APPENDIX C
STANDARD OPERATING PROCEDURES

SOP S-4: Surface Water Sampling
SOP S-5: Clean Hands Dirty Hands- Surface Water Sampling
SOP S-6: Sediment Collection
SOP S-7: Soil Description and Identification
SOP S-7A: Penobscot Sediment Description and Identification
SOP S-12: Fish Sampling Procedures
SOP S-13: Fish sample +processing and Handling Procedures
SOP S-14: Shellfish Sampling
SOP S-23: Sediment Sample Processing – Extrusion & Sampling

SOP No. S-4

AMEC FOSTER WHEELER 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. Non-phosphate detergent wash (e.g. Liquinox)
2. Tap water 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.

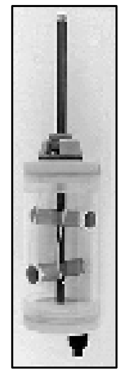
For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. When possible, collect samples in a downstream to upstream direction. Avoid disturbing the substrate.

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.

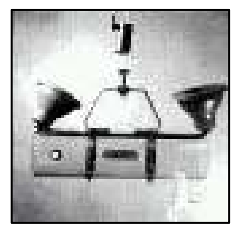
Weighted Bottle/Kemmerer/Van Dorn Sampler

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:



Kemmerer 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

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.

Dip Sampler

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

AMEC FOSTER WHEELER 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 ^{o}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.

Methyl Mercury

The appropriate preservation for methyl mercury 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.

<u>Freshwaters</u>

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

<u>Seawaters</u>

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

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, 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
Wood	Wood Environment & Infrastructure Solutions, Inc. (formerly Amec Foster Wheeler)

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 Wood, 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 Wood 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 – Alconox or equivalent detergent 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 Wood’s subcontractor with assistance from Wood field staff.

Prior to leaving the dock, Wood 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 Wood’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 and detailed in the QAPP 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

Wood, 2020a. Field Sampling Plan; Penobscot River Phase III Engineering Study – Penobscot River, Maine. July 2016.

Wood, 2020b. Quality Assurance Project Plan; Penobscot River Phase III Engineering Study – Penobscot River, Maine. July 2016.

- END OF PROCEDURE -

SOP No. S-7

AMEC FOSTER WHEELER 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

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (>50% RETAINED on the No. 200 sieve)	GRAVELS (>50% of coarse fraction RETAINED on the No. 4 sieve)	CLEAN GRAVELS (<5% fines)	GW	Well-graded gravels or gravel-sand mixtures; trace or no fines.
			GP	Poorly-graded gravels or gravel-sand mixtures; trace or no fines.
		GRAVEL WITH FINES (>12% fines)	GM	Silty gravels or gravel-sand-silt mixtures.
			GC	Clayey gravels or gravel-sand-clay mixtures.
	SANDS (50% or more of coarse fraction PASSES the No. 4 sieve size)	CLEAN SANDS (<5% fines)	SW	Well-graded sands or sand-gravel mixtures; trace or no fines.
			SP	Poorly-graded sands or sand-gravel mixtures; trace or no fines.
		SAND WITH FINES (>12% fines)	SM	Silty sands or sand-gravel-silt mixtures.
			SC	Clayey sands or sand-gravel-clay mixtures.

TERMS DESCRIBING SOILS (excludes particles > 3", organics, debris, etc.)	**TERMS DESCRIBING MATERIALS** i.e. particles > 3", organics, debris, etc.)
Trace: Particles present, but < 5%	Occasional: Particles present, but < 10%
Few: 5% - 10%	Some: 10% to 25%
Little: 10% - 25%	Frequent: >25%
Some: 25% - 45%	

TERMS DESCRIBING MOISTURE	**TERMS DESCRIBING STRUCTURE**
Dry: Absence of moisture; dusty	Layer: > 3" thick
Moist: Damp, but no visible water	Seam: 1/16" to 3" thick
Wet: Visible/free water	Parting: < 1/16" thick

CORRELATION OF STANDARD PENETRATION TEST (SPT) WITH RELATIVE DENSITY AND CONSISTENCY

GRAVEL, SAND & SILT (NON-PLASTIC)

Relative Density	N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Compact	11 - 30
Dense	31 - 50
Very Dense	> 51

SILT (PLASTIC) & CLAY

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.
		CL	Inorganic lean clays. Low to medium plasticity. PI >7 and plots on or above "A" line.
		OL	Organic silts, clays and silty clays. Low to medium plasticity.
	SILTS AND CLAYS (liquid limit ≥50)	MH	Inorganic elastic silt. PI line plots on or above "A" line.
		CH	Inorganic fat clay. High plasticity. PI line plots on or above "A" line.
		OH	Organic silts and clays. High plasticity.
	HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils. Decomposed vegetable tissue. Fibrous to amorphous texture.

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
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort.
Firm	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>31	over 4000	Indented by thumbnail with difficulty

ROCK QUALITY DESIGNATION (RQD)

RQD = <u>sum of the lengths of intact pieces of core* >100mm (0.3ft.)</u>
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:		
Olive brown, fine to medium sand, little silt, trace angular gravel, SM, medium dense, moist: FILL	-spacing (very close - <5 cm, close - 5-30 cm, mod.close 30-100 cm, wide - 1-3 m, very wide >3 m)	
- 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-7A

AMEC FOSTER WHEELER ENVIRONMENT & INFRASTRUCTURE, INC.

STANDARD OPERATING PROCEDURE

PROCEDURE FOR PHYSICAL DESCRIPTIONS AND IDENTIFICATION OF PENOBSCOT SEDIMENT CHARACTERISTICS

PROCEDURE FOR PHYSICAL DESCRIPTIONS AND IDENTIFICATION OF PENOBSCOT SEDIMENT CHARACTERISTICS

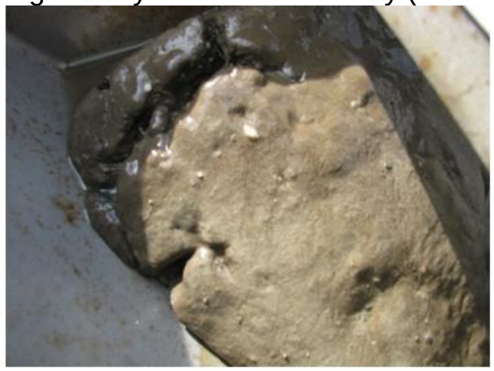
SCOPE AND PURPOSE

The purpose of this SOP is to provide a field guide for the uniform completion of the sediment description section of core forms, grab forms, visual forms and sediment trap forms. The intended users are from a broad background of environmental investigation including, geologists, biologists, chemists, engineers and environmental scientists. The visual appearance and textural properties of sediment samples will be described using the Unified Soil Classification System (USCS) without the group symbol and density. When further description is necessary the field descriptions may be supplemented with laboratory data on grain size distributions and density analyses to characterize sediments, determined by an Amec Foster Wheeler employee who has been competency tested on ASTM D 2488-09a classification skills.

