

Appendix A

Sampling and Analysis Plan Standard Operating Procedures and Field Forms

STANDARD OPERATING PROCEDURE 1

Test Pit Excavation and Sampling/Piezometer Installation/Water Level Measurements

Scope and Application

Test pits will be excavated at 12 locations within the Little Squalicum Park boundaries to further evaluate areas of historical landfill and gravel pit operations, which might have disturbed soils and distributed contamination throughout a depth range up to several feet. Soils will be collected from 1 ft intervals to an approximate depth of 3-4 ft using a stainless steel shovel, trowel, or spoon.

Three test pits (TP-3, TP-6, TP-12) will be excavated deeper (~6 ft) and piezometers will be installed while backfilling the hole to monitor groundwater levels at these locations. The piezometers will be 1-inch in diameter and made of PVC or stainless steel with slotted screens the entire depth of the installation.

Equipment and Reagents Required

- Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Site logbook and test pit log
- Indelible black-ink pens and markers
- Camera
- Backhoe and operator
- PVC or stainless steel piezometer
- 10-20 Silica sands (if required)
- Well monument, concrete, cap and lock
- Electronic water level indicator
- Stainless steel spoons, trowel, shovel, bowls
- Photoionization detector (PID)
- Plastic sheeting
- Paper towels

- Sample containers
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample labels and appropriate documentation
- Assorted geology supplies (e.g., hand lens, grain size card, scales, etc.)
- Decontamination equipment (SOP-8)

Procedures

Test Pit Excavation

1. Using a backhoe, remove the upper 1-2 ft of soil from an area approximately [5 ft by 5 ft] square, and place to one side of the excavation.
2. Continue the excavation downward using the backhoe, placing the soils on the opposite side of the excavation. Extend the pit vertically and horizontally until the appropriate depth and width are obtained (3-4 ft depth proposed for this project).
3. Collect samples at 1 ft intervals to a depth of 3 feet, and from the bottom of the pit using a stainless steel shovel, trowel or spoon. Personnel shall not enter an excavation if it is more than 4 feet deep. If deeper than 4 ft, use the backhoe bucket to collect a sample.
4. Place soil from desired depth directly into a stainless steel bowl for compositing. Collect soil from all sides of the excavation for each sample depth to provide enough material for analysis.
5. Homogenize soil within bowl/pan with decontaminated stainless steel trowel or spoon. Remove rocks, twigs, leaves and other large debris as appropriate. Fill sample containers for analytical parameters. (Volatiles samples should not be composited but collected from a discrete location within the depth interval.)
6. If groundwater with sheen or odors is encountered, collect a water sample. A sample from less than 4 feet in depth may be obtained by direct fill into bottles (if possible) or by using a decontaminated stainless steel scoop. A sample from a deeper depth should be collected using a stainless steel beaker clamped to a pole (or equivalent). Care should be exercised when pouring the water into the appropriate sample containers as not to aerate the sample. Personnel shall not enter an excavation if it is more than 4 feet deep.

7. Sketch a map of the trench showing the location (horizontally and vertically) of any stained soil layers, samples, buried wastes, etc. in the field notebook and/or on a test pit record form. Describe soil in accordance with ASTM D2488 on the sample log form.
8. Label and manage sample containers in accordance with SOP-7 for shipping and handling of samples.
9. Decontaminate sampling equipment in accordance with SOP-8.
10. Document activities in site logbook.
11. After completion of the trench or at the end of the day, whichever is more frequent, backfill the test trench(es). The soils from the deeper portion of the trench shall be returned to the trench first. If a trench was not completed and is backfilled at the end of a day, it may be restarted the next day from the point at which excavation ceased.
12. Mark the boundaries of the test pits and the ground surface location(s) of any soil/groundwater samples with stakes for subsequent surveying. Perform re-vegetation of the area as necessary and required.

Piezometer Installation

1. Once test pit has been sampled for chemical analysis as described above, excavate pit deeper until groundwater is encountered (~6 ft bgs).
2. Install 1-inch PVC or stainless steel piezometer with pre-packed slotted screen 2-3 feet below groundwater level if possible.
3. Backfill test pit around piezometer (soils are expected to be predominately coarse-grained materials (sands and gravels). If test pit soils are fine-grained, install 10-20 silica sand filter pack from 1 foot below the screen to a maximum of 3 feet above the screen, and then backfill test pit.
4. Cut PVC riser (for surface completions). Record cut length in site logbook.
5. Install concrete pad (minimum 3 feet by 3 feet by 6 inches) and locking protective monument (stand-pipe for each location). Install three bucking posts for standpipe completions, if necessary.

6. A lockable cap will be attached to the top of the casing. A protective cover, level with the ground surface, will be installed with a waterproof seal to prevent the inflow of surface water.
7. Decontaminate all equipment (SOP-8).
8. Document activities in the site logbook.
9. Ground surface at each piezometer will be surveyed to provide horizontal coordinates (northing/easting) and elevation.

Water Level Measurements

1. Rinse water level indicator probe and cable with deionized water and wipe dry with paper towels.
2. Holding cable reel atop casing, lower indicator probe gradually into well until tone and/or light indicates contact with water surface.
3. Grasp cable exactly at the measuring point marked at the top of the well casing with thumb and index finger. Pull cable out of well slowly to read measurement.
4. Record measurement depth to water surface to the nearest 0.01 ft as indicated on graduated cable.
5. Withdraw cable several feet then lower and repeat Steps 2-4. If readings differ by more than 0.2 ft, repeat until readings stabilize.
6. Remove cable and probe from well and rinse with deionized water.

STANDARD OPERATING PROCEDURE 2

Hand Auger Sampling

Scope and Application

Hand augers will be excavated at 8 locations within the Little Squalicum Park boundaries to evaluate soils along the Burlington Northern Santa Fe (BNSF) railroad right-of-way and an area northeast of Little Squalicum Creek suspected to be impacted by a historical OESER spill or contaminated runoff. Soils will be collected from 1 ft intervals to an approximate depth of 2 ft using a stainless steel hand auger or equivalent.

