinated Dibenzofuran (PCDD/PCDF) Using High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS) Using Modified Method 8290 (ASAT.II-001-02)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-24	Battelle Columbus	Polychlorinated Dibenzo-p-dioxin/Polychlorinated Dibenzofuran (PCDD/PCDF) Sample Preparation Using Modified Methods 8290 (ASAT-II-002-02)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	Y (a)

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #20 - Rev. 10/99

Fixed Laboratory Analytical Method/SOP Reference Table

Ref Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive[1] or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrmt	Mod for Project Work Y or N
L-25	Battelle Columbus	Internal QA Inspection and Corrective Action Procedures for Polychlorinated Dibenzo-p-dioxin/Polychlorinated Dibenzofuran (PCDD/PCDF) and Related Compounds Analytical Programs (ASAT.II-003-00)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-26	Battelle Columbus	Polychlorinated Dibenzo-p-dioxin/Polychlorinated Dibenzofuran (PCDD/PCDF) Desiccating Agent And Adsorbent Preparation and Storage (ASAT.II-005-00)	Definitive	NA	Dioxin/Furan	GC/ HRMS	N
L-27	Battelle Columbus	Polychlorinated Dibenzo-p-dioxin/Polychlorinated Dibenzofuran (PCDD/PCDF) Standards and Reagents Preparation and Storage for Modified Method 8290 Analysis (ASAT.II-006-00)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-28	Battelle Columbus	Chain of Custody for Dioxin/Furan Analysis (ASAT.II-007-00)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-29	Battelle Columbus	Standard Operating Procedure for Dioxin/Furan Technical Data Review (ASAT.II-010-00)	Definitive	NA	Dioxin/Furan	GC/ HRMS	N
L-30	Battelle Columbus	Standard Operating Procedure for using Electronic and Mechanical Balances (ASAT.II-011-00)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-31	Battelle Columbus	Standard Operating Procedure (SOP) for the Use of Refrigerators and Freezers used for Dioxin-Related Projects (ASAT.II-012-00)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-32	Not assigned						
L-33	Battelle Columbus	Standard Operating Procedure (SOP) for the Use and Calibration of Digital and Glass Thermometers (ASAT.II-013-00)	Definitive	NA	Dioxin/ Furan	GC/ HRMS	N
L-98	Battelle Columbus	Polychlorinated Dibenzo-p-Dioxin/Polychlorinated Dibenzofuran (PCDD/PCDF) Sample Container Preparation and Shipment (ASAT.II-004-00)	Definitive	NA	Dioxin/Furan	NA	N

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #20 - Rev. 10/99

Fixed Laboratory Analytical Method/SOP Reference Table

Ref Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive[1] or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrmt	Mod for Project Work Y or N
L-34	Battelle Marine Sciences Laboratory (MSL)	Sample Chain-of-Custody (MSL-A-002)	Definitive	NA	Hg, MeHg	CVAA, CVAF	N
L-35	Battelle MSL	Percent Dry Weight and Homogenizing Dry Sediment, Soil, and Tissue (MSL-C-003)	Definitive	NA	Moisture Content	Analytical balance	N
L-36	Battelle MSL	Glassware and Equipment Cleaning Procedures (MSL-C-011)	Definitive	NA	Hg, MeHG	CVAA, CVAF	N
L-37	Battelle MSL	Sediment Evaporation Digestion (MSL-I-004)	Definitive	NA	Hg, MeHg	CVAA, CVAF	N
L-38	Battelle MSL	Mixed Acid Sediment Digestion (MSL-I-006)	Definitive	NA	Hg, MeHG	CVAA, CVAF	N
L-39	Not assigned						
L-40	Battelle MSL	MethylMercury in Tissues and Sediments by Cold Vapor Atomic Fluorescence (MSL-I-015)	Definitive	NA	MeHg	CVAF	N
L-41	Battelle MSL	Total Mercury in Tissues and Sediments by Cold Vapor Atomic Absorption (CVAA) (MSL-I-016)	Definitive	NA	Hg	CVAA	N
L-42	Not applicable						
L-43	Not assigned						
L-44	Not applicable						
L-45	Not applicable						
L-64	Battelle MSL	Quality Assurance Inspections of MSL System and Study Activities (MSL-Q-002)	Definitive	NA	Hg, MeHg	NA	N
L-65	Battelle MSL	Quality Assurance Audits of Reports (MSL-Q-003)	Definitive	NA	Hg, MeHg	NA	N
L-67	Battelle MSL	Quality Assurance Data Audits (MSL-Q-005)	Definitive	NA	Hg, MeHg	NA	N
L-68 through L-97	Not assigned						
L-46	Applied Marine Sciences, Inc. (AMS)	Wet Preparation of Soil Samples for the Quantitative Determination of Particle Size Analysis (Sieve and Hydrometer Method) (SOP 2103)	Definitive	NA	Grain Size	Analytical balance/ drying oven	N

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #20 - Rev. 10/99

Fixed Laboratory Analytical Method/SOP Reference Table

Ref Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive[1] or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrmt	Mod for Project Work Y or N
L-47	AMS	Laboratory Determination of Moisture Content of Soils (SOP 2301)	Definitive	NA	Water Content	Analytical balance/ drying oven	N
L-48	AMS	No internal SOP – follow Method ASTM D2487	Definitive	NA	Classification	NA	N
L-49	AMS	Total Organic Carbon Content of Sediments by Coulometric Detection (SOP 2201)	Definitive	NA	TOC	Analytical balance/ CO_2 coulometer	N
L-99	AMS	Guidelines for Sample Receipt, Login, and Storage (SOP 1301)	Definitive	NA	Grain Size, TOC	NA	N
L-117	AMS	Determination of Atterberg Limits: Liquid Limit, Plastic Limit, and Plasticity Index of Soils (AMS SOP 2601)	Definitive	NA	Geotechnical	Analytical balance	N
L-118	AMS	Determination of Total, Fixed, and Volatile Solids in Sediment Samples (AMS SOP 2303)	Definitive	NA	Geotechnical	Analytical balance	N
L-50 throuh L-63	Not applicable or not assigned						
L-66	Not assigned						
L-100 through L-111	Not assigned or not assigned						
L-112 [2]	Teledyne Brown	Determination of Leachable Lead-210 In Soils And Sediments (Procedure 2015) [2]	Definitive	NA	Pb-210	Low level, gas-flow proportion al counter	N
L-113	Not applicable						
L-114	Teledyne Brown	Calibration and Control of Alpha and Beta Counting Instruments (Procedure TBE-3003, Rev. 0)	Definitive	NA	Pb-210	Low level, gas-flow proportion al counter	N
L-115	Not applicable						
L-116 [2]	Teledyne Brown	Balance Calibration Check (Procedure TBE-3006) [2]	Definitive	NA	Pb-210	Balance	N
L-119	Mitkem Corporation	Determination of Metals in Water and Soil by Inductively Coupled Argon Plasma Atomic Emission Spectroscopy	Definitive	NA	Metals	ICP/OES	N
L-120	Mitkem Corporation	Mercury Analysis in Aqueous and Soil Samples by Flow Injection Mercury System (FIMS) for Atomic Absorption	Definitive	NA	Hg	FIMS	N

EPA-NE QAPP Worksheet #20 - Rev. 10/99

Fixed Laboratory Analytical Method/SOP Reference Table

Ref Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive[1] or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrmt	Mod for Project Work Y or N
L-121	Mitkem Corporation	Sample Preparation of Aqueous Samples by Acid Digestion for ICP	Definitive	NA	Metals	ICP/OES	N
L-122	Mitkem Corporation	Preparation of Soil Samples by Acid Digestion for ICP Analysis	Definitive	NA	Metals	ICP/OES	N

All SOPs listed in shaded rows (above) are included with the QAPP Addendum 3; all other SOPs were provided with the May 23, 2001 QAPP; September 27, 2002 QAPP Addendum or April 28, 2003 QAPP Addendum 2

[1] SOPs listed here either directly or indirectly relate to the generation of definitive data.

[2] The TBE Knoxville Procedure Manual has been renumbered and the procedures have been revised to a standard format. Technical information remains the same. The following procedure numbers have been revised:

TBE-032-30 has been replaced with TBE-2015, *Lead-210 Activity in Various Matrices*.

PRO-Q-008 has been replaced with TBE-3006, *Balance Calibration and Check*.

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EPA-NE QAPP Worksheet #21 - Rev. 10/99

Fixed Laboratory Instrument Maintenance and Calibration Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[1]	Method/ SOP Ref*
GC/HRMS	Dioxin/ Furan Analysis	Column if needed; clip retention gap if needed; tune HRMS; check for leaks; analyze calibration point 3, window set, and column performance check	IC: minimum every 6 months; CC: every 12 hours	IC: RSD≤25% for native compounds and RSD≤35% for labeled compounds CC: Within limits of Method 1613B, Table 6 "VER" requirements	Remedial maintenance, new initial calibration, reanalyze samples or use of CC response factors in calculations. Document and justify	Joe Tabor (GC/HRMS Analyst) or Task Leader	L-23
Analytical balance	Moisture Content	Daily performance check (or with each use).	1×/daily using two Class "S" weights bracketing expected weight range	within 0.01 g of value	Calibration and service performed as needed or at regular intervals by professional metrology technician.	Jon Thorn (Supervisor, Sample Preparation Chemists)	L-1
GC/ECD	Pest/PCB Analysis	Change injection port liner; check for leaks	IC: prior to analytical run; CC: every 12 hours	IC: RSD≤25% mean RSD≤15% CC: PD from initial ≤25%; mean PD≤15%	Remedial maintenance, new initial calibration, or reanalyze samples. Document and justify	Bob Lizotte (Supervisor, GC/ECD Analysts)	L-9
GC/MS	PAH Analysis	Change injection port liner; tune MSD; check for leaks	IC: prior to analytical run; CC: every 12 hours	IC: RSD≤25% mean RSD≤15% CC: PD from initial ≤25%; mean PD≤15%	Remedial maintenance, new initial calibration, or reanalyze samples. Document and justify	Bob Lizotte (Supervisor, GC/MS Analysts)	L-10
Freeze Dryer	Freeze Drying	Performance check (seals, vacuum pump operation, temperature) with each use	NA	NA	Maintenance or repair as needed	Rebecca Wood Prep Lab Manager	L-35

EPA-NE QAPP Worksheet #21 - Rev. 10/99

Fixed Laboratory Instrument Maintenance and Calibration Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[1]	Method/ SOP Ref*
Analytical balance	Moisture Content	Daily performance check (or with each use).	1×/daily using two Class "S" weights bracketing expected weight range	within 0.001 g of value	Calibration and service performed as needed or at regular intervals by professional metrology technician.	Janet Cloutier QA Officer Rebecca Wood Prep Lab Manager	L-35
CVAA	Hg Analysis	Daily sensitivity and stability checks	IC: prior to analytical run; CC: every 10 samples	IC: $r^2 \geq 0.995$ CC: PD from true value ≤ 25% Mean PD ≤ 15%	Remedial Maintenance new IC or reanalyze Document and justify	Mary Ann Deuth Hg Analyst	L-41
CVAF	MeHg Analysis	As above	As above	IC: $r \leq 0.99$ CC: PD from true value ≤ 25% Mean PD ≤ 15%	As above	Jordana Wood Hg Analyst	L-40
FIMS	Hg	Examine Absorbance Levels Daily	Daily or each time the instrument is set up	Correlation Coefficient ≥ 0.995	Identify problem, perform maintenance as needed, and recalibrate	Joanna Sadlek/ Karolina Badura Hg Analysts	L-120
ICP/OES	Metals	Record Emission Counts Daily for plasma stability & longterm optical performance, Run Check Sample	As above	As above	As above	Joanna Sadlek ICP/OES Analyst	L-119
Analytical Balance	Moisture Content	Daily performance check (or with each use).	Daily using two Class "S" weights bracketing expected weight range	Within 0.01 g of value	Calibration and service performed as needed or at regular intervals by professional metrology technician.	Louie Balogh (lead analyst)	TBE-3006/ L-116
Low Background Proportional Counter	Pb-210	Daily source checks and backgrounds	Yearly	3 Standard deviations of established mean	Remedial maintenance, new initial calibration, Document and justify	Marty Webb (Production Supervisor)	TBE-3003/ L-114

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #21 - Rev. 10/99

Fixed Laboratory Instrument Maintenance and Calibration Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[1]	Method/ SOP Ref*
Drying oven/analytical balance	Grain Size, Atterberg Limits, Percent Solids and Water Content Determination	Temperature monitoring and calibrated, with annual maintenance	2x/daily (drying oven) daily (balance)	Within 0.001g of value (balance)	Re-weigh/re-calibrate/ service call	Ken Davis	L-46, L-117, L-118 and L-47

IC = Initial Calibration; CC = Continuing Calibration; RSD = Relative Standard Deviation; PD = Percent Difference; LB = Lab Blank; DL = Detection Limit; RL = Reporting Limit; ICV = Initial Calibration Verification; CCV = Continuing Calibration Verification.

[1] If specified project personnel not available; alternate and equally trained staff will perform task/corrective action

* Specify appropriate reference letter/number from Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #22a - Rev. 10/99

Field Sampling QC Table

Sampling SOP	S-17, S-19
Medium/Matrix	Sediment
Analytical Parameter	Dioxin/Furan
Concentration Level	Low
Analytical Method/ SOP Reference	1668B/L-23 1613A/L-32
Sampler's Name	Alex Mansfield
Field Sampling Organization	Battelle
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (see EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Unacceptable Field QC sample results are not a true measure of Fixed Laboratory accuracy and precision performance.

Field QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Equipment Blanks/ Rinsate Blanks	NA	NA	NA	NA	NA	NA
Bottle Blanks	NA	NA	NA	NA	NA	NA
Trip Blanks	NA	NA	NA	NA	NA	NA
Cooler Temperature Blanks	1 per cooler (bottle with clean sand – not a sample)	NA	Inform Project Manager; Document in QA/QC Narrative	Laboratory Sample Custodian	NA	< 6 °C
Field Duplicate Pairs (Duplicate Subsamples)	NA	NA	NA	NA	NA	NA
Collocated Samples	NA	NA	NA	NA	NA	NA
Field Splits	NA	NA	NA	NA	NA	NA
PES sent to Laboratory	NA	NA	NA	NA	NA	NA
Other:	NA	NA	NA	NA	NA	NA

RPD = Relative Percent Difference; MDL = Method Detection Limit

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EPA-NE QAPP Worksheet #22a - Rev. 10/99

Field Sampling QC Table

Sampling SOP	S-17, S-19
Medium/Matrix	Sediment
Analytical Parameter	PCB Aroclor/Pest and PAH
Concentration Level	Low
Analytical Method/ SOP Reference	NS&T/L-9 (GC/ECD); L-10 (GC/MS)
Sampler's Name	Alex Mansfield
Field Sampling Organization	Battelle
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (see EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Unacceptable Field QC sample results are not a true measure of Fixed Laboratory accuracy and precision performance.

Field QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Equipment Blanks/ Rinsate Blanks	NA	NA	NA	NA	NA	NA
Bottle Blanks	NA	NA	NA	NA	NA	NA
Trip Blanks	NA	NA	NA	NA	NA	NA
Cooler Temperature Blanks	1 per cooler (bottle with clean sand – not a sample)	NA	Inform Project Manager; Document in QA/QC Narrative	Laboratory Sample Custodian	NA	< 6 °C
Field Duplicate Pairs (Duplicate Subsamples)	NA	NA	NA	NA	NA	NA
Collocated Samples	NA	NA	NA	NA	NA	NA
Field Splits	NA	NA	NA	NA	NA	NA
PES sent to Laboratory	NA	NA	NA	NA	NA	NA
Other:	NA	NA	NA	NA	NA	NA

RL = Reporting Limit; RPD = Relative Percent Difference

EPA-NE QAPP Worksheet #22a - Rev. 10/99

Field Sampling QC Table

Sampling SOP	S-17, S-19
Medium/Matrix	Sediment
Analytical Parameter	Hg, MeHg
Concentration Level	Low
Analytical Method/ SOP Reference	1631c/L-41; Bloom (1989)/L-40
Sampler's Name	Alex Mansfield
Field Sampling Organization	Battelle
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (see EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Unacceptable Field QC sample results are not a true measure of Fixed Laboratory accuracy and precision performance.

Field QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Equipment Blanks/ Rinsate Blanks	NA	NA	NA	NA	NA	NA
Bottle Blanks	NA	NA	NA	NA	NA	NA
Trip Blanks	NA	NA	NA	NA	NA	NA
Cooler Temperature Blanks	1 per cooler (bottle with clean sand – not a sample)	NA	Inform Project Manager; Document in QA/QC Narrative	Laboratory Sample Custodian	NA	< 6 °C
Field Duplicate Pairs (Duplicate Subsamples)	NA	NA	NA	NA	NA	NA
Collocated Samples	NA	NA	NA	NA	NA	NA
Field Splits	NA	NA	NA	NA	NA	NA
PES sent to Laboratory	NA	NA	NA	NA	NA	NA
Other:	NA	NA	NA	NA	NA	NA

RPD = Relative Percent Difference; MDL = Method Detection Limit

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #22a - Rev. 10/99

Field Sampling QC Table

Sampling SOP	S-17, S-19
Medium/Matrix	Sediment
Analytical Parameter	Metals
Concentration Level	Low
Analytical Method/ SOP Reference	SW6010B/ L-119 SW7471/ L-120
Sampler's Name	Alex Mansfield
Field Sampling Organization	Battelle
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (see EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Unacceptable Field QC sample results are not a true measure of Fixed Laboratory accuracy and precision performance.

Field QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Equipment Blanks/ Rinsate Blanks	NA	NA	NA	NA	NA	NA
Bottle Blanks	NA	NA	NA	NA	NA	NA
Trip Blanks	NA	NA	NA	NA	NA	NA
Cooler Temperature Blanks	1 per cooler (bottle with clean sand – not a sample)	NA	Inform Project Manager; Document in QA/QC Narrative	Laboratory Sample Custodian	NA	< 6 °C
Field Duplicate Pairs (Duplicate Subsamples)	NA	NA	NA	NA	NA	NA
Collocated Samples	NA	NA	NA	NA	NA	NA
Field Splits	NA	NA	NA	NA	NA	NA
PES sent to Laboratory	NA	NA	NA	NA	NA	NA
Other:	NA	NA	NA	NA	NA	NA

RPD = Relative Percent Difference; MDL = Method Detection Limit

EPA-NE QAPP Worksheet #22a - Rev. 04/03 (continued)

Field Sampling QC Table

Sampling SOP	S-17, S-19
Medium/Matrix	Sediment
Analytical Parameter	Pb-210
Concentration Level	Low
Analytical Method/ SOP Reference	TBE-2015/L-112
Sampler's Name	Alex Mansfield
Field Sampling Organization	Battelle
No. of Sample Locations	~3 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (see EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Unacceptable Field QC sample results are not a true measure of Fixed Laboratory accuracy and precision performance.

Field QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Equipment Blanks/ Rinsate Blanks	NA	NA	NA	NA	NA	NA
Bottle Blanks	NA	NA	NA	NA	NA	NA
Trip Blanks	NA	NA	NA	NA	NA	NA
Cooler Temperature Blanks	NA	NA	Inform Project Manager; Document in QA/QC Narrative	Laboratory Sample Custodian	NA	Ambient
Field Duplicate Pairs (Duplicate Subsamples)	NA	NA	NA	NA	NA	NA
Collocated Samples	NA	NA	NA	NA	NA	NA
Field Splits	NA	NA	NA	NA	NA	NA
PES sent to Laboratory	NA	NA	NA	NA	NA	NA
Other:	NA	NA	NA	NA	NA	NA

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EPA-NE QAPP Worksheet #22a - Rev. 10/99

Field Sampling QC Table

Sampling SOP	S-17, S-19
Medium/Matrix	Sediment
Analytical Parameter	Grain Size, Atterberg Limits, Percent Solids and Water Content
Concentration Level	Low
Analytical Method/ SOP Reference	ASTM D422/L-46 D4318/L-117 D2974/L-118 D2216/L-47
Sampler's Name	Alex Mansfield
Field Sampling Organization	Battelle
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (see EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Unacceptable Field QC sample results are not a true measure of Fixed Laboratory accuracy and precision performance.

Field QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Equipment Blanks/ Rinsate Blanks	NA	NA	NA	NA	NA	NA
Bottle Blanks	NA	NA	NA	NA	NA	NA
Trip Blanks	NA	NA	NA	NA	NA	NA
Cooler Temperature Blanks	1 per cooler (bottle with clean sand – not a sample)	NA	Inform Project Manager; Document in QA/QC Narrative	Laboratory Sample Custodian	NA	< 6 °C
Field Duplicate Pairs (Duplicate Subsamples)	NA	NA	NA	NA	NA	NA
Collocated Samples	NA	NA	NA	NA	NA	NA
Field Splits	NA	NA	NA	NA	NA	NA
PES sent to Laboratory	NA	NA	NA	NA	NA	NA
Other:	NA	NA	NA	NA	NA	NA

RPD = Relative Percent Difference; MDL = Method Detection Limit

EPA-NE QAPP Worksheet #24a - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	Dioxin/ Furan
Concentration Level	Low
Analytical Method/ SOP Reference	1613B/L-23
Laboratory Name	*Battelle* Columbus
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1/sample set	NA	Reextract, reanalyze, or justify	GC/HRMS Analyst	Accuracy	<5× MDL, or associated samples >5× blank values (>10× blank values for OCDD, OCDF and totals)
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Laboratory Matrix Spike/Matrix Spike Duplicate	1/sample set	NA	Review with Laboratory Manager; re-analyze or justify in project records	Task Leader	Accuracy/ Precision	50-120% R RPD≤30% (Analyte concentration in MS/MSD must be >5× background concentration to be used for data quality assessment)
LCS	1 /sample set	Method 1613B, Table 6, "OPR" requirements	Review with Laboratory Manager; re-analyze or justify in project records NA	Task Leader	Accuracy	Method 1613B, Table 6, "OPR" requirements
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	15 per sample	NA	Review with Laboratory Manager; re-analyze or justify in project records	GC/HRMS Analyst/ Preparation Analyst	Accuracy	25 – 150% R
Other: SRM	1/sample set	NA	Reextract, reanalyze or justification documented	Task Leader	Accuracy, Comparability	PD≤30% from certified values (for cert. Analytes >5× MDL)

MDL = Method Detection Limit; R = Recovery; RPD = Relative Percent Difference; OPR = Ongoing Precision and Recovery; PD = Percent Difference.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24a - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	PCB/Pest
Concentration Level	Low
Analytical Method/ SOP Reference	NS&T/L-9 (GC/ECD)
Laboratory Name	Battelle Duxbury
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Note – Two LCSs will be prepared with each set of samples. The first LCS will be fortified with PCB congeners; the second LCS will be fortified with Aroclor 1016 and Aroclor 1260. Aroclors will not be fortified into the MS/MSD.

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	1/sample set	NA	Reextract, reanalyze, or justify	GC/ECD Analyst	Accuracy	< sample-specific RL, or associated samples >5× blank values
Reagent Blank	1/lot purchase	NA	Review findings with laboratory manager; check different lot	GC/ECD Analyst	Accuracy	Review findings with laboratory manager; check different lot
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA (as required)	NA	NA	NA	NA	NA
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Laboratory Matrix Spike/Matrix Spike Duplicate	1/sample set	NA	Reextract, reanalyze or justification documented	GC/ECD Analyst	Accuracy/ Precision	90% of analytes meet the following: 40-120% R RPD≤30% for at least 90% of analytes (Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24a (continued) - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	PCB/Pest
Concentration Level	Low
Analytical Method/ SOP Reference	NS&T/L-9 (GC/ECD)
Laboratory Name	Battelle Duxbury
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives

Note – Two LCSs will be prepared with each set of samples. The first LCS will be fortified with PCB congeners; the second LCS will be fortified with Aroclor 1016 and Aroclor 1260. Aroclors will not be fortified into the MS/MSD.

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	2/sample set	NA	Review with Project Manager; re-analyze or justify in project records	GC/ECD Analyst	Accuracy	90% of analytes meet the following: 40-120% R
LFB	NA	NA	NA	NA	NA	NA
Surrogates	4 per sample	NA	Reextract, reanalyze or justification documented	GC/ECD Analyst	Accuracy	40-125% R
Internal Standards (ISs)	3 per sample (2 used for quant.)	NA	NA	NA	NA	NA
Other: SRM	1/sample set	NA	Reextract, reanalyze or justification documented	GC/ECD Analyst	Accuracy, Comparability	PD≤30% from a range of certified values [a] (using surrogate corrected data; certified concentration in SRM must be >RL)
ICS	NA	NA	NA	NA	NA	NA

RL = Reporting Limit; PD = Percent Difference; R = Recovery; RPD = Relative Percent Difference; ICS = Independent Control Sample

[a] If detected value falls within the *range of certified values*, then the PD is reported as 0.0. However, if the detected value falls outside the range of certified values, then the PD is determined from either the upper or lower limit of the range. See Battelle SOP 7-029.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24a - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	PAH
Concentration Level	Low
Analytical Method/ SOP Reference	NS&T/L-10 (GC/MS)
Laboratory Name	Battelle Duxbury
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	1/sample set	NA	Reextract, reanalyze, or justify	GC/MS Analyst	Accuracy	< sample-specific RL, or associated samples >5× blank values
Reagent Blank	1/lot purchase	NA	Review findings with laboratory manager; check different lot	GC/MS Analyst	Accuracy	Review findings with laboratory manager; check different lot
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA (as required)	NA	NA	NA	NA	NA
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Laboratory Matrix Spike/Matrix Spike Duplicate	1/sample set	NA	Reextract, reanalyze or justification documented	GC/MS Analyst	Accuracy/ Precision	90% of analytes meet the following: 40-120% R RPD≤30% for at least 90% of analytes (Concentration of spiked analytes in MS/MSD must be >5× background concentrations to be used for data quality assessment)

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24a (continued) - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	PAH
Concentration Level	Low
Analytical Method/ SOP Reference	NS&T/L-10 (GC/MS)
Laboratory Name	Battelle Duxbury
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
LCS	1/sample set	NA	Review with Project Manager; re-analyze or justify in project records	GC/MS Analyst	Accuracy	90% of analytes meet the following: 40-120% R
LFB	NA	NA	NA	NA	NA	NA
Surrogates	3 per sample	NA	Reextract, reanalyze or justification documented	GC/MS Analyst	Accuracy	40-125% R
Internal Standards (ISs)	3 per sample (1 used for quant.)	NA	NA	NA	NA	NA
Other: SRM	1/sample set	NA	Reextract, reanalyze or justification documented	GC/MS Analyst	Accuracy, Comparability	PD≤30% from a range of certified values [a] (using surrogate corrected data; certified concentration in SRM must be >RL)
ICS	1/ sample set	NA	Internal QC check only	GC/MS Analyst	Precision	PD≤15% from true values

RL = Reporting Limit; PD = Percent Difference; R = Recovery; RPD = Relative Percent Difference; ICS = Independent Control Sample

[a] If detected value falls within the *range of certified values*, then the PD is reported as 0.0. However, if the detected value falls outside the range of certified values, then the PD is determined from either the upper or lower limit of the range. See Battelle SOP 7-029.

EPA-NE QAPP Worksheet #24a - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	Hg, MeHg
Concentration Level	Low
Analytical Method/ SOP Reference	245.5/L-41; Bloom (1989)/L-40
Laboratory Name	Battelle MSL
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1/sample set	NA	Reextract, reanalyze, and or blank subtract; document corrective action	Metals Analyst	Accuracy	<5× MDL, or associated samples >5× blank values
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA (as required)	NA	NA	NA	NA	NA
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Laboratory Matrix Spike/Matrix Spike Duplicate	1 pair/sample set	NA	Reextract, reanalyze or justification documented	Metals Analyst	Accuracy/ Precision	70-130 % R RPD ≤ 30% (Analyte concentration in MS/MSD must be >5× background concentration to be used for data quality assessment)
LCS	1/sample set (*no LCS for MeHg*)	NA	Review with Project Manager; re-analyze or justify in records	Metals Analyst	Accuracy	70-130% R
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA
Other: SRM	1/sample set	NA	Reextract, reanalyze or justification documented	Metals Analyst	Accuracy Comparability	PD ≤ 25% from certified values (for certified values >5× MDL)

MDL = Method Detection Limit; R = Recovery; RPD = Relative Percent Difference; PD = Percent Difference.

EPA-NE QAPP Worksheet #24a - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	Metals
Concentration Level	Low
Analytical Method/ SOP Reference	SW6010B/ L-119; SW7471/ L-120
Laboratory Name	Mitkem
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Laboratory QC:	Frequency/ Number	Method/ SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1/sample set	NA	Reextract, reanalyze, and or blank subtract; document corrective action	Metals Analyst	Accuracy	<RL, or associated samples >10× blank values (a)
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Laboratory Matrix Spike/Matrix Spike Duplicate	1 pair/sample set	NA	Justification documented; Flag as appropriate and perform post-digestion spikes to determine possibility of matrix interference causing unsatisfactory results	Metals Analyst	Accuracy/ Precision	70-130 % R RPD ≤ 30% (Analyte concentration in MS/MSD must be >5× background concentration to be used for data quality assessment)
LCS	NA	NA	NA	NA	NA	NA
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards	NA	NA	NA	NA	NA	NA
Other: SRM	1/sample set	NA	Reextract, reanalyze or justification documented	Metals Analyst	Accuracy Comparability	Within Manufacturer Specified Performance Acceptance Limits (for certified values >5× MDL)

RL = Reporting Limit; MDL = Method Detection Limit; R = Recovery; RPD = Relative Percent Difference; PD = Percent Difference.
(a) RL is set at or above lowest calibration standard, many MDL's are 20-100 times lower than the RL which is why the 5× MDL criteria is not used.

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EPA-NE QAPP Worksheet #24a - Rev. 04/03 (continued)

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	Pb-210
Concentration Level	Low
Analytical Method/ SOP Reference	TBE-2015/L-112
Laboratory Name	Teledyne Brown
No. of Sample Locations	~3 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	1/sample set	NA	Reanalyze, or justify	Analyst	Accuracy	< Sample-specific MDC, or associated samples >5× blank values
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA (As required)	NA	NA	NA	NA	NA
Laboratory Duplicate	1/sample set	NA	Review with Project Manager; re-analyze or justify in project records	Analyst	Precision	RPD ≤ 50% (Analytes detected at level >5× MDC)
Laboratory Matrix Spike/Matrix Spike Duplicate	1 MS/ sample set	NA	Reanalyze or justification documented	Laboratory Analyst	Accuracy/ Precision	60-140% R (Concentration of spiked analytes in MS must be >5× background concentrations to be used for data quality assessment)
LCS	1/sample set	NA	Review with Project Manager; re-analyze or justify in project records	Analyst	Accuracy	70-130% R
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA
Other: SRM	NA	NA	NA	NA	NA	NA

Sample Set = 20 or fewer authentic study samples.

MDC = Minimum Detectable Concentration; R = Recovery; RPD = Relative Percent Difference

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24a - Rev. 10/99

Fixed Laboratory Analytical QC Sample Table

Medium/ Matrix	Sediment
Sampling SOP	S-17, S-19
Analytical Parameter	Geotechnical (a)
Concentration Level	Low
Analytical Method/ SOP Reference*	ASTM D422/L-46; D4318/L-117 D2974/L-118; D2216/L-47
Laboratory Name	Applied Marine Sciences, Inc.
No. of Sample Locations	10 cores

Data that are accepted outside the measurement performance criteria will be flagged with the appropriate data qualifier (EPA-NE QAPP Worksheet #9a) and the rationale for accepting the analysis will be thoroughly documented in the QA/QC narratives.

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	NA	NA	NA	NA	NA	NA
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per sample set	NA	Review with Project Manager; re-analyze or justify in project records	Ken Davis	Precision	RPD ≤50% (for values >10×MDL)
Laboratory Matrix Spike/Matrix Spike Duplicate	NA	NA	NA	NA	NA	NA
LCS	NA	NA	NA	NA	NA	NA
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA
Other: SRM	NA	NA	NA	NA	NA	Not applicable – *No SRM for grain size in sediment/soil available*

MDL = Method Detection Limit; RPD = Relative Percent Difference.
(a) Geotechnical parameters include Grain Size, Atterberg Limits, Percent Solids and Water Content.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24b - Rev. 10/99
Fixed Laboratory Analytical QC Sample Table cont.

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-23 (Sediment); Dioxin/Furan

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limits (pg/g Dry Weight)	Analytical Precision		Analytical Accuracy/Bias	
		Laboratory Replicate	MS/MSD	SRM	LCS/MS/MSD
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	Not Applicable	RPD ≤ 30% (a)	PD ≤ 30% (b)	LCS: Within Method 1613B Table 6 OPR MS/MSD: 50 – 120% (a)
2,3,7,8-Tetrachlorodibenzofuran	1	As above	As above	As above	As above
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	5	As above	As above	As above	As above
1,2,3,7,8-Pentachlorodibenzofuran	5	As above	As above	As above	As above
2,3,4,7,8-Pentachlorodibenzofuran	5	As above	As above	As above	As above
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	5	As above	As above	As above	As above
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5	As above	As above	As above	As above
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5	As above	As above	As above	As above
1,2,3,4,7,8-Hexachlorodibenzofuran	5	As above	As above	As above	As above
1,2,3,6,7,8-Hexachlorodibenzofuran	5	As above	As above	As above	As above
1,2,3,7,8,9-Hexachlorodibenzofuran	5	As above	As above	As above	As above
2,3,4,6,7,8-Hexachlorodibenzofuran	5	As above	As above	As above	As above
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	5	As above	As above	As above	As above
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5	As above	As above	As above	As above
1,2,3,4,7,8,9-Heptachlorodibenzofuran	5	As above	As above	As above	As above
Octachlorodibenzo-p-dioxin	10	As above	As above	As above	As above
Octachlorodibenzofuran	10	As above	As above	As above	As above
Total HpCDD	Not applicable	Not applicable	Not applicable	As above	As above
Total HpCDF	As above	As above	As above	As above	As above
Total HxCDD	As above	As above	As above	As above	As above
Total HxCDF	As above	As above	As above	As above	As above
Total PeCDD	As above	As above	As above	As above	As above
Total PeCDF	As above	As above	As above	As above	As above
Total TCDD	As above	As above	As above	As above	As above
Total TCDF	As above	As above	As above	As above	As above
Dioxin/Furan Internal Standards	As above	Not applicable	Not applicable	25 – 150% R	

RPD = Relative Percent Difference; PD = Percent Difference; R = % Recovery; MS = Matrix Spike; MSD = Matrix Spike Duplicate; SRM = Standard Reference Material; MDL = Method Detection Limit;

(a) Concentration of spiked analytes in MS/MSD must be >5× background concentration to be used for data quality assessment

(b) SRM; For certified values >5× MDL

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24b - Rev. 10/99
Fixed Laboratory Analytical QC Sample Table cont.

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-9 (Sediment); PCB Aroclors/Pesticides

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limits (dry weight – ng/g)	Analytical Precision		Analytical Accuracy/Bias	
		Laboratory Replicate	MS/MSD	SRM	LCS/MS/MSD
4,4'-DDD	0.67	Not Applicable	RPD≤ 30% (a)	Not applicable	40-120% R (a)
4,4'-DDE	0.67	As above	As above	As above	As above
4,4'-DDT	0.67	As above	As above	PD ≤ 30% (b)	As above
Aldrin	0.67	As above	As above	Not applicable	As above
alpha-BHC	0.67	As above	As above	As above	As above
alpha-Chlordane	0.67	As above	As above	PD ≤ 30%	As above
beta-BHC	0.67	As above	As above	Not applicable	As above
delta-BHC	0.67	As above	As above	As above	As above
Dieldrin	0.67	As above	As above	As above	As above
Endosulfan I	0.67	As above	As above	As above	As above
Endosulfan II	0.67	As above	As above	As above	As above
Endosulfan Sulfate	0.67	As above	As above	As above	As above
Endrin	0.67	As above	As above	As above	As above
Endrin Aldehyde	0.67	As above	As above	As above	As above
Endrin Ketone	0.67	As above	As above	As above	40-120% R
gamma-BHC	0.67	As above	As above	As above	As above
gamma-Chlordane	0.67	As above	As above	As above	As above
Heptachlor	0.67	As above	As above	As above	As above
Heptachlor Epoxide	0.67	As above	As above	As above	As above
Methoxychlor	0.67	As above	As above	As above	As above
Technical chlordane	15	As above	As above	As above	Not applicable
Toxaphene	15	As above	As above	As above	As above
Aroclor-1016	15	As above	As above	As above	LCS only: 40-120% R
Aroclor-1221	15	As above	As above	As above	Not applicable
Aroclor-1232	15	As above	As above	As above	As above
Aroclor-1242	15	As above	As above	As above	As above
Aroclor-1248	15	As above	As above	As above	As above
Aroclor-1254	15	As above	As above	As above	As above
Aroclor-1260	15	As above	As above	As above	LCS only: 40-120% R
Aroclor-1268	15	As above	As above	As above	Not applicable
PCB Surrogates	As above	Not applicable	Not applicable	40 – 125% R	

RPD = Relative Percent Difference; PD = Percent Difference; LCS = Laboratory Control Sample; MS = Matrix Spike; MSD = Matrix Spike Duplicate; SRM = Standard Reference Material; R = Recovery; RL = Reporting Limit

(a) For 90% of analytes; concentration of spiked analytes in MS/MSD must be >5× background concentration to be used for data quality assessment

(b) SRM: Using surrogate corrected data, for values >RL

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24b - Rev. 10/99
Fixed Laboratory Analytical QC Sample Table cont.

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-10 (Sediment); PAH

Analyte[1]	Achievable Laboratory Sensitivity/ Quantitation Limits (dry weight – ng/g)	Analytical Precision		Analytical Accuracy/Bias	
		Laboratory Replicate	MS/MSD	SRM	LCS/MS/MSD
Biphenyl	0.84	Not Applicable	RPD ≤ 30% (a)	Not applicable	40-120% R (a)
2-Methylnaphthalene	0.84	As above	As above	As above	As above
Acenaphthene	0.84	As above	As above	As above	As above
Acenaphthylene	0.84	As above	As above	As above	As above
Benzaldehyde	0.84	As above	As above	As above	Not applicable
Anthracene	0.84	As above	As above	PD ≤ 30% (b)	40-120% R (a)
Benz[a]anthracene	0.84	As above	As above	As above	As above
Benzo[a]pyrene	0.84	As above	As above	As above	As above
Benzo[b]fluoranthene	0.84	As above	As above	As above	As above
Benzo[g,h,i]perylene	0.84	As above	As above	As above	As above
Benzo[k]fluoranthene	0.84	As above	As above	As above	As above
Chrysene	0.84	As above	As above	As above	As above
Dibenz[a,h]anthracene	0.84	As above	As above	As above	As above
Dibenzofuran	0.84	As above	As above	Not applicable	Not applicable
Fluoranthene	0.84	As above	As above	PD ≤ 30%	40-120% R (a)
Fluorene	0.84	As above	As above	Not applicable	As above
Indeno[1,2,3-cd]pyrene	0.84	As above	As above	PD ≤ 30%	As above
Naphthalene	0.84	As above	As above	As above	As above
Phenanthrene	0.84	As above	As above	As above	As above
Pyrene	0.84	As above	As above	As above	As above
PAH Surrogates	As above	Not applicable	Not applicable	40 – 125% R	

RPD = Relative Percent Difference; PD = Percent Difference; LCS = Laboratory Control Sample; MS = Matrix Spike; MSD = Matrix Spike Duplicate; SRM = Standard Reference Material; R = Recovery; RL = Reporting Limit.

[1] **Bolded** compounds are priority pollutant PAHs

(a) For 90% of analytes; concentration of spiked analytes in MS/MSD must be >5× background concentration to be used for data quality assessment

(b) SRM: Using surrogate corrected data, for values >RL

EPA-NE QAPP Worksheet #24b - Rev. 10/99
Fixed Laboratory Analytical QC Sample Table cont.

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-41 (Sediment Hg); L-40 (Sediment MeHg)

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limits (Dry Weight - µg/g)	Analytical Precision		Analytical Accuracy/Bias	
		Laboratory Replicate	MS/MSD	SRM	LCS/MS/MSD
Mercury	0.0137	Not Applicable	RPD ≤ 30% (a)	PD ≤ 25% (b)	70-130% R (a)
MeHg	0.00017	As above	As above	As above	As above *(no applicable LCS)*

RPD = Relative Percent Difference; PD = Percent Difference; R = % Recovery; MS = Matrix Spike; MSD = Matrix Spike Duplicate; SRM = Standard Reference Material; MDL = Method Detection Limit.
(a) Concentration of spiked analytes in MS/MSD must be >5× background concentration to be used for data quality assessment
(b) SRM; For certified values >5× MDL

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #24b - Rev. 10/99
Fixed Laboratory Analytical QC Sample Table cont.

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-119 and L-120 (Sediment metals)

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limits (Dry Weight - µg/g)	Analytical Precision		Analytical Accuracy/Bias	
		Laboratory Replicate	MS/MSD	SRM	LCS/MS/MSD
Aluminum	10	Not Applicable	RPD ≤ 30% (a)	Within Performance Acceptance Limits (PAL) (b)	70-130% R (a)
Antimony	1	As above	As above	As above	As above
Arsenic	1	As above	As above	As above	As above
Barium	10	As above	As above	As above	As above
Beryllium	0.25	As above	As above	As above	As above
Cadmium	0.25	As above	As above	As above	As above
Chromium	1	As above	As above	As above	As above
Cobalt	2.5	As above	As above	As above	As above
Copper	1.5	As above	As above	As above	As above
Iron	10	As above	As above	As above	As above
Lead	0.5	As above	As above	As above	As above
Manganese	2.5	As above	As above	As above	As above
Mercury	0.033	As above	As above	As above	As above
Molybdenum	1	As above	As above	As above	As above
Nickel	2.5	As above	As above	As above	As above
Selenium	1.5	As above	As above	As above	As above
Silver	1.5	As above	As above	As above	As above
Thallium	1	As above	As above	As above	As above
Vanadium	2.5	As above	As above	As above	As above
Zinc	2.5	As above	As above	As above	As above

RPD = Relative Percent Difference; PD = Percent Difference; R = % Recovery; MS = Matrix Spike; MSD = Matrix Spike Duplicate; SRM = Standard Reference Material; MDL = Method Detection Limit.

(a) Concentration of spiked analytes in MS/MSD must be >5× background concentration to be used for data quality assessment

(b) SRM; For certified values >5× MDL

EPA-NE QAPP Worksheet #24b - Rev. 04/03 (continued)

Fixed Laboratory Analytical QC Sample Table

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-112 (Sediment); Pb-210

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limits (Dry Weight -pCi/g)	Analytical Precision		Analytical Accuracy/Bias		
		Laboratory Replicate	MS/MSD	SRM	LCS	MS
Pb-210	0.1	RPD ≤ 50% (a)	Not Applicable	Not Applicable	70-130% R	60-140% R (b)

RPD = Relative Percent Difference; LCS = Laboratory Control Sample; MS = Matrix Spike; MSD = Matrix Spike Duplicate; R = Recovery.

(c) Replicates: for values >5× MDC (Minimum Detectable Concentration)
(b) Concentration of spiked analyte in MS must be >5× background concentration to be used for data quality assessment

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EPA-NE QAPP Worksheet #24b - Rev. 10/99
Fixed Laboratory Analytical QC Sample Table cont.

Sampling SOP: S-17, S-19
Analytical Method/SOP: L-46 (Grain Size); L-117 (Atterberg Limits); L-118 (Percent Solids); and L-47 (Water Content)

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limits (Dry Weight – %)	Analytical Precision	Analytical Accuracy/Bias	
		(Laboratory Replicates Only)	SRM	LCS/MS/MSD
% gravel	0.01	RPD ≤ 50% (for values >10× MDL)	Not applicable	Not applicable
% coarse sand	As above	As above	As above	As above
% medium sand	As above	As above	As above	As above
% fine sand	As above	As above	As above	As above
% silt	As above	As above	As above	As above
% clay	As above	As above	As above	As above
Grain size distribution curve	As above	Not applicable	As above	As above
Liquid Limit	1	RPD ≤ 50% (for values >10× MDL)	As above	As above
Plastic Limit	1	As above	As above	As above
Plasticity Limit	1	As above	As above	As above
Percent Solids	0.01	As above	As above	As above
Water Content	1	As above	As above	As above

RPD = Relative Percent Difference; MDL = Method Detection Limit; SRM = Standard Reference Material; LCS = Laboratory Control Sample; MS = Matrix Spike; MSD = Matrix Spike Duplicate

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #26 - Rev. 10/99

Project Documentation and Records Table

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records	Other
Custody Forms	Sediment boring/sample description logs	Sample Receipt, Custody and Tracking Forms	Performance Audit Reports (sample preparation, chemical analysis)	
Sample Labels		Standard Preparation Logs (certificates of analysis, QC checks)	Lab-wide Systems Audit Reports	
Custody Seals		Equipment Calibration Logs	Corrective Action Forms	
Telephone Logs		Sample Preparation Records	Control Charts	
Photograph log		Instrument Logbooks (e.g., GC/MS) (acquisition, maintenance, tuning)	Telephone Logs and/or electronic mail	
GPS log		Calibration Reports		
		Sample Quantification Reports		
		Sample Chromatograms		
		Laboratory Logbooks (acquisition, maintenance)		
		Final Report Tables (authentic samples and QC results)		
		Corrective Action Logs (miscellaneous documentation)		
		Study Records (*e.g.*, Data Package)		
		Sample Disposal Records		
		Telephone Logs and/or electronic mail		

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27a - Rev. 10/99

Assessment and Response Actions

Quality assurance encompasses all planned and systematic activities necessary to assure management that the products generated, and the services performed by Battelle meet the quality standards established in this QAPP. The primary mechanism for accomplishing this goal is audits. Audits refer to the formal assessment of conformance to the QA Program and its effectiveness. During an audit, the agreement with QA policy documents (*e.g.*, SOPs) is evaluated, deficiencies are identified, and corrective action is taken. Ideally, audits also serve to increase awareness and understanding of QA policies and procedures. Ms. Rosanna Buhl will serve as Battelle Duxbury's QA Officer and is responsible for identifying areas for corrective action, coordinating the QA activities such as systems and data audits, and preparing reports to management for this project. QA Officers at participating laboratories will be responsible for coordinating and performing QA activities at participating laboratories. Identity and qualifications of auditors are presented in EPA-NE QAPP Worksheet #6. The following QA audits are planned for this project.