TERMS

- Wood Waste is the broad term that encompasses four principal subgroups:
  - Twigs and bark (generally 2 inches and larger)
  - Wood mulch defined as pieces ½-inch and larger in any one direction
  - Wood chips defined as pieces 1/8-inch to ½-inch and generally appear like chain saw cuttings and often a mix of browns and black
  - Wood fines defined as pieces smaller than 1/8-inch and generally appear like flat sand grain-sized particles and often black


Typical wood chips

- New Mud- Dr. Geyer- generally a brown silt or clay (mobile) with a Munsell color of # YR #/#, add others  "New mud"
- Old Mud- Dr. Geyer – Generally a darker black silt or clay (non-mobile) with a Munsell color of # YR #/#, add others

"Old Mud"

EQUIPMENT AND SUPPLIES

USCS Key;

Munsell Soil Color Charts;

Field Data Records;

Knife or spatula;

PID (Optional based on site conditions).

SEDIMENT DESCIPTION PROCEDURE

Information to be documented on field data records with each sediment sample description will include the following observations:

Sediment descriptions are to be written in following sequence:

Primary Material [Abundance + color (Munsell code) + sediment texture "and" non-mineral observations (such as wood waste, shells, redox features, organisms, sheens] with Secondary Material [abundance + color (Munsell code) + sediment texture]…if pertinent continue in same manner for sequential Materials.

As example: Abundant brown (7.5YR4/4) sandy-silt and wood chips with some green (1 Gley 5/5G) silt and shells.

1.

The following practices will be employed for each Material by strata:

Describing the Abundance use the following nomenclature

Table 1: DESCRIBING Abundance

• Description	• Criteria	• Abbreviation
• Trace • Some • Moderate • Occasional • Abundant	• ~ 0--5% • ~ 5-20% • ~ 20-50% • ~ 50-70% • ~ 80-100%	• TR • Some • Mod • Occ • Abnt

- Primary constituent: Description of the sediment texture using USCS terminology (Sand, Silt, and Clay) using the bold text descriptions on the triangle below:

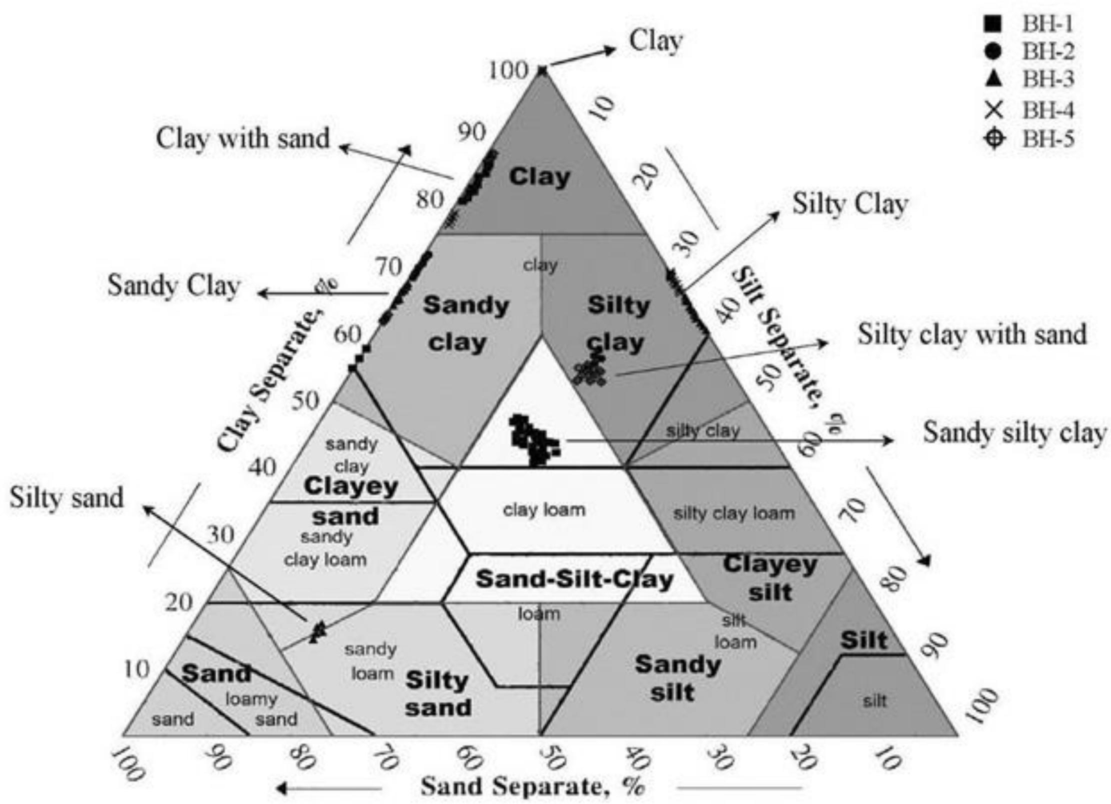


Figure 1 - Credit - Google image

- Stated color (primary or secondary): a one word description of the color as determined by the person characterizing (i.e., brown)
- Munsell soil color: Using the Munsell soil color chart describe the soil next to the soil chip. User should do this in natural sun light and while not wearing sunglasses.
- Secondary constituent: For heterogeneous samples describe other materials and strata's in the same order.

Soil Redox:[1]

Some soils will have reddish streaking through it, this is a redox feature and should be noted. Sampler should indicate the approximate percent of the observed sample is a reduction. If this is a separate mineral type then it should be indicated.


Soil redox example

Execution

The following steps are typically expected:

1. Retrieve sediment
2. Using a knife, spatula, spoon, or Nitrile-gloved hand remove about a golf-ball sized piece of the retrieved sediment. If it is solid, break apart and observe and record its primary and secondary matrix abundance and color and redox features. Record findings on FDR.
3. Using a Nitrile-gloved hand, hold and feel the material to identify its texture(s). Record findings on FDR
4. Dispose of assessed material.
5. Remove and properly dispose Nitrile gloves. Complete sediment description on FDR.

ATTACHMENT INDEX

Attachment 1: ASTM D 2488-09a
Attachment 2: Penobscot River Field Form: Grab Log
Attachment 3: Penobscot River Field Form: Core Log
Attachment 4: Penobscot River Field Form: Sediment Trap Form
Attachment 5: Penobscot River Field Form: Visual Assessment

[1] Applies to intertidal and marshes only

REFERENCES

ASTM International, 2009. Standard Practice for Description and Identification of Soils (Visual, Manual Procedure) Designation D 2488-09a. West Conshohocken, PA.

