Standard Operating Procedure
ERM Soil Sampling

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1. 0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for conducting direct push soil sampling. Direct push sampling offers an alternative, or a supplement, to conventional drilling methods by enabling rapid, high quality subsurface exploration and sampling, while significantly reducing site disturbance and waste generation.

The ultimate goal of direct push sampling is to obtain data and samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. In this SOP, all steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent. The following items will be discussed in detail in the procedure section of this SOP:

- Direct push investigation techniques; and
- Soil sampling.

Specifically, the procedures section describes the equipment, field procedures, sample containers, storage, decontamination, documentation, and field quality assurance/quality control (QA/QC) procedures necessary to conduct a direct push investigation and sampling at the Shpack Superfund Site. Site-specific QA/QC procedures are documented in the Quality Assurance Project Plan (QAPP) for the site. The step-by-step procedures are described in sufficient detail to allow field personnel to obtain data of sufficient integrity and to ensure representative soil sample collection.

This SOP serves as a reference to the Phase IB Workplan and applies to all direct push investigation and sample collection by Environmental Resources Management (ERM) personnel or their subcontractors. This workplan is to be strictly followed, and any modification to the procedure shall be approved by the project manager (PM) in advance.

2. 0 RESPONSIBILITIES AND QUALIFICATIONS

The PM is responsible for assigning project staff to perform direct push investigation and sampling activities and for assuring that this and all appropriate procedures are followed by project personnel.

The project staff assigned to the collection of data and soil samples with direct push techniques are responsible for completing their tasks according to this and other appropriate procedures. All staff are responsible for reporting deviations from the procedure or nonconformance to the PM or project QA/QC officer.

Only qualified personnel shall supervise subcontractors hired to perform this procedure. At a minimum, ERM employees qualified to supervise direct push investigations and sampling will be required to have:

- Read this SOP;
- Indicated to the PM that all procedures contained in this SOP are understood;
- Completed the Occupational Safety and Health Association (OSHA) 40-hour training course, and/or annual 8-hour refresher course, as appropriate; and
- Previously performed direct push investigations and sampling in a manner generally consistent with the procedures described in this SOP.

A qualified ERM employee will train ERM employees who do not have previous experience supervising direct push techniques on site. A qualified registered geologist or professional engineer will oversee progress of the project, results, and interpretations. The PM shall document personnel qualifications related to this procedure in the project QA files.

3. 0 PROCEDURE FOR DIRECT PUSH ANALYSIS, AND SOIL AND GROUND WATER SAMPLING

3.1 EQUIPMENT LIST

Typical equipment for direct push analysis and soil sampling:

- Direct push rig;
- Soil sampling tools;
- Polyethylene liners;
- Self-adhesive labels;
- Water quality test kit;
- Ice chest/cooler;
- Ice or frozen ice packs;
- Field notebook and location map;
- Personal protective equipment, including nitrile or powderless surgical gloves, hard hat, steel-toed boots, and respirator;
- Photoionization detector (PID) and/or flame ionization detector (FID); and
- Data collection forms.

Typical equipment for decontamination:

- Brushes;
- Wash/rinse tubs;
- Alconox detergent (or equivalent); and
- Deionized water.

3.2 PROCEDURE

The air monitor (a PID or FID) shall be checked at least once a day to ensure that it is calibrated and operational. A background reading shall be taken, and the instrument shall be re-set to zero each time the instrument is used.

Appropriated health and safety equipment described in the site specific Health and Safety Plan (HSP) will be donned before proceeding to the sample location. Organic vapor readings measured in the breathing zone with an FID or PID will be used to determine if respirators are needed throughout the direct push sampling procedures, based on action levels set by the site specific HSP. Air monitoring readings will be recorded in the field notebook and/or on data collection forms.

Although the number and type of soil samples to be collected may vary according to the QAPP, the sequence of steps will generally follow that described in this section. If a soil sample is to be submitted for laboratory analysis, the procedures for sample labeling, handling and tracking, described in Section 4.0 of this SOP, will be followed.

3.2.1 Direct Push Soil Sampling

A direct push soil-sampling rig will be used to collect soil at each specified location. The necessary sampling equipment shall be assembled and checked for proper operation before soil sampling. Soil sampling devices vary between subcontractors but most consist of a piston-type sampler with a retractable point and an inner liner. The specific soil-sampling tool will be identified prior to mobilization. The general sampling procedure will be as follows:

1. Prior to sampling and between sampling locations, decontaminate the sample equipment according to the procedures outlined in the project work plans (see Section 5.0 of this SOP).

2. Ensure that all soil sampling locations have been appropriately cleared of all underground utilities and buried objects per the project work plans. Review all forms and diagrams documenting the location of the cleared sampling locations, as well as that of any underground utilities or lines, or other buried objects.

