Interim Measures Pre-Design Investigation Work Plan for the Former Refinery at Neodesha, Kansas
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1 Introduction

On behalf of BP Products North America, Inc. (BP), formerly Amoco Oil Company (Amoco), AECOM Technologies, Inc. (AECOM) has revised this Work Plan for a pre-design investigation (PDI Work Plan) for the Former Refinery site located in Neodesha, Kansas (site). The purpose of this PDI Work Plan is to propose additional soil borings and analytical sampling to fill previously identified data gaps and to further define the extent and magnitude of lead impacts to surface soil at the site. This PDI Work Plan provides a summary of pertinent background information, a description of the planned sampling methods, a summary of the soil sampling locations, and a milestone schedule of upcoming project activities.

1.1 Background

Through previous assessment activities, BP has identified lead-impacted soils located within certain areas of the site. To address these lead impacts to soils, BP developed an interim measures soil excavation work plan (IM Work Plan, AECOM, 2009). The preparation of the IM Work Plan was proposed in a Corrective Action Study (CAS) prepared for the Former Refinery (BP, 2005) and was approved in subsequent communications between the KDHE, BP, and AECOM in 2008 (KDHE, 2008a and KDHE, 2008b), and under current revisions.

The IM Work Plan was submitted to the KDHE in a submittal dated January 8, 2009. The objective of the interim measures for lead-impacted soils was to implement an appropriate remedial action that can achieve the short-term protection goals established for the Former Refinery. The short-term protection goals identified in the CAS were to prevent exposure to any media that poses a potential risk to human health and the environment. The Remedial Action Concentration (RAC) criteria for lead impacted soil was developed as part of the Risk Assessment that was conducted for the site. The Risk Assessment document was provided to the KDHE in a submittal dated June 11, 2003 (RETEC, 2003). The KDHE has approved the Risk Assessment.

As presented in the IM Work Plan, and based on the existing soil data, three areas of the site were determined to require excavation based upon the applied RAC. The KDHE provided comments to BP related to the IM Work Plan during a telephone conference on February 17, 2009. Additionally, the KDHE provided written comments to BP, related to the IM Work Plan, in a letter dated February 13, 2009. As a result of these communications with KDHE, it was determined that revised RAC criteria (i.e., 1,000 or 400 milligrams per kilogram (mg/kg) lead) would be applied to the subject areas of the site. The application of the revised RAC to the existing soil data set (as presented in the IM Work Plan) resulted in the need to further define the extent of lead impacts to shallow soils at the three planned excavation areas (i.e., Area 1, Area 2, and Area 3, as shown on Figure 1 and Figure 2). These sample location are "stepped out" from previous locations to define vertical and horizontal extent of soil above the revised RAC criteria of (i.e., 1,000 or 400 mg/kg). Section 3 provides additional explanation of the sample locations depicted on Figure 2.

The proposed PDI scope of work has been prepared mindful of the comments provided by KDHE regarding the IM Work Plan.
2 Investigation Methods

This section presents the field sampling and laboratory analytical methods. It includes descriptions of all relevant field tasks including sampling equipment and procedures, laboratory analytical methods, quality assurance and quality control, equipment decontamination, and surveying.

2.1 Health and Safety

A Site-Specific Health and Safety Plan (HASP) has been developed for the Former Refinery as a separate document. The HASP will be amended to include the activities discussed in this PDI Work Plan to ensure the safety of those working at the site, as well as the public, during field work activities. An initial health and safety kickoff meeting will be held prior to initiating field work activities to discuss information contained in the HASP. In addition, all employees and contractors will undergo a site orientation to discuss specific AECOM and BP safety policies, as well as to complete forms to identify individual risks of work activities. Safety meetings will be held at the beginning and end of each work day to discuss daily project objectives, important safety issues, and shared learnings.

2.2 Property Ownership and Access

The current landowners of the properties at which the proposed soil sampling program will be completed are: Cobalt Boats – Fiberglass Engineering; City of Neodesha; and Mr. John Floyd. With the exception of Mr. John Floyd, BP currently has a standing history of obtaining access agreements with the remaining property owners to conduct certain environmental assessment activities. The access agreements currently in place, or that have been previously approved, have a minimum access notification requirement of 30 days. BP will request access and attempt to negotiate the appropriate access agreements to conduct the proposed activities, following approval of this Work Plan. Without executed access agreements for such properties, BP will not have the ability to perform the PDI as proposed.

2.3 Mobilization and Reconnaissance

As the majority of the planned assessment activities are located within active facilities, the ground surface within each of the soil sampling areas will be cleared to allow sampling to be completed. Site clearing and preparation activities may include removal of stored materials and the prohibition of vehicle and equipment parking during planned field work.

Obstructions or property modifications in the proposed soil areas that have been implemented following the initial Work Plan development may prohibit access to current planned sampling locations. Site crews will work directly with property owners to remove any possible identified obstructions, or identify alternate sampling locations, documenting the change.

To facilitate the planned soil sampling activities, certain previous sample locations will be marked on the ground surface by a Kansas licensed land surveyor. The surveyor will then mark the planned PDI soil sample locations on the ground surface based upon their planned position relative to the marked previous sample locations.

2.4 Sampling Methodology

This section presents procedures for site selection sampling to be conducted at the site. Standard Operating Procedures (SOPs) referenced in the text are provided in Appendix A. Where the text of the Work Plan and SOPs differ, the Work Plan takes precedence.
2.4.1 Sampling Procedures

Soil sampling activities will be conducted in accordance with the following procedures outlined in the site Quality Assurance Project Plan (QAPP) (ENSR, 2008):

- SOP 1007 – Chain-of-Custody Procedures,
- SOP 7110 – Surface Soil Sampling, and
- SOP 7510 – Packaging and Shipment of Environmental Samples.

Soil samples will be collected using hand tools, to depths of up to 4 feet below ground surface. A general description of the planned soil sampling method is provided as follows:

- Decontaminate stainless steel sampling tool (i.e., trowel or hand auger bucket),
- Collect 0-6 inch sample interval using a trowel,
- Collect subsequent sample depths (beyond 6 inches) using a hand auger,
- From each sample interval, place retrieved soil interval in a decontaminated stainless steel bowl,
- Mix soil in the bowl using a disposable plastic spoon,
- Place appropriate soil volume into laboratory supplied sample jar,
- Label sample and place in secure cooler,
- Amend chain of custody form as appropriate, and
- Repeat process for each sample interval.

Details related to sample locations, sample depths, and the estimated quantity of samples, are provided below in this work plan.

2.4.2 Analytical Methods

Soil samples collected during the PDI will be submitted to the laboratory and analyzed for lead using United States Environmental Protection Agency (USEPA) Method 6010 (as described in the QAPP). A portion of the collected soil samples will be retained as contingency samples and potentially analyzed for lead at a later date. The decision to analyze contingency samples will be made based upon the laboratory results from the primary samples.

To support the data quality objectives for the project, field quality assurance (QA) samples will be collected (e.g., duplicates and equipment rinse blanks). The frequency of collection for these field QA samples will be in accordance with the guidelines provided in the QAPP. One duplicate will be collected every 20 samples. In addition, trip blanks, a soil field/equipment rinsate blank, and sufficient sample to allow the laboratory to conduct a matrix spike and spike duplicate will be collected.

Details related to estimated quantity of samples to be submitted for laboratory analysis, and samples retained as contingency samples, are provided later in this Work Plan. Samples for laboratory analyses will be submitted to Pace Analytical of Lenexa, Kansas. Samples will be analyzed within normal turn-around times for inorganic analyses. All analytical data generated will be validated. Data validation will be
performed in accordance with the methods defined by the National Functional Guidelines for Organic Data Review (USEPA, 1991) and summarized in the QAPP.

2.5 Decontamination and Waste Management

During the soil sampling program and prior to each use, non-disposable sampling equipment will be decontaminated in accordance with applicable procedures outlined in the QAPP, specifically SOP 7600 – Decontamination of Field Equipment.

Excess soil collected from each sampling location will be containerized and stored as investigation derived waste (IDW) for a finite period of time until it can be managed as part of the soil interim measure. If for some reason the soil interim measure implementation is delayed, a request by KDHE may be made for off-site disposal of the soil IDW.

Decontamination fluids generated during the sampling effort will be temporarily stored in covered buckets and will later be disposed of and treated at BP’s Wastewater Treatment Plant.
3 Sample Collection Scope of Work

Attached Figure 2 shows the proposed PDI soil sample locations. Attached Table 1 summarizes the following:

- PDI sample identification nomenclature,
- Locations and depths of samples planned to be submitted for laboratory analysis, and
- Locations and depths of samples planned to be collected and retained for possible contingency analysis.

As depicted on Figure 2, soil samples from several step-out locations will also be collected. The decision to analyze contingency samples will be made after the primary PDI data have been received from the laboratory and subsequently reviewed. Certain contingency samples may be analyzed if these analyses will aid in the delineation of lead impacts identified at the subject areas.

3.1 Data Evaluation and Reporting

Data will be validated upon receipt from the analytical laboratory and then entered into the site analytical database. The PDI data will be used to aid in the delineation of shallow lead impacts at the site. PDI data will then be summarized in a revised IM Work Plan, which will be submitted to the KDHE.

Data generated during the investigation will be evaluated and included in a Supplemental Investigation Report. Data evaluation activities include tabulation and evaluation of field data and quantitative analytical data, and screening of the data against appropriate screening levels, identified in Appendix A of the KDHE Risk-Based Standards for Kansas RSK Manual (KDHE, 2015). The PDI portion of the Supplemental Investigation Report will include:

- Summary of field investigation activities,
- Summary of deviations from the Work Plan,
- Maps of sample locations,
- Figures and tables presenting characterization of data, including screening against the risk based standards for soil pathway defined for residential and non-residential (KDHE, 2015),
- Final characterization will also be based on future land use and institutional controls
- Raw analytical data, QA/QC summary, and validation information,
- Copies of all field notes and forms, and
- Evaluation of data.
4 Schedule

A schedule to implement the PDI Work Plan has been developed and is as follows:

- Fieldwork is planned to start within one month (30 days) following KDHE review and approval of this Work Plan, subject to access being obtained from property owners. BP will notify the KDHE of access denials.