Equipment and Reagents Required

- Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Site logbook and hand auger log
- Hand auger, drive sampler, or equivalent
- Indelible black-ink pens and markers
- Camera
- Stainless steel spoons, bowls
- Photoionization detector (PID)
- Sample bottles
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample labels and appropriate documentation
- Assorted geology supplies (e.g., hand lens, grain size card, scales, etc.)
- Decontamination equipment (SOP-10)

Procedures

1. Remove vegetation in area of station.
2. Use hand auger/drive sampler to bore into subsurface soil to a depth of 1 ft below ground surface (bgs).

3. Empty soil from hand-auger/drive sampler cuttings directly into a stainless steel bowl for compositing. Collect enough soil from each depth interval for required analysis – this may require compositing up to 3 replicate samples at each station.
4. Describe soil in accordance with ASTM D2488 on the sample log form.
5. Homogenize soil within bowl/pan with decontaminated stainless steel trowel or spoon. Remove rocks, twigs, leaves and other large debris as appropriate. Fill sample containers for chemical parameters. (Volatiles samples should not be composited but collected from a discrete location within the depth interval from one auger sample.)
6. Collect the next depth interval (1-2 ft) and follow the same compositing procedures. Care should be taken in collecting representative soil from each depth interval.
7. Label and manage sample containers in accordance with SOP-9 for shipping and handling of samples.
8. Backfill sampling hole with remaining hand auger/drive sampler cuttings.
9. Decontaminate sampling equipment in accordance with SOP-10.
10. Document activities in site logbook.

STANDARD OPERATING PROCEDURE 3

Groundwater Sample Collection

Scope and Application

Groundwater samples will be collected from three locations within the Little Squalicum Park boundaries and one background location to be determined. There are two sampling rounds planned for this investigation, once in the wet season and once in the dry season. The wet season samples will be collected between October and May the dry season samples between June and September.

Equipment and Reagents Required

- Sampling and Analysis Plan (SAP)
- Site logbook
- Indelible black-ink pens and markers
- Sample tags/labels and appropriate documentation
- Appropriate laboratory glassware
- Oil/water interface probe (if necessary)
- Water level meter
- Groundwater parameter multi-meter capable of measuring pH, reduction/oxidation (redox) potential, temperature, specific conductance, turbidity, and dissolved oxygen
- Flow-through cell
- Field alkalinity test kit
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample containers, coolers, and blue ice or equivalent
- Sampling equipment (one or more of the following): Peristaltic pump; disposable, dedicated bailers; Grundfos Redi-Flow submersible pump (or equivalent); Reel E-Z® system including control box; portable generator (5,000 watt minimum)
- Water Sampling Log Forms
- Decontamination equipment (SOP-10)

Typical Procedures

Preparation:

1. Record necessary data in site logbook.
2. Prepare sampling equipment including calibration of field meters prior to use.
3. Move equipment and supplies to sampling location.
4. Decontaminate equipment according to SOP 10.

Purging:

1. Remove well cap.
2. Measure light nonaqueous phase liquid (LNAPL) thickness (if present), measure static water level and total depth of well.
3. Remove the pump from the pump holder and rinse the pump off with distilled water. After consulting the well log to determine depth to the middle of the well screen, slowly lower the pump into the well. Position the pump at the middle of the well screen.
4. Connect the discharge hose and cable for the control box to the Reel E-Z[®] system. Start the generator and set it to 120 volts. Make sure the generator is kept downwind from the sampling system.
5. Place the discharge hose in the flow-through box. Place the probes for the calibrated field meters into the flow-through box. Place a bucket beneath the flow-through box to catch purged water.
6. Turn on the pump and adjust flow rate to approximately 2 liters per minute.
7. After approximately 4 liters of water have been purged from the well, adjust the flow rate to 1 liter per minute.
8. Start recording field parameters every 4 liters of water purged. Purging should continue at a constant rate until the selected parameters shown below have stabilized for three consecutive measurements.

| Field Parameter | Stabilization Criteria |
|----------------------|---|
| Temperature | ± 1°C |
| pH | ± 0.1 pH units |
| Specific Conductance | ± 5 percent |
| Dissolved Oxygen | ± 10 percent |
| Redox Potential (Eh) | ± 50 mV |
| Turbidity | ± 10 nephelometric turbidity units (NTUs) |

Sampling:

1. After specified parameters have stabilized, turn down flow rate on control box so pressure is maintained in the system to stop water from entering well and minimize or stop water from exiting the well.
2. Disconnect discharge hose from Reel E-Z® system.
3. Connect Teflon® sampling tube to Reel E-Z® system. Place bucket beneath sampling tube to catch unsampled water.
4. Turn up flow rate slightly and fill necessary sample bottles. If sampling for volatile organic compounds (VOCs), flow rate should be just enough to create a trickle of water. If sampling for other analytes, adjust flow rate to 1 liter per minute.
5. Samples collected for dissolved metals shall be field filtered by connecting a 0.45 micron in-line filter to the sampling tube. Dispose of filter after each sample.
6. Label and manage sample containers in accordance with SOP 9 for shipping and handling of samples.

Documentation:

1. Fill out one Water Sampling Log Form for each sample collected with all necessary information recorded in the site logbook.

STANDARD OPERATING PROCEDURE 4

Shallow Surface Water Sample Collection

Scope and Application

Surface water samples will be collected from seven locations within the Little Squaticum Park boundaries and a background location to be determined. There are two sampling rounds planned for this investigation, both during the wet season. The wet season samples will be collected between October and May.