- A technical system (initiation) audit is conducted as part of the review of this QAPP to (1) ensure that the work assignment scope and all required elements are addressed adequately, (2) verify that all required SOPs are approved and current, and (3) to verify that all participants have the required qualifications and documented training to perform their assigned tasks.
- Performance audits are independent checks of routinely obtained data. One Certified or Standard Reference Material (CRM or SRM, respectively) will be incorporated into each batch of chemistry samples (as applicable) to assess the accuracy and precision with which target analytes of known concentration are recovered from a representative matrix. The acceptance criteria are discussed in EPA-NE QAPP Worksheet #11b.
- Systems audits at Battelle Duxbury are conducted at least quarterly by the Project QA Officer or his designee. The purpose of these audits is to evaluate facilities, equipment, and processes for conformance to Battelle standards. Battelle SOP 4-009 describes the procedures for conducting the audits. Specific laboratory activities (*e.g.*, sample custody, preparation of standard solutions, training records) may be targeted for review based on need and level of laboratory activity in addition to the general criteria specified in the inspection SOP. Quality Assurance data audits will be conducted for at least 10% of the reported data. These audits will reconstruct representative data from each sample based on sample processing records, instrument calibration factors (*e.g.*, response factors) and output (*e.g.*, area counts), and sample manipulations and spiking. Samples will be tracked from receipt and processing through analysis and reporting to ensure that the reported data are accurate, complete, and traceable. A QA Statement submitted to the Project Manager with each deliverable describes the audit and review activities conducted to assess the deliverable accuracy, and any outstanding issues that could impact data quality.

Data audits/reviews are also conducted as described in EPA-NA QAPP Worksheet #9a.

EPA-NE QAPP Worksheet #27b - Rev. 10/99

Project Assessment Table

Assessment Type	Frequency	Internal or External (1)	Organization Performing Assessment	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person (s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person (s) responsible for monitoring effectiveness of CA, title and organizational affiliation
Fixed Laboratory Data Package Audit	Each HRMS data package	Internal and External	Battelle Columbus	Zachary J. Willenberg QA Officer Battelle Columbus	Analysts (GC/HRMS, Sample Preparation) Battelle Columbus	Mary Schrock Laboratory Manager and/or Karen Tracy Task Leader Battelle Columbus	Zachary J. Willenberg QA Officer Battelle Columbus
Fixed Laboratory Data Package Audit	10% of data packages (a)	Internal and External	Battelle Duxbury	Rosanna Buhl QA Coordinator Battelle Duxbury	GC/MS Analyst GC/ECD Analyst Battelle Duxbury	William Steinhauer Laboratory Manager Battelle Duxbury	Rosanna Buhl QA Coordinator Battelle Duxbury
Fixed Laboratory Data Package Audit	Each Hg and MeHg data package	Internal and External	Battelle MSL	Janet Cloutier QA Officer Battelle MSL	Analysts Battelle MSL	Brenda Lasorsa Task Leader Battelle MSL	Janet Cloutier QA Officer Battelle MSL
Fixed Laboratory Data Package Audit	Each Metals data package (b)	Internal and External	Mitkem	Reinier Courant QA Officer Mitkem	Analysts Mitkem	Evan Philo Task Leader Mitkem	Reinier Courant QA Officer Mitkem
Fixed Laboratory Data Package Audit	Each Pb/Cs data package	Internal and External	Teledyne Brown Engineering Environmental Services	William Meyer QA Manager Teledyne Brown	Lauren Larson Analyst Teledyne Brown	Marty Webb Production Manager Teledyne Brown	William Meyer QA Manager Teledyne Brown
Fixed Laboratory Data Package Audit	Each Grain Size, Atterberg Limits, Percent Solids and Water Content data package	Internal and External	Applied Marine Sciences, Inc. (AMS)	Mike Seymour QC Manager AMS	Ken Davis Grain Size/TOC AMS	Ken Davis Task Leader AMS	Mike Seymour QC Manager AMS

[1]*Note* – All data packages will receive internal validation and audits. In addition, all HRMS data packages will receive an external (E) Tier III validation by EPA-NE; whereas all non-HRMS data packages (excluding percent moisture) will receive an external (E) Tier II validation. Tier II validation will be conducted by Environmental Standards.

(a) All data packages receive a secondary review by the laboratory supervisor and project manager; 10% of all data packages receive QA review

(b) All metals data packages are QA reviewed at Mitkem by the laboratory supervisor or designee. In addition, a certain, small percentage (e.g., 3-5%) undergoes an additional review by the QA officer at his discretion.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27c - Rev. 10/99

Project Assessment Plan

QAPP Title:	Centredale Manor QAPP
Assessed Organization:	Battelle Columbus
Location of Assessment:	Battelle Columbus, Columbus, OH
Dates of Assessment:	Completion of analytical task
Assessment Team Members:	Zachary J. Willenberg
Type of Assessment:	Data audit
Assessment Scope:	Audit data package for completeness and accuracy
Documents to be Reviewed:	Dioxin/Furan data packages (custody, sample processing data, GC/HRMS data and calibrations, and final report tables)
Notification Date(s):	At completion of audit
Proposed Schedule:	Estimated March/April 2005
Assessment No.:	
Contract No.:	

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27c - Rev. 10/99

Project Assessment Plan

QAPP Title:	Centredale QAPP
Assessed Organization:	Battelle Duxbury
Location of Assessment:	Battelle Duxbury, Duxbury, MA
Dates of Assessment:	Completion of analytical task
Assessment Team Members:	Rosanna Buhl
Type of Assessment:	Data audit performed on at least 10% of the data
Assessment Scope:	Audit data package for completeness and accuracy in accordance with Battelle SOP 4-015
Documents to be Reviewed:	PCB, Pesticide and PAH data packages (custody, sample processing data, moisture data, GC/MS and GC/ECD data and calibrations, and final report tables)
Notification Date(s):	At completion of audit
Proposed Schedule:	Estimated March/April 2005
Assessment No.:	
Contract No.:	

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27c - Rev. 10/99

Project Assessment Plan

QAPP Title:	Centredale Manor QAPP
Assessed Organization:	Battelle Marine Sciences Laboratory (MSL)
Location of Assessment:	Battelle Marine Sciences Laboratory (MSL)
Dates of Assessment:	Completion of analytical task
Assessment Team Members:	Janet Cloutier
Type of Assessment:	Data audit
Assessment Scope:	Audit data package for completeness and accuracy
Documents to be Reviewed:	Hg and MeHg data package (custody, sample processing data, moisture data, instrument data and calibration records (if appropriate), final report tables
Notification Date(s):	At completion of audit
Proposed Schedule:	Estimated March/April 2005
Assessment No.:	
Contract No.:	

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27c - Rev. 10/99

Project Assessment Plan

QAPP Title:	Centredale Manor QAPP
Assessed Organization:	Mitkem Corporation
Location of Assessment:	Mitkem Corporation
Dates of Assessment:	Completion of analytical task
Assessment Team Members:	Reinier Courant
Type of Assessment:	Data audit
Assessment Scope:	Audit data package for completeness and accuracy
Documents to be Reviewed:	Metals data package (custody, sample processing data, moisture data, instrument data and calibration records (if appropriate), final report tables
Notification Date(s):	At completion of audit
Proposed Schedule:	Estimated March/April 2005
Assessment No.:	
Contract No.:	

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27c - Rev. 04/03 (continued)

Project Assessment Plan

QAPP Title:	Centredale Manor QAPP
Assessed Organization:	Teledyne Brown Engineering – Environmental Services
Location of Assessment:	Teledyne Brown Engineering – Environmental Services
Dates of Assessment:	Completion of analytical task
Assessment Team Members:	William Meyer
Type of Assessment:	Data audit
Assessment Scope:	Audit data package for completeness and accuracy
Documents to be Reviewed:	Pb-210 data package (custody, sample processing data, instrument data and calibration records (if appropriate), final report tables
Notification Date(s):	At completion of audit
Proposed Schedule:	Estimated March/April 2005
Assessment No.:	
Contract No.:	

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #27c - Rev. 10/99

Project Assessment Plan

QAPP Title:	Centredale Manor QAPP
Assessed Organization:	Applied Marine Sciences, Inc.
Location of Assessment:	Applied Marine Sciences, Inc. League City, TX
Dates of Assessment:	Completion of analytical task
Assessment Team Members:	Mike Seymour
Type of Assessment:	Data audit
Assessment Scope:	Audit data package for completeness and accuracy
Documents to be Reviewed:	Grain Size, Atterberg Limits, Percent Solids and Water Content data package (custody, sample processing data, instrument data and calibration records (if appropriate), final report tables
Notification Date(s):	At completion of audit
Proposed Schedule:	Estimated March/April 2005
Assessment No.:	
Contract No.:	

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #28 - Rev. 10/99

QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation, Title and Organizational Affiliation	Report Recipients, Title and Organizational Affiliation
Data Audit	1/data package (Dioxin/Furan, Moisture)	At end of analytical task	Zachary J. Willenberg QA Officer Battelle Columbus	Sample Preparation, HRGC/HRMS Analyst, Laboratory Manager, Task Leader Battelle Columbus
Data Audit	1/data package (Moisture)	At end of analytical task	Rosanna Buhl QA Coordinator Battelle Duxbury	Sample Preparation Task Leader Laboratory Manager, and Project Manager Battelle Duxbury
Data Audit	1/data package (PCB/Pesticide & PAH)	At end of analytical task	Rosanna Buhl QA Coordinator Battelle Duxbury	GC/ECD Analyst, GC/MS Analyst, Laboratory Manager, and Project Manager Battelle Duxbury
Data Audit	1/data package (Moisture, Hg, MeHg)	At end of analytical task	Janet Cloutier QA Officer Battelle MSL	Brenda Lasorsa Task Leader Battelle MSL
Data Audit	1/data package (Moisture, Metals)	At end of analytical task	Reinier Courant QA Officer Mitkem	Even Philo Task Leader Mitkem
Data Audit	1/data package (Pb-210)	At end of analytical task	William Meyer QA Manager Teledyne Brown	Analyst, Production Manager Teledyne Brown
Data Audit	1/data package (Grain Size, Atterberg Limits, Percent Solids and Water Content)	At end of analytical task	Mike Seymour QC Manager Applied Marine Sciences, Inc	Ken Davis Geotechnical Task Leader Applied Marine Sciences

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #29a - Rev. 10/99

Data Verification Process

Verification Task	Description	I/E [1]	Responsible for Verification (Name, Organization)
QA Audit (Dioxin/Furan, Moisture)	Described in EPA-NE QAPP Worksheet #9a (Assessment/Audit Tasks) and EPA-NE QAPP Worksheet #27a, b	I	Mark Misita (Sample Preparation) Joe Tabor (HRMS Analyst) Karen Tracy (Task Leader) Mary Schrock (Laboratory Manager) Zachary J. Willenberg (QA Officer) Battelle Columbus
QA Audit (Moisture)	As above	I	Roxanne Bracket (Sample Preparation) Deirdre Dahlen (Sample Analysis Task Manager) Rosanna Buhl (QA Coordinator) Battelle Duxbury
QA Audit (PCB/Pesticide and PAH)	As above	I	Jon Thorn (Supervisor, Sample Preparation) Bob Lizotte (Supervisor, GC and GC/MS Analysts) Deirdre Dahlen (Sample Analysis Task Manager) Rosanna Buhl (QA Coordinator) Battelle Duxbury
QA Audit (Moisture, Hg, MeHg)	As above	I	Brenda Lasorsa Task Leader Janet Cloutier (QA Officer) Battelle MSL
QA Audit (Moisture, Metals)	As above	I	Evan Philo Task Leader Reinier Courant (QA Officer) Mitkem
QA Audit (Pb-210)	As above	I	Rebecca Charles (Project Manager) William Meyer (QA Manager) Teledyne Brown Engineering Environmental Services
QA Audit (Grain Size, Atterberg Limits, Percent Solids and Water Content)	As above	I	Ken Davis (Task Leader) Mike Seymour (QC Manager) Applied Marine Sciences, Inc.

[1]*Note* – All data packages will receive internal validation and audits. In addition, all HRMS data packages will receive an external (E) Tier III validation by EPA-NE; whereas all non-HRMS data packages (excluding percent moisture) will receive an external (E) Tier II validation. Tier II validation will be conducted by Environmental Standards.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #29b - Rev. 10/99

Data Validation Summary Table

Medium/ Matrix	Analytical Parameter	Conc Level	Validation Criteria[1] (a)	Validation Criteria Modified[2] (a)	Data Validation Tier Level (a)	Modified Tier Level Used[3]	Data Validator (Name, title and organizational affiliation)	Responsibility for Data Validations (Name, title and organizational affiliation)
Sediment	Dioxin/ Furan	Low	Data will receive third party validation following EPA Region I Validation guidelines	NA	Tier III	NA	Steve Stodola Dioxin Data Validation Coordinator (QA Chemist, OEME) USEPA Region 1	Karen Tracy Dioxin/Furan Task Leader Battelle Columbus
Sediment	PCB/Pesticide and PAH	Low	As above	NA	Tier II	NA	David R. Blye Quality Assurance Specialist/Principal Environmental Standards, Inc.	Deirdre Dahlen Sample Analysis Task Leader Battelle Duxbury
Soil	Hg and MeHg	Low	As above	NA	Tier II	NA	David R. Blye Quality Assurance Specialist/Principal Environmental Standards, Inc.	Brenda Lasorsa Metals Task Leader Battelle MSL
Soil	Metals	Low	As above	NA	Tier II	NA	David R. Blye Quality Assurance Specialist/Principal Environmental Standards, Inc.	Evan Philo Metals Task Leader Mitkem
Soil	Grain Size, Atterberg Limits, Percent Solids and Water Content	Low	As above	NA	NA	NA	NA	Ken Davis Geotechnical Task Leader Applied Marine Sciences, Inc.
Soil	Percent Moisture	Low	NA	NA	NA	NA	NA	NA

[1] If the most recent revision of the Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses will not be used to validate project data, then document this fact and, on EPA-NE QAPP Worksheet #29a, provide a detailed description of the alternate validation criteria and/or procedures that will be used.

[2] If the Region I validation criteria will be modified to meet project objectives, then document this fact and, on EPA-NE QAPP Worksheet #29a, provide a detailed description of the modified validation criteria that will be used.

[3] If a modified validation Tier will be used to validate project data, then document this fact and, on EPA-NE QAPP Worksheet #29a, provide a detailed description of the Tier modifications that will be used.

(a) Note – All data packages will also receive internal validation and audits, as described in EPA-NE QAPP Worksheets #9a (Assessment/Audit Tasks), #27a, #27b, #27c, #28 and #29a.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #29c - Rev. 10/99

Data Validation Modifications

Participating laboratories (*i.e.*, Battelle Duxbury, Battelle Columbus, Battelle MSL, Mitkem Corporation, Teledyne Brown Engineering and AMS) will be responsible for performing internal data validation and verification of the data package. Data validation and verification procedures will follow internal laboratory SOPs and are further described in EPA-NE QAPP Worksheet #9a. The appropriate Task Leader will document and justify modifications to data validation/verification procedures, followed up by notification to the Project Manager/QA Officer for approval.

EPA-NE QAPP Worksheet #30 - Rev. 10/99

Data Usability Assessment

Data Usability Assessment

Data will be evaluated for usability as described in Figure 3 (EPA-NE QAPP Worksheet #30). All data will also received third party validation, which will include an assessment of data usability for the project.

Calculation of Quality Control Data

The calculation of quality control statistics is described in Battelle SOP 7-029 and routine methods used to assess precision and accuracy are described below.

Accuracy —Accuracy is the closeness of agreement between an observed value and an accepted value. Accuracy of analyses is assessed through analysis of laboratory control samples (LCS), standard reference materials (SRM), matrix spikes (MS/MSD), surrogate internal standards (SIS), and method or procedural blanks.

Accuracy is quantified through the use of the following equations:

- Percent Recovery (R) in authentic samples (*e.g.*, matrix spikes)

$$R = [(C_s - C_u) \div S] \times 100$$

Where,

C_s = concentration of spiked sample
C_u = concentration in unspiked sample and
S = expected concentration of spike in sample

- Percent Recovery based on known concentrations (*e.g.*, surrogates)

$$R = (C_s \div C_c) \times 100$$

Where,

C_c = certified or true concentration and
C_s = concentration of sample

- Percent Difference (PD) based on known concentrations (*e.g.*, SRM)

$$PD = (|C_c - C_s| \div C_c) \times 100$$

Where,

C_c = certified or true concentration and
C_s = concentration of sample

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #30 - Rev. 10/99 (continued)

Data Usability Assessment

Precision—Precision is defined as the degree of reproducibility among individual measurements of the same property, obtained under similar conditions. Measure of analytical precision may be determined by the analysis of laboratory replicate and matrix spike duplicates. Laboratory replicates are prepared by homogenizing and splitting samples in the laboratory, and carrying the subsamples through the entire analytical process.

Precision is quantified through the use of the following mathematical formulae:

- For two samples, Relative Percent Difference (RPD)

$$RPD = [\,|A - B|\, \div ((A + B)/2)] \times 100$$

Where,
A and B are the concentrations (or percent recoveries) detected in the two samples.

Coefficient of Variation (also referred to as percent relative standard deviation) is quantified through the use of the following mathematical formula:

- For three samples, Coefficient of Variation (CV)

$$CV = (SD/Mean) \times 100$$

Where,
SD is the standard deviation of the sample concentrations and
Mean is the mean of the sample concentrations

Data Evaluation Against Detection Limits

Dioxin/Furan—results will be reported relative to the sample specific estimated detection limit (EDL) for that compound. The sample specific EDL is defined as the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background signal level.

EDLs are calculated as:

$$EDL = (2.5 \times H_x \times Q_{is}) / (H_{is} \times W \times RF_n)$$

Where,

H_x = Sum of the height of the noise level for each quantitation ion for the unlabeled PCDDs/PCDFs.

H_{is} = Sum of the height of the noise level for each quantitation ion for the labeled internal standard.

W = Sample size, g wet weight

RF = Calculated mean relative response factor for each analyte

Q_{is} = Quantity, in pg, of the internal standard added to sample before extraction.

US EPA ARCHIVE DOCUMENT

EPA-NE QAPP Worksheet #30 - Rev. 10/99 (continued)

Data Usability Assessment

Dioxin/furan results detected at concentrations less than the EDL will be J flagged. Non-detects will be reported as the EDL and U flagged. Data will not be censored, instead all detected values will be reported, even contaminants detected at levels less than the MDL.

PCB Aroclor/Chlorinated pesticide and PAH—analysis results will be reported relative to the sample specific MDLs and RLs for that compound. MDLs are determined based on a seven replicate MDL study; RLs are equivalent to a final extract concentration that is the same as the low calibration standard concentration.

Sample specific RLs are calculated as:

$$RL = (Concentration\ in\ Low\ Std. \times final\ extract\ volume \times dilution\ factors) / Sample\ size$$

Non-detects, and concentrations of organic contaminants detected at concentrations less than the sample specific MDL will be reported as the sample specific MDL and U flagged. Concentrations of organic contaminants detected at levels above the sample specific MDL, but below the sample specific RL, will be reported and J flagged.

Mercury and MeHg (Battelle MSL)—results will be reported relative to the achievable laboratory MDLs and QLs reported in EPA-NE QAPP Worksheet #9b. MDLs are determined based on a seven replicate MDL study; QLs are generally 3.18 times times the MDLs.

Non-detects, and concentrations of metals detected at concentrations less than the MDL will be reported as the QL and U flagged. Concentrations of metals detected at levels above the MDL, but below the QL, will be reported and J flagged.

Metals (Mitkem)—results will be reported relative to the achievable laboratory MDLs and QLs reported in EPA-NE QAPP Worksheet #9b. MDLs are determined based on a seven replicate MDL study.

Non-detects, and concentrations of metals detected at concentrations less than the MDL will be reported as the MDL and U flagged. Concentrations of metals detected at levels above the MDL, but below the QL, will be reported and J flagged.

US EPA ARCHIVE DOCUMENT

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EPA-NE QAPP Worksheet #30 - Rev. 10/99 (continued)

Data Usability Assessment

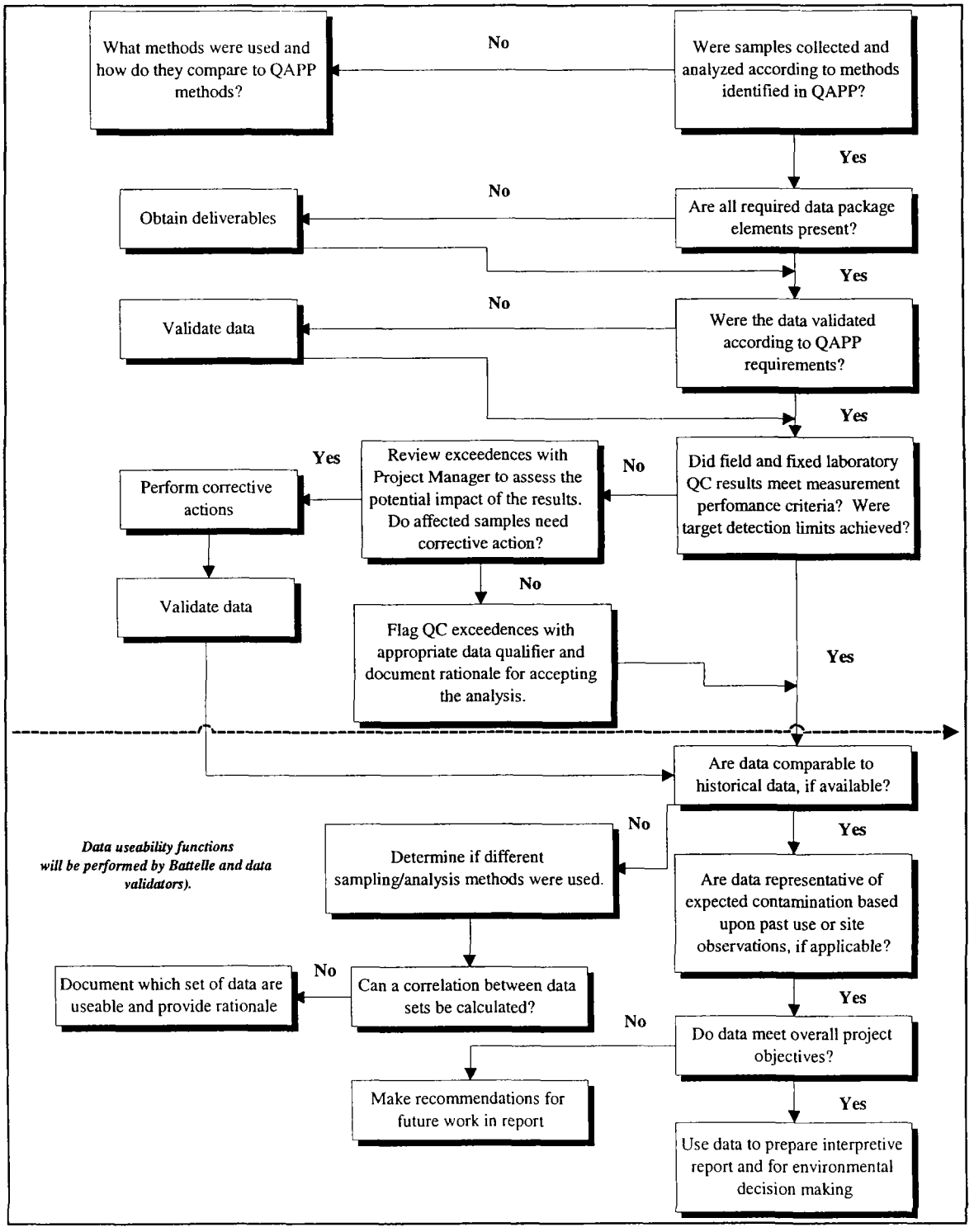


Figure 3. Preliminary Data Review Decision Tree.

US EPA ARCHIVE DOCUMENT

ATTACHMENT H

Resumes

JANET M. CLOUTIER **BATTELLE**

Quality Engineer

Process Quality Department, Quality Directorate
Pacific Northwest National Laboratory
Richland, Washington

Education:

B.S. Chemistry, Washington State University, 1994

Qualifications:

Ms. Janet Cloutier serves as Quality Engineer in charge of Quality Assurance/Quality Control (QA/QC) for the Battelle Marine Science Laboratory (MSL) in Sequim, Washington. The MSL is a subcontract laboratory for the Department of Energy and performs cutting edge research and development at a Good Laboratory Practice (GLP) level. The laboratory is certified for radio nuclear testing and has an accreditation for marine toxicity and biochemical testing. Ms. Cloutier has past experience with performing site audits in a team-lead fashion. She is presently performing QA for the U.S. Environmental Protection Agency National Fish Study and is involved in the Endocrine Disrupter Study employing Fathead Minnows. Other duties include all laboratory and subcontracted laboratory chemistry data review and project coordination.

PROFESSIONAL HISTORY/Experience

Striplin Environmental Associates -
Staff Chemist involved in production of the Quality Assurance Project Plan (QAPP) for the Remedial Investigation/Feasibility Study for the largest CERCLA site in the United States, the Lower Willamette River. EPA approved this QAPP in the beginning of December 2002. Other duties included producing SOW, RFP, Contract, and wrote reports to the management team. Laboratory coordination (of three different analytical laboratories), sample delivery, audited laboratories, and oversee all aspects of QA/QC from a laboratory perspective. Other internal duties include PSDDA data validation including: U.S. Army Corps of Engineers, Marine Sediment Sampling, Swinomish Channel, Elliot Bay, Grays Harbor and Eagle Harbor Cap monitoring activities. Prepared the minutes for the Sediment Management Annual Review Meeting May 1, 2002. Maintained health and safety records, OSHA approved 40 hr. HAZWOPPER certified employees and general health and safety on the job.

Quality By Design -
Pacific Northwest Marketing Director opened the Seattle office for QBD in January. Marketed the Pacific Northwest (including Alaska). Was awarded the Jacobs Environmental RFP within 3 weeks of opening the office. Acted as project chemist for interested clients and performed data validation of existing QBD work.

EVS Environment Consultants -
Served as database manager from EVS for NOAA on their Query Manager National Watershed Database. This project contained national watersheds/rivers such as: Charles, Willamette, Hudson, Kalamazoo, Calcasiue, St. Louis, and Duwamish), and also included international areas such as the Gulf of Fonseca (El Salvador, Nicaragua, and Honduras). Responsibility included integration of new data to existing data sets and to cross

US EPA ARCHIVE DOCUMENT

check for duplication within the existing database. Served as lead scientist for the U.S. Army Corps of Engineers, Upland Terrestrial Sampling, American Canyon and Port of Oakland, Maintenance Dredging, Sediment Sampling. Planned all field activities associated with this task, coordinated submission of samples to the lab, produced QAPP, SOW, HSP, and compiled and interpreted the chemical results, and co-authored the final data report.

Primex Aerospace-
Served as a EH&S specialist for this Redmond Washington based aerospace contractor. Duties included chemical management, hazardous waste round-ups, disposal, documentation, NPDES reports, NPDES testing, along with recycling programs and a safety audits. Prepared, produced, and gave brown bag seminars for health and safety topics for up to 50 staff members.

EMPLOYMENT HISTORY
Pacific Northwest National Laboratory (Sequim, Wa) June 2003 – Present
Analtical Resources Incorporated (Tukwilla, Wa) Jan 2003 – June 2003
Striplin Environmental Associates (Olympia, Wa) April 2002 – Jan 2003
Quality By Design (Seattle, Wa) Jan 2002 – April 2002
EVS Environmental Consultants (Seattle, Wa) Jan 2001 – Oct 2001
ACOE (Seattle, Wa) Oct 2000-Jan 2001 temporary employee library
Multichem (Renton, Wa) Jan 2000-Oct 2000 Project Manager
Primex (Redmond, Wa) 1999-2000 EH&S Specialist
Onsite Environmental Inc. (Redmond, Wa) 1995-1999 Chemist
Battelle Marine Sciences Laboratory
Pacific Northwest National Laboratory

US EPA ARCHIVE DOCUMENT

MARY ANN DEUTH **BATTELLE**

Science and Engineering Associate

Battelle Marine Sciences Laboratory
Pacific Northwest National Laboratory

Education:

B.S. Applied Chemistry, Colorado State University 1969
M.A. Elementary Education, University of Northern Colorado 1977

Relevant Experience:

- As a mercury scientist, Ms. Deuth is responsible for ongoing analyses for trace amounts of mercury in tissue, sediment, and water. She is proficient with the total mercury analyzer, EPA method 245, and has learned to repair the system since there is no maintenance support. She has eight years of experience with cold vapor atomic fluorescence and atomic absorption analysis, specifically in EPA methods 1631 and 1630.

- Experienced with computers and software including; word processing, data base management, and spreadsheet software, PC Tools, Norton Commander and DOS. Experienced in troubleshooting PCs, teaching software to new users, and solving software problems.

- Senior research technician for metabolic and soils laboratories at Colorado State University. Responsible for animal care, sampling, and the calculation of results after chemical analysis using the Kjeldahl apparatus, bomb calorimeter, spectrometers, and analytic balance. Headed a research project on cat nutrition for General Foods. Other responsibilities involved teaching graduate students chemical procedures and assisting them with their research projects. In the soils lab, Ms. Deuth maintained routine soils analysis under deadlines using atomic absorption, UV spectrometry and, titration analysis.

- Supervisory skill in managing a laboratory, preparing chemicals, recording data, scheduling workers, ordering supplies and keeping equipment in working order.

- Laboratory technician in Sanatorium Taubertal, a hospital in Bad Mergentheim, West Germany, doing routine medical procedures in blood chemistry, urinalysis, electrophoresis and spectrometry.

Publications:

Lasorsa, BK, MA Deuth, and EA Crecelius. 2001. "A Comparison of Modified EPA Method 245.6 (CVAA) and EPA 1631B, (CVAF) for the Determination of Mercury in Tissue: Does quality have to cost more?" PNWD-SA-5562. Presented at the 24th Annual Conference on Analysis of Pollutants in the Environment, Portsmouth, Virginia; April 30, 2001.

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JESSICA M. FAHEY **BATTELLE**

Technician

Education:

B.S. Environmental Science, Wheaton College, Norton, MA, 1999
M.S. Biology, University of Massachusetts, Boston, Present

Additional Training and Licenses:

DOT Hazardous Materials Shipping Course
Basic First Aid Training
Cellular Biology Graduate Course- Bridgewater State College

Qualifications:

Ms. Fahey joined Battelle in October of 2000 as a contractor and assumed the postion of laboratory helper. After a brief period cleaning laboratory glassware, she quickly joined the Laboratory Sample Custody group. In April of 2001, Ms Fahey became a full time employee of Battelle. She assumed the role as Senior Sample Custodian carrying the responsibilty of distribution, preservation, and control of all samples entering Battelle Ocean Sciences. Additionally, she acquired, renewed, and implemented all permits required for the import/export of soils, fish, wildlife, and plants across both national and international borders. Lastly, she inventoried and ordered all supplies for Battelles Environmental Chemistry department. Ms. Fahey was recongized for her work in 2002 with an Internal award for Best Lab Staff.

Ms. Fahey continued her career development by joining the Field Logistics and Operations Group in June 2004. Here she has worked on field activities including mobilization and processing for water column and benthic surveys. She has experience with Dissolved Oxygen and Respiration processing, analysis, and reporting. Additionally, she has processed and characterized sediment cores using the ASTM method. In this new position, Ms. Fahey is also working on Environmental Compliance Assessments for flood control areas . This includes site assessments to assure that all federal, state, and local environmental regulations are being practiced and completing report summaries.

Ms. Fahey has continued to expand her knowledge of Battelle by working part-time in the Quality Assurance group. Here she completes the internal audits of our Chemisty data packages. Additionally, she has completed data validation for various site wide projects.

Relevant Experience:
Technician: Ms. Fahey has been working on water column collects, filtering procedures for chlorphyll and PCN analysis, and Dissolved Oxygen and Respiration analaysis.

Laboratory Technician: This includes sample and reagent log-in, ship out, and storage. Order and Inventory all supplies for the Chemistry department. Supervised, trained, and directed others daily work load in my department.

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Professional Positions:

Laboratory Technician, Battelle Ocean Sciences, June 2004- present: member of the Field Logistics and Operiations Group. Duties include mobilization for surveries, water, sediment, and benthic collections in the field.

Laboratory Technician, Battelle Ocean Sciences, October 2001-May 2004: Senior Sample Custodian: This includes sample and reagent log-in, ship out, and storage. Order and Inventory all supplies for the Chemistry department. Supervised, trained, and directed others daily work load in my department.

Research Technician, Children's Hospital Boston, September 2000-February 2001: worked as a technician in an HIV virology lab. Daily tasks included tissue culture, plasma and cell storage, and data entry.

Research Assistant, June 2000- August 2000 & June 2001- August 2001: In 2000, I assisted Dr. Sara Lewis and Dr. Chris Crastley on the research of sexual selection and mating behaviors in *Photnis ignitus.* Summer 2001 work focused on the identification and description of Photuris LIV reproductive anatomy. Work consisted of nightly field observations, micro-dissections, video imaging and measurements of fireflies.

Vernal Pool Research Assistant, February 2000- May2000 & February 2001-July 2001: Assisting on a collaborative study of vernal pools with Hyla Consulting and Tufts University. The research is part of an on-going comparison of two vernal pools, one recently surrounded by a housing estate and the other by conservation land. Work consisted of daily trap monitoring, toe-clipping, species identification, morphological measurements, and general maintance of field site.

THERESA M. (BARBER) HIMMER **BATTELLE**

Senior Technician

Education:

B.S. Geological Sciences, B.S. Environmental Sciences, Central Michigan University, 2000
M.S. Geological and Environmental Sciences, Stanford University, 2002

Additional Training and Certifications:

40 hour HAZWOPER
Basic First Aid and CPR

Qualifications:

Ms. Himmer is a trained geologist with extensive chemistry laboratory experience. Her qualifications encompass broad-based undergraduate and graduate degrees in environmental science, geology, and soil and environmental geochemistry. As a geochemistry researcher, she has examined the influence and extent of peat mining operations on freshwater systems and has studied phosphorus retention dynamics during the reductive biomineralization of iron oxides. During the course of these projects she has collected water, soil, and sediment samples, as well as installed and monitored piezometers. Her experience working in geochemistry laboratories has resulted in experience with the use of anaerobic glove chambers, basic microbiological methods, and numerous analytical methods.

She joined Battelle in October of 2002 as a contractor within the Environmental Chemistry laboratory. In February of 2003, Ms. Himmer became a full-time Battelle employee and assumed the role of Laboratory Technician. She is fully trained in soil/sediment, tissue, and water extractions for PCB's, PAH's, pesticides and TPH. Ms. Himmer was the lead sample preparation technician on several large, high-profile projects and also assumed the responsibility for organizing all the chemical reagents within the laboratory. Additionally, her attention to detail lead to the responsibility of preparing the majority of the laboratory standard solutions and the standard check solutions.

In May of 2004, Ms. Himmer continued her career development by joining the Environmental Assessment Group, where she has performed a variety of different job functions including processing and characterizing sediment cores, statistical summaries of data, auditing electronic databases for accuracy, mobilizing for and assisting on water column and benthic field surveys, and writing Quality Assurance Project Plans for laboratory work.

Relevant Experience:

Technician, Centredale Manor Restoration Project: Ms. Himmer has validated data and maps for project reports. She has also prepared statistical summaries and graphics for project publications.

Technician, Thames River Validation Study, 2004 and Initial Sampling and Laboratory Testing in Support of Environmental Assessment for New Bedford Harbor, 2004: Ms. Himmer characterized and processed sediment cores for chemical and physical analyses.

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Assistant Project Manager, MMS cANIMIDA: Ms. Himmer has drafted workplans for the sediment and tissue laboratory analyses, revised and corrected the workplan for the laboratory portion of the waters processing. She has also worked very closely with the chief field scientist to verify that Battelle Duxbury received all the samples shipped from Alaska and to assure that the field database contains accurate information. Ms. Himmer has also been coordinating the shipment of samples to and from sub-contracted laboratories.

Field Technician: Ms. Himmer has experience as a filter technician on the Massachusetts Water Resources Association Monitoring program and has helped to mobilize and demobilize the boat for surveys. She has experience in preparing water samples for BSI (biogenic silica), chlorophyll, PCN (particulate carbon and nitrogen), TDP (total dissolved phosphorus), PP (particulate phosphorus), DIN (dissolved inorganic nutrients), and DOC (dissolved organic carbon) analyses. Ms. Himmer has also assisted on benthic surveys where she has characterized and sieved sediment to isolate benthic infauna.

Field Technician/Geologist, Naval Weapons Station Earle Sediment Characterization, 2004: Ms. Himmer helped to mobilize equipment for this survey, assisted in sediment push-core and vibracore collection, characterized and processed the sediment cores in the field.

Laboratory Technician: Ms Himmer has been the lead sample preparation technician on several large projects. She has processed sediment cores in order to extract and analyzed porewaters, managed and processed a large number of samples through the lab, and maintained laboratory prep records. She has also prepared and processed several elutriate studies for the U.S. Army Corps of Engineers/New England District.

Professional Experience:

Introductory Geology Laboratory/Field Instructor, Stanford University, 2000-2004: Ms. Himmer revised and developed classroom and laboratory exercises, delivered lectures, guided field trips, and led laboratory sections (2000, 2001, 2002).

Marine Geochemistry Seminar Teaching Assistant, Stanford University, 2002: Ms. Himmer created and instructed laboratory exercises.

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BRENDA K. LORD-LASORSA **BATTELLE**

Research Scientist V

Marine Chemistry & Ocean Processes
Battelle Marine Sciences Laboratory
Pacific Northwest National Laboratory

Education:

B.S.	Geology, Ohio State University	1983
M.S.	Geology, Ohio State University	1986

Experience:

Chemical Speciation: As a research scientist in the Marine Chemistry Group, Ms. Lasorsa is responsible for ongoing analyses as well as methods development for mercury and sulfide analysis. Experience includes assisting in development of both total and methyl mercury analysis systems and analysis of mercury in various media including tissues and sediment at the ng/g level and water at the ng/L level by cold vapor atomic fluorescence. Ms. Lasorsa has applied these speciation methods to a wide variety of matrices including tissue, sediment, hair, and water samples. She has also been responsible for the development of an acid volatile sulfide analysis system and appropriate sample handling methods associated with the system. The analytical experience with acid volatile sulfides includes an interlaboratory calibration study with the U.S. EPA in Duluth on sediments from three freshwater lakes in Minnesota, as well as analyses of samples including experimental work on the quantity of metals released during oxidation of acid volatile sulfides (AVS) for the EPA, and analysis of dissolved sulfides and AVS in fly-ash pond sediments for EPRI.

Analytical Chemistry: Ms. Lasorsa has experience in programming and calibration of automated x-ray fluorescence equipment for the Byrd Polar Research Center Laboratory for Isotope Geology and Geochemistry. She has used Rb-Sr isotope dating techniques for determining sediment provenance and dating igneous formations. At Battelle, she has helped develop mercury analytical techniques using cold vapor atomic fluorescence and has developed sulfide analytical techniques using photoionization and flame photometric detection systems, coupled with gas chromatography. She has also developed computer based data processing systems for the mercury and sulfide laboratories.

Laboratory Management: Ms. Lasorsa managed laboratory activities, including ordering of reagents and supplies, radiation safety, and supervision of junior staff and students while working at the Byrd Polar Research Center Laboratory for Isotope Geology and Geochemistry. At Battelle, she manages the mercury and sulfide analytical laboratories.

Project Management: Ms. Lasorsa has managed a wide range of projects from small short-term analytical studies to large, multi-year, multi-million dollar projects involving project planning, budgeting, field work, analysis of samples for trace level metals and organic compounds, bioassay and toxicity assessment, and reporting.

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Selected Project Experience:

Mercury Speciation and Transformations in Mine Waste, Sediment, and Water. Program Manager. Three contracts for the U.S. Geological Survey evaluated mercury and methylmercury concentrations in mine-waste calcines (retorted ore), sediment, and water samples from mines in Nevada, Texas, and Almaden, Spain. Various mercury compounds were identified using mercury-thermo-desorption pyrolysis, and rates of mercury methylation and methylmercury demethylation were determined using isotopic-tracer methods. In addition to measuring concentrations of total mercury and methylmercury, various factors that affect methylation of mercury were examined. Results suggested methylation downstream from mercury mines to be lower in arid climates due to lack of mine-water runoff and lower microbial activity. In sites characterized with greater soil organic matter, methylmercury was degraded to methane by the *mer operon* enzyme, organomercurial lyase, which catalyzes a reductive demethylation. In stream sediments, methylmercury was degraded by an oxidative pathway, which yielded primarily carbon dioxide.

Alcoa/Lavaca Bay Superfund. Program Manager. Analysis of mercury speciation in a wide variety of matrices including fresh and seawater, rainwater, sediments, soils, and tissue samples from the entire food web in an effort to understand the degree of contamination throughout the site and in what form the mercury is cycling through various parts of the ecosystem, as well as monitoring the effects of the clean-up on the environment. MSL has also provided assistance in development of sampling plans, interpretation of data, and provision of specialized sampling equipment for the collection of samples using new EPA clean techniques.

CALFED Mercury Project. Program Manager. Consultation on appropriate field-sampling techniques and specialized analyses in mercury and methyl mercury in fish, invertebrate, and avian egg tissue; mercury and methyl mercury in water; and mercury and methyl mercury in sediment.

Clear Lake Mercury / Sulphur Bank Mercury Mine Superfund Site, California. Program Manager. This EPA program involves ultra-clean total mercury and methyl mercury analyses of water, sediment, and tissue (fish, invertebrates, plankton, and algae) samples, and acid volatile sulfides/simultaneously extracted metals (AVS/SEM) analyses of sediment samples. Ms. Lasorsa also provided consultation regarding proper sampling techniques to preserve natural chemical speciation in support of field sampling efforts.

Mercury Contamination in the Florida Everglades. Program Manager. Ultra-trace level analysis of total mercury, ionic mercury, elemental mercury, and methylmercury as required for numerous large sets of water, sediment, soil, vegetation, and tissue samples. MSL provided advice on field sampling and laboratory analytical techniques to all participating laboratories and also served as a reference laboratory for intercomparison exercises.

EPA Region 4 Hg TMDL Studies, Athens, GA. Program Manager. Analysis of water, soil/sediment, tissue, and air samples for total and methylmercury at sub-parts per trillion detection limits. This project required analysis of samples with a wide range of Hg concentrations and large potential for cross contamination. MSL also provided advice on techniques and appropriate specialized containers for ultra-clean methods of collecting field samples.

Sacramento River Watershed Program. Program Manager. This program is funded through a grant from the USEAP to the Sacramento River Toxic Pollutant Control Program to monitor the mercury speciation in this region that is impacted by legacy mercury waste from mining activities in the

surrounding Sierra and Coast Mountain Ranges. Ms. Lasorsa manages the Battelle component to this program, providing ultra-clean sample collection bottles and conducting methylmercury analysis on filtered and unfiltered water samples.

Alcoa/Lavaca Bay Superfund. Ms. Lasorsa conducts analysis of mercury speciation in a wide variety of matrices including fresh and seawater, rainwater, sediments, soils, and tissue samples from the entire food web in an effort to understand the degree of contamination throughout the site and in what form the mercury is cycling through various parts of the ecosystem, as well as monitoring the effects of the clean-up on the environment.

Demonstration of EPA 1600 Series Methods for Metals in Ambient Water: Battelle assisted EPA in writing the 1600 series methods for sampling and analysis of metals in freshwater and seawater. Battelle participated in the establishment of the method detection limits for Methods 1631, 1632, 1632, 1636, 1638, 1639, and 1640, and participated in the validation exercise for metals in river water, seawater, and public-owned treatment wastewater (POTW) effluent. Ms. Brenda Lasorsa serves on the Expert Advisory Panel for subsequent revisions to EPA 1631.

PUBLICATIONS

Journal Publications

Gray, JE, DL Fey, CW Holmes, and BK Lasorsa. 2004. "Historical deposition and fluxes of mercury in Narraguinnep Reservoir, southwestern Colorado, USA." PNWD-SA-6600. *In Press: Applied Geochemistry.*

Gray JE, ME Hines, PL Higueras, I Adatto, and BK Lasorsa. 2004. "Mercury Speciation and Microbial Transformations in Mine Wastes, Stream Sediments, and Surface Waters at the Almaden Mining District, Spain." PNWD-SA-6599. *In Press: Environmental Science and Technology.*

Allen-Gil, SM, J Ford, BK Lasorsa, M Monetti, T Vlasova, DH Landers. 2003. "Heavy metal contamination in the Taimyr Peninsula, Siberian Arctic." *The Science of the Total Environment* 301(2003):119-138.