ASTM International, 2013. Standard Practice for Handling, Storing, and Preparing Soft Intact Marine Soil Designation D 3213-13. West Conshohocken, PA.

Munsell Color (Firm). (2010). Munsell soil color charts : with genuine Munsell color chips. Grand Rapids, MI :Munsell Color,

- END OF PROCEDURE -

Designation: D 2488 – 09a

Standard Practice for
Description and Identification of Soils (Visual-Manual Procedure)[1]

This standard is issued under the fixed designation D 2488; 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 procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D 2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D 2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils (either intact or disturbed).

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (see Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety problems, 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.* For specific precautionary statements see Section 8.

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:*[2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids
D 1452 Practice for Soil Exploration and Sampling by Auger Borings
D 1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils
D 1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
D 2113 Practice for Rock Core Drilling and Sampling of Rock for Site Investigation
D 2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D 3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D 4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)

3. Terminology

3.1 *Definitions*—Except as listed below, all definitions are in accordance with Terminology D 653.

NOTE 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:
Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved June 15, 2009. Published July 2009. Originally approved in 1966. Last previous edition approved in 2009 as D 2488 – 09.

[2] 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.

***A Summary of Changes section appears at the end of this standard.**

Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.1 *clay*—soil passing a No. 200 (75-µm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D 2487).

3.1.2 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.3 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.4 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.5 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.6 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-µm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-µm) sieve.

fine—passes a No. 40 (425-µm) sieve and is retained on a No. 200 (75-µm) sieve.

3.1.7 *silt*—soil passing a No. 200 (75-µm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D 2487).

4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Fig. 1a and Fig. 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols.*

Dual Symbol—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D 2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D 2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D 2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D 2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

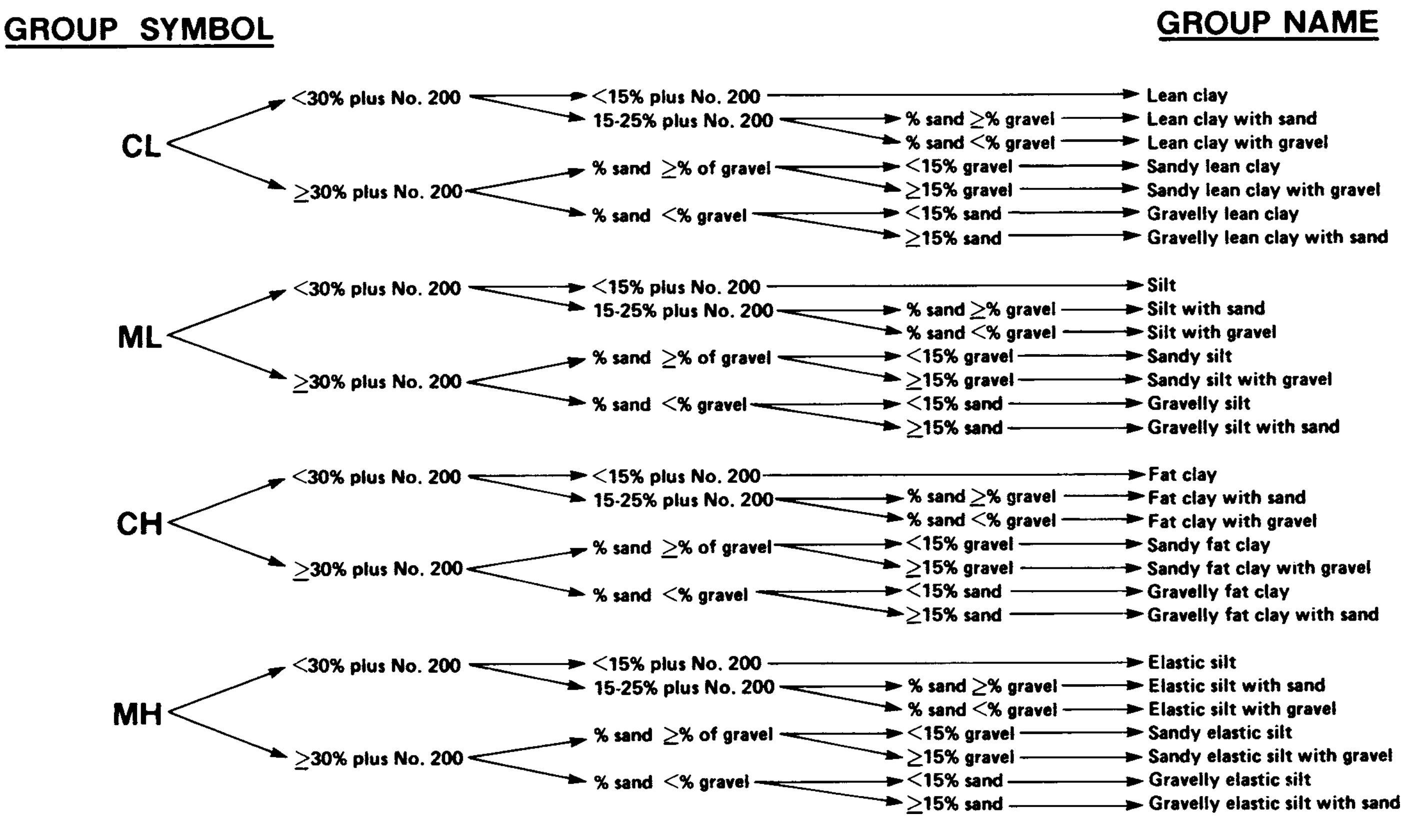
5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

5.6 When describing and identifying soil samples from a given boring, test pit, or group of borings or pits, it is not necessary to follow all of the procedures in this practice for every sample. Soils which appear to be similar can be grouped together; one sample completely described and identified with the others referred to as similar based on performing only a few of the descriptive and identification procedures described in this practice.

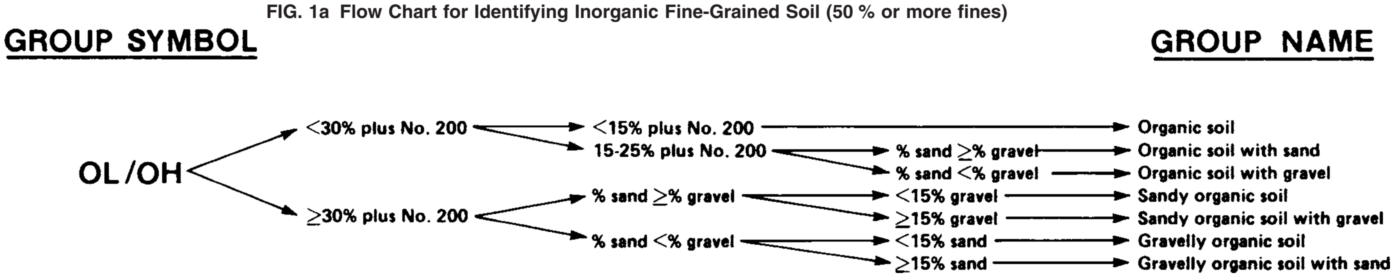
5.7 This practice may be used in combination with Practice D 4083 when working with frozen soils.