- The revised Interim Measures Work Plan is planned to be generated within three months (90 days) following receipt of analytical data.

If there is any schedule change, BP will coordinate with KDHE on the revised schedule.
5 References


Appendix A

Standard Operating Procedures (SOPs)
Standard Operating Procedure

Chain-of-Custody Procedures

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Chain-of-Custody Procedures

1.0 Scope and applicability

1.1 Chain of custody (COC) is defined as the unbroken trail of accountability that ensures the physical security of samples, data, and records (EPA Glossary of Quality-Related Terms). This standard operating procedure (SOP) describes COC procedures applicable to environmental samples collected by ENSR during field sampling and analysis programs. Custody procedures within the laboratories analyzing the samples are not addressed.

1.2 Samples are physical evidence. The objective of COC procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements in legal or regulatory situations.

1.3 The National Enforcement Investigations Center (NEIC) of the U.S. Environmental Protection Agency (EPA) defines custody of evidence in the following manner:
   - It is in your actual possession;
   - it is in your view, after being in your physical possession;
   - it was in your possession and then you locked or sealed it up to prevent tampering; or
   - it is in a secure area.

1.4 This SOP is to be utilized to conduct the work identified in the title of this SOP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

2.0 Health and safety considerations

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

The following may impact the legal or regulatory defensibility of the data:
   - The samples are not accompanied by a COC form,
   - The information recorded on the COC form is incomplete, inaccurate, or differs from the information recorded on the sample containers,
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Chain-of-Custody Procedures

- The documentation of person-to-person transfer of sample custody is incomplete, or contains unexplained gaps in time,
- COC seals or tape were not applied, were not applied correctly, or were lost or removed, for sample coolers/packages being transported by a party other than the sample custodian.

4.0 Equipment and materials

4.1 The following materials are relevant to this procedure:
- COC Form (Figure 1)
- Sample labels
- COC tape or seal (Figure 2)
- Indelible pen or Sharpie™
- Clear plastic sealing tape

4.2 Materials identified in related SOPs may also be needed.

5.0 Procedures

5.1 Pre-sample collection activities

5.1.1 Some measurement methods require preparation of sample collection media or special treatment of sample containers prior to sample collection. In these cases, COC procedures should be initiated with the media preparation or container treatment. This requires that sample identification numbers or media/container identification numbers be assigned. These numbers should be entered on the COC form, leaving room for the subsequent recording of the associated sample numbers. In this variation, the custodian responsible for media preparation or container treatment has the responsibilities outlined in Section 5.2, and the sampler or field sample custodian has the responsibilities stated in Section 5.3 when he or she receives the prepared media or treated containers. There are a number of acceptable approaches to this variation, and the detailed procedures should be defined in the project-specific QAPP.

5.2 Sample collection phase

5.2.1 As few people as possible should handle the samples. For certain programs, it is helpful if a single person is designated as the sample custodian (the person responsible for the care and custody of the samples until they are transferred to the laboratory for analysis).

5.2.2 While in the field, sampling personnel should be able to testify that tampering of the samples could not occur without their knowledge. Examples of actions taken may include sealing the sample containers with COC tape or locking the samples in a secure area.
5.2.3 If samples are to be shipped by commercial overnight carrier, the field sampler or sample custodian completes a COC form (Figure 1) for each cooler/package of samples and places the original of completed form inside the associated cooler/package before the package is sealed (a copy is retained and kept in the field record files). Each completed COC form should accurately list the sample identification numbers of the samples with which it is packaged, and should contain the identification number of the COC tape on the cooler/package. Representatives of commercial carriers are not required to sign the COC form. Refer to ENSR SOP 7510 – Packaging and Shipment of Environmental Samples for specific packaging procedures.

5.2.4 If samples are hand carried to a laboratory, the person hand carrying the samples is the sample custodian. If the carrier is a different person than the one who filled out the COC form and packaged the samples, then that person transfers custody to the carrier by signing and dating each form in the “Relinquished By” section. The carrier then signs and dates each form in the adjacent “Received By” section. When the carrier transfers the samples to the laboratory, he or she signs and dates each form in the next “Relinquished By” section, and the laboratory sample custodian signs and dates each form in the adjacent “Received By” section.

5.2.5 If samples are transmitted to the laboratory by courier, the procedures described in either Section 5.2.3 or 5.2.4 are followed, depending on whether the courier is a commercial courier or laboratory representative, and whether the cooler has been secured by COC seals prior to pick up by a laboratory courier.

5.3 Sample labeling

5.3.1 Labeling of samples occurs at the time of sample collection.

5.3.2 Waterproof, adhesive labels are preferred. Labels should be applied to the container, not the lid whenever possible. Additional interior labels may be required for certain biological samples.

5.3.3 Sample tags may be required for certain projects requiring a strict level of legal or regulatory data defensibility. If tags are utilized, their use will be addressed in the project-specific work plan or QAPP.

5.3.4 Labels should be completed in waterproof, indelible ink. Covering the label with clear plastic tape is recommended to protect the legibility of the label and to prevent the label from detaching from the sample container.

5.3.5 The following information should be recorded on the sample label:
- Project identification (project name and number/client/site)
- Field sample identification code (exactly as it appears on the COC form)
- Sampler’s initials
- Date and time of sample collection
- Analyses requested
- Preservation
5.4 Documentation of sample history

5.4.1 Sample history includes, but is not limited to, preparation of sample containers or collection media (for example, wipes), collection, handling (such as subsampling or composting), storage, shipment, analytical preparation and analysis, reporting, and disposal.

5.4.2 Refer to SOP 7515, Recording of Field Data, for specific guidance on documentation of field activities, field measurements, and sample collection.

5.5 Documentation of custody

5.5.1 It is recommended that a COC form (Figure 1 or equivalent) be initiated upon sample collection. If this is not feasible for a particular project, the COC form may be initiated at the time of sample packaging. If this is the case, the sample collection records will serve as the initial custody document and will document the collection of the sample (sample location and identification, date and time of collection, sampler, and parameters to be analyzed, including containers and preservatives).

5.5.2 The following information is recorded on the COC form:

- Project identification (ENSR project number, client, site name and location).
- Page number (for example, 1 of 2, 2 of 2).
- Field sample identification code. This code should be unique to the sampling event and to the program. This code should agree exactly with the field sample identification code recorded on the bottle label.
- Sampling point location (optional if recorded elsewhere in field records).
- Date and time of sample collection.
- Sample matrix (soil, water, air, etc.).
- Preservative.
- Analysis requested.
- Number of containers.
- Type of sample (grab or composite). Identifying if aqueous samples have been filtered in the field is recommended.
- Signature(s) of sampling personnel and signatures of all personnel handling, receiving, and relinquishing the samples.
- Date(s) and time(s) of each sample transfer.
- Sampler remarks. These comments may serve to alert the laboratory to highly contaminated samples or identify quality control (QC) sample requirements.
- Airbill number (if shipped by overnight commercial carrier).
- Laboratory name and address.
- COC tape numbers.
5.5.3 The COC is filled out completely and legibly in indelible ink. There should be no unexplained blank spaces. Blank lines should be lined out and initialed and dated.

5.5.4 Data will not obliterated. Corrections are made, if necessary, by drawing a single line through and initialing and dating the error. The correct information is then recorded with indelible ink.

5.5.5 Information on the COC should agree exactly with that recorded on the sample containers. Discrepancies may result in the samples being incorrectly logged into the laboratory or delays in initiating sample analysis.

5.6 Sample receipt and inspection

5.6.1 Upon sample receipt, the coolers or packages are inspected for general condition and the condition of the COC tape. The coolers or boxes are then opened and each sample is inspected for damage.

5.6.2 Sample containers are removed from packing material and sample label information is verified against the COC form.

5.6.3 The condition upon receipt, including any discrepancies or problems, is documented and the COC form is completed by signing and recording the date and time of receipt.

5.6.4 Receipt and inspection of samples by subcontractor analytical laboratories will adhere to written procedures established by the laboratory.

6.0 Quality assurance / quality control

6.1 The records generated in this procedure are subject to review by the sampling team leader, project manager, or designee.

6.2 The records generated in this procedure will become a part of the evidence reviewed in the data validation process (see ENSR SOP 1009, Data Validation).

7.0 Data and records management

7.1 The records generated in this procedure are part of the permanent record supporting the associated measurements and may include, as applicable, the COC forms, sample tags, carrier waybills, and field and laboratory records of sample history (collection, handling, storage, analysis, etc.).

7.2 Unanticipated changes to the procedures or materials described in this SOP (deviations) should be appropriately documented in the project records.

7.3 Records associated with the activities described in this SOP should be maintained according to the document management policy for the project.
8.0 Personnel qualifications and training

8.1 Qualifications and training

8.1.1 The individual executing these procedures should have read, and be familiar with, the requirements of this SOP.

8.1.2 No specialized skills are necessary in order to implement these procedures; however, an understanding of the concept of custody is useful.

8.2 Responsibilities

8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.

8.2.2 The individual performing the work is responsible for implementing the procedures as described in this SOP and any project-specific work plans.

8.2.3 For certain sampling programs, the project manager, sampling team leader, or designee may assign an individual to serve as sample custodian. This individual is responsible for supervising the implementation of COC procedures in accordance with this SOP and any project-specific work plans or QAPP.

9.0 References


ENSR SOP 1009 – Data Validation.

ENSR SOP 1011 – Preparation and Control of Standard Operating Procedures.

ENSR SOP 7510 – Packaging and Shipment of Environmental Samples.

ENSR SOP 7515 – Recording of Field Data.