Gray, JE, JG Crock, and BK Lasorsa. 2002. "Mercury Methylation at Mercury Mines in the Humboldt River Basin, Nevada, USA." PNWD-SA-5598. *Geochemistry: Exploration, Environment, and Analysis* 2(2002):143-149.

Bloom, N.S., and B.K. Lasorsa. 1999. "Changes in mercury speciation and the release of methyl mercury as a result of marine sediment dredging activities." PNNL-SA-31275. *The Science of the Total Environment* 237/238(1999):379-385.

Allen-Gil, S. M., D. H. Landers, T. L. Wade, J. L. Sericano, B. K. Lasorsa, E. A. Crecelius, and L. R. Curtis. 1997. "Heavy Metal, Organochlorine Pesticide and Polychlorinated Biphenyl Contamination in Arctic Ground Squirrels (*Spermophilus parryi*) in Northern Alaska." *Arctic* 50(4):323-333.

Allen-Gil, S.M., C. P. Gubala, D. H. Landers, B. K. Lasorsa, E. A. Crecelius, L. R. Curtis. 1997. "Heavy Metal Accumulation in Sediment and Freshwater Fish in U. S. Arctic Lakes." *Environ. Toxicol. Chem.* 16(4):733-741.

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Ford, J., B. Lasorsa, E. Crecelius, J. Voit, and D. Landers. 1997. *Vegetation and Soil Database for Arctic Alaska and the Taimyr Peninsula, Russia, Vol. 1: Elemental Composition.* U.S. Environmental Protection Agency Arctic Contaminants Research Program.

Lasorsa, B., and A. Casas. 1996. "A Comparison of Sample Handling and Analytical Methods for Determination of Acid Volatile Sulfides in Sediment." *Marine Chemistry* 52:211-220.

Gubala, C.P., D.H. Landers, M. Monetti, M. Heit, T. Wade, B. Lasorsa, and S. Allen-Gil. "The Rates of Accumulation and Chronologies of Atmospherically Derived Pollutants in the Arctic Alaska, USA." *Sci. Total Environ.* 160/161:347-361.

Landers, D. H., J. Ford, C. Gubala, M. Monetti, B. K. Lasorsa, and J. Martinson. 1995. □Mercury in Vegetation and Lake Sediments from the U.S. Arctic.□ *Water, Air, and Soil Pollution* 80:591-601.

Lasorsa, B., and S. Allen-Gil. 1995. □The Methylmercury to Total Mercury Ratio in Selected Marine, Freshwater, and Terrestrial Organisms.□ *Water, Air and Soil Pollution* 80:905-913.

Ford, J., D. Landers, D. Kugler, B. Lasorsa, S. Allen-Gil, E. Crecelius, and J. Martinson. 1995. "Inorganic Contaminants in Arctic Alaskan Ecosystems: Long-Range Atmospheric transport or Local Point Sources?" *The Science of the Total Environment* 160/161:323-335.

Allen-Gil, S. M., C. P. Gubala, D. H. Landers, B. Lasorsa, E. Crecelius, and L. R. Curtis. 1995. "Sex Steroids as Biomarkers for Heavy Metal Accumulation in Freshwater Fish from U.S. Arctic Lakes." *Environmental Science & Technology.* (submitted)

Lord, B. K., L. M. Jones and G. Faure. 1988. "Evidence for the Existence of the Gondwana Ice Sheet in the ^{18}O Depletion of Carbonate Rocks in the Permian Formations of the Transantarctic Mountains." *Chemical Geology (Isotope Geoscience Section)* 72:163-171.

Lord, B. K. 1986. *Strontium Isotope Evidence Regarding the Provenance and Environment of Deposition of the Beacon Supergroup, Antarctica.* M. Sc. Thesis, Dept. Geol. Mineral., The Ohio State Univ., Columbus, Ohio, 168 pp.

Faure, G. and B. K. Lord. 1986. "Age and Lithologic Composition of Pebbles from the Bottom of the Weddell Sea." *Antarctic Journal* XXI(5):140-141.

Faure, G., T. M. Mensing, and B. K. Lord. 1986. "Stratigraphic Correlation of Ferrar Dolerite Sills, Queen Alexandra Range." *Antarctic Journal* XXI(5):46-47.

Conference Proceedings

Gray JE, ME Hines, H Biester, and BK Lasorsa. 2003. "Mercury Methylation in Mine Wastes Collected from Abandoned Mercury Mines in the USA." Proceedings of the 12th International Conference on Heavy Metals in the Environment, Grenoble, France, May 26-30, 2003. *Journal de physique IV* 107:573-576.

Lasorsa, B. K. 1992. "Trends in Mercury Concentrations in the Hair of Woman of Nome, Alaska: Evidence of Seafood Consumption or Abiotic Absorption?" Presented at the Mercury as a Global

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Pollutant--Toward Integration and Synthesis International Conference, May 31-June 4, 1992, Monterey, California.

Faure, G. and B. K. Lasorsa. 1991. "Oxygen and Carbon Isotope Compositions of Calcite in Carbonate Concretions in the Beacon Rocks of Antarctica; Products of the Gondwana Ice Sheet." In *Proceedings of the 7th International Gondwana Conference, San Paulo, Brazil.*

Presentations

Hines ME, JE Gray, PL Higueras, and BK Lasorsa. 2004. "Mercury Speciation and Transformations in Mine Waste, Sediment, and Water at the Almaden Mercury Mine, Spain." Presented by Mark E. Hines at 7th International Conference on Mercury as a Global Pollutant, Ljubljana, on June 29, 2004. Reference No. PNWD-SA-6252, Battelle Marine Sciences Laboratory, Sequim, WA.

Gray JE, ME Hines, H Biester, and BK Lasorsa. 2002. "Mercury Speciation and Transformation in Mine Wastes Collected from Abandoned Mercury Mines in the USA." Presented by John E. Gray at The Geological Society of America 2002 Annual Meeting and Exposition: "Science at the Highest Level," Denver, CO, on October 29, 2002.

Lasorsa, BK, MA Deuth, and EA Crecelius. 2001. "A Comparison of Modified EPA Method 245.6 (CVAA) and EPA 1631B, (CVAF) for the Determination of Mercury in Tissue: Does quality have to cost more?" PNWD-SA-5562. Presented at the 24th Annual Conference on Analysis of Pollutants in the Environment, Portsmouth, Virginia; April 30, 2001.

Bloom, N.S., and B.K. Lasorsa. 1999. "Changes in Mercury Speciation and the Release of Methylmercury as a Result of Marine Sediment Dredging Activities." PNNL-SA-31275. 5th International Conference on Mercury as a Global Pollutant, May 23-27, 1999, Rio de Janeiro, Brazil.

Bloom, N.S., and B.K. Lasorsa. 1998. "Changes in Mercury Speciation and the Release of Methylmercury as a Result of Marine Sediment Dredging Activities." International Symposium on Marine Pollution, October 5-9, 1998, Monaco.

Ford, J., E.A. Crecelius, B.K. Lasorsa, J. Martinson, D.H. Landers. 1997. □Eurasian Sources of Industrial Contaminants: Are They an Issue for Arctic Alaskan Ecosystems?□ 48th Arctic Science Conference.

Landers, D. H., J. Ford, C. Gubala, S. Allen-Gil, and B. K. Lasorsa. 1994. □Mercury in Terrestrial and Freshwater Arctic Ecosystems.□ Third International Conference, Mercury as a Global Pollutant, July 10-14, 1994, Whistler, B.C.

Lasorsa, B. K., and S. Allen-Gil. 1994. "The Methylmercury to Total Mercury ratio in Marine and Terrestrial Organisms - An Overview." International Conference on Mercury as a Global Pollutant, July 10-14, 1994, Whistler, B.C.

Ford, J., E. Crecelius, B. Lasorsa, T. Wade, S. Allen-Gil, J. Martinson, and D. Landers. 1993. "Concentrations of Atmospheric Contaminants in Arctic Alaskan Lichens and Mosses, and Their Relevance to Arctic Food Webs.

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Ford, J., E. Steinnes, S. Allen-Gil, R. Wilson, L. Curtis, E. Crecelius, B. Lasorsa, and D. H. Landers. 1993. "Atmospheric Contaminants in Inland Ecosysems of Arctic Alaska." Chemicals in the Arctic-Boreal Environment, May 12-14, 1993, Helsinki, Finland.

Ford, J., E. Steinnes, S. Allen-Gil, R. Wilson, L. Curtis, B. Lasorsa, D. Landers. 1993. "Heavy Metal, Trace Element, and Organochlorine Contamination in the U.S. Arctic: Preliminary Results from USEPA's Arctic Contaminants Research Program (ACRP)." International Nordic Symposium on Chemicals in the Arctic-Boreal Environment, May 12-14, 1993, Helsinki, Finland.

Allen-Gil, S., L. Curtis, B. Lasorsa, E. Crecelius, and D. Landers. 1993. "Plasma Testosterone as a Sensitive Biomarker to Heavy Metal Exposure in Feral Arctic Fish." Society of Environmental Toxicology and Chemistry, 14th Annual Meeting, November 14-18, 1993, Houston, Texas.

Allen-Gil, S. M., L. Curtis, B. Lasorsa, E. Crecelius, C. Gubala, and D. Landers. 1993. "Bioaccumulation and Reproductive Effects of Heavy Metals in Freshwater Arctic Ecosystems." International Symposium on the Ecological Effects of Arctic Airborne Contaminants, October 4-8, 1993, Reykjavik, Iceland

Allen-Gil, S., S. Wilson, S., J. Ford, L. Curtis, C. P. Gubala, B. Lasorsa, E. Crecelius, and D. H. Landers. 1993. "Organochlorine and Heavy Metal Contamination in the U.S. Arctic. IARPC Workshop on Arctic Contamination, Anchorage, Alaska.

Crecelius, E. A. and B. K. Lasorsa. 1990. "Concentrations of Acid Volatile Sulfides in Contaminated Sediments of the Great Lakes." Presented at Society of Environmental Toxicology and Chemistry, November 11-15, 1990, Arlington, Virginia.

Reports

Lasorsa, B. K., and R. J. Citterman. 1991. *Segmental Analysis of Mercury in Hair in 80 Women of Nome, Alaska.* OCS Study, MMS 91-0065.

Crecelius, E. A., C. W. Apts, and B. K. Lasorsa. 1990. *Concentrations of Metals in Norton Sound Seawater Samples and Human Hair Samples, 1989.* OCS Study, MMS 90-0010.

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ROBERT D. LIZOTTE, JR. **BATTELLE**

Research Scientist

Education:

B.S. Biology, Allegheny College, 1987

Qualifications:

Mr. Lizotte joined Battelle in 1990 and has a total of 17 years of experience in the field of environmental chemistry. His responsibilities include GC and GC/MS laboratory oversight and overall laboratory scheduling. He also ensures proper procedural techniques are employed throughout the laboratory. His analytical responsiblities are the supervision of the preparation and analysis with various detectors in gas chromatography of environmental samples in various matrices. These detectors include GC/FID, PID, FPD, MS, and ECD. Analytes include petroleum hydrocarbons, polynuclear aromatic compounds, sterols, pesticides, butyltins, and polychlorinated biphenyls. Further duties include interpretation of GC/FPD, GC/FID, GC/MS, and GC/ECD chromatograms, instrumentation troubleshooting and maintenance, and final approval of data packages. He also acts a project manager, involving client contact, preparation of reports, and preparation of workplans. He also works closely with the QA coordinator to ensure that all quality assurance samples are processed, including the interlaboratory programs, the NELAP certification PE program, and the method detection limit studies. Mr. Lizotte is GC/GC/MS Supervisor of the Organics Laboratory at Battelle.

Relevant Experience:

Ecological and Human Exposure Measurement and Monitoring

Research Scientist: Performed project management tasks for a task order environmental monitoring study examining possible PCB and pesticide contamination in southern California.

Research Scientist: Performed project management tasks for a multi-year environmental monitoring study examining possible PAH metabolite, PAH, and pesticide/PCB contamination.

Research Scientist: Performed project management tasks for several US NAVY studies for the Southwest Division examining possible butyltin, PAH, and pesticide/PCB contamination.

Research Scientist: Performed project management tasks and analysis for a study in China Bay (Hong Kong) examining possible butyltin contamination.

Research Scientist: Performed project management tasks and analysis for the Consortium of Tributyltin Manufacturers for the Long Term Tributyltin Monitoring Project.

Research Scientist: Conducted butyltin analysis and prepared data report for a study conducted for EPA's Oceans and Coastland Protection Division at the 106-mile dump site.

Research Scientist: Performed PCB congener and pesticide analysis in support of the NOAA NRDA

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study at a Superfund site in San Francisco Bay (excess of 200 tissue and sediment samples).

Research Scientist: Performed PCB congener and pesticide analysis for US Army Corps of Engineers Oakland Harbor Navigation project, Richmond Harbor improvement, and J.F. Baldwin channel. An excess of 200 tissue samples were analyzed in these projects.

Research Scientist: Performed PCB congener and pesticide analysis for a U.S. Navy Superfund site. Analyzed samples and reported data for over 250 samples.

Researcher: Performed PCB congener and pesticide analysis for the NOAA Mussel Watch projects (1990 to 1994). Analyzed samples and reported data for over 500 tissue samples.

Researcher: Performed Massachusetts Water Pollution Performance Evaluation study for PCB and pesticides in 1992 through 1994.

Researcher: Analyzed and reported petroleum hydrocarbon data in many Exxon studies including two intercalibration exercises.

Researcher: Analyzed and reported data petroleum hydrocarbon data for an industrial oil and gas research program.

Trained two people from Thailand on the extraction, instrumentation, and calculation of the EPA Method 418.1 IR analysis.

Publications:

Durell, G.S. and R.D. Lizotte, Jr. PCB Levels at 26 New York City and New Jersey WPCPs that Discharge to the New York/New Jersey Harbor Estuary. Environmental Science and Technology. 1998. **32:** 1022-1031.

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ALEX D. MANSFIELD **BATTELLE**

Principal Research Scientist
Monitoring and Assessment Team

Education:

M.S. Environmental, Coastal and Ocean Science, Specialization in Marine Ecology. University Massachusetts, 1997.

B.S. University of Massachusetts, Magna cum laude, with Honors, 1993.

Qualifications:

Mr. Mansfield joined the Field Logistics and Operations Group at Battelle, Duxbury in 1999. Prior to employment with Battelle, Mr. Mansfield's research and professional work focused on analysis of inorganic nutrients and their interactions with the marine environment. To accomplish this work he combined strong analytical skills with diverse experience and knowledge of field collection techniques. His interest in "whole system" ecology has lead to experience with a wide range of both laboratory and field equipment and techniques.

With Battelle, Mr. Mansfield continues to combine his knowledge of diverse analytical and field applications to manage a variety of projects. In the past 5 years he has been involved in large- and small-scale projects with the Minerals Management Service, Navy, Massachusetts Water Resources Authority, EPA, Army Corp of Engineers, and industrial clients. During these projects he has functioned in a variety of roles. Among other roles, he has acted as Project Manager, Laboratory Task Leader for microbiology work, Chief Scientist for water quality and sediment sampling, and prepared environmental impact statements.

Professional Positions:

Research Scientist, Assessment and Monitoring Team, Battelle. 2003-present.
Researcher, Field Logistics/Operations Group, Battelle. 2000-2003
Research Associate, Field Logistics/Operations Group, Battelle. 1999-2000.
Senior Laboratory Technician, Massachusetts Water Resources Authority. 1997-1999.
Research Assistant, Phytoplankton Ecology laboratory, University of Massachusetts. 1995-1997.
Water Quality Intern, Metropolitan District Commission. May 1997-September 1997.
Research Assistant, Behavioral Psychology laboratory, University of Massachusetts. 1991-1993.

Relevant Experience:

Project Manager for 2004 Army Corps of Engineers "New Bedford Harbor Long-Term Monitoring IV". Responsibilities included managing and conducting a field and analytical program in order to assess the effectiveness of the New Bedford Harbor Superfund remediation efforts. A long term environmental monitoring plan has been developed by the U.S. Environmental Protection Agency's Research Laboratory, Atlantic Ecology Division in Narragansett, Rhode Island (AED). This plan incorporates an intensive sampling and analysis effort for the purpose of quantifying the long-term environmental effects of reduced PCB levels in the sediments and water column of the New Bedford Harbor estuary as a result of remediation efforts.

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Project Manager for 2003 U.S. EPA "Ship Waste Stream Discharge Assesment". Responsibilities included managing and conducting plume tracking surveys in the Guilf of Mexico in the wake of barges discharging nutrient laden, acidic wastewater from the the Piney Point fetilizer plant inTampa, Florida. This project is conducted under as emergency ocean dumping permit issued by the U.S. EPA to the State of Florida.

Project Manager for 2004 Army Corps of Engineers "Laboratory Testing in Support of Environmental Sampling and Testing Westport Harbor, CT". Responsibilities included the oversight of field collections, chemical analysis and reporting to assist the Corps of Engineers, North Atlantic Division New England District (NAE) NAE in gathering physical, chemical, and biological data for analyzing the environmental impacts associated with proposed maintenance dredging of sediments in Westport Harbor, CT. NAE is evaluating sediments for proposed dredging and disposal under the Westport Harbor-Saugatuck River federal project. The data was used to support the NAE determination for acceptability of the dredged material for ocean disposal under Section 103 of the Marine Protection Research and Sanctuaries Act (MPRSA).

Project Manager for 2002-2003 Army Corps of Engineers "Geophysical Surveys and Inverstigations for Boston Harbor Navigation Feasibility Study". Responsibilities included oversight of geophysical and archaelogical surveys conducted to determine feasibility of expanding the Boston Harbor Navigation chanell.

Project Manager for 2003 Army Corps of Engineers "Geophysical Explorations: Remote Sensing Survey for Utility Crossing, Salem Harbor, MA". Responsibilities included oversight of geophysical surveys conducted to determine utility locations prior to maintaintence dredging.

Project Manager for 2002-2003 Army Corps of Engineers "Waterbury Dam Repair Project: Water Quality Monitoring and Aquatic Macroinvertabrate Sample Analysis". Responsibilities included oversight of water quality monitoring and benthin macroinvertabrate sampling during the draw-down and repair phases of the Waterbury Dam, VT.

Chief Scientist for "MWRA's Effluent Outfall Dilution Plume Tracking Program". This program was designed to assess the dilution performance of the MWRA outfall in Massachusetts Bay for certification of their NPDES permit. The program consisted of extensive preliminary experiments and data evaluation, two multi-day plume tracking surveys using Rhodamine dye as a tracer, and intensive evaluation of the survey data.

Chief Scientist/Task Leader for outfall dye dilution survey in Newport, Oregon. Responsibilities including designing sampling plans to capture initial dilution values within the Hydraulic Mixing Zone and tracking nearfield and farfield transport of the effluent plume of an offshore outfall pipe. Responsibilities also included conduct of the offshore survey, post survey data processing, and contouring of dilution fields to calibrate the hydrodynamic model used in the NPDES permit renewal process.

Chief Scientist on numerous MWRA water column and nutrient flux surveys in Boston Harbor and Massachusetts Bay.

Field Manager and Health and Safety Officer on US Navy funded projects. Surveys included several sediment studies at Hunters Point Ship Yard, California and a Post Interim Remedial Action survey at Quantico Marine Corp Base, Virginia. Responsibilities included captaining several small sampling

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vessels, and collection of; sediment push-cores, sediment grabs, plants, forage fish, and catfish for human health evaluation. Other responsibilities included ensuring access to the naval facility, scheduling the sampling trip, arranging for equipment and vessels, and escorts, where required, and coordination of both the field and laboratory components, and responsible for ensuring that all technical logistics are identified and addressed.

Technical support for EPA Gulf of Mexico "Bi-national Plan for the Attention of Harmful Algal Blooms". Responsibilities included interviews with harmful algal bloom experts and government resource managers in the Gulf of Mexico States. This work was in support of the EPA's Gulf of Mexico Program (GMP) and the Accord of the States of the Gulf of Mexico (Gulf of Mexico States Accord; GoMSA). GoMSA was signed by representatives of the eleven states of the United States and Mexico that share the Gulf of Mexico region to bring together public officials, entrepreneurs, investors, scientists, and educators from the eleven states in a collaborative effort aimed at enhancing the welfare and quality of life of the citizens of their respective communities, and as a result benefiting the Gulf of Mexico as a whole. The objective of the Accord is to establish working partnerships among these states to promote the economic and infrastructure development, as well as education and cultural exchanges. As part of this program a collaborative Bi-national Plan for the Attention of Harmful Algal Blooms (HABS) in the Gulf of Mexico has been established.

Technical Writer for U.S. EPA's "Development of Programmatic Environmental Impact Statement (PEIS) for Ballast Water Discharge Standards Rulemaking: Affected Environment Section".

Field Specialist for the 2002 & 2004 Minerals Management Service "Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA)" program. Tasks included sediment and biota sampling, diver support, and bioaccumulation studies in the Beaufort Sea.

Laboratory Task Leader on US EPA funded program to develop Enterococcus monitoring protocols for recreational waters at Wollaston Beach, Quincy MA and Miami Beach, MD. Responsibilities included training and oversight of all laboratory analyses

Chief Scientist on U.S. Army Corp of Engineers (COE) vibracoring surveys located at various ports around New England.

Research Diver:
Blue-water dive collections of diatom mats along transects in the North and Central Pacific Gyres. Responsibilities included acting as safety diver, dive team leader, and sample collector. In addition to dive functions, responsibilities included on-board laboratory analysis of phytoplankton nutrient characteristics.

SCUBA collection of sediment cores in Boston Harbor, MA; Narragansett Bay, RI; and Mystic River, CT.

Certifications:
CPR, First Aid, HAZWOPER, HAZWOPER Supervisor, SCUBA (PADI & AAUS).

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Peer-Reviewed Publications:

Journal Articles

Villareal, T.A., Mansfield, A., Buskey, E.J. 1998. Growth and Chemical Composition of the Texas Brown Tide-Forming Pelagophyte *Aureoumbra Lagunensis.* in Harmful Algae. Reguera, B., Blanco, J., Fernandez, M.L., and Wyatt, T. (eds.). Xunta de Galicia and Intergovernmental Oceanographic Commission of UNESCO.

Brennan, J.F., Mansfield, A.M. and Jastreboff, P.J. 1995. Exogenous calcium protects postweanling rats from salicylate-induced changes in auditory conditioning. Psychobiology 23:204-213.

Thesis

Mansfield, A. 1997. Effects of light, nutrients and salinity on the chemical composition of *Aureoumbra lagunensis* Deyoe & Stockwell: the use of batch cultures to validate field results. M.S. thesis, University of Massachusetts Boston ·

Reports

Hunt CD, Mansfield AD, Roberts PJW, Geyer WR, Albro CA, Steinhauer WS, and Mickelson MJ. 2002. Final Report: Massachusetts Water Resources Authority Outfall Effluent Dilution: July 2001. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2002-07. p. 77

Hunt CD, Steinhauer WS, Mansfield AD, Albro CA, Roberts PJW, Geyer WR, and Mickelson MJ. 2002. Final Report: Massachusetts Water Resources Authority Effluent Outfall Dilution: April 2001. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2002-06. p.69 plus appendices.

Libby PS, Mansfield AD, Keller AA, Turner JT, Borkman DG, Oviatt CA, Mongin CJ. 2002. Semiannual water column monitoring report: February – June 2002. Boston: Massachusetts Water Resources Authority. Report ENQUAD 2002-XX. 559 p.

Mansfield M. Albro, Hunt, C, and Parrella A. 2001. Summer Plume Tracking Plume Tracking Survey Report. Submitted to Massachusetts Water Resources Authority, Environmental Quality Department Charlestown Navy Yard, Boston, MA. Battelle Duxbury Operations, Duxbury, MA 02332

Mansfield M. Albro, Hunt, C, Parrella A, and Short L. 2001. Winter Plume Tracking Winter Plume Tracking Survey Report. Submitted to Massachusetts Water Resources Authority, Environmental Quality Department Charlestown Navy Yard, Boston, MA. Battelle Duxbury Operations, Duxbury, MA 02332

Pertinent Presentations:

Mansfield, A.D., Hunt, C.D., & Albro C.S. Plume Tracking: Leading Technologies For Monitoring Outfall Dilutions And Sediment Resuspension. New England Estuarine Research Society 2004. Burlington, VT

Mansfield, A.D. & Villareal, T.A. The Chemical Composition of the Texas Brown Tide Species. April 1997. Northeast Algal Symposium. Woods Hole, MA.

Mansfield, A.D. & Villareal, T.A. The Chemical Composition of the Texas Brown (Poster). 1997.ASLO Aquatic Sciences Meeting. Santa Fe, NM.

US EPA ARCHIVE DOCUMENT

LAURIE A. NIEWOLNY **BATTELLE**

Scientist

Battelle Marine Sciences Laboratory
Pacific Northwest National Laboratory
Sequim, Washington

EDUCATION

B.S., Water Resources and Biology. Chemistry minor. University of Wisconsin-Stevens Point (UWSP), Stevens Point, WI; 1995

Pertinent Coursework: Aquatic Toxicology, Water Chemistry, Advanced Techniques of Environmental Analysis, Water and Wastewater Treatment, Statistics, Limnology, Fisheries, Aquatic Insects, Phycology, Ecological Methods, Forest Resources, Soil Resources, Wetland Characteristics and Restoration, and Biogeochemistry of the Everglades.

QUALIFICATIONS

Laurie A. Niewolny, Scientist, is Primary Analyst for methylmercury using EPA 1631 CVAF analysis for water, tissue, and sediment samples. She also serves as Backup Analyst for total mercury, using both EPA 1630 CVAF and modified EPA 245.6 CVAA analyses. She conducts all preparatory tasks for both methylmercury and total mercury analysis, including freeze drying, digesting, distilling, and extracting samples, and is responsible for maintenance of all aspects of the mercury laboratory (pipette calibrations, lab ware, and equipment). She also performs log-in tasks, acidification, and filtering of chemistry lab samples. Ms. Niewolny specializes in clean sampling techniques necessary for preventing contamination of samples for ultra-low trace-level analysis of metals and conducts workshops and provides training to clients and other interested groups. In addition, Ms Niewolny analyzes samples for acid volatile sulfides (AVS), prepares samples for simultaneously extracted metals (SEM), is competent at operating FLAA and GFAA units, as well as ion and gas chromatographs with various detectors, and is well versed in the operating theory of these analytical tools, ICP, and MS. Ms. Niewolny interprets trace metals chemistry data and writes data summaries for analytical reports, and is also qualified as a QA Representative who is trained to perform data reviews.

Ms. Niewolny has a dual background in ecotoxicology and ecology and has managed several projects relative to dredge material and marine ecosystem assessments. She has performed a variety of aquatic toxicological lab tasks, i.e., sample preparation, test initiations, water quality monitoring, test observations, terminations, and total ammonia and sulfide analyses, and played a major role in the development of a chronic sediment toxicity test with *Leptocheirus plumulosus*. Ms. Niewolny is also skilled at identifying algae, zooplankton, aquatic insects, and fish; competent in organizing and completing field data collection of water, sediment, and biota; has considerable experience in freshwater studies; and is proficient in lab procedures for standard chemical and toxicological water and sediment quality analyses.

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EXPERIENCE

Ultra-low Trace-level Analyses of Metals: Ms. Niewolny routinely performs environmental chemical analysis for mercury is tissue, water, and sediment samples for a variety of clients, including EPA, US Navy, US Army, US Army Corps of Engineers, private industry, and state and regional agencies. Analyses have been used to address issues concerning TMDL, exposure pathways, NPDES/effluent monitoring, food consumption, and food-web biomagnification.

U.S. Environmental Protection Agency *Leptocheirus plumulosus* chronic sediment toxicity test: Acted as Deputy Laboratory Task Leader and assisted project manager on all aspects of laboratory work for protocol development, round robin, and comparative toxicity testing. Was second author on final report to the U.S. EPA, which details the experiments relative to test reproducibility and sensitivity (see publication list).

Foster Wheeler/Alaska Pulp Corporation: Ms. Niewolny assisted in all phases of the toxicity testing, which consisted of *L. plumulosus* (amphipod) chronic and acute, *R. abronius* (amphipod) acute, and bivalve (*M. galloprovincialis*) elutriate tests. Also assisted the project manager with compiling data and writing the data report (see publication list).

- **Port of Oakland 50ft Deepening Program:** Assisted in the conduct of the bivalve (*M. galloprovincialis*) elutriate toxicity testing for the Port of Oakland 50ft Deepening Program. I learned how to spawn the bivalve *M. galloprovincialis*, an integral part of the test, subsequently, giving me the ability to conduct the test in it□s entirety.
- ***Neanthes arenaceodentata* (polychaete) Round Robin testing:** Deputy manager for this program supported by the USACE-Waterways Experiment Station, which involves coordinating six laboratories to conduct the WES 28-d *Neanthes* chronic sediment test. Prepared all lab materials in support of test conduct and data accumulation. Assisted in providing technical support for all participating labs and presentation of data at an informal meeting at the 18th Annual Meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in San Francisco, California, November 16-20, 1997.
- **ALCOA-Point Comfort Operations:** Project manager for this toxicity testing program with *Leptocheirus plumulosus*. Tasks included conducting the test, compiling data, and writing the data report (see publication list).
- **US Army Corps of Engineers-New England Division:** Assisted in all phases of the toxicity testing, which consisted of acute amphipod, bioaccumulation, and bivalve elutriate tests. Also assisted the project manager with data compilation and report writing (see publication list).

SPECIALIZED TRAINING

Occupational Safety and Health for Hazardous Waste Site Activities or commonly called HAZWOPER.

PUBLICATIONS

Ms. Niewolny has published numerous technical reports and data summaries involving mercury analyses and ecotoxicological testing programs. The following are examples of reports from large programs involving both wet laboratory toxicity testing and chemical evaluations.

USEPA (U.S. Environmental Protection Agency). 2001. Method for Assessing the Chronic Toxicity of Sediment-Associated Contaminants with Leptocheirus plumulosus. First Edition. PNNL-26566. EPA 600/R-01/020. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Duluth, Minnesota, by Pacific Northwest National Laboratory, Richland, Washington; Battelle Marine Sciences Laboratory, Sequim, Washington. Contributing authors LD Antrim, VI Cullinan, MR Pinza, BD Gruendell, LA Niewolny.

Gardiner, WW, and LA Niewolny. 1998. *Results of an Interlaboratory Evaluation of the 28-Day Chronic Sediment Toxicity Test Using Neanthes arenaceodentata.* PNNL-11858. Prepared for US Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, by Pacific Northwest National Laboratory, Richland, Washington; Battelle Marine Sciences Laboratory, Sequim, Washington.

Pinza, MR, NP Kohn, LA Niewolny, and WW Gardiner. 1998. *Evaluation of 1998 Proposed Maintenance Dredged Material from Port of Richmond Terminal 4.* PNWD-2440. Prepared for the Port of Richmond by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington.

Pinza, MR, NP Kohn, LA Niewolny, and WW Gardiner. 1998. *Evaluation of 1998 Proposed Maintenance Dredged Material from Richmond Marina Entrance Channel.* PNWD-2439. Prepared for the Port of Richmond by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington.

DeWitt, T.H., B.D. Gruendell, and L.A. Niewolny. 1997. "Relative Sensitivity and Inter-Laboratory Variability of the *Leptocheirus plumulosus* Chronic Sediment Toxicity Test Protocol." PNNL-SA-28856. Presented at the 18th Annual meeting of Society of Environmental Toxicology and Chemistry (SETAC): "Bridging the Global Environment: Technology, Communication, and Education," November 16-20, 1997, San Francisco, California.

DeWitt, T.H., L.A. Niewolny, S.L. Nieukirk, B.D. Gruendell, W.W. Gardiner, A.B. Borde. 1997. *Support for Development of a Standard Chronic Sediment Toxicity Protocol with the Estuarine amphipod, Leptocheirus plumulosus.* PNWD-2369. Prepared for the U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D. C., under EPA Contract Number 68-C2-0134, Work Assignment 210. Prepared by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington; Battelle Ocean Sciences, Duxbury, Massachusetts.

DeWitt, T.H., M.R. Pinza, and L.A. Niewolny. 1997. *Phase I (Dilution Series Study) and Phase II (Field-Collected Sediment Study) of the PTI Chronic Leptocheirus plumulosus Project.* PNWD-2384. Prepared for PTI Environmental by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington.

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DeWitt, T.H., M.R. Pinza, and L.A. Niewolny, V.I. Cullinan, and B.D. Gruendell. 1997. *Development and Evaluation of a Standard Marine/Estuarine Chronic Sediment Toxicity Test Method Using Leptocheirus plumulosus.* PNNL-11768. Prepared for the U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D. C., by Battelle Marine Sciences Laboratory, Sequim, Washington; Pacific Northwest National Laboratory, Richland, Washington.

Gruendell, B.D., L.A. Niewolny, and T.H. DeWitt. 1997. "Improving the Cost-Efficiency of the *Leptocheirus plumulosus* Chronic Sediment Toxicity Test Protocol." PNNL-SA-28853. Presented at the 18th Annual meeting of Society of Environmental Toxicology and Chemistry (SETAC): "Bridging the Global Environment: Technology, Communication, and Education," November 16-20, 1997, San Francisco, California.

Niewolny, L.A., V.I. Cullinan, and J.A. Ward. 1997. *Evaluation of Dredged Material Proposed for Ocean Disposal from Kennebunk River, Maine.* PNWD-2388. Prepared for the U.S. Army Corps of Engineers, New England Division, by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington; and Battelle Ocean Sciences Laboratory, Duxbury, Massachusetts.

Niewolny, L.A., T.H. DeWitt, and B.D. Gruendell. 1997. *ALCOA Point Comfort Sediment Quality Triad Project: Leptocheirus plumulosus Chronic Survival Sediment Toxicity Test.* PNWD-2381. Prepared for Parametrix, Inc., Seattle, Washington, Parametrix, Houston, Texas, and ALCOA Aluminum Company of America, Point Comfort, Texas, by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington.

Niewolny, L.A., B.D. Gruendell, and T.H. DeWitt. 1997. "Effect of Non-Contaminant Factors on the Performance of the *Leptocheirus plumulosus* Chronic Sediment Toxicity Test." PNNL-SA-28854. Presented at the 18th Annual meeting of Society of Environmental Toxicology and Chemistry (SETAC): "Bridging the Global Environment: Technology, Communication, and Education," November 16-20, 1997, San Francisco, California.

Ward, J.A., and L.A. Niewolny. 1997. *Ecological Evaluation of Proposed Dredged Material from the Charleston Harbor Entrance Channel, Charleston, South Carolina.* PNWD-2389. Prepared for Gulf Engineers and Consultants, Inc., by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington.

Ward, J.A., L.A. Niewolny, and V.I. Cullinan. 1997. *Ecological Evaluation of Proposed Dredged Material from the Charleston Harbor Entrance Channel, Charleston, South Carolina.* PNWD-2389. May, 1997. Prepared for Gulf Engineers & Consultants by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington.

Ward, J.A., L.A. Niewolny, and V.I. Cullinan. 1997. *Evaluation of Dredged Material Proposed for Ocean Disposal from Union River, Maine.* PNWD-2403. Prepared for the U.S. Army Corps of Engineers, New England Division, by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle, Pacific Northwest Division, Richland, Washington; and Battelle Ocean Sciences Laboratory, Duxbury, Massachusetts.

Ward, J.A., V.I. Cullinan, L.A. Niewolny. 1996. *Evaluation of Dredged Material Proposed for Ocean Disposal from 5-Mile River, Connecticut.* PNWD-2379. Prepared for the U.S. Army Corps of

Engineers, New England Division, under an Interagency Laboratory Agreement with Battelle Ocean Sciences, Duxbury, Massachusetts, Contract 26808, by Battelle Marine Sciences Laboratory, Sequim, Washington; Battelle Memorial Institute, Pacific Northwest Division, Richland, Washington.

Niewolny, L. A., R. L. Crunkilton, and C. T. Blackmore. 1995. Rapid toxicity assessment of Atrazine and copper using Selenastrum capricornutum fluorescence. Presented at the Third Annual Meeting of the Society of Environmental Toxicology And Chemistry, Midwest Regional Chapter in Wisconsin Dells, Wisconsin, April 5-7.

Niewolny, L. A., D. L. Villeneuve, W. M. DeVita, R. L. Crunkilton, and B. A. Browne. 1995. Assessment of Nonpolar Contaminants in Water Conservation Area-2A of the Florida Everglades using Semipermeable Polymeric Membrane Devices. Presented at the Third Annual International Semipermeable Membrane Device Symposium and Workshop in Columbia, Missouri, June 12-15.

Niewonly, L. A. and M. J. Gonzalez. 1994. Acidification experiments on three species of Daphnia from Little Rock Lake, Wisconsin, USA. Presented at the Fifth Annual Argonne Symposium for Undergraduates in Science, Engineering, and Mathematics at Argonne National Laboratory in Chicago, Illinois, November 4-5.

US EPA ARCHIVE DOCUMENT

ELIZABETH F. THOMPSON **BATTELLE**

Senior Technician

Education:

B.S., Biology, Nazareth College, Rochester, NY
M.S., Biological Sciences, State University of New York at Brockport, Brockport, NY

Additional Training:

VG Autospec Operator Training Course- Micromass- 2002
Environmental GC-MS Instrument & Chemstation Operation Training Course- Agilent- 2002
Sample Preparation for Dioxin and PCBs using manual techniques and FMS Powerprep- Terrachem- 2002
Opusquan Training Course- Midwest Research Institute- 2002
Data Dioxin Review and Reporting- Terrachem- 2003
Quality Assurance/Quality Control in an Environmental Laboratory- PittCon short course-2003
Statistically Valid Detection Limits and Quantitation Limits- PittCon short course-2004.

Qualifications:

Ms. Thompson currently analyzes samples by high resolution mass spectrometry for the polyhalogenated dibenzo-p-dioxin and dibenzofuran (PCDD/PCDF) analysis programs. She has analyzed tissue, sediment and soil samples for approximately 150 PCB congeners utilizing EPA method 1668A for a project supporting site remediation. Ms. Thompson has also analyzed sediment and tissue samples for dioxins and furans following EPA method 1613 for both the 2378 substituted and total dioxins.

Ms. Thompson was formerly employed by the University of Maine, where she served as the Organic Laboratory Supervisor. At the University of Maine, her duties included analyzing biological tissue samples for dioxins, furans, and the 12WHO PCBs by high resolution mass spectrometry (based on EPA methods 1613, 8290 and 1668A), analyzing samples for pesticides, PCBs and PAHs by low resolution GC-MS following EPA methods 8270 and 680 (homolog method). Ms. Thompson was also responsible for reviewing and reporting all data produced by the laboratory, working with clients and contracts, supervising technicians and graduate students, conducting method development, and performing instrument maintenance.

Relevant Experience:

209 PCB Congener Analysis. Ms. Thompson has analyzed sediment, soil and tissue (fish and mammals) samples for 209 PCB congeners by high resolution GC/ high resolution MS utilizing EPA method 1668A for a project supporting site remediation- *Industrial client.*

12 WHO PCBs, Dioxin and Furan Analysis. PUF samples were analyzed for the 12 WHO PCBs using EPA method 1668A and dioxins and furans using EPA method 1613. This project was part of an EPA air monitoring study at an uncontrolled combustion site.

US EPA ARCHIVE DOCUMENT

State of Maine's Surface Water Ambient Toxics Program and Dioxin Monitoring Program 4/01/2002-7/31/2003. As organic laboratory supervisor at the University of Maine's Environmental Chemistry Laboratory, Ms. Thompson took part in the preparation, data analysis and data workup of the 2001 SWAT and Dioxin Monitoring projects. In 2003, Ms. Thompson began improving the preparation methodology as well as improved the data acquisition, quantitation, and review processes. She produced good quality data for the 2002 sampling year. Ms. Thompson also oversaw and advised the work of graduate students working on the SPMD project. She has attended SWAT and Dioxin Monitoring Program meetings in Augusta as well as SPMD project committee meetings and is very familiar with these projects and the people conducting the work. She knows the needs of the projects and the importance of the deadlines.

Graduate Work

Prior to working in a dioxin laboratory, Ms. Thompson worked for her graduate advisor as a Sea Grant Scholar and Research Assistant. Her thesis focused on evaluating the impact that an exotic species of zooplankton had on the mirex concentrations in the Lake Ontario food web. This involved measuring mirex concentrations in zooplankton, amphipods, zebra mussels, sediments, perch, alewives, and salmonids. Ms. Thompson also analyzed her samples for stable isotopes of carbon and nitrogen and coupled these results with the gut analysis of forage fish to determine the position of this exotic species in the Lake Ontario food web. Ms. Thompson also worked on a number of other projects with her advisor including an EPA Embayment project measuring arochlors in turtle and fish tissue above and below the influence of Lake Ontario, stressed stream analysis and watershed studies around Conesus Lake and a number of the Finger Lakes in upstate New York, and an environmental impact study to determine the effect of a break wall on organisms in a local creek. Ms. Thompson worked at Columbia Analytical Services as an inorganic chemist analyzing samples for metals by Atomic Emission Spectroscopy, Atomic Absorption by graphite furnace and mercury analysis by a Flow Injected Mercury Analyzer. She also helped the organic laboratory by performing liquid-liquid extractions, soxhlet extractions, soil sonications and sample concentration.

Selected Publications:

Makarewicz, J.C., E. Damaske, C. Laxson, I.A. Grigorovich and H. MacIsaac. Fall 2002. Seasonal and vertical distribution, food web dynamics, and contaminant biomagnification of *Cercopagis pengoi* in Lake Ontario. *Aquatic invaders*. 13(3):1-6.

Makarewicz, J.C., E. Damaske, T.W. Lewis, M. Merner. 2003. Trend Analysis Reveals a Recent Reduction in Mirex Concentrations in Coho (*Oncorhynchus kistutch*) and Chinook (*O. tshawytscha*) Salmon from Lake Ontario. Environmental Science and Technology. 37(8): 1521-1527.

Presentation:

The invasion of Cercopagis pengoi- its effects on trophic interactions and contaminant concentrations in Lake Ontario biota. Great Lakes Research Consortium, Syracuse, NY, March 17, 2001.

US EPA ARCHIVE DOCUMENT

JORDANA REGAN WOOD **BATTELLE**

Research Scientist II

Pacific Northwest National Laboratory
Battelle Marine Sciences Laboratory
Sequim, Washington

EDUCATION AND SPECIALIZED TRAINING
M.S., Chemistry, Arizona State University, 1991
Thesis: "X-Ray Fluorescence Analysis of Geochemical and Cosmochemical Samples"
B.A., Chemistry, Hiram College, 1988
Kent State University (Summer Internship), 1987
Training: Graphite Furnace AA, Perkin Elmer, 1993

QUALIFICATIONS:
Ms. Jordana Wood's laboratory supervisory experience includes serving as Metals Laboratory Supervisor at the Battelle Duxbury Operations office in Duxbury, Massachusetts, and previously at LAS Inc., Las Vegas, Nevada. She currently runs the MSL metals laboratory housing ICP-AES, GFAA, and FIAS-AA for analyses of selenium, mercury, and arsenic. In this capacity, Ms. Wood manages the cost center for the ICP-AES instrument, which involves balancing charge-out rates with costs of operations and equipment depreciation, based on tracking expenses and budgeting funds necessary for conducting analyses and procuring standards and other supplies.

Ms. Wood has over 13 years experience as an inorganic analytical chemist, including sample preparation and trace metals analysis using a variety of recognized analytical methods and related instrumentation. She has 10 years experience as a graphite furnace operator and also operates flow injection atomic spectroscopy (FIAS) instruments using atomic absorption. She has received specialized training in the operation of Graphite Furnace AA through Perkin Elmer. Ms. Wood is proficient in trace metal analysis using graphite furnace, flow injection, and cold vapor atomic absorption spectroscopy, as well as inductively coupled plasma atomic emission spectroscopy. Ms. Wood is also proficient in MeHg sample preparation and analysis and total Hg analysis by purge and trap atomic fluorescence.

Ms. Wood has 8 years experience conducting secondary (supervisory) review in metals data. Key project management experience includes serving as assistant project manager to the EPA 20-Family Soil Ingestion Study, and project manager for coordinating all MSL metals chemistry analyses performed for the multimillion-dollar, long-term monitoring study being conducted for the Massachusetts Water Resources Authority in support of their marine outfall. Ms. Wood is proficient in MeHg sample preparation and analysis and total Hg analysis by purge and trap atomic fluorescence.

Wood's analytical expertise is complemented by a background in secondary (supervisory) inorganic data review and report preparation, as well as review of QA packages. She conducts data processing review for any deviations from either project or method protocols.

EXPERIENCE

Battelle Marine Sciences Laboratory (10-98 to present)
Sequim, WA
Science and Engineering Associate

Battelle Laboratory (4-98 to 10-98)
Duxbury, MA
Trace Metals Supervisor

LAS Laboratory, Southern Petroleum Laboratories (1997 to 1998)
Las, Vegas, Nevada
Scientist, Trace Metals Supervisor

Lockheed Environmental Systems & Technologies Co. (1994 to 1996)
Lockheed Analytical Services Division
Associate Scientist

Ms. Wood's responsibilities included instrumental analysis of environmental samples using procedures found in the USEPA CLP and SW-846, as well as other recognized methods manuals. She is proficient in trace metal analysis using graphite furnace, flame, and cold vapor atomic absorption spectroscopy, as well as inductively coupled plasma atomic emission spectroscopy. Ms. Wood was also responsible for the interpretation and review of inorganic data. She also prepares in-house and client QC Control Charts.