3. Don appropriate personal protection equipment as specified in the project Health and Safety Plan.

4. Clear the area to be sampled of surface debris and vegetation using equipment that will not be used for sample collection.

5. Place inner liner into the device and drive the soil sampling tool to the desired sampling depth with the drive tip locked in place to prevent soil from entering the sampler body. At the desired sampling depth, the locking mechanism is released, causing the drive tip to retract inside the drive rod and seat above the soil contained in the liner. The

sampling device is subsequently pushed into the soil to collect a sample.

6. Retrieve the device; check to see that soil recovery is adequate in the sample liner. If there is sufficient recovery, mark or note the leading end of the sample liner.

7. Following retrieval, the liner shall be removed from the sampler and placed on a flat surface for evaluation. The top and bottom of the core and sampled interval will be marked on the liner.

8. Cut open the liner of each soil core with a utility knife. Screen the surface of the soil for organic vapors using a PID.

9. Collect the required soil samples (see Section 3.2.3 of this SOP).

10. Appropriately label and number the sample containers per the project work plans (see Section 4.1.3 of this SOP). The label will be filled out with waterproof ink.

11. Document the sampling event on the Sample Collection Log or an equivalent form as specified in the project work plans. Log the sample for lithology, soil structure and other pertinent information. Note any pertinent field observations, conditions or problems. Any encountered problems or unusual conditions should also be immediately brought to the attention of the Field Team Leader.

12. Appropriately preserve, handle, package, and ship the samples per the project work plan. The samples shall also be maintained under proper chain-of-custody procedures.

13. Fill, abandon and mark sample hole.

3.2.2 Sample Collection

Soil samples will be collected based on a combination of visual observations and PID field screening of soil contained in the sampling liner. Based on field screening, soil samples for VOCs will be collected first, followed by samples for other analyses (SVOCs, PCBs, metals, etc.).

Upon receipt of the sample bottles from the laboratory, and prior to sampling, the field team will inspect the bottles to evaluate if the sample bottle integrity was compromised during transit. This includes, but is not limited to, checking custody seals, observing moisture, discoloration or other indications of preservative leaking from the vials. In the event that a

given sample bottle has been compromised, that sample bottle will be discarded, and the laboratory will be notified of the condition. In addition, the laboratory will notify the project manager if any of the sample bottles, or coolers have been compromised during transit from the field to the laboratory.

3.2.2.1 VOC Sample Collection

Samples for VOC analysis will be collected from the soil within the sampling liner based on PID field screening. If an interval of soil within the sampling liner exhibits elevated PID readings relative to other intervals, that interval will be sampled for VOCs.

1. In order to minimize disturbance, a 10-cubic centimeter (cc) syringe with the end removed (or other similar sampling device) will be plunged into the soil a minimum number of times required to collect a representative 5-gram soil sample. A separate sampling device sufficient to collect a representative 15-gram aliquot (e.g. a 25 cc syringe) will be used in the same manner to collect a sample for high-level VOCs.

2. The amount of soil to be collected, either 5 or 15 grams of soil, will be determined by calibrating the syringe in the field. The syringe will be field calibrated to determine a weight-volume ratio using a portable balance on a test sample. The test syringe will be weighed prior to and after test sample collection to determine a weight-volume ratio. The accurate weight of the sample will be determined at the laboratory using the initial weight of the sample container prior to sample collection and the final sample container weight after receipt at the laboratory. The range of acceptable sample weight will be +/- 10% of the desired sample weight.

3. The soil sample will be placed into four pre-weighed containers (each containing a stir bar) and completely submerged in the appropriate preservative in the following order:

    - Two 40 ml vials with 5 g of soil in 5 mL of organic-free water (low level VOCs)

    - One 40 ml vial with 15 g of soil in 15 ml of methanol (high level VOCs)

    - One 4 oz jar (percent solids)

4. Samples will be frozen in the field with dry ice and stored on a 45-degree angle.

5. If split sampling or field duplicate sampling is to be conducted, use the syringe (or other similar sampling device) to collect the other soil samples from adjacent locations within the soil liner and place the soil in the appropriate sample containers at the same time as original sample collection.

3.2.2.2 Other Sample Collection

Following VOC sample collection, soil samples for other analysis will be collected.

1. Transfer the remaining soil from the liner to a large, stainless steel mixing bowl that has been decontaminated according to procedures described in Section 5.0.

2. Mix the soil using a decontaminated, stainless steel spoon until it is reasonably homogeneous. Remove any sticks, rocks, leaves or other debris present in the sample. Transfer the composited soil to the appropriate laboratory-provided sample jars. If split-sampling or duplicate sampling is to be conducted, transfer the composited soil to the split-sampling/duplicate sampling jars in the same manner.