NOTE 5—Notwithstanding the statements on precision and bias contained in this standard: The precision of this test method 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 testing. Users of this test method are cautioned that compliance with Practice D 3740 does not in itself assure reliable testing. Reliable testing depends on several factors; Practice D 3740 provides a means for evaluating some of those factors.



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1 b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)

6. Apparatus

6.1 *Required Apparatus*:

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus*:

6.2.1 *Test Tube and Stopper* (or jar with a lid).

6.2.2 *Hand Lens.*

7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 *Hydrochloric Acid*—A small bottle of dilute hydrochloric acid, HCl, one part HCl (10 *N*) to three parts water (This reagent is optional for use with this practice). See Section 8.

8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 *N*) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 **Caution**—Do not add water to acid.

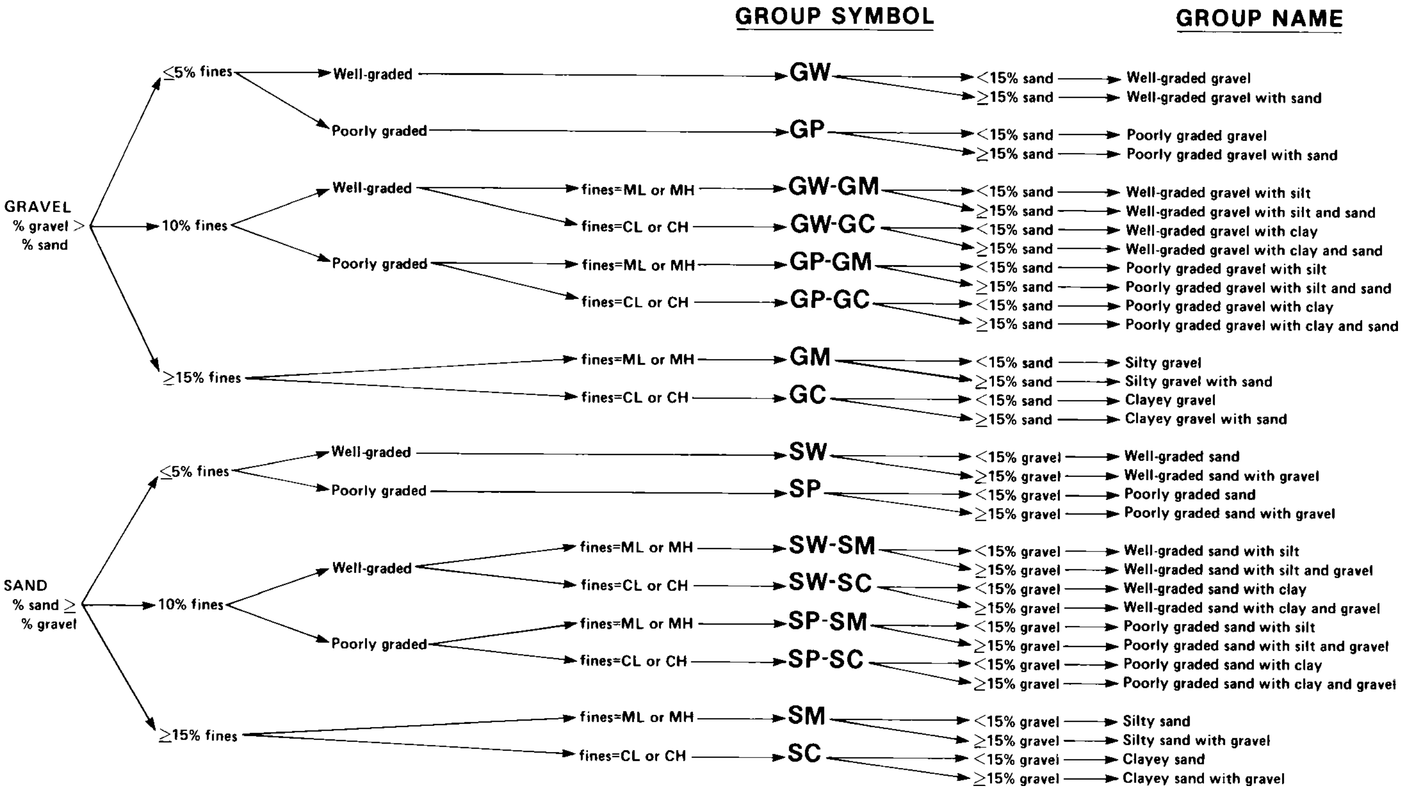
9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 6—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D 1452, D 1587, or D 2113, or Test Method D 1586.

9.2 The sample shall be carefully identified as to origin.

NOTE 7—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (3⁄8 in.)	200 g (0.5 lb)
19.0 mm (3⁄4 in.)	1.0 kg (2.2 lb)
38.1 mm (11⁄2 in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 8—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceeding schedule.

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table

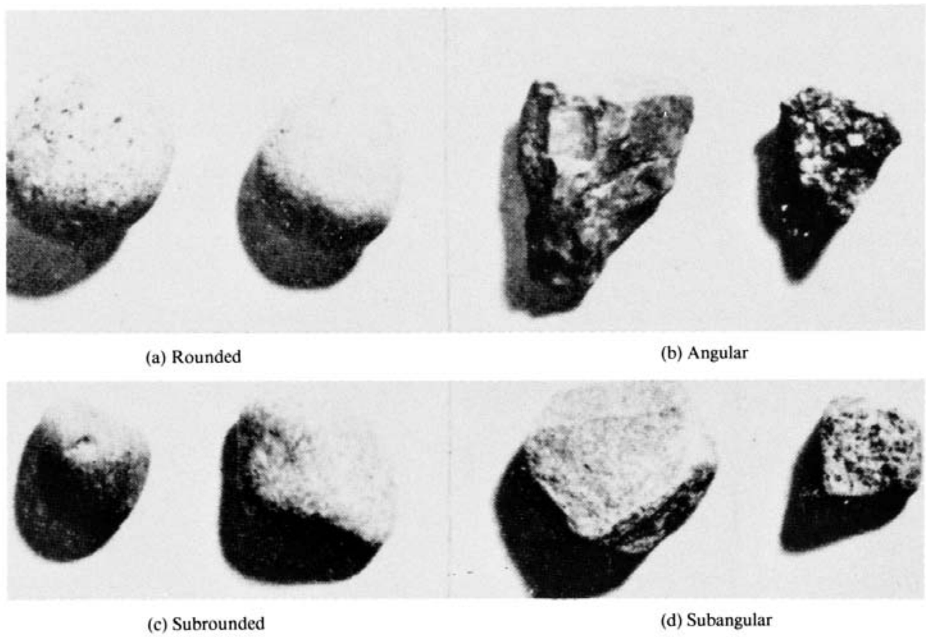


FIG. 3 Typical Angularity of Bulky Grains

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in Table 5. This observation is inappropriate for soils with significant amounts of gravel.