ICF Kaiser Engineers (1991 to 1994)
Analytical Chemist

Ms. Wood was responsible for CLP inorganic sample preparation, trace metal analysis by GFAA, microwave sample preparation, and organic extraction methods. She performed standard operating procedure reviews to meet current technologies, produced and analyzed performance evaluation standards and inorganic ICV solutions, and maintained sample inventory.

Prior to 1991:
Teaching Assistant. Ms. Wood was a Teaching Assistant at Arizona State University and Hiram College.

Research Assistant. Ms Wood was a research Assistant at Arizona State University (X-Ray Fluorescence analysis of rock samples) and Kent State University (Solubility of organic compounds in binary solvent mixtures).

Publications:
Wallach, Jordana R., Sheryl A. Tucker, Bidget M. Oswalt, Debra J. Minal and Dr. William E. Acree 1989. "Solubility of Pyrene in Binary Solvent Mixtures containing Dibutyl Ether". *Journal of Chemical Engineering Data,* 1989, vol 34, pp 70-73

US EPA ARCHIVE DOCUMENT

REBECCA WOOD **BATTELLE**

Inorganic Prep Laboratory Manager

Marine and Environmental Chemistry
Pacific Northwest National Laboratory
Battelle Marine Sciences Laboratory
Sequim, Washington

EDUCATION

Certificate in Environmental Management, University of Washington, Seattle, WA 1998
MS, Ecology, Bangor University, North Wales, 1992
BS, Environmental Science, Worcester College, England, 1989

QUALIFICATIONS

Ms. Rebecca Wood has 10 years of environmental laboratory experience, which includes 6 years of sample analysis for conventional parameters, mercury, and microbiological measures, 1 year as a Quality Assurance Associate, and 4 years as a Project Manager. MS Wood joined Battelle in May 2002. At the MSL, she is responsible for sample receipt and preparation of sediment, tissue, and water samples for analysis of metals, including mercury, methylmercury, chromium, selenium, arsenic speciation.

Ms. Wood has a multiple background in chemistry, program management, regulatory compliance, and terrestrial ecology. She has taken upper-degree courses in environmental regulations and policy, with an emphasis on CERCLA, RCRA, SEPA, CAA and CWA; stakeholder negotiations; and environmental project management. Research in this arena has included monitoring the acute and chronic effects of pulp mill effluent upon the ecology of receiving waters. Other studies have examined land-use issues, including addressing problems and solutions concerning growth in the Sammamish Plateau. Additional specialized course work has focused on land restoration, plant communities, animal ecology, nature conservation, vegetation classification, and experimental design. Her theses were on "Edge Effects and Transfer between Semi-natural Habitats and Arable Areas in Farmland and Conservation Areas" and "Habitat Restoration on a Former Open Cast Coal Site."

EXPERIENCE

Battelle Marine Sciences Laboratory, Sequim, Washington (05/2002 to present)

Brooks Rand Ltd., Seattle, Washington (7/1998 to 3/2002)
Operations/Project Manager
Directed operations and project management for a small environmental research business. Served a wide variety of clients including Industrial, Municipal, Legal and Consulting Organizations. Project experience included remedial investigations / feasibility studies, environmental toxicology, and NPDES permitting. Provided specialized services to assist clients with contamination, toxicology and water quality issues. Duties included technical report writing, performance of analytical testing and data validation, discussion of compliance issues with clients, and supervision of project team. Negotiated and managed project contracts with consultants, government agencies, and non-profits. Utilized analytical skills to implement project requirements and solve problems in research projects. Developed and maintained excellent working relationships with a wide range of client organizations. Oversaw staff, implemented project plans and budgets. Served as Sales/Marketing Coordinator for Analytical Services. Duties included preparation of proposals, contract review, and monitoring workload and capacity for

incoming projects.

North Creek Analytical, Inc., Bothell, Washington (4/1992 to 7/1998)
Team Lead/Project Manager
Lead analytical team for Conventionals and Microbiology. Acquired knowledge and experience with SW846, PSDDA, ASTM, EPA 300/600 Series Methodologies. Developed and executed methods for the production of scientific data. Ensured results were reported in a timely manner, generated data packages, reviewed data for completeness and accuracy, clarified anomalous results. Discussed with clients analytical requirements and interpretation of results. Also served as Quality Assurance Associate, with responsibilities of managing the laboratory's accreditation requirements, interfacing with accrediting agencies, submitting results for performance evaluation studies, and compiling data deliverables. Coordinated laboratory analyses to ensure the needs of the client while balancing the laboratory workload. Staff management responsibilities included the participation in the evaluation of candidates for employment and subsequent performance appraisals.

Nature Conservancy Council (Temporary Contract), Malvern, UK (7/1989 to 10/1989)
Scientific Officer

As Scientific Officer, identified and documented flora relating to the National Vegetation Classification of the British Isles. Conducted site surveys for special sites of scientific interest. Assessed for damaging land practices and performed phytosociological evaluations. Communicated with landowners and members of the public on matters of land use and nature conservation.

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Karolina Badura
Chemist

Karolina Badura is a hired chemist from Poland. She currently works as a chemist in the Metals Preparation Laboratory.

EDUCATION	**Nicholas Copernicus University of Torun** Poland Major-Chemistry, MS
RELATED EXPERIENCE	
2004- Present	**Mitkem Corporation** Warwick, Rhode Island Chemist
August 2002	Internship Sanepid, Nowy Dowor Gd.

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REINIER A. COURANT

QA Director

Mr. Courant has over twenty five years of experience in environmental chemistry. He has managed a number of large scale multi-disciplinary and international environmental baseline studies. These studies involved the collection and analysis of samples for a wide variety of parameters, the evaluation and interpretation of the generated data, and the writing of the final report. Mr. Courant has authored 25 scientific papers and held senior scientist and project manager positions as well as upper management and partner positions in several environmental firms.

Mr. Courant has extensive experience in many phases of environmental chemistry, with particular concentration in laboratory design and automation, specifically in electronic transfer of data and set-up of information management systems. He also has considerable experience in sample analysis, data review and data package preparation for EPA Contract Laboratory Program inorganic sample analyses. His experience with chemical analysis instrumentation is wide-ranging, with a primary focus on trace metals analyses.

In the past ten years he has been involved in the start-up and senior management of several environmental testing laboratories.

EDUCATION

UNIVERSITY OF RHODE ISLAND
Graduate School of Oceanography
Kingston, Rhode Island
Chemical Oceanography, MS

NORTHEASTERN UNIVERSITY
Boston, Massachusetts
Mathematics, MS

DELFT INSTITUTE OF TECHNOLOGY
Delft, Netherlands
Chemistry

RELATED EXPERIENCE

1994-Present

MITKEM CORPORATION
Warwick, Rhode Island
- Vice President and QA Director

1991-1994	**CC CORPORATION** Lexington, Massachusetts - President
1987-1991	**CEIMIC CORPORATION** Narragansett, Rhode Island - Vice President
1985-1987 1980-1983	**ENERGY AND ENVIRONMENTAL ENGINEERING, INC.** Cambridge, Massachusetts - Vice President
1983-1985	**RESEARCH PLANNING INSTITUTE** Columbia, South Carolina - Senior Chemist Niger Delta Baseline Studies
1978-1980	**INTERSTATE ELECTRONICS CORPORATION** Anaheim, California - Senior Oceanographer US EPA Studies of US Offshore Dumpsites
1976-1978	**ENERGY RESOURCES COMPANY - ERCO** Cambridge, Massachusetts - Field Operation Manager and Senior Oceanographer Georges Bank Region Environmental Baseline Studies
1972-1976	**UNIVERSITY OF RHODE ISLAND** Kingston, Rhode Island - Research Specialist/Graduate Student
1969-1972	**WOODS HOLE OCEANOGRAPHIC INSTITUTE** Woods Hole, Massachusetts - Research Assistant/Graduate Student

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Evan Philo
Inorganic Laboratory Manager

Evan Philo recently took over as Mitkem's Inorganic Laboratory Manager. He has had two years of previous experience as a metals supervisor and over three years experience working in the metals laboratory. Most recently, Mr. Philo had been working as a project manager, helping communicate project and laboratory needs between the laboratories and clients.

Mr. Philo's responsibilities at Mitkem include management of the inorganic chemistry laboratories including metals and conventional wet chemistry analyses. His duties include the day-to-day scheduling of all analytical work in the department to meet program turnaround and method holding time requirements. Mr. Philo is also responsible for the technical and QC performance of a variety of methods, as well as development and implementation of Standard Operating Procedures, method and instrument performance measures, daily review of sample and QC data. In addition, he directs the training of laboratory staff and discussion of program requirements and project status with Mitkem's project managers and clients.

EDUCATION

Cornell University
Ithaca, New York
Major-Biology, BS

RELATED EXPERIENCE

2000- Present	**Mitkem Corporation** Warwick, Rhode Island Chemist (2000-2001) Metal Supervisor (2001-2003) Project Manager (2003-2004)
2000	**United States Census Bureau** Boston, MA Census Enumerator
1998-1999	**Albert R. Mann Library** Ithica, New York Computer Laboratory Service Operator
1997	**Cornell University** Laboratory of Ornithology Ithica, New York Data Assistant

Joanna Sadlek
Chemist

Joanna Sadlek is a hired chemist from Poland. She currently works as a chemist in the Metals Instrument Laboratory, Metals Preparation Laboratory, and Wet Chemistry Laboratory. Ms. Sadlek is capable of operating an ICP-OES, AA system for cold vapor mercury analysis, an Ion Chromatograph, the TOC analyzer, and the Lachat 8000 automated spectrophotometer.

EDUCATION

Nicholas Copernicus University of Torun
Poland
Major-Analytical Chemistry, MS in progress

Nicholas Copernicus University of Torun
Poland
Major- Chemistry with Elements of
Marketing and Management- BS

RELATED EXPERIENCE

2003- Present	**Mitkem Corporation** Warwick, Rhode Island Chemist
Summer 2002	Internship in Chemistry at Secondary School Chelmza, Poland
Summer 2001	Intercept in Chemistry at Primary School Raciazek, Poland

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Ruth Smith
Chemist

EDUCATION

Thiel College
City, State
Biology and Chemistry, BA

RELATED EXPERIENCE

Jan 2003-present

Mitkem Corporation
Warwick, Rhode Island
Chemist, Wet Chemistry Analyses

Sept 2000-Jan 2003

Keyholder
Wakefield, Rhode Island
Assistant Manager

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Shiu Ting Ng (Shirley)
Analyst

EDUCATION	**University of Massachusetts Dartmouth** **North Dartmouth, MA** **Computer Science, BS**
RELATED EXPERIENCE	
August 2004- Present	**Mitkem Corporation** Warwick, Rhode Island Supervisor, Sample Receiving

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WILLIAM A. MEYER **TELEDYNE BROWN ENGINEERING**

Quality Assurance Manager

EDUCATION
B.S., Industrial Engineering, New York University, 1957

EMPLOYMENT EXPERIENCE

Teledyne Brown Engineering, 1962 – Present
Mr. Meyer, as Quality Director, is responsible for directing the programs for hardware, software and laboratory quality for Teledyne Brown Engineering. He designs quality programs, performs quality engineering tasks, and manages quality programs on NRC and DOE government contracts, subcontracts and on commercial contracts. Current Nuclear quality systems are to ASME Section III and NQA-1 & -2. Product experience includes ASME Code (under N and NPT stamps), design and fabrication for storage of radioactive waste, chemical processing facilities for destruction of Chemical warfare materials and quality system operation for radioactivity analysis laboratories.

He also writes quality plans, quality manuals, quality engineering procedures, quality control instructions, and work instructions for quality personnel.

Atlantic Research Corporation, 1961 – 1962
As an Engineer, Mr. Meyer performed reliability work on solid-propellant rocket motors.

U.S. Army Missile Command, 1958 – 1961
As Quality Engineer, Mr. Meyer managed the Stockpile Reliability Section.

Airlite Aluminum Corporation, 1957 – 1958
As Industrial Engineer, Mr. Meyer provided engineering services for aluminum furniture and contract sewing operations

Accreditation
Professional Engineering License 6706, Alabama

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AMY ELIZABETH NICHOLS **APPLIED MARINE SCIENCES**

Senior Laboratory Analyst

EDUCATION

B.S. Biology/Chemistry Minor, Millersville University (Cum Laude), 2002

QUALIFICATIONS

Ms. Nichols is a Senior Laboratory Analyst at Applied Marine Sciences, Inc. She is experienced in grain size, total organic carbon/dissolved organic carbon and physical properties testing and supervises all sample receipt and initial throughput of the laboratory. In addition, she is experienced in the collection and preservation of marine sediment samples using vibracore and grab-sampling methods.

Prior to joining AMS, Ms. Nichols conducted research at the Marine Biomedical Institute at the University of Texas Medical Branch in Galveston, TX and the Marine Biological Laboratory at the Woods Hole Oceanographic Institute in Woods Hole, MA. In both positions, she developed strong laboratory analytical skills and became experienced in field sampling techniques and practices. Ms. Nichols has coauthored and published five peer-reviewed papers and has presented her research at major scientific conferences around the world.

RELEVANT EXPERIENCE

Senior Project Analyst: Long-Term Monitoring Project, New Bedford Harbor, MA, Battelle. Responsible for grain size, TOC and physical properties analyses.

Environmental Technician and Project Analyst: Pre-dredge assessment in West Galveston Bay, Galveston, TX for private client. Collected sediment samples using vibracore and grab-sampling equipment. Ms. Nichols was responsible for sample preparation and analyses.

Research Intern: National Resource Center for Cephalopods, University of Texas Medical Branch, Galveston, TX. Ms. Nichols was responsible for the culture and husbandry of native and exotic cephalopods (octopus, cuttlefish, squid and nautilus). She also participated in field collection activities using towed and deployed capture systems. Ms. Nichols is an experienced small boat captain and operated vessels during research trips offshore.

Research Assistant: Long-term investigation into chemical signaling processes in invertebrates, University of Texas Medical Branch, Galveston, TX. Ms. Nichols was the senior biologist responsible for the collection, maintenance, and biological testing of marine invertebrates. These activities included collection of intertidal mollusks at South Padre Island, TX, developing and using experimental bioassays then performing nonparametric biostatistical analyses. Specific techniques performed during these bioassays included peptide isolation and purification (Sep-Pak), RNA/DNA isolation, RT-PCR and vector/insert ligation.

Research Intern: Marine Biological Laboratory, Woods Hole Oceanographic Institute, Woods Hole, MA. Ms. Nichols assisted in investigations of chemical signaling processes in marine invertebrates. Along with field collection of long-finned squid, she developed experimental designs of bioassays, collected data and performed biostatistical analyses.

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PUBLICATIONS

Buresch, K.C., J.G. Boal, J. Knowles, J. Debose, A.E. Nichols, A. Erwin, S.D. Painter, G.T. Nagle, and R.T. Hanlon. 2002. Contact chemosensory cues in egg bundles elicit malemale agonistic conflicts in the squid *Loligo pealeii* (Mollusca: Cephalopods). Journal of Chemical Ecology, 16:7.

Cummins, S.F., A.E. Nichols, A. Amare, A.B. Hummon, J.V. Sweedler, and G.T. Nagle. 2004. Characterization of *Aplysia* Enticin and Temptin, two novel water-borne protein pheromones that act in concert with attractin to stimulate mate attraction. Journal of Biological Chemistry, 279:25614-25622

Cummins, S.F., A.E. Nichols, K. Rajaranthnam, and G.T. Nagle. 2004. A conserved heptapeptide sequence in the waterborne attractin pheromone stimulates mate attraction in *Aplysia*. Peptides, 25:2.

Cummins, S.F., A.E. Nichols, C.J. Warso, and G.T. Nagle. 2005. *Aplysia* seduction is a water borne protein pheromone that acts in concert with attractin to stimulate mate attraction. Peptides, 26:351-359.

Painter, S.D., S.F. Cummins, A.E. Nichols, D.B.G. Akalal, C.H. Schein, W. Braun, J.S. Smith, A.J. Susswein, M. Levy, P.A.C.M. de Boer, A. ter Maat, M.W. Miller, C. Scanlan, R.M. Milberg, J.V. Sweedler, and G.T. Nagle. 2004. Structural and functional analysis of *Aplysia* attractins, a family of water-borne protein pheromones with interspecific attractiveness. PNAS, 101:8:18.

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MIKE A. SEYMOUR **APPLIED MARINE SCIENCES**

Quality Assurance Manager

EDUCATION

B.S. Marine Sciences, Texas A&M University, 2002

QUALIFICATIONS

Mr. Seymour is the QA Manager for Applied Marine Sciences, Inc., where he is responsible for the Quality Assurance, Quality Control and Safety programs. Mr. Seymour develops and implements policies complying with NELAC criteria (certification in progress) as well as regulatory and private client requirements. He was an Analyst and Supervisor with Applied Marine Sciences, Inc. from 1999 to 2002.

In the interim period, he was an Environmental Scientist and Project Manager for Conestoga-Rovers and Associates Inc. In addition, Mr. Seymour was also responsible for Project Safety, Data/Build Compliance and Quality Assurance as part of the Heavy Construction and Engineering group. Prior to working in C&E, he was a part of the Environmental Services group. In total, Mr. Seymour has over 13 years experience as a scientist and manager.

RELEVANT EXPERIENCE

Quality Assurance Manager, Applied Marine Sciences, Inc. (2005-present)
Developing and implementing updated QA/QC controls and standards leading to NELAC certification.

Project Manager, Conestoga-Rovers and Associates, Inc., (formerly BNC Environmental); (2003-2005)
Projects manager, Safety Coordinator and Quality Assurance manager within Construction and Engineering group. Acting QA manager responsible for completion of submittals and verification of compliance after project completion.

Environmental Scientist, Conestoga-Rovers and Assoc., Inc. (2002-2003)
Managed various projects for the environmental services group, specifically in groundwater remediation and spill response and reclamation. Designed and installed groundwater remediation systems for recovery of product after spill response. Responsible for development and implementation of field sampling plans, laboratory data reduction and reporting to private and regulatory clients. Primary field scientist for groundwater, runoff, soil and sediment sampling and modeling events.

Laboratory Analyst, Applied Marine Sciences, Inc. (1999-2002)
Analyzed samples and performed testing using particle size analysis, permeability, Atterberg limits, consolidation, total inorganic and organic carbon analyses (soil/sediment and water), field and laboratory chemical probe analyses, chemical sample preparation and analysis for organic and inorganic chemicals using wet chemistry techniques.

Project Manager, Quality Assurance Officer: Construction of new municipal Water Treatment Plant, supply and transmission pipelines, pump station, AST and two containment lagoons.

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Quality Control Officer and Safety Coordinator: New brine pond construction, soils remediation, pipeline installations, burn off flare and pump controls building to private client.

Project Manager, QA Manager: Repair, remediation of brine pond liner and chloride-affected soils, private client.

Project Manager, QA Manager: Mapping, remediation of chloride-affected soils, private client.

Project QA Manager, Safety Coordinator: Repair, remediation of brine pond liner with chloride-affected soils, private client.

Project Manager, QA Manager, Field Supervisor: Five quarterly groundwater-monitoring events at tank batteries and/or spill response locations. Reporting to private client(s) and regulatory bodies.

Field Manager, Environmental Scientist: Spill response and environmental assessment to gasoline feedstock spill at USACE waterway, 1 MM bbl. Responsible for response, containment, assessment and subsurface modeling for private client.

Field Supervisor: Map affected area and design sampling plan after railroad derailment, 15M bbl. volume of styrene and heavy aromatic feed stocks, private client.

Project Analyst: Palos Verdes Pilot Capping Project and Supplemental Survey. Lead Analyst for soil classification, grain size, bulk density, specific gravity, Atterberg limits, and moisture content analyses.

Project Analyst: U.S. Army Corps of Engineers, New England Division, Weymouth Fore River. Provided soil classification, moisture content, and grain size technical support.

Project Analyst: Harbor and Outfall Monitoring Program, Boston Harbor, MA. Provided total organic carbon testing of sediment samples from sites within Boston Harbor and Massachusetts Bay.

Project Analyst: Drilling Mud Assessment, U.S. Virgin Islands. Performed moisture content, grain size, and total inorganic and organic carbon analyses.

ADDITIONAL TRAINING AND CERTIFICATIONS

OSHA Health and Safety Training for Hazardous Waste Operations (29CFR 1910.120). Completed 2002; 8 hr refresher 2003, 2004 and 2005.

DOT Pipeline Operations Qualified (OQ), Pipeline Maintenance.

Certified Trainer, Loss Prevention Systems (LPS).

DOT Hazardous Materials Training (49CFR Parts 172 and 173).

Confined Space Training, ISTC.

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ATTACHMENT I

Electronic Data Deliverable (EDD) Specifications

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Electronic Data Deliverable (EDD) Specifications

EDD FIELD #	FIELD NAME	REQUIRED	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
1	NSAMPLE	Y	C	30	Field sample ID as listed on the Chain-of-Custody. The sample number indicated in this field should never be truncated. The only exception for this field not matching the chain-of-custody is for reanalyses and matrix spike results in which a RE or MS suffix will be added to the sample number respectively. For Lab QC use a unique Lab ID
2	CLASS	Y	C	15	Dioxins = 'DIOX', Metals = 'M', Volatiles = 'OV', Semivolatiles/BNAs = 'OS', Pesticides/PCBs = 'PESTP', Herbicides = 'HERB', Explosives = 'EXP', Any petroleum hydrocarbon or fuel = 'TPH', Wet Chemistry = 'WET', Radionuclide = 'RAD', Miscellaneous = 'MISC', Total Organic Carbon = 'TOC', Grain Size = 'GS'. For TCLP analyses, add "T" suffix, e.g. TCLP Metals = 'MT'.
3	PARAMETER	Y	C	45	Chemical or analyte name exactly as reported on laboratory hardcopy data package.
4	EPASAMNO	Y	C	15	If EPA Sample Number is not applicable use sample ID from NSAMPLE field.
5	CASNO		C	50	Chemical Abstract Service number for the parameter listed. The CAS number should be reported exactly as it is listed in publications such as the Merck Index. This field should be left blank for those parameters not having CAS numbers (e.g. Total PAH).
6	LAB_RESULT	Y	N	20(6)	Reported value in units specified in the UNITS field containing the proper number of significant digits. The % Recovery shall be placed in this field for matrix spike and laboratory control sample results.
7	QUAL		C	5	The laboratory qualifier as reported on the laboratory hardcopy data package. For example, a 'U' qualifier should be used for all nondetected results.
8	UNITS	Y	C	10	The units of measure as reported on the laboratory hardcopy data package.
9	CASE		C	5	In CLP Program, identifies samples sent to a laboratory over a specific period of time.
10	SDG	Y	C	15	Sample delivery group or Batch number identifier assigned by the laboratory. This number should exactly match the SDG designated on the hardcopy data package.
11	LABORATORY	Y	C	25	Laboratory name.
12	LAB_ID	Y	C	15	Laboratory ID for the given sample.
13	REC_DATE		D	8	Date sample was received by the Laboratory.
14	EXTR_DATE		D	8	Date sample was extracted or prepared by the laboratory.
15	ANAL_DATE	Y	D	8	Date sample was analyzed by the laboratory.
16	METHOD	Y	C	50	Analytical method used to quantitate parameter concentrations as listed in the laboratory technical specification (e.g. '8270A' for SW-846 Method 8270A.
17	MDL	[1]	N	15(6)	Method Detection Limit (MDL) in units specified in the UNITS field and method specified in the METHOD field.
18	IDL	[1]	N	15(6)	Instrument Detection Limit (IDL) in units specified in the UNITS field.
19	CRDL_CRQL	[1]	N	15(6)	Contract Required Detection/Quantitation Limit (CRDL/CRQL) in the units specified in the UNITS field. RDL for non-CLP parameters.
20	DIL_FACTOR		N	6(1)	Dilution factor
21	PCT_MOIST		N	5(1)	Percent moisture for soil samples; 100 for water samples.
22	COMMENTS		C	20	Analytical result qualifier or comment other than that listed in the LAB_QUAL field. Example: 'Reanalysis'.
23	DVTIER	Y	C	2	Level of data Validation. Valid values are 0 (not validated), 1 (cursory), 2 (moderately rigorous, 3 (rigorous).
24	LAB_QC_TYPE	Y	C	6	Normal Environmental Sample = "N", Laboratory Duplicate = "DUP", Matrix Spike = "MS", Matrix Spike Duplicate = "MSD", Laboratory Control Sample = "LCS", Laboratory Control Sample Duplicate = "LCSD", Method Blank = "MB", Preparation Blank = "PB", Field Replicate = "REP", Standard Reference Material = "SRM", Blank Spike = "BS".

[1] Either an IDL, MDL or CRDL_CRQL (fields 17 through 19) needs to be provided for each sample - if applicable
Y – Yes; C – Character; N – Numeric; D – Date; ( ) - number of decimal places

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Example EDD (page 1 of 2)

NSAMPLE	EPASAMNO	LAB_ID	LABORATORY	LAB_QC_TYPE	SAMP_DATE	EXTR_DATE	ANAL_DATE	CASE	SDG	PARAMETER
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Biphenyl
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	2-Methylnaphthalene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Acenaphthene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Acenaphthylene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Anthracene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Benzaldehyde
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Benzo[a]anthracene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Benzo[a]pyrene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Benzo[b]fluoranthene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Benzo[g,h,i]perylene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Benzo[k]fluoranthene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Chrysene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Dibenz[a,h]anthracene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Dibenzofuran
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Fluoranthene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Fluorene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Indeno[1,2,3-c,d]pyrene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Naphthalene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Phenanthrene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Pyrene
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Naphthalene-d8
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Phenanthrene-d10
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	Chrysene-d12
RWR-FP-5002-0000-01	RWR-FP-5002-0000-01	W5530-1	BATD	N	16-07-01	24-09-01	10-10-01		01-499	

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Example EDD (cont; page 2 of 2)

CAS_NO	CLASS	METHOD	LAB_RESULT	UNITS	QUAL	IDL	MDL	CRDL_CRQL	DIL_FACTOR	PCT_MOIST	COMMENTS	FRACTION
92-52-4	OS	BATD5-157	58.57	NG/G_DRYWT			1.73			48.08		T
91-57-6	OS	BATD5-157	170.22	NG/G_DRYWT			1.73			48.08		T
83-32-9	OS	BATD5-157	563.84	NG/G_DRYWT			1.73			48.08		T
208-96-8	OS	BATD5-157	210.65	NG/G_DRYWT			1.73			48.08		T
120-12-7	OS	BATD5-157	982.95	NG/G_DRYWT	D		34.69		33.34	48.08		T
100-52-7	OS	BATD5-157	112.08	NG/G_DRYWT			1.73			48.08		T
56-55-3	OS	BATD5-157	3311.39	NG/G_DRYWT	D		34.69		33.34	48.08		T
50-32-8	OS	BATD5-157	3204.84	NG/G_DRYWT	D		34.69		33.34	48.08		T
205-99-2	OS	BATD5-157	3263.74	NG/G_DRYWT	D		34.69		33.34	48.08		T
191-24-2	OS	BATD5-157	2183.89	NG/G_DRYWT	D		173.46		33.34	48.08		T
207-08-9	OS	BATD5-157	3098.90	NG/G_DRYWT	D		34.69		33.34	48.08		T
218-01-9	OS	BATD5-157	3844.25	NG/G_DRYWT	D		34.69		33.34	48.08		T
53-70-3	OS	BATD5-157	590.75	NG/G_DRYWT	D		34.69		33.34	48.08		T
132-64-9	OS	BATD5-157	399.25	NG/G_DRYWT			1.73			48.08		T
206-44-0	OS	BATD5-157	7686.74	NG/G_DRYWT	D		34.69		33.34	48.08		T
86-73-7	OS	BATD5-157	658.99	NG/G_DRYWT			1.73			48.08		T
193-39-5	OS	BATD5-157	2384.11	NG/G_DRYWT	D		34.69		33.34	48.08		T
91-20-3	OS	BATD5-157	302.18	NG/G_DRYWT			1.73			48.08		T
85-01-8	OS	BATD5-157	5301.36	NG/G_DRYWT	D		34.69		33.34	48.08		T
129-00-0	OS	BATD5-157	6210.02	NG/G_DRYWT	D		34.69		33.34	48.08		T
NA	OS	BATD5-157	62	PCT_REC						48.08		T
NA	OS	BATD5-157	80	PCT_REC						48.08		T
NA	OS	BATD5-157	93	PCT_REC						48.08		T

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ATTACHMENT J

Raw Data

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Raw Data Elements – Battelle Columbus

Data Package Elements	Dioxin/Furan
Inventory Sheet	✓
QA/QC Narratives	✓
Sample Custody/Receipt Data	
Airbills	✓
Custody forms	✓
Sample tags (if available)	Will provide if not adhered to sample bottles
Sample receipt/log-in sheets	✓
Miscellaneous shipping/receiving records	✓
Internal lab sample transfer/tracking records	✓
Sample Data	
Final data tables (summary data; field and QC)	✓
Tentatively identified compounds summary form	
Total ion chromatograms	✓
Raw spectra of target compound and background subtracted spectrum of target compound for each sample	
Mass spectra of all reported TICs/three best library matches for each sample	
Chromatograms (both columns, if applicable)	✓
GC integration reports	✓
Pesticide identification summary form	
For Pest/PCBs confirmed by GC/MS, copies of raw spectra	
GPC sample chromatograms	
Manual worksheets	✓
Sample preparation records	✓
Sample acquisition logsheets [1]	✓
ICP/MS raw data	
Furnace AA raw data	
Mercury raw data	
Cyanide raw data	
Other analytical raw data	
Standards Data	
MDL study final tables	✓
Initial calibration reports	✓
Continuing calibration reports (including pesticide degradation checks)	✓
Chromatograms and quant reports for all GC/MS standards	✓
Pesticide analyte resolution summary form	
Pesticide calibration verification summary form	
Pesticide analytical sequence summary form	
GC chromatograms and data system print outs for all GC standards	
For pesticides/Aroclors confirmed by GC/MS	
GPC standard chromatograms	
Florisil cartridge check summary form	
Instrument detection limits summary data	
ICP Interelement correction factors summary form	
ICP linear ranges summary form	
CRDL standards for AA and ICP summary form	
Standards preparation forms	✓

Raw Data Elements – Battelle Columbus (continued)

Data Package Elements	Dioxin/Furan
QC Data	
Tune reports	✓
SIS recovery data	✓
MS/MSD recovery data	✓
Method blank data	✓
Internal standard areas/RTs (quant reports, above)	✓
QC raw data (RICs, chromatograms, quant reports)	✓
ICP interference check sample summary form	
Spike sample recovery summary form [2]	✓
Post digest spike sample recovery data	
Sample duplicate precision data	✓
LCS recovery data	✓
Standard addition results	
ICP serial dilutions summary form	
QC raw data – ICP, Furnace, mercury	
QC sample preparation records	✓
Miscellaneous Data	
Copies of preparation/analysis logbooks	✓
Screening records	
All instrument output from screening activities	
Preparation logs raw data	✓
Percent solids data	✓
Other records (QAPP, project memorandums)	✓

[1] Battelle assumes that acquisition logsheets are records of GC oven conditions under which samples are analyzed.
[2] Battelle assumes that Spike Sample Recovery Summary Forms are summary report tables with recovery results

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Raw Data Elements – Battelle Duxbury

Data Package Elements	PCB Aroclor/Pesticide	PAH
Inventory Sheet	✓	✓
QA/QC Narratives	✓	✓
Sample Custody/Receipt Data		
Airbills	✓	✓
Custody forms	✓	✓
Sample tags (if available)	Will provide if not adhered to sample bottles	
Sample receipt/log-in sheets	✓	✓
Miscellaneous shipping/receiving records	✓	✓
Internal lab sample transfer/tracking records	✓	✓
Sample Data		
Final data tables (summary data; field and QC)	✓	✓
Tentatively identified compounds summary form		
Total ion chromatograms		✓
Raw spectra of target compound and background subtracted spectrum of target compound for each sample		
Mass spectra of all reported TICs/three best library matches for each sample		
Chromatograms (both columns, if applicable)	✓	
GC integration reports	✓	✓
Pesticide identification summary form [1]	✓	
For Pest/PCBs confirmed by GC/MS, copies of raw spectra	Not applicable	
GPC sample chromatograms		
Manual worksheets	✓	✓
Sample preparation records ***(includes moisture content results)***	✓	✓
Sample acquisition logsheets [2]	✓	✓
ICP/MS raw data		
Furnace AA raw data		
Mercury raw data		
Cyanide raw data		
Other analytical raw data		
Standards Data		
MDL study final tables	✓	✓
Initial calibration reports	✓	✓
Continuing calibration reports (including pesticide degradation checks)	✓	✓
Chromatograms and quant reports for all GC/MS standards		✓
Pesticide analyte resolution summary form	Not applicable (*)	
Pesticide calibration verification summary form [3]	✓	
Pesticide analytical sequence summary form [4]	✓	
GC chromatograms and data system print outs for all GC standards	✓	
For pesticides/Aroclors confirmed by GC/MS	Not applicable	
GPC standard chromatograms		
Florisil cartridge check summary form		
Instrument detection limits summary data		
ICP Interelement correction factors summary form		
ICP linear ranges summary form		
CRDL standards for AA and ICP summary form		
Standards preparation forms	✓	✓

Raw Data Elements – Battelle Duxbury (continued)

Data Package Elements	PCB Aroclor/Pesticide	SVOCs (PAHs)
QC Data		
Tune reports		✓
SIS recovery data	✓	✓
MS/MSD recovery data	✓	✓
Method blank data	✓	✓
Internal standard areas/RTs (quant reports, above)	✓	✓
QC raw data (RICs, chromatograms, quant reports)	✓	✓
ICP interference check sample summary form		
Spike sample recovery summary form	✓	✓
Post digest spike sample recovery data		
Sample duplicate precision data		
LCS recovery data	✓	✓
Standard addition results		
ICP serial dilutions summary form		
QC raw data – ICP, Furnace, mercury		
QC sample preparation records	✓	✓
Miscellaneous Data		
Copies of preparation/analysis logbooks	✓	✓
Screening records		
All instrument output from screening activities		
Preparation logs raw data	✓	✓
Percent solids data	✓	✓
Other records (QAPP, project memorandums)	✓	✓

[1] Battelle assumes this is a summary data table of target pesticides detected in project samples.
[2] Battelle assumes that acquisition logsheets are records of GC oven conditions under which samples are analyzed.
[3] Battelle assumes that the pesticide calibration verification summary form is the continuing calibration check report.
[4] Battelle assumes that the analytical sequence summary form is the hardcopy listing of samples acquired in the analytical sequence.
* Battelle SOP 5-128 does not require analyte resolution check.

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Raw Data Elements – Battelle MSL and Mitkem Metals Chemistry

Data Package Elements	Metals / MeHg
Inventory Sheet	✓
QA/QC Narratives	✓
Sample Custody/Receipt Data	
Airbills	✓
Custody forms	✓
Sample tags (if available)	Will provide if not adhered to sample bottles
Sample receipt/log-in sheets	✓
Miscellaneous shipping/receiving records	✓
Internal lab sample transfer/tracking records	✓
Sample Data	
Final data tables (summary data; field and QC)	✓
Tentatively identified compounds summary form	
Total ion chromatograms	
Raw spectra of target compound and background subtracted spectrum of target compound for each sample	
Mass spectra of all reported TICs/three best library matches for each sample	
Chromatograms (both columns, if applicable)	
GC integration reports	
Pesticide identification summary form	
For Pest/PCBs confirmed by GC/MS, copies of raw spectra	
GPC sample chromatograms	
Manual worksheets	✓
Sample preparation records	✓
Sample acquisition logsheets	
ICP/OES raw data	✓
Furnace AA raw data	
Mercury raw data	✓
Cyanide raw data	
Other analytical raw data	
Standards Data	
MDL study final tables	
Initial calibration reports	✓
Continuing calibration reports (including pesticide degradation checks)	✓
Chromatograms and quant reports for all GC/MS standards	
Pesticide analyte resolution summary form	
Pesticide calibration verification summary form	
Pesticide analytical sequence summary form	
GC chromatograms and data system print outs for all GC standards	
For pesticides/Aroclors confirmed by GC/MS	
GPC standard chromatograms	
Florisil cartridge check summary form	
Instrument detection limits summary data	✓
ICP Interelement correction factors summary form	
ICP linear ranges summary form	
CRDL standards for AA and ICP summary form	
Standards preparation forms	✓

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Raw Data Elements – Battelle MSL Chemistry (continued)

Data Package Elements	Metals / MeHg
QC Data	
Tune reports	
SIS recovery data	
MS/MSD recovery data	✓
Method blank data	✓
Internal standard areas/RTs (quant reports, above)	
QC raw data (RICs, chromatograms, quant reports)	✓
ICP interference check sample summary form	✓
Spike sample recovery summary form [1]	✓
Post digest spike sample recovery data	
Sample duplicate precision data	✓
LCS recovery data	✓
Standard addition results	
ICP serial dilutions summary form	
QC raw data – ICP, Furnace, mercury	✓
QC sample preparation records	✓
Miscellaneous Data	
Copies of preparation/analysis logbooks	✓
Screening records	
All instrument output from screening activities	
Preparation logs raw data	✓
Percent solids data	✓
Other records (QAPP, project memorandums)	✓

[1] Battelle assumes that Spike Sample Recovery Summary Forms are summary report tables with recovery results

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ATTACHMENT K

Standard Operating SOPs

(*not paginated*)

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CORING METHODOLOGY (Reference # S-19)
U.S. EPA ERTC/REAC, As Modified by Battelle
March 2005

INTRODUCTION

Sediment cores may be collected via a variety of sampling methods, including vibracoring, push coring, and hammer coring, among others. For this investigation, vibracoring methods will be used because gravel may be encountered at sample locations in the southern area of Lyman Mill Pond, and one consistent coring method is preferred for the study area. Further, this method is consistent with the approach used for the May 2003 investigation at Allendale and Lyman Mill Ponds.

POSITIONING VESSEL

1. Sample locations will be selected prior to commencement of the survey. Each sample station will be located using real-time differential global positioning system (dGPS).
2. The survey vessel will anchor as close to each target coordinate as possible.
3. After the vessel is anchored at the target location, actual sample locations will be identified by using data provided by real-time dGPS unit on the survey vessel immediately prior to collection of the sample.
4. If the position is unacceptable, the vessel position is adjusted and the position rechecked.
5. Once the survey vessel is anchored in an acceptable position, core samples will be collected. All non-dedicated equipment that may potentially come in contact with the sediments will be decontaminated between sample locations as specified below.
6. At the end of the sampling day, the data loaded in the dGPS units are checked to verify the existence of all locations in which data were collected. Sampling locations will be plotted onto a master chart as the samples are collected and checked with the dGPS data as a further verification that the correct locations and sampling schedule are being followed, and as a visual reference of the progress of the survey.

SAMPLING PROCEDURES

Decontamination of Equipment

Decontamination of non-dedicated sampling equipment (i.e., the polybutyrate core tube liners, aluminum or steel core tubes, and the core nose and catcher assemblies) will be performed prior to sampling and between each sample location. Visible sediment from outside the core barrel and on the vibracore unit will be removed with pressurized water and a brush. After all visible contamination has been removed, surfaces that will come in contact with the sediments will be rinsed with distilled water and then acetone. After the acetone has evaporated, all equipment will be wrapped with aluminum foil. All waste materials will be contained during decontamination and transferred to appropriate drums for disposal.

Collection of the Sediment Cores

Separate cores will be collected for radiodating (^{210}Pb) and physical/chemical testing; 5 for radiodating and 10 for physical/chemical testing.

1. Obtain water depth (depth to top of sediment), using either an onboard dual frequency fathometer (if dual frequency fathometer indicates two surfaces, use the lower of the two surface depths) or with a leadline. Calculate required penetration depth.
2. The plastic covering and aluminum foil at the top of the core barrel and liner will be removed. The core barrel will be inserted into the head of the vibracorer as it lies horizontally on the deck and secured in the vibracore.
3. The operator will slowly winch the vibracorer into its deployment orientation.
4. The vibracorer will then be then slowly lowered into the water by the deployment equipment.
5. As the vibracorer approaches the sediments, the motor will be turned on. The vibracorer is then allowed to slowly penetrate the sediments.
6. On completion of the required penetration, or upon vibracore refusal, the motor will be turned off and the vibracorer slowly raised. The actual vibracore penetration depth is recorded.
7. Clean the vibracorer and coring assembly by hosing down the equipment with water prior to being brought on board. Care should be taken not to direct water into the open end of the core barrel.
8. The vibracorer will then be returned to its deck storage location and the core nose will be immediately sealed by placing a plastic cap over the open end. The core will be carefully unbolted and taken to the core extraction area.
9. The core liner will be extracted from the core barrel and vibracoring recovery (e.g., total sediment core footage) will be measured using a tape measure and recorded to the nearest 0.1 foot.
10. Evaluate whether core penetration and recovery are acceptable.
11. If the recovery is acceptable, record this as the "primary" core and move the sample vessel a few feet prior to collecting any duplicate cores, if needed.
12. For each core collected record all pertinent information (as summarized below) in a field log book.
13. The core tubes will be capped and stored upright until transfer to the support launch for return to the sample processing area. The top of the core tube will be cut at the core sediment surface prior to capping. After capping, the top and bottom ends will be marked. Tubes will be transported to the processing facility by the support launch and will be maintained in an upright position wrapped in a cooling vest (sheets of iced gel) or stored in a refrigerated truck.

Procedures for Unacceptable Sediment Core Recovery

1. If the penetration depth or recovery ratio (total sediment core footage divided by penetration depth) are unacceptable for the specified chemical analyses, the location of the sampling vessel will be shifted a few feet to collect a second sample.
2. Establish the new location and record GPS coordinates of actual sample location.
3. Collect a vibracore at the adjusted location.
4. A maximum of two vibracores will be collected. If none of the cores meet the penetration or percent recovery ratio objectives, the longer of the two recovered cores will be selected as the primary core for analysis.

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Core Processing

As noted above, separate cores will be collected for radiodating and physical/chemical testing.

1. Cores will be stored until processing in a vertical position at 4 degrees Celsius (°C). Cores will be maintained under custody of Battelle until transferred to U.S. EPA AED laboratory in Narragansett, Rhode Island, where custody will be transferred either to a representative from the AED laboratory (i.e., William Nelson or Barbara Bergen) or to the processing team (Battelle and USACE ERDC).
2. Process areas at AED should be designated for handling hazardous materials. All personnel in the processing area, must be dressed in appropriate health and safety gear as specified in a site specific health and safety plan (HASP).
3. Remove top core cap for each core liner, and assess whether core lengths are to be processed as cohesive or non-cohesive sediments.
4. Gently remove overlying water either by a siphoning technique or cutting a small opening in the core just above the water layer and gently squeezing the core to remove the water. After overlying water is removed, replace the core cap.
5. Cores will be placed horizontally on the processing table.
6. Use the circular saw (or alternate clean, cutting device) to make longitudinal cuts through the core liner.
7. Place the core on a clean processing table and cut cores in half longitudinally.
8. Where the topmost material appears to be comprised of unconsolidated (ooze) material, a V-trough will be used to contain the sample such that the surface six inches are contained for subsequent subsampling.
9. The smear zone will be removed by scraping approximately 1/4 inch of exposed sediment. Dispose of this material as specified below.
10. The sediment cores will be visually described (core log attached) in a field log book and photo-documented. This will be the responsibility of USACE ERDC.
11. **Cores for Radioisotope Testing.** 5 cores will be collected for ^{210}Pb (Table 1). Cores selected for radioisotope testing will depend on the type of sediment recovered, and may vary based on sediment type, depth of core, and spatial distribution of vibracores. USACE ERDC will make the determination whether a core is deemed suitable for radiodating testing. The sample intervals will be selected by the project geologist based on the Conceptual Site Model (CSM) and lithology observed in the cores. A sufficient number of subsamples will be collected to establish a vertical profile.
12. **Cores for Chemical and Geotechnical Testing.** All cores will be analyzed for chemical and geotechnical parameters. Sub-samples will be collected from surface, mid-depth and deep intervals (Table 1); material will be collected from both sides of the core to ensure sufficient volume for testing (Table 2). Selection of these sections may be modified at the discretion of project geologist based upon the stratigraphy observed in the cores. Sub-samples for testing (Table 1) will be collected as follows
    a. ***Dioxin/furan*** – Three samples will be collected for dioxin/furan analysis from each core: one surface sample (0-0.5 ft), one mid-depth sample (approximately 1.2-1.3 ft below the surface), and one deep sample that is expected to be below the level of site-related contamination (approximately 2.4-2.5 ft below the mudline).
    b. ***Chemistry*** – The surface sample (0-0.5 ft) from each core will also be analyzed for other COCs (PCBs, pesticides, PAHs, metals).
    c. ***Geochemistry*** – Five samples will undergo analysis of grain size and Atterberg Limits, and fifteen samples will be tested for percent solids/water content. Samples for potential geotechnical analysis will be collected from the surface and mid-depth intervals from each sediment core, and the samples to be submitted to the laboratories will be selected after all cores have been processed to ensure that all sediment types are represented

d. ***Archive*** – One archive sample will be collected from deeper in the core (3.0 – 3.5 ft) in the event that the deep sample from any core shows evidence of dioxin contamination.