10.0 Revision history

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# Standard Operating Procedure

## Chain-of-Custody Procedures

**Figure 1** *Example Chain-of-Custody Form*

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Figure 2 Example Chain-of-Custody Tape
1.0 PURPOSE AND APPLICABILITY

1.1 Purpose and Applicability

This standard operating procedure (SOP) describes the methods used for obtaining surface soil samples for physical and/or chemical analysis. For purposes of this SOP, surface soil (including shallow subsurface soil) is loosely defined as soil that is present within 5 feet of the ground surface and can be sampled with the use of readily available and easy-to-operate sampling equipment. Various types of sampling equipment are used in the collection of surface soil samples and include spoons or scoops, trowels, shovels, and hand or bucket augers.

The purpose of this SOP is to provide a specific method and/or procedure to be used in the collection of surface soil samples which, if followed properly, will promote consistency in sampling and provide a basis for sample representativeness.

This SOP is generally applicable to surface and shallow depth soils which are unconsolidated and are of low to moderate density. Higher density or compacted soils may require use of drill rigs or other powered equipment to effectively obtain representative samples.

It should be noted that other specific state and/or federal agency standard operating procedures may be in existence in certain areas which may require deviation from this sampling procedure. The applicability of other agency operating procedures, which may differ from ENSR's SOP, needs to be determined prior to start of the sampling program. Deviations from this SOP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the project work plan, and must be documented in the field project notebook when they occur.

1.2 General Principles

Surface soil sampling generally involves use of hand-operated equipment to obtain representative soil samples from the ground surface and to shallow depths below the ground surface. If soil conditions are appropriate, surface soil sampling, following the
procedures described in this SOP, can provide representative soil samples in an efficient manner.

1.3 Quality Assurance Planning Considerations

Project personnel should follow specific quality assurance guidelines for sampling as outlined in the site-specific QAPP and/or Sampling Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements typically suggest the collection of a sufficient quantity of field duplicate, field blank, and equipment blank samples.

1.4 Health and Safety Considerations

Surface soil sampling may involve chemical exposure hazards associated with the type of contaminants present in surface soil. When surface soil sampling is performed, adequate Health and Safety measures must be taken to protect sampling personnel. These measures must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed.

2.0 RESPONSIBILITIES

2.1 Sampling Personnel

It will be the responsibility of the sampling personnel to conduct surface soil sampling in a manner consistent with this SOP. The above individual will be responsible for the proper use and maintenance of all types of equipment used for obtaining surface soil samples, and the collection, labeling, handling and storage of all samples until further chain-of-custody procedures are undertaken.

2.2 Sampling Coordinator

Large sampling programs may require additional support personnel such as a sampling coordinator. The sampling coordinator is responsible for providing management support such as maintaining an orderly sampling process, providing instructions to sampling personnel regarding sampling locations, and fulfilling sample documentation requirements, thereby allowing sampling personnel to collect samples in an efficient manner.
2.3 Project Manager

It is the responsibility of the project manager to ensure that the sampling activity is properly staffed, planned, and executed.

3.0 REQUIRED MATERIALS

3.1 Spoons or Scoops

Spoons or scoops should preferably be constructed of stainless steel as this material is abrasion resistant, can be easily decontaminated, and can be used to manually extract low to moderate density soil samples directly from the ground surface. Other spoon/scoop construction materials such as high-density polyethylene and teflon may be suitable in some applications but are difficult to use in higher density soils.

3.2 Trowel

Stainless steel construction is preferred. The blade of a trowel is generally flat or slightly curved and is 5 to 6 inches in length. Some trowels are available with depth calibrations marked on the blade.

3.3 Shovel

Shovels may be long or short-handled and are most often used for preparation of the sample collection area, i.e., for removal of surface debris or penetration of a high density/compacted surface prior to collection of the sample with another more appropriate device. Shovels may be used for the collection of samples that require large volumes of material for analysis (i.e., for bench-scale treatability studies). Shovels can also be used for scraping of test pit sidewalls in preparation for sidewall sampling using another device.

3.4 Hand Auger

This tool, commonly referred to as a soil auger, consists of a short spiral-bladed metal rod (solid-stem auger) attached to a handle. Clockwise rotation of the handle provides the cutting motion for the auger. Most of the loose soil is discharged upwards as the auger moves downwards. However, if the soil is cohesive some of it will stick to the auger flight providing a collectable sample at a measurable depth. Samples of surface soil can also be collected using a tube sampler which is attached to the end of the auger rods and advanced into the soil to extract a sample.
3.5 Bucket Auger

This device consists of a short length of hollow tube with cutting teeth at the bottom. As the handle is rotated, the sample is brought into and retained within the tube. When the auger is removed from the ground surface, the sample is retrieved from the tube with a spoon, or, if loosely consolidated, is poured directly into a collection pan or into the sample containers. Typically constructed of stainless steel, bucket augers are commonly available in diameters varying from two to four inches.

3.6 Collection Pan

A soil collection pan is often used as an intermediate sample container between removal of the sample from the ground and final bottling of the sample. Soil collection pans should preferably be constructed of stainless steel, although common household steel cooking pans may be used if the pan is lined with aluminum foil during sample collection.

3.7 Supporting Materials

- Teaspoon or spatula
- Aluminum foil
- Sample kit (i.e., bottles, labels, custody records, cooler, etc.)
- Sample logs/boring logs
- Decontamination materials
- Six-foot folding rule or tape measure for depth measurement
- Personal protective equipment (as required by the HASP)
- Field project notebook/pen

4.0 METHOD

4.1 General Procedures

Site-specific soil characteristics such as soil density and moisture will generally dictate the preferred type of sampling equipment for use at a particular site. Similarly, other project-specific requirements such as sampling depth and requested type of analysis such as physical testing (e.g., grain-size distribution) and/or chemical analysis will dictate the use of a preferred type of sampling equipment. Analytical testing requirements will indicate sample volume requirements that also will influence the selection of the appropriate type of sampling tool. The project sampling plan should define the specific requirements for collection of surface soil samples at a particular site. Should site-specific characteristics remain unidentified prior to start of the sampling
program, sampling personnel should be equipped with a variety of sampling equipment
to address the most likely sampling situations to be encountered.

As indicated, sample volume and sampling depth requirements should be defined in the
sampling plan. This information should define the size of the hole which will be created
during collection of the sample. For instance, if only a 500-ml sample will be required for
analysis from a depth interval of 0 to 6 inches, an approximate 2 to 3-inch diameter hole
will be needed. The indicated types of sampling equipment will generally make a
minimum diameter hole of approximately 3 inches, therefore, an excess volume of soil
may be generated during collection of a small volume soil sample. For samples
requiring a large volume of soil, multiple holes and soil composting may be necessary.
Collection of the requisite volume of soil to meet sample volume requirements without
underestimating the sample volume is the overall objective and is a technique which
improves with experience.

It should be noted that some sampling programs may require the use of a sampling grid
for the purpose of obtaining a statistically representative number of soil samples. This
SOP does not provide information relative to construction of a sampling grid. This
information may be found in other documents.

4.2 Equipment Decontamination

Regardless of the specific type of equipment used, each piece of equipment needs to be
decontaminated prior to its initial use and following collection of each individual soil
sample. Site-specific requirements for equipment decontamination should be outlined
within the project sampling plan. Equipment decontamination procedures are specified
within ENSR SOP 7600 - Decontamination of Equipment.

4.3 Collection of Samples for Volatile Organics Analysis

Collection of surface soil samples for volatile organics analysis (VOA) is different than
collection of soil samples for other routine physical or chemical testing primarily because
of the concern for potential loss of volatiles during the normal sample collection
procedure. To limit the potential for loss of volatiles, the soil sample must be obtained
as quickly and as directly as possible. This generally means that if a VOA sample is to
be collected as part of a multiple analyte sample, the VOA sample portion should be
obtained first. The VOA sample should also be obtained from a discrete portion of the
entire collected sample and not from a sample which has been composited or
homogenized from the entire sample interval. In general, it is best to collect the VOA
sample by transferring the sample directly from the sampling tool into the sample bottles.
Intermediate sample containers such as collection pans should not be used during
collection of VOA samples.
4.4 Standard Procedures

4.4.1 Surface Preparation

At some sampling locations, the ground surface may require preparation in advance of sampling. Surface preparation can include removal of surface debris which blocks access to the actual soil surface or loosening of dense surface soils such as those encountered in heavy traffic areas, or frozen soils. If sampling equipment is used for both removal of surface debris and for collection of the soil sample, the equipment should be decontaminated prior to sample collection to reduce the potential for sample interferences between the surface debris and the underlying soil.

4.4.2 Shovel Sampling Procedure

A detailed operating procedure for proper use of a shovel for soil sampling is unnecessary. Specific requirements for sample quantity and sampling depth should be outlined within the project sampling plan.

Decontaminate the shovel in accordance with established procedures prior to use.

Once the soil sample is obtained and placed into the appropriate sample container(s) the hole from which the sample was retrieved should be filled with surrounding soils to eliminate a potential surface hazard.

4.4.3 Spoon, Scoop, and Trowel Sampling Procedure

Spoons, scoops, and trowels are of similarly designed construction and can therefore be operated in accordance with the following procedure.

Select the sampling location and prepare the surface by removal of surface debris if present. If the sample depth interval is at some depth below the ground surface, the surface soil material should also be removed as part of the surface preparation step. Surface preparation should be completed using other appropriately decontaminated sampling equipment.

Decontaminate the sampling tool in accordance with established procedures prior to use.
The soil sample should be obtained by inserting the sampling tool into the ground and rotating the tool so that a representative "column" of soil is removed from the ground.

The immediate objective is to collect the VOA sample fraction first if this is required. If the VOA sample is to be collected from the upper sampling interval, then the first scoop of soil should be used to directly fill the sample containers. If a specific depth below the ground surface has been targeted for the VOA sample, the overlying soils should be removed and discarded or placed into a soil collection pan as part of the remaining composite sample.