3.2.3 Grouting Techniques

Upon completion of testing and sampling, the open hole shall be grouted after the direct push equipment has been removed. Grouting will be conducted in accordance with the requirements of the Massachusetts Department of Environmental Protection Standard References for Monitoring Wells. Grout will be introduced by a tremie into the bottom of the open hole and filled to the surface. The grout mix will be approximately 1 sack (94 pounds) Portland cement, and approximately 5.5 gallons water.

4. 0 SAMPLES

4.1 SAMPLE CONTAINERS, IDENTIFICATION AND LABELING

4.1.1 Sample Containers

Soil samples for laboratory analysis will be placed in pre-preserved (as appropriate) laboratory supplied containers. Appropriate sample containers, preservatives, and holding times for analytical parameters are presented in the QAPP.

4.1.2 Sample Identification

Sample identification numbers will follow the labeling conventions discussed in the QAPP.

4.1.3 Sample Labeling

Sample containers will have a plastic or waterproof paper label attached that will be filled out using waterproof ink, or information may be recorded directly on to the sampling container. The label will contain the following information:

- Project number;
- Task number (if appropriate);
- Site/project name;
- Sample number;
- Boring number;
- Sample depth;
- Sampler's name;
- Date and time the sample was collected;
- Sample description (soil or water);
- Preservatives; and
- Parameters for analysis.

4.2 SAMPLE PRESERVATION AND HANDLING

4.2.1 Sample Preservation

After collection, samples will be immediately stored in a cooler with ice or frozen ice pack to maintain a temperature of approximately 2-6° C. VOC samples will be placed on dry ice to freeze them. The appropriate preservation techniques for soil samples are shown in the QAPP.

4.2.2 Sample Handling

4.2.2.1 Packing and Storage

Samples will be packaged and stored in a manner that will prevent damage to each sample container. Sample bottles will be labeled, wrapped in protective packing material, and placed right side up in a cooler for delivery to the laboratory. VOC samples will be stored at a 45-degree angle.

4.2.2.2 Transportation

The samples will be delivered or shipped to the laboratory on the date of sample collection, or as soon afterwards as possible.

4.2.2.3 Holding Times

The holding times for the various analytical parameters listed in the QAPP are the total time from sample collection to extraction or analysis. The analyses required for each soil sample will be specified in the workplan.

4.3 SAMPLE TRACKING

A COC record will be filled out in the field, and will accompany every shipment of samples to the analytical laboratory. The purpose of the COC record is to document possession of a sample from the time of collection in the field to its final disposal by the laboratory.

Information to be provided on the COC record includes:

- Project name and number;
- Sampler signatures;
- Sample number;
- Sample collection date and time;

- Analysis parameters;
- Number of containers;
- Preservatives; and
- Comments.

An example of a COC record is provided in the QAPP.

The laboratory will record the following information:

- Name of persons receiving the sample;
- Date of sample receipt; and
- Sample condition.

All corrections to the COC record will be initialed and dated by the person making the corrections. Each COC record will include signatures of the appropriate individuals indicated on the form. The originals will follow the samples to the laboratory, and copies documenting each custody change will be retained and kept on file by ERM. The COC record will be maintained until final disposition of the samples.

4.4 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

4.4.1 Trip Blanks

A trip blank is a suite of (VOA) sample bottles containing deionized water that is prepared by the laboratory. Trip blanks (aqueous) will accompany each shipment of water sample containers from the laboratory. The trip blanks will be kept with the same shipment of sample containers at all times and will be returned, unopened, to the laboratory with that shipment. Trip blanks will be used to detect any contamination or cross-contamination during handling and transportation. One trip blank set is sent per cooler of samples for volatile analysis per day.

4.4.2 Rinsate Samples

Rinsate samples are defined as samples that are obtained by running deionized water through sample collection equipment (e.g. soil samplers) after decontamination. These rinsate samples will be collected in the appropriate sample containers and sent to the laboratory for analysis. They will be used to determine if decontamination procedures have been effective. One rinsate sample per 20 samples will be collected and sent to

the laboratory. If only disposable equipment is used, no rinsate samples are necessary.

4.4.3 Matrix Spike/Matrix Spike Duplicate for Soil Samples

Matrix spikes and matrix spike duplicates (MS/MSD) are prepared in the laboratory to assess precision and accuracy of an analytical method on various matrixes. An MS/MSD is generated by preparing three separate samples for analysis from the same soil sample, and then spiking the second and third samples with selected target compounds. For metals determined by ICP analysis, for example, the spike contains all the analyte metals at levels approximately five times the reporting limit. Following the addition of the spike to the MS/MSD, these two QC samples are carried through all laboratory procedures and analyzed as are the routine soil samples taken for the investigation. .