13. Sub-samples for radioisotope, chemical and geotechnical testing, as well as archives, will be removed from the core and placed in a decontaminated or dedicated container. The sample will be homogenized, labeled with unique sample ID (below) and the date recorded on the label.

Each analytical sub-sample will be assigned a unique sample ID, which will consist of a four- to five-segment, alpha-numeric code that identifies the area, sample medium, specific sample location identifier, sample event and sample depth, as follows

AAA - AA - NNNN – NNNN-NNNN

Sediment Core ID Core Sub-Sample ID

- The AAA-AA-NNNN represents the ID assigned to the sediment core, where the three alpha character group (AAA) identifies the area investigated (e.g., "LPX" for Lyman Mill Pond); the two alpha character group (AA) identifies the matrix sampled (e.g., "SD" for sediment); and the four numeric character group (NNNN) describes a unique location number identified sequentially (e.g., sediment cores collected using the "4500" series). Example: LPX-SD-4501.

- The NNNN-NNNN represents the ID assigned to the processed sediment core and identifies the depth interval that was sub-sampled for testing. The four numeric character group (NNNN-NNNN) describes the depth interval in feet collected (e.g., 0000-0050).

  Example: LPX-SD-4501-0000-0050

  represents a sediment core sample collected from Lyman Mill Pond at location 4501, which was sub-sampled between 0 and 0.05 feet.

14. All sub-samples will be maintained under chain of custody; sub-samples for radiodating will be maintained at ambient temperatures; sub-samples for mercury and methyl mercury analysis at Battelle Sequim will be maintained frozen (-20°C); and all remaining sub-samples (dioxin/furan, PCB/Pest/PAH, metals and geotechnical) will be maintained cold (4°±2°C).
15. All unused sediment material and solid investigative derived waste (IDW), such as PPE and core liners, will be placed in a 55-gallon drum(s) for temporary storage. Battelle's sub-contractor, ONYX Environmental, will be responsible for the transportation and disposal of the solid IDW (dioxin bearing, non-F027 listed waste. Solid IDW will be retrieved by ONYX Environmental at the completion of all data collection activities (spring/summer 2005).
16. The work area will be decontaminated prior to the start of processing for the next core.

Table 1. Sample Summary for Sediment Core Collection in Lyman Mill Pond.

Station ID	Sample Interval (ft)	Dioxin/Furan	PCB, Pesticides, PAH, Metals	Radioisotopes	Archive
New Stations [(a)]					
LPX-SD-4501	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4502	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4503	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4504	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4505	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4506	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4507	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4508	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4509	0.0 – 0.5	X	X	X	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X
LPX-SD-4510	0.0 – 0.5	X	X	-	-
	1.2 – 1.3	X	-		-
	2.4 – 2.5	X	-		-
	3.0 – 3.5	-	-		X

Table 2. Sample Container, Sample Size, Preservation Requirements, Holding Times and Analytical Laboratories.

Analytical Parameter	Minimum Sample Volume	Containers	Preservation Requirements (a)	Maximum Holding Time (preparation/ analysis)	Laboratory for Shipping
Radiodating Cores					
Pb-210	¾ full	125 mL pre-cleaned jar	Ambient	30-d	Pat Marshall Teledyne Brown 2508 Quality Lane Knoxville, TN 37931 (865) 934- 0382
Chemistry and Geotechnical Cores					
Dioxin/Furan	½ full (or 20-g wet)	125 mL pre-cleaned jar	Cold (4±2°C)	1-year	Henry Pham Battelle Columbus 505 King Avenue Columbus, OH 43201 (614) 424-7849
PCB Aroclor/ Pesticide	½ full (or 50-g wet)	125 m pre-cleaned jar	Cold (4±2°C)	14-d [1-year if frozen (b)]	Jeff Newell Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781) 952-5270
Metals (Hg, MeHg)	½ full (or 20-g wet)	125 mL pre-cleaned jar	Frozen (-20°C)	28-d	Carolynn Suslick Battelle MSL 1529 Sequim Bay Rd. Sequim, WA 98382 (360) 681-3624
Metals	½ full	125 mL pre-cleaned jar	Cold (4±2°C)	6-mo (28-d for Hg)	Shirley Ng Mitkem Corporation 175 Metro Center Boulevard Warwick, RI 02886-1755 (401) 732-3400
Geotechnical	½ full	1-L pre-cleaned jar	Cold (4±2°C)	28-d	Ken Davis Applied Marine Sciences 502 North Highway 3 League City, TX 77573 (281) 554-7272
Archive	½ full	250 m pre-cleaned jar	Cold (4±2°C)	1-year	Jeff Newell Battelle Duxbury 397 Washington Street Duxbury, MA 02332 (781) 952-5270

DOCUMENTATION

Field notes will also be kept during sampling activities. The following information will be recorded in a bound field logbook:

- Names of personnel on the vessel(s)
- Vessel Name
- Weather and tidal conditions
- Date and time of sampling
- Location and sample station number

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- Vibracore Location Number
- Vibracore Number
- Measured Water Depth
- Vibracore Penetration & Recovery Table
- Calibration information

EQUIPMENT LISTS

Survey Vessel

- Dual frequency fathometer or lead line with 0.1' markings.
- Plastic sheeting
- Permanent marker or grease pencil
- Vibracore assembly and deployment equipment (e.g., Aframes, winches, generator)
- Decontaminated polybutyrate (e.g., Lexan) core liners, fully assembled with decontaminated stainless steel core noses and core catchers
- Cooling vests, or equivalent
- Assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- Field logbooks
- Appropriate decontamination equipment
- Tape measure
- Submersible pump and hose
- DGPS with external antennae
- Core extrusion table
- Hacksaw and spare blades
- Core caps
- Tape for securing core caps
- Appropriate personal health and safety equipment
- Appropriate decontamination equipment

Core Processing Laboratory

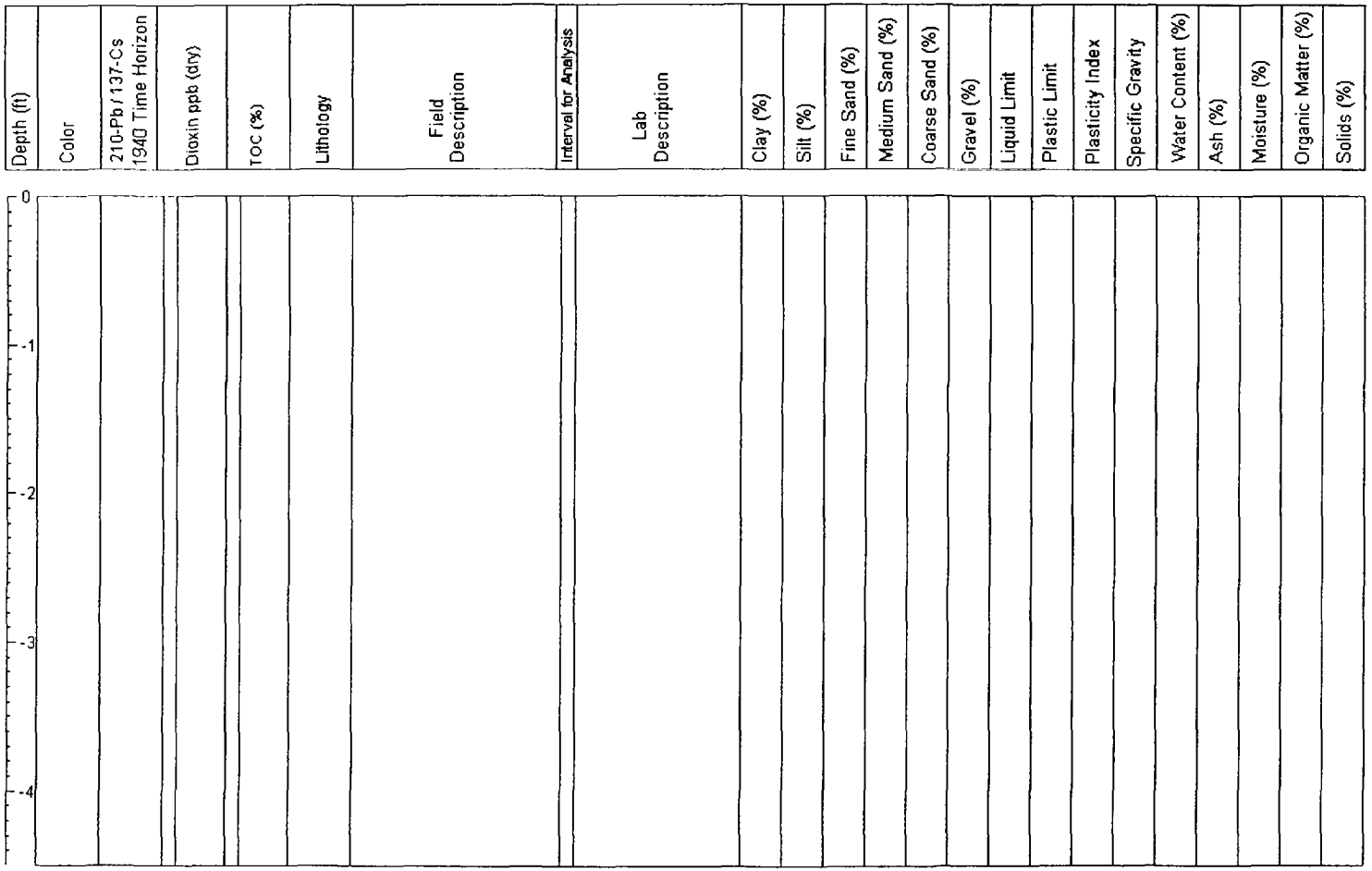
- Core processing table
- Processing laboratory notebook and associated coring documentation
- Tape measure
- Hacksaw and spare blades
- Core caps
- Sampling equipment: disposal knives and spoons
- Refrigerator, at 4°C for sample storage/archive
- Freezer
- Sample Glassware (e.g., containers)
- Samples labels and labeling tape
- Appropriate waste disposal equipment
- Appropriate personal health and safety equipment
- Appropriate decontamination equipment

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PROJECT NAME: Centredale Manor Restoration Project
LOCATION: Woonasquatucket River, North Providence, RI
BORING NUMBER:
LOCATION (lat/long):

DATE:
TOTAL DEPTH:



Example Core Log. (Lab description and results will reported as data are available)

APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2301**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS

Prepared By: _____ **Date:** _____

Approved By: _____ **Date:** _____
Laboratory Manager

_____ **Date:** _____
QA Officer

US EPA ARCHIVE DOCUMENT

APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2301**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS

1.0 INTRODUCTION

This procedure describes the laboratory determination of the moisture content of soils. The moisture content is defined as the ratio of the mass of water to the mass of the solid particles within a defined amount of material.

2.0 REFERENCE

ASTM, 1996. D2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures. Annual Book of ASTM Standards, Volume 4.08 Soil and Rock; Building Stone.

3.0 APPARATUS AND MATERIALS

* Laboratory Drying Oven, Maintain 105°C +/- 0.5°C
* Laboratory Balance, Precision of 0.0001g for samples less than 200g mass
* Laboratory Balance, Precision of 0.1 g for samples between 200 and 1000 g mass
* Laboratory Balance, Precision of 1.0 g for samples greater than 1000 g mass.
* Aluminum Weighing Boats, Reynolds #00290
* Spatula or Other Laboratory Apparatus for Aliquot of Sample
* Laboratory Desiccator

4.0 SAMPLE COLLECTION, STORAGE, AND HOLDING TIMES

4.1 Sample Collection and Storage

Samples should be collected and stored in airtight plastic or glass containers at a temperature of 4°C. To prevent loss of moisture from the sample, laboratory analysis should be done as soon as practicable after sampling.

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4.2 Sample Holding Time

Samples have a holding time of no more than six (6) months. Holding times longer than this should be avoided, due to the possibility of altered water content values, compaction due to long-term storage, or chemical degradation of the samples due to metals or other contaminants held within the soil.

5.0 PROCEDURE

5.1 Preparation

Print a Laboratory Bench Sheet for each batch of samples to be analyzed. Label and tare an aluminum boat for each sample, and record its mass on the data sheet. Remove the samples from refrigeration and allow them to equilibrate to ambient temperature.

5.2 Analysis

Using the spatula, stir the sample until it is homogeneous. Scoop a portion of the sample into the tared aluminum boat. Place the boat with wet sample on the balance, and record the mass on the Laboratory Bench Sheet. Dry the sample in the laboratory oven at 105°C until a constant mass is observed. Remove the container from the oven and store in desiccator. Allow the material and container to cool to ambient temperature. Weigh the dried sample and boat on the laboratory balance, and record the value on the Bench Sheet.

5.3 Duplicate Analysis

One duplicate sample will be analyzed with every batch of 10 samples, or with every sample set, whichever is more frequent. Duplicates will be below 25% RPD (See 6.2).

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6.0 CALCULATIONS

6.1 Water Content

Calculate the water content of the material as follows:

$$w = \left(\frac{(W_1 - W_2)}{W_2 - W_C} \right) \times 100$$

where:

w	=	water content, %
W_1	=	mass of container and moist specimen, g
W_2	=	mass of container and oven-dried specimen, g
W_C	=	mass of container, g

6.2 Relative Percent Difference

Calculate Relative Percent Difference as shown below:

$$\frac{|DuplicateA - DuplicateB|}{\left(\frac{DuplicateA + DuplicateB}{2} \right)}$$

7.0 QUALITY CONTROL

7.1 Duplicate Analysis

The duplicate analysis will have an RPD value not to exceed 25%.

7.2 Precision and Accuracy

There is no standard for precision and accuracy with this method. Unless a standard is specified in the QAPP for the samples, an arbitrary precision of 25% RPD will be followed and reported.

7.3 Equipment

Laboratory balances are calibrated daily using NIST traceable weights. This ensures that the results generated will be scientifically valid and accurate.

8.0 REPORTING CRITERIA

8.1 Report Data

The report shall include the following: sample identification, moisture content to the nearest 0.1%, and indication of any material excluded from test specimen.

8.2 Significant Figures

All results are reported to three significant figures where applicable.

8.3 Duplicate Analysis

All duplicates are reported.

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APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2301**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

9.0 SAFETY

The technician will be instructed in and made aware of the safety considerations using this method including the following:

* Protective clothing and eyewear is to be worn while in the laboratory.

* The location and use of eyewashes, emergency showers, fire extinguishers, fire blankets, and first aid kits will be given.

* The proper handling and disposal of samples and reagents necessary for the procedure will be followed.

This is in addition to standard laboratory practices, including but not limited to, the guidelines specified in the AMS Laboratory Safety Guide and SOP 1304.

APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2303**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

LABORATORY DETERMINATION OF TOTAL, FIXED, AND VOLATILE SOLIDS IN SEDIMENT SAMPLES

Prepared By: _____ **Date:** _____

Approved By: _____ **Date:** _____
Laboratory Manager

_____ **Date:** _____
QA Officer

US EPA ARCHIVE DOCUMENT

APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2303**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

LABORATORY DETERMINATION OF TOTAL, FIXED, AND VOLATILE SOLIDS IN SEDIMENT SAMPLES

1.0 INTRODUCTION

This standard operating procedure describes a standard method to determine the percent total, fixed, and volatile solids contained in a sediment sample. Total solids refers to the sediment remaining after all moisture has been evaporated at a defined temperature. Fixed solids refers to the residue of total solids remaining after ignition for a specified time at a specified temperature. Total volatile solids refers to the weight loss after ignition. Determination of fixed and volatile solids does not distinguish precisely between inorganic and organic matter, because some inorganic minerals or salts may volatize or decompose during the ignition process.

2.0 REFERENCE

APHA, 1989. Standard Methods for the Examination of Water and Wastewater, 17th Edition. American Public Health Association, Washington, D.C.

Plumb, R.H., 1981. Procedure for Handling and Chemical Analysis of Sediment and Water Samples. Technical Report EPA/CE 81-1, prepared for Great Lakes Laboratory, State University College at Buffalo, NY, for the U.S. EPA/Corps of Engineers Technical Committee on Criteria for Dredged and Fill Material. Published by the U.S. Army Engineers Waterways Experiment Station, CE, Vicksburg, MS.

3.0 APPARATUS AND MATERIALS

* Laboratory Drying Oven, Maintain 105°C +/- 0.5°C
* Laboratory Muffle Furnace, Maintain 550°C, +/- 10.0°C
* Laboratory Balance, Precision of 0.0001g
* Porcelain Crucibles, Coors #60105
* Aluminum Weighing Boats, Reynolds #00290
* Spatula or Other Laboratory Apparatus for Aliquot of Sample
* Laboratory Desiccator

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4.0 SAMPLE COLLECTION, STORAGE, AND HOLDING TIMES

4.1 Sample Collection and Storage

Samples should be collected and stored in airtight plastic or glass containers at a temperature of 4°C. To prevent loss of moisture from the sample, laboratory analysis should be done as soon as practicable after sampling.

4.2 Sample Holding Time

Samples have a holding time of no more than six (6) months. Holding times longer than this should be avoided, due to the possibility of altered water content values, compaction due to long-term storage, or chemical degradation of the samples due to metals or other contaminants held within the soil.

5.0 PROCEDURE

5.1 Preparation

Print a Laboratory Bench Sheet for each batch of samples to be analyzed. Remove the samples from refrigeration and allow them to equilibrate to ambient temperature.

5.2 Total Solids Analysis

Label and tare an aluminum weighing boat for each sample, recording its mass on the Laboratory Bench Sheet. Using a spatula, stir the sample until it is homogeneous. Scoop a portion of the sample into the tared aluminum boat. Place the boat with wet sample on the balance, and record the mass on the Laboratory Bench Sheet. Dry the sample in the laboratory oven at 105°C until a constant mass is observed. Remove the container from the oven, place it in a desiccator, and allow it to cool to ambient temperature. Weigh the dried sample and boat on the laboratory balance, and record the value on the Bench Sheet.

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5.3 Fixed and Volatile Solids

Assign a porcelain crucible to each sample to be analyzed. Each crucible will have an I.D. number inscribed above the Coors logo on the side. Write the I.D. number from the crucible on the Laboratory Bench Sheet. Combust the crucibles in a muffle furnace at 550°C for one hour. Cool the crucibles in a desiccator to ambient temperature, and record the mass of each crucible on the Laboratory Bench Sheet. Using a spatula, stir the sample until it is homogeneous. Scoop a portion of the sample into the porcelain crucible. Place the crucible with wet sample on the balance, and record the mass on the Laboratory Bench Sheet. Combust the sample in the muffle furnace at 550°C for a period of one hour. Remove the crucible from the oven, place it in a desiccator, and allow it to cool to ambient temperature. Weigh the combusted sample on the laboratory balance, and record the value on the Bench Sheet.

5.4 Duplicate Analysis

One duplicate sample will be analyzed with every batch of 10 samples, or with every sample set, whichever is more frequent. Duplicates will be below 25% RPD (See 6.2).

6.0 CALCULATIONS

All calculations for total solids, volatile solids, and fixed solids may be done as below:

6.1 Percent Total Solids

$$\%TS = \left(\frac{[W_o - B]}{[W_a - B]}\right) \times 100$$

Where:

B = Weight of Aluminum Boat

W_o = Weight of Dry Sample + Aluminum Boat

W_a = Weight of Wet Sample + Aluminum Boat

6.2 Percent Volatile Solids

$$\%VS = \left(\frac{[W_o - B_r]}{[W_o - B]} \right) \times 100$$

Where:

B = Weight of porcelain crucible

B_r = Weight of porcelain crucible + sample residue

W_o = Weight of dry sample + porcelain crucible

W_a = Weight of wet sample + porcelain crucible

6.3 Percent Fixed Solids

$$\%FS = \left(\frac{[B_r - B]}{[W_o - B]} \right) \times 100$$

Where:

B = Weight of porcelain crucible

B_r = Weight of porcelain crucible + sample residue

W_o = Weight of dry sample + porcelain crucible

W_a = Weight of wet sample + porcelain crucible

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6.4 Relative Percent Difference

Calculate Relative Percent Difference as shown below:

$$RPD = \left(\frac{|DuplicateA - DuplicateB|}{\left(\frac{DuplicateA + DuplicateB}{2} \right)} \right) \times 100$$

7.0 QUALITY CONTROL

7.1 Duplicate Analysis

Duplicate analyses are performed for each batch of 20 samples, or with every sample set, whichever is more frequent. The duplicate analysis will have an RPD value not to exceed 25%.

7.2 Precision and Accuracy

There is no standard for precision and accuracy with this test method. Unless a standard is specified in the QAPP for the samples, an arbitrary precision of 25% RPD will be followed and reported.

7.3 Equipment

Laboratory ovens are monitored daily for accuracy and operation using NIST traceable thermometers, calibrated annually. Laboratory balances are calibrated daily using NIST traceable weights. This ensures that the results generated will be scientifically valid and accurate.

8.0 REPORTING CRITERIA

8.1 Reporting Units

Reporting units are in percent total solids, fixed solids, and total volatile solids.

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8.2 Significant Figures

All results are reported to three significant figures where applicable.

8.3 Duplicate Analysis

All duplicates are reported.

9.0 SAFETY

The technician will be instructed in and made aware of the safety considerations using this method including the following:

* Protective clothing and eyewear is to be worn while in the laboratory.
* The location and use of eyewashes, emergency showers, fire extinguishers, fire blankets, and first aid kits will be given.
* The proper handling and disposal of samples and reagents necessary for the procedure will be followed.
* Procedures and cautions relating to the operation and use of laboratory ovens and furnaces.

This is in addition to standard laboratory practices, including but not limited to, the guidelines specified in the AMS Laboratory Safety Guide and SOP 1304.

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APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2601**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

DETERMINATION OF ATTERBERG LIMITS: LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS

Prepared By: _____ **Date:** _____

Approved By: _____ **Date:** _____
Laboratory Manager

_____ **Date:** _____
QA Officer

US EPA ARCHIVE DOCUMENT

APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2601**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

DETERMINATION OF ATTERBERG LIMITS: LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS

1.0 INTRODUCTION

This standard operating procedure describes the methods and procedures necessary to determine the liquid limit, plastic limit, and plasticity index of soils. There are several methods of determining the Atterberg limits for soils, as shown below:

Multiple point test using a wet or dry soil preparation
Single point test using a wet or dry soil preparation

Unless superceded by a QAPP or other regulating body, a multiple point wet preparation test shall be used to determine the Atterberg limits.

2.0 APPLICATION

For the purposes of Atterberg testing, a soil is defined as any natural or artificial aggregation of mineral or organic materials or any mixture of the above.

2.1 Correlation With Other Tests

This test method is used as an integral part of several engineering classification systems to characterize the fine-fraction of soils. The liquid limit, plastic limit, and plasticity index are also used extensively, either individually or together, with other soil properties to correlate with engineering behavior such as compressibility, permeability, shrink, swell, and shear strength.

2.2 Limitations of Atterberg Tests

A single-point test may not be valid for certain soil types, such as highly organic soils or marine sediments. The liquid limit of these soils should be determined by multipoint testing. In addition, the composition and concentration of soluble salts in a soil affects the values obtained in liquid limit, plastic limit, and water content testing.

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APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2601**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

Special consideration should therefore be given to soils from a marine environment or other sources where high soluble salt concentrations may be present. The degree to which these salts are concentrated or diluted must be given careful consideration if meaningful results are to be obtained. Finally, since the Atterberg tests are preformed on the fraction of soil passing a No. 40 (425 μm) sieve, the relative contribution of this portion of the soil to the properties of the sample as a whole must be considered when using these tests to evaluate the properties of a soil.

3.0 REFERENCES

ASTM D4318, 1996. Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. American Society for Testing and Materials.

U.S. Army Corps of Engineers (USACE), 1996. Laboratory Soils Testing: USACE Engineering Publication EM-1110-2-1906. U.S. Army Corps of Engineers, Engineering and Design CECW-EG, Washington, D.C.

4.0 EQUIPMENT AND MATERIALS

4.1 Apparatus

The following equipment is necessary for Atterberg limit testing:

* Liquid Limit Device (ELE Soiltest 24-0435)
* Liquid Limit Grooving Tool (ELE Soiltest 24-0451)
* Frosted Glass Plate for Mixing Soil and Rolling Plastic Limit Threads
* Heat Gun or Dryer
* Aluminum Weighing Boats, Reynolds #00290
* Laboratory Oven, Maintain 105°C, +/- 0.5°C
* Laboratory Balance, Precision of +/- 0.0001 g
* Spatula or Flat-Bladed Pill Knife for Soil Manipulation
* No. 40 (425 μm) Sieve for Grading Soil
* Wash Bottle for RO/DI Water
* Metal or Plastic Rod 1/8 in. (3.2 mm) Diameter (Optional)
* Stainless Steel or Pyrex Mixing and Storage Bowls

4.2 Reagents

No specialized reagents other than reverse osmosis/deionized (RO/DI) water are necessary for performing Atterberg tests.

5.0 SAMPLE COLLECTION, STORAGE, AND HOLDING TIME

5.1 Sample Collection

Soil samples should be collected according to project-specific sampling plans and quality assurance guidelines.

5.2 Sample Storage

Samples should be stored in plastic or glass containers at a temperature of 4°C.

5.3 Sample Holding Time

Samples stored at 4°C have a holding time of no more than six (6) months. Holding times longer than this should be avoided, due to the possibility of an altered water content or chemical degradation of the sample due to metals or other contaminants held within the soil.

6.0 PROCEDURES

Print a Laboratory Bench Sheet for each sample to be analyzed. If performing a multiple drop analysis, label and tare two aluminum boats for water content, three aluminum boats for liquid limit, and two aluminum boats for plastic limit analyses. Record their weights on the Data Sheet. If performing a single drop analysis, label and tare two aluminum boats for water content, two for liquid limit, and two for plastic limit analyses. Remove the samples from refrigeration and allow them to equilibrate to ambient temperature.

6.1 Water Content

Using the spatula, aliquot two portions of the sample into the tared aluminum boats. Weigh and record their weights on the Laboratory Bench Sheet.

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Dry the samples in the laboratory oven at 105°C until a constant mass is observed. Remove the container from the oven and store in desiccator. Allow the material and container to cool to ambient temperature. Weigh the dried sample and boat on the laboratory balance, and record the value on the Bench Sheet.

6.2 Multiple Point Liquid Limit Testing: Wet Preparation

Before beginning testing, determine the amount of particles within a sample that will be retained on a No. 40 (425 μm) sieve. If little or no material will be retained on the sieve, proceed to section 6.2.3. If significant material will be retained on the No. 40 sieve, but it is easily removable, proceed to 6.2.1. If a significant amount of material will be retained on the No. 40 sieve, and it is not possible to easily remove it, proceed to 6.2.2.

6.2.1 Significant Material Retained on No. 40 Sieve; Easily Removed

Pick the materials larger than 425 μm out of the sample using tweezers or a spatula. Once the sample is clean of all large particulate material, proceed to 6.2.3.

6.2.2 Significant Material Retained on No. 40 Sieve; Not Easily Removed

If it is not practical to remove particles larger than 425 μm by hand, remove lesser amounts of large particles (less than 15% total) by gentle rubbing of the sample through a No. 40 sieve. Do not crush particulate materials to force them through the sieve. Once 150g to 200g of material has been obtained, proceed to 6.2.3. If there is too much large particulate material (more than 15%) to work the sample through a sieve, proceed to 6.2.2.1.

6.2.2.1 More than 15% coarse particulates in a sample

If there are too many large particulates in a sample it may be necessary to wash the sample through a No. 40 sieve. Place the No. 40 sieve over a clean stainless steel or glass bowl. Aliquot about 500 g of sample onto the sieve. Using minimal water, rinse and remove coarse materials from the sample. Disaggregate soil lumps using a your fingers in a gentle side-to-side pattern. After washing and removing as much large particulates as possible, add sufficient RO/DI water to bring the level to about 10mm above the screen of the No. 40 sieve. Agitate the slurry by stirring with the fingers while raising and lowering the sieve in the pan and swirling the suspension so that fine material is washed from the coarser particles.

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Complete the washing operation by raising the sieve above the water surface and rinsing the materials retained on the No. 40 sieve with a small amount of RO/DI water. Discard all materials retained on the No. 40 sieve. Reduce the water content of the materials retained in the mixing bowl by either allowing the water to evaporate over time, using a hair dryer or heat gun to accelerate drying time, or decanting the overlying water from the surface of the sediment. For materials that have soluble salts, evaporation or drying is the only acceptable method. Proceed to Section 6.2.3.

6.2.3 No Significant Materials Retained on No. 40 Sieve

Thoroughly mix the sample material on the frosted glass plate using a spatula. Adjust the water content if necessary by adding small amounts of RO/DI water or by allowing the sample to dry on the glass plate. After mixing to a moisture content that will close in a liquid limit test at 25 to 35 blows, allow the soil to stand for a period of 16 hours. Mix thoroughly before beginning the liquid limit analysis. Proceed to Section 6.4.

6.3 Multiple Point Liquid Limit Testing: Dry Preparation

Select sufficient soil to provide 150 g to 200 g of material passing the No. 40 sieve after processing. Dry the sample at room temperature or in the drying oven at a temperature not to exceed 60°C until the solids will disaggregate easily. Pulverize the sample in a mortar with a rubber-tipped pestle or other apparatus in a way that will not break down individual grains or particles. Remove large particles by hand, and then dry-sieve the remaining fines through the sieve. Once the operation is complete, discard the coarse materials retained on the sieve, and place the fine material in a mixing bowl. Soak the material in the bowl using RO/DI water. Mix thoroughly, using a spatula to insure that the sample is homogenized. After mixing to a moisture content that will close in a liquid limit test at 25 to 35 blows, allow the soil to stand for a period of 16 hours. Mix thoroughly before beginning the liquid limit analysis.

6.4 Liquid Limit Test Procedure

6.4.1 Filling the Liquid Limit Cup

Verify that the drop cup is clean and dry. Place a portion of the prepared soil (6.2 to 6.3) in the cup of the liquid limit device in the center of the cup. Using a spatula, squeeze the soil down and spread it into the cup so that it has a depth of 10 mm at its deepest point.

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Ensure that no air pockets have been introduced and that the soil has been spread smoothly and quickly. Excess soil should be returned to the mixing bowl.

6.4.2 Grooving the Sample Using the Cutting Tool

Form a groove in the soil pat by drawing the grooving tool, beveled edge forward, through the soil from the top to the bottom of the cup, along the centerline. When cutting the groove, hold the grooving tool against the interior surface of the cup, perpendicular throughout its movement. In soils where a groove cannot be made in one stroke without tearing the soil, cut the groove with several strokes of the tool. An initial trench may be cut in the soil pat using the spatula, with the grooving tool used to cut the soil to its final dimensions. At no time should the soil pat be allowed to slide relative to the surface of the cup.

6.4.3 Performing the Liquid Limit Test (Drop Count)

Lift and drop the cup by turning the crank handle at a rate of 1.9 to 2.1 drops per second. Continue the drop test until the two halves of the soil pat come in contact at the bottom of the cup along a closed-groove distance of 13 mm (1/2 inch). There are three liquid limit trials, with drop counts of 15 to 25 (LL-1), 20 to 30 (LL-2), and 25 to 35 (LL-3). Verify that the groove closed with two equal and similarly shaped sides. If the test generated a drop count matching one of these three values, record the number of drops required to close the groove on the Laboratory Bench Sheet. Scoop about 10 g of sample (including the soil that met within the groove) from the cup and place it into the aluminum boat for that liquid limit. Weigh the wet sample and boat on the balance, and record the weight on the Laboratory Bench Sheet.

6.4.3.1 Problems with the drop count

Verify that an air pocket has not caused the premature closing of the groove by observing that both sides of the groove have flowed together with the same shape. If the closure is premature, reform the soil in the cup, adding a small amount to compensate for that removed in 6.4.2, and perform the grooving and drop test again. If the soil slides on the surface of the cup, repeat 6.4.2 and 6.4.3 at a higher water content. If after several tries at successively higher water content values the soil pat continues to slide within the cup or if the number of blows required to close the groove is always less than 25, record that the liquid limit could not be reached and that the soil is non-plastic on the Laboratory Bench Sheet. Stop all testing and proceed with the next sample.

6.4.4 Finishing the Liquid Limit Test

Return the excess soil from the cup to the soil on the glass plate. Wash and dry the cup, grooving tool, and spatula. Assemble the drop device, and begin preparation for the next liquid limit test. Remix the soil on the plate, either adding RO/DI water or drying the soil to adjust the moisture content as needed to obtain all three liquid limit values. After the three tests have been performed, dry all samples in the oven at 105°C for 24 hours or to constant dryness. Remove the samples from the oven, and allow to cool to ambient temperature in a desiccator. Weigh the samples on the laboratory balance, and record the values on the Laboratory Bench Sheet.

6.5 Single Point Liquid Limit Test Procedure

6.5.1 Sample Preparation

Prepare the samples in the same manner as noted in Sections 6.2 for wet preparation and 6.3 for dry preparation, except that the water content of the soil should be adjusted so that it has a consistency requiring 20 to 30 drops of the liquid limit cup to close the groove.

6.5.2 Performing the Single Drop Liquid Limit Test

Placement and grooving of the sample in the liquid limit cup should be done as instructed in Sections 6.4.1 and 6.4.2. Perform the drop test in the same manner as noted in Section 6.4.3 so that a drop count of 20 to 30 is generated. If less than 20 or more than 30 drops are required, adjust the water content of the soil and repeat the procedure. After the correct drop count has been generated, remove a portion of the sample as described in Section 6.4.3. Immediately after removing the sample, add more soil and reform the soil pat as described in Section 6.4.1. Perform a second liquid limit test. If the difference between the two tests is no more than two, take a water content sample of the second test. If the difference is larger than two drops, both tests are invalid, and must be repeated. Remix the soil and repeat the procedure.

6.5.2.1 Problems with the drop count.

Problems with the drop count, such as an improper groove closure or inability to produce a drop count between 20 and 30 are to be treated as noted in Section 6.4.3.1.

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6.6 Plastic Limit

6.6.1 Preparation of the Test Specimen

Select a 20 g portion of the sample prepared for the liquid limit test. Reduce the water content of the soil to a consistency at which it can be rolled without sticking to the hands by spreading and mixing continuously on the ground glass plate. Using an electric fan or hair dryer will accelerate the drying process.

6.6.2 Performing the Plastic Limit Test

Remove a 5 g portion of soil and form a small ellipsoidal mass. Roll this mass between the palm or fingers and the ground glass plate with a light, constant pressure. Form a thread of uniform diameter along the entire length of the soil mass. Deform the thread with each stroke until it reaches a diameter of no more than 1/8" (3 mm) in a 2-minute period. If the soil is still a cohesive solid thread, then continue to work the soil, reducing its water content until it crumbles when made into the 1/8" thread. This is the threshold at which the soil no longer acts in a plastic manner. Continue working small masses of soil until approximately 20 g of sample have been produced at the plastic limit. Place the crumbles into the two aluminum boats, weigh them, and record the masses on the Laboratory Balance Sheet. Ensure that both plastic limit samples are as identical as possible, since the water contents must be within two percent of each other for the test to be valid.

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7.0 CALCULATIONS

7.1 Water Content Calculation

Calculate the water content of a sample as follows:

$$W_N = \left(\frac{(W_1 - W_2)}{W_2 - W_C} \right) \times 100$$

where:

W_N = water content, %

W_1 = mass of container and moist specimen, g

W_2 = mass of container and oven-dried specimen, g

W_C = mass of container, g

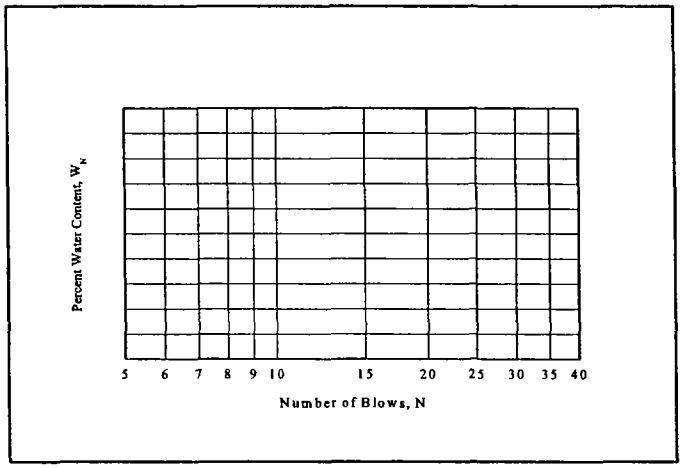
7.2 Liquid Limit Calculations

7.2.1 *Calculating the Liquid Limit for the Multiple Drop Procedure*

Plot the relationship between water content (W_N) and the corresponding number of drops (N) of the cup on a semilogarithmic graph with W_N as the ordinates on the arithmetic scale, and N as the abscissas on the logarithmic scale. Either by computational methods or by hand, draw a best-fit line between the three plotted points. Using the best-fit line, find the moisture content point that intersects with the N=25 abscissa. This is the liquid limit of the soil. Figure 1 shows the semilogarithmic graph used on the Laboratory Bench Sheet.

APPLIED MARINE SCIENCES, INC.
Standard Operating Procedure **SOP 2601**
Written By: Kenneth S. Davis, Revision By: Mike A. Seymour

Figure 1: Graph For Calculating the Liquid Limit



7.2.1 Calculating the Liquid Limit From a Single Drop Test

Calculate the liquid limit as follows:

$$LL = W_N\left(\frac{N}{25}\right)^{0.121}$$

Where:

N = Number of blows required to close the groove

W_N = Water content of the sample

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This equation may be simplified by adding a calculation factor, K, to the equation:

$$LL = K(W_N)$$

Where:

W_N = Water content of the sample

K = Factor (See Table 1)

Table 1: Factors for Obtaining Liquid Limit from Water Content and Drop Count

Number of Drops, *N*	Factor for Liquid Limit, *K*
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

7.2 Plastic Limit Calculation

The plastic limit may be calculated from the following equation:

$$PL = \left(\frac{PL_1 + PL_2}{2} \right)$$

Where:

PL_1 = Water Content for First Plastic Limit Sample

PL_2 = Water Content for Second Plastic Limit Sample

7.3 Plasticity Index

Calculate the plasticity index as follows:

$$PI = (LL = PL)$$

Where:

LL = Liquid limit percentage

PL = Plastic limit percentage

8.0 QUALITY CONTROL

8.1 Duplicate Water Content and Plastic Limit Samples

Duplicate samples are taken during the water content and plastic limit analyses. For each process, the duplicate samples must be within two percent of each other for the tests to be valid. If the double water content samples are more than two percent of each other, the tests are performed again.

8.2 Equipment

Laboratory balances are calibrated daily using NIST traceable weights. This ensures that the results generated will be scientifically valid and accurate.

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9.0 REPORTING CRITERIA

9.1 Report Data

The report will include the following:

* Sample identification
* Any variation in specimen selection process used
* Liquid limit, plastic limit, and plasticity index to the nearest whole number, omitting the percentage designation. If the liquid limit or plastic limit could not be attained, or if the plastic limit is equal to or greater than the liquid limit, a designation of non-plastic (NP) will be reported.
* An estimation of the percentage of sample retained on the No. 40 sieve
* The procedure by which the liquid limit was performed.

9.2 Significant Figures

All results are reported to three significant figures where applicable.

10.0 SAFETY

The technician will be instructed in and made aware of the safety considerations using this method including the following:

* Protective clothing and eyewear is to be worn while in the laboratory.

* The location and use of eyewashes, emergency showers, fire extinguishers, fire blankets, and first aid kits will be given.

* The proper handling and disposal of samples and reagents necessary for the procedure will be followed.

This is in addition to standard laboratory practices, including but not limited to, the guidelines specified in the AMS Laboratory Safety Guide and SOP 1304.

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STANDARD OPERATING PROCEDURE

for

Sample Preparation of Aqueous Samples by Acid Digestion for ICP

Rev. 5

1. Scope and Applications

This Standard Operating Procedure (SOP) deals with the preparation of aqueous samples for analysis by USEPA SW846 6010B. Discussion includes sample extraction and sample concentration technique for the analysis of metals in aqueous samples. A list of the analytes is shown in **figure 1**.

2. Personnel Qualifications and Responsibilities

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method. Analysts are responsible for performing analyses in accordance with this SOP and documenting any variations in the protocol. Supervisors/lab managers are responsible for ensuring that this SOP is accurate and up to date, and that it is implemented appropriately. Supervisors/lab managers review the logbooks and data generated for this procedure and approve all reported results.

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3. Summary of Procedure

A 50mL aliquot of sample is digested and brought up to final volume for metals analysis by Inductively Coupled Argon Plasma (ICAP).

4. Sample Preservation, Containers, Handling, and Storage

4.1 Hold time for ICP analysis is 180 days from date sampled.

4.2 Total aqueous samples must be preserved with concentrated HNO_3 to a pH of less than 2 and stored in an amber glass or polyethylene bottle.

4.3 Dissolved samples must be filtered through 0.45um filter paper prior to preservation with concentrated HNO_3 to a pH <2.

5. Interferences and Potential Problems

Possible contamination:

5.1 Hood fall-out.

5.2 Acid bath for glassware contaminated.

5.3 Acid dispensers.

5.4 DI water rinsing bottles contaminated.

5.5 Poor lab technique.

5.6 Cross-contamination from high-level samples.

5.7 Sample matrix effects: Extreme organic samples.

6. Equipment and Apparatus

Equipment used in this preparation method include:

6.1 10% HNO_3 acid bath.

6.2 Polyethylene digestion tubes w/ caps.

6.3 Polyethylene Watch Glasses.

6.4 Whatman 41 filter paper (if necessary).

6.5 50 ml Plastic funnels (if necessary).

6.6 Reference polyethylene digestion tube w/ 50ml colored DI water.

6.7 Thermometers- NIST Calibrated

6.8 Hot plates with graphite tube holders for even heating.

6.9 Eppendorf and/or Brandtech pipettes.

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7. Reagents

The following reagents are used during sample preparation:

7.1 Concentrated HNO_3, Fisher, ACS trace metals grade.

7.2 Concentrated HCl, Fisher, ACS trace metals grade.

7.3 1:1 (v/v) HCL, Fisher, ACS trace metals grade.

7.4 Spiking solutions, High Purity Standards.

7.5 Laboratory Control Sample Solutions, High Purity Standards.

8. Procedure

8.1 Digestion of highly-colored total water samples for ICAP Analysis (Method 3010):

8.1.1 Enter Lab ID #'s of all the samples to be digested into the proper column in the Sample Digestion Logbook. All volumes of reagents added as well as the initial and final volumes must be entered in this Logbook.

8.1.2 Check the pH for aqueous samples (pH should be <2). Enter observations in the appropriate column in the Logbook and adjust and note the pH if not less than 2. If pH adjustment needs

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to be done, be sure to notify the client first. Acidify the sample with concentrated HNO_3 to a pH <2. Shake sample well and let it sit for 24 hours before digestion.

8.1.3 Measure 50mL of sample into a plastic tube.

8.1.4 Add 1.5mL conc. HNO_3.

8.1.5 Cover with a ribbed watch glass.

8.1.6 Place in the graphite holders, on a hotplate, inside the inorganic hood (PVC ducting). Cover each tube with a ribbed watch glass.

8.1.7 Heat @ 95°C (90°C – 95°C is an acceptable temperature range) until the sample volume has been reduced to 10-20mL. Do not boil the sample or let it go dry.

8.1.8 Take tubes off the hotplate and allow them to cool to room temperature.

8.1.9 Add another 1.5mL of conc. HNO_3.

8.1.10 Heat sample again to 10-20mL ensuring a reflux action occurs.

8.1.11 Continue to add HNO_3 in 1.5mL aliquots until digestate appears pale in color. (Add no more than 5mLs conc. HNO_3).

8.1.12 Cool the tube and add 5mL of 1:1 (v/v) HCl.

8.1.13 Heat for an additional 15 minutes.

8.1.14 Rinse the walls of beaker with DI water into the beaker.

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8.1.15 If the sample is not to be filtered, bring the sample back to 50 ml with DI water using the reference tube to obtain the proper volume.

8.1.16 If sample needs to be filtered, volumize sample to 50 ml and filter through Whatman 41 filter paper.

8.1.17 All digestion information is documented in the Aqueous Metal Prep Logbook.

8.1.18 Transfer prep logbooks and extracts to Inorganic Instrument Lab.

8.2 Digestion of Dissolved or Colorless/Pale-Colored Total Aqueous Samples For ICAP Analysis (Method 3005), and Leachates:

8.2.1 Dissolved samples must be filtered first through 0.45um filter paper and preserved with conc. HNO_3.

8.2.2 Enter Lab ID# of all samples to be digested into the proper column in the Sample Digestion Logbook. All volumes of reagents added as well as the initial and final volumes must be entered in the Logbook.

8.2.3 Transfer a 50mL aliquot of the sample to a digestion tube.

8.2.4 Add 1mL of conc. HNO_3 and 2.5mL of conc. HCL.

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8.2.5 Heat to 90-95°C in graphite holders on hotplates in the hood. Cover each tube with a ribbed watch glass and evaporate until the sample volume equals 25-30ml.