Equipment and Reagents Required

- Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Site logbook and sample log
- Indelible black-ink pens and markers
- Camera
- Any of the following equipment may be used to collect samples:
 - A Teflon/stainless steel scoop with a Teflon/stainless steel handle
 - A stainless steel beaker clamped to a pole
 - Sample bottles (direct fill)
 - Portable peristaltic pump with Teflon tubing
- Water quality meter(s)
- pH paper
- Sample containers
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample labels and appropriate documentation
- Decontamination equipment (SOP-10)

Procedures

Surface water samples shall be collected moving in an upstream direction utilizing the following procedure:

1. Immediately before collecting the sample, record the temperature, dissolved oxygen, pH, turbidity, and specific conductance using a Horiba® water quality meter or equivalent and following the manufacturer's specifications.
2. Submerge the bottle, beaker or scoop and collect a sample. When pouring the water from a beaker or scoop into another bottle container, care should be exercised so as not to aerate the sample. VOC samples will be collected first.
3. A peristaltic pump can also be used if available.
4. Preserve containers as follows:
 - a. VOCs - Determine the volume of 1:1 HCl preservative required to adjust the pH of the sample to less than 2 on an extra 40 ml glass vial prior to sampling. Pre-preserve sample bottles with the determined volume of HCl (if possible) and fill with sample. Check the bottle for the presence of trapped air by tapping the bottle when filled and capped.
 - b. Other Parameters - Add appropriate volume of preservative (as specified in the SAP) to sample bottle. Verify pH by pouring a minimal portion of the sample onto broad range pH paper.
5. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
6. Place the analytical samples in a cooler for shipment and chill to 4°C (SOP-9).
7. Decontaminate sampling equipment in accordance with SOP-10.

STANDARD OPERATING PROCEDURE SOP-5

Sediment Sampling – Shallow Water

Scope and Application

Surface sediment sampling will be conducted at 6 locations within Little Squalicum Creek to define the extent of hot spots detected during previous investigations (i.e., Ecology 2004 study). A background sediment sample will also be collected at a location(s) to be determined. Surface sediments will be collected using a stainless steel shovel or trowel. Sediment samples will be obtained following the collection of surface water samples at each location, if possible, and will be collected moving in an upstream direction.

Equipment and Reagents Required

- Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Site logbook and sample log
- Indelible black-ink pens and markers
- Camera
- Stainless steel shovel, trowel, or spoon
- Photoionization detector (PID)
- Ponar grab (or equivalent), in deeper water
- Sample containers
- Sample labels and appropriate documentation
- Assorted geology supplies (e.g., hand lens, grain size card, scales, etc.)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Decontamination equipment (SOP-10)

Procedures

1. After collection of surface water samples at a location, use a decontaminated stainless steel shovel or trowel to scrape away surficial organic material (grass, leaves, etc.).

2. Obtain sediment for analysis using a stainless steel shovel, trowel or spoon from the surface to 4 inches below sediment surface. Fill sample container for volatile (e.g., H₂S) parameters as discrete grab samples. Then, empty remaining contents of shovel/trowel into a decontaminated stainless steel bowl or pan. Repeat until enough sediment is collected to fill all other required containers.
3. Homogenize sediment within bowl/pan with decontaminated stainless steel trowel or spoon. Remove rocks, twigs, leaves and other large debris as appropriate. Fill sample containers for remaining chemical parameters. (Volatiles samples should not be composited but collected from a discrete location within the depth interval.)
4. Describe soil in accordance with ASTM D2488 on the sample log form.
5. Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.
6. Place the analytical samples in coolers for shipment and chill to 4°C (SOP-9).
7. Decontaminate sampling equipment in accordance with SOP-10.

STANDARD OPERATING PROCEDURE 6

Hollow-Stem Auger Drilling/Sediment Sampling

Scope and Application

Sediment borings will be advanced at 24 locations to define the width and depth of contamination in Little Squalicum Creek. After surface samples have been collected, sediment borings will be collected along three transects (3-5 borings each) across the creek bed, using a track-mounted, portable, hollow stem auger to collect samples at depth. The drill rig proposed for this work has a small foot-print allowing maneuverability within the creek bed without excessive disturbance of creek sediment, bank soils, and vegetation.

Required Equipment

- Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Site logbook and boring log
- Indelible black-ink pens and markers
- Camera
- Hollow-stem auger drill rig
- Driller and helper
- Split-spoon samplers
- Photoionization detector (PID)
- Plastic sheeting
- 55-gallon drums (if required)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample labels and appropriate documentation
- Assorted geology supplies (e.g., hand lens, grain size card, scales, etc.)
- Decontamination equipment (SOP-10)

Typical Procedures

Preparation:

1. Conduct site activity/health and safety briefing.
2. Calibrate field instrumentation.
3. Record necessary data in field logbook.
4. Obtain photograph(s) of site before drilling.
5. Place plastic sheeting and/or drums at drilling location to collect cuttings (if necessary).
6. Move equipment and supplies to drilling location.
7. Set up decontamination and sampling stations.

Construction:

1. Obtain surface soil samples, if required.
2. Drill to first sampling depth, as described in the SAP.
3. Place decontaminated split-spoon sampler on center rods.
4. Drive split-spoon sampler as described in American Society for Testing and Materials (ASTM) Method D-1586. Drive sampler to 18 inches or to refusal (no progress for 50 blows). Record blow counts on boring log form. Retrieve sampler.
5. A larger 3-inch diameter, 2-ft length split-spoon may be used to obtain more sediment from each depth interval.
6. Screen sampler with PID (if required).
7. Describe soil in accordance with ASTM D2488 on the boring log form.
8. Composite soil sample as necessary. If volatile organic compound (VOC) samples are to be collected, collect sample prior to describing soil.
9. Continue drilling to next sample location. Collect samples as outlined above.
10. Label and manage sample containers in accordance with SOP-9 for shipping and handling of samples.
11. Decontaminate sampling equipment in accordance with SOP-10.
12. Document activities in site logbook.

13. Since the total depth of each boring will be only 5 ft below sediment surface, boreholes can be filled with cuttings after hole is complete. No grouting of borehole is required.
14. Move to next location.

STANDARD OPERATING PROCEDURE 7

Archaeological Site Boundaries

Scope and Application

The boundaries of archaeological sites (shell midden) will be evaluated within Little Squalicum Park. There is one known site located upstream of the railroad bridge, in the lower reach of the creek. The following SOP will be followed by Integral and its subcontractor Dr. Gary Wessen during this investigation.