Regardless of whether or not a VOA sample is required, one or more cores or scoops of soil may be needed until the desired sampling depth is achieved. Removal of a representative column of soil in cohesionless soils may be difficult to achieve, however. If more soil is needed to meet sample volume requirements, additional soil cores may be collected from an immediately adjacent location.

Except for VOA samples, as each portion of the sample is removed from the ground, it should be placed into an intermediate sample container (collection pan) until the entire sample interval of soil is removed.

Once the sample interval has been collected, the soil sample should be thoroughly homogenized within the collection pan prior to bottling. Sample homogenizing is accomplished by manually mixing the entire soil sample in the collection pan with the sampling tool or with a clean teaspoon or spatula until a uniform mixture is achieved.

The appropriate sample containers should be filled with soil from the collection pan. The sampling tool may be used to fill the sample bottles. If packing of the samples into the bottles is necessary, a clean stainless steel teaspoon or spatula may be used. Use of fingers/hands to fill or pack sample containers should be avoided (this also includes VOA samples).

Once each sample container is filled, the rim and threads of the sample container will be cleaned of gross soil by wiping with a paper towel, then capped and labeled. Do not submerge the sample containers in water to clean them. Once labeled the sample containers should be placed into a cooler for protection. Sample chain-of-custody and other documentation requirements should be completed at this time.
The sampling tool and other sampling equipment should be decontaminated prior to reuse. All investigation-derived waste should be properly contained before leaving the area.

The sample hole should be backfilled to eliminate any surface hazard. The project sampling plan may indicate the requirements for backfilling of the sample hole.

4.4.4 Hand Auger Sampling

Select the sampling location and prepare the surface by removal of surface debris if present.

Decontaminate the sampling tool in accordance with established procedures prior to use.

A hand auger, or soil auger, can be used to extract shallow soil samples up to three (3) feet below the surface. Representative samples can be collected directly from the auger flight as it is withdrawn from the ground, or from the tube sampler attachment which can be advanced into the soil after augering to the desired depth.

When using the hand auger, the hole should be augered to the required depth by manually pushing and turning the auger. As the auger is turned, soils will be discharged to the ground surface, although some soil will be retained on the auger flight. Augering should be continued until the desired depth is achieved. If a composite or homogenized soil sample is the objective, those soils which have been discharged to the ground surface as well as those soils which cling to the auger flight should be homogenized within a soil collection pan prior to bottling. If a VOA sample is required, this fraction of the soil sample should be collected as soon as possible without compositing. It should be noted that soil augers cause considerable disturbance of the soil, therefore, some consideration should be given toward collection of VOA sample fractions using some other method (spoons, trowels, bucket augers may cause less disturbance).

Except for VOA sample fractions, the remainder of the soil sample should be thoroughly homogenized in the soil collection pan prior to bottling.

The appropriate sample containers should be filled with soil from the collection pan. A clean spoon or spatula may be needed to fill the sample bottles as necessary.
Once each sample container is filled, the rim and threads of the sample container will be cleaned of gross soil by wiping with a paper towel, then capped and labeled. Do not submerge the sample containers in water to clean them. Once labeled the sample containers should be placed into a cooler for protection. Sample chain-of-custody and other documentation requirements should be completed at this time.

All used sampling equipment should be decontaminated prior to reuse and investigation-derived waste should be properly contained before leaving the area.

The sample hole should be backfilled to eliminate any surface hazard. The project sampling plan may indicate the requirements for backfilling of the sample hole.

### 4.4.5 Bucket Auger Sampling

A bucket auger may be used to collect soil samples from depths ranging from one (1) to approximately five (5) feet. In some instances, soil samples may be collected from greater depths, but often with considerable more difficulty. Bucket augers allow for discrete depth interval sampling as the soil is retained within the hollow tube of the auger when it is extracted from the ground. It should be noted that if depth-discrete sampling is the objective, more than one auger may be necessary, with one auger used to provide access to the required sampling depth and the other (clean) auger used for sample collection.

Select the sampling location and prepare the surface by removal of surface debris, if present.

Decontaminate the sampling tool in accordance with established procedures prior to use.

When using the bucket auger, the auger should be pushed downward and rotated until the bucket becomes filled with soil. Usually a 6 to 12-inch core of soil is obtained each time the auger is inserted. Once filled, the auger should be removed from the ground and emptied into the soil collection pan. If a VOA sample is required, the sample should be taken directly from the auger using a teaspoon or spatula and/or directly filling the sample container from the auger. The augering process should be repeated until the desired sample interval has been augered and placed into the collection pan.

If the desired sample interval is located at a specific depth below the ground surface, the unwanted interval can be removed with one auger and the soil
Sample collection can then proceed in normal fashion using a clean auger or following decontamination of the original auger.

Except for VOA sample fractions, the remainder of the soil sample should be thoroughly homogenized in the soil collection pan prior to bottling.

The appropriate sample containers should be filled with soil from the collection pan. Once each sample container is filled, the rim and threads of the sample container will be cleaned of gross soil by wiping with a paper towel, then capped and labeled. Do not submerge the sample containers in water to clean them. Once labeled the sample containers should be placed into a cooler for protection. Sample chain-of-custody and other documentation requirements should be completed at this time.

All used sampling equipment should be decontaminated prior to reuse and investigation-derived waste should be properly contained before leaving the area.

The sample hole should be backfilled to eliminate any surface hazard. The project sampling plan may indicate the requirements for backfilling of the sample hole.

5.0 QUALITY CONTROL

Quality control requirements for sample collection are dependent on project-specific sampling objectives. The Quality Assurance Project Plan (QAPP) will provide requirements for sample preservation and holding times, container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

6.0 DOCUMENTATION

Various forms are required to ensure that adequate documentation is made of the sample collection activities. These forms include:

- Field log books
- Sample collection records
- Chain-of-custody forms
- Shipping labels

The field book will be maintained as an overall log of all samples collected throughout the study. Sample collection records are generated for each sample collected and include specific
information about the sample (Figure 1). Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes. Shipping labels are required if sample coolers are to be transported to the laboratory by a third party (courier service). Original and/or copies of these documents will be retained in the appropriate project files.

7.0 TRAINING/QUALIFICATIONS

Surface soil sampling is a relatively simple procedure requiring minimal training and a relatively small amount of equipment. It is, however, recommended that initial attempts be supervised by more experienced personnel. Sampling personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous materials may be present.

8.0 REFERENCES

Not applicable.
### SURFACE SOIL SAMPLE LOG

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<td>Time:</td>
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Sample Point Description/Designation:

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### SAMPLE COLLECTION

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<table>
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<th>Analyses Requested</th>
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</table>

Comments:

Lab Designation:

Shipping ID Number:

Collector's Name:

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1.0 PURPOSE AND APPLICABILITY

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the procedures associated with the packaging and shipment of environmental samples. Two general categories of samples exist: environmental samples consisting of water and soil submitted for routine environmental testing, and waste material samples which include non-hazardous solid wastes and/or hazardous wastes as defined by 40 CFR Part 261 submitted for environmental testing or bench/pilot-scale treatability testing. Packaging and shipping procedures will differ for the two sample categories.

This SOP is applicable to packaging and shipment of environmental samples submitted for routine environmental testing. Environmental samples are not considered a hazardous waste by definition; therefore, more stringent Department of Transportation (DOT) regulations regarding sample transportation do not apply. Environmental samples do, however, require fairly stringent packaging and shipping measures to ensure sample integrity as well as safety for those individuals handling and transporting the samples.

This SOP is designed to provide a high degree of certainty that environmental samples will arrive at their destination intact. This SOP assumes that samples will often require shipping overnight by a commercial carrier service, therefore, the procedures are more stringent than may be necessary if a laboratory courier is used or if samples are transported directly to their destination by a sampling team member. Should the latter occur, the procedures may be modified to reflect a lesser degree of packaging requirements.

Respective state or federal agency (regional offices) protocols may require or recommend specific types of equipment for use in sample packaging or a specific method of shipment that may vary from the indicated procedures. Deviations from this SOP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the project work plan, and must be documented in the field project notebook when they occur.
1.2 General Principles

Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

1.3 Quality Assurance Planning Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific work plan or Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will specify sample packaging and shipment requirements if variations to the indicated procedures are necessary on a particular project.

1.4 Health and Safety Considerations

Sampling personnel should be aware that packaging and shipment of samples involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate health and safety measures must be taken to protect sampling personnel from these potential hazards. The project Health and Safety Plan (HASP) generally addresses physical and other potential hazards. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed. In the absence of a HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

2.0 RESPONSIBILITIES

2.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the procedures outlined within this SOP and with specific sampling, quality assurance, and health and safety requirements outlined within the project-specific plans. The sampling technician is responsible for proper packaging and shipment of environmental samples and for proper documentation of sampling activities for the duration of the sampling program.
2.2 Sampling Coordinator

Large sampling programs may require additional support personnel such as a sampling coordinator. The sampling coordinator is responsible for providing management support such as maintaining an orderly sampling process, providing instructions to sampling technicians regarding sampling locations, and fulfilling sample documentation requirements, thereby allowing sampling technicians to collect samples in an efficient manner.

2.3 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the activities in accordance with the project plan and this SOP. The project manager is also responsible for ensuring that proper arrangements have been made with the designated analytical laboratory. These arrangements include, but are not necessarily limited to, subcontractor agreements, analytical scheduling, and bottle/cooler orders. The project manager may delegate some of these responsibilities to other project staff.

3.0 REQUIRED MATERIALS

- Sample coolers
- Sample containers
- Shipping labels
- Chain-of-custody records, custody seals
- Bubble wrap
- Vermiculite (granular), or styrofoam pellets
- "Blue Ice" refreezable ice packs, or ice cubes
- Transparent tape, or rubber bands
- Fiber tape
- Duct tape
- Zipper-lock plastic bags
• Trash bags
• Health and Safety supplies
• Equipment decontamination materials
• Field project notebook/pen

4.0 METHOD

4.1 General Information

4.1.1 Regulatory Information

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when any of the following conditions are applicable:

• Samples are being transported to a laboratory for analysis;
• Samples are being transported to the collector from the laboratory after analysis;
• Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

4.1.2 Sample Information:

The following information must accompany each shipment of samples on a chain-of-custody form (Figure 1) where each sample has an individual entry:

• Sample collector's name, mailing address and telephone number,
• Analytical laboratory's name, mailing address and telephone number,
• A unique identification of each sample,
• Sample description (matrix),
• Number and type of sample containers,
• Container size,
• Preservative,
• Type and method of analysis requested, and
• Date and time that the samples were collected and prepared for shipping,
• Special handling instructions, including notation of suspected high concentration samples.

