FIELD SAMPLING PLAN

PENOBSCOT ESTUARY REMEDIATION

Prepared for

Greenfield Penobscot Estuary Remediation Trust LLC,
Trustee of the Penobscot Estuary Mercury Remediation Trust

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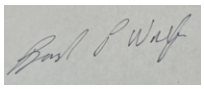

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I certify that this document and all appendices were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete.

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ACRONYMS AND ABBREVIATIONS

CLP	Contract Laboratory Program
COC	chain-of-custody
DIFW	State of Maine Department of Inland Fisheries and Wildlife
E-FDR	Electronic Field Data Records
FDR	Field Data Record
FSP	Field Sampling Plan
HASP	Health and Safety Plan
ID	Identification
IDW	investigation-derived waste
MS	Matrix Spike
MSD	Matrix Spike Duplicate
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
SOP	Standard Operating Procedure
TCLP	toxicity characteristics leaching procedure
USEPA	United States Environmental Protection Agency

1 INTRODUCTION

This Field Sampling Plan (FSP) has been prepared by WSP USA Environment & Infrastructure, Inc. (WSP) on behalf of the Greenfield Penobscot Estuary Remediation Trust LLC (Greenfield), Trustee of the Penobscot Estuary Mercury Remediation Trust (the Remediation Trust) for Work on the Penobscot River Estuary located in Hancock, Penobscot, and Waldo counties, Maine (the Site) as provided in **Figure 1-1**. This FSP has been prepared in accordance with the Consent Decree[1] and appendices, including Paragraph 31(c) of the Statement of Work (**Appendix A** to the Consent Decree). **Table 1-1** presents the compliance matrix for the Statement of Work requirements. The Supporting Deliverables (e.g., Field Sampling Plan, Quality Assurance Project Plan, Health and Safety Plan, etc.) incorporate, as appropriate, and build on the protocols, methodologies, etc. used during the Phase III Engineering Study, providing for procedures and data consistent with and comparable to existing/historical procedures and data. This FSP is a living document and may be reviewed, revised and updated as needed in accordance with the Consent Decree to support the Work activities. At minimum it will be reviewed on an annual basis from the date of approval.

This FSP has been prepared to guide sediment, surface water, and biota sampling activities for the Penobscot River Estuary Remediation. This document is intended to provide an overview of sampling methodologies expected to be employed during the Penobscot Estuary Remediation and is written to ensure that data collected meets the applicable Data Quality Objectives. The FSP contains the most commonly anticipated field techniques, while less common activity-specific processes and procedures (e.g., river flow velocity measurement, bathymetric survey) are provided in Investigation Work Plans not included herein. Included in the FSP are Standard Operating Procedures (SOPs) in **Appendix A**, and Field Data Records in **Appendix B**. Information about analytical program can be found in the Quality Assurance Program Plan (QAPP) (WSP, 2023a). The Health and Safety Plan (HASP) (WSP, 2023b) must be consulted prior to conducting any of the specific field activities presented in the FSP or QAPP.

[1] The Consent Decree was approved and entered by the U.S. District Court for the District of (in the case Maine People's Alliance and NRDC v. Holtrachem Manufacturing Company LLC, et al., No. 1:00-cv-00069-JAW (D. Me.) (ECF No. 1187, October 11, 2022).

2 OBJECTIVES

The primary objective of this document is to provide project field sampling crews with the methodologies to consistently collect reproducible data of sufficient quality during Penobscot River Estuary Remediation Work activities. **Table 2-1** provides this objective in addition to the objectives identified to meet the requirements and intent of the Consent Decree Statement of Work.

The FSP is a summary level document listing the logistics and sampling techniques to use for field sampling and data collection activities associated with the Penobscot Estuary Remediation Work and is a summary document of the following topics:

- Logistics
- Health and Safety
- Sediment Sampling
- Surface Water Sampling
- Avian Sampling
- Fish Sampling
- Shellfish Sampling
- Polychaete Sampling
- QA/QC sampling
- Electronic FDRs
- Sample Identification Nomenclature
- Sample Chain-of-Custody and Shipping
- Survey of Sample Locations
- Record Keeping
- Laboratory Deliverables and Data Validation

3 LOGISTICS

The Penobscot River Estuary in northern Maine is the second-largest river in New England, with an estuary of 90 square kilometers. The area of concern includes the entire river from the former Veazie Dam south to Upper Penobscot Bay, including Mendall Marsh and the Orland River (the Site). This section of the river is subject to downstream flow as well as tidal ebb and flow. Bangor is the head of tidal influence for the lower section of the river.

3.1 LOCAL POINTS OF CONTACT

A list of contacts for conducting field work on the Penobscot Estuary is included in **Table 3-1**.

3.2 BOATING

In order to obtain samples of sediment, surface water, and biota from the Penobscot Estuary, the use of boats will be required. Boating safety requirements are detailed in the Site-specific HASP (WSP, 2023b). Boats small enough to be trailered may be launched from numerous boat ramps along the river, which are shown in **Figure 3-1**. In addition to launching points, the locations depicted in **Figure 3-1** are available as locations to put ashore in the event of an emergency, engine trouble, or severe weather. **Figure 3-2** provides the locations of fuel and/or boat yards.

3.3 ACCESS AGREEMENTS

In many cases, property rights within the State of Maine extend to the mean low water mark, which requires obtaining permission from property owners to access intertidal and marsh areas along the Penobscot Estuary. The Remediation Trust will lead the effort to obtain access agreements from property owners; no intertidal or upland (above mean high water level) property will be accessed for the purpose of water, sediment, or biota sampling without a written authorization from the owner of the property.

3.4 PERMITS AND APPROVALS

Permits and approvals required before biota sampling activities commence include:

- U.S. Department of Interior/U.S. Geological Survey Federal Bird Banding Permit,
- State of Maine Department of Inland Fisheries and Wildlife Scientific Collection Permit for collection of Nelson's sparrow, red-wing blackbird, black duck – blood sampling, and
- State of Maine Department of Marine Resources Special License exempting samplers from regulations 12 M.R.S. and DMR Regulation Chapters pertaining to American eel, lobster, Atlantic tomcod, Rainbow smelt, mummichog, and polychaetes.

4 HEALTH AND SAFETY

A Site-specific HASP has been prepared to provide for the safety of on-Site workers (WSP, 2023b). Based on available Site information and prior activities conducted at the Site during the PRMS Phases I and II and the Phase III Engineering Study, the investigation fieldwork will be conducted in modified Level D personal protection. Specific investigation activities and required level of personal protection are set forth in the Site-specific HASP. Criteria for upgrading or downgrading the specified level of protection are also provided in the Site-specific HASP (WSP, 2023b). Should Site conditions pose a threat to those present on-Site, and/or should Site conditions warrant an upgrade from modified Level D, as defined by the HASP, work will stop, and the situation will be re-evaluated by the WSP Project Manager.

5 SEDIMENT SAMPLING

Sediment sampling will be conducted according to the procedures listed below (see **Appendix A**) and any specific protocols identified in Investigation Work Plans:

- SOP S-6, Sediment Collection
- SOP S-6A, Interval Sediment Sampling
- SOP S-7, Procedures for Description and Identification of Soils
- SOP S-17, Decontamination of Field Equipment
- SOP S-20, Sample Packaging and Shipment
- SOP S-26, Geotechnical Sediment Collection, Preservation, and Handling (ASTM D6519, D1587, D4220)

5.1 SEDIMENT SAMPLING METHODOLOGIES

Sediment samples will be collected using Ponar dredge, box corer, sample coring device, or Shelby tube as summarized below and described in detail in SOP S-6, SOP S-6A, and SOP S-26.

- Ponar dredge: Sediment grab samples may be collected with a Ponar dredge attached to a nylon rope or steel cable. Sediments collected in the dredge will be transferred to a compositing container (bowl) for homogenization. Sediment will then be transferred to an amber glass jar, labeled, and placed on ice for transport to the analytical laboratory.
- Core sampling: Sediment samples collected from a depth of greater than six inches in water will be collected with a coring device consisting of a tube sampler, removable Lexan core, extensions, and a "T" handle or drive-head. After sample collection, the Teflon core will be removed from the coring device, capped, labeled, and placed on ice for transport to the field processing station. Alternatively, for sample collection at depths greater than 20 feet below the river surface, a Vibracore sampler may be used to acquire sediment cores (SOP S-6).
- Box Corer: The corer is lowered vertically until it impacts with the riverbed. At this point the instrument is triggered by a trip as the main coring stem passes through its frame. The stem has a weight of up to 70 lbs to aid penetration. While pulling the corer out of the sediment a spade swings underneath the sample to prevent loss. When hauled back on board, the spade is under the box. Once the box corer is on board the vessel, Lexan tubes will be pushed into the sediment to capture the sediment to be processed. After core collection, the Lexan core will be removed from the coring device, capped, labeled, and placed on ice for transport to the field processing station.
- Geotechnical Core: A 3-inch diameter by 30-inch-long stainless steel, thin-walled sampler (Shelby tube) will be advanced 24 inches into the sediment with a specific driving head which will allow for the sediment to be captured within the tube. Appropriate measurements will be collected prior to extraction of the core from the tube. The extraction will be performed with minimal disturbance to the sediment in the tube. The extracted sediment core will be processed immediately after collection to minimize disturbance.

Documentation of sediment samples collected will be recorded on field data records for Sediment Sampling, Sediment Core Logs, or Sediment Grab Sample Logs as provided in **Appendix B**. Sediment samples will be described on the logs in accordance with SOP S-7 and sediment cores will be processed following SOP S-6A. Geotechnical samples will be collected, processed, and shipped in accordance with SOP S-26. The Geotechnical Core Log is included in **Appendix B**.

5.2 SEDIMENT SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

The procedures for decontamination of sediment sampling equipment can be found in SOPs S-6, S-6A, and S-17. In general, the steps to be followed in decontamination of sediment sampling equipment are as follows:

- Remove any solid particles from the equipment or material by brushing and then rinsing with clean water. This initial step is performed to remove gross contamination.
- Wash equipment with a Formula 409™ (or similar) cleaning solution and brush.
- Rinse with deionized water.
- Repeat entire procedure or any parts of the procedure if necessary.
- If sampling equipment is not to be used immediately at another location, wrap the equipment in aluminum foil and store in a safe place.

Decontamination wastewater will be containerized and managed in accordance with Section 5.3 of this FSP.

5.3 INVESTIGATION-DERIVED WASTE

The Investigation-Derived Waste (IDW) procedures described herein have been developed to meet applicable regulatory requirements. IDW generated during the Penobscot Estuary remediation work will be managed as non-hazardous solid waste, based on characterization data obtained during remediation of the Holtrachem Site and on existing data obtained during the Phase III Engineering Study. The Corrective Measures Implementation Plan for Southern Cove prepared for the Orrington Remediation Site in Orrington, Maine (CDM Smith, 2016) presents disposal characterization data for sediment samples collected from four cores within the cove. The cores were collected to characterize sediments for a suite of chemical and physical characteristics typically required by waste disposal facilities. The four cores (SD-SC-07 through SD-SC-10) were collected from the tidal flats surface up to depths of 25 inches. Each core was homogenized (composited) and an aliquot selected for submittal to the analytical laboratory. Samples for volatile organic compounds were not composited and were collected as discrete grab samples from the first composite subsampling location. Analyses performed on the samples included:

- Toxicity Characteristics Leaching Procedure (TCLP) volatile organic compounds,
- TCLP semi-volatile organic compounds
- TCLP metals
- TCLP pesticides
- TCLP select herbicides (i.e., 2,4,5-TP and 2,4-D)
- Total cyanide
- Total mercury
- Flash point

The analytical results for all samples were either non-detect or below the disposal facility requirements; thus, the material was determined not to be characteristically hazardous in accordance with RCRA requirements and was characterized and managed as solid, non-hazardous, waste.

IDW generated during remediation of mercury-contaminated sediments within the Site will therefore be managed as a non-hazardous, solid waste based on the Southern Cove characterization data. Of significance with respect to the current Penobscot Estuary remediation is that the total mercury concentrations from the four cores in Southern Cove ranged from 2.1 to 24 mg/kg, which is significantly higher than the average concentration of sediments observed to date within the rest of the Estuary. This is consistent with the understanding that Southern Cove was the source of mercury discharge to the Estuary.

The Phase III Engineering Study (AmecFW, 2018) presented area weighted average concentrations (presented as bootstrap mean values) for total mercury for areas selected for remedial action as follows:

- Orland River/Verona Northeast/Verona East: 0.767 mg/kg
- Main Channel of the Penobscot River from Bangor to Fort Point: 0.587 mg/kg

These average mercury concentrations calculated from the Phase III Engineering Study indicate that total mercury concentrations in IDW solids generated by Penobscot Estuary Remediation investigative activities are expected to be less than 1 mg/kg, significantly less than the concentrations observed from Southern Cove and therefore are highly unlikely to exceed regulatory levels for classification as hazardous waste.

When sediment samples are collected and processed for submittal to a laboratory, there is typically a small amount of sediment remaining. This IDW will be collected and containerized in U.S. Department of Transportation-approved 55-gallon steel drums, which will be bolted when not in use and staged at the field station in a locked, indoor storage area. Liquids from decontamination of field sampling equipment will also be collected and containerized in 55-gallon drums, separate from the IDW solids drums.

The IDW drums will be labeled clearly with indelible ink describing the contents and dates of sampling. IDW drums will be stored at the field station until the end of each field season (early November). The drum contents will be analyzed for hazardous characteristics to confirm designation as a non-hazardous solid waste and results provided to disposal facilities for transportation and disposal pricing. Following approval of the disposal facility and manifest by Greenfield, the IDW will be shipped to the disposal facility. Information will be provided to Mallinckrodt to support their preparation of the waste profiles.

5.4 SAMPLE HANDLING

Once sediment samples have been containerized, the containers will be labeled, placed in sealable plastic bags and placed in coolers. Sample packaging procedures are included in SOP S-20 (Appendix A). The following bullets list the type of ice to be used for samples analyzed by different methodologies:

- Mercury (medium level) by SW-846 7474: wet ice
- Mercury/methylmercury (low level) by EPA 1630 or 1631: dry ice

6 SURFACE WATER SAMPLING

Surface water sampling will be conducted according to the SOPs listed below (**Appendix A**) and any specific protocols identified in Investigation Work Plans:

- SOP S-3, Calibration of Field Instruments for Water Quality Parameters
- SOP S-4, Surface Water Sampling
- SOP S-5, Clean Hands/Dirty Hands Surface Water Sampling
- SOP S-20, Sample Packaging and Shipment

6.1 SURFACE WATER SAMPLING METHODOLOGIES

In general, a peristaltic pump will be used to collect surface water, which is defined as one foot below the water surface, unless otherwise specified by an Investigation Work Plan. Samples will be collected during out-going (ebbing) tide with lab-provided, decontaminated sample tubing. Sampling will be performed with a minimum of two people utilizing the following SOPs S-3, S-4, and S-5.

6.2 SAMPLE HANDLING

Once surface water samples are jarred, containers will be labeled and placed in sealable plastic bags and placed in coolers with wet ice. Sample packaging procedures are included in SOP S-20.

7 AVIAN SAMPLING

Avian sampling methodology varies depending on the target species. Equipment and techniques are summarized below. Additional detail for each methodology can be found in the SOPs referenced below (included in **Appendix A**). Avian species captured for collection of blood samples will be released in a safe location after all measurements and data have been recorded, blood samples obtained, and photographs have been taken (if necessary). American Black Duck tissue, if required by an Investigation Work Plan, will be opportunistically provided by waterfowl hunters.

Typical target species for avian sampling include the following:

- Nelson's sparrows (*Ammodramus nelson*)
- Red-winged blackbirds (*Agelaius phoeniceus*)
- American black duck (*Anas rubripes*)

Avian sampling will be conducted in accordance with the following SOPs contained in **Appendix A**:

- SOP S-8, Avian Mist Netting and Net Removal
- SOP S-9, Songbird Sampling
- SOP S-10, Duck Collection and Sampling of Breast Muscle Tissue and Blood
- SOP S-20, Sample Packaging and Shipment

Mist nets will be used to capture Nelson's sparrows and Red-winged blackbirds. Mist nets will be set up in accordance with SOP S-8. Non-target species caught in mist nets will be carefully extricated and released. Target species will be handled using approved handling techniques, prioritizing the health and welfare of the birds. Birds will be banded, and samples will be collected as described in SOP S-9.

Specimens of American black duck will be obtained by WSP staff and/or subcontractor biologists, with potential support from the Maine Department of Inland Fisheries and Wildlife (DIFW). Samples will be collected as described in SOP S-10.

Documentation of avian samples collected will be recorded on the following field data records, as provided in **Appendix B**:

- Mist Net Coordinates Log
- Bird Sampling Log
- Bird Banding Log
- American Black Duck Sampling Log

7.1 BLOOD SAMPLE COLLECTION

For songbirds, blood samples will be collected from the brachial vein of the wing using methods described in SOP S-9. For ducks, blood will be collected from the inner brachial artery at the base of the wing, or from the femoral vein in the leg, using a 25-gauge needle syringe, using methods described in SOP S-10.

7.2 TISSUE SAMPLE COLLECTION

Methods for whole body sample collection, as well as breast removal for tissue collection, are described in SOP S-10. Tissue collection will either be conducted in the field office/laboratory, or by the analytical laboratory upon receipt of the whole-body sample.

7.3 SAMPLE HANDLING

For songbirds, labeled vacuette tubes with blood samples will be stored in a cooler on dry ice prior to shipment to the laboratory for analysis. For ducks, whole body and tissue samples will be placed in sealable plastic bags, labeled, and placed in coolers with dry ice. Sample packaging procedures are included in SOP S-20.

8 FISH SAMPLING

Summaries of fish sampling methodologies are provided below for the various target species. Only those target species identified below will be retained. Collection of other species may occur when target species are absent, provided approval from the Remediation Trust is obtained.

Target species for fish sampling include the following:

- Atlantic tomcod (*Microgadus tomcod*)
- Rainbow smelt (*Osmerus mordax*)
- Mummichog (*Fundulus heteroclitus*)
- American eel (*Anguilla rostrata*)

Fish sampling will be conducted in accordance with the following SOPs contained in **Appendix A**:

- SOP S-12, Fish Sampling
- SOP S-13, Fish Sample Processing and Handling
- SOP S-20, Sample Packaging and Shipment

Documentation of fish samples collected will be recorded on the following field data records as provided in **Appendix B**:

- Fish Sampling Log
- Eel Sampling Log

8.1 FISH COLLECTION

Lobster traps will be employed to obtain specimens of Atlantic tomcod, seine nets will be employed to obtain specimens of rainbow smelt, and minnow traps will be used to collect mummichog. SOP S-12 details the use of minnow traps as well as other possible fish collection techniques, and sample handling procedures.

American eel specimens will be collected using baited eel traps. SOP S-12 details the use of baited eel traps, and sample handling procedures. SOP S-13 provides the sample processing, packing, and shipping procedures to be followed.

8.2 SAMPLE HANDLING

Fish will be placed in sealable plastic bags, labeled, and placed in coolers with dry ice. Sample homogenization and analysis of whole body and fillet portions of fish will be performed at the laboratory. Fish sample processing and handling methodologies are presented in SOP S-13. Sample packaging procedures are included in SOP S-20.

9 SHELLFISH SAMPLING

Shellfish sampling methodologies vary depending on the target species. However, as of the date of issuance for this FSP, the sole shellfish species targeted for sampling is:

- Lobster (Homarus americanus)

Additional detail on sampling methodology for shellfish can be found in the following SOPs contained in **Appendix A**:

- SOP S-14, Shellfish Sampling

Documentation of shellfish samples collected will be recorded on the following field data records as provided in **Appendix B**:

- Lobster Sampling Log

9.1 SHELLFISH COLLECTION

Lobster will be collected by a contracted professional/licensed lobster fisherman/boat captain with appropriate state/local permits, using traps of a type approved by said permit. GPS locations of the lobster traps that are sampled will be recorded on field data records. Field crews will measure each lobster's carapace and determine the sex. Tail portions will be homogenized and analyzed at the laboratory. SOP S-14 details the procedures for collection of lobsters via traps and is included in **Appendix A**.

9.2 SAMPLE HANDLING

Shellfish will be weighed, placed in sealable plastic bags, labeled, and placed in coolers with dry ice. Processing and homogenization of the specimens will occur at the laboratory. Sample packaging procedures are included in the attached SOP S-20.

10 POLYCHAETE SAMPLING

Polychaete sampling will be conducted according to the procedures listed below included in Appendix A:

- SOP S-15, Polychaete Sampling
- SOP S-20, Sample Packaging and Shipping

10.1 POLYCHAETE COLLECTION

Polychaetes will be collected by hand, utilizing a shovel or clam rake. Polychaetes will be dug when the sediment in the intertidal zone is exposed. Sediment will be excavated where there are small holes in the surface of the sediment. Polychaetes will be captured and extracted from the sediment with gloved hands. Polychaetes will be placed in a sample container. The polychaete collection SOP is included in **Appendix A**, as SOP S-15.

10.2 SAMPLE HANDLING

Polychaetes will be placed in artificial seawater to depurate (remove sediment from inside the body) for up to 48 hours. Samples will be shipped on wet ice to the WSP Gainesville laboratory for taxonomic identification (ID). Polychaetes need to arrive alive to facilitate ID, so an appropriate amount of wet ice should be placed in coolers to maintain biological activity and sample integrity. After taxonomic ID, samples will be weighed, placed in the appropriate container(s), then into sealable plastic bags, labeled, and placed in coolers with dry ice. The samples will then be shipped to the designated analytical laboratory. Processing and homogenization of the specimens will occur at the laboratory. Sample packaging procedures are included in SOP S-20.

11 QA/QC SAMPLING

QA/QC sampling will be conducted in accordance with the QAPP (WSP, 2023a).

11.1 DUPLICATES

Duplicates for surface water and sediment samples will be collected and analyzed at a frequency of one per 10 samples (locations to be determined in the field based on sample volume recovery).

11.2 MS/MSD

MS/MSD samples will be collected and analyzed at a frequency of one per 20 samples (locations to be determined in the field based on sample volume recovery).

11.3 EQUIPMENT AND SOURCE BLANKS

Equipment blanks will be collected at a frequency of one per type of non-dedicated sampling equipment per week. Source blanks will be collected at a frequency of one per year per type of source.

12 SAMPLE IDENTIFICATION NOMENCLATURE

Sample nomenclature is discussed in SOP S-2, included in **Appendix A**. This SOP addresses development of field sample identification (field sample ID) numbers for the various media being sampled including sediment, water, and biota.

12.1 SEDIMENT AND SURFACE WATER

Sediment and surface water sample nomenclature: **Station ID_MMDDYY_Media Type_Depth_X**

where: **MMDDYY** = Date of sample collection
Media Type = Sediment, Surface Water (SED, SW)
Depth = 2-digit depth below media surface in tenths of feet
X = C (Composite) or, G (Grab).

Example 1, Corer Collection (discrete depth):
For a sediment sample collected from 3/10ths of a foot deep at location TR-01-A on May 15, 2010, with a corer, the field sample ID would be:

TR-01-A_051510_SED_03_G

Example 2, Ponar Collection (non-discrete depth):
For a sediment sample collected from 3/10ths of a foot deep with a ponar and composited at location TR-01-B on May 15, 2010, the field sample ID would be:

TR-01-B_051510_SED_03_C

12.2 BIOTA

Biota sample nomenclature: **Station ID_MMDDYY_Species ID_Tissue ID_##**

where: **MMDDYY** = Date of sample collection
Species ID = source is Biota Species Abbreviation Table 1 (SOP S-2)
Tissue ID = source is Tissue Abbreviation Table 2 (SOP S-2)
= 2-digit number, sequential for multiple samples collected at a single location
(Note: 2-digit number optional depending on whether multiple samples are collected)

Example:
For a blood sample collected from the 12th eel at location OB-04 on May 15, 2010, the field sample ID would be:

OB-04_051510_12_EEL_BL

12.3 QA/QC

QA/QC sample nomenclature: **Station ID_MMDDYY_Media Type_Depth**

where: **Station ID** = for Samples without a fixed Station ID, (such as QC blanks) the Station ID *w*ill be populated with type of QC blank and associated equipment used for the blank.

Equipment Blank - EB

Ponar – Ponar

Petite Ponar - PPonar

Bowl – Bowl

Bowl with Spoon – Sbowl

Sawzall Blade - Sblade

where: **MMDDYY** = Date of sample collection

Media Type = The media type for which the equipment was used to collect samples: Sediment (SED), Surface Water (SW)
Depth = A value of "QC" will be used in the sample depth field, 2 characters

Example:

For an equipment blank collected from a ponar used for sediment collection in the on May 15, 2010, the field sample ID would be:

EB-Ponar_051510_SED_QC

Source Blanks:

where: **Station ID** will be populated with the material being tested (e.g., decontamination water source, dedicated equipment (e.g., sediment coring devices), items used as bait [cat food, corn, etc.])
MMDDYY = Date of sample collection
Media Type = The purpose of the source material (e.g., Bait, Sampling, Decon)
Depth = A value of "QC" will be used in the sample depth field, 2 characters

Examples:

For samples of lobster, eel, and fish bait collected on May 15, 2010, the field sample IDs would respectively be:

Herring_051510_Bait_QC

Cat Food_051510_Bait_QC

Horseshoe Crab_051510_Bait_QC

Corn_051510_Bait_QC

Core_051510_Sampling_QC

Source Water_051510_Decon_QC

Other Field QC Samples

In the case of multiple samples being collected from a location on a given day (such as field duplicates, MS/MSD, replicates etc.) additional characters will be added at the end of the field sample ID to differentiate the specific samples. These will be added to the field sample IDs specified above, as necessary:

DUP – Field Duplicate

MS – Matrix Spike

MD – Matrix Spike Duplicate

Example:

For a field duplicate blood sample collected from the 12th eel at location OB-04 on May 15, 2010, the field sample ID would be:

OB-04_051510_12_EEL_BL_DUP

13 SAMPLE CHAIN-OF CUSTODY AND SHIPPING

13.1 SAMPLE CHAIN-OF-CUSTODY FORMS

All sample shipments for analyses will be accompanied by a lab-provided and field completed Chain-of-Custody (COC) record. Analytical methods and information on laboratories where samples are to be shipped are contained in the investigation-specific Investigation Work Plans and QAPP (WSP, 2023a). COCs will be completed and sent with the samples for each laboratory and each shipment (i.e., each day). If multiple coolers are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each cooler. The COC form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of WSP. The sample management leader or designee will sign the COC form in the "relinquished by" box and note date, time, and air bill number. A copy of COCs will be retained in WSP project files. Blank and example chain-of-custody forms along with chain-of-custody instructions are included in SOP S-19 (Appendix A).

13.2 PACKAGING AND SHIPMENT

Samples will be shipped to the laboratory for analysis as soon as feasible after sample collection. Procedures to be used when packing and transporting analytical samples to the laboratory are provided in the SOP S-20 (Appendix A).

Geotechnical Shelby tubes will be packaged and handled according to SOP S-26 (Appendix A). Generally, Shelby tubes will be packaged in the field and stored on the boat in tube racks in the upright position. At the end of each day, tubes will be transferred to tube racks at the field station for storage. When all the geotechnical tubes are collected, Geotesting Express of Acton, MA will pick up the tubes for transport to their lab. Tests will include sediment grain size, bulk unit weight, percent solids, specific gravity, Atterberg limits, consolidation, permeability, and shear strength.

14 SURVEY OF SAMPLE LOCATIONS

Previously sampled locations will be re-sampled as a part of the Long-Term Monitoring program. A hand-held Global Positioning System (GPS) devise capable of sub-meter accuracy will be used to navigate to sample locations in the field. Sample locations and coordinates will be provided in Investigation Work Plans and will be uploaded to the field GPS. SOP S-25 describes the procedure used for navigation and coordinate collection with the Trimble R1 GNSS receiver using ArcGIS Field Maps on the field tablet (see **Appendix A**).

15 RECORD KEEPING

15.1 FIELD NOTES

The use of a Site Logbook and Field Logbook provide a daily record of significant events, observations, and measurements during field investigations. It is the responsibility of the Field Operation Leader (FOL) to maintain centralized daily logbook records of all significant field events, observations, and measurements during field investigations. All members of the field team are responsible for maintaining complete records of their actions, observations, etc. in their logbooks and providing this information to the team leader at the end of each day. Guidance on procedures to be used in the creation and maintenance of field logbooks is provided in SOP S-1.

The electronic field data record (e-FDR) Daily Activity Log may also be used in place of the field logbook.

15.2 ELECTRONIC FIELD DATA FORMS

The Site-specific field data forms used to document field investigation samples are included in **Appendix B**. The forms included in **Appendix B** will be created using QNOPY mobile application version 3.2.4 to allow for field data input directly to electronic field data forms (e-FDRs) on ruggedized computer tablets. The tablets will be paired with a mobile internet hot-spot connected via a cellular network so that e-FDRs will be immediately uploaded to the cloud and allow for seamless and immediate transfer of data from the field. e-FDRs will be saved as a portable document format and data collected on e-FDRs will be uploaded to the project database using QNOPY-provided EDDs.

Forms to be used during field investigation are listed below:

1	Tailgate Safety Meeting Report
2	Summary of Daily Activities
3a	Sediment Core Log
3b	Sediment Grab Log
4a	Mist Net Coordinate Log
4b	Bird Blood Sampling Log
4c	Bird Banding Data Form
5	American Black Duck Sampling Log
6	Lobster Tail Sampling Log
7	Fish Sampling Log
8	Eel Sampling Log
9	Polychaete Sampling Log
10	Equipment Calibration and Tracking Log
11	Surface Water Sampling Log
12	Daily Float Plan
13	Geotechnical Core Log

15.3 PHOTOGRAPHS

Photographs will be taken to document representative field procedures. When a photograph is taken, the date, time, weather conditions (if applicable), subject, purpose for the photograph, photograph number, and name of photographer will be recorded on the sample e-FDR and or field notebook.

16 LABORATORY DELIVERABLES AND DATA VALIDATION

16.1 LABORATORY DELIVERABLE

Full data deliverable packages equivalent to a Contract Laboratory Program (CLP) data package will be provided by the analytical laboratories. The full data deliverable package will include forms summarizing sample and QC blank results, all raw data, and forms summarizing all QC measurement parameters. Sample preparation logs will also be included in the data packages.

Hard copy data deliverables are not required for the program. Data packages will be due to WSP in 21 calendar days unless pre-approval of a delay is granted by WSP. Data packages will include a full deliverable data package in portable document format (PDF) and an electronic data deliverable (EDD).

16.2 DATA VALIDATION

All laboratory data reports will be technically reviewed for accuracy and completeness. Stage 2B data validation will be performed for 90% of project data and Stage 3 validation for the remaining 10% of off-site chemical laboratory deliverable packages. The Stage 2B validation includes review of quality control information and summary forms but does not include review of the raw data. The Stage 3 validation includes review of raw data and supporting documentation. This level of validation will allow the validator to uncover any potential data quality issues pertaining to laboratory analysis. If severe non-compliant quality control (QC) issues are identified, the laboratory will be required to correct the problem. The data validation process is outlined in Worksheets #35, #36, and #37 in the QAPP (WSP, 2023a). Data validators will produce a deliverable of validation assessment procedures and findings that include the evaluation of the precision, accuracy, representativeness, completeness, comparability, and sensitivity parameters will be completed during data validation and chemistry reviews. Data may be qualified as estimated and potentially biased during data validation. Some results may be rejected based on the guidelines and QC results.

17 REFERENCES

- AmecFW, 2018. Phase III Engineering Study Report. Penobscot River Estuary Phase III - Engineering Study, Penobscot River, Maine. Amec Foster Wheeler Environment & Infrastructure, Inc.
- CDM Smith, 2016. Corrective Measures Implementation Plan, Southern Cove, Orrington Remediation Site, Orrington, Maine. CDM Smith, Inc. June 8, 2016.
- WSP, 2023a. Draft Quality Assurance Project Plan (QAPP), Penobscot River, Maine. WSP USA Environment & Infrastructure, Inc. March 2023.
- WSP, 2023b. Health and Safety Plan (HASP), Penobscot River, Maine. WSP USA Environment & Infrastructure, Inc. March 2023.

FIGURES

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Former Veazie Dam
Former Holtrachem Facility
Southern Cove
Winterport Boat Yard
Frankfort Flats
Penobscot River
Lawrence Cove
Mendall Marsh
The Narrows
Verona Island
Eastern Channel
Odom Ledge
Fort Point Cove

Maine

Prepared for: Greenfield Penobscot Estuary Remediation Trust LCC
Trustee of the Penobscot Estuary Mercury Remdiation Trust

Prepared by: WSP USA Environment & Infrastructure, Inc.

Prepared/Date: BRP 11-10-22 | Checked/Date: BPW 11-10-22

0 1 2 3 Miles

N

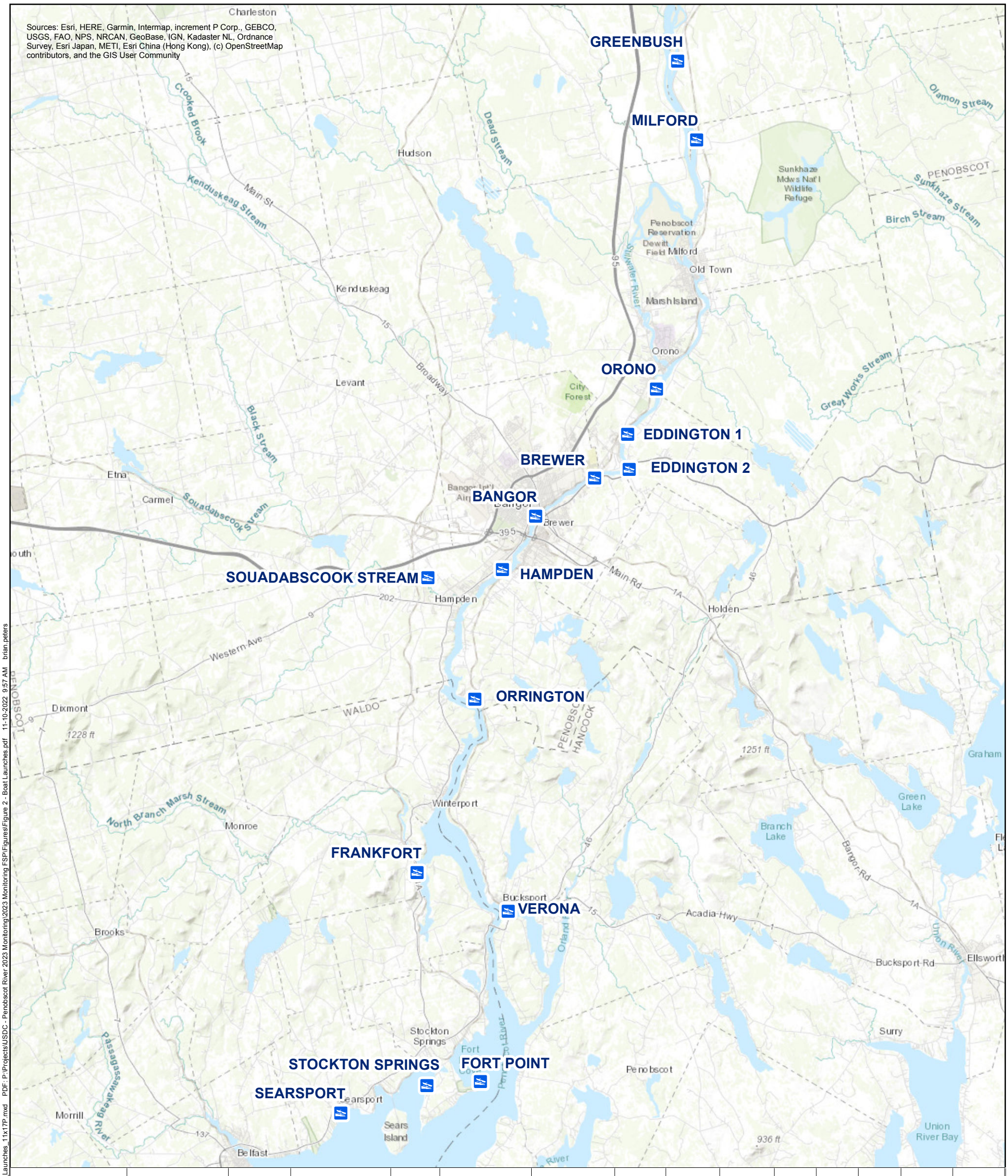
Legend

- Approximate Limit of Study Area
- Town Boundary

Figure 1-1
Site Location Map

Field Sampling Plan
Penobscot Estuary Remediation

Document: P:\Projects\USDC - Penobscot River\4.0_Deliverables\4.5_Databases\GIS\Preliminary Work\MXD\LTM 2023\Project_Location_11x17P_Index.mxd PDF: P:\Projects\USDC - Penobscot River 2023 Monitoring\2023 Monitoring FSP\Figures\Figure 1 - Site Location.pdf 11-10-2022 10:07 AM brian.peters



NAME	TOWN	COUNTY	OWNERSHIP	STATE OR LOCAL	TYPE	WATER TYPE/TIDE	TYPE OF RAMP	LENGTH OF RAMP	WIDTH OF RAMP	GRADE	FLOATS	TOILETS	Latitude	Longitude
GREENBUSH	GREENBUSH	PENOBSCOT	GREENBUSH	Local	Trailer Accessible	Freshwater	Hard	130'	16'	12%	No	No	45.057960	-68.656110
MILFORD	MILFORD	PENOBSCOT	MILFORD	Local	Trailer Accessible	Freshwater	Hard	110'	10'	14%	No	No	45.012710	-68.640660
ORONO	ORONO	PENOBSCOT	PPL-MAINE	Local	Trailer Accessible	Freshwater	Hard		10'	13.5%	No	No	44.869600	-68.672800
EDDINGTON 1	EDDINGTON	PENOBSCOT	PPL-MAINE	Local	Trailer Accessible	Freshwater	Hard		10'	13.5%	No	No	44.843300	-68.696000
EDDINGTON 2	EDDINGTON	PENOBSCOT	EDDINGTON SAL. CL.	Local	Carry-in	Freshwater					No	Yes	44.823400	-68.694700
BREWER	BREWER	PENOBSCOT	BREWER	Local	Trailer Accessible	Freshwater	Hard	120'	20'	14%	No	No	44.818420	-68.722690
BANGOR	BANGOR	PENOBSCOT	BANGOR	Local	Landing Facility	All-Tide					Yes	Yes	44.796170	-68.770120
HAMPDEN	HAMPDEN	PENOBSCOT	HAMPDEN	Local	Trailer Accessible	All-Tide Ramp	Hard	200'	50'	15%	Yes	Yes	44.765400	-68.796900
SOUADABSCOOK STREAM	HAMPDEN	PENOBSCOT	DIFW	State	Carry-in	Freshwater	Gravel				No	No	44.760700	-68.857000
ORRINGTON	ORRINGTON	PENOBSCOT	DOC	State	Trailer Accessible	Part-Tide Ramp	Hard	102'	20'	11%	No	No	44.690940	-68.818780
FRANKFORT	FRANKFORT	WALDO	FRANKFORT	Local	Trailer Accessible	All-Tide Ramp	Hard	160'	20'	13%	No	No	44.590980	-68.864790
VERONA	VERONA	HANCOCK	DOC	State	Trailer Accessible	All-Tide Ramp	Hard	100'	20'	13%	No	No	44.569170	-68.791220
FORT POINT	STOCKTON SPRINGS	WALDO	DOC	State	Landing Facility	All-Tide					Yes	No	44.471000	-68.813100
STOCKTON SPRINGS	STOCKTON SPRINGS	WALDO	STOCKTON SPRINGS	Local	Trailer Accessible	All-Tide Ramp	Hard	160'	20'	8%	Yes	No	44.468600	-68.856100
SEARSPORT	SEARSPORT	WALDO	SEARSPORT	Local	Trailer Accessible	All-Tide Ramp	Hard	110'	24'	14%	Yes	No	44.452550	-68.925130

Prepared for: Greenfield Penobscot Estuary Remediation Trust LCC
Trustee of the Penobscot Estuary Mercury Remdiation Trust

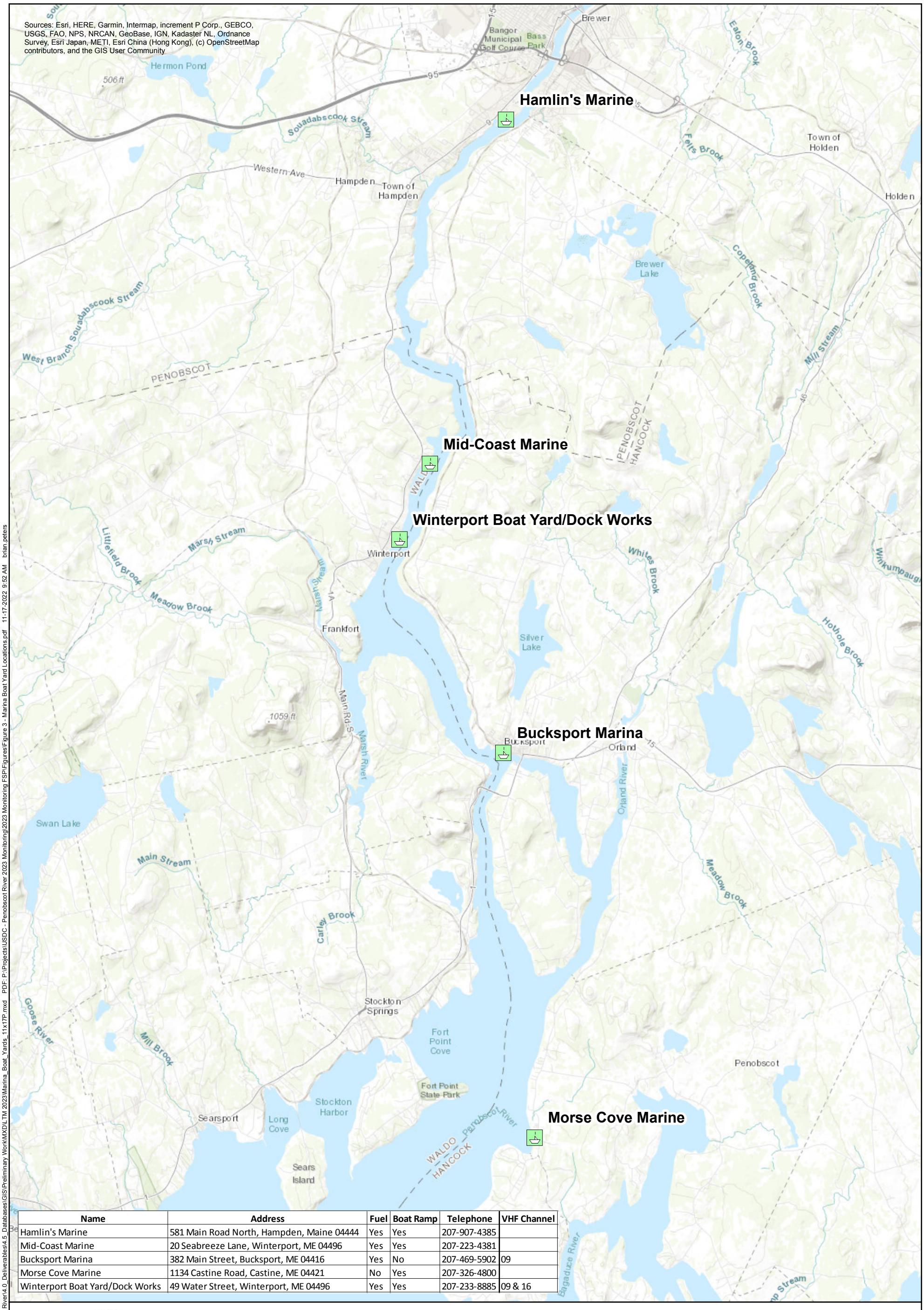
Prepared by: WSP USA Environment & Infrastructure, Inc.

