U.S. Environmental Protection Agency
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OPERATING PROCEDURE

Title: **Pore Water Sampling**

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Revision History

This Table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
SESDPROC-513-R0, Pore Water Sampling, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

The purpose of this SOP is to describe the procedures, methods, and considerations to be used when obtaining a sediment pore water sample.

1.2 Scope/Application

This document describes procedures generic to all pore water sampling methods to be used by field personnel when collecting and handling samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a pore water sample, the variant procedure will be documented in the field book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure has been prepared by personnel deemed technically competent by management based on their knowledge, skills, and abilities. The procedure has been applied in field investigations and has been reviewed in print by peers. A master copy of this procedure is kept in a central file by the Ecological Assessment Branch QA representative, along with documentation of the review conducted prior to its issuance.

1.4 Associated SESD Documents

SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011-R0)

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual, Most Recent Version

SESD Safety, Health and Environmental Management Program (SHEMP) Manual, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, (SESDPROC-205-R0)

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206-R0)

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of

Environmental and Waste Samples (SESDPROC-209-R0)

SESD Operating Procedure for Equipment Maintenance, Calibration and Verification, (ESDPROC-18-R0)

SESD Operating Procedure for Field pH Measurement (ESDPROC-100-R0)

SESD Operating Procedure for Field Specific Conductance Measurement (SESDPROC-101-R0)

SESD Operating Procedure for Field Temperature Measurement (SESDPROC-102-R0)

SESD Operating Procedure for Field Turbidity Measurement (SESDPROC-103-R0)

SESD Operating Procedure for Management of Investigation Derived Waste (SESDROC-202-R0)

SESD Operating Procedure for Pump Operation (SESDPROC-203-R0)

Puls, Robert W., Don A. Clark, and Bert Bledsoe. Metals in Ground Water: Sampling Artifacts and Reproducibility. Hazardous Waste and Hazardous Materials 9(2): 149-162 (1992)

Puls, Robert W., Michael J. Barcelona. Filtration of Ground Water Samples for Metals Analysis. Hazardous Waste and Hazardous Materials 6(4); 385-393 (1989)

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting pore water samples. Refer to the SESD Safety, Health and Environmental Management Program Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. When using this procedure, minimize exposure to potential health hazards through the use of protective clothing, eye wear and gloves. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting porewater samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) and/or International Air Transportation Association (IATA) hazardous materials shipping requirements.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as bills of lading, etc., shall be retained by the project leader and stored in a secure place.

2 Special Sampling Considerations

2.1 General

Pore water samples for VOC analysis must be collected in 40 ml glass vials with Teflon® septa. The vial may be either preserved with concentrated hydrochloric acid or they may be unpreserved. Preserved samples have a two week holding time, whereas, unpreserved samples have only a seven day holding time. During most sampling events, preserved vials are used due to their extended holding time. In some situations, however, it may be necessary to use the unpreserved vials. For example, if the surface water sample contains a high concentration of dissolved calcium carbonate, there may be an effervescent reaction between the hydrochloric acid and the water, producing large numbers of fine bubbles. This will render the sample unacceptable. In this case, unpreserved vials should be used and arrangements must be confirmed with the laboratory to ensure that they can accept the unpreserved vials and meet the shorter sample holding times.

Samples for VOC analysis must be collected using either stainless steel or Teflon® equipment. Samples should be collected with as little agitation or disturbance as possible. The vial should be filled so that there is a meniscus at the top of the vial and absolutely no bubbles or headspace should be present in the vial after it is capped. After the cap is securely tightened, the vial should be inverted and tapped on the palm of one hand to see if any undetected bubbles are dislodged. If a bubble or bubbles are present, the vial should be refilled. Care should be taken not to flush any preservative out of the vial during topping off. If, after attempting to refill and cap the vial, bubbles are still present, a new vial should be obtained and the sample re-collected.

2.2 Dissolved Metals Sample Collection

If a dissolved metals pore water sample is to be collected, an in-line filtration should be used. The use of disposable, high capacity filter cartridges (barrel-type) or membrane filters in an in-line filter apparatus is preferred. The high capacity, barrel-type filter is preferred due to the higher surface area associated with this configuration.