4.1.3 Laboratory Notifications:

Prior to sample collection, the Project Manager, or designated alternative must notify the laboratory manager of the number, type and approximate collection and shipment dates for the samples. If the number, type or date of sample shipment changes due to program changes which may occur in the field, the Project Manager or alternate must notify the laboratory of the changes. Additional notification from the field is often necessary when shipments are scheduled for weekend delivery.

4.2 General Site Preparation

4.2.1 Small Projects

Small projects of one or two days duration may require packaging and shipment of samples using the field vehicle as the sample preparation area. If sample coolers will be sent via third party commercial carrier service, adequate sample packaging materials should be sent to the project location in advance of sampling or purchased from stores located near the site.

4.2.2 Large Projects

Multi-day or week sampling programs usually require rental of an office trailer or use of existing office/storage facilities for storage of equipment as well as for sample preparation. If possible, a designated area should be selected for storage of unused sample containers/coolers and another area for sample handling, packaging, and shipment. Handling of environmental samples should preferably be conducted in a clean area and away from unused
sample containers to minimize the potential for cross contamination. Large quantities of packaging materials may require advance special ordering. Shipping forms/labels may be preprinted to facilitate shipping.

4.2.3 Cooler Inspection and Decontamination

Laboratories will often re-use coolers. Every cooler received at a project location should be inspected for condition and cleanliness. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded as their insulating properties are now compromised. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) can not be fashioned in the field. Replacement coolers may be purchased in the field if necessary.

The interior and exterior of each cooler should be inspected for cleanliness before using it. Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with ENSR SOP-7600 (Decontamination of Equipment) prior to use. Drain plugs should be sealed on the inside with duct tape.

4.2.4 Other Considerations

VOC Samples - Sample containers used for VOC analysis may be grouped into a single cooler, with separate chain-of-custody record, to limit the number of trip blanks required for transportation and analysis. Individual VOC samples may also be placed into Zipper-lock bags to further protect the samples.

Contaminated Samples - Sample containers with presumed high contaminant concentrations should be isolated within their own cooler with each sample container placed into a Zipper-lock bag.

4.3 Sample Packaging Method

Sample packaging should be conducted in the following manner:

4.3.1 Place plastic bubble wrap matting over the base of each cooler or shipping container as needed. A 2- to 3-inch thickness layer of vermiculite may be used as a substitute base material.

4.3.2 Insert a clean trash bag into the cooler to serve as a liner.
4.3.3 Check that each sample container is sealed, labelled legibly, and is externally clean. Re-label and/or wipe bottles clean if necessary. Clear tape should be placed over the labels to protect them. Wrap each sample bottle individually with bubble wrap secured with tape or rubber bands. Place bottles into the cooler in an upright single layer with approximately one inch of space between each bottle. Do not stack bottles or place them in the cooler lying on their side. If plastic and glass sample containers are used, alternate the placement of each type of container within the cooler so that glass bottles are not placed side by side.

4.3.4 Insert cooler temperature blanks if required.

4.3.5 Place additional vermiculite, bubble wrap, and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling.

4.3.6 Place cubed ice or cold packs in heavy duty Zip-lock type plastic bags, close the bags, and distribute the packages in a layer over the top of the samples. Cubed ice should be double-bagged to prevent leakage. Loose ice should never be used. Cold packs should be used only if the samples are chilled before being placed in the cooler.

4.3.7 Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.

4.3.8 Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain-of-custody form. Sign and date the chain-of-custody tape.

4.3.9 Complete the chain-of-custody form. If shipping the samples involves use of a third party commercial carrier service, sign the chain-of-custody record thereby relinquishing custody of the samples. Shippers should not be asked to sign chain of custody records. If a laboratory courier is used, or if samples are transported to the laboratory, the receiving party should accept custody and sign the chain-of-custody records. Remove the last copy from the form and retain it with other field notes. Place the original (with remaining copies) in a Zipper-lock type plastic bag and tape the bag to the inside lid of the cooler or shipping container.
4.3.10 Close the top or lid of the cooler or shipping container.

4.3.11 Place the chain of custody tape at two different locations (i.e., one tape on each side) on the cooler or container lid and overlap with transparent packaging tape.

4.3.12 Packaging tape should be placed entirely around the sample shipment containers. A minimum of two full wraps of packaging tape will be placed at least two places on the cooler.

4.3.13 Repeat the above steps for each cooler or shipping container.

4.4 Sample Shipping Method

Packaged sample coolers should be shipped using one of the following options:

4.4.1 Hand Delivery

When a project member is transporting samples by automobile to the laboratory, the cooler should only be sealed with tape. In these cases, chain-of-custody will be maintained by the person transporting the sample and chain-of-custody tape need not be used. Chain-of-custody records should be relinquished upon delivery and a copy of the record retained in the project file.

4.4.2 Laboratory Courier

Laboratory couriers are usually employees of the analytical laboratory receiving the samples. As such, they will accept custody of the samples and must be asked to sign the chain-of-custody records. Chain-of-custody records do not need to be sealed in the cooler although it is recommended that the coolers be sealed with tape. All other packaging requirements generally apply unless otherwise specified in the QAPP.

If the laboratory courier is not authorized to accept custody of the samples, or if the requirements of the project plan preclude transfer to the laboratory courier, samples will be handled as described below in Section 4.4.3.

4.4.3 Third Party Courier

If overnight shipment is required, a third party package delivery service should be used. Transport the cooler to the package delivery service office
or arrange for package pick-up at the site. Fill out the appropriate shipping form or airbill and affix it to the cooler. Some courier services may use multi-package shipping forms where only one form needs to be filled out for all packages going to the same destination. If not, a separate shipping form should be used for each cooler. Keep the receipt for package tracking purposes should a package become lost. Please note that each cooler also requires a shipping label which indicates point of origin and destination. This will aid in recovery of a lost cooler if a shipping form gets misplaced. Never leave coolers unattended while waiting for package pick-up. Airbills or waybills will be maintained as part of the custody documentation.

4.5 Sample Receipt

Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the tape number corresponds with the number on the chain-of-custody record. The laboratory will note the condition of the samples upon receipt and will identify any discrepancies between the contents of the cooler and chain-of-custody. The analytical laboratory will then forward the back copy of the chain-of-custody record to the project manager to indicate that sample transmittal is complete.

5.0 QUALITY CONTROL

The potential for samples to break during transport increases greatly if individual containers are not snugly packed into the cooler. Completed coolers may be lightly shake-tested to check for any loose bottles. The cooler should be repacked if loose bottles are detected.

Environmental samples are generally shipped so that the samples are maintained at a temperature of approximately 4°C. Temperature blanks may be required for some projects as a quality assurance check on shipping temperature conditions. These blanks usually are supplied by the laboratory and consist of a 40-ml vial or plastic bottle filled with tap water. Temperature blanks should be placed near the center of the cooler.

6.0 DOCUMENTATION

Documentation supporting sample packaging and shipment generally consists of chain-of-custody records and shipping records. In addition, a description of sample packaging procedures will be written in the field project notebook. All documentation will be retained in the project files following project completion.
7.0 TRAINING/QUALIFICATIONS

Sample packaging and shipment is a relatively simple procedure requiring minimal training and a minimal amount of equipment. It is, however, recommended that initial attempts be supervised by more experienced personnel. Sampling technicians should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present.
**Figure 1. Chain of Custody Form**

<table>
<thead>
<tr>
<th>CHAIN OF CUSTODY RECORD</th>
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| 3URMHFWXPEHU | 3URMHFWXPEHU | 3URMHFWXPEHU |
| &KLOQDRRUGVWDFW3URMHFW10PH | $QDOVLYSHQW | 
| 6HQGSHVXOWVSHSRUWWR | 6HQGSHVXOWVSHSRUWWR | 6HQGSHVXOWVSHSRUWWR |
| &KLOQDRRUGVWDFW3URMHFW10PH | $QDOVLYSHQW | 
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)RUW&ROO1QV&2

SHULDO1R
Figure 2. Chain of Custody Tape
Standard Operating Procedure
Decontamination of Field Equipment

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5.0 QUALITY CONTROL ........................................................................ 6
6.0 DOCUMENTATION .......................................................................... 6
7.0 TRAINING/QUALIFICATIONS ............................................................... 7
1.0 Purpose and Applicability

This SOP describes the methods to be used for the decontamination of field equipment used in the collection of environmental samples. The list of field equipment may include a variety of items used in the collection of soil and/or water samples such as split-spoon samplers, trowels, scoops, spoons, bailers, and pumps. Heavy equipment such as drill rigs and backhoes also require decontamination, usually in a specially constructed temporary decontamination area.

Decontamination is performed as a quality assurance measure and a safety precaution. Improperly decontaminated sampling equipment can lead to misinterpretation of environmental data due to interference caused by cross-contamination. Decontamination protects field personnel from potential exposure to hazardous materials. Decontamination also protects the community by preventing transportation of contaminants from a site.

This SOP emphasizes decontamination procedures to be used for decontamination of reusable field equipment. Occasionally, dedicated field equipment such as well construction materials (well screen and riser pipe) or disposable field equipment (bailers or other general sampling implements) may also require decontamination prior to use. The project-specific work plan should indicate the specific decontamination requirements for a particular project.

Respective state or federal agency (regional offices) regulations may require specific types of equipment or procedures for use in decontamination of field equipment. The project manager should review the applicable regulatory requirements, if any, prior to the start of the field investigation program.