Prepared/Date: BRP 11-10-22 | Checked/Date: BPW 11-10-22

Figure 3-1
Boat Launch Locations

Field Sampling Plan
Penobscot Estuary Remediation

Document: P:\Projects\USDC - Penobscot River\4.0_Deliverables\4.5_Databases\GIS\Preliminary Work\MXD\LTM 2023\Boat_Launches_11x17P.mxd PDF: P:\Projects\USDC - Penobscot River\2023 Monitoring\2023 Monitoring FSP\Figures\Figure 2 - Boat Launches.pdf 11-10-2022 9:57 AM brian.peters



Name	Address	Fuel	Boat Ramp	Telephone	VHF Channel
Hamlin's Marine	581 Main Road North, Hampden, Maine 04444	Yes	Yes	207-907-4385	
Mid-Coast Marine	20 Seabreeze Lane, Winterport, ME 04496	Yes	Yes	207-223-4381	
Bucksport Marina	382 Main Street, Bucksport, ME 04416	Yes	No	207-469-5902	09
Morse Cove Marine	1134 Castine Road, Castine, ME 04421	No	Yes	207-326-4800	
Winterport Boat Yard/Dock Works	49 Water Street, Winterport, ME 04496	Yes	Yes	207-233-8885	09 & 16

Prepared for: Greenfield Penobscot Estuary Remediation Trust LCC
Trustee of the Penobscot Estuary Mercury Remdiation Trust

Prepared by: WSP USA Environment & Infrastructure, Inc.

Prepared/Date: BRP 11-10-22 | Checked/Date: BPW 11-10-22

Legend

Marine Facilities

0 1 2 3 Miles

N

Figure 3-2
Marina and Boat Yard Locations

Field Sampling Plan
Penobscot Estuary Remediation

Document: P:\Projects\USDC - Penobscot River\4.0_Deliverables\4.5_Databases\GIS\Preliminary Work\MXD\LTM 2023\Marina_Boat_Yards_11x17P.mxd PDF: P:\Projects\USDC - Penobscot River 2023 Monitoring\2023 Monitoring FSP\Figures\Figure 3 - Marina Boat Yard Locations.pdf 11-17-2022 9:52 AM brian.peters

TABLES

Table 1-1. Statement of Work Compliance

Statement of Work (SOW) Requirement	FSP Section
¶ 31(c) The Field Sampling Plan ("FSP") addresses all sample collection activities.	✓ Entire Document
¶ 31(c) The FSP must be written to ensure that all data collected meets the applicable Data Quality Objectives	✓ Section 2
¶ 31(c) …in a format such that a field sampling team unfamiliar with the project would be able to gather the samples and field information required.	✓ Sections 5-14 Appendix A Appendix B
¶ 31(c) ...the FSP may be adapted from Amec's FSP for the Phase III Engineering Study.	✓ The FSP is an adaptation of the AmecFW FSP[1]

Notes:
1) AMEC Foster Wheeler Field Sampling Plan, 2017. Phase III Engineering Study, Penobscot River Estuary.

Table 2-1. Field Sampling Plan Objectives

Objective	Information/Data Needed	FSP Document Section
Provide project field sampling crews with the methodologies for collection of samples and data of sufficient quality during Penobscot River Estuary Remediation.	The Field Sampling Plan, including Standard Operating Procedures and Field Data Records	Sections 5-14 Appendix A Appendix B
The Field Sampling Plan ("FSP") addresses all sample collection activities.		
The FSP must be written to ensure that all data collected meets the applicable (Data Quality) Objectives.		
The FSB must be in a format such that a field sampling team unfamiliar with the project would be able to gather the samples and field information required.		
As appropriate, the FSP may be adapted from Amec's FSP for the Phase III Engineering Study.	AmecFW FSP, 2017	All

Table 3-1
Contact List

Field Sampling Plan
March 2023
Penobscot Estuary Remediation

NAME	TELEPHONE NUMBERS	
	Office	**Cell**
The Penobscot Regional Communications Center Dispatch/Public Safety Answering Point (PSAP) facility with enhanced 911 capability, operated on a 24-hour basis.	911	
Fire Department	911	
Hospital	911 or 207-973-7000	
Police Department	911	
Ambulance	911	
TriageNow - WSP early injury case management	1-877-311-0038	
WSP Group HSE Manager: Cindy Sundquist	N/A	207-650-7593
Beth McDonald - WSP contact for incident related drug testing	770-360-0551	
Project Manager: Rod Pendleton	N/A	207-229-0891
Field Operations Manager (FOM): Brad Wolfe	N/A	925-323-4082
Field Operation Lead (FOL): Chuck Lyman	N/A	617-947-6935
Avian and Overall Biota Lead: Louise Venne	N/A	678-622-5559
Aquatic Biota Lead: Jonathan Bourdeau	N/A	678-362-6122
e-FDRs and Records Lead: Lindsey Fales	N/A	207-228-3909
Project Chemist: Denise King	N/A	508-789-1738
Project Technical Director: Nelson Walter	N/A	207-651-0315
Client Contact: Lauri Gorton	Contact via Project Mgr.	
National Response Center (spills, security) - U.S. Coast Guard	800-424-8802 or 202-267-2675	
Clean Harbors 24-hr Spill Response	207-799-8111	
DFW Warden Service (Central Division – Bangor)	207-941-4470	
DMR Marine Patrol (Division II)	207-667-3373	
U.S. Coast Guard Station Rockland, ME	207-596-6667	

APPENDIX A
STANDARD OPERATING PROCEDURES

SOP #	SOP Description
S-1	Use of Field Logbooks
S-2	Sample Nomenclature Creation
S-3	Calibration of Field Instrument for Water Quality Parameters
S-4	Surface Water Sampling
S-5	Clean Hands/Dirty Hands Surface Water Sampling
S-6	Sediment Collection
S-6A	Interval Sediment Sampling
S-7	Procedure for Description and Identification of Soils
S-8	Avian Mist Netting and Net Removal
S-9	Songbird Sampling
S-10	Sampling of Breast Muscle Tissue and Blood from Ducks
S-12	Fish Sampling Procedures
S-13	Fish Sample Processing and Handling Procedure
S-14	Shellfish Sampling
S-15	Polychaete Sampling
S-17	Decontamination of Field Equipment
S-19	Sample Chain of Custody Procedure
S-20	Sample Packaging and Shipping
S-25	Trimble R1 GNSS Receiver with ArcGIS Field Maps for GPS
S-26	ASTM-Geotechnical Core Collection, Preservation, Handling

Note: SOP #s are not consecutive.

SOP No. S-1

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

USE OF FIELD LOGBOOKS

USE OF FIELD LOGBOOKS

Scope and Applicability

The use of a Site Logbook and Field Logbook provides a daily record of significant events, observations, and measurements during field investigations. A site logbook is the master log for recording activities during an investigation. Field logbooks provide data and observations which will enable field personnel to reconstruct field project events. Sufficient data and observations should be logged in the field logbook to enable reconstruction of field events and to provide sufficient evidence in the event of legal proceedings.

Responsibilities

It is the responsibility of the Field Operation Leader (FOL) to maintain centralized daily log book records of all significant field events, observations, and measurements during field investigations. All members of the field team are responsible for maintaining complete records of their actions, observations, etc. in their log books and providing this information to the team leader at the end of each day. If observations and measurements are taken in an area where the field log book may become contaminated or if the field personnel are spread over a large area, separate waterproof bound and numbered field log books may be maintained. Logbook entries should be signed and dated at the completion of each task or at the end of each day. Individual field log books are retained by the field team members until the logbook is filled or the completion of the project, at which time, possession of the log books is transferred to the FOL or project manager.

Errant field entries shall have a single line drawn through them and the correct data entered above it. All corrections shall be initialed and dated by the appropriate field personnel. Individual pages should never be removed from bound logbooks.

Equipment Descriptions

A waterproof, bound field notebook and indelible ink pen are the standard field equipment.

Procedures

The title page of each logbook will contain the following:

- The logbook number
- Project name and project number
- Site name (Penobscot River) and address (Penobscot River, Maine)
- Logbook start date

The site logbook and field logbooks provide a daily hand written account of all field activities. All entries are made in permanent black or blue ink, and corrections are made with a single line with the author initials and date. Each page of the logbook will be dated and signed by the person completing the log. Partially completed pages will have a line drawn through the unused portion at the end of each day.

Site Logbook

The site logbook is a record of all major tasks completed for each day or operation. Entries are made each day. The FOL responsible for on-site field operations will complete the site logbook. At a minimum the site logbook will contain the following information:

- A list of all field logbooks created for the project;
- Names and titles of all project related personnel present at the site during each day of operation;
- A brief summary of all activities completed for each day of operation;
- A listing of any changes made to established SI/RI program procedures; and,
- A summary of any problems encountered during the day including a description of corrective actions and impacts on the project.

Field Logbook

Field logbooks are daily records of field task activities that are entered in real time by the on-site field technicians and scientists. The following information is entered into the field logbooks:

- The date and time of each entry. The daily log should begin with weather conditions and the names and organizations of personnel performing the documented task;
- A summary of important tasks or subtasks completed during the day;
- A description of any field tests completed in association with the daily task;
- A description of any samples collected including documentation of any quality control samples that were prepared (rinse blanks, duplicates, matrix spikes, split samples);
- Documentation of equipment maintenance and decontamination activities; and,
- A summary of any problems encountered during the day including a description of corrective actions and impacts on the daily task.

- END OF PROCEDURE-

SOP No. S-2

WSP USA ENVIRONMENT AND INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

FIELD SAMPLE NOMENCLATURE

FIELD SAMPLE NOMENCLATURE

A systematic field sample identification nomenclature has been developed. Consistent nomenclature has been designed to facilitate entry, management and manipulation of field and analytical data in the Penobscot River Phase III Engineering Evaluation project.

This SOP covers the following sample naming issues separately:

Biota Sample Nomenclature

Sediment, Surface Water, and Pore Water Sample Nomenclature

Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field samples will be identified as follows:

Biota Sample Nomenclature

Station ID_ MMDDYY _ ##_ Species ID _ Tissue ID

where:

Station ID = Location identifier (typically two letters followed by a dash followed by two numbers (e.g., OV-04) **5 Characters.**

MMDDYY = Sample date of sample (e.g., 062117) **6 Characters.**

= 2 digit sequential number for single or multiple samples collected at a given location on a given date (i.e., 01 through 99) **2 Characters.**

Species ID = Comes from Biota Species Abbreviation Table 1 (e.g., ABD) **3 Characters.**

Tissue ID = Comes from Tissue Abbreviation Table 2 (e.g., BL) **2 Characters.**

Example:

For a blood sample collected from the 12th Double Crested Cormorant at location OB4 on May 15, 2010, the field sample ID would be:

OB-04_051510_12_DCC_BL

Sediment, Surface Water, and Pore Water Sample Nomenclature

Station ID_ MMDDYY _ Media Type_ Depth_X

where:

Station ID = Location identifier (typically two letters followed by a dash followed by two numbers (e.g., OV-04) but other station IDs identifies may be used to be consistent with historical sampling (e.g., WQ1b-C) **5 to 10 Characters.**

MMDDYY = Sample date of sample (e.g., 062117) **6 Characters.**

Media Type = Sediment (SED), Surface Water (SW), Pore Water (PW), Wood Chip (WCH) **2-3 Characters.**

Depth = depth below media surface in feet/tenths of feet. (e.g., core sample 0.8 feet below media surface would be 0.8, or a). Substitute "XX" for the depth identifiers where non discrete depth samples are collected (e.g., Ponar composite sample).

X = C (Composite) or, G (Grab).

Example 1, Corer Collection (discrete depth):

For a sediment sample collected from 3/10ths of a foot deep at location TR-01-A on May 15, 2010 with a corer, the field sample ID would be:

TR-01-A_051510_SED_03_G

Example 2, Ponar Collection (non-discrete depth):

For a sediment sample collected with a ponar and composited at location TR-01-B on May 15, 2010, the field sample ID would be:

TR-01-B_051510_SED_XX_C

Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Station ID_ MMDDYY _ Media Type_ Depth_X

Equipment Blanks:

where:

Station ID = For Samples without a fixed Station ID, (such as QC blanks) the Station ID will be populated with type of QC blank and associated equipment used for the blank.

Equipment Blank - EB

Ponar – Ponar

Petite Ponar - PPonar

Push Core – Pcorer

Vibracore - VCorer

Hand Auger – Auger

Drill Mixer – Mixer

Paring knife – Knife

Bowl – Bowl

Bowl with Spoon – Sbowl

Sawzall Blade - Sblade

MMDDYY = Sample date of sample (e.g., 062117) **6 Characters.**

Media Type = The media type for which the equipment was used to collect samples: Sediment (SED), Surface Water (SW), Pore Water (PW), Wood Chip (WCH) **2-3 Characters.**

Depth = A value of "QC" will be used in the sample depth field **2 Characters.**

Example: For an equipment blank collected from a ponar used for sediment collection in the on May 15, 2010, the field sample ID would be

EB-Ponar_051510_SED_QC

EB-Knife_012317_ABD_QC

Source Blanks:

where:

Station ID = will be populated with the material being tested (e.g., dedicated equipment like Cores, things used as bait [Cat Food, Corn etc.] **15 Characters or less**

MMDDYY = Sample date of sample (e.g., 062117) **6 Characters**

Media Type = Populate with the purpose of the source material (e.g., Bail, Sampling, Decon) **10 Characters or less**

Depth = A value of "QC" will be used in the sample depth field **2 Characters**

Examples: For samples of lobster, eel, and fish bait collected on May 15, 2010, the field sample ID would respectively be:

Herring_051510_Bait_QC

Cat Food_051510_Bait_QC

Horseshoe Crab_051510_Bait_QC

Cat Food_051510_Bait_QC

Corn_051510_Bait_QC

Core_051510_Sampling_QC

Source Water_051510_Decon_QC

Other Field QC Samples

In the case of multiple samples being collected from a location on a given day (Such as field duplicates, MS/MSD, replicates etc.) additional characters will be added at the end of the field sample ID to differentiate the specific samples. These will be added to each of the nomenclature samples specified above, as necessary:

DUP – Field Duplicate

MS – Matrix Spike

MD – Matrix Spike Duplicate

R1 – Replicate 1

R2 – Replicate 2

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Acrididae	Acrididae	ACR	Short-horned Grasshopper
Alder Flycatcher	Alder Flycatcher	ALF	Alder Flycatcher
American black duck	American black duck	ABD	American black duck
American Goldfinch	American Goldfinch	AMG	American Goldfinch
American Robin	American Robin	AMR	American Robin
Amphipod	Amphipod	AMP	Amphipod
Amphipods	Amphipods	AMP	Amphipod
Annelide	Annelide	ANN	Ringed/ Segmented Worm
Apidae	Apidae	API	Bee
Araneidae	Araneidae	ARA	Orb-weaver Spider
Araneidae+Lycosidae	Araneidae+Lycosidae	ARL	Orb-weaver Spider + Wolf Spider
Asillidae	Asillidae	ASI	Robber Flies
Atlantic Herring	Atlantic Herring	ATH	Atlantic Herring
Belted Kingfisher	Belted Kingfisher	BEK	Belted Kingfisher
Black Guillemot	Black Guillemot	BLG	Black Guillemot
Black-And-White Warbler	Black-And-White Warbler	BWW	Black-And-White Warbler
Black-Capped Chickadee	Black-Capped Chickadee	BCC	Black-Capped Chickadee
Black-throated Green Warbler	Black-throated Green Warbler	BGW	Black-throated Green Warbler
Blue Mussel	Blue Mussel	BLM	Blue Mussel
Bobolink	Bobolink	BOB	Bobolink

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Brown-Headed Cowbird	Brown-Headed Cowbird	BHC	Brown-Headed Cowbird
Bufflehead	Bufflehead	BUF	Bufflehead
Bufo americanus	Bufo americanus	BUA	American Toad
Campelona sp.	Campelona sp.	CAM	Freshwater Snail
Cancer crab	Cancer crab	CAC	Atlantic Rock Crab
Cancer irroratus	Cancer irroratus	CAI	Atlantic Rock Crab
Carcinus maenas	Carcinus maenas	CMA	Green Crab
Cercopidae	Cercopidae	CER	Froghopper (xylem-feeding insect)
Cerulean Warbler	Cerulean Warbler	CEW	Cerulean Warbler
Chestnut-Sided Warbler	Chestnut-Sided Warbler	CSW	Chestnut-Sided Warbler
Chironomidae	Chironomidae	CHI	Non-Biting Midge
Cicadellidae	Cicadellidae	CIC	Leafhopper
Clubionidae	Clubionidae	CLU	Sac Spider
Coleopteran	Coleopteran	COL	Beetle
Common Goldeneye	Common Goldeneye	COG	Common Goldeneye
Common Yellowthroat	Common Yellowthroat	COY	Common Yellowthroat
Crangon	Crangon	CRA	Caridean Shrimp
Culicidae	Culicidae	CUL	Mosquito
Cyprinidae	Cyprinidae	CYP	Minnow
Dictynidae	Dictynidae	DIC	Mesh Web Weaver Spider
Diptera	Diptera	DIP	True Flies

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Dolichopodidae	Dolichopodidae	DOL	Longlegged Flies
double-crested cormorant	Double-crested cormorant	DCC	double-crested cormorant
Eagle	Eagle	EAG	Eagle
Eastern Phoebe	Eastern Phoebe	EAP	Eastern Phoebe
Eastern Wood-Pewee	Eastern Wood-Pewee	EWP	Eastern Wood-Pewee
Eel	Eel	EEL	Eel
Elliptio complanata	Elliptio complanata	ELC	Freshwater Mussel
Eptesicus fuscus	Eptesicus fuscus	EPF	Big Brown Bat
Fish	Fish	FIS	Fish
Formicidae	Formicidae	FOR	Ant
Fulgoroidea	Fulgoroidea	FUL	Planthopper
Gammarus daiberi	Gammarus daiberi	GAD	Amphipod
Glycera	Glycera	GLY	Bloodworm
Glycera & Neanthes Virens	Glycera & Neanthes Virens	GNV	Bloodworm and Clam Worm
Golden Shiner	Golden Shiner	GOS	Golden Shiner
Grass shrimp	Grass shrimp	GRS	Grass shrimp
Gray Catbird	Gray Catbird	GRC	Gray Catbird
Halichoerus grypus	Halichoerus grypus	HAG	Grey Seal
Heleromastus filiformis	Heleromastus filiformis	HEF	long thin bright red worm
Helisoma anceps + P.a.	Helisoma anceps + P.a.	HAP	Two-Ridge Rams-Horn Snail
Hermit Thrush	Hermit Thrush	HET	Hermit Thrush

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Ichneumonidae	Ichneumonidae	ICH	Parasitic Wasp
Killdeer	Killdeer	KIL	Killdeer
Lasiurus borealis	Lasiurus borealis	LAB	Eastern Red Bat
Least Sandpiper	Least Sandpiper	LES	Least Sandpiper
Linyphiidae	Linyphiidae	LIN	Sheetweb Weaver Spider
Littorina Littorea	Littorina Littorea	LIL	Common Periwinkle
Lobster	Lobster	LOB	Lobster
Lycosidae	Lycosidae	LYC	Wolf Spider
Lymnaca columella	Lymnaca columella	LCO	American ribbed fluke snail
Lymnaea megasoma	Lymnaea megasoma	LME	Mammoth Lymnaea
Lymnaedae	Lymnaedae	LYM	Air-Breathing Freshwater Snails
Macoma	Macoma	MAC	Saltwater Clams
Marsh Wren	Marsh Wren	MAW	Marsh Wren
Membracidae	Membracidae	MEM	Treehopper
Menidia menidia	Menidia menidia	MME	Atlantic silverside
Mink	Mink	MIN	Mink
Miridae	Miridae	MIR	Capsid bugs
Mummichog	Mummichog	MUM	Mummichog
Muscidae	Muscidae	MUS	House Flies
Muskrat	Muskrat	MUR	Muskrat
Myotis lucifigus	Myotis lucifigus	MYL	Little Brown Bat

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Myotis septentrionalis	Myotis septentrionalis	MYS	Northern Long-Eared Bat
Nashville Warbler	Nashville Warbler	NAW	Nashville Warbler
Neanthes virens	Neanthes virens	NEV	Clam Worm
Nelson's sharp-tailed sparrow	Nelson's sharp-tailed sparrow	NSS	Nelson's sharp-tailed sparrow
Nereis sp.	Nereis sp.	NES	Polychaete worms
Northern Parula	Northern Parula	NOP	Northern Parula
Northern Waterthrush	Northern Waterthrush	NWT	Northern Waterthrush
Oligochaeta	Oligochaeta	OLI	Earthworms
Osprey	Osprey	OSP	Osprey
Otter	Otter	OTT	Otter
Ovenbird	Ovenbird	OVE	Ovenbird
Pentatomidae	Pentatomidae	PEN	Terrestrial Turtle Bugs
Philodromidae	Philodromidae	PHI	philodromid crab spiders
Physa gyrine	Physa gyrine	PHG	Pond Snail
Planorbis campanulatus	Planorbis campanulatus	PLC	Snail
Polychaetes	Polychaetes	POL	Annelid Worm
Pyganadon cataracta	Pyganadon cataracta	PYG	Eastern Floater
Rainbow Smelt	Rainbow Smelt	RAS	Rainbow Smelt
Red-Eyed Vireo	Red-Eyed Vireo	REV	Red-Eyed Vireo
Red-Winged Blackbird	Red-Winged Blackbird	RWB	Red-Winged Blackbird
Salticidae	Salticidae	SAL	Jumping Spider

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Saltmarsh Sharp-Tailed Sparrow	Saltmarsh Sharp-Tailed Sparrow	SSS	Saltmarsh Sharp-Tailed Sparrow
Savannah Sparrow	Savannah Sparrow	SAS	Savannah Sparrow
Scallop	Scallop	SCA	Scallop
Scathophagidae	Scathophagidae	SCT	Calyptrate flies
Sciomyzidae	Sciomyzidae	SCI	Marsh Flies
Seal	Seal	SEA	Seal
Semipalmated Plover	Semipalmated Plover	SEP	Semipalmated Plover
Semipalmated Sandpiper	Semipalmated Sandpiper	SES	Semipalmated Sandpiper
Sepsidae	Sepsidae	SEP	Black Scavenger Flies
Sharp-Tailed Sparrow	Sharp-Tailed Sparrow	STS	Nelson's sharp-tailed sparrow
Shrimp	Shrimp	SHR	Shrimp
Snail	Snail	SNA	Snail
Soft-shell Clam	Soft-shell Clam	SSC	Soft-shell Clam
Song Sparrow	Song Sparrow	SOS	Song Sparrow
Sparrow	Sparrow	SPA	Sparrow
Spider	Spider	SPI	Spider
Spotted Sandpiper	Spotted Sandpiper	SPS	Spotted Sandpiper
Swamp Sparrow	Swamp Sparrow	SWS	Swamp Sparrow
Syrphidae	Syrphidae	SYR	Hoverflies
Tabanidae	Tabanidae	TAB	Horse and Deer Flies
Tabanus	Tabanus	TAB	Biting Horse Flies
Tachinidae	Tachinidae	TAC	Tachinid Flies

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Talitridae	Talitridae	TAL	Amphipod
Tetragnathidae	Tetragnathidae	TET	Long-Jawed Orb Weaver Spider
Tettigoniidae	Tettigoniidae	TTT	Long-Horned Grasshoppers
Theridiidae	Theridiidae	THE	Cobweb Spiders
Thomisidae	Thomisidae	THO	Crab Spider
Tick	Tick	TIC	Tick
Terrestrial Insect	Terrestrial Insect	TIN	Terrestrial Insect
Tipula sp (diptera larvae)	Tipula sp (diptera larvae)	TDL	Crane Fly (Larvae)
Tipulidae	Tipulidae	TIP	Crane Fly
Tomcod	Tomcod	TOM	Tomcod
Tree Swallow	Tree Swallow	TRS	Tree Swallow
Ulidiidae	Ulidiidae	ULI	Picture-winged Fly
Unknown	Unknown	UNS	Unknown
Unknown Bird	Unknown Bird	UNB	Unknown Bird
Unknown Fish	Unknown Fish	UNF	Unknown Fish
Unknown Mammal	Unknown Mammal	UNM	Unknown Mammal
Unspecified	Unspecified	UNS	Unspecified
Veery	Veery	VEE	Veery
Virginia Rail	Virginia Rail	VIR	Virginia Rail
Wilson's Snipe	Wilson's Snipe	WIS	Wilson's Snipe
Winter Flounder	Winter Flounder	WIF	Winter Flounder
Yellow Palm Warbler	Yellow Palm Warbler	YPW	Palm Warbler

Table 1			
Biota Species Abbreviations			
Original W&C Species	**TED Species Fix**	**TED Species Abbreviation**	**Common Name**
Yellow Warbler	Yellow Warbler	YEW	American Yellow Warbler
Zooplankton	Zooplankton	ZOO	Zooplankton

Table 2			
Biota Tissue Media Abbreviations			
Original W&C Tissue	**TED Tissue Fix**	**TED Tissue Abbreviation**	**MEDIA**
Blood	Blood	BL	Blood
Brain	Brain	BR	Brain
Breast	Breast	BR	Breast
Breast Feathers	Breast Feathers	FB	Feather
Egg	Egg	EG	Egg
Feather	Feather	FF	Feather
P1-feather	P1-feather	FP	Feather
Shed Feather	Shed Feather	FX	Feather
Small Feathers	Small Feathers	FS	Feather
P-Feather	P-Feather	FP	Feather
T-Feather	T-Feather	FT	Feather
Feces	Feces	FE	Feces
Fur	Fur	FU	Fur
Claw	Claw	CL	Lobster
Tail	Tail	TA	Lobster
Tomalley	Tomalley	TO	Lobster

Table 2			
Biota Tissue Media Abbreviations			
Original W&C Tissue	**TED Tissue Fix**	**TED Tissue Abbreviation**	**MEDIA**
Mud	Mud	MD	Mud
Muscle	Muscle	MU	Muscle
Kidney	Kidney	KI	Organ
Liver	Liver	LI	Organ
Sand	Sand	SA	Sand
Stomach Contents (chironomidae)	Stomach Contents (chironomidae)	SC	Stomach
Stomach Contents (shrimp Crangon)	Stomach Contents (shrimp Crangon)	SC	Stomach
Vomit	Vomit	VO	Stomach
Unspecified	Unspecified	UN	Unspecified
Whole Body	Whole Body	WB	Whole Body

- END OF PROCEDURE -

SOP No. S-3

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

CALIBRATION OF FIELD INSTRUMENTS FOR WATER QUALITY PARAMETERS

CALIBRATION OF FIELD INSTRUMENTS FOR WATER QUALITY PARAMETERS

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to provide a framework for calibrating field instruments used to measure water quality parameters for groundwater and surface water. Water quality instruments addressed in this SOP include those that measure temperature, pH, dissolved oxygen (DO), conductivity/specific conductance, oxidation-reduction potential (ORP), and turbidity. This SOP is written for instruments that utilize multiple probes for temperature, pH, DO, conductivity/specific conductance, ORP, and turbidity. This SOP refers to instrumentation and outlines calibration procedures consistent with those discussed in U.S. Environmental Protection Agency (USEPA) Region I Standard Operating Procedure, Draft Calibration of Field Instruments, June 3, 1998.

For groundwater monitoring during well development and/or purging prior to sample collection, the multiple probe instrument must be equipped with a flow-through cell, and the display/logger or computer display screen should be large enough to simultaneously display the readouts of each probe in the instrument. Turbidity is measured using a separate instrument because turbidity cannot be measured accurately in a flow-through cell.

Responsibilities

All monitoring instruments must be calibrated before they are used to measure environmental samples. Most instruments will require at least two standards to bracket the expected measurement range, one standard less than the expected value and one higher. At a minimum, calibration must be performed at the beginning of each sampling day prior to sample collection. Site-specific plans should be consulted for required calibration frequency. Note: Part of the instrument preparation and initial calibration is performed prior to the field event.

This SOP requires that the manufacturer's instruction manual (including the instrument specifications) accompany the instrument into the field.

Definitions

SOP Standard Operating Procedure pH Potential of Hydrogen ORP Oxidation-Reduction Potential NIST National Institute of Standards and Technology C Celsius mg Milligram L Liter DO Dissolved Oxygen mm Millimeter NTU Nephelometric Turbidity Unit PPE Personal Protective Equipment Sonde Device that holds the measuring probes SU Standard Units µg Microgram

Health and Safety Warnings

WSP USA Environment & Infrastructure, Inc. (WSP) employees will be on site when implementing this SOP. Therefore, WSP personnel shall follow the site-specific Health & Safety Plan (HASP). WSP personnel will use the appropriate level of personal protective equipment (PPE), which includes the following:

1) hardhat; 2) safely boots (steel toe/steel shank); 3) safety glasses; and 4) chemical resistant gloves. Implementing this SOP will require the use of calibration solutions. The following health and safety precautions must be taken with the pH, conductivity, and ORP solutions: Avoid inhalation, skin and eye contact or ingestion.

Maintenance of the instruments will require the use of liquid cleaners. Although these substances are not hazardous materials, WSP will appropriately handle and store them at times in accordance with manufacturer's instructions.

Cautions & Potential Problems

Prior to calibration all instrument probes must be cleaned according to the manufacturer's instructions. Failure to perform this step (proper maintenance) can lead to erroneous measurements.
Prior to using calibration standards, check all expiration dates.
Use a ring stand and clamp to secure the sonde in an upright position. This will prevent the sonde from falling over and damaging the probes.

The volume of the calibration solutions must be sufficient to cover both the probe being calibrated and the temperature sensor (see manufacturer's instructions for additional information).
While calibrating or performing sample measurements, make sure there are no air bubbles lodged between the probe and the probe guard.

DO content in water is measured using a membrane electrode. The DO probe's membrane and electrolyte solution should be replaced prior to the sampling period. Failure to perform this step may lead to erratic and or erroneous measurements. If the probe reading shows the error message "value out of range", the instrument probe must be recalibrated.

Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, all WSP personnel must be adequately trained.

Before implementing this SOP alone, WSP personnel must be trained in these procedures by a senior staff member with experience operating the equipment. In addition, all personnel utilizing this SOP must have completed the following:

- 40-hour OSHA training;
- 8-hour annual refresher training; and
- On-site training.

In addition to the 40-hour initial OSHA; training (and annual 8-hour refresher training), all WSP field staff will complete 24 hours of supervised field experience that contribute toward the 24-hour field supervised requirement in compliance with OSHA regulation: 29 CFR 1910.120(e)(4).

Equipment and Supplies

The following equipment should be used when calibrating water quality parameter measuring equipment. Site-specific conditions may warrant the use of additional items or deletion of items from this list.

- Appropriate level of personal protection
- Water quality meter capable of measuring pH, temperature, DO, specific conductivity, Salinity, and ORP (e.g., YSI 600XL, or equivalent)
- Turbidity Meter (e.g., LaMotte 2020, or equivalent)
- Distilled water
- Deionized water
- Flow-through cell
- Ring stand with clamp
- Paper towels
- Soft tissue (e.g., Kimwipes)
- Cuvette
- pH buffer solutions (4, 7, 10 SU)
- Conductivity solution (100, 1000 µmhos)
- Zobell solution
- Turbidity standards (0.5, 20 NTU)
- Zero DO solution (0.0 milligrams per liter [mg/L])
- DO membrane kit (electrolyte solution, membranes)
- NIST thermometer (0.01 C accuracy)
- Small glass or polyethylene jars to hold the calibration standards (4-8 oz.)
- Calibration Logbook
- Field Instrument Calibration Field Data Record (See FDR Appendix of QAPP)
- Cup or spray bottle for the distilled water

Procedures

The probe readings for pH, dissolved oxygen, and specific conductance are automatically corrected for temperature by the instrument. Communications to the instrument (programming and displaying the measurement files) are performed using a display/logger or a computer. Information sent to the instrument is entered through the keypad on the display/logger or computer. It is desirable that the display/logger or computer have data storage capabilities. If the instrument does not have a keypad, follow the manufacturer's instructions for entering information into the instrument.

- Program the multi-probe instrument so that the following parameters to be measured will be displayed: temperature, pH, percent DO, mg/L dissolved oxygen, conductivity, specific conductance, and ORP.
- For instrument probes that rely on the temperature sensor (pH, DO, conductivity/specific conductance, and ORP), each temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). Before any instrument is calibrated or used to perform environmental measurements, the instrument must stabilize (warm-up) according to manufacturer's instructions.

Temperature Most instrument manuals state that calibration of the temperature sensor is not required, but this SOP requires that the temperature sensor be checked to verify its accuracy. This accuracy check is performed at least once per year and the accuracy check date/information is kept with the instrument. If the accuracy check date/information is not included with the instrument or the last check was performed over a year prior to the date of use, it is recommended that the temperature sensor accuracy be checked at the beginning of the sampling event. If the instrument contains multiple temperature sensors, each sensor must be checked.

VERIFICATION PROCEDURE

1. Allow a container filled with water to equilibrate to ambient temperature.
2. Place a NIST -traceable thermometer and the instrument's temperature sensor into the water and wait approximately five minutes for both temperature readings to stabilize.
3. Compare the two measurements. The instrument's temperature sensor must agree with the NIST - traceable thermometer measurement within the accuracy of the sensor (usually to +/-15°C). If the measurements do not agree, the instrument may not be working properly, and the manufacturer needs to be consulted.

Dissolved Oxygen DO is the volume of oxygen that is dissolved in water and is measured using a membrane electrode. The DO probe's membrane and electrolyte solution should be replaced prior to the sampling period. Failure to perform this step may lead to erratic or erroneous measurements.

CALIBRATION PROCEDURE

1. Gently dry the temperature sensor according to manufacturer's instructions.
2. Place a wet sponge or a wet paper towel on the bottom of the DO calibration container that comes with the instrument.
3. Place the DO probe in the container without the probe coming in contact with the wet sponge or paper towel. The probe must fit loosely in the container to ensure it is vented to the atmosphere.
4. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During this time, turn on the instrument to allow the DO probe to warm up. Select monitoring/run mode. Check temperature readings. Readings must stabilize before continuing to the next step.
5. Select calibration mode; then select "DO%".
6. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement can be determined from an on-site barometer. Do not use barometric pressure obtained from the local weather services unless the pressure is corrected for the elevation of the sampling location and unless this is the only source of barometric data. [Note: inches of mercury times 25.4 mm/inch mercury equals mm of mercury].
7. The instrument should indicate that the calibration is in progress. After calibration, the instrument should display percent saturated DO. Check the reading against the Temperature Atmospheric Pressure table in Attachment A. For example, if the barometric pressure is 752 mm Hg at an elevation of 278 feet, the percent saturation value after calibration should be 99%.

8. While the probe is still in the calibration cup, select monitoring/run mode. Compare the DO mg/L reading to the Oxygen Solubility at Indicated Pressure chart in Attachment B. For example, if the barometric pressure is 750 mm Hg and the temperature inside the calibration cup is 20°C, the DO mg/L reading should be 8.94 mg/L. If they do not agree to the accuracy of the instrument (usually
9. ±0.2 mg/L), repeat calibration. If this does not work, change the membrane and electrolyte solution and repeat calibration.
10. Remove the probe from the container, rinse it with distilled water, pat it dry with a towel and place it into a 0.0 mg/L DO Standard. The standard must be filled to the top of its container and the DO probe must fit snugly into the standard's container (no headspace). Check temperature readings. They must stabilize before continuing.
11. Wait until the "mg/L DO" readings have stabilized. The instrument should read < 0.5 mg/L or to the accuracy of the instrument (usually ± 0.2 mg/L) within 30 seconds. If the instrument cannot reach this value, it will be necessary to clean the probe and change the membrane and electrolyte solution.
12. If this does not work, prepare a new 0.0 mg/L standard. If these measures do not work, contact the manufacturer.

pH (electrometric) The pH is the measure of the degree of the acidity or alkalinity of a solution as measured on a scale of 0 to 14. The pH of a sample is determined electrometrically using a glass electrode. All pH measurements are in standard units (SU).

Choose the appropriate buffered standards that will bracket the expected values at the sampling locations. For groundwater, the pH will usually be close to seven. Three standards are needed for the calibration: one close to seven, one at least two pH units below seven and the other at least two pH units above seven. For those instruments that will not accept three standards, the instrument will need to be recalibrated if the water sample's pH is outside the range defined by the two standards used in the initial calibration.

CALIBRATION PROCEDURE

1. Allow the buffered standards to equilibrate to the ambient temperature.
2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.
3. Remove the cover of the probe, rinse in a cup filled with distilled water or use a spray bottle, and blot dry with soft tissue.
4. Select monitoring/run mode. Immerse probe in the initial buffered standard (e.g., pH 7) and allow at least 1 minute for temperature equilibration before proceeding.
5. Enter the buffered standard value (7) into the pH calibration menu of the instrument. Allow the pH reading to stabilize for approximately 30 seconds and if the reading does not change, finish the calibration. The reading should remain within the manufacturer’s specifications; if it changes, recalibrate. If readings continue to fluctuate or readings do not stabilize after recalibration, consult the manufacturer.
6. Remove probe from the initial buffered standard, rinse in a cup filled with distilled water or use a spray bottle and blot dry with soft tissue.

7. Immerse probe into the second buffered standard (e.g., pH 4). Repeat step 5 substituting "4" into the pH calibration menu instead of “7”.
8. Remove probe from the second buffered standard, rinse in a cup filled with distilled water or use a spray bottle and blot dry with soft tissue. If the instrument only accepts two standards the calibration is complete. Proceed to step 11. Otherwise continue with step 9.
9. Immerse probe m third buffered standard (e.g., pH 10). Repeat step 5, substituting "10" into the pH calibration menu instead of "7".
10. Remove probe from the third buffered standard, rinse in a cup filled with distilled water or use a spray bottle and blot dry with soft tissue.
11. Select monitoring/run mode, if not already selected. To ensure that the initial buffered calibration standard (e.g., pH 7) has not changed, immerse the probe into the initial standard. Wait for the reading to stabilize. The reading should read the initial standard value (e.g., 7) within the manufacturer's specifications. If not, re-calibrate the instrument. If re-calibration does not help, the calibration range may be too great. Reduce calibration range by using standards that are closer together.

Specific Conductance. Conductivity is used to measure the ability of an aqueous solution to conduct an electrical current. Specific conductance is the conductivity value corrected to 25°C. Calibrating an instrument for specific conductance automatically calibrates the instrument for conductivity, and vice-versa.

Most instruments are calibrated against a single standard which is near, but below the specific conductance of the environmental samples. A second standard which is above the environmental sample specific conductance is used to check the linearity of the instrument in the range of measurements.