8.2.6 Remove tube and cool.

8.2.7 Rinse the walls of the beaker with DI water and volumize to 50mL with DI water.

8.2.8 If insoluble material remains, volumize sample to 50 ml and filter through Whatman 41 filter paper.

8.2.9 Record all digestion information in the Sample Digestion Logbook.

8.2.10 Transfer logbooks and extracts to the Inorganic Instrument Lab.

9. Data Reduction and Calculations

Not applicable.

10. Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) procedures are established to ensure generation of data of known quality. QA/QC procedures associated with the Inorganic Prep Lab include preparation of Method Blanks, Lab Control Samples, matrix spikes and sample duplicates.

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10.1 Method blanks:

A method blank must be run with every discrete batch of samples that is prepped. The number of samples per batch may not exceed 20.

10.1.1 Use 50mL of DI water as the method blank for aqueous sample preparation. Prep this sample as described in **Section 8**. Label appropriately (see **Section 10.4**)

Recovery Criteria = The method blank concentration of each analyte must be less than the Mitkem established MRL for that analyte. For Navy (NFESC) projects the method blank concentration must be less than or equal to one-half the reporting limit.

10.2 Laboratory Control Samples:

A laboratory control sample must be prepped and analyzed for each batch of samples. The number of samples per batch may not exceed 20.

10.2.1 For water samples: measure approximately 40 ml of DI water as if it were a sample and add High Purity Standard CLP-CV-1 at 0.45mL; CLP-CV-2 and CLP-CV-3 at 0.045mL each. Prep this sample as described in **Section 8**. Label appropriately (see **Section 10.4**)

Recovery Criteria = The criteria for each analyte is determined by the most recent Mitkem Corporation established Control Chart information.

10.3 Matrix Spikes and Duplicate Samples:

10.3.1 Water Samples:
With at least every 20 samples a sample duplicate and sample spike must be prepped and analyzed by the laboratory.

Spike Sample:

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Prepare 3 digestion tubes to be used for the same aqueous sample. Designate one tube as the sample, one as the duplicate of that sample, and the other as a spiked portion of the sample. Into each tube, measure 50mL of sample (the same sample). Add three spiking standards; High Purity Standard CLP-CV-1 at 0.45mL; CLP-CV-2 and CLP-CV-3 at 0.045mL each. Label this sample: "LabID"'S'.

Recovery Criteria – A control limit of +/- 20% is used for matrix spike analysis. Any failed analytes must have a post-digestion spike **(Section 12.4)**.

Sample Duplicate:

Label the other additional 50mLs of sample as "LabID"'D'. This is an exact duplicate of the original sample. Digest sample duplicate as described in **Section 8**.

Recovery Criteria = A control limit of 20% RPD is used for sample and duplicate analytes at concentrations greater than or equal to 5 times the MRL. There is no corrective action for failed duplicate criteria.

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10.4 Standard Preparation

All standards made from a primary standard expire on or before the primary standard's expiration date. For standards without manufacturer-designated expiration dates, the expiration date will be 1 year from receipt.

11. Data Validation and Reporting

Data generated in the inorganic preparation laboratory will be reviewed and signed by a peer, the supervisor or the manager.

12. Corrective Action Procedures

12.1 If the method blank concentration for any analyte is greater than the established method criteria, the samples are re-prepped and re-analyzed. However, if sample concentration exceeds 10 times the concentration of the method blank, the analysis is acceptable.

12.2 If LCSW is outside of control limits, samples are re-prepped and re-analyzed for those analytes.

12.3 If a Spike sample was not spiked, it will be re-prepped and re-analyzed with the appropriate sample and duplicate.

12.4 If the matrix spike recovery is outside the ±20% acceptance criteria, but the sample concentration for that analyte exceeds 4 times the spike added, a post-digestion spike will not need to be performed. For those analytes that require a post digestion spike it is performed at the same concentration as the original spike.

13. Health and Saftey

Health and safety hazards in the Inorganic Preparation Laboratory (prep lab) include exposure to concentrated acids, their fumes and toxic metals standards. Labcoats, gloves and safety glasses must be worn in the prep lab at all times.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

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See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. Reference

1. U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Update 3 Method 3005.

2. U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Update 3 Method 3010.

Attachments:

1. **Figure 1**: Metals Analyte List.

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Figure 1

Metals Analyte List

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STANDARD OPERATING PROCEDURE

for

Preparation of Soil Samples by Acid Digestion for ICP Analysis

by

SW846 Method 3050B

Rev. 5

1. Scope and Application

This Standard Operating Procedure (SOP) deals with the preparation of soil samples for analysis by USEPA SW846 6010B. Discussion includes sample digestion and sample concentration technique for the analysis of metals in soil samples. A list of the analytes is shown in **Figure 1.**

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2. Personnel Qualifications and Responsibilities

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method. Analysts are responsible for performing analyses in accordance with this SOP and documenting any variations in the protocol. Supervisors/lab managers are responsible for ensuring that this SOP is accurate and up to date and that it is implemented appropriately. Supervisors/lab managers review logbooks and data generated for this procedure and approve all reported results.

3. Summary of Procedure

A 1.00 to 1.25 gram sample is digested with the addition of acids and hydrogen peroxide for metals analysis by Inductively Coupled Argon Plasma (ICAP).

4. Sample Preservation, Containers, Handling, and Storage

4.1 Hold time for ICP analysis is 180 days from date sampled.

4.2 Samples are stored at 4°C in amber glass jars with Teflon lined caps.

5. Interferences and Potential Problems

Possible sources of contamination:

5.1 Hood fall-out.

5.2 Acid bath for glassware.

5.3 Acid dispensers.

5.4 Sample matrix effects: Extreme organic samples.

6. Equipment and Apparatus

Equipment used in this preparation method include:

6.1 10% HNO_3 acid bath.

6.2 50 ml polyethylene tubes.

6.3 Watch Glasses.

6.4 Hot plates.

6.5 Centrifuge.

7. Reagents

The following reagents are used during sample preparation:

7.1 Concentrated HNO_3, Fisher, ACS trace metals grade.

7.2 1:1 (v/v) HNO_3, Fisher, ACS trace metals grade.

7.3 Concentrated HCl, Fisher, ACS trace metals grade.

7.4 30% Hydrogen peroxide (H_2O_2), Fisher, ACS certified.

7.5 Spiking solutions, High Purity Standards.

7.6 Laboratory Control Sample Solutions, High Purity Standards.

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8. Procedure

See SOP 110.0039 for sub-sampling procedures.

8.1 Digestion of soil samples for ICAP analysis:

8.1.1 Note in Soil/Solid Sample Preparation Logbook the presence of any artifacts (see **Figure 2**).

8.1.2 Mix the sample thoroughly so that a homogenous representative aliquot can be taken. Weigh an approximate1.00 to 1.25 gram aliquot of the sample to the nearest 0.01g and transfer it to a 50mL digestion tube.

8.1.3 Add 5mLs of 1:1 (v/v) HNO_3, mix well. Cover the tube with a ribbed watch glass. Heat to 95°C ± 5°C in graphite holders on hotplates in the hood, and reflux for 15 minutes without boiling.

8.1.4 Remove from hotplate and allow to cool.

8.1.5 Add 2.5mLs of conc. HNO_3. Replace on hotplate and reflux for 30 minutes. If brown fumes are generated at this step repeat the addition of 2.5mLs conc. HNO_3 with heating steps until no more brown fumes are given off. Do not allow the volume to fall below 5mLs.

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8.1.6 Allow the sample to cool and add 1ml of 30% H_2O_2. Return the tube to hotplate to start peroxide reaction making sure no losses occur due to excessive effervescence action. Heat until effervescence subsides and allow tube to cool

8.1.7 Continue adding 30% H_2O_2 in 1mL aliquots with warming until minimal effervescence occurs, the appearance of the sample remains unchanged or 5ml's have been added.

Note: do not add more than a total of 5mLs H_2O_2

If blank or sample no longer have effervescence set them aside, do not continue to add H_2O_2. When all are done proceed to next step.

8.1.8 Add 5mLs of concentrated HCl and return to the hotplate for an additional 15 minutes.

8.1.9 Take tube off the hotplate and cool to room temp.

8.1.10 Volumize to 50mLs with DI Water.

8.1.11 Centrifuge sample for approximately 5 minutes at 3000 rpms.

8.1.12 Label the tube properly. Store digestate and transfer to Inorganic Instrument Lab. All digestion information is documented in the Soil/Solid Metals Prep Logbook, **Figure 2**.

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9. Data Reduction and Calculations

Not applicable.

10. Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) procedures are established to ensure generation of data of known quality. QA/QC procedures associated with the Inorganic prep lab include preparation of Method Blanks, Lab Control Samples, matrix spikes and sample duplicates.

10.1 Preparation Blanks:

A method blank must be run with every discrete batch of samples that is being prepped. A batch of samples cannot exceed 20 samples.

10.1.1 Use 1 ml of DI water as a "soil blank" and treat it as if it were a regular sample. Label appropriately.

Recovery Criteria = The method blank concentration of each analyte must be less that the Mitkem established MRL for that analyte. For Navy NFESC work the blank concentration cannot exceed one-half the reporting limit.

10.2 Laboratory Control Samples:

A laboratory control sample must be prepped and analyzed for each batch of samples. The number of samples per batch cannot exceed 20.

10.2.1 For soil samples measure between 1-2mL DI water into a 50mL -digestion tube. Spike 0.45mLs of CV-1 and 0.045mLs each of CV-2 and CV-3 into the tube and digest as described in **Section 8**. (see **Figure** 3 for analytes and concentration.). Label appropriately.

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Recovery Criteria = The criteria for each analyte is determined by the most recent Mitkem Corporation established Control Chart information.

10.3 Matrix Spikes and Duplicate Samples:

Spike Sample:

Prepare 3 digestion tubes to be used for the same aqueous sample. Designate one tube as the sample, one as the duplicate of that sample, and the other as a spiked portion of the sample. Into each tube, measure 1.00-1.25 g of sample (the same sample). Add three spiking standards; High Purity Standard CLP-CV-1 at 0.45mL; CLP-CV-2 and CLP-CV-3 at 0.045mL each. Label this sample: "LabID"'S'. (see **Figure 3** for Spike analytes and concentrations) and digest as described in **Section 8**.

Recovery Criteria = A control limit of +/- 25% is used for matrix spike analysis. Any failed analytes must have a post-digestion spike **(Section 12.4)**.

Sample Duplicate:

Label the tube designated for the sample duplicate as "LabID"'D'. This is an exact duplicate of the original sample. Digest sample duplicate as described in **Section 8**.

Recovery Criteria = A control limit of 20% RPD is used for sample and duplicate analytes at concentrations greater than or equal to 5 times the MRL. There is no corrective action for failed duplicate criteria.

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10.4 Standard Preparation

All standards made from a primary standard expire on or before the primary standard's expiration date.

11. Data Validation and Reporting

Data generated in the inorganic preparation laboratory will be reviewed and signed by a peer, the supervisor or the manager.

12. Corrective Action Procedures

12.1 If the method blank concentration for any analyte is greater than the Mitkem established MRL, the samples are re-prepped and re-analyzed. However, if sample concentration exceeds 10 times the concentration of the method blank, the analysis is acceptable.

12.2 If LCSS is outside of control limits, samples are re-prepped and re-analyzed for those analytes.

12.3 If a Spike sample was not spiked, it will be re-prepped and re-analyzed with the appropriate sample and duplicate.

12.4 If the matrix spike recovery is outside the ±25% acceptance criteria, but the sample concentration for that analyte exceeds 4 times the spike added, a post-digestion spike will not need to be performed. For those analytes that require a post digestion spike it is performed at the same concentration as the original spike.

13. Health and Safety

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Health and safety hazards in the Inorganic Preparation Laboratory (prep lab) include exposure to concentrated acids, their fumes and toxic metals standards. Labcoats, gloves and safety glasses must be worn in the prep lab at all times.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

U. S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, SW-846,Update III, Revision 2, December 1996, Method 3050B.

Attachments:

1. **Figure 1**: Metals Analyte List.
2. **Figure 2**: LCS/Spike Analyte List and Concentrations.

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Figure1

Metals Analyte List

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Figure 2

LCS/Spike Analyte List and Concentrations

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STANDARD OPERATING PROCEDURE

for

Determination of Metals in Water and Soil by Inductively Coupled Argon Plasma Atomic Emission Spectrometry

by

SW846 Method 6010B

Rev. 7

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	Signature	Date
QA Director:	_____	_____
Lab Director:	_____	_____

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STANDARD OPERATING PROCEDURE

for

Determination of Metals in Water and Soil by Inductively Coupled Argon Plasma Atomic Emission Spectrometry

by

SW846 Method 6010B

Rev. 7

1. Scope and Application

This SOP describes the procedures applicable to the analysis of the elements listed in Attachment 1. All matrices, including ground water, aqueous samples, TCLP and EP extracts, industrial and organic wastes, soils, sludges, sediments, and other solid wastes, require digestion prior to analysis. Section 8.1 provides the SOP references for sample digestion procedures.

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2. Personnel Qualifications and Responsibilities

Personnel must be qualified according to the requirements of their job descriptions and trained for this procedure prior to analyzing samples. **Analysts and technicians** are responsible for performing analyses in accordance with the SOP and documenting any variations in the protocol. **Supervisors/Managers** are responsible for ensuring that SOPs are accurate and up-to-date, and that they are implemented appropriately. **Supervisors/Managers** review the logbooks and data generated from this procedure and approve all reported results.

3. Summary of Procedure

3.1 Prior to analysis, samples must be digested using appropriate sample preparation methods (see SOPs for sample preparation).

3.2 The method measures element specific emitted light by optical spectrometry. The samples are nebulized and the resulting aerosol is transported to the plasma torch. The metals pass through the hot zone of the plasma, where they take up energy. Subsequently the metals pass through the cold zone (relatively) of the plasma where they give up the excess energy at element specific wavelength. The spectra are dispersed by a grating spectrometer, and the intensity of the emitted light is measured by a solid state photomultiplier. Background correction is required for trace element determination. The position selected for the background-intensity measurement, on either or both sides of the analytical line, will be determined by the complexity of the spectrum adjacent to the

analyte line. The position used must be free of spectral interferences and reflect the same change in background intensity as occurs at the analyte wavelength measured.

4. Sample Preservation, Containers, Handling, and Storage

4.1 Samples are collected by the client and submitted for analysis in pre-cleaned sample containers provided by the laboratory. For metals analysis by Method 6010B, water samples are collected in 500 ml plastic containers and preserved (acidified) with nitric acid to a pH of less than 2. Soils are collected in 8-ounce glass containers. Sample volume requirements depend upon the number of different preparation procedures necessary for the analyses requested. Additional sample volume may also be required for the analysis of laboratory QC samples.

4.2 Soil samples are stored at 4°C ± 2°C until analyzed.

4.3 Sample holding time for metals analysis by method 6010B is 180 days from the date of sample collection for both water and soil.

5. Interferences and Potential Problems

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Several types of interference effects may contribute to inaccuracies in the determination of an analyte by ICAP-AES.

5.1 Spectral interferences - Can be categorized as (1) overlap of a spectral line from another element; (2) unresolved overlap of molecular band spectra; (3) background contribution from continuous or recombination phenomena. The first of these can be compensated for by utilizing a computer correction of raw data, requiring monitoring and measurement of the interfering element. The second effect may require selection of an alternative wavelength. In addition one could select an alternate wavelength where interference is minimal or absent. The 4300DV and the 3100XL we use at Mitkem have many spectral lines from which to choose. The third effect can usually be compensated by a background correction adjacent to the analyte line.

5.2 Physical interferences are effects associated with the sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high dissolved salts or high acid concentrations. If physical interferences are present, they must be reduced by such means as a high-salts nebulizer, diluting the sample, using a peristaltic pump, or using an appropriate internal standard element. Another problem that can occur with high dissolved salts is a salt buildup at the tip of the nebulizer, which affects aerosol flow rate and causes instrumental drift. This problem can be controlled by a high-salts nebulizer, wetting the argon prior to nebulization, using a tip washer, or by diluting the samples. A mass flow controller is used to control the argon gas flow rate.

5.3 Chemical interferences include molecular-compound formation, ionization effects, and solute-vaporization effects. These effects can be minimized by careful selection of

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operating conditions, by buffering of the sample, by matrix matching, and by standard-addition procedures.

5.4 Memory interferences result when analytes in a previous sample contribute to the signals measured in a new sample. Memory effects can result from sample deposition on the uptake tubing to the nebulizer, or from the buildup of sample material in the plasma torch and spray chamber. The site where these effects occur is dependent on the element and can be minimized by flushing the system with the rinse solution between samples. This method requires a rinse period of at least 60 seconds between samples and standards. If memory interference is suspected, the sample must be reanalyzed using a longer rinse period.

5.5 Physical, Cchemical and Sspectral interferences are primarily attributed to the sample matrix. If an interference caused by a particular sample matrix is known, in many cases it can be circumvented. However, when the nature of the sample is unknown, following tests can be used to ensure the analyst that neither positive nor negative interference effects are operative on any of the analyte elements thereby distorting the accuracy of the reported values.

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5.5.1 ~~Serial d~~Dilution Test ~~If the analyte concentration is sufficiently high (minimally~~ a factor of ~~50x~~ above the instrument detection limit ~~M(IDL.))~~, an analysis of a 1:5 dilution ~~should agree within 10% of the original determination, or within an established acceptable control limit. If not, a chemical or physical interference effect could be suspected.~~

5.5.2. ~~Analyte~~Post Digestion Spike ~~a~~Addition - If the spike (pre-digestion) recovery falls outside of the control limits (75% - 125%), a matrix interference is suggested. In this case ~~A~~an ~~post digestion~~ analyte spike~~addition~~ is added to a portion of a prepared sample or it's dilution at a level just below the mid-point of the calibration curve. ~~(reporting limit) or 2X the sample concentration, whichever is greater.~~Post digestion spikes should be recovered to within 85% to 115% of the known value. If not, a matrix effect should be suspected.

5.5.3. Comparison with alternative method analysis-when investigating a sample matrix, comparison tests may be performed with other analytical techniques, such as atomic absorption spectrometry, or ICP-mass spectrometry. This should only be done after consultation with the client.

6. Equipment and Apparatus

6.1 Inductively coupled argon plasma emission spectrophotometer (ICAP).

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The ICAPs used at Mitkem are a Perkin-Elmer Model 4300DV and a 3100XL. The 4300DV is outfitted with an AS-93plus, 157-position autosampler and a high precision, three channel, peristaltic pump. The 3100XL is outfitted with an AS-91, 160-position autosampler and a high precision, three channel peristaltic pump. Both ICPs have axial viewing capability, as compared to the more traditional radial viewing ICAP. Axial viewing provides greater sensitivity for all elements analyzed. The solid state detector is capable of analyzing at approximately 6000 wavelengths.

The built-in radio-frequency generator is FCC compliant.

The systems are computer controlled through a 32-Bit, Microsoft Windows NT operating system. This system allows for great flexibility in controlling the instrument.

The required argon gas comes in industrial size Dewar tanks. Two tanks are hooked up to an automated gas switch. This switch will sense the decrease in pressure of the present tank and will automatically switch to the reserve tank. This feature is particularly important when a long instrumental run is planned.

6.2. Operating conditions - The analyst should follow the instructions provided by the instrument manufacturer. Instrument detection limits, linear dynamic ranges and interference effects are established for each analyte line used. All measurements must be in the instrument linear range where spectral interference correction factors are valid. The analyst must (1) verify that the instrument configuration and operating conditions satisfy the analytical requirements and (2) maintain quality control data confirming instrument performance and analytical results.

Daily emissions for arsenic, copper, lead and selenium are recorded as a means to ensure the plasma is stable before analysis and also to chart potential problems especially with the power tube, sample introduction system, or RF generator.

For analysis of normal environmental samples use the following standard operating conditions:

Wattage: 1450 – 1500
Argon flow rate (L/min): 15
Nebulizer flow rate (L/min): 0.55
Sample flow rate (mL/min): 2
Rinse time (sec): 60
Read delay (sec): 60

For regular day-to-day ICAP measurements, the plasma need not be optimized prior to analysis. The plasma needs to be optimized each time a major change occurs in instrument configuration, such as replacement of the torch and/or scheduled manufacturer's maintenance. Optimization is a feature of the software and occurs with the use of a 1 mg/L Mn solution.

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To optimize the plasma, follow the instructions in the Optima 3000 Software Guide.

6.3 ICP Instrument Maintenance:

6.3.1 Preventative Maintenance:

6.3.1.1 Peristaltic pump tubing will be replaced every 16 hours of instrument time or sooner if memory effects are manifested.

6.3.1.2 The plasma torch is cleaned using concentrated HNO_3 when torch and sample injector buildup is noted.

6.3.1.3 The spray chamber and nebulizer are replaced approximately every month as needed.

6.3.1.4 Air filters are cleaned once every two weeks or as needed upon visual inspection.

6.3.1.5 The RF coil, window and cone are cleaned every 2-3 weeks.

6.3.1.6 Once every 6 months the instrument undergoes extensive maintenance by a manufacturer's service engineer.

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6.3.2 Troubleshooting:

6.3.2.1 Sudden drop in QC check (CCV) concentration occurs in a run:

6.3.2.1.1 Check to see that sample introduction system (tubing) has not become disconnected.

6.3.2.1.2 Check to see if a clog has occurred in the sample introduction system.

6.3.2.1.3 Check QC Check Standard to ensure it is not empty.

6.3.2.1.4 Check room temperature to see if a fluctuation has occurred.

6.3.2.1.5 Recalibrate and rerun if necessary.

6.3.2.2 CCVs drift up and down:

6.3.2.2.1 Remake the CCV standard.

6.3.2.2.2 Check room temperature to see if a fluctuation has occurred.

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6.3.2.2.3 If problem persists, call Perkin-Elmer. The problem is usually indicative of a power tube failure.

6.3.2.3 Plasma goes out during analysis:

6.3.2.3.1 Sample is not reaching spray chamber (tubing came apart or there is a clog)

6.3.2.3.2 High levels of salt in the sample caused plasma temperature changes.

6.3.2.3.3 The sample injector is coated with high salt material and needs to be changed.

6.3.2.3.4 The power tube is going (after all others fail repeatedly) and Perkin-Elmer must be called for service.

6.4 Glassware:

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6.4.1 Class A volumetric flasks: 100 ml and 50 ml.

6.4.2 Class A volumetric pipettes:

6.4.2.1 100µL adjustable Eppendorf.

6.4.2.2 5mL adjustable Fisher Scientific.

6.4.2.3 100µL, 500µL, and 1mL fixed Wheaton.

7. Reagents

7.1 All standard solutions (multi-, and single element), and second source QC solutions are purchased from outside vendors (Perkin-Elmer, Inorganic Ventures, ERA, and High Purity Standards, Inc.). All these solutions are traceable and meet with Mitkem's high purity requirements.

7.2 Hydrochloric acid (conc.), HCl, Trace Grade, Fisher Scientific.

7.3 Nitric acid (conc.), HNO_3, Trace Grade, Fisher Scientific.

7.4 Reagent water (ASTM Type II water). Mitkem's Type II water system consists of a Culligan high volume, 1 Megohm feed water system, combined with a Millipore Milli-Q, four bowl, high purity system. Type II water is also referred to as DI water.

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7.5 Mixed calibration standard solutions. Mixed calibration standards, obtained from High Purity Standards, come in three stock solutions:

7.5.1 CLP CAL 1 consists of two solutions:

7.5.1.1 CLP CAL 1B contains silver only.

7.5.1.2 CLP CAL 1A contains all other elements other than antimony, arsenic, cadmium, lead, thallium, and selenium.

7.5.2 CLP CAL 2 contains antimony only.

7.5.3 CLP CAL 3 contains arsenic, cadmium, lead, thallium, and selenium.

7.5.4 Calibration standards and QC solution are made up on a daily basis:

7.5.4.1 High standard (ICP Standard 1):

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7.5.4.1.1 Pipet 1mL HNO_3 (conc) and 2.0mL HCl (conc) into a 50mL volumetric flask.

7.5.4.1.2 Pipet 0.5mL each of CLP CAL 1A & 1B stock solution and 0.05mL each of intermediate CLP CAL 2 and 3 into the flask.

7.5.4.1.3 Pipet 0.05mL of Titanium single element standard into the flask.

7.5.4.1.4 Bring to volume with DI water.

7.5.4.1.5 Label as IWyymmdd# where:
IW = Inorganic working standard
yy = year of preparation
mm = month of preparation
dd = date of preparation and
# = letter used to designate which working standard was prepared on this date.

7.5.4.1.6 Calibration standards are prepared fresh daily. All standards made from a primary standard expire on or before the primary standard's expiration date.

See **Table 1** for analytes and concentrations.

7.5.4.2 Second (middle) standard (ICP Standard 2):

7.5.3.2.1 Pipet 5mL of a 1% HNO_3 and 1.5% HCl acid mixture into a sample tube.

7.5.3.2.2 Pipet 5mL of the first ICP working standard. Mix and label by the scheme discussed in **7.5.4.1.4**.

7.5.4.3 Third (low) standard (ICP standard 3):

7.5.3.3.1 Pipet 10mL of 1% HNO_3 and 1.5% HCl solution into a sample tube.

7.5.3.3.2 Withdraw 100µL.

7.5.3.3.3 Add 100µL of ICP Standard 1 and mix well. Label by the scheme discussed in **7.5.4.1.4**.

7.5.3.3.4 Calibration standards are prepared fresh daily.

See **Table 1** for analytes and concentrations.

7.5.5 Second source QC standards (QCP-CICV-1, -2, -3) are obtained from Inorganic Ventures, Inc.

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7.5.5.1 The QCP-CICV 1 solution is used as prepared by the manufacturer.

7.5.5.2 The QCP-CICV 2 solution is used as prepared by the manufacturer.

7.5.5.3 The QCP-CICV 3 solution is used as prepared by the manufacturer.

7.5.6 Calibration Verification (ICV/CCV) solution:

7.5.6.1 Pipet 1mL of HNO_3 (conc.) and 2.0mL HCl into a 50mL volumetric flask.

7.5.6.2 Pipet 0.5mL of QCP-CICV-1 stock solution into the flask.

7.5.6.3 Pipet 0.05mL of QCP-CICV-2 stock solution into the flask.

7.5.6.4 Pipet 0.05mL of QCP-CICV-3 stock solution into the flask.

7.5.6.5 Bring to volume with DI water.

7.5.6.6 Transfer the solution to a 50mL plastic ICP tube.

7.5.6.7 Label using the same scheme as discussed in **7.5.4.1.4**.

7.5.6.8 This standard is prepared as needed, usually every 1 – 2 days.

See **Table 2** for analytes and concentrations.

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7.5.7 QC Standards ICSA and ICSB solutions are obtained from High Purity Standards. In addition to the normal element composition, sodium, potassium, lead and selenium are added to the ICSAB solution. These stock solutions are also obtained from High Purity Standards.

7.5.7.1 ICSAB solution:

7.5.7.1.1 Pipet 1mL of HNO_3 (conc.) and 1.5mL HCl into a 50mL volumetric flask.

7.5.7.1.2 Pipet 0.5mL of ICSB stock solution (ANALCS-R) into the flask.

7.5.7.1.3 Pipet 5mL of ICSA (CLP-INF-1) stock solution into the flask.

7.5.7.1.4 Pipet 0.5mL of the sodium/potassium stock solution (INFCS-5) into the flask.

7.5.7.1.5 Pipet 0.5mL of 50mg/L Pb intermediate standard solution into the flask.

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7.5.7.1.5.1 The intermediate is prepared by adding 4.5mL of Pb at 1000mg/L (#100028-1) up to 100mL with 1%HNO_3 and 1.5% HCL acid solution in a volumetric flask.

7.5.7.1.5.2 The standard is labeled using the same scheme as discussed in **7.5.2.4**.

7.5.7.1.5.3 Hold time for the intermediate is 180 days.

7.5.7.1.6 Pipet 0.5mL of 45mg/L Se intermediate solution into the flask.

7.5.7.1.6.1 The Selenium intermediate standard is prepared by adding 4.5mL of Se at 1000mg/L (#031) up to 100mL with 1% HNO_3 and 1.5% HCl acid solution in a volumetric flask.

7.5.7.1.6.2 The standard is labeled using the same scheme as discussed in **7.5.2.4**.

7.5.7.1.6.3 Hold time for the intermediate is 180 days.

7.5.7.1.7 Bring to volume with DI water.

7.5.7.1.8 Transfer the solution to a 50mL plastic ICP tube.

7.5.7.1.9 Label using the same scheme as discussed in **7.5.4.1.4**.

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See **Table 3** for analytes and concentrations.

7.5.8 Laboratory control samples (LCS) and Matrix spikes

7.5.8.1 The LCS standards for soils and waters are obtained from High Purity Standards.

7.5.8.2 LCS/Spike standard 1 is prepared by adding 0.45mL of CLP-CV-1.

7.5.8.3 LCS/Spike standard 2 and 3 are prepared by adding 0.045mL each of CLP-CV-2 and CLP-CV-3.

See **Table 4** for analytes and concentrations.

All standards and solutions are documented in the Primary Standard Logbook. the Intermediate Standard Logbook, and the Working Standard Logbook.

8. Procedure

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8.1 The methods in SW-846 for sample digestion or preparation are as follows:

8.1.1 Method 3005A, SOP No.100.0003, prepares ground water and surface water samples for total recoverable and dissolved metals determination by ICP. The unfiltered or filtered sample is heated with dilute HCl and HNO_3 prior to metal determination.

8.1.2 Method 3010A, SOP No.100.0003, prepares aqueous samples, mobility-procedure extracts and waste samples that contain suspended solids for total metal determination by ICP. The samples are vigorously digested with nitric acid followed by dilution with hydrochloric acid.

8.1.3 Method 3050B, SOP No.100.0104, prepares solid waste samples for total metals determination by ICP. The samples are vigorously digested in nitric acid and hydrochloric acid.

8.2 The wavelengths and background correction locations in the reference method can be substituted if they can provide the needed sensitivity and are corrected for spectral interferences. The analyst should follow the instrument manufacturer's instructions, and if possible, approximate the recommended ~~(whose?)~~ operating conditions.

For each analyte there are a number of possible wavelengths at which analyses could be made. The wavelengths used were selected based on consultations with the ICP specialists at Perkin-Elmer and our own experience.
Background **correction factors** are obtained by aspirating a concentrated solution, usually about 200-500ppm, of the interfering element, and measuring the resulting

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concentrations at the wavelength used. The background correction factors for that interfering element is obtained by dividing the measured concentrations by the actual concentration. For example: by aspirating a 500ppm solution of aluminum, one measures a cadmium concentration 0f 0.010ppm. The aluminum correction factor for cadmium is (0.010)/500 = 0.000020. This means that if the aluminum concentration in a sample is, say, 120ppm, one must subtract 120*0.000020 = 0.0024ppm from the measured cadmium concentration in that sample.

Correction factors are established for the major salts: aluminum, calcium, iron, magnesium, and also for chromium, copper, manganese, nickel, thallium, titanium and vanadium.

See **Table 5** for an example of an IEC table.

Linear ranges are established as follows:

Following instrument calibration, solutions with varying concentrations of each analyte are analyzed. The highest concentration whose found value is within ±5% of the true value, established the linear range. These are established quarterly.

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Instrument detection limits (IDLs) are established twice a year. Seven solutions with a concentration of approximately 3-5x the IDL are analyzed on three non-consecutive days. The IDL for a particular element is three times the standard deviation of the measured concentration for that element.

Method detection limits (MDLs) are established once a year. The MDL is obtained by multiplying the standard deviation of seven analyses by the appropriate one-sided 99% t-statistic. The value of this statistic equals 3.143 if the number of analyses is seven. The concentration of the analyte in the analyzed solution should be between three to five times the calculated MDL. Less than 50% of the MDLs may exceed this requirement provided the concentration of the analyte in the analyzed solution is between one to ten times the calculated MDL. Hence:

MDL = 3.143 * (standard deviation of seven analyses)

MDLs and Reporting Limits (RLs) are presented in **Table 6**.

8.3 Allow the plasma to become thermally stable before beginning the analyses. This usually requires at least 45 minutes. If the plasma is (for whatever reason) extinguished and needs to be re-lit, subsequent re-stabilization of the plasma takes only 15 minutes provided the plasma is re-lit immediately after it is extinguished.

The nebulizer flow rate used is constant for all aqueous sample extracts and needs not be reset prior to analysis.

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One additional daily check needs to be performed before start of analyses. Note and record the emission count for the high lead standard. This emission is monitored to determine how the instrument is functioning. A steady downward drift in the daily lead emission counts should alert the analyst and the instrument setup should be checked. If no obvious adjustments can be made (such as replacement of tubing, cleaning of sample intake) a complete instrument check should be scheduled with Perkin-Elmer service.

8.4 The instrument operating conditions finally selected as being optimum should provide the lowest reliable instrument detection limits. The calibration curve ~~should~~ consists of a blank and at least 3 calibration standards (see Section 7.5). ~~Flush the system with the calibration blank between each standard.~~ The lowest standard must be at a concentration ~~equal to or less than the MRL~~approximately 3x the MDL (for USACE this is the MQL; for AFCEE this is the RL). This low concentration is equal to or less than the reporting limit. Sample concentrations less than the lowest standard can only be reported after method modifications have taken place. The highest concentration must be within the instrument's linear dynamic range. The standards are run in a sequence from high concentration to low concentration.

The minimum correlation coefficient for the calibration curve is 0.995. If a correlation coefficient less than 0.995 is obtained, the calibration must be repeated. The highest standard is then analyzed as a check sample. Recoveries ~~should~~ must be ± 10% of the true values or the calibration must be repeated.

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8.5 Immediately following the calibration check standard, linear range standards are analyzed. The recovery for each analyte must be within 10 percent of the true value. These standards establish the upper calibration range for the analytical sequence. Sample concentrations exceeding this analytical linear range must be diluted and reanalyzed for each analyte that applies.

8.6 An ICV (Initial Calibration Verification Sample of an independent source from the calibration standards) precedes the analysis of the samples. Recovery limits for the ICV are ± 10% of the true value. If the ICV recoveries do not meet acceptance criteria, corrective action must be taken and the calibration must be repeated. Immediately following the ICV, an ICB (Initial Calibration Blank) ~~and~~ is analyzed. A CCV (Continuing Calibration Verification Sample) is analyzed after at least every tenth sample and at the end of the sample run. Recovery limits for the CCV are ±10% and in the case of failure for a particular element, all samples following the last acceptable ICV or CCV must be reanalyzed ~~.~~ for that element. An ICV or CCV can be reanalyzed only once.

8.7 The ICB is analyzed after the ICV and is of the same source as the calibration blank. The CCB (Continuing Calibration Blank) is analyzed after each CCV. Concentrations of the analytes detected must not exceed the MRL ~~MRL~~or corrective action must be taken.

USACE: the absolute value of the ICB and CCB must be < 2x MDL.

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AFCEE: ICB and CCB must be < AFCEE RL.

8.7 The ICS (ICSA and ICSAB) standards must be run at the beginning, every 8 hours and at the end of each analytical run.

8.7.1 The ICSA solution, containing the Al, Ca and Mg at 500mg/L, and Fe at 200mg/L, must be run at all wavelengths used for each analyte reported. The analytical results for those target analytes with MRLs ≤ 10ug/L shall fall within ± 2x MRL of the analyte's true value (the true value shall be zero unless otherwise stated). If the results for these analytes fall outside the ± 2x MRL window, check that the background correction factors are appropriate, and readjust if necessary. Recalibration may be necessary. For analytes with a MRL > 10 ug/L, the ICSA results shall fall with ± one MRL of the analytes true value (0).

8.7.2 The ICSAB contains Al, Ca, Mg and Fe at the same concentrations as the ICSA as well as all other analytes of interest. Recovery limits for the ICSAB must be within ± 20% of the true value. If the ICSAB recoveries do not meet acceptance criteria, corrective action must be taken. Check that the background correction factors are appropriate, and readjust if necessary. Recalibration may be necessary. If the ICSAB at the end of an analytical sequence falls for a particular element, all samples must be reanalyzed for that element.

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8.8 After completion of the initial requirements of this method, samples should be analyzed in the same operational manner used in the calibration routine.; ~~with~~ A 60 second rinse ~~blanks also being used~~ (rinse solution: 1% HNO_3 and 1.5% HCl) is conducted between all sample solutions, ~~LCS~~quality control samples, method blanks, and check solutions. Samples that exceed the linear calibration must be diluted and reanalyzed.

Analytical Sequence: The following QC protocol should be employed.

Blank
1. Standard #1
2. Standard #2
3. Standard #3
4. Check Standard (high standard) run as a sample
5. Linear range standards to establish the linearity of each analyte for this run
6. ICV
7. ICB
8. ICSA
9. ICSAB
10. Sample 1
11. *

US EPA ARCHIVE DOCUMENT

12. *
13. *
14. *
15. *
16. *
17. Sample 8
18. CCV
19. CCB
20. Sample 9
21. *
22. *
23. *
24. *
25. Sample 14
26. ICSA
27. ICSAB
28. CCV
29. CCB

Note: The ICSA and ICSAB sample counts as analytical samples between CCV/CCBs.

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8.9 Any deviations ~~must be approved by the Inorganic Laboratory Manager or the Operations Manager before they can be implemented.~~

All analyses are documented in the Instrument Run Log.

9. Data Reduction and Calculations

9.1 Sample data should be reported in units of mg/L for aqueous samples and mg/Kg dry weight for solid samples. Results are reported to two or three significant figures.

~~9.2~~ For dissolved aqueous analytes report the data generated directly from the instrument with allowance for sample dilution. Do not report analyte concentrations below the reporting limit ~~M~~(RL) unless specifically requested by the client.

9.3 Soil concentrations ~~is~~are calculated using the equation below:

$$\text{Sample Conc. (mg/Kg)} = \frac{C \times V \times D}{W}$$

~~Dry weight basis~~

Where: C = Concentration in extract (µg/L)
V = Volume of extract (L, 100mL = 0.1L)
D = Dilution factor (undiluted =1)
W= Dry weight of sample aliquot extracted (g)

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[MReporting Limits are occasionally Mfor dilutions made on analytes over their linear range.]

9.4 Recovery Calculations:

The recovery of a spiked analyte is to be calculated as follows:

% Recovery (%R) = 100 x (SSR-SR)/(SA)

where: SSR = spiked sample result
SR = sample concentration
SA = spike added

9.5 Relative Percent Difference Calculations:

The relative percent difference (RPD) between replicate determinations is calculated as follows:

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

RPD = (D1-D2) / (D1+D2)/2 x 100

where: RPD = relative percent difference
D1 = first sample value
D2 = second sample value (replicate)

10. Quality Assurance/Quality Control

10.1 Personnel - Use of this method is restricted to analysts who are knowledgeable in the operation of this instrumentation and have performed a proficiency test with acceptable accuracy and precision results.

10.2 Method blanks - A preparation blank is prepped and analyzed with every batch not to exceed 20 samples. Corrective action for method blank contamination involves determining the source of the contamination and re-prepping the entire batch.

USACE - The absolute value of method blank concentration must be less than 2x MDL unless the sample concentration is at least 20 times higher than the blank concentration

AFCEE - Method blank concentrations must be less than the AFCEE RLs.

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NAVY (NFESC)-Method blank concentrations must be less than or equal to one-half the reporting limit.

10.3. Calibration verification - An ICV analyzed immediately after standards ~~will~~must be within 90 -110% of the true value. The ICV is an independent source purchased from a different vendor than the calibration standards. The CCV is of identical source as the ICV and is analyzed a minimum of every 10 samples in the analysis and at the end of the analytical sequence. ~~Both t~~The ICV and CCV analyses are followed~~preceded~~ by the ICB/ and CCB analyses, respectively. The ICV and CCV must pass the 90-110% criteria or be re-analyzed. If the closing CCV does not meet the criteria, the CCV and all analyses from the opening CCV must be re-analyzed after the problem has been eliminated.

10.4 Matrix spike (MS) samples - A matrix spike is processed with each batch of samples. Spike recoveries must be within 75-125% of the expected value. If the spike recovery falls outside this range a post-digestion spike is analyzed if the sample result does not exceed 4x the spike added.

For USACE and AFCEE work a matrix spike and spike duplicate are prepared and spiked with standards at a level less than one half the concentration of the highest calibration standard. (See Attachment 4 for spiking concentrations.)

USACE: Spike recoveries must be within 80-120% for water and 75-125% for soil. Precision requirements are ≤ 20 % Relative Percent Difference (RPD) for water and ≤ 35 % RPD for soil. [Unless superceded by project requirements, it is not necessary to spike Na, K, Ca, and Mg for waters; or Na, K, Ca, Mg, Fe, Mn, and Al for soils.] Evaluate matrix spike results in conjunction with post-digestion spike recoveries - see below.

AFCEE: Spike recoveries must be within 80-120%. Precision requirements are ≤ 15 % Relative Percent Difference (RPD) for water and ≤ 25 % RPD for soil. There is no corrective action for MS recoveries outside the acceptance range other than data qualification.

10.5 Matrix duplicate (MD) and matrix spike duplicate (MSD) samples - Duplicates are prepped and analyzed with every batch not to exceed 20 samples. Relative Percent Difference (RPD) is calculated for the results of duplicate samples.

A control limit of 20% RPD shall be used for sample values greater than 5x the MRL.

A control limit of (±) the MRL level must be used if either the sample or the duplicate value is less than 5x MRL.

If one result is above 5x MRL and one below, use the ± MRL criteria.

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If both values are below the MRL, no RPD is calculated.

USACE - For MDs, evaluate precision for all detected concentrations greater than the low-level calibration standard. For MSs, evaluated precision when the spiked sample concentration is at least 2x the native analyte concentration. The acceptance criteria are 20% RPD for water samples and 35% for soil samples. If the RPD>25%, reanalyze the MD or MS. Calculate the %RSD for the set of three analyses. If the %RSD is >15%, a matrix interference is suspected.

AFCEE - MD precision is evaluated for all analytes. Precision requirements are ≤ 15 % RPD for water and ≤ 25 % RPD for soil. There is no corrective action for MS/MD precision outside the acceptance range other than data qualification.

10.6 ~~A~~ Laboratory Control Sample (LCS) - is prepped with a minimum of every 20 samples of the same matrix. For an aqueous LCS sample, mixed standards are spiked into a beaker of DI water resulting in concentrations approximately ½ the concentration of the high calibration standard and prepped as an aqueous sample. Recoveries must be within the established control limits. The ID of the aqueous LCS sample is LCSW.

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For soils, a small amount (5mL) of DI is poured in a beaker and spiked with standards at the mid-point of the calibration curve. The LCS is then prepped as a soil. The ID for the solid LCS sample is LCSS.

For AFCEE, the LCS associated with a soil batch consists of 1 ml of DI water that is spiked at a level equivalent to the water LCS and is prepared as a soil sample.

USACE - Water LCS samples may be used for soil batches. Acceptance ranges for LCS recoveries are 80-120% for water and 75-125% if a soil LCS is used.

AFCEE – DI water is spiked for soil batches. The acceptance range for both water and soil is 80-120%.

Laboratory control sample acceptance limits are based on control charts which are established at Mitkem.

10.7 ~~Serial~~ dDilution test (Serial Dilution) - is performed once per analytical run or if an unusual matrix is present. If the analyte concentration is sufficiently high (minimally, a factor of 10 above the MDL, an analysis of a 1:5 dilution should agree within ±10% of the original determination. If not, a chemical or physical interference effect should be suspected and a post-digestion spike addition is performed.

USACE - Only analytes at least 50x the MDL in the original sample can be evaluated using the dilution test.

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10.8 Post digestion spike (PDS) addition: - An analyte spike added to a portion of a prepared sample, or its dilution, at a minimum level of 10x the MDL and a maximum of 100x the MDL. ~~should be recovered to within 75% to 125% of the known value. The spike addition level is 2Xx the sample concentration or 2Xx the MRL, whichever is greater.~~ PDS is spiked at the same concentrations as the matrix spike. -If the spike is not recovered within the specified limits, a matrix effect should be suspected.

USACE - Run a PDS with each batch of samples (PDS spiking of the same sample as used for matrix spiking is recommended) or when a new or unusual matrix is encountered within a batch; or when the dilution test fails. Acceptance criteria for PDS is 85-115%.

Corrective action is taken if the spike concentration is at least 2x the native sample concentration: (a) If the MS fails for any analyte but the PDS passes, the sample is re-digested and reanalyzed (except when low MS recovery can be explained as a historically poor performer in that matrix). (b) If the MS passes but the PDS fails, the PDS is reanalyzed. (c) If both the MS and PDS fail, the laboratory must make a reasonable effort to address the matrix interference and perform method of standard additions (MSA), internal standard addition, or use of a different procedure.

AFCEE - PDS should be analyzed whenever the dilution test fails. Spiked analytes should be recovered to within 75% to 125% of the known value. If acceptance criteria are not met, correct the problem and reanalyze the PDS sample.

11. Data Validation and Reporting

11.1 All raw data, including calibrations, QC results, and sample results, are peer reviewed for technical accuracy and completeness. Sample preparation logs, notebooks, and instrument logs are reviewed and signed daily by the supervisor. The laboratory manager reviews 100% of the data prior to report generation. The QA Director randomly reviews 10% of the data reported by the laboratory. Refer to Section 11 of the QAP for details.

11.2 Reports are generated by the reporting group. The data submitted for report preparation is dependent on project requirements.

11.3 Electronic files are validated by the analyst and transferred to the report generation group via the LAN.

12. Corrective Action Procedures

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12.1 Corrective action to be implemented in the event QC results are outside of the acceptance range are covered in Section 10. QC corrective action tables for the USACE and AFCEE are presented in Attachment 5.

