FS 4000. SEDIMENT SAMPLING

See also the following Standard Operating Procedures:

- FA 1000 Administrative
- FC 1000 Field Cleaning
- FD 1000 Documentation
- FM 1000 Field Mobilization
- FQ 1000 Quality Control
- FS 1000 General Sampling
- FS 7400 Benthic Macroinvertebate Sampling
- FT 1000 – 2000 Field Testing

1. INTRODUCTION AND SCOPE

Sediments occur in freshwater and marine environments such as streams/rivers, ponds/lakes, canals, ditches, wetlands, lagoons, and estuaries. Recently exposed sediment (due to low water levels) may also be sampled, but exposure to air could affect the characteristics of the sediment (for example, redox) and hence, the interpretation of the results of chemical or other analyses. The following methods are for physical, chemical, and toxicological sampling. See FS 7400 for benthic invertebrate sampling.

1.1. Select sampling locations for sediments depending upon the project objectives. Collect:

1.1.1. Sediment samples as an adjunct to surface water samples;

1.1.2. A series of sediment samples for compositing to determine water or sediment quality in a system;

1.1.3. Sediment samples above and below an outfall to document degradation due to a point source discharge; or

1.1.4. Sediment samples if stressed shore vegetation or visible surface water contamination is evident.

1.2. Decisions related to the selection of sampling locations will not be discussed in this document.

1.3. Collect, preserve and containerize surface water samples prior to collecting sediment samples (see FS 2100).

2. EQUIPMENT AND SUPPLIES

2.1. Refer to Table FS 4000-1 and FS 1000, Tables FS 1000-1, 1000-2 and 1000-3, for selection of sampling equipment and construction.

2.2. For information on the selection of appropriate sample containers, see FS 1000 Table FS 1000-6.

2.3. For information on cleaning requirements for sample containers, equipment and utensils, see FC 1000.

2.4. For information on documentation requirements, see FD 1000.

2.5. For information on preservation and holding time requirements, see FS 1000 Table FS 1000-6.

3. SAMPLE COLLECTION PROTOCOLS

Take sediment samples using one of three different types of equipment: scoops, corers and dredges or grab samplers.

3.1. Soil sampling equipment is generally not applicable to sediments because of the low cohesion of the medium.

3.2. When selecting the appropriate sampling equipment, consider sampling location (edge or middle of lagoon), depth of water and sediment, sediment grain size (fineness), water velocity and analytes of interest.

3.3. Direct collection with the appropriate sample container may be appropriate in very low water or where sediment is exposed.

3.4. Use dredges for hard or rocky substrates. They are heavy enough to use in high velocity streams.

3.5. Use coring devices in quiescent waters, unless water depth precludes effective sample collection.

3.6. Scoops or Similar Equipment

3.6.1. Scooping is generally most useful around the margin or shore of the water body or by wading in shallow waters.

3.6.1.1. Stand facing the direction of flow and approach the location from the downstream direction.

3.6.1.2. Take precautions not to disturb the bottom prior to scooping.

3.6.1.3. Scoop the sample in the upstream direction of flow.

3.6.2. For obtaining samples several feet from shore or from a boat, DEP recommends attaching the scoop to an extendible pole.

3.6.3. Transfer sample to the appropriate sample container(s), using a clean non-reactive utensil.

3.6.4. Label, preserve to 4°C with wet ice and complete field notes.

3.7. Corers

3.7.1. Coring devices can be easily fabricated from many materials. Although stainless steel, glass or Teflon must be used for sampling extractable organics, volatile organics and inorganics, aggregate organics, petroleum hydrocarbons and oil & grease, other inexpensive material (e.g., PVC, carbon steel, etc.) may be used for inorganic non-metallics and metals.

3.7.2. Some corers are simple “push tubes,” whereas other more sophisticated models may be finned, gravity driven devices.

3.7.3. A core may be useful for preserving the historical layering of sediments.

3.7.4. Upon descent, water displacement is minimal with core samplers, which minimizes the shock wave produced by other equipment such as dredges.

3.7.5. The corer is an acceptable choice for sampling fine sediments in static waters, especially those containing trace organics and metals.

3.7.6. Corer diameter, grain size and sample consistency will determine if the sample will remain in the corer upon withdrawal.

3.7.7. Sample washout can be a problem and there are several ways to reduce or prevent it.

3.7.7.1. Fit the leading edge of the corer with a nosepiece or core catcher that physically keeps the sample from slipping back out of the corer. The core catcher material must also be compatible with the analytes of interest.