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.2 and 3.1.6. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.6. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maxi-

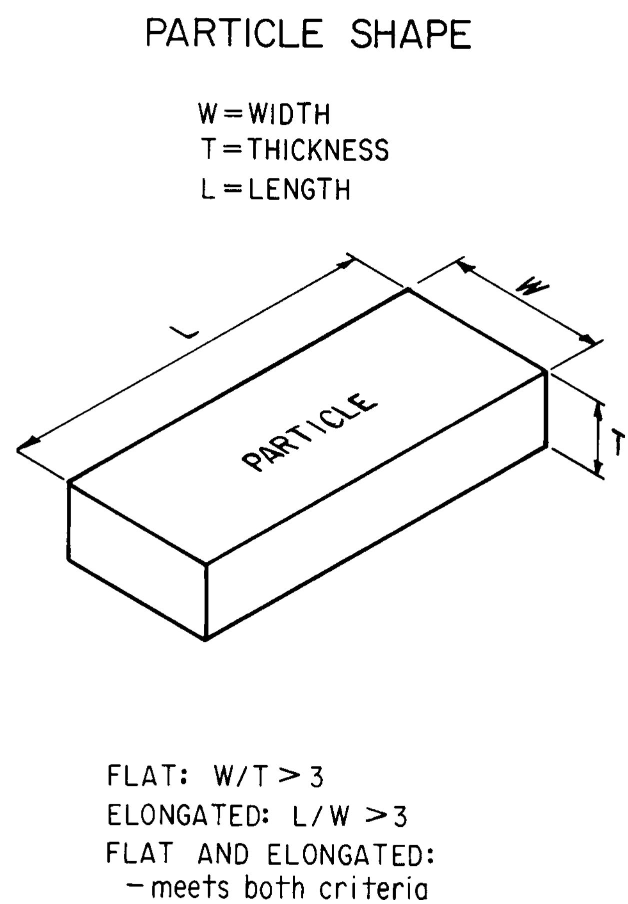


FIG. 4 Criteria for Particle Shape

TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

mum particle size, 1½ in. (will pass a 1½-in. square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. "Hard" means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering hole, caving of trench or hole, or the presence of mica.

10.14 A local or commercial name or a geologic interpretation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates will be on the basis of volume percentage.

NOTE 9—Since the percentages of the particle-size distribution in Test Method D 2487 are by dry weight, and the estimates of percentages for gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 10—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*, for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or more fines. Follow the procedures for identifying fine-grained soils of Section 14.

13.2 The soil is *coarse grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-grained soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughness tests.

14.2 *Dry Strength*:

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½ in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 11—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accorance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

14.3 *Dilatancy*:

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness*:

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about ⅛ in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about ⅛ in. The thread will crumble at a diameter of ⅛ in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils*:

14.7.1 Identify the soil as a *lean clay*, CL, if the soil has medium to high dry strength, no or slow dilatancy, and medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if the soil has high to very high dry strength, no dilatancy, and high toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil has no to low dry strength, slow to rapid dilatancy, and low toughness and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if the soil has low to medium dry strength, no to slow dilatancy, and low to medium toughness and plasticity (see Table 12).

NOTE 12—These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D 2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

14.8 *Identification of Organic Fine-Grained Soils*:

14.8.1 Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soils usually have a dark brown to black color and

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A ⅛-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

TABLE 12 Identification of Inorganic Fine-Grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness and Plasticity
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

NOTE 13—In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

14.9 If the soil is estimated to have 15 to 25 % sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the group name. For example: "lean clay with sand, CL" or "silt with gravel, ML" (see Fig. 1a and Fig. 1b). If the percentage of sand is equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more sand or gravel, or both, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean clay, CL", "gravelly fat clay, CH", or "sandy silt, ML" (see Fig. 1a and Fig. 1b). If the percentage of sand is equal to the percent of gravel, use "sandy."

15. Procedure for Identifying Coarse-Grained Soils (Contains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of gravel is estimated to be more than the percentage of sand.

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as a *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as a *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with fines* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM).

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, SC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: "silty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

NOTE 14—*Example: Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness; weak reaction with HCl; original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 15—Other examples of soil descriptions and identification are given in Appendix X1 and Appendix X2.

NOTE 16—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:

Trace—Particles are present but estimated to be less than 5 %

Few—5 to 10 %

Little—15 to 25 %

Some—30 to 45 %

Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D 2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range:
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity: angular, subangular, subrounded, rounded
7. Particle shape: (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines: nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl: none, weak, strong

For intact samples:

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure: stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation: weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments: presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc.

17. Precision and Bias

17.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

18. Keywords

18.1 classification; clay; gravel; organic soils; sand; silt; soil classification; soil description; visual classification

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF VISUAL SOIL DESCRIPTIONS

X1.1 The following examples show how the information required in 16.1 can be reported. The information that is included in descriptions should be based on individual circumstances and need.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—About 75 % fine to coarse, hard, subangular gravel; about 25 % fine to coarse, hard, subangular sand; trace of fines; maximum size, 75 mm, brown, dry; no reaction with HCl.

X1.1.2 *Silty Sand with Gravel (SM)*—About 60 % predominantly fine sand; about 25 % silty fines with low plasticity, low dry strength, rapid dilatancy, and low toughness; about 15 % fine, hard, subrounded gravel, a few gravel-size particles fractured with hammer blow; maximum size, 25 mm; no reaction with HCl (Note—Field sample size smaller than recommended).

In-Place Conditions—Firm, stratified and contains lenses of silt 1 to 2 in. (25 to 50 mm) thick, moist, brown to gray; in-place density 106 lb/ft^3; in-place moisture 9 %.