12.2 Corrective action reports (CARs) are generated in the event of an out-of-control situation that cannot be corrected by the analyst. The procedure for submitting a CAR for the purpose of identifying the appropriate corrective action is covered in SOP No. Q07.

13. Health and Safety

13.1. The toxicity or carcinogenicity of each reagent used in the method has not been fully established. However, Eeach chemical should be regarded as a potential health hazard, and exposure to these compounds should be as low as reasonably achievable. A reference file of material safety data ~~handling~~ sheets (MSDS) is available to all laboratory personnel at the Safety Officer's desk. In addition, laboratory personnel should follow the precautions outlined in the laboratory's Chemical Hygiene Plan.

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In general, use gloves, a lab coat, and goggles when handling these reagents and work in a hood whenever possible.

Concentrated nitric and hydrochloric acids are moderately toxic and extremely irritating to skin and mucus membranes. Always wear safety ~~goggles~~glasses or a face shield for eye protection when working with acids. If eye or skin contact occurs, flush with large volumes of water.

Many metal salts are extremely toxic if inhaled or swallowed. Use good housekeeping practices in areas where metal salts are being used and wash hands thoroughly after handling.

13.2. Inductively coupled plasma sources emit radio frequency radiation and intense UV radiation.

13.3. Basic good housekeeping practices such as the wiping up of spills immediately and regular cleaning of counters and hoods, will help reduce the potential for cross-contamination and create a safe working environment.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's Quality Assurance Plan.

15. References

14.1 Fassel, V.A. et al. Simultaneous Determination of wear metals in lubricating oils by Inductively-Coupled Plasma Atomic Emission Spectrometry . Anal. Chem. 48: 516-519, 1976.

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Attachments:

1. **Figure 1**: Analytes and Concentrations of Calibration Standards.
2. **Figure 2**: Analytes and Concentrations of ICV Standard.
3. **Figure 3**: Analytes and Concentrations of ICSAB Standard.
4. **Figure 4**: Analytes and Concentrations of the LCS and Matrix Spike.

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Figure 1
Analytes and concentrations of Calibration Standards

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Figure 2
Analytes and concentrations of ICV Standard

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Figure 3
Analytes and concentrations of ICSAB Standard

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Figure 4
Analytes and concentrations of the LCS and Matrix Spike

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MITKEM CORPORATION

STANDARD OPERATING PROCEDURES

for

Mercury Analysis in Aqueous and Soil Samples by Flow Injection Mercury System (FIMS) for Atomic Absorption

by

SW846 Method 7470A/7471A

Rev. 6

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	Signature	Date
QA Director:	_____	_____
Lab Director:	_____	_____

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MITKEM CORPORATION

STANDARD OPERATING PROCEDURE

for

Mercury Analysis in Aqueous and Soil Samples by Flow Injection Analysis System for Atomic Analysis

by

SW846 Method 7470Aand 7471A

Rev. 6

1. Scope and Application

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This SOP describes the procedures applicable to the preparation and analysis of mercury in aqueous and soil samples. Matrices include ground waters, aqueous samples, soils, sediments, sludges, and TCLP. All samples require digestion prior to analysis. The Minimum Reporting limit (MRL) for mercury in aqueous samples is 0.0003 mg/L and for soils is 0.1mg/Kg.

AFCEE – The reporting limit (i.e. MRL) for mercury in water is 0.001 mg/L.

2. Personnel Qualifications and Responsibilities

Personnel must be qualified according to the requirements of their job descriptions and trained for this procedure prior to analyzing samples. **Analysts and technicians** are responsible for performing analyses in accordance with the SOP and documenting any variations in the protocol. **Supervisors/Managers** are responsible for ensuring that SOPs are accurate and up-to-date, and that they are implemented appropriately. **Supervisors/Managers** review the logbooks and data generated from this procedure and approve all reported results.

3. Summary of Procedure

3.1 The aqueous samples are digested with concentrated HNO_3, concentrated H_2SO_4, potassium permanganate and potassium persulfate at 95°C. The procedure converts various organically bound compounds and inorganic forms of mercury into mercuric ions, which can be analyzed with a Flow Injection Analysis System (FIAS) for atomic spectroscopy. The soil/sediment samples are digested using aqua regia and potassium permanganate at 95^0C and analyzed same as the aqueous samples.

3.2 The mercury ions formed during the digestion step are reduced to the elemental state and aerated into an absorption cell. Absorbance is measured at 253.7nm and is a function of mercury concentration.

4. Sample Preservation, Containers, Handling and Storage

4.1 Samples are collected by the client and submitted for analysis in pre-cleaned sample containers provided by the laboratory. For mercury analysis by method 7470A water samples are collected in one-liter plastic containers and preserved (acidified) with nitric acid to a pH of less than 2. Sample volume requirements depend upon the number of different preparation procedures necessary for the analyses requested. Additional sample volume may also be required for the analysis of laboratory QC samples.

4.2 All samples are stored at room temperature until analyzed.

4.3 Sample hold time for mercury analysis by methods 7470A and 7471A is 28 days from date of sample collection.

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5. Interferences and Potential Problems

5.1 Sulfides at levels above 20 mg/L or 20mg/Kg interfere.

5.2 Copper at levels above 10 mg/L or 10mg/Kg interfere.

5.3 Seawaters, brines and industrial effluents high in chlorides interfere and require additional potassium permanganate for conversion to free chlorine. Free chlorine also absorbs radiation at 253.7nm. Therefore, the free chlorine is removed by addition of hydroxylamine sulfate reagent. In addition, the dead air space in the BOD bottle must be purged before adding the stannous sulfate.

5.4 Some volatile organic materials absorb at 253.7nm and may interfere.

6. Equipment and Apparatus

Equipment and instrumentation used in this analysis method include:

6.1 Equipment:

6.1.1 Perkin-Elmer FIMS 100.

6.1.2 HP Jet Printer.

6.1.3 Wheaton BOD bottles.

6.1.4 Top loading balance - capable of accurate measurement to 0.01gram.

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6.1.7 Water bath –maintained at a temperature of 90 – 95^{0}C.

6.2 Preventative Maintenance:

6.2.1 Pump tubing is replaced every 48 hours of instrument run time.

6.2.2 The windows of the optical cell are cleaned whenever the cell is replaced.

6.2.3 The inside of the optical cell is cleaned once every 48 hours of instrument run time.

6.3 Troubleshooting - Refer to the FIMS manual.

6.4 Glassware

6.4.1 100mL Class "A" volumetric flasks.

6.4.2 Class "A" volumetric pipettes ranging from 10µL to 1.0mL.

6.4.3 250mL Class "A" graduated cylinder or equivalent.

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7. Reagents

7.1 Sulfuric Acid: Ultra Trace Grade

7.2 Nitric Acid: Ultra Trace Grade

7.3 Reagent Water (ASTM Type II water):
Prepared by passing distilled water through a mixed bed of cation and anion exchange resin.

7.4 Stannous chloride solution:
15 g $SnCl_2$ to 1000mLs of 3% HCl solution.

7.5 Sodium chloride-hydroxylamine sulfate solution:
12 g NaCl and 12g hydroxylamine sulfate to 100mLs of reagent water.

7.6 5% Potassium permanganate solution:
Dissolve 50g of $KMnO_4$ in 1000mLs of DI H_2O.

7.7 5% Potassium persulfate solution:
Dissolve 50g of $K_2S_2O_8$ in 1000mL of DI H_2O.

7.8 Stock mercury solution:
1000 mg/L purchased commercially.

7.9 Stock mercury solution:

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1000 mg/L (independent source) purchase commercially.

7.10 Mercury standards are stored in cupboards. Expiration dates for the standards are either the date one year from date of receipt or that designated by the manufacturer whichever comes first. Reagents and intermediate standards have a 28-day hold time.

7.11 3% HCl:
30mL concentrated HCl diluted to 1L with DI H_2O.

7.12 HCl: conc., Ultra Trace grade.

7.13 Aqua Regia: prepare immediately before use by carefully adding three volumes of conc. HCl to one volume HNO_3.

8. Procedure

8.1 Transfer 100mL of sample or an aliquot diluted to 100mL to a reagent water-rinsed BOD bottle. Add 5mL concentrated H_2SO_4 and 2.5mL concentrated HNO_3; mix. Add 15mL of potassium permanganate solution. Additional permanganate may be required until the purple color persists for at least 15 minutes. Add 8mL potassium persulfate solution; mix. Heat for 2 hours at 95°C in a water bath.

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8.2 Cool samples and add 6mLs sodium chloride-hydroxylamine sulfate solution in section **7.5 (in hood)**; mix. With a Class A 250mL graduated cylinder, measure the final volume of the sample and record in the prep logbook. Immediately prepare for analysis.

8.3 See SOP 110.0039 for sub-sampling techniques. Soil samples: weigh a 0.60 – 0.75g portion of untreated sample and place in the bottom of a BOD bottle. Add 5mLs of reagent water and 5mLs of aqua regia. Heat 2 minutes in a water bath at 95°C. Cool; then add 50mLs reagent water and 15mLs of the potassium permanganate solution to each sample bottle. Mix thoroughly and place in the water bath for 30 minutes at 95°C. Cool and add 6mLs of the sodium chloride – hydroxylamine sulfate solution to reduce the excess permanganate. **CAUTION**: do this addition under the hood, Cl_2 could be evolved. Volumize with reagent water to 100mLs. Pour an aliquot into a polyethylene tube for analysis. Be careful to avoid pouring the sediment into the tube.

A single sub-sample is prepared rather than triplicate portions as the sample is sufficiently homogenized in order to obtain a representative subsample. This subsample weighs 0.60-0.75g rather than weighing 3 separate 0.20-0.25g portions.

8.4 Calibration standards are prepared from a mercury intermediate standard at 500µg/L. The intermediate is prepared by pipetting 50µL of 1000mg/L Primary standard into a 100mL volumetric flask. Bring up to volume with 3% HCl in section **7.11**.

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Label standard as IIyymmdd#, where:
II = Inorganic Intermediate
yy = year of preparation
mm = month of preparation
dd = day of preparation and
# = numerical sequence of intermediate standards prepped on this day.

The intermediate standard is stable for 28 days. All standard preparation information is documented in the Metals Primary Standard Receipt Logbook, and in the Inorganic Working Standard Logbook.

All standards made from a primary standard expire on or before the primary standard's expiration date.

Into BOD bottles containing approximately 50mL of DI H_2O, pipet the following volumes of intermediate standard in order to achieve the following corresponding final concentrations:

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Volume	Concentration (µg/L Hg)
40µL	0.2
200µL	1.0
400µL	2.0
1mL	5.0
2mL	10.0

Calibration standards are prepped with each daily batch of samples and undergo a digestion of at least 30 minutes. Standards are volumized to 100mL with DI H_2O prior to analysis.

Sample concentrations are not reported below the lowest calibration standard of 0.2ug/L without method modification. This effectively becomes the method reporting limit.

8.5 ICV/CCV standards are prepared at 5.0µg/L from an independent source Hg standard. An intermediate Hg CCV standard is prepared by pipetting 50µL of 1000mg/L Hg into a 100mL volumetric flask. The standard is brought to volume with 3%HCl in section **7.11**.

Final concentration is 5µg/L and the standard is labeled as for mercury intermediate calibration standard.

The intermediate standard is stable for 28 days.

8.6 The CCV is prepared by pipetting 1mL of the intermediate into 50mLs of DI H_2O in a BOD bottle. The CCV is digested for at least 30 minutes and is volumized to

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100mLs with DI H_2O prior to analysis. A CCV is prepped with each daily batch of samples.

8.7 LCSW/Matrix spike standard is also an intermediate standard prepped by combining 50mL of the CCV intermediate standard and 5mL of the 3% HCl.

The standard is labeled as for Hg intermediate calibration standards.

The intermediate is good for 28 days.

1mL of the LCS/spike intermediate standard spiked into 50mLs DI H_2O and digested as an aqueous sample makes up the LCS-Water. The true value = 4.55µg/L.

To 100mL of sample, spike 1mL of the LCS/spike intermediate and digest the sample. At the time of analysis, the spike = 4.55µg/L times the sample dilution factor.

8.8 A Calibration Blank, ICB/CCB, and Prep Blanks are prepared by digestion of approximately 50mLs reagent water as described in steps **8.1** and **8.2** to a final volume of 100mL at the time of analysis.

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8.9 Adjust the argon pressure to 34psi for FIMS analysis. Turn on the FIMS system with the auto-sampler. Turn on the computer, printer. Allow the lamp to stabilize for 35-45 minutes.

8.10 Prepare the reductant solution, stannous chloride in section **7.4**, and the carrier solution, 3% HCl in section **7.11**.

8.11 Bring up the appropriate element file (Hg comm).

8.12 Set up the sample info file to coincide with the locations and sample identifications that will be analyzed in the run.

8.13 Fill out the Automated Control Window:

8.13.1 Type in a data file name.

8.13.2 Type in the name of the sample info file

8.14 Load the auto-sampler tray.

8.15 Place the carrier tubing inlet into the carrier solution, and the reductant tubing inlet in the reductant solution. The reductant solution tubing has a red tab on it, and the carrier solution a yellow tab. Remove the cap from the gas chamber and

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start the pump to ensure it is working properly. Turn off the pump and replace the cap.

8.16 On the AS-90 control window either click on "Run All" to run both standards and samples or "Calibrate" to run only the standards. If you choose only to calibrate at this time, you will need to click on "Reset Sampler" and "Run Samples" when calibration is complete. Analyze standards and samples. Samples that exceed the linear calibration must be diluted and reanalyzed.

8.17 When analysis is complete place both carrier tubing inlet and the reductant tubing inlet with the auto-sampler probe in a beaker of DI water. Allow the water to pump through the system. Continue to flush all the water through until no more bubbles appear in the waste tubing. Turn off the pump.

8.18 Turn off the FIMS unit.

8.19 No rinse between samples is necessary per manufacturer's instructions.

Analytical Sequence: The following QC protocol should be employed.

Calibration Blank
1. Standard #1
2. Standard #2
3. Standard #3
4. Standard #4
5. Standard #5
6. ICV
7. ICB
8. Method blank
9. LCS
10. Samples (≤6)
11. CCV
12. CCB
13. MS
14. Sample Duplicate
15. Serial dilution if required
16. Post digestion spike if required
17. Samples (<5)
18. CCV
19. CCB

All information including the analytical sequence is documented in the FIMS 100 Run Logbook.

9. Data Reduction and Calculations

9.1 Sample data should be reported in units of ug/L for aqueous samples. Results are reported to two significant figures.

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9.2 For dissolved aqueous analytes, report the data generated directly from the instrument with allowance for sample dilution. Do not report analyte concentrations below the reporting limit (RL) unless specifically requested by the client.

9.3 Recovery calculations - the recovery of a spiked analyte is calculated as follows:

% Recovery (%R) = 100 x (SSR-SR)/(SA)

where: SSR = spiked sample result
SR = sample concentration
SA = spike added

9.4 Relative percent difference calculations - the relative percent difference (RPD) between replicate determinations is calculated as follows:

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

where: RPD = relative percent difference
D1 = first sample value
D2 = second sample value

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10. Quality Assurance/Quality Control

10.1 Personnel - Use of this method is restricted to analysts who are knowledgeable in the operation of this instrumentation and have performed a proficiency test with acceptable accuracy and precision results.

USACE - MDL check samples are analyzed annually after the new MDLs have been established.

10.2 Linear correlation for the standard curve is to be no less than 0.995.

10.3 Method blanks - A preparation blank is prepped and analyzed with every batch not to exceed 20 samples. The mercury value of the prep blank is not to exceed the MRL. Corrective action for method blank contamination involves determining the source of the contamination and re-prepping the entire batch.

USACE - The absolute value of the method blank concentration must be less than the 2x MDL, unless the sample concentration is at least 20 times higher than the blank concentration.

AFCEE - Method blank concentrations must be less than the AFCEE RL of 0.001 mg/L.
Navy NFESC-Method blank concentrations must be less than or equal to the RL.

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10.4 Calibration verification - An ICV prepped with the corresponding samples is analyzed immediately after the curve and must be within 90-110% of the true value. The ICV concentration is at the mid-level calibration standard. CCVs are analyzed at least every 10 samples with 80-120% recovery requirements.

For USACE and AFCEE work, the ICV must be from an independent source and the measured concentration must be within ± 10% of the expected value.

USACE – The ICV must be a mid-level standard concentration.

10.5 An ICB/CCB is run immediately after the ICV/CCV; mercury value is not to exceed protocols identical to those listed for the method blank.

10.6 A matrix spike and a matrix duplicate are prepped and analyzed with every batch not to exceed 20 samples. The RPD for duplicates is 20%; spike recovery control limit is 75-125%.

For USACE and AFCEE work, a matrix spike and matrix duplicate are prepared and spiked with standards at a level less than one half the concentration of the highest calibration standard or two times greater than the native concentration. The spike amount is 4.55µg/L.

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USACE – Spike recoveries must be within 80-120% for aqueous samples. Precision requirements are ≤ 20% RPD. Evaluate matrix spike results in conjunction with post-digestion spike recoveries - see 10.10.

AFCEE – Spike recoveries must be within 77-120% for aqueous samples. Precision requirements are ≤ 15% RPD. There is no corrective action for MS recoveries outside the acceptance range other than data qualification.

10.7 Laboratory Control Sample (LCS) -An LCS is prepped with a minimum of every 20 samples of the same matrix. Control limits are 80-120% of the true value for mercury. If the LCS is outside the acceptance limits, the corresponding samples are re-prepped and reanalyzed. Corrective action includes re-digestion/reanalysis for all samples and QC in the batch.

USACE – LCS recovery for mercury in aqueous samples is 80-120%.

AFCEE – LCS recovery for mercury in aqueous samples is 77-120%.

10.8 Dilution test (serial dilution) - A dilution test is performed once for each analytical run or if a unique sample matrix is encountered. If the analyte concentration is at least 25 times the MDL, an analysis of a 1:5 dilution should agree within ±10% of the original determination. If not, a chemical or physical

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interference effect should be suspected and a post digestion spike addition is performed.

USACE - Only analytes at least 50x the MDL in the original sample can be evaluated using the dilution test.

10.9 Recovery Test/Post digestion spike (PDS) addition - An analyte spike added to a portion of a prepared sample, or its dilution, at a minimum level of 2 to 5 times the samples original concentration. If all of the samples in the batch have analyte concentrations below the MDL, spike a selected sample at 20 times the MDL. If the spike is not recovered within 85-115%, a matrix effect should be suspected.

USACE - Run a PDS with each batch of samples (PDS spiking of the same sample as used for matrix spiking is recommended) or when a new or unusual matrix is encountered within a batch; or when the dilution test fails. Acceptance criteria for PDS is 85-115%. Corrective action is taken if the spike concentration is at least 2x the native sample concentration: (a) If the MS fails but the PDS passes, the sample is redigested and reanalyzed (except when low MS recovery can be explained as a historically poor performer in that matrix). (b) If the MS passes, but the PDS fails, the PDS is reanalyzed. (c) If both the MS and PDS fail, the laboratory must make a reasonable effort to address the matrix interference and perform method of standard additions (MSA), internal standard addition, or calculate the %RSD for the set of three analyses (e.g., the sample, the first MSD, and the second MSD). If the %RSD for the set of three analyses is greater than 15%, matrix interference is confirmed.

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AFCEE - PDS should be analyzed whenever the dilution test fails. Spiked analytes should be recovered to within 85-115% of the known value. If acceptance criteria are not met, correct the problem and reanalyze the PDS sample or run MSA on all samples from batch.

10.10 Sample concentrations that exceed the highest calibration are diluted and rerun so that their concentration fall within the calibration range.

10.11 The Inorganic Laboratory Supervisor/Manager authorizes any method deviations.

11. Data Validation and Reporting

11.1 Sample preparation logs, notebooks, and instrument logs are reviewed and signed daily by the Supervisor/Lab Manager. The Supervisor/Lab Manager reviews 100% of the data prior to report generation. The QA Director randomly reviews 10% of the data reported by the laboratory. After each review, the appropriate section of the Data Review Checklist is checked off.

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11.2 Reports are generated by the reporting group. The data submitted for report preparation is dependent on project requirements.

11.3 Data is manually reported to the *PQLs*. If clients require reporting limits different from the PQLs, the reported data is flagged with an '*'.

11.4 Electronic files are generated by the Data Management Department and are stored in the server until downloaded to tapes by the server backup system.

12. Corrective Action Procedures

12.1 Corrective action to be implemented in the event QC results are outside of the acceptance range are covered in Section 10.

12.2 Discrepancy reports are generated in the event of an out-of-control situation that cannot be corrected by the analyst. The procedure for submitting a discrepancy report for the purpose of identifying the appropriate corrective action is covered in SOP No. Q07.

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13. Health and Safety

13.1 The toxicity or carcinogenicity of each reagent used in the method has not been fully established. However, each chemical should be regarded as a potential health hazard, and exposure to these compounds should be as low as reasonably achievable. A reference file of material safety data sheets (MSDS) is available to all laboratory personnel. These sheets are stored in the Health & Safety Officer's office. In addition, laboratory personnel should follow the precautions outlined in the laboratory's Chemical Hygiene Plan. In general, use gloves, a lab coat, and goggles when handling these reagents and work in a hood whenever possible.

13.2 Concentrated nitric, sulfuric and hydrochloric acids are moderately toxic and extremely irritating to skin and mucus membranes. Always wear safety goggles or a face shield for eye protection when working with acids. If eye or skin contact occurs, flush with large volumes of water.

13.3 The cell-heating compartment maintains a temperature of 100°C throughout the analysis. Care should be taken to avoid burns from the cell-heating compartment.

13.4 Basic good housekeeping practices, such as the wiping up of spills immediately and regular cleaning of counters and hoods, will help reduce the potential for cross-contamination and create a safe working environment.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

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15. References

1. U.S. Environmental Protection Agency: Test Methods for Evaluating Solid Waste, Update 3, SW-846 Methods 7470A and 7471A.

2. "Quality Assurance Project Plan," Version 2.0, Air Force Center for Environmental Excellence, January 1997 with updates.

3. "Methods Compendium for Inorganic and Organic Methods," United States Army Corps of Engineers, Appendix I, 1997.

4. "Shell for Chemical Analytical Requirements," United States Army Corps of Engineers, Appendix H, 1997.

Attachments:

Attachment 1: Data Review Checklist Form.

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Attachment 1

Data Review Checklist Form

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HEALTH AND SAFETY PLAN

Centredale Manor Restoration Project Site
North Providence, Rhode Island

Task RI-13
Lyman Mill Pond Sediment Investigation

CONTRACT NO. DACW33-01-D-0004
DELIVERY ORDER NO. 01

Submitted to:

Department of the Army
U.S. Army Corps of Engineers
New England Division

March 2005

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TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
1.1 Key Project Personnel and Organization 1-1
1.1.1 Project Manager 1-1
1.1.2 Field Operations Leader 1-1
1.1.3 Site Safety Officer 1-1
1.1.4 Regional Safety and Health Officer 1-2
1.2 Site Information and Personnel Assignments 1-3

2.0 EMERGENCY ACTION PLAN 2-1
2.1 Introduction 2-1
2.2 Pre-Emergency Planning 2-1
2.3 Emergency Recognition and Prevention 2-2
2.3.1 Recognition 2-2
2.3.2 Prevention 2-2
2.4 Safe Distances and Places of Refuge 2-2
2.5 Evacuation Routes and Procedures 2-2
2.6 Decontamination Procedures/Emergency Medical Treatment 2-3
2.7 Emergency Alerting and Action/Response Procedures 2-3
2.8 PPE and Emergency Equipment 2-3
2.9 Man Overboard Situations/Ring Buoys 2-3
2.10 Adverse Weather Conditions 2-3
2.11 Emergency Contacts 2-4
2.12 Emergency Route to Hospital 2-4

3.0 SITE BACKGROUND 3-1
3.1 Site Information 3-1
3.2 Working Project Definitions 3-1
3.2.1 Site 3-1
3.2.2 Facility 3-1

4.0 SCOPE OF WORK 4-1

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION 5-1

6.0 HAZARD ASSESSMENT 6-1
6.1 Chemical Hazards 6-1
6.1.1 Sediment Core Sampling 6-1
6.1.2 Sampling Equipment Decontamination 6-1
6.1.3 Mobilization/Demobilization 6-1
6.2 Physical Hazards 6-1
6.2.1 Heavy/Awkward Lifting 6-2
6.2.2 Inclement Weather/Ambient Temperature Extremes 6-2
6.2.3 Natural Hazards 6-2

7.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS 7-1
7.1 Introductory/Refresher/Supervisory Training 7-1
7.2 Site-Specific Training 7-1
7.3 Medical Surveillance 7-2
7.4 Hazard Communication 7-2
7.5 Bloodborne Pathogen Exposure 7-2

8.0 SPILL CONTAINMENT PROGRAM 8-1

8.1 Scope and Application 8-1
8.2 Potential Spill Areas 8-1
8.2.1 Site Drums/Containers 8-1
8.3 Leak and Spill Detection 8-1
8.4 Personnel Training and Spill Prevention 8-1
8.5 Spill Prevention and Containment Equipment 8-1
8.6 Spill Control Plan 8-2

9.0 SITE CONTROL 9-1
9.1 Exclusion Zone 9-1
9.2 Contamination Reduction Zone 9-1
9.3 Support Zone 9-1
9.4 Site Visitors 9-1
9.5 Site Security 9-2
9.6 Buddy System 9-2
9.7 Material Safety Data Sheet (MSDS) Requirements 9-2
9.8 Communication 9-2

10.0 CONFINED SPACE ENTRY 10-1

11.0 MATERIALS AND DOCUMENTATION 11-1
11.1 Materials to be Available at the Site 11-1

12.0 HASP APPROVALS 12-1

13.0 REFERENCES 13-1

TABLES

Table 1. Emergency Reference Table
Table 2. Tasks/Hazards/Control Measures Compendium
Table 3. Toxicological Information, Exposure Limits and Symptoms of Exposure

FIGURES

Figure 1. Hospital Map And Directions
Figure 2. Site Location Map
Figure 3. Site Specific Training Documentation

ATTACHMENTS

Appendix A. Medical Clearances

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) was developed to provide safe work practices and procedures for Battelle and team subcontractor personnel engaged in selected site activities to be conducted in support of sediment core sampling at the Centredale Manor Restoration Project (CMRP) Superfund site, located in North Providence, Rhode Island. This HASP was developed in accordance with the requirements established by OSHA 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" (HAZWOPER) and sections of 29 CFR 1926 "Safety and Health Regulations for Construction."

This HASP was also developed using information gathered from previous site visits and/or historical site background information regarding known or suspected chemical contaminants, and potential physical hazards associated with the proposed work and the history of the CMRP site. This HASP will be modified, as necessary, if new information becomes available. Changes to the HASP will be made with the approval of the Regional Safety and Health Officer (RSHO). Requests for modifications to the HASP will be directed to the RSHO, who will determine whether or not to make changes. The RSHO will notify the Field Operations Leader (FOL), who will then notify all affected personnel of the changes.

1.1 Key Project Personnel and Organization

This section defines responsibility for site safety and health for Battelle and team subcontractor personnel engaged in on-site activities. The specific project personnel (Project Manager and Field Operations Leader) assigned to these positions have primary responsibility for implementing on-site health and safety requirements and the RSHO and the Site Safety Officer (SSO) will be the primary points of contact for any questions.

1.1.1 Project Manager

Ms. Deirdre Dahlen has overall project management (PM) responsibilities for the project. Those responsibilities, as they relate to safety and health, include provision for developing this HASP; the necessary resources to meet requirements of this HASP; coordinating staff assignments to ensure that personnel assigned to the project meet medical and training requirements; and the means and materials necessary to resolve any safety and health issues that are identified or that develop during field activities associated with this project. Medical clearances for Battelle personnel are provided in Appendix A.

1.1.2 Field Operations Leader

Alex Mansfield is the FOL, and will be responsible for organizing, scheduling, and implementing all field activities. He is familiar with the project plans, and will be in charge of day-to-day field activities and direction of subcontractors at the site. Mr. Mansfield will be in frequent communication with the PM, and will make recommendations for any additional activities, if warranted. He will also be responsible for the maintenance of field records and documentation through the completion of sample collection activities. Mr. Mansfield will be the PM's on-site designate, vested with the authority to carry out day-to-day site operations.

1.1.3 Site Safety Officer

Mr. Alex Mansfield has been designated by the PM as SSO for the field activities in support of the site investigation. The qualifications of the SSO are as follows:

- Shall be 40-hr Hazardous Waste Operations and Emergency Response (HAZWOPER) trained;
- Shall be 8-hr Site Supervisor trained;
- Current first aid/CPR (cardio-pulmonary resuscitation) certification;

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- Thirty days or more hazardous waste field experience;
- At least 5 days Level D field experience to be an SSO at a Level D site;
- Familiar with all applicable monitoring equipment and capable of interpreting results; and
- Familiar with U.S. Department of Transportation (DOT) shipping requirements.

In addition, the person designated as SSO must be prepared to accept the following responsibilities:

- Become familiar with site history and prepare, oversee the preparation, or be intimately familiar with the site-specific HASP;
- Organize and implement site indoctrination meetings;
- Coordinate safety equipment requests with the FOL;
- Monitor compliance with the HASP;
- Assume the role of off-site coordinator during emergency response activities;
- Coordinate with the Health and Safety Department;
- Determine appropriate level of protection and answer questions regarding determination;
- Conduct and document on-site inspections of conditions as they relate to implementation of the HASP;
- Maintain the Site logbook and records; and
- Identify a Health and Safety Designee (HSD) as necessary.

The SSO is responsible for developing and implementing this HASP in accordance with the Battelle Health and Safety Program. The SSO will investigate and document all accidents, illnesses, and incidents occurring on-site. The SSO will also conduct safety briefings and site-specific training for on-site personnel. As necessary, the SSO will accompany all U.S. Environmental Protection Agency (USEPA), OSHA, or other governmental agency personnel visiting a site in response to health and safety issues. The SSO, in consultation with the RSHO, is responsible for updating and modifying this HASP as site or environmental conditions change. In the event that the SSO is not able to tend to his or her task, the RSHO or another qualified Harding ESE designee will be assigned SSO responsibilities.

1.1.4 Regional Safety and Health Officer

Mr. Gary Carlin is the Battelle RSHO. Mr. Carlin is responsible for the implementation and operation of the Battelle Health and Safety Program in the Eastern Region. Those responsibilities, as they relate to this HASP, are:

- Oversight of the development and implementation of this HASP;
- Development and presentation of training courses that meet the applicable Battelle health and safety program training requirements;
- Review of the policies and procedures and oversight of the administration of the Battelle Monitoring Program; and
- Review of all accident reports and responses as appropriate.

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1.2 Site Information and Personnel Assignments

Site Name: Centredale Manor Restoration Project (CMRP)

Address: 2072 and 2074 Smith Street (Route 44), North Providence, Rhode Island

Site Contact: Anna Krasko **Phone Number:** 617-918-1232

EPA Contact: Anna Krasko **Phone Number:** 617-918-1232

Purpose of Site Work:
Perform fieldwork to collect additional data to characterize the nature and extent of contamination in Lyman Mill Pond sediments to support of the remedial investigation and feasibility study (RI/FS).

Proposed Dates of Work:
February 2005

Battelle Personnel:	Discipline/Tasks Assigned:
Deirdre Dahlen	Project Manager (PM)
Alex Mansfield	Field Operations Manager (FOL)
Alex Mansfield	Site Safety Officer (SSO)
Gary Carlin	Regional Safety and Health Officer (RSHO)

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2.0 EMERGENCY ACTION PLAN

2.1 Introduction

This section has been developed as part of preplanning to direct and guide field personnel in the event of an emergency. As needed, site activities will be coordinated with local fire protection and emergency services prior to commencement. In the event of on-site emergencies, site personnel will be evacuated to a safe place of refuge and the appropriate emergency response agencies will be notified. Since a majority of foreseeable emergency situations will require assistance from outside emergency responders, Battelle/Team subcontractor personnel will not provide emergency response support beyond the capabilities of onsite response. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of operations, which ensures adequate emergency response time. This Emergency Action Plan, therefore, conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), and as designated in OSHA 29 CFR 1910.120(i)(1)(ii).

Battelle/Team subcontractor personnel will, through necessary services, provide the following response measures:

- Incipient stage fire fighting support and prevention;
- Incipient spill control and containment measures and prevention;
- Removal of personnel from emergency situation;
- Initial medical support for injuries or illnesses requiring only first-aid level support; and
- Site control and security measures, as necessary.

2.2 Pre-Emergency Planning

Through the initial hazard/risk assessment effort, injuries resulting from exposure to physical hazards have been designated as the most probable emergencies that could be encountered during site activities.

To minimize and eliminate these potential emergency situations, pre-emergency planning activities associated with this project include the following (which are the responsibility of the SSO and/or the FOL):

- Coordinating with local Emergency Response personnel in order to ensure that Battelle emergency action activities are compatible with existing emergency response procedures.
- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:
  - List of phone numbers for local emergency services; and
  - A logbook or sign-in log sheet identifying personnel on site.

It will be the responsibility of the Battelle FOL to ensure specific information is available and present at the site, including:

- The chain of command for emergency action; and
- Potential hazards and control measures associated with planned activities at the site, and providing methods for early recognition and prevention when possible.

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2.3 Emergency Recognition and Prevention

2.3.1 Recognition

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation is primarily relevant for physical hazards that may be associated with the proposed scope of work. However, visual observation will also play a role in detecting some chemical exposures. To adequately recognize exposures to site contaminants, site personnel must have a clear knowledge of the signs and symptoms of exposures associated with the site contaminants. This information is provided in Table 3 of this HASP. Potential site hazards, the activities that they have been associated with, and the recommended control methods are discussed in detail in Section 5.0 and 6.0 of this HASP. Additionally, early recognition of emergency situations will be supported by site surveys to eliminate situations considered predisposed to an emergency. The FOL/SSO will be responsible for performing site surveys and document them in the site Logbook. The above actions provide early recognition for potential emergency situations. However, should an incident occur, Battelle/Team Subcontractor personnel will withdraw and notify the appropriate response agencies listed in Table 1.

2.3.2 Prevention

Battelle personnel will minimize the potential for emergencies by following the Battelle Health and Safety Manual and complying with the HASP and applicable OSHA regulations.

2.4 Safe Distances and Places of Refuge

In the event that the site must be evacuated, all personnel will immediately stop activities and report to the designated safe place of refuge. Safe places of refuge will be identified prior to the commencement of site activities and will be conveyed to personnel as part of the safety meeting conducted each morning. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the Battelle/Team Subcontractor FOL/ SSO. The FOL/ SSO will take a head count at this location to account for and to confirm the location of all site personnel. Emergency response personnel will be immediately notified of any unaccounted for personnel.

2.5 Evacuation Routes and Procedures

An evacuation will occur whenever the health, safety or welfare of site workers is compromised. Specific examples of conditions that may initiate an evacuation include but are not limited to the following: severe weather conditions; the occurrence of a fire or explosion; readings on monitoring instrumentation indicate levels of contamination that are greater than instituted action levels; or personnel show signs or symptoms of overexposure to potential site contaminants. In the event of an evacuation, personnel will proceed immediately to the designated place of refuge unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to an alternate location, designated by the SSO/FOL, and remain until further notification from the FOL. Evacuation procedures will be discussed before the initiation of any work at the site. Evacuation routes from the site and safe places of refuge are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may dictate evacuation routes. As a result, assembly points will be selected and communicated to the workers during morning safety meetings relative to the site location where work is being performed.

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2.6 Decontamination Procedures/Emergency Medical Treatment

During an evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. However, it is unlikely that an evacuation would occur which would require workers to evacuate the site without first performing decontamination procedures.

2.7 Emergency Alerting and Action/Response Procedures

Battelle personnel will be working within view or earshot of each other at the CMRP site. Because of the close proximity of personnel hand signals, voice commands and air horns will be sufficient to alert site personnel of an emergency. Two-way radios may also be used to communicate between site workers.

If an emergency occurs, the following steps are to be taken:

- Initiate an evacuation by hand signals, voice commands, air horn or two-way radios. Report to the designated refuge point.
- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and as many details as possible. Once all personnel are evacuated, appropriate response procedures will be enacted to control the situation.

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL/SSO will enact the emergency notification procedures to secure additional assistance in the following manner:

- Call 911 or other emergency contacts (Table 1) and report the emergency. Give the operator the location of the emergency, the type of emergency, the number of people injured, and a brief description of what occurred. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

2.8 PPE and Emergency Equipment

A first-aid kit, eye wash units and fire extinguishers (strategically placed) will be maintained on-site and shall be immediately available for use in the event of an emergency.

2.9 Man Overboard Situations/Ring Buoys

Using a ring buoy is the first course of action in the event an individual has fallen overboard. It can be thrown to a victim in the water, and it will provide sufficient flotation to keep the individual afloat until help arrives. This device should be stowed in a location on the vessel that provides quick and ready access to sampling personnel working on deck. All personnel involved with the handling of sampling gear on deck should be aware that the most important rules to remember in a man overboard situation are to, NEVER LOSE SIGHT OF THE INDIVIDUAL IN THE WATER BY CONTINUOSLY POINTING IN THE DIRECTION OF THE VICTIM, and to inform the captain as quickly as possible. A ring buoy should be thrown to the general vicinity of the victim. Do not throw a ring buoy directly at the victim, hitting the victim with the ring buoy may cause injuries. The recovery of an individual from the water is best made by keeping the person to leeward, or to the downwind side of the vessel. In all recovery efforts, the stern should be kept away from the person in the water to avoid injury from the propeller. A boarding ladder, or other suitable means, should be available to facilitate recovery. Man overboard training and procedures will be covered by each vessel captain and the SSO with all personnel working aboard the vessels.

2.10 Adverse Weather Conditions

A weather radio will be monitored on the boat for the duration of the water-based project operations to monitor for severe weather, such as strong winds, large seas or lightning. If severe

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weather warnings are issued for the site location or surrounding county, work will cease. The boat shall not be operated when small craft advisories are in effect. The boat captain will decide when sea conditions are deemed unsafe for boat operations. However, boat operations are generally terminated when sea conditions are such that the integrity of the samples is in jeopardy or if the operation of handling sampling equipment over the side is deemed too hazardous.

2.11 Emergency Contacts

Prior to performing work at any of the sites, all personnel will be thoroughly briefed on the emergency procedures that are to be followed in the event of an accident/incident. Table 1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted on-site where it is readily available to all site personnel.

2.12 Emergency Route to Hospital

Directions to the Hospital:

Our Lady of Fatima / Saint Joseph's Hospital
200 High Service Avenue
North Providence, Rhode Island 02940

Telephone: (401) 456-3000
Emergency: (401) 456-3400

From Lyman Mill Pond, head North on Woonasquatucket Avenue. At rotary turn Right onto 44 West (Smith St.). At lights make a right onto Mineral Springs Avenue. Follow that for approximately 1.1 miles, turn right onto High Service Avenue. The hospital is approximately 0.5 miles down, on the right.

Driving time is approximately 5 minutes. Refer to Figure 1 for a map to the Hospital.

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3.0 SITE BACKGROUND

3.1 Site Information

The Centredale Manor is a multi-unit apartment complex that houses elderly and handicapped adults. It is located at 2074 Smith Street (Route 44) in Centredale, a village of North Providence, Rhode Island. This building, as well as the adjacent apartment building known as "Brook Village", is located on the property of the former Metro-Atlantic Chemical Corporation, which occupied a mill complex on the property from the 1940s to the 1970s. The Woonasquatucket River follows the west boundary of the property and the remains of a raceway for the mill complex is on the eastern boundary of the property.

Trichlorophenols were shipped to the site, where it is believed that Metro Atlantic, Inc. manufactured hexachlorophene in approximately 1965. Hexachloroxanthene (HCX) and dioxin are byproducts of this process (Archer and Crone, 2000). The New England Container Company, Inc. operated an incinerator-based drum reconditioning facility on a portion of the site from 1952 until the early 1970s. Chemical residues were believed to have been dumped or burned prior to drum reconditioning. The mill complex was destroyed by fire in the late 1970s, the apartment buildings were constructed in 1982. During construction of the apartment buildings, 400 drums and 6000 cubic yards of soil were removed from the site. Drum labels indicated that caustics, halogenated solvents, polychlorinated biphenyls (PCBs), and inks may have been contained in the drums.

Dioxin was first identified in the Woonasquatucket River in 1996 in fish collected by the U.S. EPA as part of a water quality investigation (U.S. EPA, 1996 and 1998). Since that time, elevated levels of contaminants including dioxins, furans, PCBs, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and metals have been detected in various media including soil, groundwater, sediment, surface water and biota at the site. In 1999, U.S. EPA constructed two interim soil caps in the source area and fenced contaminated areas to reduce the immediate risk from exposure to contaminated soils at the site. The site was listed on the National Priorities List (NPL) in 2000.

3.2 Working Project Definitions

This section provides definitions of the project site.

3.2.1 Site

The site is currently occupied by the Brook Village and Centredale Manor apartment complexes. The site also includes free-flowing reaches and impoundments of the Woonasquatucket River adjacent to and downstream to the former Dyerville Dam (Figure 2). Areas where sampling activities are to occur include Lyman Mill Pond.

3.2.2 Facility

The facility is the former Metro Atlantic Chemical at 2074 Smith Street, North Providence, Rhode Island. It is currently occupied by the Centredale Manor and Brook Village apartment complexes and associated parking areas.

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4.0 SCOPE OF WORK

The field activities scoped under this HASP includes the following:

- Mobilization/demobilization;
- Collection of sediment core samples from Lyman Mill Pond; and
- Disposal of Investigation Derived Waste (IDW).

Refer to the Field Sampling Plan (FSP) for more detailed information regarding all sampling activities.

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5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 2 of this section serves as the basis of the site-specific HASP and identifies the contaminants and physical hazards that are associated with each of the proposed tasks that are to be performed at the site. Table 2 may be modified in the future should additional tasks occur at the site. Table 2 details the anticipated hazards, recommended control measures, air monitoring recommendations, required personal Protective Equipment (PPE), and decontamination measures for each site task. This table and the associated control measures may be revised if the scope of work, contaminants of concern, or other conditions change.

By using the table, site personnel can determine the hazards associated with each task, the hazards present at each area of the site, and the associated control measures necessary to minimize potential exposures or injuries related to those hazards. The table also assists field team members in determining which PPE and decontamination procedures to use, based on proper air monitoring techniques, historical data, and site-specific conditions.

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6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical and physical hazards associated with the site inspection and the activities that are to be conducted as part of the scope of work. Table 3 provides information on the most common and significant substances likely to be present at the site, based on review of available data. Specifically, toxicological information, exposure limits, symptoms of exposure, and physical properties are discussed in the table. Section 6-1 provides a general list of the contaminants that are expected to be present at the site. Section 6-2 lists the physical hazards that are anticipated at the site or associated with site activities.

6.1 Chemical Hazards

The following contaminants are or may potentially be present in site sediments: dioxin, PCBs, volatile organic compounds, hexachlorophene, trichlorophenols, caustics, halogenated solvents, and inks. Site personnel may be exposed to these contaminants via ingestion and dermal absorption.

Dioxin is known to be present in sediment at concentrations above 1 ppb at some of the areas under investigation. This concentration warrants concern of dermal contact. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (e.g., sediment core sampling); non-intrusive activities will be of lesser concern to worker health.

Hazards associated with this investigation include the potential for exposure to site contaminants via dermal contact. A chemical hazard evaluation for the work activities is provided below.

6.1.1 Sediment Core Sampling

Sediment-disturbing activities present the highest exposure potential of this investigation. Exposure concerns include direct skin contact with contaminants. The physical hazards associated with these tasks are addressed in the Section 6.2 and associated task tables. Sediment core processing activities are discussed in Battelle (2005).

6.1.2 Sampling Equipment Decontamination

This task presents a low exposure potential. The primary concern for this task is dermal contact with contaminant-laden particulates as a result of decontamination activities. However, the potential for an inhalation or dermal hazard is unlikely due to the method of decontamination.

6.1.3 Mobilization/Demobilization

These tasks, which are defined in the FSP, present a low exposure potential. No exposure potential is anticipated during these activities. However, concern for potential exposure during these tasks may exist when conducting work in areas of known or suspected surface contamination. Personal protective clothing should be worn when the potential may exist for dermal exposure or potential contamination of work clothes.

6.2 Physical Hazards

The physical hazards that may be present during the performance of site activities are summarized below:

- Uneven or unstable terrain (slip, trip, and fall hazards);
- Strain/muscle pulls from heavy or awkward lifting;
- Pinch/compression points;
- Inclement weather;

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- Ambient temperature extremes (heat or cold stress);
- Natural hazards (insect/animal bites or stings, poisonous plants);
- Other physical hazards associated with site activities/ongoing operations (proximity to vehicular traffic, etc.); and

These physical activities are discussed in Table 2 as applicable to each site task. Specific discussion on some of these hazards is presented below.

6.2.1 Heavy/Awkward Lifting

During any manual handling/lifting tasks, personnel are to lift with the force of the load supported by their legs and not their backs. The correct number of personnel must be used to lift or handle awkward/heavy equipment. These procedures are to be employed to attempt to avoid back strain.

6.2.2 Inclement Weather/Ambient Temperature Extremes

In the event of inclement weather (heavy rain, thunder and lightning, etc.), work will be terminated and will not commence until conditions become safe to do so.