Potential differences could result from variations in filtration procedures used to process water samples for the determination of trace element concentrations. A number of factors associated with filtration can substantially alter "dissolved" trace element concentrations; these include filter pore size, filter type, filter diameter, filtration method, volume of sample processed, suspended sediment concentration, suspended sediment grain-size distribution, concentration of colloids and colloidally-associated trace elements, and concentration of organic matter. Therefore, consistency is critical in the comparison of short-term and long-term results. Further guidance on filtration may be obtained from the following: 1) Metals in Ground Water: Sampling Artifacts and Reproducibility; 2) Filtration of Ground Water Samples for Metals Analysis; and 3) Ground Water Sampling - A Workshop Summary. See Section 1.4, References, for complete citation for these documents.

2.3 Special Precautions for Trace Contaminant Pore Water Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned prior to handling sampling equipment and sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately trace level samples.
- All background or control samples shall be collected and placed in separate ice chests or shipping containers. Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Samplers must use new, verified, certified clean disposable equipment, or pre-cleaned non-disposable equipment. Non-disposable equipment should be pre-cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205-R0, for collection of samples for trace metals or organic compound analyses.

2.4 Sample Handling and Preservation Requirements

1. Pore water will typically be collected from sediments using a peristaltic pump and placed directly into the sampling containers. In some cases a syringe may be used to collect the sediment pore water and then transfer the sample into the appropriate container.
2. During sample collection, if transferring the sample from a collection device, make sure that the device does not come in contact with the sample containers.
3. Place the sample into appropriate, labeled containers. Samples collected for VOC analysis must not have any headspace (see Section 2.1, Volatile Organic Compound Analysis). All other sample containers must be filled with an allowance for ullage.
4. All samples requiring preservation must be preserved as soon as practically possible, soon after sample collection. If preserved VOA vials are used, these will be preserved with concentrated hydrochloric acid by the US EPA Region 4, SESD, Analytical Services Branch personnel prior to departure for the field investigation. All other chemical preservatives required for the remaining suite of

analytes will be supplied by ASB personnel and will be added to the samples by SESD field personnel or other authorized persons. The adequacy of sample preservation will be checked after the addition of the preservative for all samples, except for the samples collected for VOC analysis. If it is determined that a sample is not acceptably preserved, additional preservative should be added to achieve adequate preservation. Preservation requirements for surface water samples are found in the Analytical Support Branch *Laboratory Operations and Quality Assurance Manual, Most Recent Version.*

2.5 Quality Control

If possible, a control sample should be collected from a location not affected by the possible contaminants of concern and submitted with the other samples. In streams or other bodies of moving water, the control sample should be collected upstream of the sampled area. For impounded bodies of water, particularly small lakes or ponds, it may be difficult or inappropriate to obtain an unbiased control from the same body of water from which the samples are collected. In these cases, it may be appropriate to collect a background sample from a similar impoundment located near the sampled body of water if there is a reasonable certainty that the background location has not been impacted. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by pumps, bailers or other sampling equipment.

2.6 Records

Information generated or obtained by SESD personnel will be organized and accounted for in accordance with SESD records management procedures found in SESD Operating Procedure for Project File Management, SESDPROC-004-R0. Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation (SESD Operating Procedure for Field Records and Documentation, SESDPROC-204-R0 and SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005-R0).

3 General Considerations

3.1 General

The pore water sampling techniques and equipment described in the following Sections 4, 5 and 6 of this procedure document are designed to minimize effects on the chemical and physical integrity of the sample. If the procedures in this section are followed, a representative sample of the pore water should be obtained.

3.2 Collection Considerations

The physical location of the investigator when collecting a sample may dictate the equipment to be used. Wading is the preferred method for reaching the sampling location, particularly if the stream has a noticeable current (is not impounded). However, wading may disrupt bottom sediments causing biased results; therefore, the samples should be collected facing upstream. If the stream is too deep to wade, the pore water sample may be collected from a platform such as a boat.

3.3 Summary of Procedure

Sediment pore water is collected using a pore water extractor, called a PushPoint, made out of stainless steel tubing developed by M.H.E Products (Figure 1). The sampling end of the PushPoint is inserted into the sediment to the desired depth, and pore water is extracted using a syringe or peristaltic pump.