CALIBRATION PROCEDURE

1. Allow the calibration standard to equilibrate to the ambient temperature.
2. Remove probe from its storage container, rinse the probe with a small amount of the conductivity/specific conductance standard (discard the rinsate), and place the probe into the conductivity/specific conductance standard. Gently move the probe up and down in the solution to remove any air bubbles from the sensor. Allow the probe to sit in the solution for at least l minute for temperature equilibration before proceeding.
3. Select calibration mode.
4. Select Specific Conductance from the Calibration menu. Enter the calibration value of the solution (mS/cm at 25°C) and continue. Allow the Specific Conductance reading to stabilize for approximately 30 seconds and finish the calibration. The reading should remain within manufacturer's specifications. If it does not, recalibrate. If readings continue to change after recalibration, consult the manufacturer.
5. Remove probe from the standard, rinse the probe with a small amount of the second conductivity/specific conductance standard (discard the rinsate), and place the probe into the second conductivity/specific conductance standard. The second standard will serve to verify the linearity of the instrument. Read the specific conductance value from the instrument and compare the value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If

they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer, but above the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consult the manufacturer.

NOTE: These procedures should only be used for instruments that are capable of automatically correcting specific conductance for temperature (to 25°C). For instruments that cannot calibrate for specific conductance, follow the procedures in the instrument's manual for conductivity calibration. If calibrating for conductivity instead of specific conductance, the solutions conductivity value must be corrected for the temperature that the sensor is reading.

Oxidation-Reduction Potential. The ORP is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts (mV) and is temperature dependent.

CALIBRATION OR VERIFICATION PROCEDURE

1. Allow the calibration standard (a.Zobell Solution) to equilibrate to ambient temperature.
2. Remove the cover of the probe and place it into the standard.
3. Select monitoring/run mode.
4. While stirring the standard, wait for the probe temperature to stabilize, and then read the temperature.
5. Look up the mV value at this temperature from the mV versus temperature correction table found in Attachment C. It may be necessary to interpolate mV values between temperatures. Select “calibration mode”, then "ORP". Enter the temperature corrected ORP value and calibrate the instrument.
6. Select monitoring/run mode. The reading should remain unchanged within manufacturer's specifications. If it changes, recalibrate. If readings continue to change after calibration, consult manufacturer.
7. If the instrument instruction manual states the instrument is factory calibrated, then verify the factory calibration against the standard. If reading does not agree within the specification of the instrument, the instrument will need to be re-calibrated by the manufacturer.

Turbidity Turbidity refers to how clear the water is and is a measure of relative sample clarity. The greater the amount of total suspended solids in the water, the higher the measured turbidity. The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension. A turbidity meter is a nephelometer with a visible light source for illuminating the sample and one or more photoelectric detectors placed ninety degrees to the path of the light source.

Some instruments will only accept one standard. For these instruments, the standards will serve as check points.

CALIBRATION PROCEDURES

1. If the standard cuvette is not sealed, rinse a cuvette with deionized water. Shake the cuvette to remove as much water as possible. Do not wipe the inside of the cuvette

because lint from the wipe may remain in the cuvette. Add the standard to the cuvette.

2. Before performing the calibration procedure, make sure the cuvettes are not scratched and the outside surfaces are dry, free from fingerprints and dust. If the cuvette is scratched or dirty, discard or clean the cuvette, respectively.
3. Zero the instrument by using either a zero or 0.02 NTU standard. A zero standard (approximately 0 NTU) can be prepared by passing distilled water through a 0.45 micron pore size membrane filter.
4. Using a standard at I NTU, calibrate according to manufacturer's instructions or verify calibration if instrument will not accept a second standard. If verifying, the instrument should read the standard value to within the specifications of the instrument. If the instrument has a range of scales, check each range that will be used during the sampling event with a standard that falls within that range.
5. Using a standard at 10 NTU, calibrate according to manufacturer's instruction or verify calibration if instrument does not accept a third standard. If verifying, the instrument should read the standard value to within the specifications of the instrument.

Note: If only performing a two-point calibration (depending on project requirements), the 0.02 NTU and 10 NTU standard should be used.

Data Management and Records Management

Prior to calibrating, the field equipment and calibration standard information should be recorded on a separate Field Instrument Calibration Field Data Record (See FSP Appendix B). For field equipment, the information recorded should include the make, model number and the serial number of the instrument. Each instrument can be assigned an identification number which can be referenced in future field notes or when filling out the Field Instrument Calibration Field Data Record.

For calibration standards, the information recorded should include the manufacturer, expiration date, true value, and standard description such as lot number. Each calibration standard can also be assigned an identification number which can be referenced in future field notes or when filling out the Field Instrument Calibration Log.

All standards should be initialed and dated when opened.
At a minimum, the log must include the instrument information described above, calibration standard information described above, calibration date and time, and the instrument calibration results.

References

Amec Foster Wheeler, 2016. “Quality Assurance Project Plan”; Penobscot River Phase III Engineering Study, July 2016.

USEPA Region I, June 3, 1998. Standard Operating Procedure, Draft Calibration of Field Instruments.

USEPA Region I, July 30, 1996. Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples for Monitoring Wells.

- END OF PROCEDURE -

SOP No. S-4

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

SURFACE WATER SAMPLING

SURFACE WATER SAMPLING

OBJECTIVES

The purpose of this procedure is to describe the methods for surface water sampling. It describes the procedures and equipment to be used to obtain representative surface water samples that are capable of producing accurate quantification of water quality.

SCOPE AND APPLICABILITY

This procedure is intended for the collection of surface water samples to support site investigations as required by the scope of work.

If surface water samples are to be collected for analysis of methylmercury, then SOP S-5, Clean Hands/Dirty Hands Surface Water Sampling must be implemented.

RESPONSIBILITIES

The Project Manager is responsible for ensuring that groundwater measurements are implemented in accordance with this SOP and any other site-specific or project specific planning documents.

The Field Personnel are responsible for understanding and implementing this SOP during all field activities, as well as obtaining the appropriate field logbooks, forms and records necessary to complete the field activities.

The Site Safety Officer (SSO), typically the supervising field manager, is responsible for overseeing the health and safety of employees and for stopping work if necessary to fix unsafe conditions observed in the field.

DEFINITIONS

Surface water samples: Samples of water collected from streams, ponds, rivers, lakes, or other impoundments open to the atmosphere.

REQUIRED MATERIALS

Equipment needed for collection of surface water samples may include (depending on technique chose):

- Maps/plot plan
- Safety equipment and personal protective equipment
- Tape Measure
- Paper towels
- Global positioning system (GPS)
- Cooler(s) and ice
- Clean latex or nitrile gloves
- Waders/Hip Waders
- Sampling device (e.g. bottle sampler, dip sampler, peristaltic pump)

- Tubing
- Decontamination equipment/supplies
- Water quality monitoring equipment (e.g. pH/conductivity/dissolved oxygen meter)
- Sample Containers/preservatives
- Sample Labels
- Field Notebooks/logbooks
- Chain of Custody Forms

PROCEDURES

A variety of sampling methods and equipment are available for the collection of surface water samples because of the varied conditions and locations where samples may be collected. Refer to the work plan and field sampling plan to determine which sampling method is appropriate for the project.

Sampling Equipment

The objective of surface water sampling is to evaluate the surface water quality. There is a variety of equipment available for surface water sampling. Because each site may contain varied surface water conditions, collection of a representative sample may be difficult. In general, a sampling device will include the following characteristics:

- Be constructed of disposable or non-reactive material (e.g. Teflon, glass, or stainless steel); and
- Be designed to maintain sample integrity and to provide the desired level of quality in achieving desired analytical results.

Decontamination

The primary purpose of equipment decontamination is to prevent the potential of cross-contamination within the samples collected.

If surface water samples are collected directly into sample jars, decontamination is not required as shared sampling equipment does not come into contact with the water sample, and new sampling containers are used at each sampling location.

If samples are being collected for methylmercury, then pre-cleaned, laboratory certified methyl mercury-free sampling equipment (tubing, fittings, etc.) must be used.

If samples are being collected for total mercury only, prior to and after each sampling event, all sampling equipment must be thoroughly decontaminated following the methods outlined below and in SOP-17 Equipment Decontamination. Because decontamination procedures are time consuming, having a quantity of pre-cleaned sampling tools available is recommended. Equipment decontamination will consist of the following steps:

1. Tap water rinse
2. Formula 409 rinse

3. Deionized water rinse
4. Air Dry

Sampling Methods

General

The specific sampling method utilized will depend on the accessibility to, the size, and the depth of the water body, as well as the type of samples being collected. In most ambient water quality studies, grab samples will be collected. However, the objectives of the study will dictate the sampling method. General cautions for sampling are as follows:

- When conducting surface water sampling in water bodies influenced by tidal effects, conduct the sampling on the outgoing tide.
- When using water craft, take samples near the bow, away and upwind from any gasoline outboard engine. Orient watercraft so that bow is positioned in the upstream direction.
- Never collect surface water samples for mercury from a boat with a diesel engine, as these engines can emit trace amounts of mercury in their exhaust.
- When wading, collect samples upstream from the body.
- Avoid disturbing sediments in immediate area of sample location.
- Collect water samples prior to taking sediment samples when obtaining both from the same site.
- Sampling near structures may not provide representative data because of unnatural flow patterns.
- Collect surface water samples from downstream towards upstream.
- An additional sample should be collected, or extra quantity of the collected sample should be poured off to a separate container, for determination of field parameters such as pH, conductivity, dissolved oxygen, temperature, turbidity, odor, or other significant characteristics.

Peristaltic Pump

Gathering surface water samples with the assistance of a peristaltic pump is another commonly used sampling technique. In this method the sample is drawn through heavy-walled tubing and pumped directly into the sample container. If methymercury is to be analyzed, the laboratory should provide sample tubing that is pre-cleaned and certified as free of methylmercury. New tubing will be used at each sample location and disposed of after use. The peristaltic sampling system allows the operator to extend the sample tubing into the liquid body to sample from depth, or sweep the width of narrow streams. Peristaltic pumps are available with a range of power sources. For field use, the battery operated units have proven most convenient and very reliable.

Peristaltic Pump

Perform the following procedures when sampling with a peristaltic pump:

1. Prepare the peristaltic pump in accordance with manufacturer's instructions. When using a battery-operated pump, be sure battery is fully charged prior to entering the field.
2. In most situations, it is necessary to change the suction line and the silicon pump tubing between sample locations to avoid cross-contamination. This action requires maintaining a sufficiently large stock of tubing material to avoid having to decontaminate the tubing in the field.
3. Gently lower the pump intake tube to the desired sample depth. Avoid unnecessary agitation (aeration) of the liquid to be sampled and bottom sediments.
4. Prior to activating the pump, note in which direction the pump will be rotating. (Most peristaltic pumps are capable of rotating in two directions.) Accidental reverse rotation of the pump will cause aeration of the liquid to be sampled.
5. Run the pump until no air bubbles are noted in the discharge.
6. Discharge water shall be released downstream from sampling area during sampling event.
7. To prevent excess agitation and/or aeration of the sample, fill the sample containers by tilting the container and flow the sample water down the side of sampling container.

Direct Grab Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples directly into the sample container(s). Health and safety considerations must be addressed when sampling lagoons or other impoundments where specific conditions may exist that warrant the use of additional safety equipment. Using adequate protective clothing, access the sampling station by appropriate means.

1. Use an unpreserved sample container to collect the sample.
2. Slowly remove the container cap and slowly submerge the container, opening first, into the water.
3. Invert the bottle so the opening is upright and pointing towards the direction of water flow (if applicable). Allow water to run slowly into the container until filled.
4. Return the filled container quickly to the surface.
5. Pour out a small volume of sample away from and downstream of the sampling location. This procedure allows for addition of preservatives and sample expansion. Do not use this step for analytes where headspace is not allowed in the sample container.
6. Add preservatives, if required, securely cap container, label and complete field notes.
7. If preservatives have been added, invert the container several times to ensure sufficient mixing of sample and preservatives.
8. Check preservation of the sample and adjust pH with additional preservative, if necessary.

For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. When possible, collect samples in a downstream to upstream direction. Avoid disturbing the substrate.

For lakes and other impoundments, collect the sample under the water surface while avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

Weighted Bottle/Kemmerer/Van Dorn Sampler

Kemmerer Sampler

Collecting a representative sample from a larger body of water may require the gathering of samples from various depths and locations. For this type of sampling a weighted bottle sampler, Kemmerer bottle or Van Dorn sampler may be used. The sampler typically consists of a sample bottle, a weighted sinker, a bottle stopper and a wire cord used to raise, lower and open the samples. These samplers should not be used to collect samples that will be analyzed for methylmercury, due to the fact that the components are not pre-cleaned and laboratory-certified as free of methylmercury. The following procedures will be followed when sampling with a weighted bottle sampler:

1. Decontaminate all equipment.
2. Assemble the weighted bottle sampler in accordance with the sampler instruction manual.
3. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely. Do not let sampler disturb bottom sediments.
4. Pull out the stopper to open the container if not already open.
5. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.
6. Send a weighted messenger down the suspension line to close the container and seal the sample in.
7. Retrieve the sampler and discharge the first 10-20 ml from the drain to clear any potential contamination.

Van Dorn Sampler

Dip Sampler

Dip Sampler

The dip sampler consists of a scoop or container attached to the end of a telescoping or solid pole. The sampler shall be constructed of non-reactive material such as wood, plastic, or metal. The sample will be collected in a jar or beaker made of stainless steel or Teflon. Preferably, a disposable beaker that can be replaced prior to each sampling will be used at each station. Liquid wastes from water courses, ponds, pits, lagoons or open vessels will be ladled into a sample container. A dip sampler should not be used to collect samples that will be analyzed for methylmercury, due to the fact that the components are not pre-cleaned and laboratory-certified as free of methylmercury.

Perform the following procedures when sampling with a dip sampler:

1. Decontaminate all sampling equipment.
2. Assemble the dip sampler in accordance with manufacturer's instructions.
3. Extend pole to length that will allow safe access to desired sample location.
4. Submerge the dip sampler to the desired sample depth, doing so very slowly to minimize surface disturbance.
5. Allow the sampler to fill very slowly.
6. Retrieve the sampling device with minimal surface water disturbance.
7. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the sampler edge.
8. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence. Fill sample bottle to appropriate head space, if any.

Manual Hand Pumps

Manual pumps are available in various sizes and configurations. Manual hand pumps are commonly operated by bellows or diaphragm and should not be used to collect samples that will be analyzed for methylmercury, due to the fact that the internal components are not pre-cleaned and laboratory-certified as free of methylmercury.

Perform the following procedures when collecting surface water samples with a manual hand pump:

1. Assemble and operate the pump in accordance with the manufacturer's instructions.
2. The inlet hose and any surface of the pump used for sampling will be constructed of materials that are operable and non-reactive.
3. To avoid agitation, insert the sampling tube into the liquid sample prior to pump activation.
4. Insert a liquid trap (preferably the sample container) into the sample inlet hose to collect the sample and to prevent pump contamination.

QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance activities which apply to the implementation of these procedures are located in the site QAPP, including the collection of required quality control samples such as field duplicates, field blanks and equipment blanks. In addition, the following general procedures apply:

- All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment calibration activities must occur prior to sampling/operation and they must be documented.

Descriptions of any deviations and the reason for deviations from the site QAPP or this SOP should be noted in the field notebook, as necessary. In addition, the logbook should track pertinent sample collection information such as:

- Sample date/time;
- Personnel;
- Weather conditions;
- Sample identification information; and
- Visible staining or other indications of non-homogeneous conditions.

- END OF PROCEDURE -

SOP No. S-5

WSP USA ENVIRONMENT AND INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

CLEAN HANDS/DIRTY HANDS SURFACE WATER SAMPLING

CLEAN HANDS/DIRTY HANDS SURFACE WATER SAMPLING

SCOPE AND APPLICATION

This SOP describes the techniques used to collect and preserve water samples for trace metals analysis in a way that neither contaminates, loses, or changes the chemical form of the analytes of interest.

Samples are collected in the field into previously cleaned and tested sample bottles of a material appropriate to the analysis to be conducted.

Appropriate sampling technique may vary depending on the location, sample type, sampling objective, client sampling plan, etc. This SOP is based on USEPA Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (USEPA, 1996).

SUMMARY OF METHOD

Sample bottles that have tested low for trace metals after the cleaning procedure are double bagged in a class-100 clean air bench. At the site, the bottles are filled with water samples using the clean hands, dirty hands technique. Bottles are sealed and re-bagged using the opposite series of steps as were used to open them. Bottles are shipped to the laboratory via over-night courier for further processing (filtration, etc.) and preservation.

Most samples are preserved in the laboratory, but occasionally samples will need to be preserved in the field.

INTERFERENCES

High levels of organics in some samples may necessitate the addition of more BrCl to samples for the determination of mercury. This addition will be conducted at the laboratory under controlled conditions. Some samples may buffer the preservation effects. Sample pH should be checked approximately 24 hours following preservation to ensure that the proper pH is being maintained.

EQUIPMENT

Sample Bottles

Teflon, glass, HDPE, LDPE, polycarbonate, or other bottles, as appropriate to the analytes of interest are cleaned and tested according to Frontier SOP FGS-007 and FGS-065. Teflon or glass bottles with Teflon-lined lids may be used for all total trace metals, while polyethylene and polycarbonate bottles may be used only if mercury is not an analyte of interest. The preferred type of bottle for total trace metals is HDPE. If speciation of selenium is required, only glass bottles with Teflon-lined lids should be used.

Sampling Pump

Typically, samples are collected near the water surface (but occasionally at depths up to 50 feet) using a battery powered peristaltic or diaphragm pump.

When using a peristaltic pump, a short piece of specially cleaned silicone silastic tubing is used in the pump head, while all other sampling tubing is 0.25-inch O.D. Teflon, which has been cleaned according to Eurofins/Frontier SOP FGS-007. The silastic pump tubing (12-inch sections) are cleaned by heating 24-hours in a sealed Teflon jar with a mixture of 5% acetic acid (reagent grade) + 0.2% HCl (v/v), and then rinsing with reagent water and repeating the heating procedure two times with low trace- metal reagent water. Pieces of silastic tubing are stored wet in a Teflon jar until use, to avoid contamination by gaseous Hg. NOTES: Any attempt to clean the silastic tubing with strong mineral acids will result in embrittlement, rendering the tubing unusable.

When using the diaphragm pump, lengths of Masterflex tubing is used of whatever length is appropriate. Tubing is secured to pump tubing adapters with cable ties. This tubing is cleaned according to Eurofins/Frontier SOP #FGS-007.2.

PROCEDURES

Samples are collected only into laboratory-certified cleaned or pre-tested bottles.

Samples are collected using rigorous ultra-clean protocols which are summarized as follows.

At least two persons, wearing fresh clean-room gloves at all times, are required on a sampling crew. A three-person sampling crew is preferred.

- One person (dirty hands) pulls a bagged bottle from the cooler, and opens the outer, dirty bag, avoiding touching inside that bag.
- The other person (clean hands) reaches in, opens the inner bag, and pulls out the sample bottle.
- This bottle is opened (with a plastic shrouded wrench, if necessary) and rinsed three times with sample water, and then filled with the sample.
- Preservative may be added at this time or within 48-hours at the clean laboratory.
- See Sample Preservation section.
- The cap is replaced and secured as tightly as possible (with the plastic shrouded wrench, if necessary). The bottle re-bagged in the opposite order from which it was removed.

Clean-room gloves are changed between samples and whenever something not known to be clean is touched.

Water samples are most cleanly obtained by surface grab, using gloved hands, and facing into a flowing body of water or off the bow of a moving boat. If samples are to be taken from depth, the only non-contaminating method generally available is pumping.

CAUTION: DISCRETE SAMPLERS, i.e.; Niskin“ and Kemerer BOTTLES ARE TO BE AVOIDED, AS, UNDER EVEN THE BEST OF CONDITIONS THEY ARE OFTEN FOUND TO CONTAMINATE SAMPLES AT THE PART-PER-TRILLION LEVEL. In the event that deep sampling is required, the only discrete sampler which is known to be cleanable is the Teflon-coated, Go-Flo“ (General Oceanics, FL) bottle. These bottles must have all metal components coated with epoxy or silicone, and then be filled and stored for long periods (i.e., 1 month) with 5%

HCl, and then tested for contamination by the metal of interest until satisfactory results are obtained.

Samples will be sent to the laboratory unpreserved in the following condition:

- collected in appropriate containers as specified in the QAPP
- filled to the top with no headspace, and
- shipped at 1-4 °C by overnight shipping.

The samples will be acid preserved soon after arrival at the laboratory (within 24 hours). Samples to be analyzed for dissolved/particulate or volatile Hg speciation must be stored in this manner until analysis of these very labile parameters. Unpreserved samples have been found stable (for Hg speciation) for at least 1 week, when stored in the appropriate bottles. Samples which are acid preserved may lose Hg to coagulated organic materials in the water or condensed on the walls (Bloom, 1994). The best approach is to add BrCl directly to the sample bottle at least 24 hours before analysis. If other Hg species are to be analyzed, these aliquots must be removed prior to the addition of BrCl. If BrCl cannot be added directly to the sample bottle, then it should be vigorously shaken prior to sub- sampling.

All handling of the samples in the lab should be undertaken in a trace metal-free clean air bench, after rinsing the outside of the bottles in low metals water, and drying in the clean air hood.

SAMPLE PRESERVATION

All sample preservation will be conducted upon sample receipt at the laboratory under controlled conditions. The preservation recommendations below are guidelines based on the most common matrices, but may not hold true for every project and every matrix. When in doubt, the project manager should be consulted.

Methylmercury

The appropriate preservation for methylmercury depends upon the salinity of the sample. The proper chloride concentration must be maintained in order for the distillation procedure to be efficient. Acid preserved samples are stable indefinitely (> 6 months), although the current EPA-mandated holding time is still 28 days.

Freshwaters

Samples for determination of methyl mercury should be pre- served to 0.4% (v/v) with HCl if their salinity is less than 1%.

Seawaters

Samples for the determination of methyl mercury should be preserved to 0.2% H2SO4 if their salinity is greater than 1%.

Total Mercury

Samples for determination of total mercury are preserved to 1-5% (v/v) with 0.2 N BrCl, but this should only occur in the laboratory. If samples for total mercury need to be preserved in the field, they should be preserved to 0.4% (v/v) with HCl. Acid preserved samples are stable indefinitely (> 6 months), although the current EPA-mandated holding time is still 28 days.

In the case that total Hg, methyl mercury, and other total trace metals are to be determined on the sample bottle, the following sequence should be employed, assuming the sample is received in a Teflon bottle:

1 Pour off about 100 mL of sample into a 125-mL Teflon bottle, and acidify to 0.4% (v/v) HCl for methyl Hg analysis.

2 Add HNO3 to the remaining sample in the original Teflon bottle to preserve it to either 0.08% or 1.0% (v/v), depending upon the matrix of the sample and the method of analysis requested.

3 Shake the bottle and allow to stand about 3 hours.

4 Pour off about half into a HDPE bottle for total trace metals analysis. Additional preservation may be required depending upon the sample digestion desired.

5 Add 0.2 N BrCl to the original sample bottle to preserve it to 1-5% (v/v) in the bottle (this sample is for total Hg analysis).

QUALITY ASSURANCE

Equipment and field blanks should be sampled following the Quality Assurance Project Plan or as specified by the regulating entity.

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- END OF PROCEDURE -

SOP No. S-6

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

SEDIMENT COLLECTION

DEFINITIONS

FDR	Field Daily Record
FOL	Field Operation Lead
FSP	Field Sampling Plan
HASP	Health and Safety Plan
PM	Project Manager
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
WSP	

TERMINOLOGY

- Sampling Station or Location
- Sediment Collection – retrieval of bulk sediment
- Sediment Sample – aliquot of the bulk sediment to be subjected to laboratory analyses
- Deployment – individual use of sampling device to recover sediment
- Penetration – depth of the sampling device beneath the mudline
- Recovered Sediment – sediment removed and contained within sampling device
- Percent Recovery – amount of recovered sediment divided by penetration or capacity of sampling device
- Interval – a measured amount or increment, often measured where zero is surface of recovered sediment within the sampling device
- Strata – a layer of physically-similar material such as a 3-inch gravel layer or 2-foot sand layer
- Homogenization – blending of the recovered sediment often performed by designated interval
- Composing – combining homogenized recovered sediment often performed to add like strata or like intervals from multiple deployments (or across multiple stations) to achieve laboratory-required sample volume or mass

SEDIMENT COLLECTION

PURPOSE

The purpose of this SOP is to provide a standardized method for collecting polluted or contaminated sediment samples. This SOP may be used by employees of WSP, or its subcontractors supporting the Penobscot River Estuary Project. Deviations from the procedures outlined in this document are to be approved by the Project Manager (PM), Technical Lead (TL), or Field Operation Leader (FOL) prior to initiation of the sampling activity.

This SOP is applicable to the collection of representative sediment samples. Analysis of sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- toxicity
- biological availability and effects of contaminants
- benthic biota
- extent and magnitude of contamination
- contaminant migration pathway and potential source
- fate of contaminants
- physical characteristics

The methodologies discussed in this SOP are applicable to the sampling of sediment in flowing waters, tidal flats, or vegetated marshes/wetlands.

This SOP is intended to provide general procedure and guidance for the operation of multiple types of sediment sampling equipment. On-water and nearshore operations are heavily dependent on a number of factors and conditions that may change during the period of work performance. If conditions change in the field that would require changing the proposed sampling method or location, field personnel shall contact the FOL, TL, or PM before making field changes.

RESPONSIBILITIES

Project Manager – responsible for work execution in accordance with scope of work, budget, and corporate policies and procedures.

Technical Lead – designated personnel with the requisite knowledge, skills, and abilities to develop scope, provide instruction, and resolve field conditions encountered to achieve the task objectives.

Field Operation Leader - may be a WSP employee or contractor who is responsible for overseeing the sediment sampling activities. The FOL is also responsible for checking work performed and verifying that the work satisfies the specific tasks outlined by this SOP and the Field Sampling Plan (FSP). It is the responsibility of the FOL to communicate with the field

personnel regarding specific collection objectives and anticipated situations that require deviation from the FSP. It is also the responsibility of the FOL to communicate the need for any deviations from the Field Sampling Plan with the appropriate personnel (Project Manager or Technical Leader).

Field Crew Member / Field Personnel - performing sediment sampling are responsible for adhering to the applicable tasks outlined in this procedure while collecting samples.

EQUIPMENT

The following list of equipment shall be maintained by the field personnel and equipped on the vessel or in the field while performing sampling. This list does not include the sampling device and the parts of the device. See following sections on the specific equipment needs for each sampling device.

- Aluminum foil – cover decontaminated equipment or used to lay sampling equipment or sample upon as a clean surface (as a separation barrier)
- Brush – for clearing debris and contamination from sampling equipment prior to decontamination. Also, for scrubbing sampling equipment in decontamination detergent prior to rinse.
- Bucket – 2 or 5-gallon bucket, minimum of two, one for mixing decontamination detergent, one for rinse water for equipment decontamination.
- Camera device – for photographic documentation of each core or grab collected. Device should be a standalone camera, not a tablet, phone or other device.
- Collection containers - glass or plastic jars or bottles, commonly supplied by the analytical laboratory, with lined lids.
- Clear Packing Tape – for placing over the sample label on sampling containers once the label has been completed filled out. This will prevent label degradation from field conditions.
- Decontamination Detergent – Formula 409 to perform equipment decontamination.
- FDR – Enough copies of the FDR paperwork to fill out in the field at each sampling location that is planned to be visited during the workday. Ensure enough copies are provided each day in case multiple are needed at a given sampling location.
- Field Clothing and Personal Protective Equipment (PPE) - as specified in the HASP.
- Field notebook - a bound book used to record progress of sampling effort and record any problems and field observations during sampling. Alternatively, an electronic tablet device with pre-loaded forms for electronic data entry may be used.
- Gloves - for personal protection and to prevent cross-contamination of samples. May be nitrile or latex, disposable, powderless.
- GPS Device - for recording coordinates of each deployment at a sampling location and to provide navigation to the proposed station.

- Tablet - to store necessary forms used to record and track samples collected at the site. iPads, or equivalent, will contain the necessary field forms and maps for field personnel reference.
- Lead line – measuring tape with a weighted end to measure water depth at sampling location.
- Marker flags - Used for identifying sediment sampling locations.
- Permanent marking pen - used to mark sample jars/lids, coring tubes, and for documentation of field logbooks and data sheets.
- Ruler – wooden preferred
- Sample Labels –sample labels to affix to collection containers for each sampling location to be visited during the workday, as appropriate pre-printed.
- Stainless steel lab spoon - or equivalent. Used for homogenizing sediment samples.
- Stainless steel bowls or bucket - used for compositing samples; sized appropriate for sample volume capacity.
- Stainless steel or equivalent tray – upon which sampling devices will be placed providing a decontaminated surface for the equipment (e.g., ponar dredge).
- Trash bags - used to dispose of gloves and any other non-hazardous waste generated during sampling.
- White Board – used for documentation project name, project number, sampling station, core ID, date and time sampled while photo documenting sampling efforts. Place behind or under a core when taking photograph.

METHOD SUMMARY

Sediments can be collected with numerous sampling devices.

- For recovering sub-aqueous surface sediment from the 0 – 6-inch depth interval, collection can be performed with a grab sampler such as a Ponar dredge The Ponar dredge requires sufficient water depth is available to allow sufficient gravitational force during descent for the Ponar dredge to engage (or “dig in to”) surface sediments and to trigger its pressure-activated closure springs. If used in shallow depths, or does not adequately engage, the Ponar dredge may not trigger as intended or adequately engage, resulting in no recovery of sediment, leading to multiple deployments.

- For recovering sediment deeper than 6 inches, a coring device is commonly required. Coring devices can consist of gravity core, vibracore, box core, push core or hammer core.
- For sediment samples in shallow water (less than 1 foot), submerged, mud flat or marsh/wetland areas collection can be performed using push core, hammer core, shovel, hand auger or split spoon sampler.

Procedures on how to operate each type of coring device are detailed in the following sections.

SAMPLE COLLECTION PROCEDURE BY METHOD

Before sampling with any of the below sampling devices, the following procedures shall be performed:

1. Sampling equipment shall be decontaminated prior to deployment. If the sampling station is the first to be visited that day, decontamination of equipment shall be performed before deployment. At the completion of sample collection at a given station, the equipment shall be decontaminated prior to moving to the next sampling location so as to not track contaminated materials or equipment to the next location. Decontamination shall be performed in accordance with SOP S-17.

2. An individual FDR will be completed for each deployment with deployments sequentially identified with an Alpha designation added to the Station ID. On each individual FDR, the station and deployment information will be fully completed including indicating not pertinent information rather than blank cells (if left blank, mark through cell to indicate not applicable). The FDR serves to record station information, conditions, deployment sequence, work conditions and crew, collection details, recovered sediment characteristics, and incremental sample identification and handling.

3. For each deployment, individual date, time, weather and water conditions, GPS coordinates, and crew roles will be recorded on the FDR.

4. When handling the recovered sediment and its incremental samples, a new pair of nitrile gloves shall be donned.

Grab Sample with Ponar Dredge

The Ponar dredge is a commonly used grab sampler When the scoop strikes the bottom, its tapered cutting edges penetrate beneath the mudline with minimal disturbance. Removable screens on top of each scoop allow water to flow through as it descends and minimize wash out upon retrieval. Often a winch is used for deployment and recovery due to the device's working weight especially when fully loaded.

Prior to leaving the field station, ensure all required parts of the Ponar dredge are properly functioning and the equipment is ready for deployment per the following:

1. Ensure that a sturdy nylon rope is securely fastened to the shackle at the top of the Ponar dredge. If needed, secure the knot in the line using cable ties to ensure the knot cannot work its way loose, causing it to come untied from the equipment during deployment. This can prevent equipment loss during sampling.

2. Inspect the nylon rope for any wear. If excessive where is noted, replace rope, or cut and splice together. Use cable ties at the splice to ensure knot will not loosen during deployment.

3. Ensure the Ponar dredge has at a minimum two screens free of damage. Damage that would require replacement may include screen broken from the frame or rips/tears in the screen covers. Carry extra screens with the equipment in the field in case screens are lost during deployment.

4. Ensure the spring-loaded trigger pin attached to the Ponar dredge is functioning by depressing the spring. Inspect the spring for signs of rust and significant wear that may lead to functionality issues while in the field.

5. Inspect all screws on the jaw and on the weight blocks and ensure they are securely fastened.

6. Safety check the functionality of the Ponar dredge by opening the jaws, placing the trigger pin in place and gently placing the dredge back on the ground. If the pin does not trigger, pull the pin out and then lift the ponar, closing the jaws. Ensure the jaws close completely.

7. For sampling stations where collection is for purposes of monitoring (station is re-visited from past campaigns) FOL will review the available logs and records of previous sampling campaigns and provide station-specific expectations to the field personnel.

The following steps shall be followed when deploying the Ponar dredge for collecting a sediment sample:

1. Ensure the deployment line is securely fastened on the Ponar dredge shackle.

2. Measure water depth and pull enough deployment line to reach the bottom with some contingency length. Tie off deployment line to a cleat or secure location on the vessel/working platform such that if the operator's grip is lost on the rope during deployment, the equipment is not lost.

3. Place the screens in the correct locations.

4. Arrange the jaws of the Ponar dredge in the open position and place the spring-loaded trigger pin into the alignment hole on the Ponar dredge arms.

5. Lift and deploy the Ponar dredge over the side of the vessel/working platform, slowly lowering the sampler to approximately one to two meters above mudline. The drop depth can be adjusted based on field or site conditions including flows and sediment type. Stop momentarily and then drop the sampler to impact the sediment. Slack on the deployment line will allow the Ponar dredge to trigger, releasing the trigger pin and Ponar dredge jaws.

6. Give the deployment line a few quick, sharp tugs to ensure the Ponar dredge has property triggered.

7. Lift the Ponar dredge slowly and deliberately to the water surface and lift onto the deck of the vessel/working platform. Place the Ponar dredge onto the sampling tray.

8. Before removing the screens, carefully tip the Ponar dredge towards one side to slowly decant water through the screen. Care should be taken to retain the fine sediment fraction during this operation.

9. Remove the screens from the Ponar dredge, measure recovery, and collect interval by placing into bowl or equivalent. If necessary, follow procedures to re-deploy sampler if needed to obtain sufficient quantity of sample.

10. Take a photo of the sample, in the Ponar with whiteboard denoting project name, project number, sampling station, Core ID, date and time.

11. Record depth of recovery on the FDR form. With nitrile gloved hands, remove a small portion of the sediment to provide a sample classification on the FDR.

12. Properly mark or label the sample container per the FSP sampling nomenclature.

Watermark Universal Core Head Sediment Sampler (Push Core)

The Watermark universal core head sediment sampler is a device used to collect sediment in submerged, mud flat or marsh/wetland areas under human power. The sample is slowly lowered, or placed, at the sediment interface and pushed into the subsurface strata to obtain a sample. The sampler is then retrieved from the sediment by pulling the device out or by digging around the sampler, if on land or in shallow water, to minimize sample disturbance.

A push core sampler can be used at deeper depths (up to 10 feet of water depth) but manipulation and handling of the device becomes more difficult in deeper waters. The optimum depth for push sampling in most water conditions is 4 feet or less. The sampler is human powered and pushed into the sediment to the collection depth, or refusal. The push sampler consists of the following parts:

- Lexan tube (typically 2-4 ft in length; diameter may vary)
- Sampler head with check valve
- Nosecone, or core catcher, if needed
- T-handle to attach at sampler head or drive head
- Extension rods (typically 4 ft in length)

Prior to leaving the field station, ensure all required parts of the Watermark sampler are properly functioning and the equipment is ready for deployment per the following:

1. Inspect the pipe clamps securing the rubber sleeve secured to the sampler head. Ensure the clamps are not damaged or severely rusted and that the screw advances easily using the nut driver or screwdriver.

2. Inspect the rubber sleeve for any visible cracks or damage. If sleeve has large cracks splitting through the rubber, replace the sleeve.

3. Inspect the check valve in the sampler head. Submerge the head in a bucket of water and ensure the valve functions properly. As the sampler head is pushed deeper into the water, the valve should rise to the top of the sampler head. As the sampler head is lifted through the water column, the valve should lower to the bottom of the sampler head and should seal to provide suction on the sample tube holding the sample or water in the tube. A simple function test is to shake the sampler head in a vertical orientation. If the valve moves freely, a click can be heard as it moves in its travel channel.

4. Inspect Lexan liner tubes used to collect sample and ensure they are free from cracks or other debris. Ensure the ends of the tubes are not cracked or gouged. If longitudinal cracks (running the length of the tube) are present, replace the tube as these cracks can prevent the valve from providing a seal when retrieving the sample, increasing the possibility that sample will be lost during retrieval.

5. Inspect liner end caps for cracks and other damage. If cracks exist, replace caps.

6. Inspect threads in the top of the sampler head. T-handle or extensions rods should freely thread into the top of the sampler head. Fasten either the T-handle or extension rod to the top of the sampler head to ensure a proper fit.

7. Inspect the threads on extension rods, if used to ensure they are free of debris and that they thread correctly to other rods and the sampler head.

8. Inspect the core catcher, if used, for any signs of wear or rust. Ensure the teeth of the catcher are stiff and provide resistance to hold the sample in the liner tube. This can be performed by pulling the teeth away from the center and feeling if there is resistance.

9. For sampling stations where collection is for purposes of monitoring (station is re-visited from past campaigns) FOL will review the available logs and records of previous sampling campaigns and provide station-specific expectations to the field personnel.

The following steps shall be followed when deploying the Watermark sampler for collecting a sediment core. Steps below in **bold** are for when the sample is being obtained from **below water only.**

1. Secure a Lexan liner tube into the bottom of the rubber sleeve secured to the sampler head. Fasten pipe clamp using nut driver or flat head screwdriver. Pull gently upward on the sampler head while holding the liner stationary to ensure a tight fit.

   When fastening or removing a liner from the sampler head, only loosen and tighten the pipe clamp at the bottom of the rubber sleeve.

2. **Measure water depth at the sampling location and determine the required length of extension rods, if needed, and secure to the sampler. Measurement shall include water depth, air gap from water surface to vessel/working platform deck, and length of liner tube to account for the depth the sampler will be pushed into the mudline.**

   2a. When sampling on land, ensure enough length of rods are used to reach the desired depth.

3. **Slowly lower the sampler through the water column to the mudline.**

4. Push the sampler to the required depth, or refusal, defined as resistance at which the sampler will no longer advance under human power. Ensure the sampler is always perpendicular to the mudline while sampling.

   4a. If a sample is being collected in the marsh platform and a drive hammer is required to reach the required depth, thread the drive hammer into the top of the sampler head and drive the sampler to the required depth.

5. Twist the sampler clockwise 1 – 2 full rotations to shear the bottom of the sediment core, allowing the core to be recovered in the liner and not pulled back out of the liner during

retrieval. **Gently and deliberately retrieve the sampler to the water surface, leaving the bottom end of the liner just below the water surface.**

6. **Reach over the side of the vessel/working platform and cap the bottom of the liner so as the core breaks the water surface it does not slide out of the liner.**

7. **Keep the sample vertical. If overlying water exists above the sediment, carefully tip the sample slowly decant the overlying water from the top of the core. Take care to retain the fines fraction of sample that may be at the sediment interface.**

8. Keep the sample vertical and record pertinent information on the FDR.

9. Take a photo of the sample, in the liner with whiteboard denoting project name, project number, sampling station, Core ID, date and time.

10. Proceed to process the sample per SOP S-23.

AMS Professional Series Multi-Stage Sediment Sampler (Push/Hammer Core)

The AMS sediment sampler is a device used to collect sediment in submerged, mud flat, or marsh/wetland areas under human power. The sample is slowly lowered, or placed, at the sediment interface and pushed or hammered into the subsurface strata to obtain a sample. The sampler is then retrieved from the sediment by pulling the device out or by digging around the sampler, if on land or in shallow water, to minimize sample disturbance.

A push core sampler can be used at deeper depths (up to 10 feet of water depth) but manipulation and handling of the device becomes more difficult in deeper waters. The optimum depth for push sampling in most water conditions is 4 feet or less. The sampler is human powered and pushed into the sediment to the collection depth, or refusal. The push sampler consists of the following parts:

- Lexan tube (typically 2-4 ft in length)
- Sampler head with check valve
- Nosecone
- Core catcher, if needed
- T-handle to attach at sampler head
- Drive hammer, if needed
- Extension rods (typically 4 ft in length)

Prior to leaving the field station, ensure all required parts of the AMS sediment sampler are properly functioning and the equipment is ready for deployment per the following:

1. Inspect the threads on the stainless-steel sleeves to ensure they are clean and that the nose cone and sampler head thread properly to the sleeve.

2. Inspect the check valve in the sampler head. A simple function test is to shake the sampler head in a vertical orientation. If the valve moves freely, a click can be heard as it moves in its travel channel.

3. Inspect Lexan liner tubes used to collect sample and ensure they are free from cracks or other debris. Ensure the ends of the tubes are not cracked or gouged. If longitudinal cracks (running the length of the tube) are present, replace the tube as these cracks can prevent the valve from providing a seal when retrieving the sample, increasing the possibility that sample will be lost during retrieval.

4. Inspect liner end caps for cracks and other damage. If cracks exist, replace caps.

5. Inspect threads in the top of the sampler head. T-handle or extensions rods should freely thread into the top of the sampler head. Fasten either the T-handle or extension rod to the top of the sampler head to ensure a proper fit.

6. Inspect the threads on extension rods, if used to ensure they are free of debris and that they thread correctly to other rods and the sampler head.