X1.1.3 *Organic Soil (OL/OH)*—About 100 % fines with low plasticity, slow dilatancy, low dry strength, and low toughness; wet, dark brown, organic odor; weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—About 75 % fine to coarse, hard, subangular reddish sand; about 25 % organic and silty dark brown nonplastic fines with no dry strength and slow dilatancy; wet; maximum size, coarse sand; weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—About 75 % fine to coarse, hard, subrounded to subangular gravel; about 15 % fine, hard, subrounded to subangular sand; about 10 % silty nonplastic fines; moist, brown; no reaction with HCl; original field sample had about 5 % (by volume) hard, subrounded cobbles and a trace of hard, subrounded boulders, with a maximum dimension of 18 in. (450 mm).

X2. USING THE IDENTIFICATION PROCEDURE AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, AND THE LIKE

X2.1 The identification procedure may be used as a descriptive system applied to materials that exist in-situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, and the like).

X2.2 Materials such as shells, crushed rock, slag, and the like, should be identified as such. However, the procedures used in this practice for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, an identification using a group name and symbol according to this practice may be assigned to aid in describing the material.

X2.3 The group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how group names and symbols can be incororated into a descriptive system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. (50 to 100-mm) pieces of shale from power auger hole, dry, brown, no reaction with HCl. After slaking in water for 24 h, material identified as "Sandy Lean Clay (CL)"; about 60 % fines with medium plasticity, high dry strength, no dilatancy, and medium toughness; about 35 % fine to medium, hard sand; about 5 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"; about 90 % fine to medium sand; about 10 % nonplastic fines; dry, reddish-brown.

X2.4.3 *Broken Shells*—About 60 % uniformly graded gravel-size broken shells; about 30 % sand and sand-size shell pieces; about 10 % nonplastic fines; "Poorly Graded Gravel with Silt and Sand (GP-GM)."

X2.4.4 *Crushed Rock*—Processed from gravel and cobbles in Pit No. 7; "Poorly Graded Gravel (GP)"; about 90 % fine, hard, angular gravel-size particles; about 10 % coarse, hard, angular sand-size particles; dry, tan; no reaction with HCl.

X3. SUGGESTED PROCEDURE FOR USING A BORDERLINE SYMBOL FOR SOILS WITH TWO POSSIBLE IDENTIFICATIONS.

X3.1 Since this practice is based on estimates of particle size distribution and plasticity characteristics, it may be difficult to clearly identify the soil as belonging to one category. To indicate that the soil may fall into one of two possible basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example: SC/CL or CL/CH.

X3.1.1 A borderline symbol may be used when the percentage of fines is estimated to be between 45 and 55 %. One symbol should be for a coarse-grained soil with fines and the other for a fine-grained soil. For example: GM/ML or CL/SC.

X3.1.2 A borderline symbol may be used when the percentage of sand and the percentage of gravel are estimated to be about the same. For example: GP/SP, SC/GC, GM/SM. It is practically impossible to have a soil that would have a borderline symbol of GW/SW.

X3.1.3 A borderline symbol may be used when the soil could be either well graded or poorly graded. For example: GW/GP, SW/SP.

X3.1.4 A borderline symbol may be used when the soil could either be a silt or a clay. For example: CL/ML, CH/MH, SC/SM.

X3.1.5 A borderline symbol may be used when a fine-grained soil has properties that indicate that it is at the boundary between a soil of low compressibility and a soil of high compressibility. For example: CL/CH, MH/ML.

X3.2 The order of the borderline symbols should reflect similarity to surrounding or adjacent soils. For example: soils in a borrow area have been identified as CH. One sample is considered to have a borderline symbol of CL and CH. To show similarity, the borderline symbol should be CH/CL.

X3.3 The group name for a soil with a borderline symbol should be the group name for the first symbol, except for:

CL/CH lean to fat clay
ML/CL clayey silt
CL/ML silty clay

X3.4 The use of a borderline symbol should not be used indiscriminately. Every effort shall be made to first place the soil into a single group.

X4. SUGGESTED PROCEDURES FOR ESTIMATING THE PERCENTAGES OF GRAVEL, SAND, AND FINES IN A SOIL SAMPLE

X4.1 *Jar Method*—The relative percentage of coarse- and fine-grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 s. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

X4.2 *Visual Method*—Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then, do the same with the sand size particles and the fines. Then, mentally compare the number of sacks to estimate the percentage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (X4.3).

X4.3 *Wash Test (for relative percentages of sand and fines)*—Select and moisten enough minus No. 4 sieve size material to form a 1-in (25-mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

X4.3.1 While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.

X5. ABBREVIATED SOIL CLASSIFICATION SYMBOLS

X5.1 In some cases, because of lack of space, an abbreviated system may be useful to indicate the soil classification symbol and name. Examples of such cases would be graphical logs, databases, tables, etc.

X5.2 This abbreviated system is not a substitute for the full name and descriptive information but can be used in supplementary presentations when the complete description is referenced.

X5.3 The abbreviated system should consist of the soil classification symbol based on this standard with appropriate lower case letter prefixes and suffixes as:

Prefix:	Suffix:
s = sandy	s = with sand
g = gravelly	g = with gravel
	c = with cobbles
	b = with boulders

X5.4 The soil classification symbol is to be enclosed in parenthesis. Some examples would be:

Group Symbol and Full Name	Abbreviated
CL, Sandy lean clay	s(CL)
SP-SM, Poorly graded sand with silt and gravel	(SP-SM)g
GP, poorly graded gravel with sand, cobbles, and boulders	(GP)scb
ML, gravelly silt with sand and cobbles	g(ML)sc

SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this standard since the last issue (D 2488 – 09) that may impact the use of this standard. (Approved June 15, 2009.)

(*1*) Revised Section 1.2.3.

Penobscot River Mercury Study - Phase III Engineering Evaluation

SEDIMENT GRAB LOG

Owner:	USDC, District of Maine	Project No.:	3616166052	Logger:	
Sub:		WO: 3 - Geophysical		Crew:	
Tablet #:	Date:		Time :	Vessel:	
Coordinates: **Lat**		**Long**		Plan Volume:	
Sampling Station:				Sub-tidal Location? **Y** **N**	
Weather:	Winds:	Waters:	Traffic: None	Water Temp: __°F	

Measured Water Depth [NAVD88]:	Total Number of Deployments:
Correction to NAVD88 (+/- ft. from NAVD88):	*Conditions:*
Mudline (Corrected Depth) @ NAVD88:	
Study Depth (-NAVD88):	

All Recovered Quantities are in Percent

Deployment	Recovery	Description	Sample ID

Number of containers:					Grab Equipment Sampler Type: Standard Ponar
Type of container:	bucket	liner bag	jar	other	Capacity

Live Organisms present	Y	N
Oil-Like Present	Y	N
Odor Present	Y	N
Debris Present	Y	N

Photo Numbers

Comments

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Penobscot River Mercury Study - Phase III Engineering Evaluation