Equipment Required

- Shovel
- Screen box with ¼ inch mesh
- Pin flags
- EDM or 30 meter tape
- Hand-held GPS Receiver
- Camera
- Decontamination equipment (SOP-10)

Procedures

1. Careful visual inspection of all available horizontal and vertical exposures.
2. Establish the extent of the presently visible cultural materials and mark the boundaries of this area with pin flags.
3. Once the latter is done, shovel testing is used to further refine our knowledge of the site's boundaries. (Washington State law forbids the knowing disturbance of an archaeological site - - including any type of sample collection - - without a permit, and so this effort will be conducted without actually impacting the site.)
4. Radial transects will be established out from the marked site boundary. (Depending upon the site's size and shape, four to six transects will be established.)

5. Starting at a point 10 meters beyond the marked site boundary - - on one of the transects - - a small (i.e., 30 centimeter diameter) shovel test pit will be dug.
6. Digging will be done in 10 centimeter arbitrary levels and the sediments recovered from each level will be screened through ¼ inch mesh in order to facilitate the recognition of any cultural materials that might be present.
7. Digging will stop as soon as either potentially intact archaeological deposits or obvious glacial deposits are encountered.
8. Once the first pit is completed, additional pits will be dug at 3 meter intervals on the transect - - moving either toward or away from the site, as appropriate - - until the edge of the buried cultural deposit is located.
9. Steps 5 through 8 will be repeated on each transect.
10. When the shovel testing is completed, additional pin flags marking the extent of the buried cultural deposit will be placed and a map showing the distribution of both the exposed materials and the buried deposits will be prepared.
11. The site are will be photographed and its location recorded with a hand-held GPS receiver in both UTM and State Plane coordinates.
12. At the completion of the effort, all of the shovel test pits will be backfilled and all pin flags will be removed from the area. Wooden stakes or equivalent may be driven along the boundaries of each site for future reference.
13. Decontaminate sampling equipment in accordance with SOP-10.
14. Document activities in site logbook.

STANDARD OPERATING PROCEDURE SOP-8

Hydrocarbon Field Screening for Soil and Sediment

Scope and Application

This SOP presents the qualitative field screening methods for hydrocarbons in soil and sediments.

Equipment and Reagents Required

- Clean stainless steel or plastic pan
- Camera
- Ziploc® bags
- Photo ionization detector (PID) or flame ionization detector (FID)

Procedures

Headspace Field Screening

1. Calibrate PID/FID in accordance with the manufacturer's specifications.
2. Label Ziploc® bag with the sample number.
3. Place representative soil/sediment sample in Ziploc® bag until bag is approximately one-half full. Seal Ziploc® bag and homogenize sample.
4. Allow bag to sit at ambient temperature for approximately 10 minutes. Place PID/FID wand into bag, being careful not to contact soil/sediment with probe.
5. Shake Ziploc® bag and record highest sustained reading in the field logbook.

Visual Screening

Visual screening consists of inspecting the soil/sediment for the presence of stains indicative of residual petroleum hydrocarbons. Visual screening is generally more effective in detecting the presence of heavier petroleum hydrocarbons, such as motor oil, or when hydrocarbon concentrations are high.

1. Visually inspect soil/sediment sample.
2. Indications of the presence of hydrocarbons typically include a mottled appearance or dark discoloration of the soil/sediment.
3. Record observations in logbook. Note: Visual observations do not definitively indicate the presence of hydrocarbons.

Sheen Screening

Sheen testing involves immersion of the soil/sediment sample in water and observing the water surface for signs of sheen.

1. A representative soil/sediment sample is placed into a clean stainless steel or plastic pan filled with deionized water with as little disturbance as possible.
2. Record observations in the logbook. Visual evidence of a sheen forming on the surface of the water is classified as follows:

No sheen (NS)--No visible sheen on the water surface

Colorless Sheen (CS)--Light, nearly colorless sheen; spread is irregular, not rapid; film dissipates rapidly (Note: light colorless sheens can be confused with sheens produced by organic content). Note that this sheen may or may not indicate the presence hydrocarbons.

Heavy Sheen (HS)--Light to heavy colorful film with iridescence; stringy, spread is rapid; sheen flows off the sample; most or all of water surface is covered with sheen

Note: Samples used for field screening shall not be used for other analyses.

STANDARD OPERATING PROCEDURE SOP-9

Shipping and Handling of Samples

Equipment and Reagents Required

- Sampling and Analysis Plan (SAP)
- Site logbook
- Sample logs
- Sample labels
- Indelible black ink pens
- Ziploc® bags
- Cooler
- Blue Ice® or other ice packs
- Strapping tape or duct tape
- Chain of custody forms
- Custody seals
- Bubble wrap, newspaper, or other packing material

Procedures

NOTE: Before packaging, all samples will be individually labeled and noted in the site logbook by the sampler. Labels will be completed with all required information (refer to SAP). The samples will be assigned individual numbers that describe sample type and sample location. The sample numbers will be used to complete the chain-of-custody forms and track the samples.

Samples to be hand-delivered to the laboratory:

1. Place each sample in a plastic Ziploc® bag and align the label so it can be easily read. Seal the bag.
2. Place individual samples into the cooler so that each container is safely secured.
3. Include enough (four or more) ice packs to maintain a temperature of 4°C or lower.
4. Complete a chain-of-custody form for the containers and seal in a Ziploc® bag.

5. Tape bag containing the chain-of-custody form to the inside of the cooler lid. Always transport the cooler together with its accompanying chain-of-custody form.
6. Close and latch cooler and affix signed custody seals over the edge of the lid and the top of the cooler body at front and rear.
7. Deliver samples to the laboratory and obtain a signed copy of the chain-of-custody form for tracking purposes.