7. Inspect the core catcher, if used, for any signs of wear. Ensure the teeth of the catcher are stiff and provide resistance to hold the sample in the liner tube. This can be performed by pulling the teeth away from the center and feeling if there is resistance. If teeth are weak, or broken, replace core catcher.

8. For sampling stations where collection is for purposes of monitoring (station is re-visited from past campaigns) FOL will review the available logs and records of previous sampling campaigns and provide station-specific expectations to the field personnel.

The following steps shall be followed when deploying the AMS sediment sampler for collecting a sediment core. Steps below in **bold** are for when the sample is being obtained from **below water only.**

11. Secure the nose cone to the bottom of the stainless-steel sleeve. Insert a lexan liner into the sleeve.

12. Secure the sampler head to the top of the stainless-steel sleeve.

13. **Measure water depth at the sampling location and determine the required length of extension rods, if needed, and secure to the sampler. Measurement shall include water depth, air gap from water surface to vessel/working platform deck, and length of liner tube to account for the depth the sampler will be pushed into the mudline.**

    2a. When sampling on land, ensure enough length of rods are used to reach the desired depth.

14. **Slowly lower the sampler through the water column to the mudline.**

15. Push the sampler to the required depth, or refusal, defined as resistance at which the sampler will no longer advance under human power. Ensure the sampler is always perpendicular to the mudline while sampling.

    4a. If a sample is being collected which must be hammered to reach the proposed depth, thread the drive hammer into the top of the sampler head, or onto the extension rods, and drive the sampler to the required depth.

16. Twist the sampler clockwise 1 – 2 full rotations to shear the bottom of the sediment core, allowing the core to be recovered in the liner and not pulled back out of the liner during retrieval. **Gently and deliberately retrieve the sampler to the water surface, leaving the bottom end of the liner just below the water surface.**

17. **Reach over the side of the vessel/working platform and cap the bottom of the liner so as the core breaks the water surface it does not slide out of the liner.**

18. **Keep the sample vertical. If overlying water exists above the sediment, carefully tip the sample slowly decant the overlying water from the top of the core. Take care to retain the fines fraction of sample that may be at the sediment interface.**

19. Remove the sampler head and nosecone from the stainless-steel sleeve and remove the lexan liner, maintain a vertical orientation during this process.

20. Take a photo of the sample, in the liner with whiteboard denoting project name, project number, sampling station, Core ID, date and time.

21. Keep the sample vertical and record pertinent information on the FDR.

22. Proceed to process the sample per SOP S-23.

Gravity Core Sampler

There are several types of gravity coring devices. Generally, the gravity core sampler uses the pull of gravity with a weighted sampler head to penetrate the mudline with a polycarbonate liner. The device can generally obtain cores up to 3 feet in length in deep water, depending on water and current conditions. The device is generally only effective in water depths greater than 4 feet with slack conditions facilitating the gravitational force to drive the liner into the sediments with sufficient penetration to preclude device falling over. The sediment is retained in the liner using suction induced by a ball valve or sealing cover. Recovering sediment using the gravity core is dependent upon multiple factors, which are tailored to station conditions, including: water depth, water circulation, weights, sediment type and compaction, liner length and diameter, suction efficiency, overlying water between the suction device and recovered sediment in liner, retrieval rate, and ability to effectively plug the liner at or beneath the water surface. The polycarbonate liner can be either dedicated or re-usable where the recovered sediment is extruded from the liner.

Field crews will review the manufacturer instruction manual prior to device use and tailor the means and methods outlined in this SOP to the device obtained and sampling station conditions. It is recommended that a ponar grab be performed at the sampling station prior to tailoring the gravity core and its deployment.

The gravity core device generally consists of the following parts:

- Sampler head
- Nylon deployment rope
- Polycarbonate liner tube
- Weight rings
- Suction device with integrated trigger
- Plug, stopper, or caps

Prior to leaving the field station, ensure all required parts of the gravity core sampler are properly functioning and the equipment is ready for deployment per the following:

1. Inspect the sampler head plunger for any significant wear including the rubber washer used to create a seal on the top of the liner during sample retrieval. If any cracks or damage or found, discontinue use of sampler.
2. Inspect shackle at top of sampler head. Ensure shackle bolt is securely fastened.
3. Inspect the nylon rope for any wear. If excessive wear is noted, replace rope, or cut and splice together. Use cable ties at the splice to ensure knot will not loosen during deployment.
4. Inspect the polycarbonate liner tube for any damage. If significant damage including chips, and gouges are noted, especially around the top of the liner, discard and use new liner.
5. Inspect liner clamp to ensure proper functionality. Lift the sampler head and place a liner into the head. Gently tug on the liner downward to test resistance of liner clamp. If liner falls out or is easily pulled out, discontinue use of the sampler until repairs have been made.
6. For sampling stations where collection is for purposes of monitoring (station is re-visited from past campaigns) FOL will review the available logs and records of previous sampling campaigns and provide station-specific expectations to the field personnel.

The following steps shall be followed when deploying the gravity core sampler for collecting a sediment sample.

1. Secure a polycarbonate liner into the sampler head and ensure it is secure by gently pulling downward on the liner.

2. Measure water depth and pull enough deployment line to reach the bottom with some contingency length. Tie off deployment line to a cleat or secure location on the vessel/working platform such that if the operator's grip is lost on the rope during deployment, the equipment is not lost.

3. Slowly lower the sampler through the water column to approximately 2-3 meters above the mudline. Hold the sampler at this depth for approximately 10-15 seconds to ensure it is stationary and perpendicular to the sediment surface.

4. Release the sampler and allow it to penetrate the mudline. Hold slight tension on the deployment line so that the operator can feel if the sampler remained perpendicular during penetration and to feel when the sampler reaches refusal.

5. Pull the sampler out of the mudline with the deployment line and slowly retrieve the sampler to the water surface, leaving the bottom end of the liner just below the water surface.

6. Reach over the side of the vessel/working platform and cap the bottom of the liner so as the core breaks the water surface it does not slide out of the liner.

7. Keep the sample vertical. If overlying water exists above the sediment, carefully tip the sample slowly decant the overlying water from the top of the core. Take care to retain the fines fraction of sample that may be at the sediment interface.

8. Keep the sample vertical and record pertinent information on the FDR.

9. Take a photo of the sample, in the liner with whiteboard denoting project name, project number, sampling station, Core ID, date and time.

10. Proceed to process the sample per SOP S-23.

11. Log the remaining recovered sediment on the FDR.

12. Dispose of the remaining sediment and decontaminate the equipment.

Box Core Sampler

The box core sampler is a grab sample device that recovers a cube of sediment. For the Penobscot River sediment collection, the box core sampler is a tool to, in essence, bring undisturbed sediment to the vessel deck where the field crew will hand-insert a cylinder (liner segment) thereby creating a "core" suitable for incremental sampling. The box core is a heavy sampling device often capable to withstand water circulation forces in the water column during descent and requires the use of an A-frame and properly sized vessel to deploy. The sampler is attached to a winch cable and lowered through the moonpool of the vessel. Depending on the stiffness of the sediment at the mudline, the box core can be dropped from different water depths to ensure sufficient penetration is achieved. As the box impacts the mudline, it penetrates until it reaches sufficient resistance to stop advancement. The device is retrieved and as the bottom of the box breaks the mudline interface, the jaws close to retain the sediment within the box. The device is then raised to deck and placed in a stand where short Lexan liner tubes can be manually pushed into the undisturbed sediment to recover a cylindrical core. The device operation is performed by WSP's subcontractor with assistance from WSP field staff.

Prior to leaving the dock, WSP field staff shall work with the subcontractor to ensure all required parts for the box core sampler are properly functioning and the equipment is ready for deployment per the following:

1. Inspect the box core sampler arms to ensure there is no significant damage of wear. Ensure the jaws open and close as intended.

2. Inspect shackle at top of box core sampler. Ensure shackle bolt is securely fastened.

3. Inspect winch cable to ensure no fraying is present or burrs are present that could cause hand injury.

4. For sampling stations where collection is for purposes of monitoring (station is re-visited from past campaigns) FOL will review the available logs and records of previous sampling campaigns and provide station-specific expectations to the field personnel.

The following steps shall be followed when deploying the box core sampler for collecting a sediment sample.

The box core sampler shall only be handled by WSP's subcontractor or those personnel who have been properly trained in the operation of the sampler.

1. Using a lead line, and depth sounder if equipped, measure and confirm water depth.
2. Secure the winch cable to the shackle on top of the box core sampler.
3. With two crew members supporting, lift the box core sampler out of the stand and in a controlled manner, move the sampler over the moonpool of the vessel.
4. Slowly lower the box core sampler into the water to the prescribed depth for deployment.
5. Release the box core sampler into the mudline. Allow the sampler to sit for a short period of time to allow it to fully penetrate.

6. Retrieve the box core sampler to deck and place in the stand.
7. Push two short Lexan liner segments about 1 foot long each parallel to one another into the sediment inside the box core sampler.
8. Let the Lexan liners sit for approximately 30-60 seconds once pushed into the sediment to allow the sediment to gain cohesion and stick to the inside of the liner.
9. Place a cap on top of each liner to create suction when pulling the liner out of the sediment. Twist the liner clockwise 1 – 2 full rotations to shear the sediment and pull the liner from the box corer contained sediment. If the twisting removal results in sediment loss, separation, or disturbance within the liner, then manually dig out the second liner segment by excavating the box core-containing sediment around the second liner. If the twisting removal of the first liner is successful, repeat for second liner.
10. Pull the liners out of the box core sampler and record pertinent information on the FDR.
11. Dispose of remaining sediment in the box core sampler and decontaminated the equipment.
12. Take a photo of the sample, in the liner with whiteboard denoting project name, project number, sampling station, Core ID, date and time.
13. Process the cores per SOP S-23.

HEALTH AND SAFETY

All field personnel must wear protective clothing and equipment as specified in the HASP.

SITE CLEAN-UP

Excess sediment not included in the sample shall be returned into the waterbody from which it was collected.

Throw all used wipes and gloves into the trash bags and take with you to dispose of at the field office.

RECORD KEEPING AND QUALITY CONTROL

Each field crew will carry and complete at the time of work field data sheets, site diagrams, and sample labels. In addition, a field notebook shall be maintained by each individual or team that is collecting samples, as described in the QAPP. Each sample shall have an ID number affixed to the outside of the collection container. Deviations from the SOP shall be noted in the field notebook, as necessary.

Samples taken from waters with visible color abnormalities, foaming, unusual odor, iridescent film, or other indications of non-homogeneous conditions shall also be noted. Field personnel will collect the proper type and quantity of quality control samples as prescribed in the QAPP.

DECONTAMINATION

Because decontamination procedures are time consuming, having a quantity of pre-cleaned sampling tools available is recommended. All sampling equipment must be decontaminated prior to reuse as prescribed in the FSP SOP No. S-17, Decontamination of Field Equipment.

The general procedure for equipment decontamination is as follows:

1. Brush off any loose soil/sediment
2. Detergent Wash
3. River water rinse
4. Deionized water rinse
5. Air Dry

REFERENCES

WSP, 2023a. 2023 Long Term Monitoring Plan; Penobscot River, Maine. February 2023.

WSP, 2023b. Quality Assurance Project Plan; Penobscot River, Maine. February 2023.

- END OF PROCEDURE -

SOP No. S-6A

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

Interval Sediment Sampling

Interval Sediment Sampling

SOP S-6A

Table of Contents

Interval Sediment Sampling Wetland, Intertidal, Subtidal

SOP S-6A

The objectives of this SOP is as follows;

1. **Maintain sample interval integrity,**
2. **Minimize sample exposure to the environment,**
3. **Reproducible sample collection and process methods.**

Note: Once sediment is collected in plastic core sleeves, always keep sleeves in the vertical orientation until the core is completely frozen.

Intertidal Sediment Coring Methodology

Equipment

- Sample and Analysis Plan, SOP, HASP, and Figures
- Boat
- Safety equipment
- Salinometer
- Three 3 inch diameter X 24 inch long plastic core sleeves
- Six 3 inch diameter end caps
- Watermark sediment sampler and appropriate tools
- 12 feet of Watermark extension rods
- 3 inch stainless steel pipe cutter.
- Ruler that measures tenths of a foot
- Camera
- IPAD with electronic FDRs
- R1 GPS receiver
- Nitrile gloves
- Paper towels
- Permanent marker
- 8.5” X 11” blank paper
- Two Ozark Coolers
- Dry Ice (two 3”diameter X24” long cores sleeves filled with dry Ice per cooler)
- Zip Ties
- Cordless Drill
- ¼ inch drill bit
- Decontamination Equipment
    - Plastic containers
    - 409 multipurpose cleaner
    - Knock off brushes
    - DI water

Pre-Coring Core Sleeve Markings

Prior to loading plastic core sleeves into the stainless steel slide hammer barrel, use a permanent marker to write the following markings on the plastic core sleeves:

- Location Name
- Core Collection Date
- Core Collection Time
- 18” target line
- Top
- Bottom

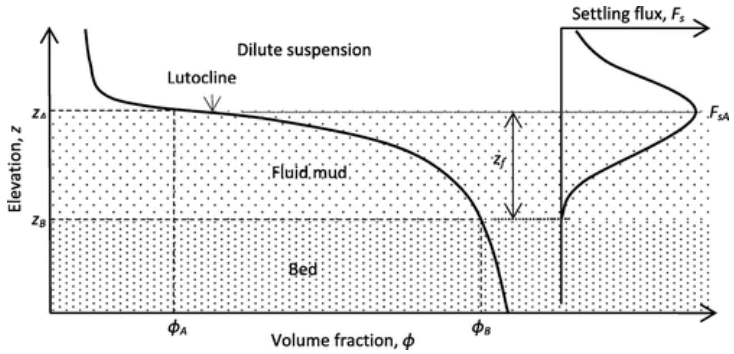
Intertidal Sediment Core Collection

- Navigate to the desired sediment sample location while intertidal sediments are covered with water.
- Collect the surface water salinity utilizing the salinometer.
- Use the watermark sediment coring handle with core to advance the core tube to 18” below ground surface in a vertical manner from the boat.
- Remove the core from the ground and water.
- Cap the bottom of the core.
- Remove the top of the core from the Watermark coring handle.
- Measure the total amount recovered.

Calculate: Length Recovered/Total Cored = % recovery

- Ensure that there is at least 70% recovery within the core sleeve.
- Utilizing the stainless steel pipe cutter, cut the plastic core sleeve ¼ inch above the top of the recovered material.
- Cap the top of the core sleeve.
- Repeat the process for the second and third core sleeve using a new plastic core sleeve.
- If 70% recovery is achieved, identify the Lutocline.
- Identify the Lutocline.

Lutocline (fluid mud top) and consolidated mud Identification



- Hold a blank piece of white paper behind the watery top of the vertical core.
- Mark on the core with a permanent pen where the light dissipates in half. (Lutocline or bottom of overlying clear water and the top of fluid mud interval)
- Then mark on the core where the light completely dissipates. (this is 0.0 or bottom of the fluid mud and the top of the consolidated mud interval)
- Drill a 1/4 inch hole with the cordless drill at the Lutocline to let the overlying clear water drain out.
- Collect the overlying water and record a salinometer reading.
- Using the 3" decontaminated stainless steel pipe cutter, cut the core sleeve horizontally at the drilled hole such that no cutting equipment touches the media to be sampled.
- Cap the top of the core and place it in the Ozark cooler to begin freezing.
- Repeat the process above for the second and third cores.
- If the recovery is less than 70%, preserve and stand core sleeve aside and try the second core.
- Ensure that there is at least 70% recovery or that the recovery is within 10% of the previous core attempt at the same location.
- Collect GPS location at sediment collection location.

Post-Coring Core Sleeve Markings

Use a permanent marker to mark the following on the core;

- Lutocline (top of fluid mud as identified in the previous section)
- Top of consolidated mud (as identified in the previous section) = 0.0
- Salinity

Core Sleeve Handling and Management

- Each set of three core sleeves will be bound together with zip ties and placed in the Ozark cooler ensuring that the length of the sleeves are in contact with the dry ice sleeves.
- Core sleeves will be secured in the upright manner to ensure the sleeves remain in the vertical manner as they freeze.
- Sets of full core sleeves will be transferred to a freezer at the field staging area.
- Core sleeves will be placed and stored in the field office freezer in the vertical orientation until core sleeve material is frozen and are removed from the freezer for sample processing.

Sediment Logging and Classification

- Back in the field staging area, the third core will be split open and utilized to log and classify the sediments according to SOP S-7 Procedures for Description and Identification of Soils on the E-FDR.

Core Sleeve Processing Methodology – Field Lab

Equipment

- Sample and Analysis Plan, SOP, HASP, and Figures
- Safety core sleeve splitter
- Kevlar cut resistant gloves
- Hook blade box cutter
- Nitrile gloves
- Sawzall
- Munsell Soil Color Book
- Tin Foil
- Cutting pans
- Camera
- Ruler that measures tenth of feet
- 8.5” X 11’ Paper
- Dry Ice
- Permanent marker
- Sample containers
- Shipping Coolers
- 409 multipurpose cleaner
- FDRs

Core Processing

Note: Cores should be processed on shore at the field lab after freezing in an on-site freezer.

Table 1.1 Sediment Core Sample and Analysis Plan

Interval (ft)	Solids Analysis	Plastic Container	Processing
0.0-0.1	MeHg, Hg (TOC if volumes allows)	1 X 8 oz	Lab homoginize and subsample
0.1-0.3	MeHg, Hg, TOC	1 X 16 oz	Lab homoginize and subsample
0.3-0.5	MeHg, Hg, TOC	1 X 16 oz	Lab homoginize and subsample
0.5-0.7	Hg, TOC	1 X 16 oz	Lab homoginize and subsample
0.7-1.0	Hg, TOC	1 X 16 oz	Lab homoginize and subsample

All samples with MeHg analysis get immediately frozen and stay frozen until lab receives.

Core Interval Processing

See Table 1.1 for Sediment Core Sample and Analysis Plan

Preparing intervals to send to lab for homogenization and subsampling

Step 1

- Put on a new pair of nitrile gloves
- Remove core 1 from the freezer
- Remove the end caps from core 1.
- Secure the core in the safety core sleeve splitter.

- Use the hook blade to slice down each side of the first core.
- Identify the six intervals
    - Overlying water - 0.0,
    - 0.0 - 0.1 ft,
    - 0.1 - 0.3 ft,
    - 0.3 – 0.5 ft,
    - 0.5 – 0.7 ft,
    - 0.7 – 1.0 ft.
- Lay the core on a new piece of tinfoil on a solid surface.
- Utilizing a Sawzall and decontaminated saw blade, separate the frozen core into pucks representing the five intervals. (decontaminate the saw blade between each separation)
- Utilizing a new pair of nitrile gloves for each sample interval collection,
- Place each of the sample interval's frozen pucks into the appropriately labeled plastic container according to Table 1.1.
    - 0.0 - 0.1 ft,
    - 0.1 - 0.3 ft,
    - 0.3-0.5 ft,
    - 0.5 – 0.7 ft,
    - 0.7-1.0 ft.
- Place the plastic containers containing the samples back in the freezer until shipment.

Note: Do not over fill containers that get instant frozen or the container can break.

Sediment Logging and Classification

- Put on a new pair of nitrile gloves
- Remove the end caps off the third core
- Secure the core in the safety core sleeve splitter.
- Use the hook blade to slice down each side of the third core.
- Lay a tape measure next to the core.
- On a piece of paper write the location name, date, and indicate top of the core. (Info sheet)
- Take a photo with the ruler and info sheet.
- Classify and log the sediments in the third core sleeve on the Core Sediment Sampling E-FDR.
    - Note the presence/absence of woody material
    - Note root depth and density

- END OF PROCEDURE-

SOP No. S-7

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

PROCEDURE FOR DESCRIPTION AND IDENTIFICATION OF SOILS

PROCEDURE FOR DESCRIPTION AND IDENTIFICATION OF SOILS

SCOPE AND APPLICABILITY

The appearance and textural properties of soil samples will be described using the Unified Soil Classification System (USCS). The USCS uses grain size to divide soils into different soil classes, coarse grained vs. fine grained. The system then further describes the soils based on the mix of coarse materials such as sand and gravel or the relative plasticity of the fine grained materials such as silt and clay.

Soil type identifications and descriptions will be recorded by field samplers during field investigation activities. Soil types will determined when completing explorations (monitoring well installations, soil borings, and surface soil sampling) and other activities where descriptions of soils are needed to characterize site location conditions. These field descriptions may be supplemented with laboratory data on grain size distributions analyses to characterize soils.

EQUIPMENT AND SUPPLIES

- USCS Key
- 6 foot folding rule or other measuring tool
- PID
- Field Data Records
- Knife of spatula

PROCEDURE

Soil descriptions are made using the USCS Classifications and will include the following observations:

- Color
- Name
- Gradation
- Density
- Moisture
- Plasticity
- Structure
- geologic origin
- USCS classification designation.

A USCS key to soil descriptions and terms is included as Attachment 1. All sample descriptions will be recorded in a field log book and/or the Field Data Record for the media being sampled (see FDR Appendix).

ATTACHMENT 1 - KEY TO SOIL DESCRIPTIONS AND TERMS

<table>
<tr><td colspan="5">UNIFIED SOIL CLASSIFICATION SYSTEM</td><td>TERMS DESCRIBING SOILS (excludes particles > 3", organics, debris, etc.)</td><td>TERMS DESCRIBING MATERIALS i.e. particles > 3", organics, debris, etc.)</td></tr>
<tr><td colspan="3">MAJOR DIVISIONS</td><td>GROUP SYMBOLS</td><td>TYPICAL NAMES</td><td>Trace: Particles present, but < 5%</td><td>Occasional: Particles present, but < 10%</td></tr>
<tr><td colspan="5"></td><td>Few: 5% - 10%</td><td>Some: 10% to 25%</td></tr>
<tr><td colspan="5"></td><td>Little: 10% - 25%</td><td>Frequent: >25%</td></tr>
<tr><td rowspan="10">COARSE-GRAINED SOILS (>50% RETAINED on the No. 200 sieve)</td><td rowspan="5">GRAVELS (>50% of coarse fraction RETAINED on the No. 4 sieve)</td><td rowspan="2">CLEAN GRAVELS (<5% fines)</td><td>GW</td><td>Well-graded gravels or gravel-sand mixtures; trace or no fines.</td><td>Some: 25% - 45%</td><td></td></tr>
<tr><td>GP</td><td>Poorly-graded gravels or gravel-sand mixtures; trace or no fines.</td><td>TERMS DESCRIBING MOISTURE</td><td>TERMS DESCRIBING STRUCTURE</td></tr>
<tr><td rowspan="3">GRAVEL WITH FINES (>12% fines)</td><td rowspan="2">GM</td><td rowspan="2">Silty gravels or gravel-sand-silt mixtures.</td><td>Dry: Absence of moisture; dusty</td><td>Layer: > 3" thick</td></tr>
<tr><td>Moist: Damp, but no visible water</td><td>Seam: 1/16" to 3" thick</td></tr>
<tr><td>GC</td><td>Clayey gravels or gravel-sand-clay mixtures.</td><td>Wet: Visible/free water</td><td>Parting: < 1/16" thick</td></tr>
<tr><td rowspan="5">SANDS (50% or more of coarse fraction PASSES the No. 4 sieve size)</td><td rowspan="2">CLEAN SANDS (<5% fines)</td><td>SW</td><td>Well-graded sands or sand-gravel mixtures; trace or no fines.</td><td colspan="2">CORRELATION OF STANDARD PENETRATION TEST (SPT) WITH RELATIVE DENSITY AND CONSISTENCY</td></tr>
<tr><td>SP</td><td>Poorly-graded sands or sand-gravel mixtures; trace or no fines.</td><td colspan="2">GRAVEL, SAND & SILT (NON-PLASTIC)</td></tr>
<tr><td rowspan="3">SAND WITH FINES (>12% fines)</td><td rowspan="2">SM</td><td rowspan="2">Silty sands or sand-gravel-silt mixtures.</td><td>Relative Density</td><td>N-Value (blows per foot)</td></tr>
<tr><td>Very loose</td><td>0 - 4</td></tr>
<tr><td>SC</td><td>Clayey sands or sand-gravel-clay mixtures.</td><td>Loose
Compact
Dense
Very Dense</td><td>5 - 10
11 - 30
31 - 50
> 51</td></tr>
<tr><td colspan="5"></td><td colspan="2">SILT (PLASTIC) & CLAY</td></tr>
</table>

ATTACHMENT 1 - KEY TO SOIL DESCRIPTIONS AND TERMS

FINE-GRAINED SOILS (50% or more PASSES the No. 200 sieve)	SILTS AND CLAYS (liquid limit <50)	ML	Inorganic silts or rock flour, non-plastic or very slightly plastic. PI <4 or plots below "A" line.	Consistency	SPT N-Value	Su (psf)	Field Guidelines
				Very Soft	0 - 2	0 - 250	Fist easily penetrates
				Soft	3 - 4	250 - 500	Thumb easily penetrates
		CL	Inorganic lean clays. Low to medium plasticity. PI >7 and plots on or above "A" line.	Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort.
				Firm	9 - 15	1000 - 2000	Indented by thumb with great effort
		OL	Organic silts, clays and silty clays. Low to medium plasticity.	Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
	SILTS AND CLAYS (liquid limit ≥50)	MH	Inorganic elastic silt. PI line plots on or above "A" line.	Hard	>31	over 4000	Indented by thumbnail with difficulty
		CH	Inorganic fat clay. High plasticity. PI line plots on or above "A" line.	**ROCK QUALITY DESIGNATION (RQD)**			
		OH	Organic silts and clays. High plasticity.	RQD = sum of the lengths of intact pieces of core* >100mm (0.3ft.)			
	HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils. Decomposed vegetable tissue. Fibrous to amorphous texture.	length of core advance			
				*Minimum NQ rock core (1.88 in. OD of core)			

ATTACHMENT 1 - KEY TO SOIL DESCRIPTIONS AND TERMS

Desired Soil Observations: (in this order)					Quality Description	RQD
Color				-	Very Poor	<25%
Primary Soil Component					Poor	26% - 50%
Secondary Soil Components					Fair	51% - 75%
Angularity and/or shape of sand/gravel particles					Good	76% - 90%
USCS Symbol (See ASTM D 2488 Figs 1a, 1b, & 2)					Excellent	>91%
Density/Consistency					**Desired Rock Observations: (in this order)**	
Moisture						
Plasticity (as applicable)					Color (i.e. olive brown, gray, reddish brown)	
Structure					Texture (aphanitic, fine-grained, etc.)	
Geologic Origin					Lithology (igneous, sedimentary, metamorphic, etc.)	
Fill, Alluvium, Lacustrine, Glacial Till, etc.					Hardness (very hard, hard, mod. hard, etc.)	
Presence of organics (leaves, roots, rootlets, etc.) or debris (concrete, brick, wood, metal, etc.)					Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)	
Presence of cobbles or boulders (based on observations of drilling)					Geologic discontinuities/jointing:	
Odor, PID data, Torvane or pocket penetrometer data, etc.					-dip (horiz - 0°-5°, low angle - 5°-35°, mod. dipping - 35°-55°, steep - 55°-85°, vertical - 85°-90°)	
Example Descriptions:					-spacing (very close - <5 cm, close - 5-30 cm, mod.close 30-100 cm, wide - 1-3 m, very wide >3 m)	
Olive brown, fine to medium sand, little silt, trace angular gravel, SM, medium dense, moist: FILL						
- occasional concrete and brick fragments; petroleum odor; PID = 1.4 ppm					-tightness (tight, open or healed)	
Gray, CLAY, little fine sand, trace angular gravel, CL, stiff, moist, desiccated: LACUSTRINE					-infilling (grain size, color, etc.)	
Yellowish brown, fine SAND, trace silt, trace rounded gravel, poorly-graded, SP, loose, wet: ALLUVIUM					Interpreted Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)	
					RQD and Rock Mass Description (very poor, poor, fair, etc.)	
- occasional partings of fine sand; 1-inch seam of olive brown silt at 8' bgs; Torvane = 0.55 tsf					Recovery	

Sample Container Labeling Requirements (if retained): Site, Boring ID, Sample Number, Sample Depth, Sample Recovery, Blow Counts, Personnel Initials.

- END OF PROCEDURE -

SOP No. S-8

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

AVIAN MIST NETTING AND NET REMOVAL

AVIAN MIST NETTING AND NET RETRIEVAL

OBJECTIVES

This standard operating procedure (SOP) sets forth the field procedures used to mist net and retrieve birds. Where applicable, mist netting and the methods used will be consistent with state or federal permit requirements. A U.S. Geological Survey (USGS) Federal Bird Banding Permit, as well as the appropriate state (scientific collection) permits, must be obtained prior to all mist netting.

Pre-Collection Activities

Staff assigned the responsibility of mist netting will be provided the following:

- Work documents (i.e., copies of permits)
- Locations for mist net placement
- Mist nets
- Pole assembly
- Mist net assembly procedures
- Bird retrieval/handling procedures
- Special instructions (if any)

Mist Netting Procedures

The general procedures to be followed when mist netting and retrieving birds are outlined below.

Materials

The following collection equipment and materials will be available, as appropriate, during mist netting:

- Health and safety equipment (as required by the health and safety plan)
- Mist nets (polyester, 30mm)
- Clean, sturdy and lightweight holding bags
- Pole assembly
- Guylines
- Binoculars
- Scissors
- Pens/Pencils/sharpies
- Field Notebook
- Digital Camera
- Handheld GPS
- Tent or other shade providing shelter

Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following information:

- Names of field crew and additional personnel present on site
- General weather conditions
- Date, time, and location, including a general description and GPS coordinates
- Mist net opening and closing times
- General observations
- Representative photographs

Mist Netting Procedures

Birds will be captured by mist netting and processed using approved handling techniques. Mist nets must have the appropriate mesh size (appropriateness is determined by the size of birds targeted), be of good quality, and be in good condition.

The following items are problems unique to mist netting and must be paid attention to:

- Wear simple clothing with as few buttons, zippers or Velcro as possible. Do not wear jewelry or rings. Be careful of sunglasses or other items that may become entangled in the mesh and rip the nets.
- Do not open the nets until just before sunrise, and close them before dusk.
- Be aware that other animals may become entangled in the nets.
- Do not mist net in inclement weather conditions or extreme heat

General Guidelines for Operating Mist Nets

- Make sure the nets are clear of vegetation.
- Keep the nets free of debris and pieces of broken or dead vegetation.
- When the nets are not in use, furl them to prevent animals or birds from becoming caught.
- Ensure that the guylines are tied to secure anchors to prevent the mist net from collapsing
- Ensure proper net tension. Too much tension can result in birds “bouncing” off the net. Too little tension may cause birds to be caught in more than one tier.
- Ensure proper tier spacing. Each tier or loop should be no more than 18 inches from the next on the pole. Ideal spacing is critical to catching birds (See Figures 1 and 2).
- If there is standing water directly under a net lane, be sure to place 4 loops/trammel lines over the guylines and 1 under, so that the bottom tier pocket does not touch the water.
- Remove the nets at the end of the day to prevent theft or damage.
- Do not put nets away when wet or with vegetation stuck in them.

When taking down mist nets, use a plastic bag for storage.

a. Close both sides of the mist net
b. Take one side off of the poles first, placing the loops/trammel lines around the handle of the plastic bag, so that the handle is through the center of the loops.
c. Then while pulling on the net gently to create slight tension, slowly grab the net and insert the net into the plastic bag.
d. When you reach the end, place the other plastic bag loop through the trammel lines/loops.

Techniques to removing songbirds from mist nets:

- Do not play with the birds, and always be as quiet as possible.
- Be cautious when moving the net so as not to disturb others who are removing birds at the same net.
- The most important step is to determine from which side the bird has entered the net.
- Grasp the legs of the bird gently and remove the mist net from the legs first.
- Continue to hold the legs with your index and middle fingers firmly placed close to the bird's belly, where the legs join the body. (In as close to a photographer's grip as possible. See Songbird Sampling SOP S-9 for details of this grip)
- Use this hold with caution – if the bird begins to flap its wings excessively, put the bird in a bander's grip (See Songbird Sampling SOP S-9 for details of this grip) to prevent exhaustion.
- Once the mist net has been removed from the legs, gently pull the strands of the net over the bird's head. Place your thumb on the top of the beak when necessary to prevent strain on their neck (except grosbeaks or cardinals).
- Use caution when removing the mist net from wings, to prevent wing strain from occurring.
- Remember to keep all movements of the wing close to the body, or extended in a natural position for the bird.
- Smooth feathers at the end of removal to prevent discomfort to the bird.
- Place the bird into a holding bag, while holding the bag tightly around the wrist with your other hand.
- Remove the hand holding the bird while still gripping your wrist and the top of the bag to prevent the bird from escaping. Close the bag immediately.
- Never leave the bag on the ground. This can result in the bird losing too much body heat into the ground, and they can be stepped on and crushed.
- Always loop the bag onto your wrist or hang it on a branch in the shade, in plain sight, or somewhere where it will not be forgotten.

Take bird to bird processing location as soon as possible so bird can be processed and released as quickly as possible to reduce stress on the bird.

Figure 1. Typical Mist Net Assembly (Constructed)

Figure 2. Mist Net Assembled Properly

- END OF PROCEDURE-

SOP No. S-9

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

SONGBIRD SAMPLING

SONGBIRD SAMPLING

OBJECTIVE

This standard operating procedure (SOP) sets forth the field procedures used to band and sample blood from songbirds. Where applicable, the bird species banded and the methods used will be consistent with state or federal permits. Project personnel will possess the appropriate U.S. Geological Survey (USGS) Federal Bird Banding Permits authorizing banding and the appropriate state (scientific collection) permits.

Pre-Collection Activities

Staff assigned the responsibility of banding birds will be provided the following:

- Work documents (banding data sheets, copies of permits)
- Target species information
- Banding equipment
- Blood sampling equipment
- Collecting and processing procedures
- Special instructions (if any)

Bird Banding Procedures

The general procedures to be followed when banding songbirds are outlined below.

Materials

The following collection equipment and materials will be available, as appropriate, during bird banding and blood collection:

- Health and safety equipment (as required by the health and safety plan)
- Banding data sheets
- *Identification Guide to North American Birds*: Part I (Pyle 1997)
- *The Tabular Pyle* (Sakai and Ralph 2007)
- USGS Bird Banding Lab Aluminum Bands (with 9-digit numbers)
- Banding Pliers (Sizes 0A-3)
- Wing ruler
- Tail ruler
- Leg gauge
- Weighing Scale(s)
- Weighing Bags and/or tubes

- Clean holding bags
- Band Opener/Remover Pliers
- Mist nets and pole assembly
- Alcohol wipes
- Antiseptic ointment
- Microhematocrit capillary tubes
- Vacuette tubes
- 27-gauge needles
- Sharps container
- Crito-caps or crito-seal capillary tube sealant
- Powdered styptic for clotting minor cuts or abrasions
- Tweezers
- Scissors
- Pens/Pencils/Sharpies
- Field Notebook
- Digital Camera
- Handheld GPS
- Tent or other shade providing shelter

Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following information:

- Names of field crew and any additional personnel present on site
- General weather conditions
- Date, time, and location, including a general description and GPS coordinates
- Capture technique
- Sampling duration
- General observations
- Representative photographs
- Banding information and sample identification from blood collection

Banding Data Form

Banding data forms must be filled out completely and include the following information:

- Band Number
- 4-Digit Alpha Species Code
- Month/Day/Year
- Location (site coordinates and net number)
- Time (24-Hour)
- Age
- Aging Method
- Sex
- Sexing Method
- Fat
- Body Molt
- Wing Chord
- Tail Length
- Weight
- Bander Initials
- Other, optional information (Brood Patch, Cloacal Protuberance, photo number)

Blood Collection Form

Blood collection forms must be filled out completely and include the following information:

- Band number
- 4-Digit Alpha Species Code
- Sample identification number
- Month/Day/Year
- Location
- Time (24-Hour)
- Weight
- Number of mercury capillary tubes
- Bander Initials

Songbird Banding and Blood Collecting Procedures

Birds will be captured by mist netting (see Avian Mist Netting SOP S-8) using approved handling techniques.

The following basic handling ethics/rules are to be applied:

- The bander's primary responsibility is the health and welfare of the birds
- Handle each bird as quietly, carefully, and gently as possible in the quickest time possible to minimize stress
- Use the correct band size and banding pliers for each individual bird species
- Treat any bird injuries
- Only capture and process as many birds as team members can safely handle
- If the bird appears stressed, immediately release it in a safe area
- Do not open nets or release handled birds when predators are present
- Do not band in inclement weather conditions or extreme heat
- Provide shaded areas to process birds, if possible
- Take accurate data

Songbirds (passerines) are most efficiently handled by one person, using the bander's grip/ringer's hold method (see Figure 1):

a. Use your non-dominant hand to grasp the bird. For example, if you are right-handed, place the holding band in your right hand and grasp the bird in your left hand. This allows your dominant hand to be free for banding and biometric measurements/other data.
b. Firmly but gently grasp the bird with its back and wings against the palm of your hand. Make sure the wings are closed properly to prevent wing strain.
c. Place the head between the index and middle finger at the middle phalanges.
d. Close the ring and little finger around the body of the bird.
e. When applying the band, place the appropriate leg of the bird between your thumb and index finger.
f. Take wing chord and other measurements while the bird is in this grip.
g. Manipulate the wing in this grip to perform blood sampling, the wing can be held open by gripping the upper wing between the thumb and tip of the index finger.
h. Use an alcohol wipe to adjust feathers away from and clean the area around the brachial vein near elbow of wing
i. Use a sterile syringe needle to puncture the vein, entering laterally. Withdraw needle and discard in sharps container.

j. Collect blood with a heparin-treated capillary tube. Cap tube on both ends immediately after tube is filled with blood and place in labeled vacuette tube.

k. Store labeled vacuette tubes with samples in cooler on wet ice prior to shipment to lab for analysis.

l. Insert a piece of cotton under wing adjacent to wound to stop bleeding and place wing against bird body.

m. Remove cotton before releasing bird.

n. To take photographs, transfer the bird to another bander, change your grip to the photographer's grip (see Figure 2) or release the bird. While the bird is in the bander's grip, take your dominant hand and place the legs of the bird in between your index and middle finger while pushing your thumb gently on the bend of the leg.

Biometric Data Collection

a. Wing chord: gently and carefully slide the top of the wing rule to rest against the radial joint. Record the measurement at the tip of the longest primary flight feather in millimeters.

b. Tail measurement: slide a thin, small scientific ruler in between the retrices/tail feathers until the ruler stops at the base of the tail. Record the measurement in millimeters.

c. Fat and molt: in the bander's grip, bend the bird's head gently backwards and pull the legs downward to expose the abdomen. Gently blow the body feathers upward to expose any pin feathers (molt) and the furcular hollow (fat). Pull the wing outward gently and blow to check for fat and molt. Blow the skull feathers last. Cloacal protuberance and brood patches can be checked this way as well.

d. Aging/molt limits: while holding the bird in bander's grip, take your thumb and forefinger and stretch the wing outward (Figure 3).

Release the bird in a safe location when all measurements/data have been recorded, blood has been collected, and photographs have been taken (if necessary).

Figure 1. Bander's Grip

Figure 2. Photographer's Grip

Figure 3. Bander's Grip Gently Stretching Wing Outward

- END OF PROCEDURE -

SOP No. S-10

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

DUCK COLLECTION AND SAMPLING OF BREAST MUSCLE TISSUE AND BLOOD

DUCK COLLECTION AND SAMPLING OF BREAST MUSCLE TISSUE AND BLOOD

OBJECTIVE

This standard operating procedure (SOP) sets forth the field procedures used to collect duck tissue and blood samples. Project personnel will possess the appropriate scientific collection permits and training.

Pre-Collection Activities

Staff assigned the responsibility of duck sample collection will be provided the following:

- Work documents (data sheets, copies of permits)
- Target species information
- Blood and tissue sampling equipment
- Collection and processing procedures
- Special instructions (if any)

Sample Collection Procedures

The general procedures to be followed when sampling ducks are outlined below.

Materials

The following collection equipment and materials will be available, as appropriate:

- Health and safety equipment (as required by the health and safety plan)
- *Identification Guide to North American Birds*: Part I (Pyle 1997)
- *The Tabular Pyle* (Sakai and Ralph 2007)
- Wing ruler
- Tail ruler
- Leg gauge
- Weighing scale(s)
- Weighing bags
- Clean holding bags
- Net guns
- Wire traps (and bait)
- Alcohol wipes
- Antiseptic ointment
- Nitrile gloves
- Vacutainer tubes (royal blue) with EDTA
- 25-gauge needle syringes
- Sharps container

- Powdered styptic for clotting minor cuts or abrasions
- Scalpels with spare blades
- Tweezers
- Scissors
- Pens/Pencils/Sharpies
- Field Notebook
- Digital Camera
- Handheld GPS
- Ziploc bags
- Sample coolers (with ice)

Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following information:

- Names of field crew and additional personnel present on site
- General weather conditions
- Date, time, and location, including a general description and GPS coordinates
- Capture technique
- Sampling duration
- General observations
- Representative photographs
- Banding information (if applicable) and sample identification from blood and tissue collection

Blood and Tissue Collection Form

Blood and tissue collection forms must be filled out completely and include the following information:

- 4-Digit Alpha Species Code
- Sample identification number
- Month/Day/Year
- Location
- Time (24-Hour)
- Weight
- Number of vacutainer tubes
- Number of tissue samples
- Sampler initials

Field Forms

Field forms may include the electronic field data record and chain of custody forms. Forms will be filled out completely and include the below listed information.