SEDIMENT CORE LOG

Owner:	USDC, District of Maine	Project No.:	3616166052	Logger:	
Sub:		WO:		Crew:	
Tablet #:	Date:		Time :	Vessel:	
Coordinates: Lat		Long		Plan Volume:	
Sampling Station:			Deploy No.	Sub-tidal Location? **Y** **N**	
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		

					Core Volumes	
Number of containers:					Nominal core-barrel diameter	EST. Volume
Type of container:	bucket	liner bag	jar	other		
Liner Type: Soft	Hard	Vibracorer:			4.0"	.50gal/ft
		Push Corer		Slambar	3.5"	.33gal/ft

Live Organisms present	Y	N
Oil-Like Present	Y	N
Odor Present	Y	N
Debris Present	Y	N

Photo Numbers

Comments

Penobscot River Mercury Study - Phase III Engineering Evaluation

Sediment Trap Forms

Date: ____ **Logger:** ____
Time: ____ **Crew:** ____ **Weather:** ____
Location: ____ **Vessel:** ____ **Winds:** ____
Lat: ____ **Sub-tidal Location? Y N** **Surface Waters:** ____
Long: ____ **Tide:** ____ **Open Waters:** ____

Retrieval Date: 10/15/2016 Station Name: FF_TRAP1

I. Description of Trap

A. Trap Method

Trap Types (Circle)
- Outside Cover
- Uncovered
- Inside Cover
- Other (describe below)

Trap Size in Inches

Eel pot	9X11X24
Lobster Pot	12X12X36

Further description (if needed): Burlap Sack

B. Sediment Recovered

Chip Size
- Twigs & Bark
- Leaves & Grass
- Shredded Mulch (1-2")
- Sawdust (1/4")
- Particle (grain)

Abundant:	80-100%
Occasional:	50-70%
Scattered:	20-50%
Some:	5-20%
Trace:	0-5%

Base Sediment
Gravel Sand Silt

Sediment Description:

Collection Method: Photographed: **Y N**
Comments: Collected: **Y N**

Samples:

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Penobscot River Mercury Study - Phase III Engineering Evaluation

VISUAL ASSESSMENT

Date: ______ **Logger:** ______ **Tablet #:** ______
Time: ______ **Crew:** ______ **Weather:** ______
Location: ______ **Vessel:** ______ **Winds:** ______
Lat: ______ **Sub-tidal Location? Y N** **Surface Waters:** ______
Long: ______ **Tide:** ______ **Open Waters:** ______

I. Surf Line

A. Strata 1

Chip Size:
- Twigs & Bark ______
- Leaves & Grass ______
- Shredded Mulch (1-2") ______
- Sawdust (1/4") ______
- Particle (grain) ______

Abundant:	80-100%
Occasional:	50-70%
Scattered:	20-50%
Some:	5-20%
Trace:	0-5%

Base Sediment: Gravel Sand Silt

Intermingled Wood Chip **Y N** % chip

Munsel Color: ______

Redox: ______

Sediment Description: ______

B. Strata 2

Chip Size:
- Twigs & Bark ______
- Leaves & Grass ______
- Shredded Mulch (1-2") ______
- Sawdust (1/4") ______
- Particle (grain) ______

Abundant:	80-100%
Occasional:	50-70%
Scattered:	20-50%
Some:	5-20%
Trace:	0-5%

Base Sediment: Gravel Sand Silt

Intermingled Wood Chip **Y N** % chip

Munsel Color: ______

Redox: ______

Sediment Description: ______

Collection Method: Ponar ______ Photographed: **Y N**
Comments: ______ Collected: **Y N**

II. Mud Line

A. WC Explosed above mudline **Y N**

Approx. Surface Thickness (in): ______
Collection Method: ______ Photographed: **Y N**
Comments: ______ Collected: **Y N**

B. WC below mudline

Deposition band offset from surf line **Y N**
Approx. Surface Thickness (in): ______
Collection Method: ______ Photographed: **Y N**
Comments: ______ Collected: **Y N**

III. Edge Conditions *(Circle)*
- Vegetated
- Bulkhead
- Rock (cliff)

IV. Bank Conditions *(Circle)*
- Boulder Outcrops
- Sloping Mudflats
- Slumped Mudflats

SOP No. S-12

AMEC FOSTER WHEELER 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

AMEC FOSTER WHEELER 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

AMEC FOSTER WHEELER 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.

<u>Materials</u>

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.

<u>Shellfish Sampling By Hand, Shovel, Dredge, or Net</u>

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-23

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
STANDARD OPERATING PROCEDURE

SEDIMENT PROCESSING – EXTRUSION & SAMPLING

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
Wood	Wood Environment & Infrastructure Solutions, Inc. (formerly Amec Foster Wheeler)

SEDIMENT PROCESSING – EXTRUSION & SAMPLING

PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standardized method for processing a collected sediment core using incremental and mass extrusion. This SOP may be used by employees of Wood, or its subcontractors supporting the Penobscot River Estuary Project. Deviations from the procedures outlined in this document are to approved by the Project Manager (PM), Technical Lead, or Field Operation Lead prior to initiation of the sampling activity.

This SOP is a companion document to SOP-6, which outlines the sediment collection.

The methodologies and general procedures discussed in this SOP are applicable to the processing of collected sediment cores by extrusion methods in the field.

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

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 Wood 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 sample processing.

- 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 to 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 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 – Alconox or equivalent detergent 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.
- 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.
- Mass Extraction Tool – used for pushing sediment out of the liner into a tray for processing.
- Permanent marking pen - used to mark sample jars/lids, coring tubes, and for documentation of field logbooks and data sheets.
- Plastic tray – tray or gutter section for placing mass extruded core for processing

- Ruler – wooden preferred
- Sample Extruder – Device used to extrude sample from liner.
- 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 bowls or bucket **-** used for compositing samples; sized appropriate for sample volume capacity.
- Stainless steel lab spoon **-** or equivalent. Used for homogenizing sediment samples.
- 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.

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

METHOD SUMMARY

Sediment cores can be processed using several different methodologies. Incremental extrusion or mass extrusion of a sediment core are commonly used methods allowing for discrete sampling of specified intervals. The extrusion method allows for a single increment of sediment to be removed from the liner at a time. Once extruded, the interval is placed in a clean bowl, homogenized and aliquot placed into the analytical laboratory-specified sample container. The mass extrusion method involves removing an entire sediment core from the liner into a tray, and incrementally processing the core by removing a defined interval from the tray into clean bowl, homogenizing, and an aliquot placed into the analytical laboratory-specified sample container. Each of the processes are repeated until the required laboratory samples have been collected.

Procedures on how to complete each method are detailed in the following sections.