3.7.7.2. A second option is fit the top or back end with a check valve which creates negative pressure on the back of the sample as it is being pulled from the substrate and prevents surface water from washing out the top portion of the sample.

3.7.8. Rotate the corer, if needed, as it is pushed into the sediment.

3.7.8.1. Rotate be around its axis (do not rock the coring device back and forth).

3.7.8.2. Rotation improves penetration and prevents compaction of the sample as it is pushed to the full length of the corer.

3.7.9. Upon withdrawal from the water surface, place a cap on the bottom to prevent the sample from sliding out.

3.7.10. Corers can also be fitted with liners. This is advantageous if a complete core is desired that has not been in contact with the atmosphere. It is also advantageous if the coring device is not constructed of the proper material (e.g., PVC) and one of the analytes requires a sampler of inert construction (glass, stainless steel or Teflon).

3.7.11. As the core is extruded, carefully remove the sample with a clean, non-reactive utensil and transfer into the appropriate sample container(s).

3.7.12. Label, preserve to 4°C with wet ice and complete field notes.

3.8. Dredges or Grab Samplers

3.8.1. The three main types of devices used in freshwater are the Ekman, Peterson and Ponar. Heavier oceanographic dredges are used in marine and estuarine waters.

3.8.2. Refer to Table FS 4000-1 for additional types of dredges. The Peterson and Ponar dredges are suitable for hard or rocky substrates or deep water bodies.

3.8.2.1. The Peterson and Ponar are virtually the same, except that the Ponar has been adapted with a top screen and side plates to prevent sample loss upon ascent. For this reason, the Ponar is the dredge of choice for rocky substrates. These dredges are heavy enough to use in streams with fast currents.

3.8.2.2. Open the jaws and place the cross bar into the proper notch.

3.8.2.3. Lower the dredge to the bottom, making sure it settles flat.

3.8.2.4. When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.

3.8.2.5. Pull the sampler to the surface. Check to make sure the jaws are fully closed and that no sample was lost while lifting the dredge.

3.8.2.6. Carefully open the jaws, remove the sample with a clean, non-reactive utensil and transfer the sample into the appropriate sample container(s), label, preserve to 4°C with wet ice and complete field notes.

3.8.3. The Ekman is designed for sampling soft substrates (e.g., sand, silt or mud) in areas with little current.

3.8.3.1. Open the spring-loaded jaws and attach the chains to the pegs at the top of the sampler.

3.8.3.2. Lower the dredge to the bottom, making sure it settles flat.

3.8.3.3. Holding the line taut and send down the messenger to close the jaws of the dredge.

3.8.3.4. Pull the sampler to the surface. Check to make sure the jaws are fully closed and that no sample was lost while lifting the dredge.

3.8.3.5. Carefully open the jaws, remove the sample with a clean, non-reactive utensil and transfer the sample into the appropriate sample container(s).

3.8.3.6. Label, preserve to 4°C with wet ice and complete field notes.

4. PROCEDURES FOR COMPOSITING

4.1. The following is not a complete discussion regarding all available sampling protocols nor the appropriateness or inappropriateness of compositing sediment samples. The appropriateness of compositing sediment samples will depend on the data quality objectives of the project. However, it is sometimes advantageous to composite sediment samples to minimize the number of samples to be analyzed when sampling highly contaminated areas. Obtain permission from the DEP program.

4.1.1. Select sampling points from which to collect each aliquot.

4.1.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

4.1.3. **Combine the aliquots of the sample directly in the sample container with no pre-mixing**.

4.1.4. Record the amount of each aliquot (volume or weight).

4.1.5. Label container, preserve on wet ice to 4°C and complete field notes.

4.1.6. Notify the laboratory that the sample is an unmixed composite sample, and request that the sample be thoroughly mixed before sample preparation or analysis.

5. COLLECTION OF INTERSTITIAL OR PORE WATER SAMPLES

5.1. ASTM identifies interstitial water or pore water as the "water occupying the space between sediment…particles." It "is often isolated to provide either a matrix for toxicity testing or an indication of the concentration and partitioning of contaminants with a sediment matrix." See American Society for Testing and Materials, Annual Book of ASTM Standards, Standard Guide for Collection, Storage, Characterization and Manipulation of Sediments for Toxicological Testing and for Selection of Samplers Used to Collect Benthic Invertebrates, Section E 1391-03, Volume 11-05. Collect pore water using available technology that will preserve the integrity of the analytes of interest during collection. Pore water may be extracted in the laboratory from field-collected sediments. Consult the detailed discussion in the ASTM guidance if pore water is to be extracted and analyzed as part of the sampling design. Use of pore water wells (e.g., shallow PVC wells) or pore water equilibrators (e.g., Plexiglas plates with built-in wells or other appropriate construction) is also acceptable.