Samples to be shipped to the laboratory:

1. Place each sample in a plastic Ziploc® bag and align the label so it can be easily read. Seal the bag.
2. Wrap each sample with bubble wrap, newspaper, or other packing material.
3. Place individual samples into the cooler so that the addition of Blue Ice® and/or packing materials will prevent significant movement of samples during shipping. Keep in mind that we cannot predict in what position the cooler will be shipped. Each container has clearance on all sides.
4. Fill the void spaces with ice packs, bubble wrap, newspaper, or other packing material to ensure samples do not break during shipment.
5. Cover the head space inside the cooler with ice packs.
6. Tape bag containing the chain-of-custody form to the inside of the cooler lid. Remember to remove the last copy of the form for tracking purposes.
7. Close and latch cooler, and wrap cooler and lid with at least two turns of strapping, duct, or packaging tape. Affix signed custody seals over the edge of the lid and the top of the cooler body at front and rear.
8. Label coolers with up arrows and information to comply with Department of Transportation requirements.
9. Notify the laboratory approximately when and how many samples will arrive. The samples must be kept under refrigeration (or packed with ice) between sampling and analysis.

Note: If samples are to be stored overnight before shipping, they must be secured in a locked room or other inaccessible area. The cooler should be sealed with a signed and dated custody seal. Before shipping, the Blue Ice® in the cooler should be replaced and the cooler resealed according to the instructions in this SOP. Samples may be shipped in coolers or any other sturdy, water-tight, appropriate container. This SOP refers to coolers for simplicity and because they are the most common type of transport container.

STANDARD OPERATING PROCEDURE SOP-10

Equipment Decontamination

Scope and Application

This SOP describes procedures for decontamination of sampling equipment, drilling equipment and other tools that could come in contact with contaminated media (Ecology 2003, PSEP 1997). Personnel performing the decontamination procedures will wear protective clothing as specified in the site-specific Health and Safety Plan.

Equipment and Reagents Required

- Plastic sheeting
- Steam cleaner and collection basin (if required)
- 55-gallon drums (if required)
- Non-phosphate detergent (e.g., Alconox or Liquinox).
- Acid Rinses (inorganic constituents) shall be reagent grade diluted nitric or hydrochloric acid (if required)
- Solvent Rinses (organic constituents) shall be pesticide grade methanol, hexane, isopropopanol or acetone (if required)
- Deionized or distilled water rinse available from retail stores. Note that distilled water generally contains low levels of organic contaminants and can not be used for field blanks (must receive reagent-grade from laboratory).
- Tap water rinse from local tap water.
- 5-gallon buckets, or other appropriate containers
- Scrub brushes
- Teflon squirt bottles
- Gloves (e.g., nitrile or polyethylene)
- Personal protective clothing

Procedures

Drill Rig or Test Pit Sampling Equipment Decontamination Procedures

1. Decontaminate sampling equipment before use, between samples and stations, and upon completion of sampling operations.
2. Equipment used during drilling/test pit operations should be decontaminated in the Exclusion Zone prior to transport to the Support Zone (refer to HASP).
3. If the steam cleaning location is in an area outside of the Exclusion Zone, remove loose sediment on the drill rig, augers, drill pipe and rods, and other large equipment at the drill site, then move the equipment directly to the steam cleaning decontamination area for more thorough cleaning.
4. To decontaminate a drill rig or backhoe, pressure wash with a steam cleaner using potable water rinse upon mobilization, between drilling locations, and upon demobilization. Cleaning water can be allowed to drain directly on the ground near the station.
5. To decontaminate auger, drill rods, and other downhole tools, pressure wash with a steam cleaner and potable water rinse upon mobilization, between drilling locations, and upon demobilization.
6. To decontaminate split-spoon and hand-auger samplers, wash with laboratory-grade detergent/water solution, rinse with tap water and a final distilled water rinse. If the samplers were exposed to visibly contaminated sediments (e.g. creosote, diesel, etc), include a methanol rinse followed by a hexane rinse. The hexane rinse would be followed by another distilled water rinse. To the extent possible, allow to air dry prior to sampling. If the split-spoon is not used immediately, wrap it in aluminum foil.

Decontamination of Sampling Implements and Processing Materials

1. Decontaminate sampling implements (e.g., spoons and knives) and other processing materials such as mixing bowls and pans, before use, between samples, and upon completion of sampling operations.
2. To decontaminate sampling spoons, mixing bowls and other hand-held tools, wash using a laboratory-grade detergent/water solution, rinse with tap water, followed by distilled water or ASTM Type II Reagent-grade water. As described above, if the sediment is visibly contaminated, a hexane rinse may be necessary

following a methanol rinse to remove water. To the extent possible, allow to air dry. Once decontaminated, this equipment will be wrapped in aluminum foil to prevent contamination by airborne contaminants during transportation to the sampling site.

3. To decontaminate sampling spoons used to collect volatile organics, wash the spoon using a laboratory-grade detergent/water solution, and rinse with distilled water. Wrap the spoon in aluminum foil. The solvent rinses are eliminated in order to avoid interference with the analysis.
4. If necessary, to decontaminate wash buckets, pressure wash with a steam cleaner using a laboratory-grade detergent/water solution and potable water rinse upon mobilization, between station locations, upon demobilization, or as needed during sampling operations.

References

Ecology. 2003. Sediment sampling and analysis plan appendix. Guidance on the development of sediment sampling and analysis plans meeting the requirements of the sediment management standards (Chapter 173-204 WAC). Prepared by Washington State Department of Ecology, Olympia, WA

PSEP. 1997. Recommended guidelines for sampling marine sediment, water columns, and tissue in Puget Sound. Final report. Prepared for the Puget Sound Estuary Program, U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA, and Puget Sound Water Quality Authority, Olympia, WA.

STANDARD OPERATING PROCEDURE SOP-11

Quality Control Sample Preparation

Scope and Application

To establish procedures for preparation of field quality control samples collected during field investigations as described in the Sampling and Analysis Plan (SAP).

Equipment and Reagents Required

- Sample labels
- Indelible ink pens
- Master Sample Log and Chain-of-Custody Record forms
- Sample Bottles with preservatives (if required)

Procedures

The following procedures describe the preparation of various types of field quality control samples. Although general collection frequencies are given below, the type and number of quality control samples collected is dependent upon project specific requirements.