Ambient temperature extremes (heat or cold stress) may exist during performance of this work depending on the project schedule. Work performed when temperatures are below 50°F may result in varying levels of cold stress (frost nip, hypothermia, frost bite, etc.) depending on factors such as temperature, wind speed, and humidity; physiological factors such as metabolic rate and moisture content of the skin; and other factors such as the use of protective clothing. Work performed when ambient temperatures exceed 70°F may result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on factors similar to those present for cold stress. Staff will be made aware of symptoms of cold and heat stress during onsite safety meetings, as appropriate.

6.2.3 Natural Hazards

Given that proposed work will be conducted outdoors and sometimes in brush, marsh, and other natural areas, various animals, insects, or poisonous plants indigenous to the area may be encountered. During warm months (spring through early fall), tick-borne Lyme Disease may be a potential health hazard in the region. In general, avoidance of areas of known insect infestation or poisonous plant growth will be the preferred exposure control. Employees shall perform a visual check of themselves for parasites after exiting areas suspected of housing these vectors. In addition, individuals with known allergic reactions to insect bites and poisonous plants should notify SSO prior to engaging in activities where these hazards may be encountered.

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7.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

This section is included to specify health and safety training and medical surveillance requirements for both Battelle and team subcontractor personnel participating in site activities. Medical clearances for Battelle staff are provided in Appendix A. Battelle's sub-contractor, TG&B, has recently enrolled in an occupational health program managed by Jordon Hospital located in Plymouth, MA. Copies of TG&B's medical clearances will be maintained at Battelle and field work will not commence until that documentation is available.

7.1 Introductory/Refresher/Supervisory Training

All personnel must complete 40 hours of introductory hazardous waste operations and emergency response (HAZWOPER) training prior to performing work at the site. Additionally, Battelle/Team personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before they can be cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel. At least two personnel on each shift shall be qualified to administer first aid and CPR.

Documentation of training for Battelle personnel shall be on file at the Battelle Duxbury Operations office. Copies of certificates or other official documentation will be used to fulfill this requirement. Team subcontractor personnel shall maintain appropriate copies of their training records at their respective office.

Battelle/Team subcontractor personnel will also conduct a brief Health & Safety meeting to discuss operations planned for that day. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems encountered.

7.2 Site-Specific Training

Battelle will provide site-specific training to all team subcontractor personnel who will perform onsite work for this project. Site-specific training will also be provided to all personnel (EPA, etc.) who may enter the site to perform functions that may be directly related to site operations. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health;
- Safety, health, and other hazards present on-site;
- Use of personal protective equipment;
- Work practices to minimize risks from hazards;
- Safe use of engineering controls and equipment;
- Medical surveillance requirements;
- Signs and symptoms of overexposure;
- Contents of the Health and Safety Plan;
- Emergency response procedures (evacuation and assembly points); and
- Spill response procedures.

Site-specific documentation will be verified through the use of Figure 3. All site personnel and visitors must sign this document upon receiving site-specific training.

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7.3 Medical Surveillance

All Battelle and Team Subcontractor personnel participating in project field activities will have had a physical examination meeting the requirements of a medical surveillance program (per paragraph (f) of OSHA 29 CFR 1910.120) and shall be medically qualified to perform hazardous waste operations using the appropriate level of respiratory protection as designated by the SSO.

Documentation for medical clearance will be maintained by the Health Services Department at Battelle, Columbus, and/or respective Team Subcontractor's office, and made available, as necessary.

7.4 Hazard Communication

In 1986, OSHA began enforcing the Hazard Communication Standard (HCS) (29 CFR 1910.1200). This standard requires employers to make their associates aware of the hazards to which they may be exposed. This standard does not apply to exposures to hazardous waste. Therefore, on hazardous waste sites, the only chemicals covered by the HCS are those that Battelle or their subcontractors bring onto the site, such as for decontamination and sample preservation purposes. In 1987 when the Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) was first promulgated, most of the components of the HCS were incorporated into the new standard. Because of this, the only components of the HCS that need to be addressed separately at a hazardous waste site are labeling and MSDSs, the rest of the standard has been included in 1910.120 or is part of the overall Battelle Health and Safety Program.

MSDSs for all chemicals brought to the site will be added to the MSDS section of the Health and Safety Plan and will be reviewed by all employees and subcontractors working at the site. However, it is not anticipated that any chemicals will be brought on site as the decontamination procedures for this sampling event require soap and water only and do not include the use of solvents.

7.5 Bloodborne Pathogen Exposure

Bloodborne Pathogen Exposure (BPE) is discussed during Battelle BPE safety training, although the OSHA Bloodborne Pathogens Standard does not apply to Battelle employees because these employees are not "reasonably anticipated" to come in contact with blood or other potentially infectious materials as a result of performing their job duties.

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8.0 SPILL CONTAINMENT PROGRAM

8.1 Scope and Application

Varying quantities of wastewater (decontamination) and IDW may be generated as part of the site activities. It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment. Furthermore, it is possible that as the job progresses, that disposable PPE and other non-reusable items will be generated. IDW and other unwanted items generated during investigation activities will be containerized in 55-gallon drums. The waste profile from previous IDW testing at the site will be used to determine appropriate disposal measures in accordance with the FSP. Once all sampling efforts are completed, the waste can be removed from the staging area and disposed of in accordance with Federal, State and local regulations.

8.2 Potential Spill Areas

Potential spill areas will be monitored by visual inspection in an ongoing attempt to prevent and control further potential contamination of the environment. The areas vulnerable to this hazard include the central staging area and decontamination area.

8.2.1 Site Drums/Containers

All drums/containers used for containing soils and liquids will be sealed, labeled, and staged within a centralized area awaiting shipment or disposal.

8.3 Leak and Spill Detection

To establish an early detection of potential spills or leaks, a walk around of the day's investigation area will be conducted by the SSO at the beginning and end of the working day to visually determine that containers are not leaking. If a leak is detected, the first approach will be to transfer the container contents into a new container. Other provisions for the transfer of container contents will be made and the appropriate emergency contacts will be notified, if necessary. In most instances, leaks will be collected and contained using absorbents such as Oil-dry, vermiculite, or sand. This material will also be containerized for disposal pending analyses. All inspections will be documented in the Project Logbook.

8.4 Personnel Training and Spill Prevention

All personnel will be instructed on the protocols for spill prevention, containment and collection of hazardous materials in the site-specific training. The FOL/SSO will serve as the Spill Response Coordinator for this operation should the need arise.

8.5 Spill Prevention and Containment Equipment

The following represents the minimum equipment which will be maintained at the staging area at all times for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- Drums (55-gallon U.S. DOT 17-E or 17-H);
- Portable storage tanks (if necessary);
- Non-sparking tools such as shovels, rakes, and brooms; and
- Labels.

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8.6 Spill Control Plan

This section describes the procedures the Battelle field crewmembers will employ upon the detection of a spill or leak.

1. Notify the SSO or FOL immediately upon the detection of a leak or spill.
2. Don personal protective equipment (PPE level must be specified by SSO prior to entry) stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the drum. Spread the absorbent material in the area of the spill covering completely.
3. Transfer the material to a new container, collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.
4. Solid spills will be recontainerized with 2-inches of top cover and will await test results for treatment or disposal options.

It is not anticipated that a spill will occur in which the field crews cannot handle. Should this occur notification of appropriate emergency response agencies will be carried out by the FOL or SSO.

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9.0 SITE CONTROL

This section outlines the means by which the Battelle SSO will delineate work zones. Personnel will use these work zones in conjunction with decontamination procedures in order to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three-zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants and protect individuals who are not cleared to enter work areas.

9.1 Exclusion Zone

The exclusion zone will be considered the area of the site where there is known or suspected contamination (river, pond, wetlands, etc.).

9.2 Contamination Reduction Zone

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. The personnel and equipment decontamination will take place in this area at a central location to facilitate and support field activities. When applicable, this area will be delineated using barrier tape and/or cones to inform and direct personnel and will be located upwind from the exclusion zone.

9.3 Support Zone

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

9.4 Site Visitors

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by Battelle personnel;
- Regulatory personnel (EPA, RIDEM, OSHA, etc.); and
- Residents of properties at or adjacent to sampling areas.

Because some of the investigation areas are public property, and not controlled, only each sample location currently active will be considered secure. All persons who require site access into active sampling locations will be required to obtain permission from the FOL/SSO. Upon gaining access to the site, all site visitors who contact the field team and are interested in observing operations in progress will be escorted by a Battelle representative (arranged for in advance by the FOL) and shall be required to meet the following minimum requirements:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.
- All site visitors not associated with the sampling team will be required to maintain a safe distance from the active sampling location as determined by the SSO.

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Any and all visitors not meeting the requirements stipulated in this plan will not be permitted to enter the site operational zones during planned activities. All unauthorized visitors will be removed from the premises. Removal of unauthorized visitors will be accomplished with support from the FOL/SSO.

9.5 Site Security

Security of each active sampling location will be the responsibilities of Battelle/Team Subcontractor personnel as necessary. Battelle/Team Subcontractor personnel will retain control over active sampling locations. The first line of security consists of visual barriers (e.g., site security fence, safety cones, or barrier tape) that restrict the general public. The second line of security will take place at the work site referring interested parties to the FOL. The FOL will serve as a focal point for site personnel, and will serve as the final line of security and the primary enforcement contact.

9.6 Buddy System

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

9.7 Material Safety Data Sheet (MSDS) Requirements

Battelle and/or Team Subcontractor personnel will provide MSDSs for all chemicals brought onsite as well as the chemicals of concern at the site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed and maintained for the duration of site activities. The MSDSs will then be maintained in a central location and will be available for anyone to review upon request.

9.8 Communication

If personnel are not working in proximity to one another during field activities, a supported means of communication between field crews may be necessary. As a result, two-way radio communication devices may be used by field personnel while at the site.

External communication will be accomplished by using cellular telephones.

10.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that permit-required confined space activities will be conducted. Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces. A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized and serious safety or health hazard.

For further information on confined space, consult the SSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

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11.0 MATERIALS AND DOCUMENTATION

Battelle shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP;
- Incident Reports;
- Medical Data Sheets; and
- Emergency Reference Forms.

11.1 Materials to be Available at the Site

The following documentation is to be available at the Site for quick reference purposes. In situations where posting of these documents is not feasible, these documents should be separated and immediately accessible.

Material Safety Data Sheets (MSDSs) – The MSDSs shall also be in a central area accessible to all site personnel. These documents should correspond with all of the substances employed on site. It is acceptable to have these documents within a central folder.

Site Clearance Sheet – This list is found within the training section of the HASP (See Figure 3). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. This list indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) - This list of numbers and the directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards – Medical Data Sheets will be filled out by all on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility.

Visitors

Visitors must furnish their own PPE. Visitors are required to sign the Visitor Log and comply with guidelines, rules, and procedures presented herein. If the visitor represents a regulatory agency concerned with site health and safety issues, the SSHO must immediately notify the DSHO.

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VISITOR LOG

Name of Visitor (Please Print)	Company Name	Date of Visit	Signature

Health and Safety Meetings

Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SSHO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

Date	Topics	Name of Attendee (Please Print)	Company Name

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MEDICAL DATA SHEET

This Medical Data Sheet will be completed by all on-site personnel and kept in the Support Zone during site operations. It is not a substitute for the Medical Surveillance Program requirements consistent with the Battelle policies regarding Hazardous Waste Operations. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required. If more space is required, use the back of this sheet.

Project: Centredale Manor Restoration Project Superfund Site, North Providence, Rhode Island

Name: _____

Address: _____

Home Telephone: _____-_____-_____.

Age: _____ Height: _____ Weight: _____

In case of emergency, contact: _____

Address: _____

Telephone:_____-_____-_____ Do you wear contact lenses? Yes ( ) No ( )

Allergies: _____

List medication(s) taken regularly: _____

Particular sensitivities: _____

Previous/current medical conditions or exposures to hazardous chemicals:

_____

Name of Personal Physician: _____

Telephone: _____-_____-_____

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12.0 HASP APPROVALS

By their signatures, the undersigned certify that this HASP will be used for the protection of the health and safety of all persons entering the CMRP site. Signatures also serve as certification of completion of the Hazard Assessments as required by 29CFR 1910.132.

Site Safety Officer — Date: 3/21/2005

Project Manager — Date: 03-21-2005

Health and Safety Manager — Date: 03-21-05

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13.0 REFERENCES

Archer, J., and T. Crone. 2000. "Hexachloroxanthene Analysis with TCDD." In *Organohalogen Compounds*, 45: 29-32.

Battelle. 2005. *QAPP Addendum 3 to Centredale Manor Tasks 19-22 QAPP.* Prepared for U.S. Army Corps of Engineers New England District. January. (Draft)

U.S. Environmental Protection Agency. 1996. *Human Health Risk Screening Analysis for a Subsistence Fisherman in the Woonasquatucket River.*

U.S. Environmental Protection Agency. 1998. *Human Health Risk Screening Analysis for Recreational Exposure to Sediments in the Woonasquatucket River.*

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TABLES

Table 1. Emergency Reference Table

Contact	Phone Number
North Providence Emergency Numbers: Ambulance Police Fire Hospital Emergency Room	 911 911 (or 401- 272-1111) 911 (or 401- 274-3434) 401- 456-3000
Rhode Island Dig Safe	1-888-DIGSAFE (344-7233)
Poison Control Center	1-800-222-1222
Chemtrec National Response Center	1-800-424-8802
Project Manager: Deirdre Dahlen	781-952-5253
Field Operations Leader: Alex Mansfield	Office: 781-952-5329 Cell: 781-424-3817
EPA Work Assignment Manager: Anna Krasko	617-918-1232
Health and Safety Manager: Gary Carlin	614-424-4929
Battelle Program Manager: Lisa Lefkovitz	781-952-5254
USACE Project Manager: Heather Sullivan	978-318-8543

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Table 2. Tasks/Hazards/Control Measures Compendium

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Surface and Subsurface Sediment Sampling	***Chemical Hazards:*** 1) Various organic vapors and air/particulate borne contaminants at low to medium concentrations primarily consisting of dioxin, VOCs, SVOCs, metals, and PCBs. 2) Transfer of contamination into clean areas or onto persons. ***Physical Hazards:*** 1) Noise in excess of 85 dBA (not anticipated). 2) Contact with underground utilities (electric lines, gas lines, water lines, etc.) (not anticipated). 3) Strain/muscle pulls from heavy/awkward lifting. 4) Uneven or unstable terrain (slip, trip, and fall hazards). 5) Pinch/compression points. 6) Other physical hazards associated with ongoing operations (foot and vehicular traffic). 7) Natural hazards (insect/animal bites or stings, poisonous plants, etc.). 8) Ambient temperature extremes. 9) Man overboard. 10) Severe Weather hazards	***Chemical Hazards:*** 1) Use PPE to control exposures to potentially contaminated medias (e.g., air, water, soils, etc.). Exposure to dusty conditions will be controlled through the use of water suppression and personnel avoidance of visible dust plumes. ➢ Identify and physically barricade operational zones where potential contamination may exist to prevent incidental contact and transfer outside of the operational area. 2) Decontaminate all equipment and supplies between sampling locations as well as prior to leaving the site. ***Physical Hazards:*** 1) Excessive noise levels will be mitigated through the use of hearing protection. Any piece of equipment or operation that has the potential to generate excessive noise levels (i.e., you must raise your voice to speak to someone within two feet of where you are standing) will require hearing protection. 2) Use multiple personnel and proper lifting techniques for heavy/awkward lifting. Use proper lifting techniques. 3) Preview work location for uneven/unstable terrain. Keep work area organized and free from clutter. 4) Use other equipment to remove hands from points of operation. 5) Traffic and equipment considerations are to include the following: ➢ Establish safe work zones and utilize safety cones and/or tape as necessary. ➢ All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility. 6) Wear appropriate clothing and PPE. Avoid potential nesting areas and suspicious vegetation (poison ivy, poison oak, etc.). Refer to the Health and Safety Guidance Manual for additional information regarding ticks and Lyme's disease. 7) Wear appropriate clothing for the anticipated weather conditions while maintaining the required level of protection. Terminate or reschedule work if weather conditions are severe. 8) Appropriate clothing will be worn to suit weather. No work will be conducted under extreme temperatures. 9) Type III or V Personal Flotation devices (PFDs) will be used as PPE when on or near water 10) A weather radio will be monitored on the boat for the duration of the water-based project operations to monitor for severe weather, such as strong winds, large seas or lightning. If severe weather warnings are issued for the site location or surrounding county, work will cease.	Elevated airborne concentrations impacting the field crews or downwind receptors are not anticipated. The following information is provided as a contingency action only. Visible plumes of dust will trigger a halt in sampling activities and a reassessment of the situation.	All sampling activities are anticipated to proceed in a modified Level D protection. Level D respiratory protection and the following minimal personal protective equipment: ➢ Standard field dress (long pants and long or short sleeve shirts). Hats and sunblock will be used when necessary. ➢ Where potential for skin contact with materials contaminated with volatiles or semivolatiles, PE coated tyvek will be used. PE coated tyvek will also be used where potential for saturation of the work clothes exists, along with impermeable boots (covers) and nitrile gloves. ➢ Steel toe/shank safety boots; ➢ Disposable latex/nitrile gloves when sampling; ➢ Safety glasses; Area evacuation will be required if breathing zone readings are greater than described at left.	***Personnel Decontamination:*** This function will take place at an area adjacent to the sampling operations. This decontamination procedure for Level D protection will consist of: ➢ Equipment drop; ➢ Soap/water wash and rinse of outer gloves and outer boots, as applicable; ➢ Soap/water wash and rinse of the outer splash suit, as applicable; and ➢ Wash hands and face, leave contamination reduction zone **<u>Sampling Equipment Decontamination:</u>** All equipment used in the exclusion zone requires decontamination between locations and prior to removal from the site. All site vehicles will be restricted from access to exclusion zones.

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Table 2. (continued)

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Decontamination of sampling equipment.	***Chemical Hazards:*** 1) Dermal contact – Various organic compounds consisting of dioxin VOCs, SVOCs, PCBs, and metals. 2) Airborne particulate contaminants – Various organic vapors at low to medium concentrations primarily consisting of dioxin, VOCs, SVOCs, metals, and PCBs. ***Physical Hazards:*** 1) Strain/muscle pulls from heavy lifting..	1) Use protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. ➢ Have a means by which the eyes and/or skin may be flushed (i.e., portable camp shower, emergency eyewash, etc.) readily accessible. 2) Use multiple persons where necessary for lifting and handling heavy pieces of equipment for decontamination purposes. 3) If necessary, provide stacking racks for air drying of decontaminated equipment to prevent unstable drying stacks of equipment from collapsing.	1) Use visual observation on all equipment and/or areas, which have been cleaned and dried to ensure they have been properly cleaned of potentially contaminated medias (e.g., air, water, soils).	*For sampling equipment including trowels, split bailers, etc.:* Level D Minimum requirements – ➢ Standard field attire (long and short sleeve shirt; long pants); ➢ Safety shoes (steel toe/shank); ➢ Nitrile gloves; ➢ Safety glasses or a splash shield. Respiratory protection is not anticipated for these activities.	***Personnel Decontamination:*** This decontamination procedure for Level D protection will consist of: ➢ Soap/water wash and rinse of outer gloves. ➢ Soap/water wash and rinse of the outer splash suit, as applicable. ➢ Wash hands and face and leave contamination reduction zone.

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Table 2. (continued)

Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Mobilization / Demobilization	***Chemical Hazards:*** Exposure to potential site contaminants are not anticipated during this activity. However, chemicals brought on site in support of field activities are to be identified, logged, accompanied by an appropriate MSDS, properly stored, and evaluated for purposes of hazard communication. ***Physical Hazards:*** Potential physical hazards associated with this task may include: 1) Strain/muscle pulls from heavy/awkward lifting. 2) Pinch/compression points. 3) Uneven or unstable terrain (slip, trip, and fall hazards). 4) Natural hazards (insect/animal bites and stings, poisonous plants). 5) Other physical hazards associated with ongoing operations (foot and vehicular traffic).	***Chemical Hazards:*** To eliminate potential chemical hazards associated with this task ensure the following: ➢ A chemical inventory list is generated and MSDSs are available for all chemicals brought on-site. ➢ Materials are stored in accordance with recommended practices and according to compatibility (see MSDS for storage and compatibility recommendations). ***Physical Hazards:*** 1) Use machinery or multiple personnel for heavy lifts. ➢ Use proper lifting techniques. 2) Use pinch bars or other equipment to keep hands from the point of operation. 3) Preview and prepare work locations where unstable/uneven terrain exists. 4) Avoid insect/animal nesting areas, use repellents. Report potential hazards to the SSO. Frequently inspect clothing and persons during and after activities in wooded areas for ticks and other vectors. 5) Set-up work area to reduce exposure to vehicle hazards. Use safety vests and safety cones as necessary.	Not required during mobilization / demobilization. Air monitoring will not be performed during these tasks given that these activities will not be performed in areas of known/suspect contamination.	Mobilization/demobilization activities are intended to initiate and proceed in Level D protection. Level D – (Minimum Requirements) ➢ Standard field attire (work shirt; long pants; or coveralls); ➢ Safety work boots (boots with steel toe/shank); ➢ Safety glasses; ➢ Hardhat (when overhead hazards exists, or identified as an operation requirement); ➢ Reflective vest for high traffic areas; ➢ Hearing protection for high noise areas, or as directed on an operation by operation scenario. As a general rule of thumb, if you need to raise your voice to be heard while engaged in conversation with someone who is within 2 feet of your position, you may be exposed to excessive noise levels. If this occurs, use hearing protection. **Note:** Additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task. The following strategically placed emergency equipment will be maintained during onsite activities: ➢ Fire Extinguishers ➢ First Aid Kit ➢ Emergency Eye Wash ➢ Cellular Phone	***Personnel Decontamination:*** As potential site contaminants are not anticipated as part of this task, personal decontamination is not required. **<u>Equipment Decontamination:</u>** All equipment arriving/leaving the site will be inspected prior to permitting this equipment to enter or exit the site. The SSO will inspect the equipment and give the clearance to allow the equipment to pass. All equipment which fails the inspection will have to be decontaminated again to a level acceptable to the SSO prior to passage on or off site.

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Table 3. Toxicological Information, Exposure Limits and Symptoms of Exposure (a)

Material	OSHA PEL/ ACGIH TLV (b)	NIOSH IDLH	AIHA Warning	Signs & Symptoms	IP (eV)
Aldrin (skin)	250 µg/m3	25 mg/m3	<1 mg/m3	Headache, dizziness, nausea, jerks of limbs	NA
Aluminum (dust) (Respirable Dust)	5 mg/m3	NE	Dust	Coughing, spitting, pulmonary fibrosis	Dust
Aluminum alkyls or soluble salts	2 mg/m3 (c)	NE	Dust	Coughing, spitting, pulmonary fibrosis	Dust
Antimony compounds	500 µg/m3	50 mg/m3	Dust	Irritated nose, cough, headache, diarrhea	Dust
Arsenic, inorganic	10 µg/m3 (REL = 2 µg/m3)	5 mg/m3	Dust	Nasal ulcers, fever, bronchitis, melanosis, peripheral neuropathy	Dust
Barium (soluble) compounds	500 µg/m3	50 mg/m3	NA	Muscle spasms, slow pulse, bronchial irritation	NA
Barium sulfate (dust) (Respirable Dust)	5 mg/m3	NE	Dust	Few symptoms, chronic baritosis	Dust
Benzaldehyde	NA	NA	NA	Contact dermititis, feeble anaesthetic, convulsions	NA
Benzo(a)pyrene (Coal Tar Pitch Volatiles)	200 µg/m3 (REL = 100 µg/m3)	80 mg/m3	0.1 mg/m3	Eye irritation, difficulty breathing, skin irritation and burns.	NA
Beryllium	2 µg/m3 (REL = 0.5 µg/m3)	4 mg/m3	Dust	Respiratory symptoms, weakness, weight loss	Dust
Biphenyl	0.2 ppm	100 mg/m3	0.01 ppm	Irritated eyes, nose, twitching, breathing difficulty	Dust
Bis(2-ethylhexyl)phthalate	5 mg/m3	5000 mg/m3	5 mg/m3	Mild skin, eye, mucuous membrane irritation, gastric disturbance.	NA
Cadmium dust	5 µg/m3	9 mg/m3	Dust	Pulmonary edema, tight chest, chills	Dust
Chlordane (skin)	500 µg/m3	100 mg/m3	no odor	Blurred vision, delirium, twitches, stomach pain, diarrhea	NA
4-Chloroaniline	**1 mg/m3**	**100 mg/m3**	**NA**	**Toxic if inhaled, swallowed, or absorved. Effects of contact may be delayed.**	**9.96**
Chlorinated camphene (Toxaphene) (skin)	500 µg/m3	200 mg/m3	NA	Nausea, confusion, agitation	NA
Chromium (II) compounds	500 µg/m3	250 mg/m3	Dust	Lung damage, skin sensitization	Dust
Chrysene (Coal Tar Pitch Volatiles)	200 µg/m3 (REL = 100 µg/m3)	80 mg/m3	Dust	Eye irritation, dermatitis, bronchitis	7.75
Cobalt (metal) (dust & fumes)	20 µg/m3 (d)	20 mg/m3 (d)	>1 mg/m3 (d)	Coughing, respiratory sensitivity, pneumoconiosis, dyspnea (d)	Dust (d)
Copper (dust)	1 mg/m3	100 mg/m3	Dust	Nasal perforation, metal taste	Dust
Cresol (skin)	5 ppm (REL = 2.3 ppm)	250 ppm	0.001 ppm	Depression, dyspnea, weak pulse, skin & eye burning	9.00
DDT (skin)	1 mg/m3 (REL = 0.5 mg/m3)	500 mg/m3	2.9 mg/m3	Numb face, lips & tongue, tremors, apprehension, headache	NA
Dichloro propionic acid (Dalapon)	1 ppm	NE	428 ppm	Eye, nose & throat irritation, nausea	NA
Dieldrin (skin)	250 µg/m3	50 mg/m3	0.041 ppm	Headache, dizziness, vomiting, nausea, convulsions	NA

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Table 3. (continued)

Material	OSHA PEL/ ACGIH TLV (b)	NIOSH IDLH	AIHA Warning	Signs & Symptoms	IP (eV)
Dioxins	Contact H&S for limits			see polychlorinated dioxins	
Endosulfan (skin)	100 µg/m3	NE	NA	Headaches, dizziness, nausea, convulsions	NA
Endrin (skin)	100 µg/m3	2 mg/m3	NA	Convulsions, stupor, headache, dizziness	NA
Heptachlor & epoxides (skin)	50 µg/m3 (d)	35 mg/m3	0.02 ppm	Tremors, convulsions	NA
Lead compounds	50 µg/m3	100 mg/m3	Dust	Fatigue, pallor, colic, insomnia	Dust
Lindane (skin)	500 µg/m3	50 mg/m3	21 mg/m3	Headache, nausea, clonic convulsions, difficult breathing	NA
Magnesium oxide	10 mg/m3 (d)	750 mg/m3	Dust	Flu-like fever, cough	Dust
Manganese (dust)	0.2 mg/m3 (d)	500 mg/m3	Dust	"Dead face", dry throat, cough metal fume fever, pneumonia	Dust
Mercury and compounds (skin)	50 µg/m3	10 mg/m3	NA	Severe abdominal pain tremors, weakness, GI irritation, fatigue	10.40
Methoxychlor	10 mg/m3 (d)	5,000 mg/m3	NA	Twitches, convulsions	NA
Methylene chloride	25 ppm	2,300 ppm	160 ppm	Weakness, tingling & numbness, vertigo, nausea	11.35
Molybdenum compounds	500 µg/m3 (d)	1,000 mg/m3	Dust	Loss of appetite, incoordination, eye, nose & throat irritation	Dust
Naphthalene	10 ppm	250 ppm	38 ppb	Eye irritation, headache, confusion, excitement, nausea	8.12
Nickel (dust)	1 mg/m3 (REL = 0.015 mg/m3)	10 mg/m3	Dust	Skin sensitivity, chest pain, "asthma"	Dust
Nickel (soluble compounds)	100 µg/m3 (d) (REL = 15 µg/m3)	NE	Dust	Skin sensitivity, chest pain, "asthma"	Dust
Nitrophenol	NE	NE	NA	Headache, nausea, drowsiness, skin irritation, blue color in lips, ears, and fingernails.	NA
PAHs (Coal Tar/Pitch Volatiles)	200 µg/m3 (REL = 100 µg/m3)	80 mg/m3	NA	Eye irritation, difficulty breathing, skin irritation and burns.	8.97
Pentachlorophenol (skin)	500 µg/m3	2.5 mg/m3	9.3 mg/m3	Irritated eyes, & nose, lost appetite, weakness, sweating, sneezing	NA
Phenanthrene	NE	NE	NA	Skin, eye, and mucous membrane irritation.	NA
Phenol (skin)	5 ppm	250 ppm	0.06 ppm	Skin corrosive, eye irritant, muscle aches, dark urine	8.50
Polychlorinated biphenyl (PCBs - skin) (54% Chlorine)	500 µg/m3 (REL = 1 µg/m3)	5 mg/m3	Mist	Irritated eyes, chloracne	Mist
Polychlorinated dibenzodioxins (hex isomers)	1 µg/m3 (Company - internal)	Carc.	Dust	Chloracne, loss of feeling, fatigue	
Polychlorinated dibenzodioxins (other isomers)	10 pg/m3 (Tetra equivalent)	Carc.	Dust	Chloracne, loss of feeling, fatigue	Dust

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Table 3. (continued)

Material	OSHA PEL/ ACGIH TLV (b)	NIOSH IDLH	AIHA Warning	Signs & Symptoms	IP (eV)
Polychlorinated dibenzofurans (hex isomers)	1 µg/m3 (Company - internal)	Carc.	Dust	Chloracne, loss of feeling, fatigue	Dust
Polynuclear aromatics (Coal Tar Pitch Volatiles)	200 µg/m3 (REL = 100 µg/m3)	80 mg/m3	Dust	Confusion, nausea, eye irritant, headaches, stomach pain	Dust
Selenium compounds	200 µg/m3	1 mg/m3	Dust	Headache, chill, fever, garlic breath, disturbed vision	Dust
Silver (dust)	100 µg/m3 (c)	10 mg/m3	Dust	Blue-gray eyes & skin, gastrointestinal irritation	Dust
Silver (metal & soluble)	10 µg/m3	10 mg/m3	Dust	Blue-gray eyes & skin, gastrointestinal irritation	Dust
Tetrachloroethylene	25 ppm (c)	150 ppm	47 ppm	Irritated eyes, nose, throat, flushed face & neck, dizziness	9.32
Thallium (skin)	100 µg/m3	15 mg/m3	NA	Nausea, diarrhea, stomach pain	NA
Trichloroethylene	50 ppm (c) (REL = 25 ppm)	1,000 ppm	82 ppm	Vertigo, visual disturbance, headache, drowsiness	9.45
Trichlorophenol	NE	NE	NA	Eye swelling, irritation of nose and throat	NA
Trimethyl benzene	25 ppm (c)	NE	2.4 ppm	Eye, nose & throat irritation, pneumonia	NA
Vanadium (dust)	50 µg/m3 (c)	35 mg/m3	Dust	Green tongue, metal taste, coughing, throat irritation	Dust
Zinc Oxide (dusts) TLV	2 mg/m3 (d)	500 mg/m3	Dust	Sweet metal taste, dry throat, cough, tight chest, chills	Dust

(a) Except where indicated, exposure limits reported include OSHA PEL (Occupational Safety and Health Administration Permissible Exposure Limit), ACGIH TLV (American Conference of Governmental and Industrial Hygienists Threshold Limit Value), NIOSH IDLH (National Institute of Occupation Safety and Health Immediately Dangerous to Life and Health) and AIHA (American Industrial Hygiene Association). NIOSH REL (Recommended Exposure Limit) also reported where the REL is less than the OSHA PEL or ACGIH TLV.

OSHA PEL, ACGIH TLV and NIOSH IDLH generally available at www.cdc.gov/niosh/
AIHA warning limits available at www.aiha.org/committees/html/ei_sig/chemtabl.xls

(b) Where OSHA PEL and ACGIH TLV are not equal, the lower of the two exposure limits is reported.

(c) ACGIH, 2004.

(d) OSHA CFR.

IP, Ionization Potential

µg: microgram

mg: milligram

m3: cubic meter

NE: Not Established

NA: Not Available

ppm: parts per million

H&S: Health & Safety

GI: gastro intestinal

Carc.: carcinogen

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FIGURES

FROM:	TO:
Centredale Manor Site 2074 Smith Street North Providence, RI 02911	Our Lady of Fatima Hospital 200 High Service Avenue North Providence, RI 02904 (401) 456-3000 (401) 456-3400 Emergency
Proceed North on Woonasquatucket Avenue	1.0 mi
At rotary, proceed west on SMITH ST./US- 44W	0.13 mi
At lights Turn Right onto MINERAL SPRING AVE/RI-15E	0.1 mi
Turn RIGHT onto SMITHFIELD RD.	0.25 mi
Turn SLIGHT RIGHT onto HIGH SERVICE AVE.	0.25 mi
Total estimated time: 7 minutes	Total distance: 1.75 mi

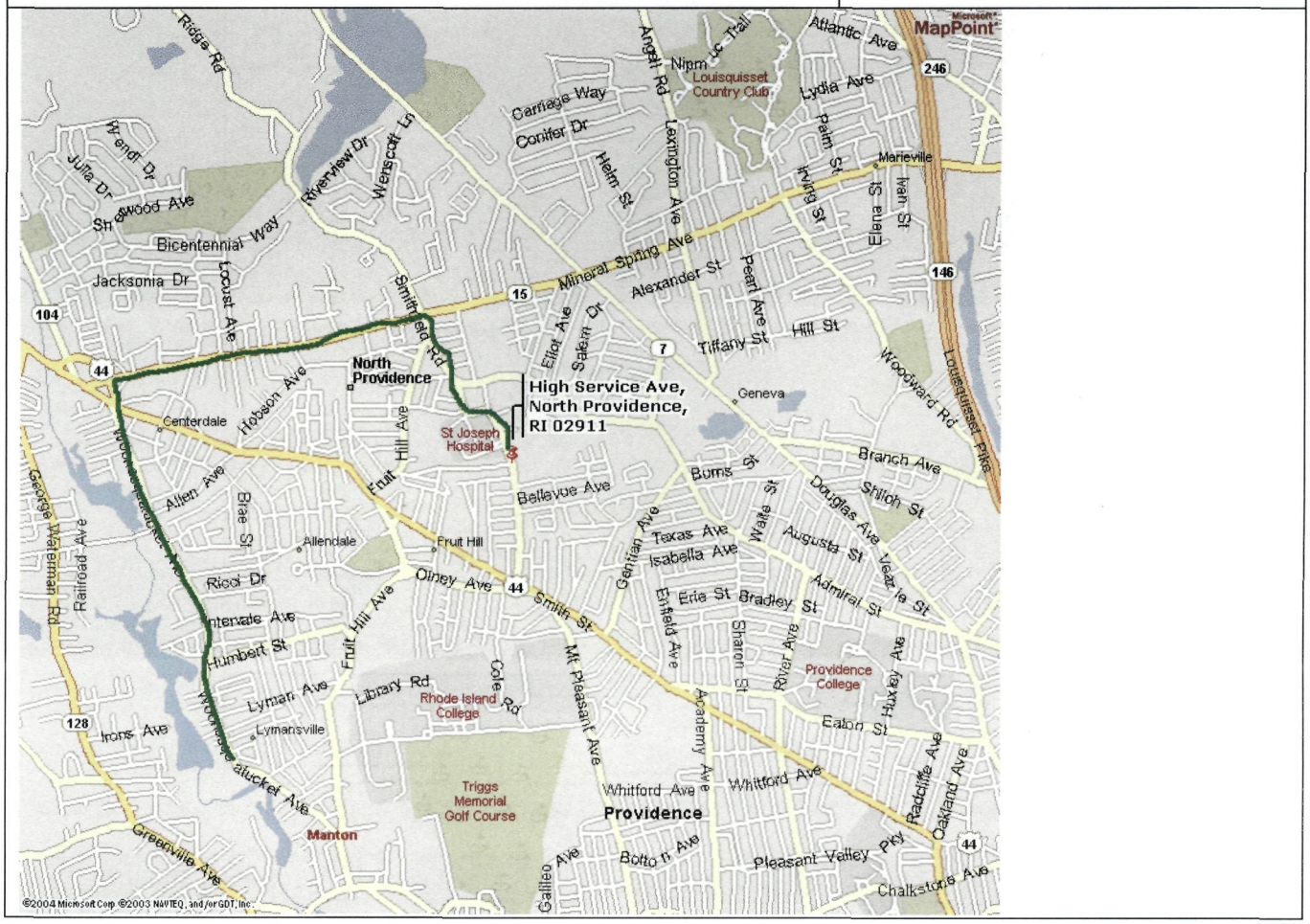


Figure 1. Hospital Map and Directions

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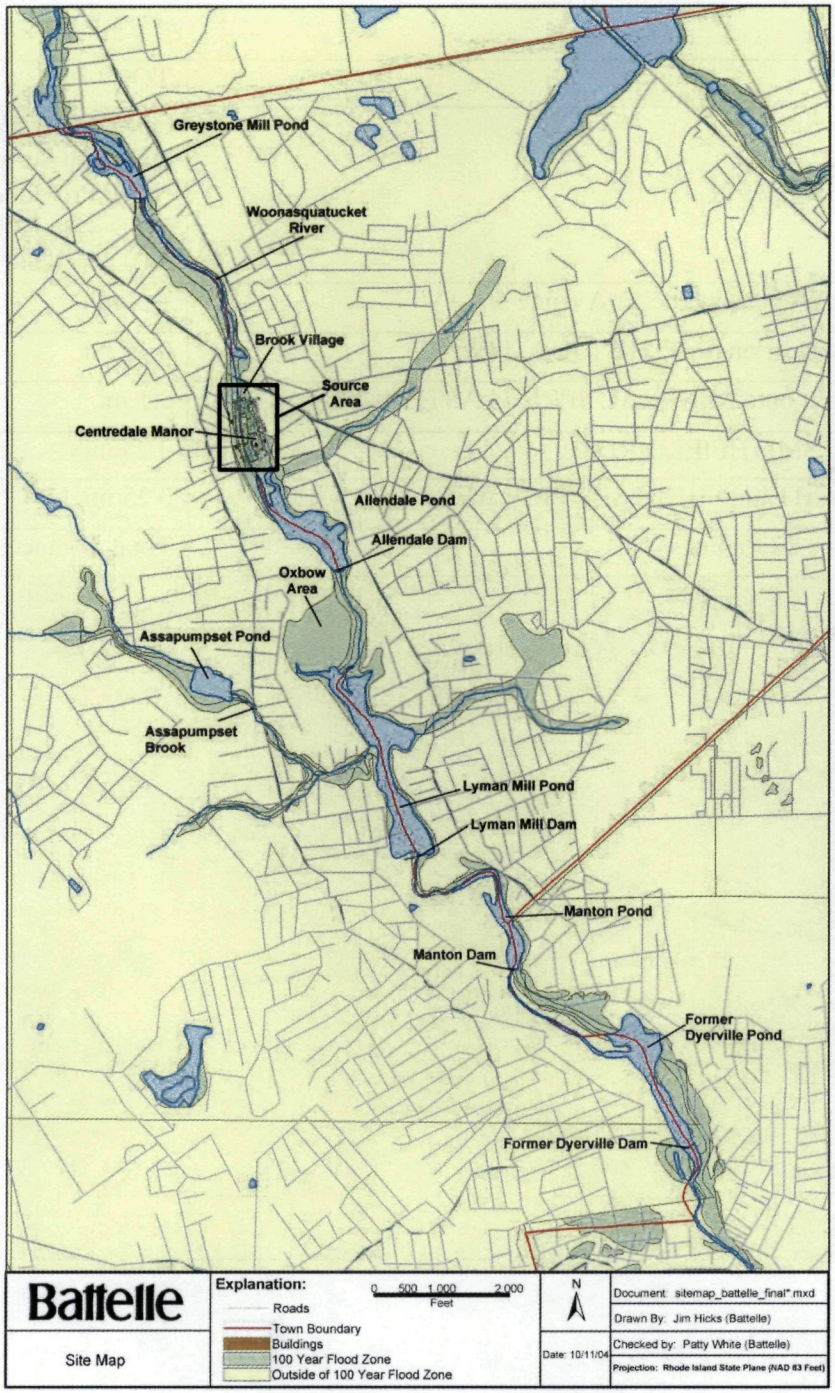


Figure 2. Site Map

Figure 3. Site Specific Training Documentation

My signature below indicates that I am aware of the potentially hazardous nature of performing site activities and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health.
- Safety, health, and other hazards present on-site.
- Use of personal protective equipment.
- Work practices to minimize risks from hazards.
- Safe use of engineering controls and equipment.
- Medical surveillance requirements.
- Signs and symptoms of overexposure.
- Contents of the Health and Safety Plan.
- Emergency Response Procedures (evacuation and assembly points).
- Spill response procedures.
- Review of contents of relevant Material Safety Data Sheets.

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

Name (Print Clearly)	Signature	Date

APPENDIX A

Medical Clearances

Battelle
. . . Putting Technology To Work

☐ **NEW HIRE MEDICAL EVALUATION Start date** _____

☒ **PERIODIC MEDICAL EVALUATION REPORT**

Next evaluation due _____ **Requisition#** _____

Staff Member: Alex Mansfield Badge #: 105563

Job Title: Research Scientist Manager: TRACY STENNER

Location: Duxbury MA ES&H Rep: MARY JANE FERSON

I hereby certify that this individual is:

☑ Medically qualified to perform the job described above.

☑ Approved for respirator use per OSHA 29 CFR 1910.134

- ✓ Dust Mask
- ✓ Half Face APR
- ___ Full Face APR
- ✓ Powered APR
- ✓ Supplied Air
- ___ SCBA

☐ Approved for CA work

☐ Approved for BL3 work

☐ Approved for the following special duty: _____

☐ Medically qualified to perform job described above with the following restrictions:

_____

_____

☐ Decision requires additional data: _____

☐ Not medically qualified or fit for the job listed above.

Note: These fitness-for-duty determinations do not consider any drug test results.

Signed: R.J. Freedy MD
Battelle Physician

Printed: R. J. FREEDY MD Date: 10-6-03
Battelle Physician

5/01/03

US EPA ARCHIVE DOCUMENT

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Battelle
. . . Putting Technology To Work

☐ **NEW HIRE MEDICAL EVALUATION Start date** _____

☒ **PERIODIC MEDICAL EVALUATION REPORT**

Next evaluation due _____ **Requisition#** _____

Staff Member: Theresa Barber Badge #: 109908

Job Title: Technician Manager: Nancy Bonnevie

Location: Duxbury, MA ES&H Rep: _____

I hereby certify that this individual is:

☑ Medically qualified to perform the job described above.

☑ Approved for respirator use per OSHA 29 CFR 1910.134

✓ Dust Mask ✓ Powered APR ____ Requires Ocular Inserts for Full Face Respirator

✓ Half Face APR ✓ Supplied Air

✓ Full Face APR ✓ SCBA

☐ Approved for CA work

☐ Approved for BL3 work

☐ Approved for the following special duty: _____

☐ Medically qualified to perform job described above with the following restrictions:

_____

_____

☐ Decision requires additional data: _____

☐ Not medically qualified or fit for the job listed above.

Note: These fitness-for-duty determinations do not consider any drug test results.

Signed: R.J. Freedy MD
Battelle Physician

Printed: R.J. FREEDY MD Date: 5-7-04
Battelle Physician

10/03

Medical Clearance, Ms. Jessica Fahey

Ms. Fahey is enrolled in Battelle's occupational health program managed by Jordon Hospital (located in Plymouth, MA). Ms. Fahey's most recent annual medical examination was conducted in January 2004 and she is scheduled for her 2005 annual examination during the week of March 21, 2005. A copy of Ms. Fahey's medical clearance will be provided to USACE once her 2005 annual examination has been conducted, and prior to field sampling which is currently scheduled to begin on March 30, 2005.

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OCCUPATIONAL HEALTH
JORDAN
HOSPITAL
JORDAN ON THE JOB

March 18, 2005

Mr. Robert Reynolds
TG&B Marine Services, Inc.
P.O. Box 767
North Falmouth, MA 02556

Dear Robert,

Jordan on the Job is pleased to be the provider of Cancer Physicals to the employees of TG&B Marine Services, Inc. As discussed, the physical exam will consist of the following components:

- Audiometric Testing
- Physical exam
- Cardiac Profile (Cholesterol-HDL/LDL/Triglycerides)
- Complete Blood Count & Differential
- Electrocardiogram (35 or older)
- GGT (Gamma-Glutamyl Transferase) Liver function
- Guiac - Stool test for blood
- Iron Binding Capacity
- Magnesium
- Medical History
- Occupational Health Blood Work (profile)
- PSA - Prostate Specific Antigen (male age 50 and over)
- Simple Spirometry
- Tuberculin testing
- Thyroxin (T4)
- Urinalysis
- Eye Exam
- Work & Exposure History
- Chest x-ray

If you have any questions, please do not hesitate to call me at (508) 830-2296. We at Jordan On The Job look forward to serving the health and wellness needs of TG&B Marine Services!

Sincerely,

Sarah Simpson
Account Executive

278 Sandwich Street, Plymouth, MA 02360 • (508) 830-2388 • Fax: (508) 830-2389
A division of Jordan Hospital, Inc.,
An affiliate of Jordan Health Systems, Inc.