1.1 General Principles

Decontamination is accomplished by manually scrubbing, washing, or spraying equipment with detergent solutions, tap water, distilled/de-ionized water, steam and/or high pressure water, or solvents. The decontamination method and agents are generally determined on a project-specific basis and must be stated in the Quality Assurance Project Plan (QAPP).

Generally, decontamination of equipment is accomplished at each sampling site between collection points. Waste decontamination materials such as spent liquids and solids will be collected and managed as investigation-derived waste for later disposal. All decontamination materials, including wastes, should be stored in a central location so as to maintain control over the quantity of materials used or produced throughout the investigation program.

1.2 Quality Assurance Planning Considerations

1.2.1 General Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific QAPP. The QAPP guidelines typically require collection of equipment blank samples in order to determine the effectiveness of the decontamination procedure.

The decontamination method, solvent, frequency, location on site and the method of containment and disposal of decontamination wash solids and solutions are dependent on site logistics, site-specific chemistry, and
nature of the contaminated media to be studied and the objectives of the study. Each topic must be considered and addressed during development of a decontamination strategy and should be outlined in the Quality Assurance Project Plan (QAPP).

1.2.2 Solvent Selection

There are several factors which need to be considered when deciding upon a decontamination solvent. The solvent should not be an analyte of interest. The sampling equipment must be resistant to the solvent. The solvent must be evaporative or water soluble or preferably both. The applicable regulatory agency may have specific requirements regarding decontamination solvents. The QAPP should specify the type of solvent to be used for a particular project.

The analytical objectives of the study must also be considered when deciding upon a decontamination solvent. Pesticide-grade methanol is the solvent of choice for general organic analyses. It is relatively safe and effective. Hexane, acetone, and isopropanol are sometimes used as well. A 10% nitric acid in deionized water solution is the solvent of choice for general metals analyses. Nitric acid can be used only on Teflon, plastics and glass. If used on metal equipment, nitric acid will eventually corrode the metal and lead to the introduction of metals to the collected samples. Dilute hydrochloric acid is usually preferred over nitric acid when cleaning metal sampling equipment.

Equipment decontamination should be performed a safe distance away from the sampling area so as not to interfere with sampling activities but close enough to the sampling area to maintain an efficient working environment. If heavy equipment such as drill rigs or backhoes are to be decontaminated, then a central decontamination station should be constructed with access to a power source and water supply.

1.3 Health and Safety Considerations

Decontamination procedures may involve chemical exposure hazards associated with the type of contaminants encountered or solvents employed and may involve physical hazards associated with decontamination equipment. When decontamination is performed on equipment which has been in contact with hazardous materials or when the quality assurance objectives of the project require decontamination with chemical solvents, the measures necessary to protect personnel must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing equipment decontamination, and must be adhered to as field activities are performed.

2.0 Responsibilities

2.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the decontamination procedures outlined within this SOP and with specific quality assurance, and health and safety requirements outlined within project-specific work plans (HASP, QAPP). The sampling technician is responsible for decontamination of field equipment and for proper documentation of decontamination activities. The sampling technician is also responsible for ensuring that decontamination procedures are followed by subcontractors when heavy equipment requires decontamination.
Standard Operating Procedure
Decontamination of Field Equipment

2.2 Field Project Manager

The field project manager is responsible for ensuring that the required decontamination procedures are followed at all times. The project manager is also responsible for ensuring that subcontractors construct and operate their decontamination facilities according to project specifications. The project manager is responsible for collection and control of IDW in accordance with project specifications.

3.0 Required Materials

- Decontamination agents (per work plan requirements):
- LIQUI-NOX, ALCONOX, or other phosphate-free biodegradable detergent,
- Tap water,
- Distilled/de-ionized water,
- Nitric acid and/or hydrochloric acid,
- Methanol and/or hexane, acetone, isopropanol.
- Health and Safety equipment
- Chemical-free paper towels
- Waste storage containers: drums, 5-gallon pails w/covers, plastic bags
- Cleaning containers: plastic buckets or tubs, galvanized steel pans, pump cleaning cylinder
- Cleaning brushes
- Pressure sprayers
- Squeeze bottles
- Plastic sheeting
- Aluminum foil
- Field project notebook/pen

4.0 Methods

4.1 General Preparation

1. It should be assumed that all sampling equipment, even new items, are contaminated until the proper decontamination procedures have been performed on them or unless a certificate of analysis is available which demonstrates the items cleanliness.

   Field equipment that is not frequently used should be wrapped in aluminum foil, shiny side out, and stored in a designated "clean" area. Small field equipment can also be stored in plastic bags to
eliminate the potential for contamination. Field equipment should be inspected and decontaminated prior to use if the equipment appears contaminated and/or has been stored for long periods of time. Unless customized procedures are stated in the QAPP for decontamination of equipment, the standard procedures specified in this SOP shall be followed.

2. Establish the decontamination station within an area that is convenient to the sampling location. If single samples will be collected from multiple locations, then a centralized decontamination station, or a portable decontamination station should be established.

3. An investigation-derived waste (IDW) containment station should be established at this time also. The project-specific work plan should specify the requirements for IDW containment. In general, decontamination solutions are discarded as IDW between sampling locations. Solid waste is disposed of as it is generated.

4.2 Decontamination for Organic Analyses

1. This procedure applies to soil sampling and groundwater sampling equipment used in the collection of environmental samples submitted for organic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items. Submersible pump decontamination procedures are outlined in Section 4.4.

2. Decontamination is to be performed before sampling events and between sampling points.

3. After a sample has been collected, remove all gross contamination from the equipment or material by brushing and then rinsing with available tap water. This initial step may be completed using a 5-gallon pail filled with tap water. Steam or a high-pressure water rinse may also be conducted to remove solids and/or other contamination.

4. Wash the equipment with a phosphate-free detergent and tap water solution. This solution should be kept in a 5-gallon pail with its own brush.

5. Rinse with tap water or distilled/deionized water until all detergent and other residue is washed away. This step can be performed over an empty bucket using a squeeze bottle or pressure sprayer.

6. Rinse with methanol or other appropriate solvent using a squeeze bottle or pressure sprayer. Rinsate should be collected in a waste bucket.

7. Rerinse with deionized water to remove any residual solvent. Rinsate should be collected in the solvent waste bucket.

8. Allow the equipment to air-dry in a clean area or blot with chemical-free paper towels before reuse. Wrap the equipment in tin foil and/or seal it in a plastic bag if it will not be reused for a while.

9. Dispose of soiled materials and spent solutions in the designated IDW disposal containers.

4.3 Decontamination for Inorganic (Metals) Analyses

1. This procedure applies to soil sampling equipment used primarily in the collection of environmental samples submitted for inorganic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items.

2. For plastic and glass sampling equipment, follow the steps outlined in 4.2 above, however, use a 10% nitric acid solution (acid in water) in place of the solvent rinse in Section 4.2.6.

3. For metal sampling equipment, follow the steps outlined in 4.2 above, however, use a 10% hydrochloric acid solution (acid in water) in place of the solvent rinse in Section 4.2.6.
4.4 Decontamination of Submersible Pumps

1. This procedure will be used to decontaminate submersible pumps before and between ground-water sample collection points. This procedure applies to both electric submersible and bladder pumps. This procedure also applies to discharge tubing if it will be reused between sampling points.

2. Prepare the decontamination area if pump decontamination will be conducted next to the sampling point. If decontamination will occur at another location, the pump and tubing may be removed from the well and placed into a clean trash bag for transport to the decontamination area. Pump decontamination is easier with the use of 3-foot tall pump cleaning cylinders (i.e., Nalgene cylinder) for the various cleaning solutions, although the standard bucket rinse equipment may be used.

3. Once the decontamination station is established, the pump should be removed from the well and the discharge tubing and power cord coiled by hand as the equipment is removed. If any of the equipment needs to be put down temporarily, place it on a plastic sheet (around well) or in a clean trash bag. If a disposable discharge line is used it should be removed and discarded at this time.

4. As a first step in the decontamination procedure, use a pressure sprayer with tap water to rinse the exterior of the pump, discharge line, and power cord as necessary. Collect the rinsate and handle as IDW.

5. Place the pump into a pump cleaning cylinder or bucket containing a detergent solution (detergent in tap water). Holding the tubing/power cord, pump solution through the system. A minimum of one gallon of detergent solution should be pumped through the system. Collect the rinsate and handle as IDW.

6. Place the pump into another cylinder/bucket containing a 10% solution of solvent (methanol, or other designated solvent) in distilled/deionized water. Pump until the detergent solution is removed. Collect the rinsate and handle as IDW.

7. Place the pump into another cylinder/bucket containing distilled/deionized water. Pump a minimum of 3 to 5 pump system volumes (pump and tubing) of water through the system. Collect the rinsate and handle as IDW.

8. Remove the pump from the cylinder/bucket and if the pump is reversible, place the pump in the reverse mode to discharge all removable water from the system. If the pump is not reversible the pump and discharge line should be drained by hand as much as possible. Collect the rinsate and handle as IDW.

9. Using a pressure sprayer with distilled/deionized water, rinse the exterior of the pump, discharge line, and power cord thoroughly, shake all excess water, then place the pump system into a clean trash bag for storage. If the pump system will not be used again right away, the pump itself should also be wrapped with aluminum foil before placing it into the bag.

4.5 Decontamination of Large Equipment

1. Consult the QAPP for instruction on the location of the decontamination station and the method of containment of the wash solutions. On large projects usually a temporary decontamination facility (decontamination pad) is required which may include a membrane-lined and bermed area large enough to drive heavy equipment (drill rig, backhoe) onto with enough space to spread other equipment and to contain overspray. Usually a small sump with pump is necessary to collect and contain rinsate. A water supply and power source is also necessary to run steam cleaning and/or pressure washing equipment.
2. Upon arrival and prior to leaving a sampling site, all heavy equipment such as drill rigs, trucks, and backhoes should be thoroughly cleaned and then the parts of the equipment which come in contact or in close proximity to sampling activity should be decontaminated. This can be accomplished in two ways, steam cleaning or high pressure water wash and manual scrubbing. Following this initial cleaning, only those parts of the equipment which come in close proximity to the sampling activities (i.e., auger stems, rods, backhoe bucket) must be decontaminated in between sampling events.