Field Data Record

- Collector's initials and method of collection
- Date, time, and location
- Number and type of individual samples
- Coordinates
- Photo numbers (if taken)
- Notes

Chain of Custody

- Project name and number
- Date and time (24-hour)
- Sample identification numbers
- Analytical method requested
- Signature of recording personnel

Sample Capture Procedures

Wire Traps. Wire traps can be an effective collection procedure for trapping multiple ducks at a time. Trapping should be conducted following the hunting season closure. Collection sites should be baited to accustom the ducks to finding food at the site. Toward the end of the baiting period open wire traps should be constructed on the bait site, allowing free access into and out of the baited trap. After ducks begin to willingly enter the open traps to eat the bait, the traps should be rebaited and set. To set, the traps should be closed, leaving only narrow access chutes which allowed the ducks to enter, but not exit the trap.

Net Gun. A pneumatic net gun is a suitable capture technique for short-duration handling, generally less than 10 minutes, which enables rapid capture and release of target duck. Net guns should only be used to capture a single duck at a time, as attempts to capture two or more ducks within a single net are likely to result in injury, or possibly death. At least two capture guns with loaded nets, or a gun with detachable barrel and multiple nets, should be available to the gunner for each capture. This provides a back-up that can be used to reduce chase duration if the first net missed the target duck or to re-net a duck if the first net did not provide adequate restraint. Pursuit and capture must occur on smooth, open terrain with good footing. Final, close pursuit for the purpose of netting a duck should be kept short (less than 1 min of strenuous flying), and must always be terminated when the target duck show signs of fatigue. Ducks must be handled and released as quickly as possible following capture. Attempts to capture two ducks with separate nets prior to handling and sampling must not be done unless there is an additional handler present to attend to the first captured duck while the net gunner and second handler pursue a second duck. Where multiple individuals are to be captured from the same flock or group, the capture crew must avoid causing fatigue and stress in non-target ducks.

Sample Collecting Procedures

Blood Collection. Blood should be collected from the inner brachial artery at the base of the wing, or from the femoral vein in the leg, using a 25 gauge needle syringe. However, the leg veins are typically not as good for drawing blood, and it is recommended that draws are attempted from both wings prior to attempting to draw from a leg. Blood should be collected into a trace element vacutainer (royal blue) containing EDTA to prevent clotting.

Wear nitrile gloves during blood collection. To collect blood from the brachial artery on the inside of either wing, have one person hold the bird on its back on a flat work surface. Spread one wing out and pluck the feathers from the inside of the "elbow" and wipe the area with alcohol until the darker brachial artery going over the wing bone is visible.

Remove the cap and sleeve of the syringe, and twist and remove the needle cover. As the needle is threaded on the syringe, twist the needle cover clockwise so it is tightening the needle while removing the cover. Pull out the plunger of the syringe about ½" and push it back in, this breaks the seal and makes it easier to pull gently on the plunger when drawing blood.

Use both hands on the syringe when collecting blood. One hand steadies the syringe and the other controls the plunger on the syringe. The needle should enter at a very slight angle (almost parallel) to the artery. Do not go all the way through artery as it is more difficult to find the center when the needle is pulled back through the artery. Once the needle is inserted into the skin, pull back very slightly on the plunger so that when the needle enters the artery, blood will immediately enter the syringe. Once good flow of blood is started, freeze needle movement, as any movement may remove the needle from the artery. Gradually pull back on the syringe plunger; do not pull back hard on the syringe plunger as the resulting suction may collapse the artery. The target collection is 1.5 cc (1.5 ml) of blood. Sometimes good blood flow is difficult and the needle must be removed to try the other wing.

Once sufficient blood is obtained, remove the needle, press briefly on the puncture spot and release the bird. Only rarely does the bird bleed enough to notice it on the feathers after its release. Transfer the blood from the syringe to a vacutainer tube (royal blue with EDTA). As the tubes have a slight vacuum, stick the needle into the tube and the blood will be sucked out of the syringe and into the tube. The 1.5 ml of blood should be gently mixed, appropriately labeled, and placed on ice for transport to the lab. Make sure that needles are disposed of in a sharps container.

Tissue Collection. Tissue collection from "taken" ducks may be conducted in the field or whole ducks may be shipped on ice to the laboratory. Both breasts are to be collected from each duck. Wear nitrile gloves during tissue collection. Insert a clean scalpel or a knife to make a midline incision through the skin of the breast (Figure 1A). Take care not to penetrate the body cavity, particularly in the abdominal region. Continue the skin incision to the vent and to the base of the neck, and reflect the skin away from the neck, breast, and abdominal areas (Figure 1B). Use the thumb and the first finger of each hand to reflect the skin, it is easiest to place the thumb and the first finger of each hand along the incision line in the breast area and then push and gently pull the skin to the side. When an opening in the skin has been established, work towards the bill and then the vent.

Make a shallow transverse incision just below the breast muscles and sternum (Figure 1C). Insert the thumb of one gloved hand into the incision along the midpoint of the sternum and

apply a slight pressure upwards, then with a scissors in the other gloved hand, carefully cut through the ribs extending the cut on each side of the breast through the area of the wishbone (Figure aD). Gently separate the breastplate from the carcass, and use a scissors or a scalpel to sever any remaining connections (Figure 1E). The breastplate may be shipped to the laboratory for final processing, or the breasts may be removed by hand manually or with a scalpel in the field. Tissue should be double-bagged in Ziploc bags, labeled, and shipped on ice to the laboratory under the appropriate chain of custody procedures.

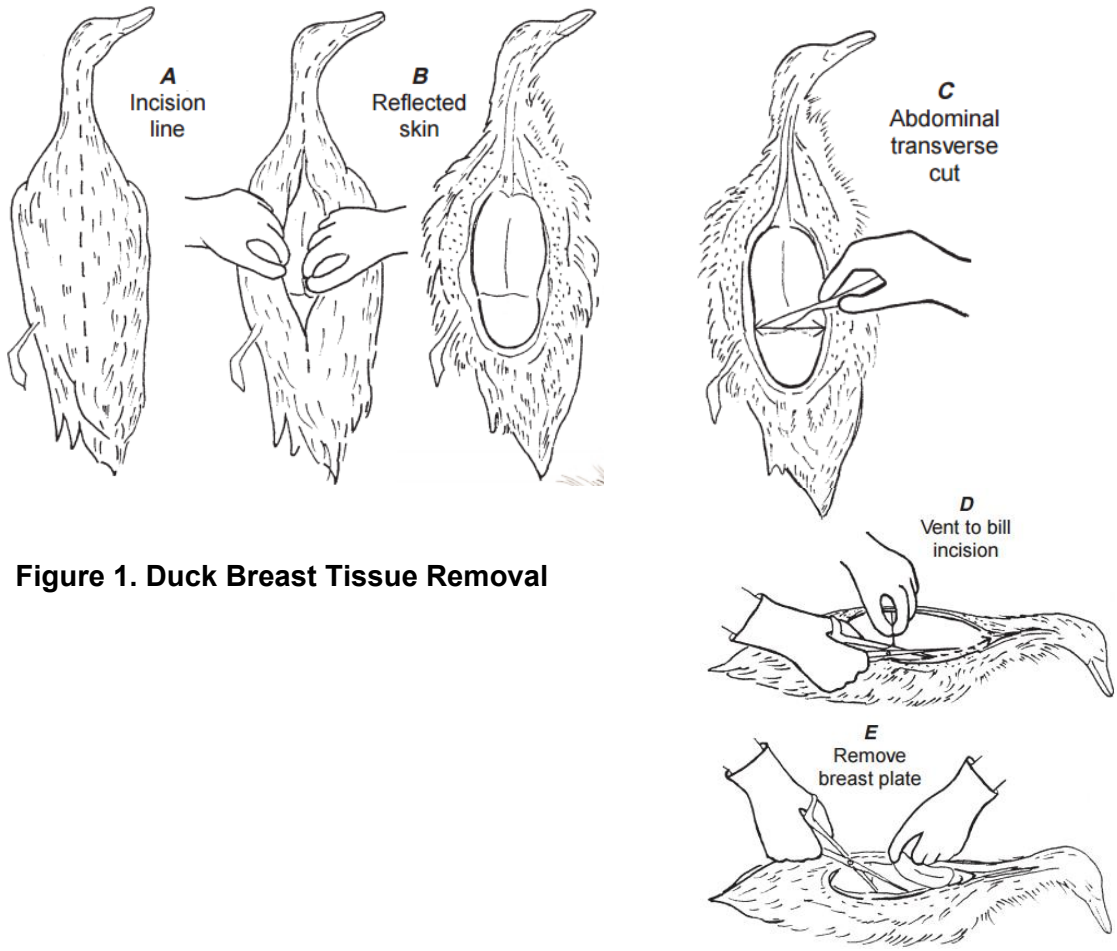


Figure 1. Duck Breast Tissue Removal

- END OF PROCEDURE -

SOP No. S-12

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

FISH SAMPLING

FISH SAMPLING

OBJECTIVE

This standard operating procedure (SOP) sets forth the field procedures used to collect resident fish from a river. Where applicable, the methods used will be consistent with any state agency-approved work plan. Fish may be captured and collected using electrofishing, fish nets and traps, and/or angling methods.

Pre-Collection Activities

Staff assigned the responsibility of collecting fish will be provided the following information:

- Work documents (field sampling plan, health and safety plan, etc.)
- Water body name and site maps
- Number and size of each species to be collected
- Collecting and processing procedures
- Special instructions (if any)
- Appropriate fisheries office contact
- Sampling permits and licenses

Fish Sampling Procedures

The general procedures to be followed when obtaining fish samples are outlined below.

Materials

The following collection equipment and materials will be available, as appropriate, during fish sampling:

- Health and safety equipment (as required by the health and safety plan)
- Boat, engine, life jackets, anchors, buoys, and rigging
- Electrofishing equipment
- Dip nets with non-conductive handles
- Fish nets and traps
- Angling tackle and bait
- Chest or hip waders
- Live well, cooler, or 5-gallon bucket
- Measuring tape or ruler
- Top-loading electronic and suspended-weight spring balances
- Insulated coolers with ice
- Plastic sealable bags and indelible ink markers
- Digital camera
- Realtime Kinematic Global Positioning System (RTK GPS)
- Electronic range finder
- Field data record
- Field notebook

Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following information:

- Names of field crew and oversight personnel
- General weather conditions
- Date, time, and general capture location (Record RTK GPS coordinates for adult fish location, if needed) (Unless otherwise indicated in Area-specific work plans, geographic surveys will be to a minimum accuracy of 0.1 foot horizontally and 0.2 foot vertically using RTK GPS.)
- Capture technique
- Sample duration
- General observations of fish habitat, abundance, and diversity
- Captured fish species, length and weight
- External deformities, erosion, lesions, or tumor (DELT) anomalies will be noted and a photograph will be taken, which will include a sample identification number in the photo
- A representative photograph of each species of fish captured will be taken and the photograph number noted in the field book; a sample identification card will be included in the photo

Fish Sampling Procedures

Fish will be collected by trained personnel using approved sampling techniques. State personnel (conservation officers) will be notified of the sampling activities prior to going into the field. Only those target species identified in the work plan and scientific collectors permit will be retained. Collection of other species may occur when target species are absent, if provided for in the Area-specific Work Plan. Non-target species will be released to the water body.

The following procedures will be used, as necessary, to collect fish.

Fish Sampling Procedures Using Electrofishing Techniques

This section describes the procedures associated with the use of boat-mounted, barge-mounted, and backpack electrofishing units. Electrofishing activities will be temporarily halted when any persons, pets, or livestock are observed in the water or on the shore near the electrofishing unit.

1. Boat or Barge-Mounted Electrofishing

   The following procedures describe the use of an electrofishing boat to collect fish:

   a. The field crew will don personal protective equipment (life jackets, nonconductive shoes and gloves, etc.), set up the electrofishing equipment, and test it upon arrival at the site.

b. The boat/barge operator will be responsible for control of the boat and operation of the control equipment and generator. The remaining field crew will operate from the front of the boat/barge and will be responsible for controlling the on-off floorboard switch and capturing the fish.

c. Electricity will be applied to the water by actively maintaining the on-off switch in the closed position or by cycling the switch on and off to stun fish that might skirt the edge of the electric field while the generator and control equipment are operative.

d. The electrical current will be set to stun the fish, but should not cause mortality.

e. Target species of appropriate size will be collected using nonconductive dip-nets and will be placed in a live-well with fresh water until the fish can be transferred to a cooler with ice.

2. Backpack Electrofishing

The following procedures describe the use of a backpack electrofishing unit to collect fish:

a. The field crew will don personal protective equipment (nonconductive waders and gloves, etc.), set up the electrofishing equipment, and test it upon arrival at the site.

b. The backpack operator will be responsible for control of the on-off switch on the anode handle, operation of the control equipment, and for capturing fish. The remaining field crew will work alongside the backpack operator and will capture fish.

c. Electricity will be applied to the water by actively maintaining the on-off switch in the closed position while the control equipment is operative.

d. The electrical current will be set to stun the fish, but should not cause mortality.

e. Target species of appropriate size will be collected using non-conductive dip-nets and will be placed in a 5-gallon bucket or a plastic tote with fresh-water until the fish can be transferred to a cooler with ice.

f. Backpack electrofishing batteries will be recharged as needed.

Fish Sampling Using Fish Nets and Traps

This section describes the procedures for using fish nets (gill nets, seines, and trawl nets) and traps (trap nets, minnow traps, and eel traps) to collect fish.

1. Gill Nets

The following procedures describe the use of gill nets to collect fish:

a. The field crew will ready the appropriately sized gill nets (length, depth, and mesh size) for site conditions prior to field sampling.

b. In large water bodies, the boat operator will be responsible for selecting the locations to place the gill nets and for controlling the boat. The remaining crew will be responsible for setting the buoys, and anchoring, playing out, and retrieving the gill nets.

c. In small water bodies, where boat use is impractical, one crew member will be responsible for tossing a lead line that is attached to the gill net across the water body. Another crew member will retrieve the lead line and pull the gill net into position.

d. Gill nets will be placed within or adjacent to aquatic habitats that contain the target fish species desired for collection, and will be set to intercept moving fish.
e. Gill nets will be checked a minimum of once per 24-hour period.
f. Target species of appropriate size will be removed from the gill nets and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

2. Seines

The following procedures describe the use of seines to collect fish:

a. The field crew will ready the appropriate sized seines (length, depth, and mesh size) for site conditions prior to field sampling.
b. In large water bodies, one crew member will hold the end of a large seine secure at the shoreline. The other crew member will pull the seine away from shore in a semicircular pattern, reconnecting with the shoreline a distance away. Both crew members will haul the net in, keeping the bottom of the seine in contact with the substrate and the top of the seine above the water, to collect fish.
c. In small water bodies, two crew members will use a small seine to guide fish to the shoreline or to scoop them up. When moving through the water, the bottom of the seine should remain in contact with the substrate.
d. Target species of appropriate size will be removed from the seines and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

3. Trawling

The following procedures describe the use of trawling to collect fish:

a. The boat operator will provide an adequately sized vessel, preferably with a designated sample area, complete with a trawl net.
b. The boat operator, along with the Field Operations Lead (FOL), will be responsible for selecting the locations to tow the trawl nets. The remaining crew will be responsible for writing down observations in the field notebooks.
c. Trawl nets will be placed within or adjacent to aquatic habitats that contain the target fish species desired for collection, and will be set to intercept moving fish.
d. The FOL will determine the duration of the tow (1-3 hours at a time). This will give the remaining field crew ample time to sort and weigh samples.
e. Target species of appropriate size will be removed from the trawl nets and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

4. Trap Nets

The following procedures describe the use of trap nets to collect fish:

a. The field crew will ready the appropriately sized trap nets (hoop diameter and mesh size) for site conditions prior to field sampling. An assortment of lead-net and wing-net panels will be available to meet site-specific demands.
b. In large water bodies, the boat operator will be responsible for selecting the locations to place the trap nets, and for controlling the boat. The remaining crew will be responsible for setting the buoys, and anchoring, playing out, and retrieving the trap nets.

c. In small water bodies, where boat use is impractical, one crew member will be responsible for tossing a lead line that is attached to the trap net across the water body. Another crew member will retrieve the lead line and pull the trap net into position.
d. Trap nets will be placed within or adjacent to aquatic habitats that contain the target fish species desired for collection, and will be set to intercept moving fish.
e. Trap nets will be checked a minimum of once per 24-hour period.
f. Target species of appropriate size will be removed from the trap nets and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

5. Minnow Traps

The following procedures describe the use of minnow traps to collect small fish:

a. The field crew will ready the minnow traps prior to field sampling.
b. In large water bodies, the boat operator will be responsible for selecting the locations to place the minnow traps, and for controlling the boat. The remaining crew will be responsible for setting the buoys, and baiting, anchoring, and retrieving the minnow traps.
c. Without a boat, minnow traps will be baited, tethered, and set just off the shoreline.
d. Minnow traps will be placed within or adjacent to aquatic habitats that contain the target fish species desired for collection.
e. Minnow traps will be checked a minimum of once per 24-hour period.
f. Target species of appropriate size will be removed from the minnow traps and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

6. Eel Traps

The following procedures describe the use of eel traps to collect eels:

a. The field crew will ready the eel traps prior to field sampling.
b. In large water bodies, the boat operator will be responsible for selecting the locations to place the eel traps, and for controlling the boat. The remaining crew will be responsible for setting the buoys, and baiting, anchoring, and retrieving the eel traps.
c. Without a boat, eel traps will be baited, tethered, and set just off the shoreline.
d. Eel traps will be placed within or adjacent to aquatic habitats that contain the target eel species desired for collection.
e. Eel traps will be checked a minimum of once per 24-hour period.
f. Target species of appropriate size will be removed from the eel traps and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

Fish Sampling Using Angling Techniques

This section describes the procedures used to collect fish by angling (rod and reel) and trotline techniques (multiple hooks on an anchored line).

1. Rod-and-Reel

   The following procedures describe the use of rods and reels to collect fish:

   a. The field crew will ready the rods and reels and tackle (hooks, line, bait, and artificial lures) prior to field sampling.
   b. Baited hooks or artificial lures will be cast into aquatic habitats that contain the target fish species desired for collection.
   c. Target species of appropriate size will be retained and will be placed on a stringer, in a live-well, or into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

2. Trotlines

   The following procedures describe the use of trotlines to collect fish:

   a. The field crew will ready the trotlines and clip-on hooks prior to field sampling.
   b. In large water bodies, the boat operator will be responsible for selecting the locations to place the trotlines, and for controlling the boat. The remaining crew will be responsible for setting the buoys, and anchoring, baiting, playing out, and retrieving the trotlines.
   c. In small water bodies, where boat use is impractical, one crew member will be responsible for tossing a lead line that is attached to the trotline across the water body. Another crew member will retrieve the lead line and pull the trotline into position.
   d. Trotlines will be placed within or adjacent to aquatic habitats that contain the target fish species desired for collection, and will be set to intercept moving fish.
   e. Trotlines will be checked a minimum of once per 24-hour period.
   f. Target species of appropriate size will be removed from the trotlines and will be placed into sealable plastic bags, and then into a cooler with ice. Non-target species will be counted and noted in the field notebook.

Sample Handling

The following identifies the temporary storage procedures that will be used to preserve fish in the field prior to sample processing, handling, and shipment to the laboratory:

1. Measure or weigh each fish after collection, as necessary, to ensure that appropriately sized fish are taken and that minimum sample mass requirements are satisfied.
2. Count the number of fish to ensure that the correct amount is taken.
3. Transfer fish to sealable plastic bags (if not done previously) and label with sampling date and capture location, and place in coolers with ice until field processing can occur. Large fish that do not fit into plastic bags may be placed on ice in clean coolers that are clearly labeled.

- END OF PROCEDURE-

SOP No. S-13

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

FISH SAMPLE PROCESSING AND HANDLING

FISH SAMPLE PROCESSING AND HANDLING

OBJECTIVE

This standard operating procedure (SOP) sets forth the field procedures for the processing and handling of fish.

The following procedures describe the general methodologies that will be used in the field to process (handle, pack, and ship) whole-body fish for shipment to an analytical laboratory for processing and chemical analysis of individual fillet and whole-body composite fish samples. Where applicable, the methods used will be consistent with an agency-approved work plan. The general procedures to be followed when processing and handling fish samples are outlined below.

Materials

The following equipment and materials will be available, as appropriate, to process whole-body biota samples:

- Measuring board or ruler
- Top-loading electronic and suspended-weight spring balances
- Forceps or knife
- Storage envelopes and glass vials
- Heavy-duty aluminum foil and freezer paper
- Tape (duct, strapping, masking, or freezer, and clear packing)
- Sealable plastic bags and indelible ink markers
- Cleaning and decontamination materials
- Potable water
- Insulated coolers with or without ice
- Forms (chain-of-custody, custody seal, address label, and air bill)
- Camera
- Field data record
- Field notebook

Field Notes

Field notes will be recorded during processing of fish samples, and at a minimum, will include the following:

- Names of field processing crew and oversight personnel
- Date and time of processing
- Sample identification numbers that correspond to analysis, sampling date, and collection location
- Sample type (fillet/whole body, individual/composite)
- Body lengths and weights, and number of organisms per sample

- External deformities, erosion, lesions, or tumor (DELT) anomalies will be noted and a photograph will be taken, which will include a sample identification number in the photo
- The collection of bony structures for aging (where applicable). Laboratory procedures for aging fish will be adapted from Zale et al. 2012 (Zale, A., D. L. Parrish, and T.M. Sutton, eds., 2012. Fisheries Techniques, 3rd edition. American Fisheries Society, Bethesda, Maryland)
- The collection of whole fish for fish gender (where applicable) (fish gender will be determined in the laboratory by internal fish inspection)
- Photograph number when pictures are taken (if necessary)

Handling, Packing, and Shipping Procedures

The following procedures will be used to handle, pack, and ship whole-body fish samples:

Handling

1. All samples will be given a sample identification number that will be recorded in the field notebook and that corresponds to the sample analysis, sampling date, and collection location.
2. Chain-of-custody forms, custody seals, address labels, and air-bill forms will be initiated. Chain-of-custody forms will identify the tissue sample preparation procedure and chemical analysis that the lab will follow. A copy of the completed chain-of-custody form and air-bill form will be retained by the sampler.
3. To begin processing, sediments, soil, and other debris will be removed from the biota samples by hand-picking or by rinsing with potable water.
4. Biota samples will be measured and weighed following project-specific requirements, but will generally include total length measurements of each individual in a sample, and total weight measurements of the entire sample.
5. Individual and composite biota samples will have sufficient sample mass to meet the minimum sample mass requirements for chemical analysis.
6. Photographs will be taken, as needed, and any DELT anomalies or visible parasites will be noted in the field notebook.
7. Hard body parts will be removed from biota in the field, as required, as long as it does not compromise the integrity of the sample. If there is a potential that sample integrity could be compromised, the laboratory may instead be asked to remove the bony structure. The structure will be archived for possible aging at a later date.
8. Biota samples will be wrapped in decontaminated heavy-duty aluminum foil (shiny side out). The wrapped samples will be placed in double resealable bags. An index card containing the sampling label and collection information will be placed between the inside and outside bag. Both resealable bags will be sealed, taking care to remove excess air.
9. Samples will be separated by organism type and by sample location, and will be placed into large, sealable plastic bags in preparation for packing.

10. All equipment will be cleaned with a laboratory-grade detergent and a potable water rinse as required or immediately following processing.

Packing

1. Coolers used for transport will be duct-taped to hold the drain plug open on the outside and inside of the cooler.
2. Dry ice will be placed in the bottom of the cooler in a manner which prevents leakage of ice. The sealed biota samples will be placed inside the cooler with enough room for additional dry ice to be placed on top. The dry ice will be separated from direct contact with the resealable plastic bags containing the fish with a piece of cardboard to prevent destruction of the fish tissues due to flash freezing.
3. The completed chain-of-custody form will be placed into a plastic bag and taped to the inside of the cooler lid.
4. The cooler will be closed and fastened with duct or shipping tape around the seam of the lid to prevent water leakage and with shipping tape around the entire cooler to prevent it from opening during transport.
5. A completed custody seal will be placed across the seam of the cooler lid. A completed address label will be placed on top of the cooler. Both will be taped-over using clear packing tape.

Shipping

1. Samples with holding time requirements will be shipped to the laboratory by hand or by express carrier within 48 hours or less from the date of sample collection. Samples that do not have stringent holding times will be delivered in a timely manner.
2. The laboratory will be notified of the shipment and will be contacted immediately following the arrival date to ensure that delivery has occurred.

- END OF PROCEDURE-

SOP No. S-14

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

SHELLFISH SAMPLING

SHELLFISH SAMPLING

This standard operating procedure (SOP) sets forth the field procedures used to collect resident shellfish from a river. Where applicable, the methods used will be consistent with any state agency-approved work plan. Shellfish may be captured and collected using nets, traps, and/or dredging methods. A Department of Natural Resources Fisheries Division Application for Scientific Collectors Permit and an example of a Collector's Permit are included as Attachment 2 and Attachment 3 to this SOP, respectively.

Pre-Collection Activities

Staff assigned the responsibility of collecting shellfish will be provided the following information:

- Work documents (field sampling plan, health and safety plan, etc.)
- Water body name and site maps
- Number and size of each species to be collected
- Collecting and processing procedures
- Special instructions (if any)
- Appropriate fisheries office contact
- Sampling permits and licenses

Shellfish Sampling Procedures

The general procedures to be followed when obtaining shellfish samples are outlined below.

Materials

The following collection equipment and materials will be available, as appropriate, during fish sampling:

- Health and safety equipment (as required by the health and safety plan)
- Boat, engine, life jackets, anchors, buoys, and rigging;
- Dip nets
- Dredge (e.g., Ponar or Ekman dredge)
- Fish nets and traps
- Bait for traps
- Chest or hip waders
- Live well, cooler, or 5-gallon bucket
- Measuring tape, ruler, and/or caliper
- Top-loading electronic and/or suspended-weight spring balances
- Insulated coolers with ice and/or dry ice
- Plastic sealable bags and indelible ink markers
- Digital camera
- Realtime Kinematic Global Positioning System (RTK GPS)
- Electronic range finder
- Field data record
- Field notebook

Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following information:

- Names of field crew and oversight personnel
- General weather conditions
- Date, time, and general capture location (Record RTK GPS coordinates for capture location, if needed) (Unless otherwise indicated in Area-specific work plans, geographic surveys will be to a minimum accuracy of 0.1 foot horizontally and 0.2 foot vertically using RTK GPS.)
- Capture technique
- Sample duration
- General observations of habitat, abundance, and diversity
- Captured shellfish species, length (total and/or carapace), and weight
- External deformities, erosion, lesions, or tumor (DELT) anomalies will be noted and a photograph will be taken, which will include a sample identification number in the photo
- A representative photograph of each species of shellfish captured will be taken and the photograph number noted in the field book; a sample identification card will be included in the photo

Shellfish Sampling Procedures

Shellfish will be collected by trained personnel using approved sampling techniques. State personnel (conservation officers) will be notified of the sampling activities prior to going into the field. Only those target species identified in the work plan and scientific collectors permit will be retained. Collection of other species may occur when target species are absent, if provided for in the Area-specific Work Plan. Non-target species will be released to the water body.

The following procedures will be used, as necessary, to collect fish.

Shellfish Sampling Using Nets and Traps

This section describes the procedures for using nets (dip nets and seines) and traps (lobster traps) to collect shellfish.

1. Dip Nets

   The following procedures describe the use of dip nets to collect shellfish:

   a. The field crew will ready the appropriately sized dip nets (handle length, mouth size, and mesh size) for site conditions prior to field sampling.

   b. Dip nets may be used in shallow water, when the target shellfish species is observed moving through the water (e.g., lobster), or attached to hard substrate (e.g., mussels).

c. Dip nets will be used to scoop up target species.

d. Target species of appropriate size will be removed from the dip nets and will be placed into sealable plastic bags, and then into a cooler with ice and/or dry ice. Non-target species will be noted in the field notebook and released to the water body.

2. Seines

The following procedures describe the use of seines to collect shellfish:

a. The field crew will ready the appropriate sized seines (length, depth, and mesh size) for site conditions prior to field sampling.

b. In large water bodies, one crew member will hold the end of a large seine secure at the shoreline. The other crew member will pull the seine away from shore in a semicircular pattern, reconnecting with the shoreline a distance away. Both crew members will haul the net in, keeping the bottom of the seine in contact with the substrate and the top of the seine above the water, to collect shellfish.

c. In small water bodies, two crew members will use a small seine to guide shellfish to the shoreline or to scoop them up. When moving through the water, the bottom of the seine should remain in contact with the substrate.

d. Target species of appropriate size will be removed from the seines and will be placed into sealable plastic bags, and then into a cooler with ice and/or dry ice. Non-target species will be counted and noted in the field notebook and released to the water body.

3. Traps

The following procedures describe the use of traps to collect lobster:

a. Lobster will be collected by a contracted professional lobster fisherman/boat captain with appropriate state/local permits, using traps of a type approved by said permit.

b. The traps will be lowered in the desired sample collection location, and left for a period of time determined to be appropriate for the local conditions by the contracted lobster fisherman.

c. The boat operator/contract fisherman will be responsible for selecting the locations to place the traps, and for controlling the boat. The remaining crew will be responsible for setting the buoys, and anchoring, playing out, and retrieving the traps, as directed by the boat operator.

d. Traps will be checked a minimum of once per 24-hour period.

e. Target lobster of appropriate size will be removed from the traps and will be placed into sealable plastic bags, and then into a cooler with ice and/or. Non-target species will be counted and noted in the field notebook and released to the water body.

Shellfish Sampling By Hand, Shovel, Dredge, or Net

1. Hand Collection

The following procedures describe the collection of shellfish by hand:

a. The field crew will ready the collection equipment (e.g., gloves, buckets, nets) prior to field sampling.

b. In large water bodies, the boat operator will be responsible for selecting safe locations and tide conditions for getting the field crew close enough to shore to safely disembark and wade to the shallows/shoreline to collect shellfish.

c. The boat operator will move the boat to a safe depth offshore, maintaining both visual and voice contact with the field crew (via radio or cell phone).

d. In small water bodies, or in areas accessible by road vehicles, where boat use is impractical, crew members will walk/wade along the shoreline.

e. Shellfish will be collected by hand for those growing attached to hard surfaces (such as mussels). Target species will be picked from the substrate, taking care not to damage the tissue (e.g., if mussel byssal threads do not pull freely from the substrate, a scraper or knife will be used).

f. All crew members will watch the tides to ensure safe egress from the sample location.

g. Target species of appropriate size will be removed from the substrate, brushed with a soft-bristle brush to remove sediment, and will be placed into sealable plastic bags, and then into a cooler with ice and/or dry ice. Non-target species will not be collected.

2. Collection by Shovel, Dredge, or Net

The following procedures describe the use of shovels, dredges, and nets to collect shellfish:

a. The field crew will ready the collection equipment (e.g., gloves, buckets, shovels, dredges, nets) prior to field sampling.

b. In large water bodies, the boat operator will be responsible for selecting safe locations and tide conditions for getting the field crew close enough to shore to safely disembark and wade to the shallows/shoreline to collect shellfish.

c. The boat operator will move the boat to a safe depth offshore, maintaining both visual and voice contact with the field crew (via radio or cell phone).

d. In small water bodies, or in areas accessible by road vehicles, where boat use is impractical, crew members will walk/wade along the shoreline.

e. Shellfish will be collected using shovels (for buried species such as clams), by looking for bivalve excurrent siphons, or holes in the sediment that could potentially be siphons. The shovel will be pushed into the sediment to a depth appropriate for the target species, and the sediment will be turned over to expose the shellfish for collection.

f. Shellfish will be collected using hand nets where they are visible in shallow water, and can be pulled free of the substrate.

g. Shellfish will be collected using a sediment collection dredge (e.g., Ponar or Ekman dredge) by lowering the dredge into the water to collect sediment samples, and then removing the target shellfish from the collected sediment.

h. All crew members will watch the tides to ensure safe egress from the sample location.

i. Target species of appropriate size will be removed from the substrate, brushed with a soft-bristle brush to remove sediment, and will be placed into sealable plastic bags, and then into a cooler with ice and/or dry ice. Non-target species will not be collected.

Sample Handling

The following identifies the temporary storage procedures that will be used to preserve shellfish in the field prior to sample processing, handling, and shipment to the laboratory:

1. Measure or weigh each specimen after collection, as necessary, to ensure that appropriately sized shellfish are taken and that minimum sample mass requirements are satisfied.
2. Count the number of shellfish to ensure that the correct number of samples are collected.
3. Transfer shellfish to sealable plastic bags (if not done previously) and label with sampling date and capture location, and place in coolers with dry ice for shipment to the laboratory for processing and analysis. Large shellfish that do not fit into plastic bags may be placed on ice/dry ice in clean coolers that are clearly labeled.

- END OF PROCEDURE-

SOP No. S-15

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

POLYCHAETE SAMPLING

POLYCHAETE SAMPLING

OBJECTIVE

This standard operating procedure (SOP) sets forth the field procedures used to collect aquatic polychaete samples. Project personnel will possess the appropriate scientific collection permits.

Pre-Collection Activities

Staff assigned the responsibility of polychaete sample collection will be provided the following:

- Work documents (health and safety plan, quality assurance project plan, logbook, field forms, field maps, copies of permits, chain of custody forms)
- Sample collection equipment
- Collecting and processing procedures
- Special instructions (if any)

Sample Collection Procedures

The general procedures to be followed are outlined below.

Materials

The following collection equipment and materials will be available, as appropriate:

- Health and safety equipment (as required by the health and safety plan)
- Logbook and field forms
- Handheld GPS
- Pens, pencils, and sharpies
- Decontamination supplies: American Society for Testing and Materials (ASTM) Type II water, liquinox, scrub brush, 5 percent nitric acid, spray bottles, sealable 5-gallon buckets, aluminum foil
- Forceps
- Tweezers
- Shovel
- Sediment grab sampler
- Stainless steel bowls and spoons
- Large mesh sieve or hardware cloth
- Digital camera
- Spare batteries for GPS, scale, and camera
- Sample containers (or petri dishes)
- Clean artificial seawater
- Labels
- Coolers
- Cooler liners
- Bubble wrap
- Ziploc bags
- Packing tape
- Dry ice

- Custody seals
- Chain of custody forms
- Shipping forms and labels

Field Notes

Field notes will be recorded during sampling activities, and at a minimum, will include the following information:

- Project name and number
- Purpose
- Names of field crew and additional personnel present on site
- Equipment list
- Decontamination procedures
- General weather conditions
- Date, time (24-hour), and location, including a general description and GPS coordinates
- Sample collection techniques
- Sampling duration
- General observations
- Representative photographs
- Sample identification numbers
- Sample description
- Signature of recording personnel

Field Forms

Field forms may include the electronic field data record and chain of custody forms. Forms will be filled out completely and include the below listed information.

Field Data Record

- Collector's initials and method of collection
- Date, time, and location
- Number of individuals per composite and composite weight
- Coordinates
- Photo numbers (if taken)
- Notes

Chain of Custody

- Project name and number
- Date and time (24-hour)
- Sample identification numbers
- Analytical method requested
- Signature of recording personnel

Decontamination Procedures

Equipment that will contact environmental samples will be decontaminated using the following procedure.

1. Rinse with deionized water
2. Liquinox scrub
3. Rinse with deionized water
4. Rinse with 5 percent nitric acid solution
5. Rinse with deionized water
6. Air dry

A rinsate blank will be collected during sampling of deionized water as it is poured over the sampling equipment after decontamination and collected in a rinsate blank sample container. Decontaminated equipment will be wrapped in aluminum foil until sample collection.

Materials that become muddy during sample collection but do not come into direct contact with samples will also be cleaned as necessary between sample locations.

Sample Collecting Procedures

Surficial sediment (0-6 inches) from the polychaete sample locations will be collected using a shovel or clam rake. Search for holes in the mud at the mid to high intertidal zone when the tide is at low. Dig in the mud where the holes are. Collect the worms when you see them with a gloved hand and transfer them to a sample container. Record the number of polychaetes per sample and weight of the sample.

Sample Quantity

A target of 3 grams of tissue will be collected per polychaete sample. Should sample mass not be achieved within a reasonable timeframe, then the specimens collected may be composited with those collected from the nearest available habitat/sampling location to achieve minimum mass requirements for chemical analysis (1 gram for mercury).

Depuration

Polychaetes that are collected after the sieving process will be placed in a 2-ounce polyethylene container filled two-thirds with clean artificial seawater. Samples will be shipped on wet ice to the WSP Gainesville laboratory for taxonomic identification (ID). Polychaetes need to arrive alive to facilitate ID so an appropriate amount of wet ice should be placed in coolers to maintain biological activity and sample integrity. Samples stored in polyethylene containers will be depurated for up to 48 hours at ambient temperature including prior to and during shipment and during taxonomic ID.

Taxonomic ID

Upon receipt at the WSP Gainesville laboratory, depurated polychaetes will be identified to the lowest taxonomic level possible, typically family. As needed, samples will be re-composited so

that individuals of the same taxonomic grouping are in the same sample. The requisite mass for laboratory analysis shall be achieved during re-compositing. After taxonomic ID and any necessary re-compositing, samples will be packaged (see below) and shipped to the designated analytical laboratory.

Sample Processing

Polychaete samples will be weighed using a digital scale with 0.1 gram accuracy. Samples will be placed in labeled sample containers in a designated sample cooler. Glass sample jars will be wrapped in bubble wrap and placed in Ziploc® bags. After taxonomic ID, samples will be shipped via chain of custody procedures on dry ice to Eurofins Frontier Global Sciences, Inc. in Tacoma, Washington. Polychaete samples will be analyzed for mercury (Method 1631E).

- END OF PROCEDURE-

SOP No. S-17

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

DECONTAMINATION PROCEDURES

Decontamination Procedures

PURPOSE

This Standard Operating Procedure (SOP) describes the methods to be used for the decontamination of all field equipment and sample processing equipment which becomes potentially contaminated during sampling tasks. The equipment may include coring devices, dredgers, hand-augers, biota collection devices, trowels, shovels, or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross- contamination between samples and also helps to maintain a clean working environment for the safety of field personnel.

Decontamination is mainly achieved by rinsing with liquids which include: tap-water (potable water), Formula 409 cleaner solution (50 % Formula and 50% potable water), and deionized (DI) water. Equipment will be allowed to air dry after being cleaned or may be wiped dry paper towels if immediate re-use is needed. The frequency of equipment use dictates that most decontamination be accomplished at each sampling site, between collection points.

This same decontamination procedure will be used for sediment, soil, biota, or any other sampling where non-dedicated equipment is being used and the potential for cross contamination exists.

RESPONSIBILITIES

It is the primary responsibility of the project Field Operations Leader and field samplers to assure that the proper decontamination procedures are followed and that all waste materials produced by decontamination are properly stored and disposed of.

It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors to follow the proper designated decontamination procedures that are stated in their contracts and outlined in the Project Health and Safety Plan.

It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that any contaminants are not negligently introduced to the environment.

EQUIPMENT AND MATERIALS

- Squeeze bottles or stainless steel sprayers– labeled squeeze bottles for dispensing decontamination fluids used in the rinsing process.
- Paper Towels - used for drying equipment after final rinse.

- Cleaning containers – plastic or stainless steel buckets to place equipment in during the decontamination procedure
- Cleaning Liquids – potable water, DI water, and Formula 409 cleaner solution
- Cleaning Brushes – to be used in conjunction with decontamination fluids to facilitate removal of stuck on sample media.
- Gloves - for personal protection and to prevent cross-contamination of samples. May be plastic or latex, disposable, powderless.
- Field Clothing and Personal Protective Equipment - as specified in the Health and Safety Plan.
- Trash bags - used to dispose of gloves and any other non-hazardous waste generated during sampling.

PROCEDURE

All non-dedicated equipment that comes in contact with the media that is sampled should be included in the decontamination process. Dedicated equipment does not require decontamination. Include equipment that is used for sample processing (e.g., stainless steel bowls and spoons) as well as equipment used for sample collection.

Sample collection equipment should be decontaminated between sampling locations. Sample processing equipment should be decontaminated between samples.

The standard procedures listed in the following section can be considered the procedure for full field decontamination. If different or more elaborate procedures are required for a specific task, they will be spelled out in the Field Sampling Plan (FSP). Such variations in decontamination may include following all, just part, or an expanded scope of the decontamination procedure stated herein. Any variation in the decontamination procedure should be documented in the log book and or, electronic field data record.

- Remove any solid particles (soil or sediment) from the equipment or material by brushing and then rinsing with clean water. This can be accomplished with a squeeze bottle and brush, or the equipment can be soaked in a bucket of potable water and bushed in place. This initial step is performed to remove gross contamination. Repeat the procedure until visibly free of gross contamination
- Rinse with potable water.
- Rinse with Formula 409 cleaner solution (50 % Formula and 50% potable water). This can be accomplished with a squeeze bottle and brush, or the equipment can be soaked and scrubbed in a bucket with solution.
- Thorough DI water rinse.
- Air dry or if needed for re use, dry with paper towels.

- If sampling equipment is not to be used immediately at another location, wrap the equipment in aluminum foil or place in a clean plastic bag and store in a clean safe place.

- If rinsate equipment blanks are specified in the FSP, collect rinsate by pouring DI water over sampling equipment and into sample containers.