The collection and handling of all QA/QC samples will be documented in the field notebook and/or on data collection forms. The QAPP documents the frequency of MS/MSD analysis per matrix and analysis.

5. 0 EQUIPMENT DECONTAMINATION

Specific equipment decontamination procedures are described in the following paragraphs. Equipment decontamination will include the following:

- Decontamination of direct push equipment (rods and sampling devices) will be conducted between individual sampling points to minimize potential cross-contamination. Sampling equipment will be decontaminated between each sample collected; and
- The direct push soil sampling rig, depending on the extent of chemical occurrence and the cleaning requirements, will be decontaminated at each sampling site or at the equipment decontamination pit.

5.1 EQUIPMENT DECONTAMINATION PROCEDURES

Samples collected using the mechanical coring device will be collected in dedicated new PVC liner tubes. Any non-dedicated manual sampling equipment used to collect soil samples will be cleaned and decontaminated prior to its initial use, between each sampling location and after the final use.

The following general procedures will be adhered to concerning decontamination efforts:

1. If visual signs such as discoloration indicate that decontamination was insufficient, the equipment will again be decontaminated. If the situation persists, the equipment will be taken out of service until the situation can be corrected.
2. Verification of the non-dedicated sampling equipment cleaning procedures will be documented by the collection of field blanks (equipment rinsate).
3. All properly decontaminated equipment will be stored in aluminum foil and/or plastic bags during storage and transport.

The following step-by-step decontamination procedures will be followed for all non-dedicated sampling tools and for the appropriate set of analytes:

Organics Only	Organics and Inorganics	Inorganics Only
1. Non-phosphate detergent wash	1. Non-phosphate detergent wash	1. Non-phosphate detergent wash
2. Tap water rinse	2. Tap water rinse	2. Tap water rinse
3. Methanol rinse	3. Methanol rinse	3. 0.1 N HNO_3 rinse
4. Deionized/distilled water rinse	4. Deionized/distilled water rinse	4. Deionized/distilled water rinse
5. Air dry	5. 0.1 N HNO_3 rinse	5. Air dry
	6. Deionized/distilled water rinse	
	7. Air dry	

Decontamination protocols will be strictly adhered to in order to minimize the potential for cross-contamination between sampling locations and contamination of off-site areas.

Following decontamination, equipment will be placed in a clean area on clean plastic sheeting to prevent contact with contaminated soil during drying. If the equipment is not used immediately, the equipment will be covered or wrapped in plastic sheeting to minimize potential airborne contamination.

5.2 HEAVY EQUIPMENT DECONTAMINATION PROCEDURES

The following steps will be used to decontaminate drilling and heavy equipment.

- Personnel will dress in suitable safety equipment to reduce personal exposure.
- Equipment caked with soil or other material will be scraped off with a flat-bladed scraper. The scrapings will be disposed in drums or roll-off bins.
- Equipment that will not be damaged by water, such as the direct push soil sampling rig and shovels, will be sprayed with detergent water by a high-pressure steamer, then rinsed with clear potable water.

Following decontamination, equipment will be placed on the clean direct push soil-sampling rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated secure, clean area.

5.3 QA/QC SAMPLING AND DOCUMENTATION

Field rinsate samples will be taken from the decontaminated sampling equipment to verify the effectiveness of the decontamination procedures. The rinsate procedure will include rinsing reagent-quality deionized water through or over a decontaminated sampling tool (such as liners). Samples of the rinsate water will be collected in sample bottles and sent to the laboratory for analysis. Qualified ERM personnel will record the rinsate procedure.

6. 0 DOCUMENTATION

The field documentation requirements for the field sampler will include recording all observations made during probing, sampling, or decontamination that could affect the quality of a sample. The documentation for each sample should be entered in a bound field notebook with consecutively numbered pages or on a data collection form.

Documentation should include at a minimum:

- Date of investigation/location/diagram or map;
- Date of sample collection;
- Time of day;
- Direct push rig type;
- Depth of sample;
- Type of sample (e.g. soil or water, QA/QC sample);
- Sampling device;
- Surrounding conditions (e.g. weather, etc.);
- Unusual conditions;
- Decontamination procedures;
- FID or PID readings;
- Generalized log with sample locations, sample numbers, and relevant observations; and
- A brief description of the area around the direct push location and the weather conditions at the time of sample collection. Each entry (or page) in the field notebook should be dated and initialed by the individual making the entry.

The field sampler will keep detailed field data logs of each boring.