Occasionally, well construction materials such as well screen and riser pipe may require decontamination before the well materials are used. These materials may be washed in the decontamination pad, preferably on a raised surface above the pad (i.e., on sawhorses), with clean plastic draped over the work surfaces. Well materials usually do not require a multistep cleaning process as they generally arrive clean from the manufacturer. Usually, a thorough steam-cleaning of the interior/exterior of the well materials will be sufficient. The QAPP should provide specific guidance regarding decontamination of well materials.

### 5.0 Quality Control

#### 5.1 Field Blank and Equipment Blank Sample Collection

Quality control samples in the field generally include the collection of field blank and equipment blank samples. The QAPP specifies the type and frequency of collection of each type of quality assurance sample depending upon the media sampled. The quality control check of field equipment decontamination and field sample handling requires the collection of equipment blanks from the decontaminated equipment and field blanks using laboratory-provided deionized water. Equipment and field blanks should be collected using the following procedures:

- **Equipment blanks** (i.e., equipment rinsate blanks) are generally made by pouring laboratory-supplied deionized water into, over, or through the freshly decontaminated sampling equipment and then transferring this water into a sample container for analyses.

- **Field blanks** are generally made by pouring laboratory-supplied deionized water directly into a sample bottle while in the field to demonstrate that sample handling in the field does not introduce contamination and that the sample bottle is not contaminated.

Both field blanks and equipment blanks should then be labeled as samples and submitted to the laboratory to be analyzed for the same parameters as associated samples. Field blank and equipment blank sample numbers, as well as the collection method, time and location should be recorded in the field notebook.

### 6.0 Documentation

Specific information regarding decontamination procedures should be documented in the project-specific field notebook. Documentation within the notebook should thoroughly describe the construction of each decontamination facility and the decontamination steps implemented in order to show compliance with the
Decontamination events should be logged when they occur with the following information documented:

- Date, time and location of each decontamination event
- Equipment decontaminated
- Method
- Solvents
- Notable circumstances
- Identification of field blanks and decontamination rinsates
- Method of blank and rinsate collection
- Date, time and location of blank and rinsate collection
- Disposition of IDW

Repetitive decontamination of small items of equipment does not need to be logged each time the item is cleaned.

### 7.0 Training/Qualifications

All sampling technicians performing decontamination must be properly trained in the decontamination procedures employed, the project data quality objectives, health and safety procedures and the project QA procedures. Specific training or orientation will be provided for each project to ensure that personnel understand the special circumstances and requirements of that project. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous materials may be present.
Tables
### Table 1
Data Evaluation and Proposed Pre-Design Investigation Activities

<table>
<thead>
<tr>
<th>Site ID1</th>
<th>Start Depth (ft bgs)</th>
<th>End Depth (ft bgs)</th>
<th>Conc. (mg/kg)</th>
<th>Proposed PDI Activity</th>
<th>Primary PDI Samples2</th>
<th>Sample IDs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Area 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA-73 10E</td>
<td>0</td>
<td>0.5</td>
<td>1580</td>
<td>Collect additional samples at 1-2 and 2-4</td>
<td>RA-73 10E (1-2)</td>
<td>RA-73 10E (2-4)</td>
</tr>
<tr>
<td>RA-73 10E</td>
<td>0.5</td>
<td>1</td>
<td>1820</td>
<td>Collect new horizontal samples 10' W, 10' N, and 10' E</td>
<td>RA-73 10W10N (0.5-1)</td>
<td>RA-73 10W10N (1-2)</td>
</tr>
<tr>
<td>RA-73 10N</td>
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<td>0.5</td>
<td>138</td>
<td>Collect new horizontal samples 10' W, 10' N, and 10' E</td>
<td>RA-73 20N (0.5-1), RA-73 20N (1-2)</td>
<td>RA-73 20N (2-4)</td>
</tr>
<tr>
<td>RA-73 10N</td>
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<td>1</td>
<td>584</td>
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<td>RA-73 10E10N (1-2)</td>
</tr>
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<td>RA-73 10S</td>
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<td>279</td>
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<td>RA-73 10W10S (1-2)</td>
</tr>
<tr>
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<td>RA-73 20S (2-4)</td>
</tr>
<tr>
<td>RA-73 20E</td>
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<td>672</td>
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<td>RA-73 20E10N (1-2)</td>
</tr>
<tr>
<td>RA-73 20E</td>
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<td>1</td>
<td>2430</td>
<td>Collect new horizontal samples 10' W, 10' N, and 10' E</td>
<td>RA-73 30E (0.5-1), RA-73 30E (1-2)</td>
<td>RA-73 30E (2-4)</td>
</tr>
<tr>
<td>RA-73 20S</td>
<td>1</td>
<td>2</td>
<td>650</td>
<td>Collect contingency samples for potential use in horizontal and vertical delineation</td>
<td>RA-73 20E10S (0.5-1)</td>
<td>RA-73 20E10S (1-2)</td>
</tr>
<tr>
<td><strong>Soil Area 2</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point1 20W</td>
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<td>None</td>
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<td>NA</td>
</tr>
<tr>
<td>Point2 10E</td>
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</tr>
<tr>
<td>Point2 10S</td>
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<td>None</td>
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</tr>
<tr>
<td>Point2 20N</td>
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<td>0</td>
<td>3460</td>
<td>Collect new horizontal samples 20' W and 20' E</td>
<td>Point2 20W20N (0-0.5)</td>
<td>Point2 20W20N (0.5-1)</td>
</tr>
<tr>
<td>Point2 20N</td>
<td>0</td>
<td>0</td>
<td>3460</td>
<td>Collect new horizontal samples 20' W and 20' E</td>
<td>Point2 20E20N (0-0.5)</td>
<td>Point2 20E20N (0.5-1), Point2 20E20N (1-2), Point2 20E20N (2-4)</td>
</tr>
<tr>
<td>Point2 20S</td>
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<td>1400</td>
<td>Collect new horizontal samples 20' S</td>
<td>Point2 40S (0-0.5)</td>
<td>Point2 40S (0.5-1)</td>
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<tr>
<td>Point2 20W</td>
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<td>4980</td>
<td>Collect additional samples at 0.5-1, 1-2, 2-4</td>
<td>Point 2 20W (0-0.5)</td>
<td>Point 2 20W (0.5-1), Point 2 20W (1-2), Point 2 20W (2-4)</td>
</tr>
<tr>
<td>Point2 20W10S</td>
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<td>0</td>
<td>3760</td>
<td>Collect new horizontal samples 20' W</td>
<td>Point2 30W10S (0-0.5)</td>
<td>Point2 30W10S (0.5-1), Point2 30W10S (1-2), Point2 30W10S (2-4)</td>
</tr>
<tr>
<td>Point2 20W20S</td>
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<td>Collect new horizontal samples 20' S</td>
<td>Point2 20W40S (0-0.5)</td>
<td>Point2 20W40S (0.5-1)</td>
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<tr>
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<td>Point2 40N</td>
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<td>1410</td>
<td>Collect new horizontal samples 20' N and 20' E</td>
<td>Point2 60N (0-0.5)</td>
<td>Point2 60N (0.5-1)</td>
</tr>
</tbody>
</table>

1. Site ID: Identification number for the soil sample location.
2. Start Depth: Depth at which the sample was collected from the surface.
3. End Depth: Depth at which the sample was collected from the surface.
4. Conc.: Concentration of the sample collected, measured in mg/kg.
5. Proposed PDI Activity: Activity proposed for the sample.
6. Primary PDI Samples: Sample designations for primary PDI activities.
7. Sample IDs: Unique identifiers for the samples.
### Data Evaluation and Proposed Pre-Design Investigation Activities

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Start Depth (ft bgs)</th>
<th>End Depth (ft bgs)</th>
<th>Conc. (mg/kg)</th>
<th>Proposed PDI Activity</th>
<th>Primary PDI Samples②</th>
<th>Contingency PDI Samples③</th>
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<tbody>
<tr>
<td>Point2 40N40W</td>
<td>0</td>
<td>0.5</td>
<td>1160</td>
<td>Collect new horizontal samples 20' N, 20' W, and 20' S</td>
<td>Point2 40W60N (0-0.5)</td>
<td>Point2 40W60N (0.5-1), Point2 40W20N (0-0.5), Point2 40W20N (0.5-1)</td>
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<td>RA-49 20W20N (0-0.5)</td>
<td>RA-49 20W20N (0.5-1), RA-49 20W20N (1-2)</td>
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<td>RA-49 20W</td>
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<td>0.5</td>
<td>589</td>
<td>Collect new horizontal sample 20' S</td>
<td>RA-49 20W20S (0-0.5), RA-49 20W20S (0.5-1)</td>
<td>RA-49 20W20S (1-2), RA-49 20W20S (2-4)</td>
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<tr>
<td>RA-49 30N</td>
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<td>0.5</td>
<td>5160</td>
<td>Collect new horizontal sample 20' W and 20' N (one sample)</td>
<td>RA-49 20W50N (0-0.5)</td>
<td>RA-49 20W50N (0.5-1), RA-49 20W50N (1-2)</td>
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<td>RA-49 50W</td>
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<td>0.5</td>
<td>3770</td>
<td>Collect new horizontal samples 15' N and 15' S</td>
<td>RA-49 50W15N (0-0.5)</td>
<td>RA-49 50W15N (0.5-1), RA-49 50W15N (1-2)</td>
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<td>Collect additional samples at 1-2 and 2-4</td>
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<td>RA-49 70W50S (2-4)</td>
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<td>RA-49 70W70S</td>
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<td>1610</td>
<td>Collect new horizontal samples 10' W, 10' S, and 10' E</td>
<td>RA-49 80W70S (0-0.5)</td>
<td>RA-49 80W70S (0.5-1), RA-49 80W70S (1-2), RA-49 80W70S (2-4)</td>
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<tr>
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<td>RA-49 80W15S (0-0.5)</td>
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<tr>
<td>RA-49 80W20N</td>
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<td>0.5</td>
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<td>Collect new horizontal sample 15' E</td>
<td>RA-49 65W20N (0-0.5)</td>
<td>RA-49 65W20N (0.5-1)</td>
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<td>RA-49 80W50S</td>
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<td>Collect new horizontal sample 10' W</td>
<td>RA-49 90W50S (0-0.5)</td>
<td>RA-49 90W50S (0.5-1), RA-49 90W50S (1-2), RA-49 90W50S (2-4)</td>
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## Table 1
### Data Evaluation and Proposed Pre-Design Investigation Activities