3.4 Sampling Equipment

The PushPoint sampler consists of a tubular 316 stainless steel body with a screened zone at one end and a sampling port at the other. It comes with a guard rod that is nested in the tube during deployment to provide structural support and to prevent plugging and deformation of the screened zone (Figure 1). The screened zone consists of a series of interlaced machined slots which form a short screened zone with approximately 20% open area. Additional filters can be placed over the screened zone if additional screening is needed. Pore water is collected through the opposite end of the PushPoint through flexible tubing using a syringe or peristaltic pump through the sampling port. Teflon tubing is the preferred tubing to be used with PushPoints. However, other tubing can be used, if allowed by data quality objectives for the specific application. PushPoints can be custom made to any width or length.

There are many modifications that can be incorporated into the procedure to satisfy data quality objectives for a specific application. The procedures discussed in the following sections provide guidance on the basic operation of the PushPoint and issues to consider when deploying the PushPoints to collect pore water.

3.5 PushPoint Deployment Considerations

It is critical in the collection of pore water to avoid surface water intrusion. Water will flow in a path of least resistance. If space is created around the sides of the PushPoint during deployment surface water may flow down the outside of the tube to the screened area and into the intended sample. Therefore, the PushPoint should be used with a sampling platform or flange (Figure 2), especially when collecting pore water near the sediment-surface water interface. If pore water is collected from deep in the sediments, a flange may not be necessary. When inserted though the sampling platform, or flange, the flange should fit securely around the PushPoint to eliminate surface water intrusion from around the PushPoint body during sample collection.

The flange can be made of any material that will not cross contaminate the intended sample. If full scan analytical analysis is required, the flange should be made of inert material such as stainless steel or Teflon. The size of the flange depends on the volume of pore water to be collected. If large volumes of pore water are to be collected, use a large flange size. If it is not practical to use a large flange, then multiple PushPoints with smaller flanges can be deployed and smaller volumes can be collected from several PushPoints for a composite sample. If multiple PushPoints are deployed, they should be spaced at least 30 cm apart.

3.6 PushPoint Basic Operation

The Push Point should be inserted through the flange and into the sediment as carefully as possible (Figure 2). When deploying the PushPoint, care must be taken not to disturb the sampling area. If sampler is wading in the water body, the sampler should lean out and insert the PushPoint as far as possible away from where the sampler is standing to reduce potential effects of the sampler on the integrity of the pore water sample. Depth of penetration of the PushPoint into the sediment depends on the objectives of the specific investigation.

After the PushPoint has been deployed, carefully remove the guard rod and attach the sample tubing (Figure 3). The other end of the sample tubing can be connected to the sample withdrawing device, such as a peristaltic pump or syringe (Figure 4). Before collecting a pore water sample, be sure to purge out all air and surface water from the PushPoint and sample tubing with the appropriate amount of pore water.

3.6.1 Peristaltic Pump/Vacuum Jug Collection

The peristaltic pump/vacuum jug can be used for sample collection because it allows for sample collection without the sample coming in contact with the pump head tubing. This is accomplished by placing a Teflon® transfer cap assembly onto the neck of a clean standard 1-liter amber glass container. Teflon® tubing (¼-inch O.D.) connects the container to both the pump and the sample source. The pump creates a vacuum in the container, thereby drawing the sample into the container without it coming into contact with the pump head tubing.

Because the sample is exposed to a vacuum and is agitated as it enters the vacuum jug, this method cannot be used for collection of samples for volatile organic compounds. An alternative method for collecting volatile organics involves filling the Teflon® tubing with sample by running the pump for a short period of time. Once the tubing is full of water, the tubing is removed from the PushPoint and, after the tubing is disconnected from the pump head tubing, the water is allowed to drain, by gravity, into the sample vials. Alternatively, without disconnecting the tubing from the pump head, the contained sample can be pushed out of the tubing, into the sample vials, by reversing the peristaltic pump at low speed.