SAMPLE PROCESSING - EXTRUSION

Before processing a sample by either incremental or mass extrusion, the following procedures shall be performed:

1. Processing equipment shall be decontaminated prior to use. If the sampling station is the first to be visited that day, decontamination of equipment shall be performed before use. 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. Personnel performing the processing shall review the FDR completed for the collection. If the processing is not performed sequential to the collection, the FDR will be annotated to indicate the date, time, location, and crew members for the processing.

3. The individual FDR for the recovered sediment deployment to be processed will be supplemented with completion of the logging and incremental sampling. 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.

4. The processing crew will confirm that the top and bottom of the liner to be processed are known. If there is uncertainty as to the location of the mudline within the liner, the liner will not be processed.

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

Incremental Extrusion

There are several types of coring devices that facilitate incremental extrusion. There are nuances specific to each device as the extrusion apparatus is commonly customized to the coring device. 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. It is recommended that the processing crew perform one or two "practice cores" after reviewing the manufacturer instructions prior to performing incremental extrusion on a station-specific collected core.

The incremental extruder is a sample processing device that allows for the removal of a discrete interval of sediment from a liner in centimeter lengths. When the core is collected, a plug/stopper or extruding plug is inserted into the bottom of the core liner. This plug allows for the sample to be pressed out of the liner without impacting the sediment.

Prior to leaving the field station, ensure all required parts of the incremental extruder are properly functioning and the equipment is ready for use per the following:

1. Inspect extruder disks to ensure rubber seals are in good condition. If damage is noted, replace plug/puck or rubber seal.

2. Inspect threaded rod for any wear or damage. Ensure the threaded plugs/puck will properly thread onto the rod.

3. Ensure a sufficient quantity of plastic spacers are equipped for the proposed sampling.

The following steps shall be followed when using the incremental extruder to interval a core:

1. Mount the core barrel atop the barrel stabilizer disk.

2. Adjust the threaded disk on the threaded rod such that the gap between the threaded disk and barrel stabilizer disk can be filled with the plastic spacers. Adjust this gap to be equal to the total thickness of sample that will be aliquoted (i.e., 6 inches or 15 cm).

3. Place the core extruder funnel on the top of the liner section.

4. Remove the plastic spacers that coincide with the thickness of the sediment interval to be aliquoted (i.e., for a 0.0-0.1ft interval (2cm) remove 2 plastic spacers).

5. Push the liner tube down so that the bottom of the tube rests on the next in-place plastic spacer. This will push the sediment out of the liner and onto the extruder funnel.

6. Scrape the displaced sediment in the extruding funnel into a stainless-steel bowl, or cleaned equivalent (e.g, ziplock bag). Classify the material as it is placed into the bowl and record on the FDR specific to the interval.

7. Photograph the extruded interval. Include the white board within the photo view where the white board has clearly written the station identification, core deployment, interval extruded, and date and time.

8. Homogenize the extruded interval in the bowl by manually mixing 50 strokes or greater if additional blending is necessary. If encountered, remove pieces of gravel or wood greater than 1 inch in any one direction and record the type and dimensions of removed material on the FDR specific to the interval extruded.

9. Aliquot sufficient volume/mass to support the laboratory analyses, commonly outlined in the Field Sampling Plan or instructions from the laboratory, and place into the sample container.

10. Label the sample container by fully completing labels and place clear tape over the sample label for protection. Write the sample ID on the lid of the sample container.

11. Place sample container in cooler or equivalent to maintain analytical requirements for sample preservation commonly outlined in the Field Sampling Plan or instructions from the laboratory.

12. Remove the extruding funnel from the top of the liner and decontaminate and reinstall before continuing.

13. Repeat steps 1 – 11 until the required intervals have been extruded.

14. Log the entire core, including the material that is not being collected for analysis. Record pertinent data on the FDR as the core is aliquoted and samples are collected in the sample containers.

Mass Extrusion

Mass extrusion of a sediment core involves pushing the material out of the liner tube into a tray using a mass extraction tool, like a plunger. The entire length of a collected sediment core is placed in a plastic tray, intervals extracted, and materials mixed and processed consistent with the interval extrusion method.

Prior to leaving the field station, ensure all required equipment for mass extraction is ready for use per the following:

1. Inspect the mass extraction tool for damage or wear. Ensure the plastic disk at the end of the rod is securely fastened.
2. Inspect the plastic tray for any cracks or sharp edges. Remove from use if damaged.

The following steps shall be followed when using the mass extrusion method is used to interval a core:

1. Lay the sediment core in the plastic tray with the top approximately 1 foot from the end of the tray.
2. Using the mass extraction tool, push the sediment core out of the liner and into the tray.
3. Take a photo of the sediment using a whiteboard to identify the station location, date and time of collection, project number and name. The view should include the ruler positioned to measure from the mudline.
4. Remove the material within the measured interval (e.g., 0.1 to 0.3 ft) placing sediment in into a stainless-steel bowl, or cleaned equivalent (e.g, ziplock bag). Classify the material as it is placed into the bowl and record on the FDR specific to the interval.
5. Homogenize the extruded interval in the bowl by manually mixing 50 strokes or greater if additional blending is necessary. If encountered, remove pieces of gravel or wood greater than 1 inch in any one direction and record the type and dimensions of removed material on the FDR specific to the interval extruded.
6. Aliquot sufficient volume/mass to support the laboratory analyses, commonly outlined in the Field Sampling Plan or instructions from the laboratory, and place into the sample container.
7. Label the sample container by fully completing labels and place clear tape over the sample label for protection. Write the sample ID on the lid of the sample container.
8. Place sample container in cooler or equivalent to maintain analytical requirements for sample preservation commonly outlined in the Field Sampling Plan or instructions from the laboratory.

9. Decontaminate bowls and mixing tools before continuing.

10. Repeat steps 4 to 9 until the required intervals have been removed.

11. Log the entire core, including the material that is not being collected for analysis. Record pertinent data on the FDR as the core is aliquoted and samples are collected in the sample containers.

HEALTH AND SAFETY

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

SAMPLE CONTAINERS AND LABELING

Sample labeling will occur as prescribed in the Field Sampling Plan.

All samples will be stored temperature controlled as outlined in the Field Sampling Plan, Quality Assurance Project Plan, or analytical laboratory instructions.
Labeled sample containers may be stored in the field station and subsequently shipped to the analytical laboratory. Samples will be shipped under chain-of-custody, protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

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 or 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 and detailed in the QAPP 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

Wood, 2020a. Field Sampling Plan; Penobscot River Phase III Engineering Study – Penobscot River, Maine. July 2016.

Wood, 2020b. Quality Assurance Project Plan; Penobscot River Phase III Engineering Study – Penobscot River, Maine. July 2016.

- END OF PROCEDURE -