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<th>Site ID</th>
<th>Start Depth (ft bgs)</th>
<th>End Depth (ft bgs)</th>
<th>Conc. (mg/kg)</th>
<th>Proposed PDI Activity</th>
<th>Primary PDI Samples</th>
<th>Contingency PDI Samples</th>
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<tr>
<td>RA-75 100E120N</td>
<td>0</td>
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<td>3130</td>
<td>Collect new horizontal sample 20' W</td>
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<td>End Depth (ft bgs)</td>
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<td>Contingency PDI Samples&lt;sup&gt;3&lt;/sup&gt;</td>
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<td>RA-75 60E70N (1-2)</td>
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<td>7850</td>
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<td>8780</td>
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<td>RA-75 100E (0.5-1), RA-75 100E (1-2)</td>
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<td>End Depth (ft bg)</td>
<td>Conc. (mg/kg)</td>
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<td>Primary PDI Samples 2</td>
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<td>RA-75 90E40N</td>
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<td>RA-75 90E40N (2-4)</td>
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<td>RA-79 10W20N (1-2)</td>
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**Table 1**

Data Evaluation and Proposed Pre-Design Investigation Activities

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<th>Soil Area 3</th>
<th>Start Depth (ft bg)</th>
<th>End Depth (ft bg)</th>
<th>Conc. (mg/kg)</th>
<th>Proposed PDI Activity</th>
<th>Primary PDI Samples 2</th>
<th>Sample IDs</th>
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<td>RA-79 10E</td>
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<td>Collect new horizontal sample 10' E</td>
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<td>RA-79 10W</td>
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<td>Collect new horizontal sample 10' S</td>
<td>RA-79 10W10S (0.5-1)</td>
<td>RA-79 10W10S (1-2), RA-79 10W10S (2-4)</td>
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<td>Collect new horizontal samples 10' W, 10' N, and 10' E</td>
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Page 5 of 6
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<th>End Depth (ft bgs)</th>
<th>Conc. (mg/kg)</th>
<th>Proposed PDI Activity</th>
<th>Sample IDs</th>
<th>Contingency PDI Samples³</th>
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<td>0.5</td>
<td>32</td>
<td>Collect new horizontal samples at 10° N, 10° W, and 10° S</td>
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<td>RA-79 20W10S (0.5-1)</td>
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<td>Collect contingency samples for potential use in horizontal and vertical delineation</td>
<td>RA-79 20W10S (0.5-1)</td>
<td>RA-79 15W25S (0.5-1), RA-79 15W25S (1-2)</td>
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</table>

Notes:
1) Sample ID nomenclature example - RA-75 100E120N: RA-75 is the original Risk Assessment sample location; 100E indicates that the sample was collected 100 feet east of the original location; 120N indicates that the sample was collected 120 feet north of the original location.
2) Total of 75 PDI soil samples for laboratory analysis (13 from Area 1, 52 from Area 2, and 10 from Area 3).
3) Total of 136 PDI contingency soil samples - to be held for possible laboratory analysis (26 from Area 1, 89 from Area 2, and 21 from Area 3).

Conc. = concentration
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
NA = Not applicable
ND = Not detected
PDI = Pre-Design Investigation

- Concentration exceeds the Remedial Action Concentration (RAC) of 1,754 mg/kg
- Sample concentration between the revised cleanup criteria (e.g., 400 or 1,000 mg/kg) and the RAC
### Table 2

**Additional Soil Investigation Data - TCLP/SPLP Lead Concentrations**

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<th>Site ID(^1,2)</th>
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<th>Start Depth (ft bgs)</th>
<th>End Depth (ft bgs)</th>
<th>Laboratory Method</th>
<th>Analyte</th>
<th>Conc. (ug/L)</th>
<th>Reporting Limit (ug/L)</th>
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<tr>
<td>RA-49 10E</td>
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**Note:**

1) Site ID nomenclature - RA-75 10E, RA-75 indicates the original boring ID, 10 indicates offset distance in feet, E indicates direction (E for east)

2) All sample locations are shown on Figure 2.

- Conc. = concentration
- ft bgs = feet below ground surface
- ND = nondetect
- TCLP = toxicity characterization leaching procedure
- SPLP = synthetic precipitation leaching procedure
- ug/L = micrograms per liter
Figures
LEGEND
SOIL AREA
PROPERTY LINES
CURRENT PROPERTY OWNERS
PROPERTIES WITH DEED RESTRICTIONS
1 CITY OF NEODESHA
2 WILLIAMS PIPELINE (SEE NOTE 1)
3 GBW
4 COBALT
PROPERTIES WITH NO RESTRICTIONS
5 JOHN FLOYD
6 STEVE AESCHLIMAN
7 AIROSOL
8 FIBERGLASS ENGINEERING (COBALT BOATS)
9 HARMON INC.
10 NEW BEGINNINGS
11 ART HOOPER & FRED ROHLING
12 LANNY & RHONDA FORSYTHE
13 DAVID GREEN & DANNY WILLIAMS
14 RODNEY & DARLENE SCHLEGEL
15 SOMMER (SEE NOTE 2)
16 LINDA & THOMAS SMITH
17 DAVID & LORRAINE MCROBERTS
18 WILLIAM & LINDA FULLER
19 (SEE NOTE 2)

NOTES:
1) DEED RESTRICTIONS PENDING WITH KDHE.
2) PROPERTY NOT PART OF THE FORMER REFINERY.

Interim Measures Pre-Design
Investigation Work Plan
BP Products North America Inc., Neodesha, KS
Project No. 489910 Date: 03/08/16

AREA PROPERTY OWNERSHIP

Figure 1
LEGEND

- Lead sample location below revised cleanup criteria (i.e., 1,000 mg/kg or 400 mg/kg)
- Lead sample location with concentration between revised cleanup criteria and remedial action concentration of 1,750 mg/kg
- Surface soil lead sample location above remedial action concentration for potential future outdoor worker (1,750 mg/kg)
- Proposed PDI sample location - Used for horizontal and vertical delineation
- Proposed PDI sample location - Used for vertical delineation
- Proposed contingency sample location - Hold for potential use in horizontal and vertical delineation

Figure 2
March 24, 2016

Joel Jamison  
Geology Associate  
Kansas Department of Health and Environment  
Remedial Section/ Site Remediation Unit  
Bureau of Environmental Remediation  
Curtis State Office Building  
1000 SW Jackson St., Suite 410  
Topeka, KS 66612-1367

RE: Interim Measures Pre-Design Investigation Work Plan  
Former Refinery at Neodesha, Kansas

Dear Mr. Jamison:

Remediation Management Services Company, an affiliate of BP Products North America Inc. (BP), respectfully submits the Interim Measures Pre-Design Investigation Work Plan for the Former Refinery at Neodesha, Kansas (Site) for your review and approval.

If you have any questions or require additional information, please do not hesitate to contact me at (312)702-3252.

Sincerely,

Mary C. Wojciechowski  
Remediation Management Services Company  
An affiliate of BP Products NA Inc.

cc:  Chris Carey, KDHE, Chief Remedial Section  
     Ryan Weiser, KDHE  
     John Frankenthal, BP  
     Bill Solberg, AECOM  
     Michael Orth, AECOM  
     Joshua Haney, AECOM

APPROVED
August 19, 2016

Mary Wojciechowski
Site Manager, EBM
BP Products North America
150 West Warrenville Road, Bldg. 200
Naperville, IL 60563

Re: IM Pre-Design Investigation Work Plan for the Former Refinery at Neodesha, Kansas
Neodesha, Kansas

Dear Ms. Wojciechowski,

The Kansas Department of Health and Environment (KDHE) received the above document, prepared by AECOM, in March 2016. KDHE has reviewed the document and conditionally approves it with consideration of the following comments.

- **Page 1-1, Background, third paragraph:** Please provide additional language indicating that the current work plan is concerned with identification of step-out sampling from previously defined areas with concentrations above the remedial action concentrations (RAC) for lead of 1,000 or 400 milligrams per kilogram (mg/kg) that will be excavated.

  Please reference page 3-1 section 3 Sample Collection Scope of Work for the further explanation and delineation of the symbols on Figure 2 indicated in the last line of this paragraph.

- **Page 2-1, Section 2.1 Health and Safety:** Although KDHE does not review H&S plans a work plan is still required to have one. Please provide the updated H&S plan for the PDI work plan at your earliest convenience.

Please provide the requested revisions, the H&S document, and an electronic copy of the revised document at your earliest convenience. Should you have questions regarding this letter, please contact me by phone at 785-296-1936 or email at mtownsend@kdheks.gov.

Sincerely,

Margaret Townsend, PG
Environmental Specialist
Remedial Section/Site Remediation Unit
Bureau of Environmental Remediation

cc: Randy Carlson, KDHE → Neodesha Refinery File - C3-103-00027 1.0
Kate Gleeson, KDHE Office of Legal Services (e copy)
William Solberg, AECOM (e copy)
Christopher Pearson, AECOM (e copy)
Joshua Haney, AECOM (e copy)
Ed Truelove, City Administrator, City of Neodesha (e copy)