For samples that are collected for metals analyses, or other analysis not effected by the silastic tubing, it is permissible to collect the sample directly from the discharge of the pump head tubing after an adequate purge has been demonstrated. When collecting samples in this manner, there are several considerations to be aware of. The pump head tubing (silastic, etc,) must be changed after each sample and a rinsate blank must be collected from a representative piece of the pump head tubing (only one blank per investigation). Also, precautions must be taken to ensure that the end of the discharge tubing is not allowed to touch the ground or other surface to ensure the integrity of the sample collected in this manner.

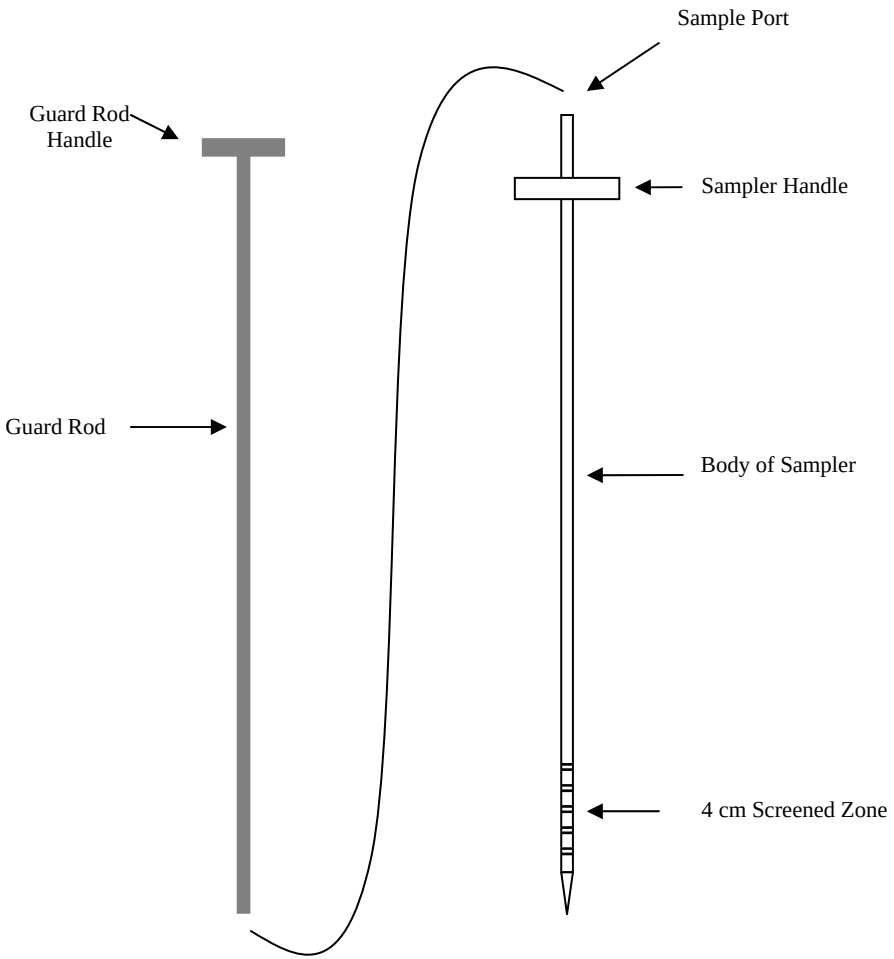
3.6.2 Syringe

Syringes in conjunction with PushPoint samplers can be used to collect pore water samples, if the integrity of the sample analysis is not compromised. The tubing from the sampling port of the PushPoint can be directly attached to a syringe and a pore water sample can be manually withdrawn from the sediment. The syringe can be used as the final sample container or the pore water can be transferred to another container, depending on project objectives and analytical requirements.

3.7 Specific Sampling Equipment Quality Assurance Techniques

All equipment used to collect pore water samples shall be cleaned as outlined in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205-R0 or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206-R0 and repaired, if necessary, before being stored at the conclusion of field studies. Cleaning procedures utilized in the field or field repairs shall be thoroughly documented in field records.