REFERENCES

U.S. Environmental Protection Agency (USEPA), January, 1986. "Decontamination Techniques for Mobile Response Equipment Used at Waste Sites (State-of-the-Art Survey)." EPA/600/52-85/105.

- END OF PROCEDURE -

SOP No. S-19

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

SAMPLE CHAIN OF CUSTODY PROCEDURES

SAMPLE CHAIN OF CUSTODY PROCEDURE

INTRODUCTION

This SOP describes chain of custody procedures to be followed whenever collecting environmental samples.

CROSS-REFERENCES

- ASTM D4840-95: Guide for Sampling Chain-of-Custody Procedures
- U.S. EPA Region 4 “Environmental Investigations Standard Operating Procedures and Quality Assurance Manual,” May 1996 Including 1997 Revisions
- Site-specific Health and Safety Plan

MATERIALS

DOCUMENTATION

- Work Plan
- Field Data Records (FDR)
- Chain-of-custody forms
- Sample labels
- Field logbook
- Permanent marker
- Lab contact information
- Chain-of-Custody Form

PREPARATION

Review Work Plan/Work Order to identify samples to be collected, analyses to be performed, laboratory performing the analyses, and any other project specific-objectives of the sampling program. Review sample collection SOPs for media being sampled.

SAMPLE LABELING

Enter in the log book and label each sample container with the following information: a) Project number b) Date and time of collection c) Sample location d) Sample number e) Analysis to be performed f) Sampler's initials g) Preservative If using field sample tracking system labels will be generated and printed by the field sample coordinator.

CHAIN OF CUSTODY

Definition

EPA provides the following definition of chain-of-custody:

“A sample is considered to be in your custody if any of the following criteria are met:

- The sample is in your possession or is in your view after being in your possession;

- The sample was in your possession and then locked up or sealed to prevent tampering; or
- You have placed the sample in a secured area."

Purpose

"The chain-of-custody form is functionally similar to a packing slip that accompanies a shipment of goods. The chain-of-custody form includes a chain-of-custody record located at the bottom of the form. The form is used as physical evidence of sample custody. EPA guidelines specify that official custody of samples must be maintained and documented from the time of collection until the time the samples are introduced as evidence in the event of litigation. The sampler is responsible for the care and custody of the sample until sample shipment."

Documentation

After samples are collected and labeled, fill out the chain-of-custody form. Examples of computer generated COC forms and hand written laboratory COC forms that may be used are presented in Attachment A of this SOP. The sampler becomes the initial sample custodian.

Chain-of-custody forms must be completed for every shipment of samples to an analytical laboratory.

Use indelible ink only, no pencil (a ball point pen is best). Make corrections by drawing a line through and initialing and dating the error, then enter the correct information. Erasures are not allowed.

A separate chain-of-custody form must accompany each cooler for each shipment. Place the original COC form in a zipper-type plastic bag in the cooler with the samples. The chain-of-custody forms must address all samples in that sample shipment. If multiple coolers are shipped a copy of the COC should accompany each cooler. This practice maintains the chain-of-custody for all samples in case of mis-shipment.

Transfer of Custody

When transferring the possession of samples, the individuals relinquishing and receiving custody will sign, date, and note the time on the record. Persons receiving the custody of a sample group are responsible for confirming the accuracy of the COC with regard to the number and type of sample containers for which they are accepting responsibility.

When samples are to be shipped to an analytical facility by commercial delivery service, the samples will be relinquished to the courier in sealed containers, and, if practicable, the shipment number will be noted on the COC form. When samples are transferred by commercial delivery service, a copy of the shipping documentation will serve as the COC record for the delivery service's role in the chain of custody.

The sample custodian relinquishing custody to a facility or agency will request the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this will be noted in the "Received by" space on the COC. When appropriate, the custody record will contain a statement that the samples were delivered to the designated location at the designated time.

Attachment A
Examples of Field Chain Of Custody and Lab Chain of Custody

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Environmental Analysis Request/Chain of Custody

Page 3 of 5

Client: Amec Foster Wheeler / 511 Congress St. Suite 200 Portland, ME 04101	
Project Name/#: USDC Penobscot	PN #:3616166052.04A.0225
Project Manager: Rod Pendleton	P.O. #:
Sampler: Matt Martin	PWSID #:
Phone #:	Quote #:
State where samples were collected: ME	For Compliance: Yes ☐ No ☑

Matrix: Soil ☐ Sediment ☑ Tissue ☐; Water: Potable ☐ Ground ☐ Surface ☑ NPDES ☐; Other:

Analyses Requested / Preservation Codes: Total Hg 1631e 4 oz Plastic / frozen (O); MeHg 1630 4 oz Plastic / frozen (O); Flett THg 7473 (O)

For Lab Use Only: SF #: ________ SCR #: ________

Preservation Codes: H = HCl; T = Thiosulfate; N = HNO_3; B = NaOH; S = H_2SO_4; P = H_3PO_4; O = Other

	Sample Identification	Collection Date	Collection Time	Grab	Composite	Soil / Sediment / Tissue	Water	Other	Total # of Containers	Total Hg 1631e 4 oz Plastic / frozen	MeHg 1630 4 oz Plastic / frozen	Flett THg 7473	Remarks
1	MM69_10202016_SED	10/20/2016	13:00	X		X			1	X	X		
2	MM54_10202016_SED	10/20/2016	13:10	X		X			1	X	X		
3	MM55_10202016_SED	10/20/2016	13:35	X		X			1	X	X		
4	MM65_10192016_SED	10/19/2016	14:21	X		X			1	X	X		
5	MM65_10192016_SED_MS	10/19/2016	14:21	X		X			1	X	X		QC SAMPLE
6	MM65_10192016_SED_MD	10/19/2016	14:21	X		X			1	X	X		QC SAMPLE
7	VE58THRU60_SIEVE_03072017_WCH_R1	3/7/2017	13:45		X	X			1	X	X		8 oz plastic/ Triple Replicate
8	VE58THRU60_SIEVE_03072017_WCH_R2	3/7/2017	13:45		X	X			0	X	X		Shared with 8 oz
9	VE58THRU60_SIEVE_03072017_WCH_R3	3/7/2017	13:45		X	X			0	X	X		Shared with 8 oz
10	VN80_10172016_SED	10/17/2016	14:29	X					1	X	X		
11	VE58THRU60_SIEVE_03072017_SED_PRE	3/7/2017	13:00		X	X			1	X	X		
12	VE505253_SIEVE_03072017_SED_PRE	3/7/2017	14:05		X	X			1	X	X		

Turnaround Time Requested (TAT) (please check): Rush ☐
(Rush TAT is subject to laboratory approval and surcharges.)

Notes:

FedEx # ____________
# of Coolers ________
Sample disposal - Standard 30 days after report
Report and EDD to: denise.king@amecfw.com / 978-692-6633

Data Package Options (please check if required)
High ☐ Standard

EDD Required? Yes ☑ No ☐ If yes, format: ________

Relinquished by:	Date	Time	Received by:	Date	Time
[illegible signature]	030917	153[illegible]			

Relinquished by Commercial Carrier: UPS ______ FedEx ______ Other ________

Temperature upon receipt ________ °C

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Computer Generated Chain Of Custody

Olin Chemical Superfund Site

MACTEC E&C

Lab:

Sample #	Sample Date	Sample Time	Field Sample ID	Qty Total	Qty Each	Bottle Size and Material		Preservative	Media	Method	Fraction
556	10/25/2207	16:20	ATMW012XXX03XX	5							
					2	1 Liter	Amber Glass	4 deg.C	GW	PCBs -8082	T
					1	500 mL	Poly	HNO3,4 deg.C	GW	TAL Metals + Mo -6010B / 7470A	T
					2	40 mL	Glass Vial	HCL, 4 deg.C	GW	VOCs -8260B + TICs	T
558	10/25/2207	16:20	ATMW012XXX03XX	4							
					2	1 Liter	Amber Glass	4 deg.C	GW	SVOCs -8270C + TICs	T
					2	40 mL	Glass Vial	HCL, 4 deg.C	GW	VOCs -8260B + TICs	T

*Relinquished:*_____ *Date:* ___/___/____ *Time:*_____ *Received:*_____ *Date:* ___/___/_____ *Time:*____

*Relinquished:*_____ *Date:* ___/___/____ *Time:*_____ *Received:*_____ *Date:* ___/___/_____ *Time:*____

Thursday, October 25, 2007 *Page 1 of 1*

Environmental Analysis Request/Chain of Custody

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Page ____ of ____

Client:				
Project Name/#:		PN #:		
Project Manager:		P.O. #:		
Sampler: KB/BW		PWSID #:		
Phone #:		Quote #:		
State where samples were collected: ____	For Compliance:	Yes ☐	No ☑	

Matrix: Soil ☐ Sediment ☐ Tissue ☐ | Water: Potable ☐ Ground ☐ NPDES ☐ Surface ☐ | Other: Tissue | Total # of Containers

Sample Identification	Collection Date	Collection Time	Grab	Composite	Soil	Water	Other:	Total # of Containers	Analyses Requested / Preservation Codes										Remarks
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

For Lab Use Only

SF #: __________

SCR #: __________

Preservation Codes

H - HCl	T - Thiosulfate
N - HNO_3	B - NaOH
S - H_2SO_4	P - H_3PO_4
O - Other	

Turnaround Time Requested (TAT) (please check): Standard ☐ Rush ☐

(Rush TAT is subject to laboratory approval and surcharges.)

Notes:

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

Data Package Options (please check if required)

High ☐ Standard ☑

EDD Required? Yes ☐ No ☐ If yes, format: __________

Relinquished by Commercial Carrier:

UPS ______ FedEx ______ Other __________

Temperature upon receipt __________ °C

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- END OF PROCEDURE -

SOP No. S-20

WSP USA ENVIRONMENT AND INFRASTRUCTURE, INC. STANDARD OPERATING PROCEDURE

SAMPLE PACKAGING AND SHIPMENT

SAMPLE PACKAGING AND SHIPMENT

SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) establishes methodologies for shipping samples collected during environmental field investigation/remediation activities. This SOP applies to all environmental samples including drinking water, groundwater, surface water samples, soil, and sediment samples, and treatment plant samples.

DEFINITIONS

Shipper's Declaration – A paper document describing the contents of a shipment.

HEALTH AND SAFETY WARNINGS

Shippers of dangerous goods should take all precautions to eliminate any hazards associated with the goods being shipped. The shipper should consult the most-recent version of the International Air Transportation Association (IATA) regulations regarding shipment of dangerous goods.

PERSONNEL QUALIFICATIONS

Any person designated as a shipper of dangerous goods shall be trained in the U.S. Department of Transportation Hazardous Materials Regulations, which must be renewed every two years. Shipment of environmental samples does not require specialized training; however, a familiarity with the regulations and the materials being shipped is considered beneficial.

EQUIPMENT AND SUPPLIES

Consult the most-recent version of the IATA regulations for a listing of proper shipping materials.

- Cooler -Samples -Labels -Ink pen
- Packing materials (bubble wrap) to prevent breakage, absorb leakage, and insulate samples.
- Polyethylene zip-type baggies large enough to contain the largest sample bottles.
- Custody seals if shipped through Federal Express (FEDEX) or similar shipping vendor.
- Large plastic trash bag to act as containment for the packing materials.
- Dry-Ice label

PROCEDURES

1. Be certain that all containers are sufficiently tight, preserved, and labeled correctly. Sediment samples should be allowed to settle for a minimum of 2 hrs prior to shipping to the laboratory. The sample manger should look closely at all sediment samples to see if a clear water layer forms above the sediment. Any water layer should be decanted from the sample jar prior to shipping to the laboratory.
2. Clean the exterior of each sample container such that no gross contamination remains.
3. Complete the Chain of Custody (COC) as described SOP S-19. When the COC form is completed, verify that bottle labels, analytical fractions, and bottle numbers match what is written on the COC form.

4. Wrap sample containers in bubble wrap. Zip-type plastic baggies may be used as additional containment.
5. Line the cooler with the trash bag and add a layer of packing material. If the cooler has a drain, close and seal to prevent leakage of water from melting ice.
6. Place sample containers into the cooler, and pack them sufficiently to prevent them from shifting during shipment.
7. Place ice-filled zip-type bags on samples such that all samples are contacted by the ice. Place sufficient ice to retain the sample temperature between 2 and 6 degrees C. Place a temperature blank in with the samples.

   7a. Place dry-ice on cardboard separator such that dry-ice does not contact containers. Place sufficient dry-ice to retain the sample temperature between 2 and 6 degrees C. Place a temperature blank in with the samples.
8. Fill the remaining space in the cooler with packing material and close and secure the top of the trash bag.
9. On the chain of custody, sign in the relinquished by box and add in the subsequent received by box the name of the courier/carrier and the air bill No. (if applicable).
10. Place the COC into a plastic bag and tape it to the inside top of the cooler.
11. Close the cooler and tape the cooler shut with strapping tape or similar high-strength shipping tape.
12. If more than one cooler is being shipped under the same COC, copies of the COC should be placed into each additional cooler in the same manner as the original COC.
13. If shipped through FEDEX or other shipping vendor, apply custody seals to the cooler such that the seals must be broken in order to open the cooler.
14. Apply “UP Arrows” in the appropriate direction on at least opposing sides of the cooler exterior,or indicate on top “this side up”.
15. Add the appropriate shipping address labels to the cooler along with a return address to the cooler. If more than one cooler is being shipped, add “one of ” to the label so that the recipient is aware that more than one cooler should be received.

DATA AND RECORDS MANAGEMENT

A copy of the COC shall be retained by the shipper until the completed laboratory data package is received. In addition, a copy of the air bill shall also be retained for validation/custody purposes and also for payment.

REFERENCES

AMEC Environment and Infrastructure, Inc. Standard Operating Procedure for Chain of Custody
S-9 Code of Federal Regulations 40 CFR Part 261.4(d) Samples. Dangerous Goods Regulations, IATA, Most-Current Version.

-END OF PROCEDURE -

SOP No. S-25

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.

STANDARD OPERATING PROCEDURE

USE OF TRIMPLE R1 RECEIVER AND ArcGIS FIELD MAPS FOR GPS

QUICK START

TRIMBLE R1 GNSS RECEIVER

A. TURN ON R1

1. Press and hold the power button on the R1 until both LEDs turn green, then release
    a. After a few seconds the Bluetooth/GNSS LED (on the left) will flash blue-amber-blue-amber. This flashing pattern means the R1 is not connected to Bluetooth or to GNSS Status.
    b. The Battery LED (on the right) will turn off if the device is charged > 50%

B. PAIR TABLET AND R1

1. Turn on Bluetooth on the Tablet
    a. Go to Settings > Bluetooth to turn on
2. Press and hold the power button on the R1 until the Bluetooth/GNSS LED flashes only blue. This means the device is in pairing mode.
3. On the tablet, select the R1 device to pair
    a. The device name will show up as the serial number on the back of the R1

NOTE: If the device is not pairing properly, check for any iAP2 devices listed under My Devices. If there are any iAP2 devices, then press the info icon and select Forget This Device. Try pairing again.

C. LAUNCH GNSS STATUS APP

1. Open the GNSS Status app and press Select New Receiver on the bottom of the screen
2. Select the paired R1 device
    a. The screen should show the number of satellites and estimated accuracy of the R1 receiver
    b. Do not close this app while using the R1. The app is a middle man that allows the R1 receiver to send information to the Collector app.
3. Select Real-time Config from the menu on the left side of the screen and verify that the Primary Source Type is SBAS
4. Once set up, press the home button on the tablet to return to the home screen and allow GNSS Status to run in the background

D. LAUNCH ARCGIS FIELD MAPS APP

1. Log in is required with an ArcGIS Online username and password while on a Wi-Fi network
2. Select USDC Penobscot River Field from the All Maps drop down in the top left corner
3. Select On Device in the top center of the screen to check if the map you need has already been downloaded
    a. If your map has been downloaded then it is ready to start collecting points
    b. If your map has not been downloaded then select All in the top center of the screen, find the appropriate map and press the cloud icon with the downward facing arrow to download.

4. Once a map is downloaded it can be accessed without an internet connection. When you enter the ArcGIS Field Maps without an internet connection only the maps that are On Device will show

NOTE: The maps need to be downloaded on the tablet with a steady internet connection. We are working on a large river and this imagery will take time to download. It is best to download before going in the field. Reference sites, such as Addison and Frenchman's Bay, will have separate maps due to the size of the imagery file.

E. COLLECT A POINT!

1. Open an On Device map in the ArcGIS Field Maps App
    a. It should be centered on the location of the R1 if the device is on and paired
2. To collect a point press the + located on the upper right side of the screen
3. Select the feature you would like to add and enter the appropriate information into the designated fields.
    a. Avoid tapping on the map when collecting a point. This overrides the point collected with the R1. If this happens press Cancel and start again.
4. Press submit. This saves the point to the tablet
5. At the end of the day, connect the tablet to Wi-Fi and sync the data with ArcGIS Online by pressing the cloud icon
    a. Select Maps in the top left corner to return to the list of maps – this is where you will find the cloud icon for the map you've been working with.
    b. Syncing the data with ArcGIS online allows the office GIS staff to review the data

NOTE: The lat/long collected is based on the position of the R1 not the position of the tablet.

NOTE: To toggle between screens (QNOPY, GNSS Status, ArcGIS Field Maps, etc.) double click the home button on the tablet and choose the app you need.

F. TURN OFF THE R1

1. Press and hold the power button until both LEDs turn red and continue to hold until the Bluetooth/GNSS LED turns off.
2. Release the power button when only the Battery LED stays red

G. TROUBLESHOOTING

1. If issues arise, then try turning off the app and restarting it
    a. Double click the home button on the tablet, find the app you want to close and then swipe it up until it disappears
2. If restarting the app doesn't work, then try turning off the tablet and restarting it
    a. Press and hold the power button located above the camera
    b. You will have to pair the R1 with the tablet and GNSS Status again
3. If you are still experiencing trouble contact support
    a. For R1 Support: Duncan-Parnell, Inc. (919) 460-8886
    b. For ArcGIS Field Maps Support: Nathan Soule (WSP)

R1 FLASHING LIGHTS

For the battery LED (on the right):

Power LED

LED		Status
	Solid amber	Battery is charging, charge is < 100%.
	Solid green	Battery is fully charged (Charger is connected).
Off		Battery charge is >50% (Charger is not connected).
	Slow flashing amber	Battery charge is >15% (Charger is not connected).
	Slow flashing red	Battery charge is <15% (Charger is not connected). The battery needs charging.
	Rapid flashing red	Battery / power error.

Note – *If the battery is severely discharged, for example if the receiver is new and not yet charged, or it has been stored for more than a few months, the Power LED will not turn on until the battery has charged for a while. In this case, charge the battery for an hour using the supplied charger then disconnect and reconnect the USB cable. The Power LED should turn on.*

For the Bluetooth/GNSS LED (on the left):

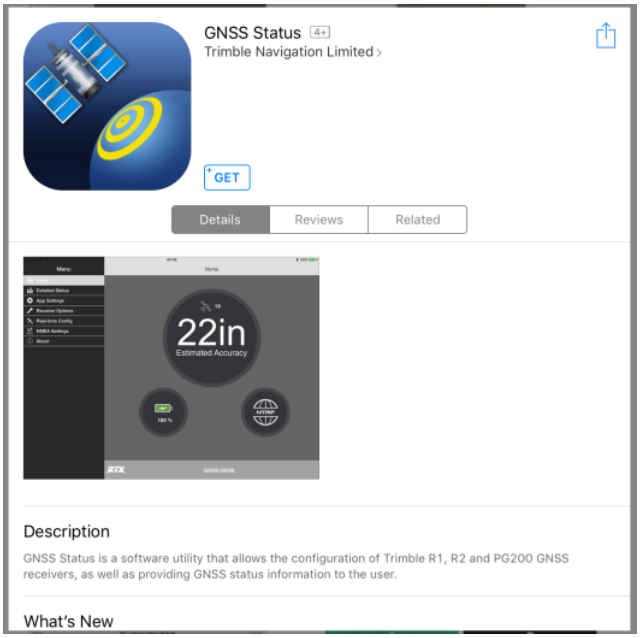
Bluetooth / GNSS LED

LED		Bluetooth status	GNSS status
	Rapid flashing blue	Receiver is in Bluetooth pairing mode (see Connecting the R1 GNSS receiver to a device, page 15.	Not connected.
	Flashing blue / amber	Not connected.	Not connected.
	Flashing blue / green	Not connected.	Connected.
	Flashing amber	Connected.	Not connected.
	Slow flashing green	Connected.	Connected, sending autonomous positions.
	Solid green	Connected.	Connected, sending corrected positions.

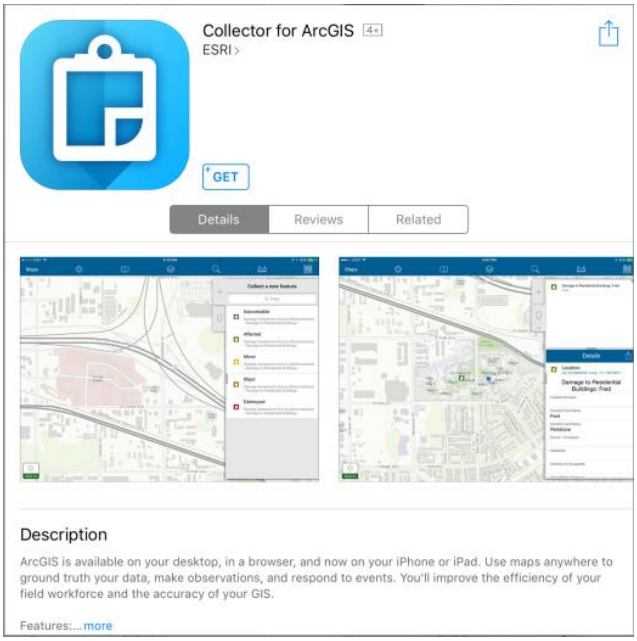
THE APPS ARE FROM THE APP STORE

Both apps are free in the app store! Here is what they look like:

GNSS Status



Arc Collector



SOP No. S-26

WSP USA ENVIRONMENT & INFRASTRUCTURE, INC.
STANDARD OPERATING PROCEDURE

Geotechnical Sediment Collection, Preservation, and Handling (ASTM D6519, D1587, D4220)

Designation: D 6519 – 05

SOP No. S-26

Standard Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler[1]

This standard is issued under the fixed designation D 6519; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers a procedure for sampling of cohesive, organic, or fine-grained soils, or combination thereof, using a thin-walled metal tube that is inserted into the soil formation by means of a hydraulically operated piston. It is used to collect relatively undisturbed soil samples suitable for laboratory tests to determine structural and chemical properties for geotechnical and environmental site characterizations.

1.1.1 Guidance on preservation and transport of samples in accordance with Practice D 4220 may apply. Samples for classification may be preserved using procedures similar to Class A. In most cases, a thin-walled tube sample can be considered as Class B, C, or D. Refer to Guide D 6286 for use of the hydraulically operated stationary piston soil sampler for environmental site characterization. This sampling method is often used in conjunction with rotary drilling methods such as fluid rotary; Guide D 5783; and hollow stem augers, Practice D 6151. Sampling data should be reported in the substance log in accordance with Guide D 5434.

1.2 The hydraulically operated stationery piston sampler is limited to soils and unconsolidated materials that can be penetrated with the available hydraulic pressure that can be applied without exceeding the structural strength of the thin-walled tube. This standard addresses typical hydraulic piston samplers used on land or shallow water in drill holes. The standard does not address specialized offshore samplers for deep marine applications that may or may not be hydraulically operated. This standard does not address operation of other types of mechanically advanced piston samplers.

1.3 *This practice does not purport to address all the safety concerns, if any, associated with its use and may involve use of hazardous materials, equipment, and operations. It is the responsibility of the user to establish and adopt appropriate safety and health practices. Also, the user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines, while using this practice. For good safety practice, consult applicable OSHA regulations and other safety guides on drilling.*[2]

1.4 The values stated in SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.5 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgement. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process. This practice does not purport to comprehensively address all of the methods and the issues associated with sampling of soil. Users should seek qualified professionals for decisions as to the proper equipment and methods that would be most successful for their site investigation. Other methods may be available for drilling and sampling of soil, and qualified professionals should have flexibility to exercise judgment as to possible alternatives not covered in this practice. The practice is current at the time of issue, but new alternative methods may become available prior to revisions, therefore, users should consult with manufacturers or producers prior to specifying program requirements.*

2. Referenced Documents

2.1 *ASTM Standards-Soil Classification:*[3]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 2488 Practice for Description and Identification of Soils

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Evaluation

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[2] *Drilling Safety Guide*, National Drilling Assn., 3008 Millwood Ave., Columbia, SC 29205.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

(Visual-Manual Method)

D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock

2.2 *ASTM Standards-Drilling Methods:*

D 5782 Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D 5783 Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D 5784 Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D 6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling

D 6286 Selection of Drilling Methods for Environmental Site Characterization

2.3 *ASTM Standards—Soil Sampling:*

D 420 Guide to Site Characterization for Engineering, Design, and Construction Purposes

D 1587 Practice for Thin-Walled Tube Geotechnical Sampling of Soils

D 5299 Guide for Decommissioning of Ground Water Wells, Vadose Zone, Monitoring Devices, Boreholes, and Other Devices for Environmental Activities

D 4220 Practices for Preserving and Transporting Soil Samples

D 6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations

3. Terminology

3.1 Terminology used within this guide is in accordance with Terminology D 653 with the addition of the following:

3.1.1 *incremental drilling and sampling*—insertion method where rotary drilling and sampling events are alternated for incremental sampling. Incremental drilling is often needed to penetrate harder or deeper formations.

3.1.2 *sample recovery*—the length of material recovered divided by the length of sampler advancement and stated as a percentage.

3.1.3 *sample interval*—Defined zone within a subsurface strata from which a sample is gathered.

3.1.4 *soil core*—cylindrically shaped soil specimen recovered from a sampler.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *friction clutch*—a device to lock the thin-walled tube head to the outer barrel of the stationary piston sampler to prevent uncontrolled thin-walled tube rotation.

3.2.2 *hydraulically activated stationary piston sampler*—a stationary piston sampler in which the thin-walled tube is forced over a fixed piston into the soil strata by hydraulic fluid pressure or pneumatic pressure. Also known as an "Osterberg" piston sampler, which was developed by Professor Jori Osterberg of Northwestern University.

4. Summary of Practice

4.1 Hydraulic stationary piston sampling of soils consists of advancing a sampling device into subsurface soils generally through a predrilled bore hole to the desired sampling depth. See Fig. 1 for a schematic drawing of the sampling process. The sampler is sealed by the stationary piston to prevent any intrusion of formation material. At the desired depth, fluid or air is forced into the sampling barrel, above the inner sampler head, forcing the thin-walled tube sampler over the piston into the soil formation. The hydraulically operated stationary piston sampler has a prescribed length of travel. At the termination of the sampler travel length the fluid flow is terminated. The sample is allowed to stabilize in the thin-walled tube. The sample is then sheared by rotating the sampler. The sampler is retrieved from the borehole, and the thin-walled tube with the sample is removed from the sampler. The sample tube is then sealed properly or field-extruded as desired. The stationary piston sampler is cleaned and a clean thin-walled tube installed. The procedure is repeated for the next desired sampling interval. Sampling can be continuous for full-depth borehole logging or incremental for specific interval sampling.

5. Significance and Use

5.1 Hydraulically activated stationary piston samplers are used to gather soil samples for laboratory or field testing and analysis for geologic investigations, soil chemical composition studies, and water quality investigations. The sampler is sometimes used when attempts to recover unstable soils with thin-walled tubes, Practice D 1587, are unsuccessful. Examples of a few types of investigations in which hydraulic stationary piston samplers may be used include building site foundation studies containing soft sediments, highway and dam foundation investigations where softer soil formation need evaluation, wetland crossings utilizing floating structures, and hazardous waste site investigations. Hydraulically activated stationary piston samplers provide specimens necessary to determine the physical and chemical composition of soils and, in certain circumstances, contained pore fluids (see Guide D 6169).

5.2 Hydraulically activated stationary piston samplers can provide relatively undisturbed soil samples of soft or loose formation materials for testing to determine accurate information on the physical characteristics of that soil. Samples of soft formation materials can be tested to determine numerous soil characteristics such as; soil stratigraphy, particle size, moisture content, permeability, sheer strength, compressibility, and so forth. The chemical composition of soft formation soils can also be determined from the sample if provisions are made to ensure that clean, decontaminated tools are used in the sample gathering procedure. Field-extruded samples can be field-screened or laboratory-analyzed to determine the chemical composition of soil and contained pore fluids. Using sealed or

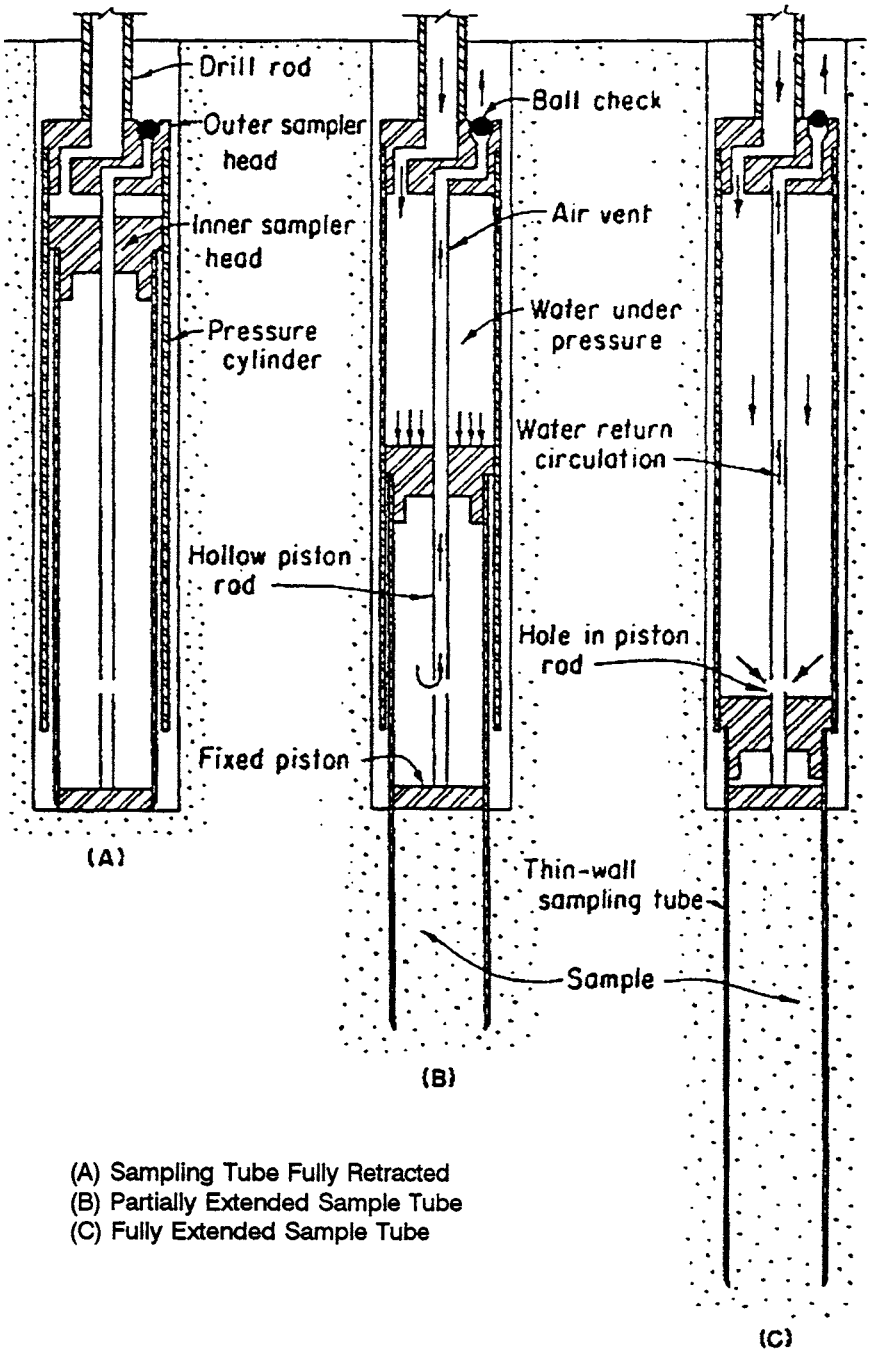

FIG. 1 Sampler in Operation

protected sampling tools, cased boreholes, and proper advancement techniques can help in the acquisition of good representative samples. A general knowledge of subsurface conditions at the site is beneficial.

5.3 The use of this practice may not be the correct method for investigations of softer formations in all cases. As with all sampling methods, subsurface conditions affect the performance of the sample gathering equipment and methods used. For example, research indicates that clean sands may undergo volume changes in the sampling process, due to drainage[4]. The hydraulically activated stationary piston sampler is generally not effective for cohesive formations with unconfined, undrained shear strength in excess of 2.0 tons per square foot,

[4] Marcosion and Bieganovsky, "Liquefaction Potential of Dams & Foundations, Report 4, Determination of In situ Density of Sands," *Research Report S-76-2,* U.S. Army Engineer Water Way Experimental Station, Vicksburg, MS, 1977.

coarse sands, compact gravelly tills containing boulders and cobbles, compacted gravel, cemented soil, or solid rock. These formations may damage the sample or cause refusal to penetration. A small percentage of gravel or gravel cuttings in the base of the borehole can cause the tube to bend and deform, resulting in sample disturbance. Certain cohesive soils, depending on their water content, can create friction on the thin-walled tube which can exceed the hydraulic delivery force. Some rock formations can weather into soft or loose deposits where the hydraulically activated stationary piston sampler may be functional. The absence of ground water can affect the performance of this sampling tool. As with all sampling and borehole advancement methods, precautions must be taken to prevent cross-contamination of aquifers through migration of contaminates up or down the borehole. Refer to Guide D 6286 on selecting drilling methods for environmental site characterization for additional information about work at hazardous waste sites.

6. Criteria for Selection

6.1 Important criteria to consider when selecting the hydraulically activated stationary piston sampler include the following:

6.1.1 Size of sample.

6.1.2 Sample quality (Class A, B, C, or D) for physical testing. Refer to Practices D 4220.

6.1.3 Sample handling requirements such as containers and preservation requirements.

6.1.4 Soil conditions anticipated (cohesiveness).

6.1.5 Ground-water depth anticipated.

6.1.6 Boring depth required.

6.1.7 Chemical composition of soil and contained pore fluids.

6.1.8 Available funds.

6.1.9 Estimated cost.

6.1.10 Time constraints.

6.1.11 History of tool performance under anticipated conditions (consult experienced users and manufacturers).

6.1.12 Site accessibility.

6.1.13 Decontamination requirements.

7. Apparatus

7.1 The hydraulically activated stationary piston sampler consists of an outer barrel, an outer barrel head with threaded connection for drill rod with a fluid-injection port leading into the inner barrel, a fluid-exit port fitted with a check valve, a friction clutch assembly to control rotation, a piston rod that attaches to the sampler head and serves as a conduit from the base of the piston for the discharge of fluid, an inner sampler head which slides over the piston rod to which the thin-walled tube is attached, a piston that attaches to the lower end of the piston rod, a thin-walled tube, and in some cases a removable outer barrel shoe. Necessary expendable supplies are thin-walled tubes, tube sealing material, sample containers for use in field extrusion, and O-ring seals.

7.1.1 *Thin-walled Tube*—The hydraulically activated stationary piston sampler is designed to accommodate standard sized 3.0-in. (76.2-mm) diameter thin-walled tubes. Samplers are also available to utilize 5.0-in. (127.0-mm) diameter thin-walled tubes as well (Fig. 2). The thin-walled tubes are generally manufactured in accordance with Practice D 1587. Thin-walled tube retaining fastener patterns may vary (Fig. 2). The most desirable pattern is the one recommended in Practice D 1587. Regardless of the pattern used, a minimum of four fasteners should be utilized to provide sufficient strength to resist any rotation or extraction forces. Sealing of thin-walled tube ends should be completed in accordance with Practice D 1587 and with Practices D 4220.

7.1.2 *Sample Tube*—Thin-walled tubes are available in various types of materials, including stainless steel, galvanized steel, and brass. There are also different types of materials that can be used to coat the tube surfaces. When using thin-walled tubes in areas with chemically contaminated soil, consideration should be given to the effect these chemicals may have on the tube composition. The reaction of the chemical with the thin-walled tube may affect the sample properties as well as storage procedures. Samples for geotechnical testing require certain minimum volumes and specific handling techniques. Practices D 4220 offers guidance for handling samples submitted for physical testing.

7.2 *Power Sources*—Hydraulic activation of the stationary piston sampler requires a power source to supply fluid or air to the sampler. Rotary drilling equipment fitted with fluid pumps or air compressions may be used. The drill rig should have a tower for placing and removing the sampler from the borehole. The drill rig should also have sufficient retraction power to extract the full sample tube, overcoming the suction and the friction of the formation soils. The fluid pump should be capable of supplying 200 psi (1380 kN/m^2). Piston, progressive cavity, and peristaltic pumps work well. The pump should be equipped with a pressure-relief valve set at a minimum of 200 psi. Air compressors capable of delivering 175 psi (1207.5 kN/m^2) are acceptable. Pressure requirements are governed by the soil resistance values of the formation being sampled. Drilling tools needed to operate the sampler include drill rods to position the sampler and to transfer the activation fluid,

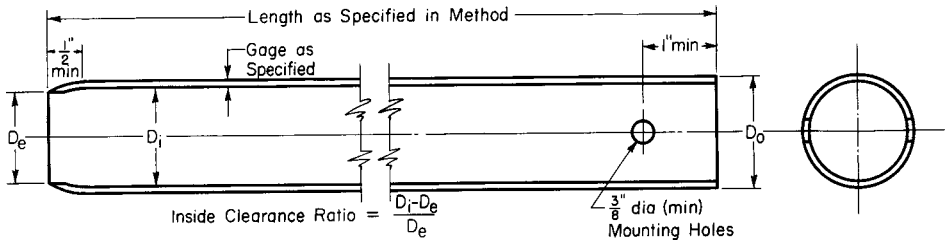

FIG. 2 Thin-Walled Tube Sampler, Practice D 1587

rod-handling tools, pipe wrenches, fluid swivels, and so forth; casing or hollow stem augers to provide a stable borehole; a pipe vise to secure the sampler for thin-walled tube removal and loading; wood blocks for reloading the thin-walled tube into the sampler barrel without damage to the cutting edge; hand tools to remove and install the tube fasteners; and a brush with buckets for cleaning the sampler.

7.2.1 *Rotary Drilling Equipment*—Drills are required that are capable of performing drilling functions in accordance with Practice D 6151 and Guide D 5783. Drill units generally offer a ready hydraulic system for the retraction of samplers from the sampled formation and downward thrust for pushing the sampler through minimal amounts of borehole cave-in to reach desired sampling depth as well as reactive weight to counteract the thin-walled tube discharge pressure. Because most drills are equipped with leveling jacks, better weight application is achieved. Vertical pushing is improved because of the ability to level the machine. Tool handling is facilitated by high-speed winches common to drilling rigs, extended masts for long tool pulls, and sampler holding devices. Drill units are commonly fitted with fluid pumps that will provide the activation fluid. The unit must have a working pressure measurement gage in the fluid discharge line positioned where it can be easily read. This gage will be the indicator of how the sampler is functioning as well as when the thin-walled tube has been fully extruded.

7.3 *Activation Fluid*—The generally accepted activation fluid for using the hydraulically activated stationary piston sampler is clean water. The sealing areas inside the sampler have tight tolerances and as such cannot tolerate many physical impurities. The use of regular drilling water that is contaminated with drill cuttings can impair the operation of the sampler and cause damage to the seal system. Water containing drill fluid additives can be used to activate the sampler. However, this fluid must also be free of foreign particles. In certain cases it may be advantageous to use drilling fluid additives such as when the injection of clean water may negatively affect borehole stability. When using bentonite-based drill additives, a fluid of 30 to 45-s marsh funnel viscosity (API RP13B.1 Standard Procedure for Field Testing Water-Based Drilling Fluids) will work adequately. However, the sampler will need to be thoroughly cleaned after each use if drill fluid additive borehole stabilization techniques are required. As the amount of drill fluid needed to activate the sampler is quite small, in the range from 5 to 10 gal depending on hole depth, the impact on borehole stability may be minor. When using air as the drill fluid it will generally be clean as it has been processed through the compressor. Refer to Guide D 5782 for additional information on air drilling. The air entering the sampler may be heated and will probably be quite dry. These conditions can affect the operation of the sampler by increasing the friction at the piston and piston rod seals.

7.4 *Sample Handling*—To protect the sample and retain it in its most natural state, the tube ends must be sealed and the sample immobilized in the tube. Expandable packers, correctly sized for tubes, work well. The tubes can also be cut smoothly and plastic caps attached to the ends. If the tubes are not cut, sample trimming tools will be required to remove soil from the ends for insertion of the packers. An alternative to packers might be wax-coated wooden plugs that can be inserted and waxed into contact with the sample ends.

8. Conditioning

8.1 *General Cleaning*—Thoroughly clean the hydraulically operated stationary piston sampler prior to being taken to the field. The unit contains several close tolerance parts that may become dysfunctional during long storage. Completely disassemble the sampler, wash all parts, inspect for damage, and replace if necessary. Apply a light film of lubricant to all parts if the sampling program allows. Silicon-based sprays and silicon grease can be applied to the O-rings. Check thin-walled tubes for roundness and conformance to the piston O-ring tolerance. Install a thin-walled tube and shop test the unit by applying air or fluid to extrude the thin-walled tube.