Trip Blanks

Trip blanks are 40-milliliter (40-mL) glass sample bottles (with septum lids) filled in the analytical laboratory with analyte-free water. They are shipped to the field with the empty sample coolers and stored with those bottles until they are used. One set of trip blank samples are enclosed in each sample cooler sent to the analytical laboratory which contains volatile organic compound samples for analysis. The field scientists do not open or otherwise disturb these samples except to label them with a sample number, if required, and prepare them for shipment with environmental samples. Trip blanks are analyzed for volatile organic compounds only.

Equipment Rinsates

Equipment rinsates are collected by capturing the final distilled water rinse from equipment cleaning. Decontamination procedures are detailed in SOP-10. These samples are collected during a sampling event by filling a full suite of environmental sample

containers with rinse water using the same procedures employed for collection of environmental water samples. The results are used to flag analytical data and/or assess the concentrations of analytes in environmental samples during the data validation process. Rinsate samples are analyzed for the same compounds as related environmental samples.

Field Blanks

Field blanks are collected in the field during sampling activities by filling a full suite of environmental sample containers with analyte-free or distilled water, at the field sampling location, by pouring water from analyte-free water containers directly into the sample containers. At a minimum, one field blank will be collected during each sampling event. Field blanks are analyzed for the same compounds as related environmental samples.

Field Duplicates/Splits

Duplicates or splits, except for volatile organic compound analyses, are collected, homogenized, and split at the sampling location. Volatile organic compound sediment samples are collected from the length of the sediment grab or core, and placed immediately into appropriate sample containers for packaging and shipment to the analytical laboratory. Duplicate water samples are collected simultaneously by alternately filling similar sample bottles during the collection procedure. Duplicate samples may either be submitted to the analytical laboratory as a blind sample, or may be identified to the laboratory, depending on project objectives. Duplicate environmental samples are analyzed for the same suite of analytes.

Field Replicate Samples

Field replicate samples are collected as separate samples from the same location as the initial sample collected. Unlike duplicate/split samples, they are not subsamples of one homogenous sample. They are collected and processed according to the same procedures followed for the initial sample. Similar to the field duplicates, they may either be submitted to the analytical laboratory as blind samples, or may be identified as replicate samples, depending on project objectives. Replicate environmental samples are analyzed for the same suite of analytes as the initial sample.

Water Source Blanks

Water source blanks are collected in the field during sampling activities by filling a full suite of environmental sample containers with water from the source used for decontamination and steam cleaning using the same procedures employed for collection

of environmental water samples. At a minimum, one water source blank will be collected during each sampling event (the time frame determined by the arrival of sampling personnel at a sampling area until those personnel leave for more than one day) and from each source of water used in decontamination and steam cleaning. Water source blanks are analyzed for the same compounds as the related environmental samples.

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT _____ SAMPLE NO. _____
DATE _____ TIME _____ SAMPLED BY _____
WEATHER CONDITIONS _____

SAMPLE LOCATION _____
SAMPLE DEPTH _____
SURFACE WATER FLOW RATE _____
SURFACE WATER TYPE _____
SAMPLE CONDITION (i.e. turbidity, odor, oily) _____

SAMPLE COLLECTION
COLLECTION METHOD _____
COLLECTION TIME _____

SAMPLE INFORMATION pH _____ COND. _____ T(C) _____ D.OXYGEN _____
ANALYSIS CONTAINERS SAMPLE PREP/PRESERVATION

CHAIN OF CUSTODY FORM _____ COC TAPE _____
SHIPPING CONTAINER _____

COMMENTS _____

EQUIPMENT CALIBRATION AND MAINTENANCE FORM (TYPICAL)

INSTRUMENT (NAME / MODEL NO. / SERIAL NO.): _____

MANUFACTURER: _____ DATE PURCHASED or LEASED: _____

CALIBRATION LOGSHEET

| Calibration Date | Initial Settings | Standard(s) Used | Procedure | Adjustments Made | Final Settings | Signature of Operator | Comments |
|------------------|------------------|------------------|-----------|------------------|----------------|-----------------------|----------|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

MAINTENANCE LOGSHEET

| Maintenance Date | Reason for Maintenance | Maintenance Performed | Signature of Operator | Comments |
|------------------|------------------------|-----------------------|-----------------------|----------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: _____ Project No.: _____
Client: _____ Request No.: FCR-_____

To: _____ Date: _____

Field Change Request Title: _____

Description:

Reason for Change:

Recommended Disposition:

Field Operations Lead (or designee) Signature Date

Disposition:

Project Manager Signature Date

Approval:

Project Manager Signature Date

Distribution:

City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead

QA Officer
Project File
Other:

(Additional Field Forms will be provided in Final SAP)

Appendix B

Sampling and Analysis Plan Biological Results

Table B-1. 10-day Amphipod Sediment Toxicity Test Results.

| Sample | <i>Hyalella azteca</i> | |
|-----------------|------------------------|-----------------------------------|
| | Mean Survival (%) | Mean Dry Weight per Organism (mg) |
| Lab Control | 88 | 0.1 |
| SD9 (Reference) | 91 | 0.24 |
| SD1 | 88 | 0.18 |
| SD2 | 90 | 0.13 |
| SD3 | 93 | 0.15 |
| SD4 | 78 | 0.18 |
| SD5 | 81 | 0.14 |
| SD6 | 93 | 0.2 |
| SD7 | 83 | 0.2 |
| SD8 | 93 | 0.16 |
| SD10 | 93 | 0.15 |

Table B-2. 28-day Oligochaete Sediment Bioaccumulation Test Results.

| Sample | <i>Lumbriculus varietagus</i> | | | Sediment TOC (%) |
|-------------|-------------------------------|-------------------|------------------------|------------------|
| | Replicate | Tissue Weight (g) | Mean Tissue Weight (g) | |
| Lab Control | A | 9.84 | 8.89 | unknown |
| | B | 9.79 | | |
| | C | 9.75 | | |
| | D | 7.99 | | |
| | E | 7.1 | | |
| SD2 | A | 3.36 | 3.69 | 1.3 |
| | B | 3.69 | | |
| | C | 5.24 | | |
| | D | 3.3 | | |
| | E | 2.85 | | |
| SD5 | A | 3 | 2.89 | 1.8 |
| | B | 2.47 | | |
| | C | 3.08 | | |
| | D | 4.64 | | |
| | E | 1.24 | | |
| SD6 | A | 7.98 | 11.21 | 11 |
| | B | 6.19 | | |
| | C | 10.26 | | |
| | D | 14.24 | | |
| | E | 17.36 | | |