Figure 1. Pore Water PushPoint



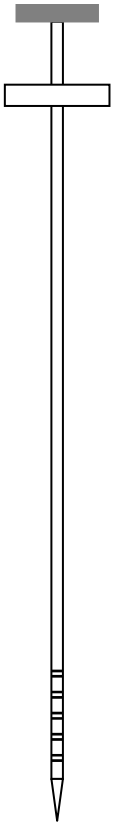


Figure 1A. Disassembled PushPoint

Figure 1B. Assembled PushPoint

Actual length and width of PushPoints will vary, depending on sampling needs and site conditions.

Figure 2. PushPoint deployed with a Sampling Platform

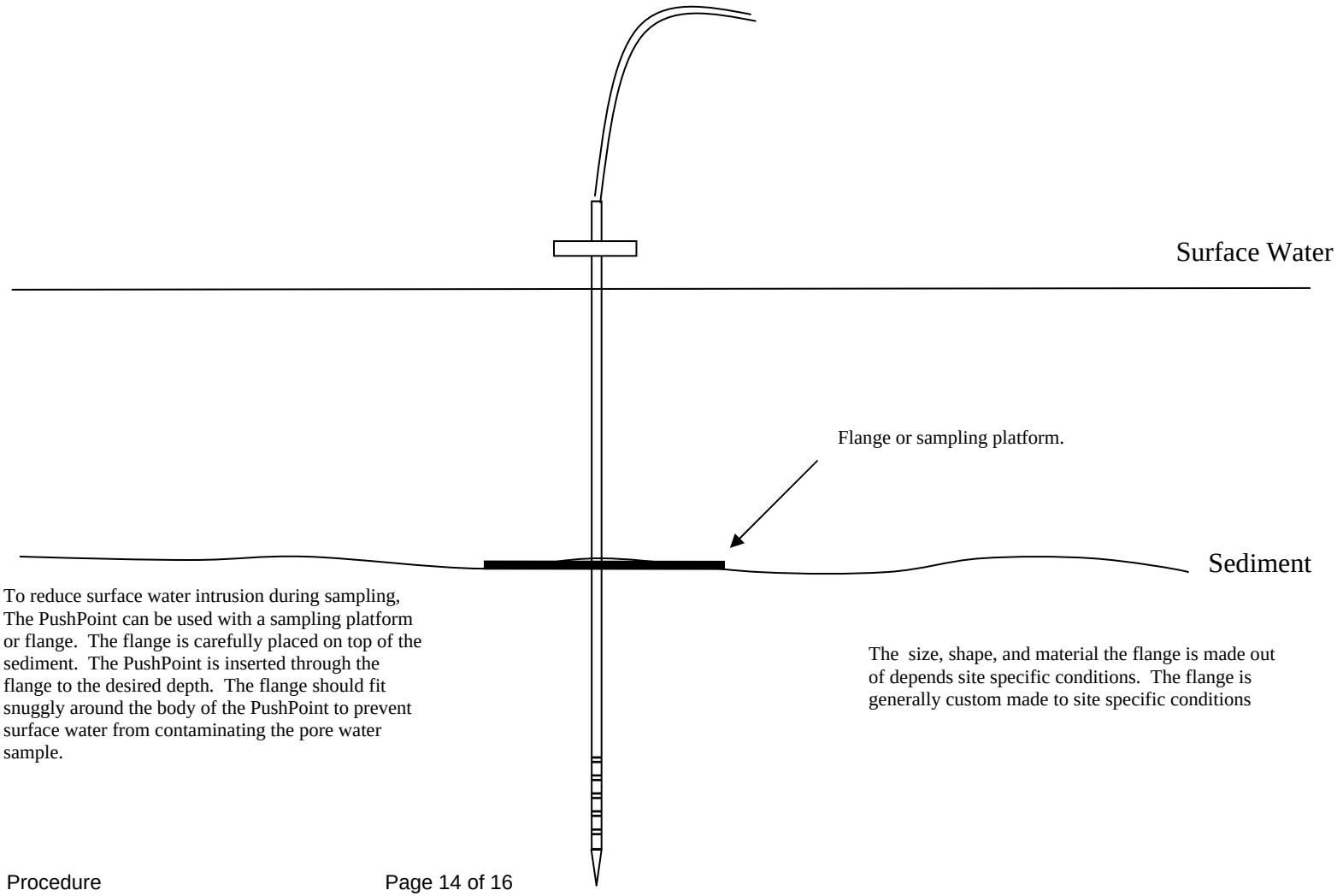


Figure 3. PushPoint Being Deployed into the Sediment

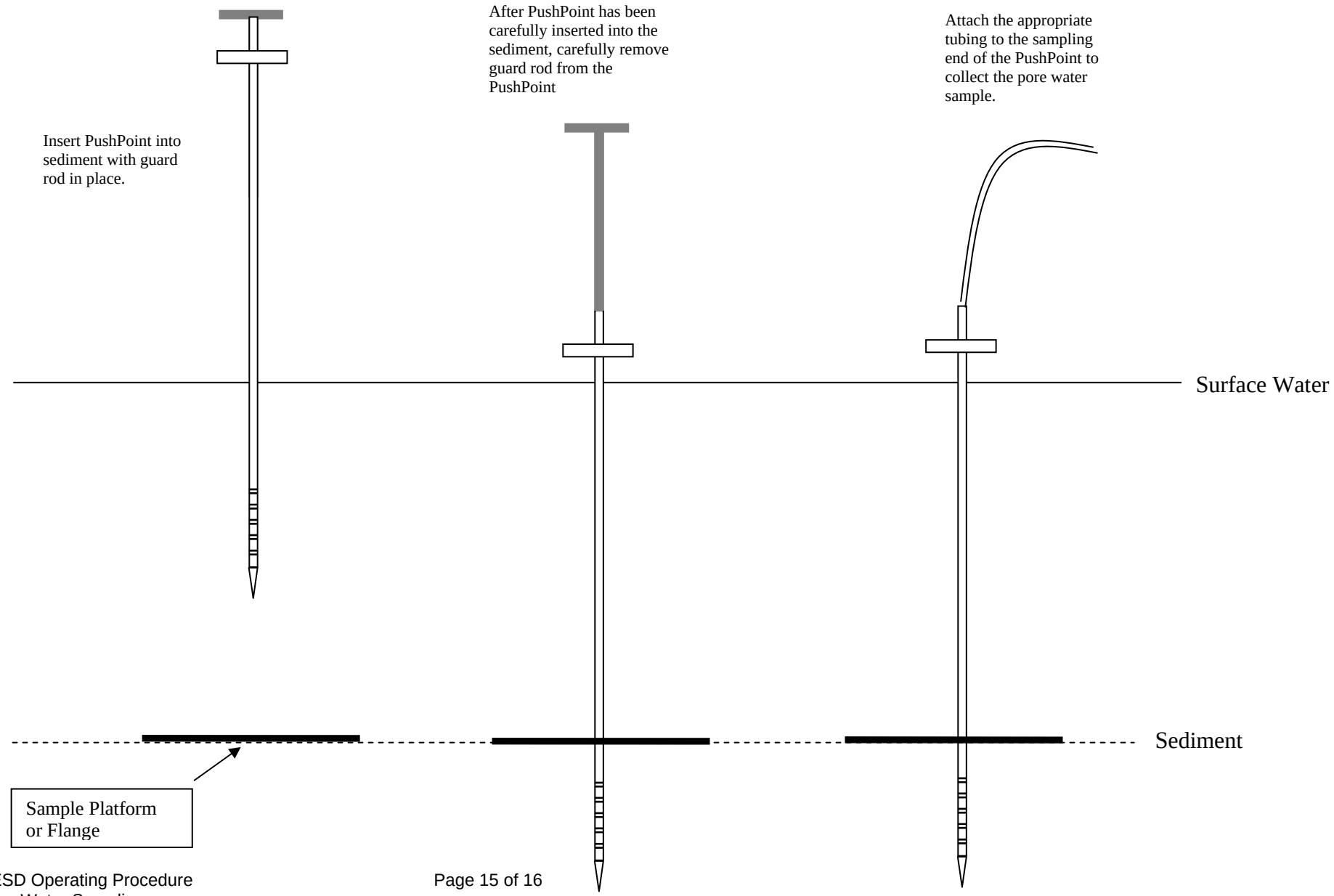


Figure 4 PushPoint deployed with a Sampling Platform using a Peristaltic Pump to Sample.