8.1.1 *Decontamination*—If the sampler is to be used on a chemically contaminated site, refer to D 5088 for recommended decontamination procedures.

8.2 *Thin-Walled Tubes*—Check the thin-walled tubes (Fig. 2) planned for use in the sampling program for the proper inside sample clearance ratio of 1 % (maximum) of the tube diameter. The cutting edge should be sharp and not dented, nicked, or otherwise impaired. The tubes should be the prescribed length for the sampler used. Tubes that are less than the prescribed length will function, however, the sample volume will be reduced. Tubes that are longer than the prescribed length are not recommended as the tube section extending beyond the stationary piston can accumulate borehole cave-in and can be subjected to damage during insertion into the borehole. A damaged cutting edge can ruin the integrity of the sample. The attachment fastener holes should be the in the correct pattern for the sampler piston head. The fastener holes in the thin-walled tube should be free of dents, burrs, or other distortions. The fastener end of the tube should be round with flat finished edges. No dents, kinks, or other metal distortions are allowed. The body of the tube must be dent free. The interior of the tube must be smooth to slide over the piston and to accommodate the extrusion equipment. No weld seam protrusions are allowed. The interior must be rust free and clean of any accumulated dirt.

8.3 *Tool Selection*—Prior to dispatch to the project site make an inventory of the necessary sampler supplies. Stock and check thin-walled tubes, sample containers for field extrusion, tube sealing materials, and sampler service parts such as O-ring seals, O-ring lubricant, and tube retaining fasteners to ensure proper sustained operation for the work program prescribed. Refer to Guide D 420 for additional information on soil sampling tool selection. Materials for proper sealing of boreholes should always be available at the site.

9. Procedure

9.1 *General Setup*—Advance the borehole to the prescribed sampling depth using fluid or air rotary, hollow stem auger, or other accepted drill method in the necessary diameter to accommodate the hydraulically activated stationary piston

sampler. Bottom discharge bits are not permitted. Side discharge as well as diffused jet discharge are generally acceptable. Drilling techniques used must keep the surface of the sampling zone as undisturbed as possible. Remove the drilling tools from the borehole[5,6].

9.1.1 *Tool Preparation*—Inspect the hydraulically activated stationary piston sampler. Inspect the check valve to be sure it is not obstructed. Load the thin-walled tube into the sampler. Slide the thin-walled tube over the sampler piston and align the fastener holes with the fastener sockets in the piston head. Insert the fasteners and tighten securely. Elevate the sampler and set the sharp edge of the tube on a non-damaging surface such as a block of wood. Apply down pressure on the top of the sampler to force the thin-walled tube into the sampler barrel the full length of the tube. Tube insertion will cease when the piston reaches the end of its upward travel or when the lower lip of the thin-walled tube reaches the base of the piston. There will be approximately ½ in. (12.7 mm) of the thin-walled tube protruding ahead of the sampler piston. Use caution in handling the sampler to avoid personal injury from the sharp edge as well as to prevent damage to this cutting edge while placing the sampler into the borehole.

9.2 *Sampler Insertion*—Attach the sampler assembly to the drill rod tool string. Tighten the sampler/rod joint tightly to avoid any leakage at the joint. Lower the sampler to the base of the borehole. Record the assembly length so it can be added to the length of the drill rod string to determine the exact position of the sampler. Measure the actual sampler location in the borehole to determine if any cave-in has occurred and to determine the sampler location in relation to the desired sampling depth. If minimal borehole cave-in has occurred and soil conditions allow, apply down pressure to the drill rod string to displace the cuttings or slough. Because the thin-wall tube is sealed by the piston, the tube will remain free of soil intrusion. However, forcing the sampler through cave-in may disturb the top of the sampling zone. If the sampler can not be advanced to the desired depth in this manner, it may be necessary to redrill the borehole or use borehole stabilization techniques such as pressure equalization or casing installation. Under certain conditions, the thin-walled tube can be discharged through the cave-in into the undisturbed soil. Accurate measurement must be taken if this technique is used to determine actual sampling depth and to verify the amount of disturbed material in the sample.

9.3 *Activation*—With the sampler at a desired location in the borehole, connect the drill and the fluid injection swivel to the drill rod string. Put a slight amount of down pressure on the rod string to prevent any upward movement of the sampler when activation begins. Upward movement of the sampler could result in less recovery and a loss of vacuum at the piston. Start the activation source, fluid or air, observing the discharge line pressure gage. Increase the pressure slowly until penetration begins to occur. Tube penetration should be slow and constant to prevent sample distortion. The pressure will generally remain constant unless stiffer or softer layers are encountered by the tube. The discharge line pressure can provide an indication of resistance to peetration of the soil being sampled. The discharge pressure should be oted an recorded on the boring log. When the inner sampler head reaches the end of its travel length, the fluid will vent at the piston rod discharge port and move through the piston rod and check valve (Fig. 1). At that point the pressure in the discharge line will drop. In some cases a rise in the borehole water level may occur. A bubble of air may also appear as the sampler activation fluid is released from the sampler. The thin-walled tube is now fully extended. Stop the fluid or air flow immediately as no further effort is needed.

9.4 *Sampler Recovery*—At completion of the thin-walled tube advancement, allow the tube to remain stationary for a minimum of 1 min. In the case of soft saturated clays, a longer waiting period may be necessary to improve sample recovery. When the stabilization period is complete, slowly rotate the tube two revolutions to shear off the sample. Slowly withdraw the sampler from the soil formation and bring it to the surface. If the soils sampled are quite soft it may be necessary to immediately cover the bottom end of the tube to prevent any specimen loss. Sample fall-out will generally occur just as the sampler clears the drill fluid. Be prepared to slide a flat object under the edge of the thin-walled tube as it clears the fluid to prevent specimen loss. An expandable packer will work well for this. Clamp the outer barrel into a vice or other holding device. Remove the tube attachment fasteners. Rotate the tube against the friction brake and pull on it simultaneously. It may require significant effort to overcome the vacuum that is created between the piston surface and the soil sample. Once the thin-walled tube is removed, process it as quickly as possible to prevent moisture loss or sample distortion. Guidelines for processing and shipping samples are outlined in Practice D 1587 and Practices D 4220. If the sample requires sealing of the ends, remove slough and seal. If packers are used, trim soil at the bottom of the tube to insert the packer. The removed soil can be used for classification and moisture determination. The sampler is then reloaded with a thin-walled tube and the procedure repeated at the next desired sampling interval.

10. Completion and Sealing

10.1 Information on the sealing of boreholes can be found in Guides D 5299, D 5782, D 5783, and D 5784. State or local regulations may control both the method and the materials for borehole sealing.

11. Record Keeping

11.1 *Field Report*—The field report may consist of boring log or a report of the sampling event and a description of the sample. Soil samples can be classified in accordance with Practice D 2488 or other methods as required for the investigation. Prepare the log in accordance with Guide D 5434 which lists the parameters required for the field investigation program. Record the sampler type as thin wall tube with hydraulically operated stationary piston sampler.List all information related to the sampling event, including depth, discharge fluid

[5] *Earth Manual*, Part 2, U.S. Department of the Interior, Bureau of Reclamation, 1990.

[6] Bosscher, Peter and Ruda, Thomas C., *Drillers Handbook*, National Drilling Assn., 3008 Millwood Ave., Columbia, SC 29205, 1990.

pressure, recovery, strength index readings such as pocket pentrometer taken in the end of the sample, classification of soil in the ends of sample, and any comments on sampler advancement.

12. Keywords

12.1 hydraulically activated; stationary piston; thin-walled tube

Designation: D 1587 – 00

Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes[1]

This standard is issued under the fixed designation D 1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of engineering properties, such as strength, compressibility, permeability, and density. Thin-walled tubes used in piston, plug, or rotary-type samplers should comply with Section 6.3 of this practice which describes the thin-walled tubes.

NOTE 1—This practice does not apply to liners used within the samplers.

1.2 This Practice is limited to soils that can be penetrated by the thin-walled tube. This sampling method is not recommended for sampling soils containing gravel or larger size soil particles cemented or very hard soils. Other soil samplers may be used for sampling these soil types. Such samplers include driven split barrel samplers and soil coring devices (D 1586, D 3550, and D 6151). For information on appropriate use of other soil samplers refer to D 6169.

1.3 This practice is often used in conjunction with fluid rotary drilling (D 1452D 5783) or hollow-stem augers (D 6151). Subsurface geotechnical explorations should be reported in accordance with practice (D 5434). This practice discusses some aspects of sample preservation after the sampling event. For information on preservation and transportation process of soil samples, consult Practice D 4220. This practice does not address environmental sampling; consult D 6169 and D 6232for information on sampling for environmental investigations.

1.4 The values stated in inch-pound units are to be regarded as the standard. The SI values given in parentheses are provided for information purposes only. The tubing tolerances presented in Table 2 are from sources available in North America. Use of metric equivalent is acceptable as long as thickness and proportions are similar to those required in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Standard Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Penetration Resistance and Split Barrel Sampling of Soils[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 3550 Practice for Ring-Lined Barrel Sampling of Soils[2]

D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[2]

D 4220 Practices for Preserving and Transporting Soil Samples[2]

D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock[3]

D 5783 Guide for Use of Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices[3]

D 6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling[3]

D 6169 Guide for Selection of Soil and Rock Sampling

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

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[2] *Annual Book of ASTM Standards,* Vol 04.08.

[3] *Annual Book of ASTM Standards,* Vol 04.09.

***A Summary of Changes section appears at the end of this standard.**

TABLE 1 Suitable Thin-Walled Steel Sample Tubes[A]

Outside diameter (D_o):			
in.	2	3	5
mm	50.8	76.2	127
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.065	0.120
mm	1.24	1.65	3.05
Tube length:			
in.	36	36	54
m	0.91	0.91	1.45
Inside clearance ratio, %	<1	<1	<1

[A] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

TABLE 2 Dimensional Tolerances for Thin-Walled Tubes

Nominal Tube Diameters from Table 1[A] Tolerances						
Size Outside Diameter	2 in.	50.8 mm	3 in.	76.2 mm	5 in.	127 mm
Outside diameter, D_o	+0.007 -0.000	+0.179 -0.000	+0.010 -0.000	+0.254 -0.000	+0.015 -0.000	0.381 -0.000
Inside diameter, D_i	+0.000 -0.007	+0.000 -0.179	+0.000 -0.010	+0.000 -0.254	+0.000 -0.015	+0.000 -0.381
Wall thickness	±0.007	±0.179	±0.010	±0.254	±0.015	±0.381
Ovality	0.015	0.381	0.020	0.508	0.030	0.762
Straightness	0.030/ft	2.50/m	0.030/ft	2.50/m	0.030/ft	2.50/m

[A] Intermediate or larger diameters should be proportional. Specify only two of the first three tolerances; that is, D_o and D_i, or D_o and Wall thickness, or D_i and Wall thickness.

Devices Used With Drill Rigs for Environmental Investigations[3]

D 6232 Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities[4]

3. Terminology

3.1 *Definitions:*

3.1.1 For common definitions of terms in this standard, refer to Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *inside clearance ratio, %*—the ratio of the difference in the inside diameter of the tube, D_i, minus the inside diameter of the cutting edge, D_e, to the inside diameter of the tube, D_i expressed as a percentage (see Fig. 1).

3.2.2 *ovality*—the cross section of the tube that deviates from a perfect circle.

4. Summary of Practice

4.1 A relatively undisturbed sample is obtained by pressing a thin-walled metal tube into the in-situ soil at the bottom of a boring, removing the soil-filled tube, and applying seals to the soil surfaces to prevent soil movement and moisture gain or loss.

5. Significance and Use

5.1 This practice, or Practice D 3550 with thin wall shoe, is used when it is necessary to obtain a relatively undisturbed specimen suitable for laboratory tests of engineering properties or other tests that might be influenced by soil disturbance.

NOTE 2—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective sampling. Users of this practice. are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 5740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Drilling Equipment*—When sampling in a boring, any drilling equipment may be used that provides a reasonably clean hole; that minimizes disturbance of the soil to be sampled; and that does not hinder the penetration of the thin-walled sampler. Open borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.5 times the outside diameter of the thin-walled tube.

6.2 *Sampler Insertion Equipment*, shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

6.3 *Thin-Walled Tubes*, should be manufactured to the dimensions as shown in Fig. 1. They should have an outside diameter of 2 to 5 in. (50 to 130 mm) and be made of metal having adequate strength for the type of soil to be sampled. Tubes shall be clean and free of all surface irregularities including projecting weld seams. Other diameters may be used but the tube dimensions should be proportional to the tube designs presented here.

6.3.1 *Length of Tubes*—See Table 1 and 7.4.1.

6.3.2 *Tolerances*, shall be within the limits shown in Table 2.

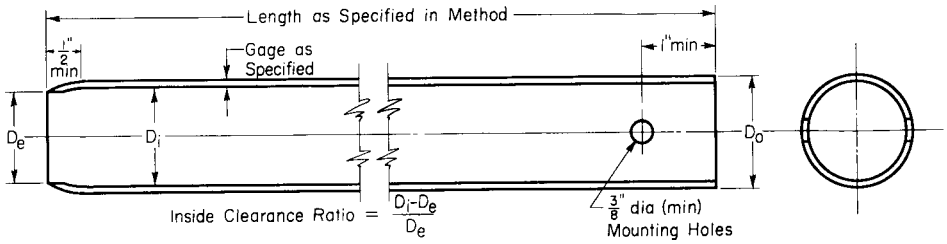
6.3.3 *Inside Clearance Ratio*, should be not greater than 1 % unless specified otherwise for the type of soil to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled, except for sensitive soils or where local experience indicates otherwise. See 3.2.1 and Fig. 1 for definition of inside clearance ratio.

6.3.4 *Corrosion Protection*—Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective coating, unless the soil is to be extruded less than 3 days. The type of coating to be used may vary depending upon the material to be sampled. Plating of the tubes or alternate base metals may be specified. Galvanized tubes are often used when long term storage is required. Coatings may include a light coat of lubricating oil, lacquer, epoxy, Teflon, zinc oxide, and others.

NOTE 3—Most coating materials are not resistant to scratching by soils that contain sands. Consideration should be given for prompt testing of the sample because chemical reactions between the metal and the soil sample con occur with time.

6.4 *Sampler Head*, serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube,

[4] *Annual Book of ASTM Standards*, Vol 11.04.



NOTE 1—Minimum of two mounting holes on opposite sides for D_o smaller than 4 in. (101.6 mm).
NOTE 2—Minimum of four mounting holes equally spaced for D_o 4 in. (101.6 mm) and larger.
NOTE 3—Tube held with hardened screws or other suitable means.
NOTE 4—2-in (50.8 mm) outside-diameter tubes are specified with an 18-gage wall thickness to comply with area ratio criteria accepted for "undisturbed samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-gage tubes are generally readily available.

Metric Equivalent Conversions

in.	mm
⅜	9.53
½	12.7
1	25.4
2	50.8
3	76.2
4	101.6
5	127

FIG. 1 Thin-Walled Tube for Sampling

comprises the thin-walled tube sampler. The sampler head shall contain a venting area and suitable check valve with the venting area to the outside equal to or greater than the area through the check valve. In some special cases, a check valve may not be required but venting is required to avoid sample compression. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.

7. Procedure

7.1 Remove loose material from the center of a casing or hollow stem auger as carefully as possible to avoid disturbance of the material to be sampled. If groundwater is encountered, maintain the liquid level in the borehole at or above ground water level during the drilling and sampling operation.

7.2 Bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted.

NOTE 4—Roller bits are available in downward-jetting and diffused-jet configurations. Downward-jetting configuration rock bits are not acceptable. Diffuse-jet configurations are generally acceptable.

7.3 Lower the sampling apparatus so that the sample tube's bottom rests on the bottom of the hole and record depth to the bottom of the sample tube to the nearest 0.1-ft (.03 m)

7.3.1 Keep the sampling apparatus plumb during lowering, thereby preventing the cutting edge of the tube from scraping the wall of the borehole.

7.4 Advance the sampler without rotation by a continuous relatively rapid downward motion and record length of advancement to the nearest 1 in. (25 mm).

7.4.1 Determine the length of advance by the resistance and condition of the soil formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays. In no case shall a length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3-in. (75 mm) for sludge and end cuttings.

NOTE 5—The mass of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 1.

7.5 When the soil formation is too hard for push-type insertion, the tube may be driven or Practice D 3550 may be used. If driving methods are used, the data regarding weight and fall of the hammer and penetration achieved must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."

7.6 Withdraw the sampler from the soil formation as carefully as possible in order to minimize disturbance of the sample. The tube can be slowly rotated to shear the material at the end of the tube, and to relieve water and/or suction pressures and improve recovery. Where the soil formation is soft, a delay before withdraw of the sampler (typically 5 to 30 minutes) may improve sample recovery.

8. Sample Measurement, Sealing and Labeling

8.1 Upon removal of the tube, remove the drill cuttings in the upper end of the tube and measure the length of the soil sample recovered to the nearest 0.25 in. (5 mm) in the tube. Seal the upper end of the tube. Remove at least 1 in. (25 mm) of material from the lower end of the tube. Use this material for soil description in accordance with Practice D 2488. Measure the overall sample length. Seal the lower end of the tube. Alternatively, after measurement, the tube may be sealed without removal of soil from the ends of the tube.

8.1.1 Tubes sealed over the ends, as opposed to those sealed

with expanding packers, should be provided with spacers or appropriate packing materials, or both prior to sealing the tube ends to provide proper confinement. Packing materials must be nonabsorbent and must maintain their properties to provide the same degree of sample support with time.

8.1.2 Depending on the requirements of the investigation, field extrusion and packaging of extruded soil samples can be performed. This allows for physical examination and classification of the sample. Samples are extruded in special hydraulic jacks equipped with properly sized platens to extrude the core in a continuous smooth speed. In some cases, further extrusion may cause sample disturbance reducing suitability for testing of engineering properties. In other cases, if damage is not significant, cores can be extruded and preserved for testing (D 4220). Bent or damaged tubes should be cut off before extruding.

8.2 Prepare and immediately affix labels or apply markings as necessary to identify the sample (see Section 9). Assure that the markings or labels are adequate to survive transportation and storage.

NOTE 6—Top end of the tube should be labeled "top".

9. Field Log

9.1 Record the information that may be required for preparing field logs in general accordance to ASTM D 5434 "Guide for Field Logging of Subsurface Explorations of Soil and Rock". This guide is used for logging explorations by drilling and sampling. Some examples of the information required include;

9.1.1 Name and location of the project,

9.1.2 Boring number,

9.1.3 Log of the soil conditions,

9.1.4 Surface elevation or reference to a datum to the nearest foot (0.5 m) or better,

9.1.5 Location of the boring,

9.1.6 Method of making the borehole,

9.1.7 Name of the drilling foreman and company, and

9.1.8 Name of the drilling inspector(s).

9.1.9 Date and time of boring-start and finish,

9.1.10 Depth to groundwater level: date and time measured,

9.2 Recording the appropriate sampling information is required as follows:

9.2.1 Depth to top of sample to the nearest 0.1 ft. (.03 m) and number of sample,

9.2.2 Description of thin-walled tube sampler: size, type of metal, type of coating,

9.2.3 Method of sampler insertion: push or drive,

9.2.4 Method of drilling, size of hole, casing, and drilling fluid used,

9.2.5 Soil description in accordance with Practice D 2488,

9.2.6 Length of sampler advance (push), and

9.2.7 Recovery: length of sample obtained.

10. Keywords

10.1 geologic investigations; sampling; soil exploration; soil investigations; subsurface investigations; undisturbed

SUMMARY OF CHANGES

In accordance with committee D18 policy, this section identifies the location of changes to this standard since the last edition, 1994, which may impact the use of this standard.

(1) Editorial corrections to various sections based on comments received from Committee Balloting

(2) Added D 6232 to Section 2.

(3) Changed Note 7 to Section 8.1.2.

(4) Renumbered Note 8.

Designation: D 4220 – 95 (Reapproved 2000)

Standard Practices for Preserving and Transporting Soil Samples[1]

This standard is issued under the fixed designation D 4220; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 These practices cover procedures for preserving soil samples immediately after they are obtained in the field and accompanying procedures for transporting and handling the samples.

1.2 *Limitations*—These practices are not intended to address requirements applicable to transporting of soil samples known or suspected to contain hazardous materials.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* See Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*

D 420 Guide to Site Characterization for Engineering, Design, and Construction Purposes[2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Test Method for Penetration Test and Split-Barrel Sampling of Soils[2]

D 1587 Practice for Thin-Walled Tube Sampling of Soils[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 3550 Practice for Ring-Lined Barrel Sampling of Soils[2]

D 4564 Test Method for Density of Soil in Place by the Sleeve Method[2]

D 4700 Guide for Soil Sampling from the Vadose Zone[2]

3. Terminology

3.1 Terminology in these practices is in accordance with Terminology D 653.

4. Summary of Practices

4.1 The various procedures are given under four groupings as follows:

4.1.1 *Group A*—Samples for which only general visual identification is necessary.

4.1.2 *Group B*—Samples for which only water content and classification tests, proctor and relative density, or profile logging is required, and bulk samples that will be remolded or compacted into specimens for swell pressure, percent swell, consolidation, permeability, shear testing, CBR, stabilimeter, etc.

4.1.3 *Group C*—Intact, naturally formed or field fabricated, samples for density determinations; or for swell pressure, percent swell, consolidation, permeability testing and shear testing with or without stress-strain and volume change measurements, to include dynamic and cyclic testing.

4.1.4 *Group D*—Samples that are fragile or highly sensitive for which tests in Group C are required.

4.2 The procedure(s) to be used should be included in the project specifications or defined by the designated responsible person.

5. Significance and Use

5.1 Use of the various procedures recommended in these practices is dependent on the type of samples obtained (Practice D 420), the type of testing and engineering properties required, the fragility and sensitivity of the soil, and the climatic conditions. In all cases, the primary purpose is to preserve the desired inherent conditions.

5.2 The procedures presented in these practices were primarily developed for soil samples that are to be tested for engineering properties, however, they may be applicable for samples of soil and other materials obtained for other purposes.

6. Apparatus

6.1 The type of materials and containers needed depend upon the conditions and requirements listed under the four groupings A to D in Section 4, and also on the climate and transporting mode and distance.

6.1.1 *Sealing Wax*, includes microcrystalline wax, paraffin, beeswax, ceresine, carnaubawax, or combinations thereof.

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[1] These practices are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved April 15, 1995. Published June 1995. Originally published as D 4220 – 83. Last previous edition D 4220 – 89.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

***A Summary of Changes section appears at the end of this standard.**

6.1.2 *Metal Disks*, about 1⁄16 in. (about 2 mm) thick and having a diameter slightly less than the inside diameter of the tube, liner, or ring and to be used in union with wax or caps and tape, or both.

6.1.3 *Wood Disks*, prewaxed, 1 in. (25 mm) thick and having a diameter slightly less than the inside diameter of the liner or tube.

6.1.4 *Tape*, either waterproof plastic, adhesive friction, or duct tape.

6.1.5 *Cheesecloth*, to be used in union with wax in alternative layers.

6.1.6 *Caps*, either plastic, rubber or metal, to be placed over the end of thin-walled tubes (Practice D 1587), liners and rings (Practice D 3550), in union with tape or wax.

6.1.7 *O'ring (Sealing End Caps)*, used to seal the ends of samples within thin-walled tubes, by mechanically expanding an O'ring against the tube wall.

NOTE 1—Plastic expandable end caps are preferred. Metal expandable end caps seal equally well; however, long-term storage may cause corrosion problems.

6.1.8 *Jars*, wide mouthed, with rubber-ringed lids or lids lined with a coated paper seal and of a size to comfortably receive the sample, commonly ½ pt (250 mL), 1 pt (500 mL) and quart-sized (1000 mL).

6.1.9 *Bag*, either plastic, burlap with liner, burlap or cloth type (Practice D 1452).

6.1.10 *Packing Material*, to protect against vibration and shock.

6.1.11 *Insulation*, either granule (bead), sheet or foam type, to resist temperature change of soil or to prevent freezing.

6.1.12 *Sample Cube Boxes*, for transporting cube (block) samples. Constructed with ½ to ¾ in. (13 to 19 mm) thick plywood (marine type).

6.1.13 *Cylindrical Sample Containers*, somewhat larger in dimension than the thin-walled tube or liner samples, such as cylindrical frozen food cartons.

6.1.14 *Shipping Containers*, either box or cylindrical type and of proper construction to protect against vibration, shock, and the elements, to the degree required.

NOTE 2—The length, girth and weight restrictions for commercial transportation must be considered.

6.1.15 *Identification Material*—This includes the necessary writing pens, tags, and labels to properly identify the sample(s).

7. Precautions

7.1 Special instructions, descriptions, and marking of containers must accompany any sample that may include radioactive, chemical, toxic, or other contaminant material.

7.2 Interstate transportation containment, storage, and disposal of soil samples obtained from certain areas within the United States and the transportation of foreign soils into or through the United States are subject to regulations established by the U.S. Department of Agriculture, Animal, and Plant Health Service, Plant Protection and Quarantine Programs, and possibly to regulations of other federal, state, or local agencies.

7.2.1 Samples shipped by way of common carrier or U.S. Postal Service must comply with the Department of Transportation Hazardous Materials Regulation, 49CRF Part 172.

7.3 Sample traceability records (see Fig. 1) are encouraged and should be required for suspected contaminated samples.

7.3.1 The possession of all samples must be traceable, from collection to shipment to laboratory to disposition, and should be handled by as few persons as possible.

7.3.2 The sample collector(s) should be responsible for initiating the sample traceability record; recording the project, sample identification and location, sample type, date, and the number and types of containers.

7.3.3 A separate traceability record shall accompany each shipment.

7.3.4 When transferring the possession of samples the person(s) relinquishing and receiving the samples shall sign, date, record the time, and check for completeness of the traceability record.

8. Procedure

8.1 *All Samples*—Properly identify samples with tags, labels, and markings prior to transporting them as follows:

8.1.1 Job name or number, or both,

8.1.2 Sampling date,

8.1.3 Sample/boring number and location,

8.1.4 Depth or elevation, or both,

8.1.5 Sample orientation,

8.1.6 Special shipping or laboratory handling instructions, or both, including sampling orientation, and

8.1.7 Penetration test data, if applicable (Test Method D 1586).

8.1.8 Subdivided samples must be identified while maintaining association to the original sample.

8.1.9 If required, sample traceability record.

8.2 *Group A*—Transport samples in any type of container by way of available transportation. If transported commercially, the container need only meet the minimum requirements of the transporting agency and any other requirements necessary to assure against sample loss.

8.3 *Group B*:

8.3.1 Preserve and transport these samples in sealed, moistureproof containers. All containers shall be of sufficient thickness and strength to ensure against breakage and moisture loss. The container types include: plastic bags or pails, glass or plastic (provided they are waterproof) jars, thin walled tubes, liners, and rings. Wrap cylindrical and cube samples in suitable plastic film or aluminum foil, or both, (Note 3) and coat with several layers of wax, or seal in several layers of cheesecloth and wax.

8.3.2 Transport these samples by any available transportation. Ship these samples as prepared or placed in larger shipping containers, including bags, cardboard, or wooden boxes or barrels.

NOTE 3—Some soils may cause holes to develop in aluminum foil, due to corrosion. Avoid direct contact where adverse affects to sample composition are a concern.

Sample Identification/Traceability Record
(Controlled Document)

Project: _____ W.O. # _____
Shipped by: _____
Shipped to: _____ Attention of:
Comments: _____ Hazardous materials suspected? (yes/no)
_____

Sampling Point	Location	Field ID #	Date	Sample Type	No. of Containers	Analysis/Test Required	(optional) Lab ID

Sampler(s) (signature) _____

Field ID	Relinquished by: (signature)	Date/Time		Received by: (signature)	Date/Time		Comments

Shipment prepared by: (signature) _____ Date/Time _____ Shipment method: _____
Received for Lab by: (signature) _____ Date/Time _____ Comments _____
_____
Receiving Laboratory: Please return original form after signing for receipt of samples. _____

FIG. 1 Example Layout of Record Form

8.3.3 *Plastic Bags*—Place the plastic bags as tightly as possible around the sample, squeezing out as much air as possible. They shall be 3 mil or thicker to prevent leakage.

8.3.4 *Glass-Plastic Jars*—If the jar lids are not rubber ringed or lined with new waxed paper seals, seal the lids with wax.

8.3.5 *Plastic Pails*—If the plastic pail lids are not air tight, seal them with wax or tape.

8.3.6 *Thin-Walled Tubes*:

8.3.6.1 *Expandable Packers*—The preferred method of sealing sample ends within tubes is with plastic, expandable packers.

8.3.6.2 *Wax With Disks*—For short-term sealing, paraffin wax is acceptable. For long term sealing (in excess of 3 days) use microcrystalline waxes or combine with up to 15 % beeswax or resin, for better adherence to the wall of the tube and to reduce shrinkage. Several thin layers of wax are preferred over one thick layer. The minimum final thickness shall be 0.4 in. (10 mm).

8.3.6.3 *End Caps*—Seal metal, rubber, or plastic end caps with tape. For long term storage (longer than 3 days), also dip them in wax, applying two or more layers of wax.

8.3.6.4 *Cheesecloth and Wax*—Use alternating layers (a minimum of two each) of cheesecloth and wax to seal each end of the tube and stabilize the sample.

NOTE 4—Where necessary, spacers or appropriate packing materials, or both, must be placed prior to sealing the tube ends to provide proper confinement. Packing material must be nonabsorbent and must maintain its properties to provide the same degree of continued sample support.

8.3.7 *Liners and Rings*—Refer to 8.3.6.3 or 8.3.6.4.

8.3.8 *Exposed Samples*:

8.3.8.1 *Cylindrical, Cubical or Other Samples Wrapped in Plastic*, such as polyethylene and polypropylene, or foil should be further protected with a minimum of three coats of wax.

8.3.8.2 *Cylindrical and Cube Samples Wrapped in Cheesecloth and Wax*, shall be sealed with a minimum of three layers of each, placed alternatively.

8.3.8.3 *Carton Samples (Frozen Food Cartons)*—Samples placed in these containers must be situated so that wax can be poured completely around the sample. The wax should fill the void between the sample and container wall. The wax should be sufficiently warm to flow, but not so hot that it penetrates the

pores of the soil. Generally, the samples should be wrapped in plastic or foil before being surrounded with wax.

8.4 *Group C*:

8.4.1 Preserve and seal these samples in containers as covered in 8.3. In addition, they must be protected against vibration and shock, and protected from extreme heat or cold.

8.4.2 Samples transported by the sampling or testing agency personnel on seats of automobiles and trucks need only be placed in cardboard boxes, or similar containers into which the sealed samples fit snugly, preventing bumping, rolling, dropping, etc.

8.4.3 For all other methods of transporting samples, including automobile trunk, bus, parcel services, truck, boat, air, etc., place the sealed samples in wood, metal, or other type of suitable shipping containers that provide cushioning or insulation, or both, for each sample and container. Avoid transporting by any agency whose handling of containers is suspect.

8.4.4 The cushioning material (sawdust, rubber, polystyrene, urethane foam, or material with similar resiliency) should completely encase each sample. The cushioning between the samples and walls of the shipping containers should have a minimum thickness of 1 in. (25 mm). A minimum thickness of 2 in. (50 mm) shall be provided on the container floor.

8.4.5 When required, the samples should be shipped in the same orientation in which they were sampled. Otherwise, special conditions shall be provided such as freezing, controlled drainage, or sufficient confinement, or a combination thereof, to maintain sample integrity.

8.5 *Group D*:

8.5.1 The requirements of 8.4 must be met, in addition to the following:

8.5.1.1 Samples should be handled in the same orientation in which they were sampled, including during transportation or shipping, with appropriate markings on the shipping container.

8.5.1.2 For all modes of private or commercial transportation, the loading, transporting and unloading of the shipment containers should be supervised as much as possible by a qualified person.

NOTE 5—A qualified person may be an engineer, geologist, soil scientist, soils technician or responsible person designated by the project manager.

8.6 *Shipping Containers* (see Figs. 2-7 for typical containers):

8.6.1 The following features should be included in the design of the shipping container for Groups C and D.

8.6.1.1 It should be reuseable,

8.6.1.2 It should be constructed so that the samples can be maintained, at all times, in the same position as when sampled or packed, or both,

8.6.1.3 It should include sufficient packing material to cushion or isolate, or both, the tubes from the adverse effect of vibration and shock, and

8.6.1.4 It should include sufficient insulating material to prevent freezing, sublimation and thawing, or undesirable temperature changes.

8.6.2 *Wood Shipping Containers*:

8.6.2.1 Wood is preferred over metal. Outdoor (marine) plywood having a thickness of ½ and ¾ in. (13 to 19 mm) may be used. The top (cover) should be hinged and latched, or fastened with screws.

8.6.2.2 The cushioning requirements are given in 8.4.4.

8.6.2.3 For protection against freezing or extreme temperature variation, the entire shipping container should be lined with a minimum insulation thickness of 2 in. (50 mm).

8.6.3 *Metal Shipping Containers*—The metal shipping containers must incorporate cushioning and insulation material to minimum thicknesses in accordance with 8.6.2, although slightly greater thicknesses would be appropriate. Alternatively, the cushion effect could be achieved with a spring suspension system, or any other means that would provide similar protection.

8.6.4 *Styrene Shipping Containers*—Bulk styrene with slots cut to the dimensions of the sample tube or liner. A protective outer box of plywood or reinforced cardboard is recommended.

8.6.5 *Other Containers*—Containers constructed with laminated fiberboard, plastic or reinforced cardboard outer walls, and properly lined, may also be used.

9. Reporting

9.1 The data obtained in the field shall be recorded and should include the following:

9.1.1 Job name or number, or both,

9.1.2 Sampling date(s),

9.1.3 Sample/boring number(s) and location(s),

9.1.4 Depth(s) or elevation(s), or both,

9.1.5 Sample orientation,

9.1.6 Groundwater observation, if any,

9.1.7 Method of sampling, and penetration test data, if applicable,

9.1.8 Sample dimensions,

9.1.9 Soil description (Practice D 2488),

9.1.10 Names of technician/crewman, engineer, project chief, etc.,

9.1.11 Comments regarding contaminated or possible contaminated samples,

9.1.12 If used, a copy of traceability records,

9.1.13 Weather conditions, and

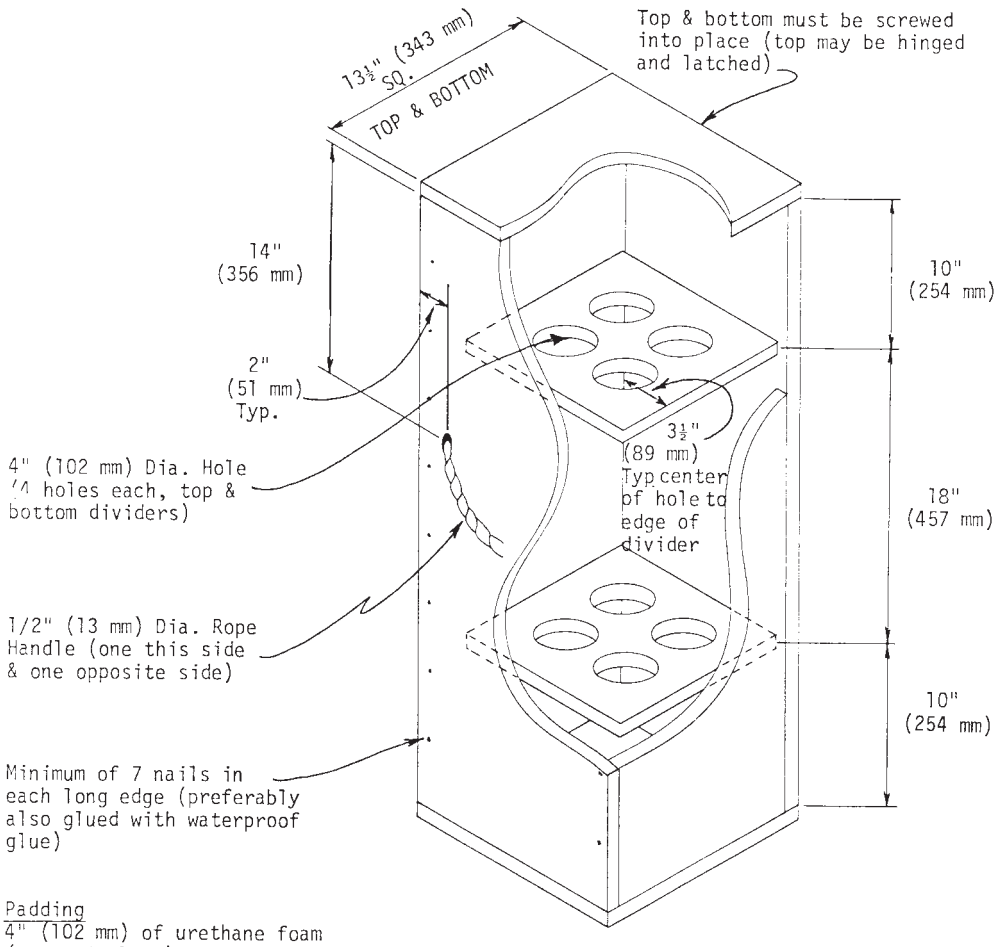
9.1.14 General remarks.

10. Precision and Bias

10.1 This practice provides qualitative and general information only. Therefore, a precision and bias statement is not applicable.

11. Keywords

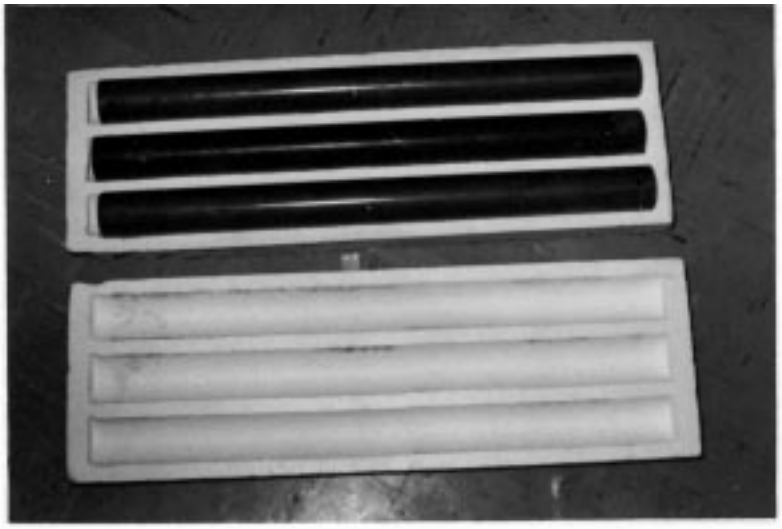
11.1 preservation; soil samples; transportation



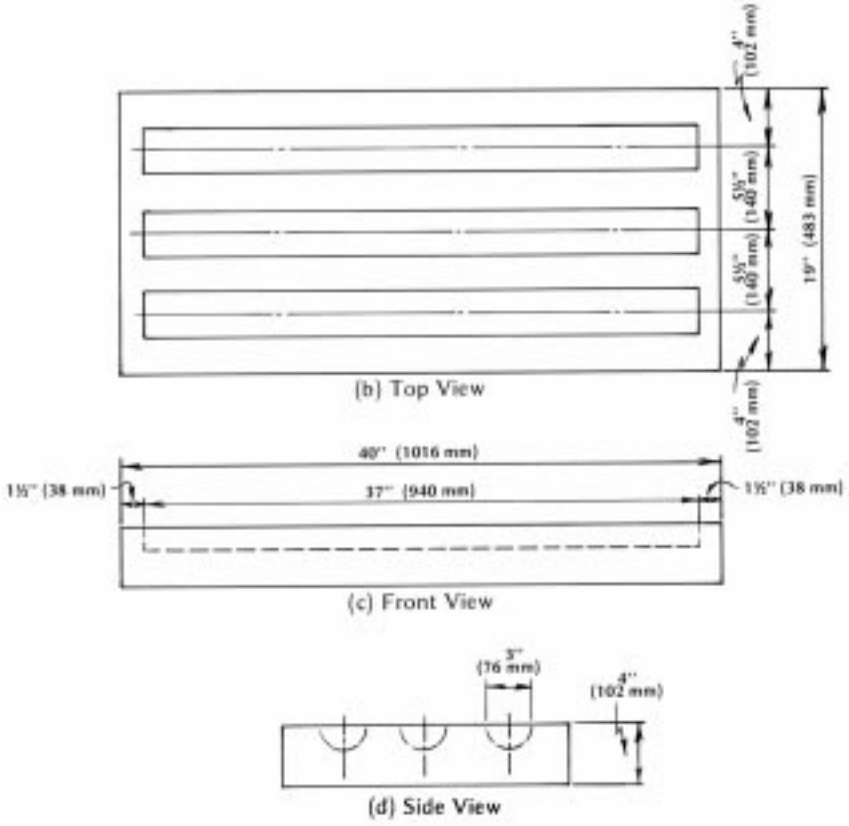
Padding
4" (102 mm) of urethane foam (or equivalent) in the bottom of the box. 1" (25 mm) around the tubes and on top.