Table B-3. Sediment Oligochaete Tissue Concentrations.

| Analyte | Location Study | <i>Lumbriculus variegatus</i> | | | Sediment | | |
|-----------------------|----------------|-------------------------------|---------------|-----------------------|---------------|---------------|---------------|
| | | SD2 & SD5 RI | SD6 RI | Laboratory Control RI | SD2 RI | SD5 RI | SD6 RI |
| Dioxins | | | | | | | |
| 1,2,3,4,7,8-HxCDD | ng/Kg | 7.394 | NA | 0.203 U | 3.81 | 4.95 | 16.7 |
| 1,2,3,6,7,8-HxCDD | ng/Kg | 119.97 | NA | 0.14 U | 223 | 30 | 79.6 |
| 1,2,3,4,6,7,8-HpCDD | ng/Kg | 1883.7 J | NA | 1.907 UJ | 10100 | 978 | 25100 |
| 1,2,3,4,6,7,8-HpCDF | ng/Kg | 292.16 | NA | 0.193 U | 1950 | 163 | 421 |
| 1,2,3,4,7,8,9-HpCDF | ng/Kg | 15.07 | NA | 0.275 UJ | 68.3 | 10.7 | 31.6 |
| OCDD | ng/Kg | 16282.4 | NA | 20.121 UJ | 126000 | 60200 | 304000 |
| OCDF | ng/Kg | 856.7 | NA | 0.801 UJ | 11500 | 1210 | 39400 |
| Total TCDD | ng/Kg | 11.2 | NA | 0.128 U | 3.4 | 0.345 | 2.23 |
| Total TCDF | ng/Kg | 30.1 | NA | 0.182 U | 23 | 0.558 | 1.74 |
| Total PeCDD | ng/Kg | 6.8 | NA | 0.197 U | 5.6 | 1.25 | 9.85 |
| Total PeCDF | ng/Kg | 231.3 | NA | 0.166 U | 337 | 31.9 | 90.9 |
| Total HxCDD | ng/Kg | 346.8 | NA | 0.14 U | 820 | 130 | 381 |
| Total HxCDF | ng/Kg | 982.5 | NA | 0.141 U | 1800 | 175 | 473 |
| Total HpCDD | ng/Kg | 3346.2 | NA | 1.36 | 18500 | 1780 | 43500 |
| Total HpCDF | ng/Kg | 307.2 | NA | 1.27 | 1950 | 174 | 453 |
| TEQ (ND=0.5 DL) | ng/Kg | 36.36 | NA | NA | 320.96 | 81.25 | 624.13 |
| SVOCs | | | | | | | |
| 2,4,6-Trichlorophenol | mg/kg | NA | 0.74 J | 0.13 U | 0.013 | 0.013 | 0.031 |
| 2-Methylphenol | mg/kg | NA | 1 J | 0.13 U | 0.013 | 0.013 | 0.031 |
| 3&4-Methylphenol | mg/kg | NA | 3.3 J | 0.27 J | 0.013 | 0.012 | 0.1 |
| Anthracene | mg/kg | NA | 0.37 | 0.027 U | 2.2 | 0.061 | 0.56 |
| Benzo(a)anthracene | mg/kg | NA | 0.17 J | 0.027 U | 3.7 | 0.12 | 1.7 |
| Benzo(a)pyrene | mg/kg | NA | 0.4 | 0.027 U | 2.4 | 0.34 | 1.4 |
| Benzo(b)fluoranthene | mg/kg | NA | 0.28 J | 0.027 U | 0.82 | 0.15 | 0.7 |
| Benzo(j)fluoranthene | mg/kg | NA | 0.28 J | 0.27 U | | | |
| Benzo(k)fluoranthene | mg/kg | NA | 0.28 J | 0.027 U | 0.82 | 0.15 | 0.7 |
| Benzoic acid | mg/kg | NA | 5.3 J | 0.27 U | 0.026 | 0.026 | 0.061 |
| Benzyl alcohol | mg/kg | NA | 13 J | 1.5 J | 0.013 | 0.013 | 0.031 |
| Chrysene | mg/kg | NA | 0.46 J | 0.027 U | 8.3 | 0.23 | 2.2 |
| Fluoranthene | mg/kg | NA | 1.3 | 0.027 U | 0.47 | 0.1 | 3.2 |
| Naphthalene | mg/kg | NA | 0.11 | 0.027 U | 0.024 | 0.0058 | 0.025 |
| Pentachlorophenol | mg/kg | NA | 2.1 J | 0.13 UJ | 0.033 | 0.056 | 0.46 |
| Phenanthrene | mg/kg | NA | 0.48 | 0.027 U | 0.61 | 0.041 | 0.41 |
| Phenol | mg/kg | NA | 0.34 J | 0.13 U | 0.013 | 0.013 | 0.031 |
| Pyrene | mg/kg | NA | 0.43 J | 0.027 U | 0.66 | 0.096 | 2.9 |
| Tetrachlorophenols | mg/kg | NA | 4 J | 0.13 U | 0.0054 | 0.013 | 0.079 |

NA = not applicable
 Bold font indicates detected concentrations

Table B-4. Berry Tissue Concentrations.