5.2. Collect adequate amounts of sample in the field to obtain desired quantities of pore water for testing. Sandy sediments retain less water than fine sediments do; thus, the substrate type will dictate the amount of additional sample needed. In all cases, consult the laboratory conducting the analyses to provide estimates of the amount of sediment necessary to obtain the desired quantity of pore water.

Appendix FS 4000

Tables, Figures and Forms

Table FS 4000-1: Summary of Bottom Sampling Equipment [from ASTM E 1391-94]

TABLE FS 4000-1 Summary of Bottom Sampling Equipment [from ASTM E 1391-94]

Device	Use	Advantages	Disadvantages
Teflon or glass tube	Shallow wadeable waters or deep waters if SCUBA available. Soft or semi-consolidated deposits.	Preserves layering and permits historical study of sediment deposition. Rapid - samples immediately ready for laboratory shipment. Minimal risk of contamination.	Small sample size requires repetitive sampling.
Hand corer with removable teflon or glass liners	Same as above except more consolidated sediments can be obtained.	Handles provide for greater ease of substrate penetration. Above advantages.	Careful handling necessary to prevent spillage. Requires removal of liners before repetitive sampling. Slight risk of metal contamination from barrel and core cutter.
Box corer	Same as above.	Collection of large sample undisturbed, allowing for subsampling.	Hard to handle.
Gravity corers, such as Phleger Corer	Deep lakes and rivers. Semi-consolidated sediments.	Low risk of sample contamination. Maintains sediment integrity relatively well.	Careful handling necessary to avoid sediment spillage. Small sample, require repetitive operation and removal of liners. Time consuming.
Young grab (Teflon or kynar-lined, modified 0.1-m^2 Van Veen)	Lakes and marine areas.	Eliminates metal contamination. Reduced bow wake.	Expensive. Requires winch.
Ekman or box dredge	Soft to semi-soft sediments. Can be used from boat, bridge, or pier in waters of various depths.	Obtains a larger sample than coring tubes. Can be subsampled through box lid.	Possible incomplete jaw closure and sample loss. Possible shock wave, which may disturb the “fines”. Metal construction may introduce contaminants. Possible loss of “fines” on retrieval.
PONAR grab sampler Petite PONAR grab sampler	Deep lakes, rivers and estuaries. Useful on sand, silt, or clay.	Most universal grab sampler. Adequate on most substrates. Large sample obtained intact, permitting subsampling.	Shock wave from descent may disturb “fines.” Possible incomplete closure of jaws results in sample loss. Possible contamination from metal frame construction. Sample must be further prepared for analysis.
BMH-53 piston corer	Waters of 4 to 6 ft deep when used with extension rod. Soft to semi-consolidated deposits.	Piston provides for greater sample retention.	Cores must be extruded on-site to other containers. Metal barrels introduce risk of metal contamination.
Van Veen dredge	Deep lakes, rivers and estuaries. Useful on sand, silt, or clay.	Adequate on most substrates. Large sample obtained intact, permitting subsampling.	Shock wave from descent may disturb “fines.” Possible incomplete closure of jaws results in sample loss. Possible contamination from metal frame construction. Sample must be further prepared for analysis.
BMH-60 grab sampler	Sampling moving waters from a fixed platform.	Streamlined configuration allows sampling where other devices could not achieve proper orientation.	Possible contamination from metal construction. Subsampling difficult. Not effective for sampling fine sediments.
Petersen grab sampler	Deep lakes, rivers and estuaries. Useful on most substrates.	Large sample; can penetrate most substrates.	Heavy. May require winch. No cover lid to permit subsampling. All other disadvantages of Ekman and Ponar.
Shipek grab sampler	Used primarily in marine waters and large inland lakes and reservoirs.	Sample bucket may be opened to permit subsampling. Retains fine- grained sediments effectively.	Possible contamination from metal construction. Heavy. May require winch.
Orange-Peel grab Smith-McIntyre grab	Deep lakes, rivers and estuaries. Useful on most substrates.	Designed for sampling hard substrates.	Loss of fines. Heavy. May require winch. Possible metal contamination.
Scoops Drag Buckets	Various environments, depending on depth and substrate.	Inexpensive, easy to handle.	Loss of fines on retrieval through water column.