Material
3/4" (19 mm) thick plywood (exterior grade)

FIG. 2 Shipping Box for 3-in. (76-mm) Thin-Walled Tubes



(a) Photo of Open Box For 5" (127 mm) Tubes



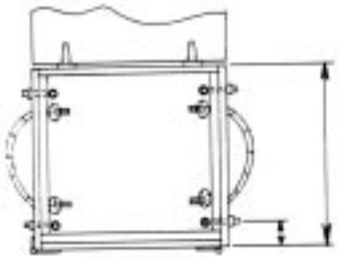
(b) Top View

(c) Front View

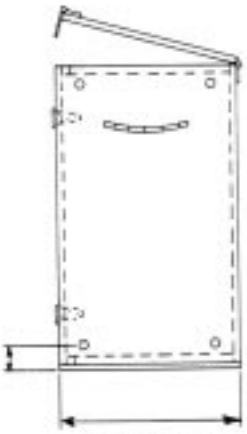
(d) Side View

NOTE 1—Top and bottom halves are identical.

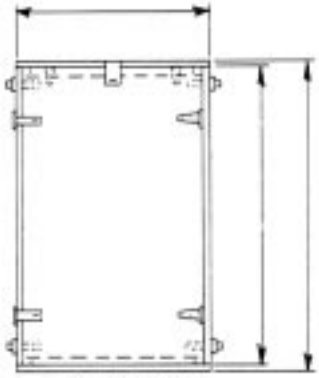
FIG. 3 Styrene Shipping Container for 3-in. (76-mm) Thin-Walled Tubes



A. TOP VIEW
(lid open)



C. SIDE VIEW



B. FRONT VIEW

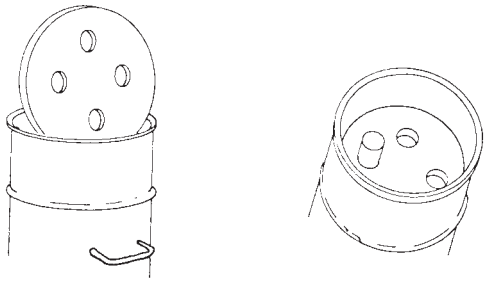
D. PHOTOGRAPH OF OPEN BOX

BILL OF MATERIALS

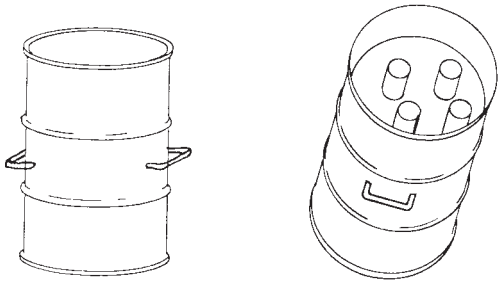
Item No.	Description of Item	Quantity
1	*Plywood*, 4 ft by 8 ft by ¾ in. (1220 mm by 2440 mm by 19.1 mm) exterior, Grade AC	1 Sheet
2	*Hinge*, strap, 4 in. (102 mm), heavy duty with screws	4 Each
3	*Hasp*, hinged, 4½ in. (114 mm), with screws	3 Each
4	*Screw, Wood, Steel, Flathead*, No. 10 by 1¾ in. (44.5 mm)	72 Each
5	*Bolt, Machine*, ⅜ in. (9.5 mm), with nut to secure hasps	3 Each
6	*Washer*, flat, ⅜ in. (9.5 mm)	3 Each
7	*Eye Bolt*, ½ by 2 in. (6.4 mm by 51 mm), zinc-plated, with nut	8 Each
8	*Washer*, flat, ¼ in. (6.4 mm), for hasp bolt	8 Each
9	*S Hooks*, 2 in. (51 mm), open, zinc-plated	8 Each
10	*Clamp*, adjustable, hose, steel, worm screw adjustment	2 Each
11	*Spring*, expansion	8 Each
12	*Adhesive*, woodworking	1 lb (454 g)
13	*Rope*, nylon, ½-in. (12.7-mm) diameter, solid braided	5 ft (1524 mm)
14	*Cushioning Material*, expanded polystyrene foam	10 ft^3 (0.28 m^3)

Notes– (a) All wooden components can be sawed from one sheet of plywood.
(b) This shipping box will accommodate approximately three 3-in. (76-mm) diameter tubes or two 5-in (127-mm) diameter tubes up to 30 in. (762 mm) in length. For longer tubes the inside height of the box must be a minimum of 6-in. (152 mm) greater than the length of the tube.
(c) All joints to be glued and fastened with screws.
(d) Stencil all sides as follows (See Views B and C).
TO PROTECT FROM FREEZING
(e) After suspending samples as indicated above, all void space must be filled with a suitable resilient packing material.

FIG. 4 Suspension System Container for Thin-Walled Tubes



(a) 55-gallon (0.21 m^3) oil barrels with sections of styrofoam insulation; welded handles on each side.



(b) Same as (a) showing barrel ready for shipment. Steel lids bolted on to provide tight seal.

NOTE 1—Two in. (51 mm) of foam rubber covers 2 in. of styrofoam at the base. One in. (25 mm) of foam rubber overlays the top of the tubes, and the remaining space to the lid is filled with styrofoam.

FIG. 5 Shipping Barrel for Thin-Walled Tubes

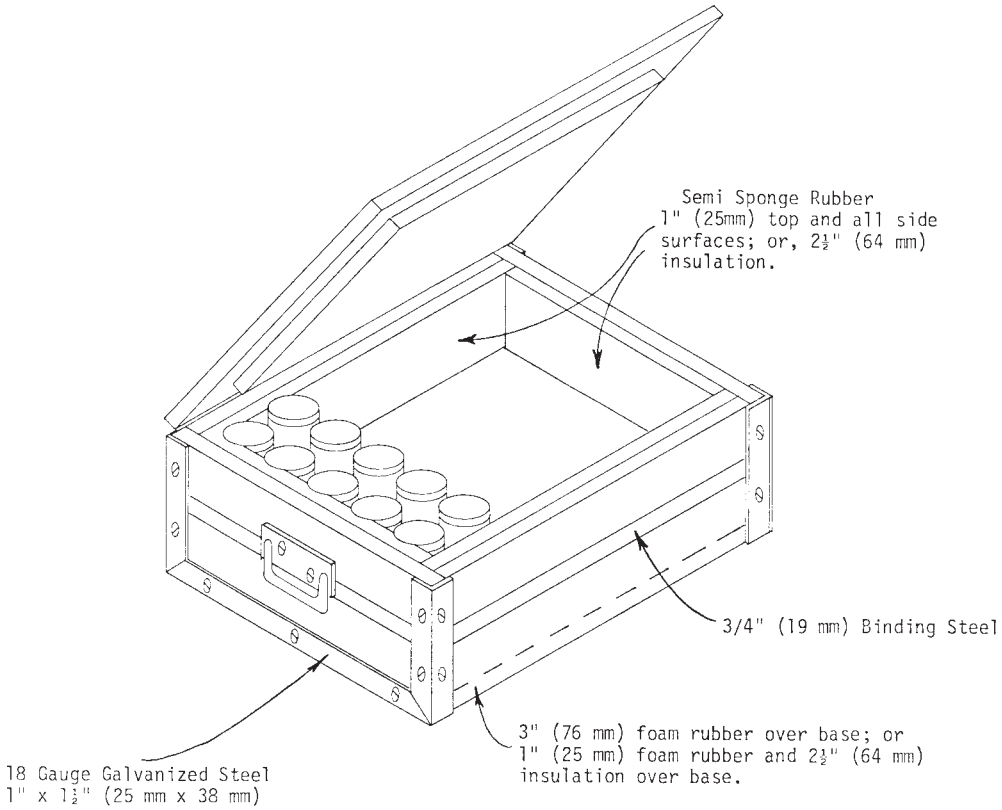
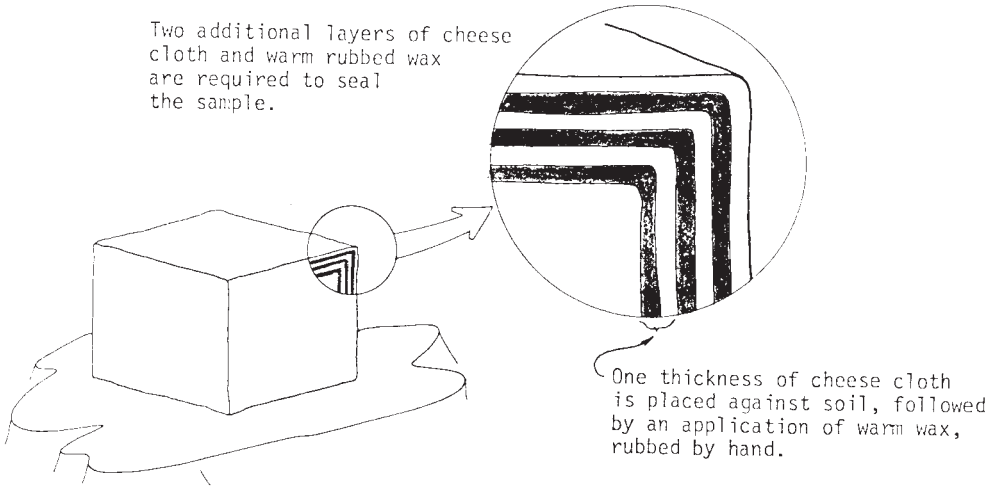
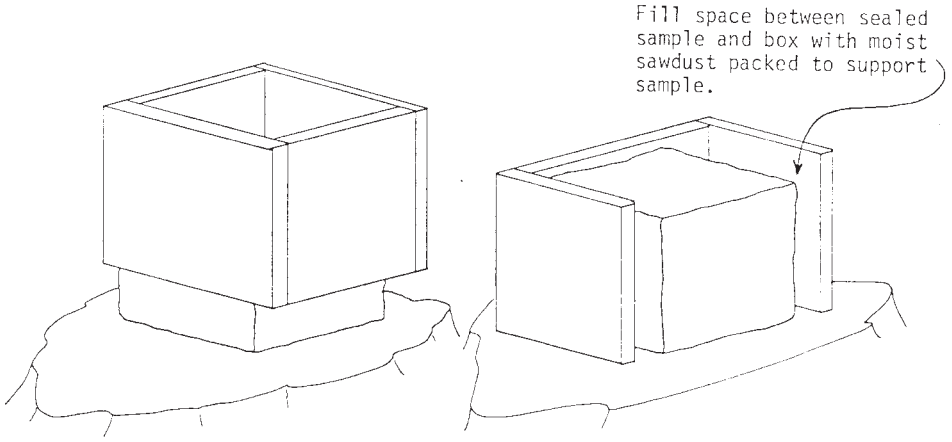


FIG. 6 Shipping Box for Liner (Short Tube) or Ring Samples



A. METHOD FOR SEALING HAND-CUT UNDISTURBED SAMPLES



B. ENCASE EASILY DISTURBED SAMPLES IN BOX PRIOR TO CUTTING

Box constructed with 1/2"-3/4" (13 - 19 mm) exterior plywood.

FIG. 7 Preparing and Packaging a Block Sample

SUMMARY OF CHANGES

This section identifies the location of changes to these practices that have been incorporated since the last issue. Committee D-18 has highlighted those changes that affect the technical interpretation or use of these practices.

(1) Section 11 was added since the last revision.

(2) Section 2 was expanded since the last revision.

APPENDIX B
FIELD DATA RECORDS

FDR #	FDR Description
1	Tailgate Safety Meeting Report
2	Summary of Daily Activities
3a	Sediment Core Log
3b	Sediment Grab Log
4a	Mist Net Coordinate Log
4b	Bird Blood Sampling Log
4c	Bird Banding Data Form
5	American Black Duck Sampling Log
6	Lobster Tail Sampling Log
7	Fish Sampling Log
8	Eel Sampling Log
9	Polychaete Sampling Log
10	Equipment Calibration and Tracking Log
11	Surface Water Sampling Log
12	Daily Float Plan
13	Geotechnical Core Log

TAILGATE SAFETY MEETING REPORT

WSP E&E 511 Congress Street, Suite 200, Portland, Maine, 04101

Site Name: Penobscot Estuary Remediaion **Project Number:**

Field Manager Name: **Date and Time:**

Safety Meeting Type: **Site Health and Safety Officer (HSO):**

Order of Business

Topics Discussed (check all that apply):

- ☐ Site History/Site Layout
- ☐ Scope of Work
- ☐ Personnel Responsibilities
- ☐ Medical Surveillance Requirements
- ☐ Training Requirements
- ☐ Safe Work Practices
- ☐ Logs, Reports, Recordkeeping
- ☐ Sanitation and Illumination
- ☐ Air Surveillance Type and Frequency
- ☐ Monitoring Instruments and Personal Monitoring
- ☐ Action Levels
- ☐ Accident Reporting Procedures
- ☐ Site Control (visitor access, buddy system, work zones, security, communications)
- ☐ Discussion of previous "near misses" including work crew suggestions to correct work practices to avoid similar occurrences
- ☐ Engineering Controls
- ☐ PPE Required/PPE Used
- ☐ Define PPE Levels, Donning, Doffing Procedures
- ☐ Physical Hazards and Controls (e.g., overhead utility lines)
- ☐ Decontamination Procedures for Personnel and Equipment
- ☐ General Emergency Procedures (e.g., locations of air horns and what 1 or 2 blasts indicate)
- ☐ Site/Regional Emergency Procedures (e.g. earthquake response, typhoon response, etc.)
- ☐ Medical Emergency Response Procedures (e.g., exposure control precautions, location of first aid kit, etc.)
- ☐ Hazardous Materials Spill Procedures
- ☐ Applicable SOPs (e.g., Hearing Conservation Program, Safe Driving, etc.)
- ☐ Injury/Illness Reporting Procedures
- ☐ Route to Hospital and Medical Care Provider Visit Guidelines
- ☐ Hazard Analysis of Work Tasks (chemical, physical, biological and energy health hazards and effects)

Safety suggestions by site workers:

Action taken on previous suggestions:

Injuries/accidents/personnel changes since previous meeting:

Observations of unsafe work practices/conditions that have developed since previous meeting:

Location of (or changes in the locations of) evacuation routes/safe refuge areas:

Additional comments:

Attendee signatures below indicate acknowledgment of the information and willingness to abide by the procedures discussed during this safety meeting.

Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Attendee Name: Company: Signature:
Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Attendee Name: Company: Signature:	Meeting Conducted by (Name and Title): Signature:	

SUMMARY OF DAILY ACTIVITIES

WSP E&E 511 Congress Street, Suite 200, Portland, Maine, 04101

Site Name:	Penobscot Estuary Remediation	**Project Number:**	Penobscot Estuary Remediation
Technician Name:		**Date and Time:**	
Personnel Onsite:			
Weather Conditions:			

Description of Daily Activities and Events:

List Samples Collected:

Deviation from Plans:

Visitors on Site:	**Important Telephone Calls / Photos Taken:**	**Technician Signature:**
		Technician Name (print)

QA/QC'd by: **QA/QC Date:**

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SEDIMENT CORE LOG

Penobscot Estuary Remediation

Owner:	Project No.:	Logger:
Sub:	WO:	Crew:
	Date: Time :	Vessel:
Coordinates: **Lat**	**Long**	Plan Volume:
Sampling Station:	Deploy No.	Sub-tidal Location?

Weather:	Winds:	Waters:	Traffic:	Water Temp:

Measured Water Depth [NAVD88]:	Core Penetration Length (ft.):
Correction to NAVD88 (+/- ft. from NAVD88):	Recovered Core Length (ft.):
Mudline (Corrected Depth) @ NAVD88:	Sample Length Retained (ft.):
Study Depth (-NAVD88):	Acceptable Core (80% recovery):
Required Penetration Length:	Core Volume Retained (gal.):

All Length Measurements are in Decimal Feet

Sample Interval (ft.)	Sample Id #	Description
Top		
Bottom		

Number of containers:				
Type of container:	bucket	liner bag	jar	other
Liner Type:		Vibracorer:		
		Push Corer		Slambar

Core Volumes	
Nominal core-barrel diameter	EST. Volume
4.0"	.50gal/ft
3.5"	.33gal/ft

Live Organisms present
Oil-Like Present
Odor Present
Debris Present

Photo Numbers

Comments

WSP E&E 511
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Maine, 04101

SEDIMENT GRAB LOG

Penobscot Estuary Remediation

Owner: USDC, District of Maine	Project No.: 3616166052	Plan Volume:	Logger:
Sub: AquaSurvey	WO:	Deploy No.:	Crew:
Tablet #:	Date:	Time :	Vessel:

Coordinates: **Lat** **Long**

Location ID (GPS Point Name): Sample Name: Sub-tidal Location? **Y** **N**

Weather:	Winds:	Waters:	Traffic:	Water Temp: ___ °F

Measured Water Depth (ft.):	Conditions:
Correction to NAVD88 (+/- ft. from NAVD88):	
Mudline (Corrected Depth) @ NAVD88:	
Study Depth (-NAVD88):	

All Recovered Quantities are in Percent

Deployment #	Recovery	Description	Sample ID

Number of containers and estimated amount:					Grab Equipment
					Sampler Type:
Type of container:	5-gal Bucket	2-gal Bucket	1-gal Bag	Other	Capacity:

Live Organisms Present	Y	N
Oil-Like Present	Y	N
Odor Present	Y	N
Debris Present	Y	N

Photo Numbers

Comments

	Initials	Date
Prepared by:		
Checked by:		

WSP E&E 511
Congress Street,
Suite 200,
Portland, Maine,
04101

MIST NET LOG
GPS COORDINATES

Project Name: Penobscot Estuary Remediation **Project Number:**

Date: **Location ID:**

Collectors: **Weather:**

Net Number	Time Opened	SPC X Coordinate	SPC Y Coordinate	Time Closed

Sampler Signature:

Reviewed by:

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

Bird Banding Data Form

Project Name: Penobscot Estuary Remediation

Project Number:

Starting Band Number:

Banders name(s) and initials:

Band Size:

Page: 1 of 2

Band Number (9 digits - if band has 8 digits, place leading 0 at beginning)	Alpha Code (4 digits)	Date MMDDYY	Location ID	Time (24hr)	Age[1]	How Aged[2]	Sex[3]	How Sexed[4]	Fat[5]	Body Molt[6]	Wing Chord (mm)	Tail Length (mm)	Weight (g)	Bander Initials	Net #	Notes

NOTES:

AGE[1]	HOW AGED[2]	SEX[3]	HOW SEXED[4]	FAT[5]	BODY MOLT[6]	SKULL[7]	BR PATCH[8]	CLOACAL PROTUBERANCE[9]	FF MOLT[10]	FF WEAR[11]	CONDITION[12]
1 = AHY	1 = Adult Plumage	M = Male	1 = Adult Plumage	0 = None	0 = None	0 = None	0 = None	0 = None	N = None	0 = None	M = Malformed
2 = HY	2 = Juvenal Plumage	F = Female	2 = Juvenal Plumage	1 = Trace	1 = Trace	1 = Trace	1 = Smooth	1 = Small	A = Adventitous	1 = Slight	O = Old (healed) Injury
4 = Local	A = Nestling in nest, no flight feathers	U = Unknown	3 = Eye Color	2 = Light	2 = Light	2 = < 1/3	2 = Vascular	2 = Medium	S = Symmetric	2 = Light	I = Illness/Disease
5 = SY	B = Nestling in nest, flight feathers in pin	6 = Male sexed subsequently	B = Brood Patch	3 = half	3 = Medium	3 = Half	3 = Heavy	3 = Large	J = Juv Growth	3 = Moderate	S = Stress/Shock
6 = ASY	C = Nestling fledged, incapable of flight	7 = Female sexed subsequently	C = Cloacal Protuberance	4 = Filled	4 = Heavy	4 = > 2/3	4 = Wrinkled			4 = Heavy	E = Eye Injury
7 = TY	E = Eye color		E = Egg in Oviduct	5 = Bulging		5 = Almost Complete	5 = Molting			5 = Excessive	T = Tongue Injury
8 = ATY	F = Flight Feather Wear		W = Wing Chord	6 = Greatly Bulging		6 = Complete					W = Wing Injury
0 = Unknown	S = Skull		T = Tail Length	7 = Very Excessive		7 = Invisible					B = Body Injury
	L = Molt Limits Present		Y = Culmen								L = Leg Injury
	N = Molt Limits Absent		Z = Multiple Measurements								P = Predation
	P = Primary covert shape and/or primary feather shape/wear		X = Not attempted								D = Dead
	T = Tail Shape and Wear										
	X = Not Attempted										

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Maine, 04101

Bird Banding Data Form

Project Name: Penobscot Estuary Remediation

Project Number:

Starting Band Number:

Banders name(s) and initials:

Band Size:

Page: 2 of 2

Band Number (9 digits - if band has 8 digits, place leading 0 at beginning)	Alpha Code (4 digits)	Date MMDDYY	Location ID	Time (24hr)	Skull[7]	Brood Patch[8]	Cloacal Prot[9]	Crown Patch	Culmen Length	Culmen Width	FF Molt[10]	FF Wear[11]	Condition[12]	Bander Initials	Net #	Notes

NOTES:

AGE[1]	HOW AGED[2]	SEX[3]	HOW SEXED[4]	FAT[5]	BODY MOLT[6]	SKULL[7]	BR PATCH[8]	CLOACAL PROTUBERANCE[9]	FF MOLT[10]	FF WEAR[11]	CONDITION[12]
1 = AHY	1 = Adult Plumage	M = Male	1 = Adult Plumage	0 = None	0 = None	0 = None	0 = None	0 = None	N = None	0 = None	M = Malformed
2 = HY	2 = Juvenal Plumage	F = Female	2 = Juvenal Plumage	1 = Trace	1 = Trace	1 = Trace	1 = Smooth	1 = Small	A = Adventitous	1 = Slight	O = Old (healed) Injury
4 = Local	A = Nestling in nest, no flight feathers	U = Unknown	3 = Eye Color	2 = Light	2 = Light	2 = < 1/3	2 = Vascular	2 = Medium	S = Symmetric	2 = Light	I = Illness/Disease
5 = SY	B = Nestling in nest, flight feathers in pin	6 = Male sexed subsequently	B = Brood Patch	3 = half	3 = Medium	3 = Half	3 = Heavy	3 = Large	J = Juv Growth	3 = Moderate	S = Stress/Shock
6 = ASY	C = Nestling fledged, incapable of flight	7 = Female sexed subsequently	C = Cloacal Protuberance	4 = Filled	4 = Heavy	4 = > 2/3	4 = Wrinkled			4 = Heavy	E = Eye Injury
7 = TY	E = Eye color		E = Egg in Oviduct	5 = Bulging		5 = Almost Complete	5 = Molting			5 = Excessive	T = Tongue Injury
8 = ATY	F = Flight Feather Wear		W = Wing Chord	6 = Greatly Bulging		6 = Complete					W = Wing Injury
0 = Unknown	S = Skull		T = Tail Length	7 = Very Excessive		7 = Invisible					B = Body Injury
	L = Molt Limits Present		Y = Culmen								L = Leg Injury
	N = Molt Limits Absent		Z = Multiple Measurements								P = Predation
	P = Primary covert shape and/or primary feather shape/wear		X = Not attempted								D = Dead
	T = Tail Shape and Wear										
	X = Not Attempted										

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SAMPLE COLLECTION LOG
BIRD BLOOD

Project Name: Penobscot Estuary Remediation
Date:
Collectors:
Media: Blood (BL)
Species: Nelson's Sparrow (NSS)

Project Number:
Location ID:
Lat/Long:
Weather:
Collection Method: Mist Net

Sample ID	Time	Band Number	4 Digit Alpha Species Code	Weight (grams)	Number of Hg Capillary Tubes	Mist Net Number	Bander Initials	Notes
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								

Requested Analyses:
Analytes:
Methods:
Container:

Additional Questions:
Additional QC Collected:
QC Sample Types:
Were samples frozen?

If yes, MS sample ID: _ _ _BL_MS
If yes, MSD sample ID: _ _ _BL_MD

Sediment/Soil Sample

Sample ID	Time	Odor	Color	Type	Notes
_ _SED_03					

Requested Analyses:
Analytes:
Methods:
Container: 4 oz AG

Additional Questions:
Additional QC Collected:
QC Sample Types:

If yes, Duplicate ID: _ _SED_03_DUP
If yes, MS sample ID: _ _SED_03_MS
If yes, MSD sample ID: _ _SED_03_MD

Sampler Signature:

Reviewed by:
Date:

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SAMPLE COLLECTION LOG
BIRD BLOOD

Project Name: Penobscot Estuary Remediation
Date:
Collectors:
Media: Blood (BL)
Species: Red-Winged Blackbird (RWB)

Project Number:
Location ID:
Lat/Long:
Weather:
Collection Method:

Sample ID	Time	Band Number	4 Digit Alpha Species Code	Weight (grams)	Number of Hg Capillary Tubes	Mist Net Number	Bander Initials	Notes
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								
_ _								

Requested Analyses:

Analytes:
Methods:
Container:

Additional Questions:

Additional QC Collected:
QC Sample Types:
Were samples frozen?

If yes, MS sample ID: _ _ _BL_MS
If yes, MSD sample ID: _ _ _BL_MD

Sediment/Soil Sample					
Sample ID	**Time**	**Odor**	**Color**	**Type**	**Notes**
_ _SED_03					

Requested Analyses:

Analytes:
Methods:
Container: 4 oz AG

Additional Questions:

Additional QC Collected:
QC Sample Types:

If yes, Duplicate ID: _ _SED_03_DUP
If yes, MS sample ID: _ _SED_03_MS
If yes, MSD sample ID: _ _SED_03_MD

Sampler Signature:

Reviewed by:
Date:

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SAMPLE COLLECTION LOG
AMERICAN BLACK DUCK BLOOD

Project Name: Penboscot Estuary Remediation
Project Number:
Date:
Location ID:
Collectors:
Collection Method (Equip):

Sample ID	Time	Band Number	Weight (grams)	Sex	Age	Capillary Tubes	Notes

Requested Analyses

Analytes:	Methods:	Container:	Preservative
Total Hg	1631e	70 uL Capillary Tubes	Frozen

Additional Questions:

Preservative at Collection: Wet Ice Dry Ice

QC Collected: MS/MSD None MS/MSD Source:

Notes:

Duck sampling was conducted according to the following SOPs included in the QAPP: SOP S-10 American Black Duck Sampling

Technician name (Print):
Technician Signature:
QA/QC by:
Date:

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SAMPLE COLLECTION LOG
LOBSTER TAILS

Project Name: Penobscot Estuary Remediation
Date:
Collectors:
Media: Tails (TA)
Species:

Project Number:
Location ID:
Lat/Long:
Weather:
Collection Method: Commercial Lobsterman

Sample ID		Time	Length (cm)	Weight (grams)	Sex F/M	Legal/ Sublegal	Photo Number	Notes: (deformities, lesions, etc.)
_	_LOB_TA_01							
_	_LOB_TA_02							
_	_LOB_TA_03							
_	_LOB_TA_04							
_	_LOB_TA_05							
_	_LOB_TA_06							
_	_LOB_TA_07							
_	_LOB_TA_08							
_	_LOB_TA_09							
_	_LOB_TA_10							
_	_LOB_TA_11							
_	_LOB_TA_12							
_	_LOB_TA_13							
_	_LOB_TA_14							
_	_LOB_TA_15							
_	_LOB_TA_16							
_	_LOB_TA_17							
_	_LOB_TA_18							
_	_LOB_TA_19							
_	_LOB_TA_20							

Requested Analyses:

Analytes:	Total Hg
Methods:	1631e
Container:	

Additional Questions:

MS/MSD Collected: yes no — If yes, MS sample ID: _ _LOB_TA_MS
If yes, MSD sample ID: _ _LOB_TA_MD

General observations of habitat, abundance and diversity:

Were samples frozen? yes no

Sediment/Soil Sample

Sample ID		Time	Odor	Color	Type	Notes
_	_LOB_SED_03					

Requested Analyses:

Analytes:	Total Hg	Total MeHg	TOC
Methods:	1631e	1630	Lloyd-Khan
Container:	4 oz AG	4 oz AG	4 oz AG

Additional Questions:

Duplicate Collected: yes no — If yes, Duplicate ID: _ _LOB_SED_03_DUP
MS/MSD Collected: yes no — If yes, MS sample ID: _ _LOB_SED_03_MS
If yes, MSD sample ID: _ _LOB_SED_03_MD

Sampler Signature: _____

Reviewed by: _____
Date: _____

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SAMPLE COLLECTION LOG
FISH WHOLE BODY

Project Name: Penobscot Estuary Remediation
Project Number:
Date:
Location ID:
Collectors:
Lat/Long:
Media: Whole Body (WB)
Weather:
Species:
Collection Method:

Sample ID	Time	Length (mm)	Weight (grams)	Photo Number	Notes
_ _ _WB_01					
_ _ _WB_02					
_ _ _WB_03					
_ _ _WB_04					
_ _ _WB_05					
_ _ _WB_06					
_ _ _WB_07					
_ _ _WB_08					
_ _ _WB_09					
_ _ _WB_10					
_ _ _WB_11					
_ _ _WB_12					
_ _ _WB_13					
_ _ _WB_14					
_ _ _WB_15					
_ _ _WB_16					
_ _ _WB_17					
_ _ _WB_18					
_ _ _WB_19					
_ _ _WB_20					

Requested Analyses:

Analytes: Total Hg
Methods: 1631e
Container:

Additional Questions:

MS/MSD Collected: yes no If yes, MS sample ID: _ _ _WB_MS
If yes, MSD sample ID: _ _ _WB_MD

General observations of habitat, abundance and diversity:

Were samples frozen? yes no

Sediment/Soil Sample

Sample ID	Time	Odor	Color	Type	Notes
_ _ _SED_03					

Requested Analyses:

Analytes:	Total Hg	Total MeHg	TOC
Methods:	1631e	1630	Lloyd-Khan
Container:	4 oz AG	4 oz AG	4 oz AG

Additional Questions:

Duplicate Collected: yes no If yes, Duplicate ID: _ _ _SED_03_DUP
MS/MSD Collected: yes no If yes, MS sample ID: _ _ _SED_03_MS
If yes, MSD sample ID: _ _ _SED_03_MD

Sampler Signature:

Reviewed by:
Date:

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SAMPLE COLLECTION LOG
EEL WHOLE BODY

Project Name:	Penobscot Estuary Remediation	**Project Number:**	
Date:		**Location ID:**	
Collectors:		**Lat/Long:**	
Media:	Whole Body (WB)	**Weather:**	
Species:		**Collection Method:**	Eel Traps - Salted Herring Bait

Sample ID		Time	Length (mm)	Weight (grams)	Sex F/M	Photo Number	Notes
_	_EEL_WB_01						
_	_EEL_WB_02						
_	_EEL_WB_03						
_	_EEL_WB_04						
_	_EEL_WB_05						
_	_EEL_WB_06						
_	_EEL_WB_07						
_	_EEL_WB_08						
_	_EEL_WB_09						
_	_EEL_WB_10						
_	_EEL_WB_11						
_	_EEL_WB_12						
_	_EEL_WB_13						
_	_EEL_WB_14						
_	_EEL_WB_15						
_	_EEL_WB_16						
_	_EEL_WB_17						
_	_EEL_WB_18						
_	_EEL_WB_19						
_	_EEL_WB_20						

Requested Analyses:

Analytes:	Total Hg
Methods:	1631e
Container:	

Additional Questions:

MS/MSD Collected:	yes	no	If yes, MS sample ID:	_	_EEL_WB_MS
			If yes, MSD sample ID:	_	_EEL_WB_MD

General observations of habitat, abundance and diversity:

Otolith?	yes	no
Were samples frozen?	yes	no

Sediment/Soil Sample

Sample ID		Time	Odor	Color	Type	Notes
_	_EEL_SED_03					

Requested Analyses:

Analytes:	Total Hg	Total MeHg	TOC
Methods:	1631e	1630	Lloyd-Khan
Container:	4 oz AG	4 oz AG	4 oz AG

Additional Questions:

Duplicate Collected:	yes	no	If yes, Duplicate ID:	_	_EEL_SED_03_DUP
MS/MSD Collected:	yes	no	If yes, MS sample ID:	_	_EEL_SED_03_MS
			If yes, MSD sample ID:	_	_EEL_SED_03_MD

Sampler Signature: _____

Reviewed by: _____
Date: _____

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

SAMPLE COLLECTION LOG
POLYCHAETES WHOLE BODY

Project Name: Penobscot Estuary Remediation
Date:
Collectors:
Media: Whole Body (WB)
Species:
Project Number:
Location ID:
Lat/Long:
Weather:
Collection Method: Shovel/Clam Rake

Sample ID	Time	Number of Individuals per Composite	Weight of Composite (grams)	Photo Number	Notes
_ _POL_WB_01					
_ _POL_WB_02					
_ _POL_WB_03					
_ _POL_WB_04					
_ _POL_WB_05					
_ _POL_WB_06					
_ _POL_WB_07					
_ _POL_WB_08					
_ _POL_WB_09					
_ _POL_WB_10					
_ _POL_WB_11					
_ _POL_WB_12					
_ _POL_WB_13					
_ _POL_WB_14					
_ _POL_WB_15					
_ _POL_WB_16					
_ _POL_WB_17					
_ _POL_WB_18					
_ _POL_WB_19					
_ _POL_WB_20					

Requested Analyses:

Analytes:	Total Hg
Methods:	1631e
Container:	

Additional Questions:

MS/MSD Collected:	yes	no	If yes, MS sample ID:	_	_POL_WB_MS
			If yes, MSD sample ID:	_	_POL_WB_MD
Were samples frozen?	yes	no			

Sediment/Soil Sample

Sample ID	Time	Odor	Color	Type	Notes
_ _POL_SED_03					

Requested Analyses:

Analytes:	Total Hg	Total MeHg	TOC
Methods:	1631e	1630	Lloyd-Khan
Container:	4 oz AG	4 oz AG	4 oz AG

Additional Questions:

Duplicate Collected:	yes	no	If yes, Duplicate ID:	_	_POL_SED_03_DUP
MS/MSD Collected:	yes	no	If yes, MS sample ID:	_	_POL_SED_03_MS
			If yes, MSD sample ID:	_	_POL_SED_03_MD

Sampler Signature: _____

Reviewed by: _____
Date: _____

EQUIPMENT CALIBRATION AND TRACKING LOG

WSP E&E 511 Congress Street Suite 200 Portland, Maine, 04101

Site Name: Penobscot Estuary Remediaion **Project Number:** **Date:**

Weather (AM): **Calibration Start Time:** **Calibration End Time:**

Weather (PM): **Sample Technician:**

Morning (AM) Calibration

Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%, mg/L)	Salinity (ppt)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments

Afternoon (PM) Calibration Check

Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%, mg/L)	Salinity (ppt)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
		NA							
		NA							

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)		
pH (7)		
pH (10)		

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance		
D.O.		
Salinity		
ORP		

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10		
20		
100		
800		

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter:		
Turbidity Meter:		
GPS:		

Calibrated Within Acceptance Criteria (Y/N):

If No, Provide Explanation:

GPS DATUM:

GPS Map Projection:

GPS Units/Format:

Notes:

Technician Signature:

Technician Name (print)**:**

QA/QC'd by: **QA/QC Date:**

SURFACE WATER SAMPLING RECORD

WSP E & E
511 Congress Street
Suite 200
Portland, Maine 04101

PROJECT NAME	SAMPLE LOCATION	DATE
Penobscot Estuary Remediaion		
PROJECT NUMBER	**START TIME**	**END TIME**
SAMPLE ID	**SAMPLE TIME**	**PAGE**
		of
Lat.	**Long.**	

SURFACE WATER DATA

WATER DEPTH AT SAMPLE LOCATION _____ FT.

DEPTH OF SAMPLE BELOW WATER SURFACE _____ FT.

SAMPLING FLOW RATE _____ ML/MIN

TIDE DIRECTION [ ] INCOMING [ ] OUTGOING

FIELD SKETCH SHOWN/AT [ ] YES [ ] NO

TOTAL PURGE VOLUME _____ ML

WATER QUALITY PARAMETERS:

TEMPERATURE		°C
SPEC. COND.		mS/cm
PH		pH Units
ORP		mV
TURBIDITY		NTUs
DO		mg/L
SALINITY		ppt

EQUIPMENT USED:

[ ]	BEAKER	
[ ]	BOTTLE	
[ ]	PACS BOMB	
[X]	PUMP	Peristaltic Pump (Geopump)
[X]	FILTER	DOC - .45 micron
[X]	5 ft of lab precleaned 1/4 " Teflon Tubing	
[X]	3 ft of lab precleaned Masterflex Tubing	

TYPE OF SURFACE WATER:

[ ]	STREAM
[X]	RIVER
[ ]	LAKE
[ ]	POND
[ ]	SEEP
[ ]	

[ ] FIELD DUPLICATE COLLECTED
DUP. ID _____
TIME _____

[ ] MATRIX SPIKE COLLECTED
MS ID _____
TIME _____

[ ] MATRIX SPIKE DUPLICATE COLLECTED
MSD ID _____
TIME _____

DECON FLUIDS USED

[ ]	ALL USED
[ ]	LIQUINOX/DI H_2O SOLUTION
[ ]	DEIONIZED WATER
[ ]	POTABLE WATER
[ ]	NITRIC ACID
[ ]	HEXANE
[ ]	ETHYL ALCOHOL
[X]	N/A

SAMPLING EQUIPMENT

WATER QUALITY METE MODEL NO. YSI 556 MPS UNIT ID NO. _____
TURBIDITY METER MODEL NO. Hach 2100 _ UNIT ID NO. _____

ANALYTICAL PARAMETERS

		PARAMETER	METHOD NUMBER	PRESERVATION METHOD	VOLUME REQUIRED	SAMPLE COLLECTED
X		Total Mercury	1631e	4°c	250 ml PETG	
X	Filter	Dissolved Mercury	1631e	4°c	250 ml PETG	
X		Total Methyl Mercury	1630	H_2SO_4/4°c	250 ml Borosilicate Glass	
X	Filter	Dissolved Methyl Mercury	1630	H_2SO_4/4°c	250 ml Borosilicate Glass	
X	Filter	DOC	SW-846/9060A	H_2SO_4/4°c	100 ml glass	
X		TOC	SW-846/9060A	H_2SO_4/4°c	100 ml glass	
X		TSS	2450D	4°c	1 L Plastic	
X		SSC	ASTM 3977	4°c	1 L Plastic	

NOTES/SKETCH

Note:
DOC = field fIltered
PETG = Polyethelene Terephthalate Glycol
dissolved mercury and dissolved methyl mercury will be lab filtered to avoid cross contamination in the field.

Sampler Signature: Print Name:

Checked By: Date:

WSP E&E 511
Congress Street,
Suite 200, Portland,
Maine, 04101

DAILY FLOAT PLAN

General Information			
Vessel Operator:		Phone:	
Vessel Name:		Registration Number:	

Trip Description	
Date and Time of Departure:	
Departing From:	
Departing To:	
Estimated Time of Arrival:	
In NO Case Later Than:	

Description of Vessel			
Type:		Make:	
Trim Color:		Hull Color:	
Most Distinguishing/ Identifiable Feature:			

Rafts/Dinghies					
Number:		Size:		Color:	

Radio			
Type:		Frequencies Monitored:	

Number of Persons on Board		
Name	Age	Address and Phone Number

Engine Type			
Horse Power:		Normal Fuel Supply (days):	

Survival Equipment on Board
(Check as appropriate)

Life Jackets		Flares		Smoke Signals		Sampler Signature:
Medical Kit		Marine Radio		Other:		
Anchor		GPS				

Depth (ft)	Casing Blows/ft	Sample No.	Sample Depth (ft)	Blows / 6"	Recovery (ft)	SOIL DESCRIPTION	USCS	Piez. Data	PID

Sample & Test Types: S:split spoon **R**:rock core **C**:2" dia. thin wall tube **U**: 3" thin wall tube **V**: field vane **TV**: torvane **PP**: pocket pen.

SOIL DESCRIPTION: Color, predominant soil type and gradation, secondary soil proportions and gradation, structure (stratified, varved, cemented/bonded, etc.), sand/gravel shape (angular, rounded, subangular, subrounded), consistency or density, plasticity, moisture. Other observations (debris, organics, refusal/drilling difficulty, wash water/mud start depth, color variations [mottling, etc.]).

Water Level Readings					Project Information		Equipment	ID	Hammer/Drop
		Depth of (ft)			Client:		Casing / Augers:		
Date	Time	Casing	Hole	Water	Project:		Split spoon:		
					Project No.:		SPT Info:		
					Location:		Core Barrel ID:		
					Contractor:		Core Barrel Type:		
					Driller:	Drill Rig:	Other:		
Ground Surface Elev. (ft)					WSP E		BORING _____		
Date Boring Completed:							page # 1		
Boring Logged By:									

Depth (ft)	Casing Blows/ft	Sample No.	Sample Depth (ft)	Blows / 6"	Recovery (ft)	SOIL DESCRIPTION	USCS	Piez. Data	PID

Sample & Test Types S:split spoon **R**:rock core **C**:2" dia. thin wall tube **U**: 3" thin wall tube **V**: field vane **TV**: torvane **PP**: pocket pen.

SOIL DESCRIPTION: Color, predominant soil type and gradation, secondary soil proportions and gradation, structure (stratified, varved, cemented/bonded, etc.), sand/gravel shape (angular, rounded, subangular, subrounded), consistency or density, plasticity, moisture. Other observations (debris, organics, refusal/drilling difficulty, wash water/mud start depth, color variations [mottling, etc.]).

Ground Surface Elev. (ft)	
Date Boring Completed:	
Boring Logged By:	

BORING _____

page