| Analyte | Sample Location Treatment Study Date | 99070520 | 99070521 | 99070522 | 99070523 | 99070524 | 99070525 | 99070524 | 99070525 |
|------------------------|---|---------------------------------------|---|---------------------------------------|---|---------------------------------------|---|--|--|
| | | Berry 1 Washed RI 8/20/1999 | Berry 1 Unwashed RI 8/20/1999 | Berry 2 Washed RI 8/20/1999 | Berry 2 Unwashed RI 8/20/1999 | Berry 3 Washed RI 8/20/1999 | Berry 3 Unwashed RI 8/20/1999 | Berry 4 (Reference) Washed RI 8/20/1999 | Berry 4 (Reference) Unwashed RI 8/20/1999 |
| Dioxins | | | | | | | | | |
| 1,2,3,4,6,7,8-HpCDD | ng/Kg | 1.50 U | 3.19 U | 1.59 U | 2.7 | 2.21 U | 1.07 | 0.92 U | 0.92 U |
| OCDD | ng/Kg | 14.47 | 30.42 | 17.84 | 31.07 | 22.02 | 9.45 | 10.89 U | 17.72 |
| OCDF | ng/Kg | 1.36 U | 2.72 | 1.46 U | 2.91 | 1.04 U | 2.52 U | 0.91 U | 0.87 U |
| Total HpCDD | ng/Kg | 1.50 U | 0.60 U | 1.59 U | 5.04 | 1.20 U | 1.07 | 0.92 U | 0.92 U |
| TEQ (ND=0.5 DL) | ng/Kg | 0.001 | 0.003 | 0.002 | 0.3 | 0.002 | 0.012 | NA | 0.002 |
| VOCs | | | | | | | | | |
| p-Isopropyltoluene | mg/kg | 0.003 | 0.0067 | 0.013 | 0.015 J | 0.012 J | 0.018 | 0.027 J | 0.013 |
| Styrene | mg/kg | 0.003 U | 0.00034 J | 0.00018 J | 0.00022 J | 0.0013 | 0.0022 | 0.0045 | 0.00061 |
| SVOCs | | | | | | | | | |
| 1,2,3-Trichlorobenzene | mg/kg | 0.003 U | 0.00036 U | 0.00036 U | 0.00032 UJ | 0.00032 UJ | 0.00034 U | 0.00033 | 0.00035 U |
| 2-Methylnaphthalene | mg/kg | 0.0013 U | 0.0019 U | 0.0017 | 0.002 | 0.0017 | 0.0011 J | 0.0013 U | 0.0013 U |
| Benzoic acid | mg/kg | 0.013 U | 0.032 | 0.013 U | 0.013 U | 0.013 U | 0.013 U | 0.013 U | 0.013 U |
| Benzyl alcohol | mg/kg | 0.056 | 0.06 | 0.0065 U | 0.04 | 0.063 | 0.063 | 0.0063 U | 0.0065 U |
| Fluoranthene | mg/kg | 0.0047 | 0.0058 | 0.0013 U | 0.0027 U | 0.0012 J | 0.0013 U | 0.0041 | 0.0013 U |
| Fluorene | mg/kg | 0.0032 | 0.0033 | 0.0013 U | 0.0013 U | 0.0013 U | 0.0013 U | 0.0013 U | 0.0013 U |
| Naphthalene | mg/kg | 0.0003 | 0.00036 | 0.00036 U | 0.00032 UJ | 0.00032 UJ | 0.00034 U | 0.00033 U | 0.00035 U |
| Phenanthrene | mg/kg | 0.015 | 0.016 | 0.0087 | 0.0072 | 0.0053 | 0.0053 | 0.0086 | 0.011 |
| Phenol | mg/kg | 0.0066 U | 0.004 J | 0.0065 U | 0.0065 U | 0.0065 U | 0.009 | 0.0063 U | 0.0065 U |
| Pyrene | mg/kg | 0.0013 U | 0.0037 | 0.0013 U | 0.0013 U | 0.0013 U | 0.0013 U | 0.0013 U | 0.0013 U |

NA = not applicable

Bold font indicates detected concentrations

Table B-5. Ecology Sediment Toxicity Test Results.

| Site | 10-day Amphipod (<i>Hyalella azteca</i>) | | | 20-day Midge (<i>Chironomus tentans</i>) | | | | | | Microtox | |
|--------------------|--|---------------------|--|--|---------------------|--------------------------|------------------------------|--|--|---|--|
| | Mean % Survival | Mean RPD % Survival | Reference p-values ^a Survival | Mean % Survival | Mean RPD % Survival | Mean Weight per Org (mg) | T/R Mean Weight per Org (mg) | Reference p-values ^a Survival | Reference p-values ^a Growth | Light Reading Mean Change I ₍₁₅₎ /I ₍₀₎ | Light Reading Mean Change T ₍₁₅₎ /R ₍₁₅₎ |
| Control | 88 | NA | NA | 96 | NA | 1.044 | NA | NA | NA | 0.89/0.93 ^b | NA |
| LSC-01 (Reference) | 80 | NA | NA | 86 | NA | 1.564 | NA | NA | NA | 0.90/0.92 ^b | NA |
| LSC-02 | 79 | 1 | 0.445 | 60 | 36 | 1.824 | 1.2 | 0.006 | --- | 1 | 1.02 |
| LCS-03 | 0 | 200 | <0.001 | 0 | 200 | NA | NA | <0.001 | <0.001 | 0 | 0.41 |
| LSC-04 | 70 | 13 | 0.107 | 80 | 7 | 2.005 | 1.3 | 0.288 | --- | 1 | 1.04 |
| LCS-05 | 84 | 5 | --- | 84 | 2 | 1.927 | 1.2 | 0.427 | --- | 1 | 0.79 |
| LSC-06 | 67 | 18 | 0.006 | 82 | 5 | 2.113 | 1.4 | 0.370* | --- | 1 | 0.79 |

^a One-tailed t-test. Survival data arcsine square-root transformation prior to t-test.

^b Microtox test were run in two batches. Test samples LSC-02 and LSC-03 were run with a control and reference in the first batch and test samples LSC-04, LSC-05, and LSC-06 were run with a control and a reference in the NA-Not Available or Not Applicable

--- Site response greater than control or reference sediment response.

I₍₀₎ is the light reading after the initial five minute incubation period

I₍₁₅₎ is the light reading fifteen minutes after I₍₀₎

C_(t), R_(t), and T_(t) are the changes in light readings from the initial reading in each sample container for the control, reference sediment and test sites. I_(t)/I₍₀₎

T = test sample

R = reference sample

RPD = relative percent difference

RPD = ((T-R)/((T+R)/2))*100