FIELD SAMPLING PLAN

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this Field Sampling Plan is to provide a comprehensive description of all sampling protocols that will be generally required for use for projects at Tooele Army Depot (TEAD). All sampling activities will be performed according to protocols, specific to each parameter of interest, promulgated by the U.S. Environmental Protection Agency (EPA) and by USACE. Where such protocols have not been established by the EPA or the USACE, protocols established by some other recognized authority (ASTM, State of Utah) will be utilized.

1.1 Sample Types

This section provides a description of the types of quality control samples that will be routinely obtained for specific projects. The project specific SAP will provide a description of sample types that will be relevant for each project in the discussion of Sampling Process Design.

1.2.1 Trip Blanks

Trip blanks are composed of purged DI water added to a clean preserved VOA vial. The trip blank accompanies sample containers from the laboratory to the field and back again to the laboratory. Trip blanks will be prepared and submitted to the Contract Laboratory (and the QA laboratory) for each shipment of environmental samples for VOC analyses (every cooler containing VOC samples will contain a trip blank that will be analyzed by the Contract Laboratory). Trip blanks will be analyzed for all VOC analyses (including 8015 mod.-gas) specified for samples in the corresponding cooler with the exception that if samples are to be analyzed for multiple VOC analyses covering the same analyte list the trip blanks will be analyzed only for the method incorporating the lowest PQL.

1.2.2 Quality Control (QC) Samples

Quality Control samples are blind duplicates submitted to the Contract Laboratory for the purpose of assessing Contract Laboratory precision. QC samples will be collected as 10% of the total sampling effort. Generally QC duplicates will be collected for the first sample and every tenth sample thereafter. If information regarding areas of particular interest at a site is available (i.e. highly contaminated areas) the distribution of QC samples may be placed at the discretion of field personnel with the concurrence of the project manager. QC duplicate samples will be analyzed for the same parameters as the corresponding primary sample.

1.2.3 Quality Assurance (QA) Samples

QA samples are duplicates that are submitted to a designated QA laboratory. The QA Laboratory may be a government laboratory or an independent laboratory chosen by the USACE. Results of these analyses compared to Contract Laboratory data will be used in preparation of the Chemical Quality Assurance Report by USACE. QA samples will not be collected for the long term monitoring program for the ground water remediation system at Tooele. QA samples will be generally collected as 10% of the total sampling effort, however the decision to collect QA samples will be determined on a project and site specific basis as a part of the technical project planning process and determined as part of the project DQOs. If information regarding areas of particular interest at a site is available (i.e. highly contaminated areas) it will be used in the determination of the distribution of QA samples. Changes in collection sites of QA samples due to field conditions may be made at the discretion of field personnel with the concurrence of the project manager. QA duplicate samples will be analyzed for the same parameters as the corresponding primary sample. The specific rate of QA samples and the laboratories that QA samples will be sent to will be directed in individual delivery orders.

1.2.4 Rinsate Samples

One rinsate sample will be collected for each day of sampling and for each crew performing groundwater sampling during field operations. Rinsate samples will be analyzed for all analytical methods that primary samples will be analyzed for. Rinsate samples will be performed daily for groundwater sampling activities if reusable bailers are used. If disposable bailers are utilized for sampling rinsate samples will not be required. For soil sampling the District will propose a minimum rate of rinsate sampling in project specific SAP's. Daily rinsate samples for soil sampling will generally not be required.

1.2.5 Field Blanks

One field blank will be obtained for each lot (5 gallon container, lot #, etc.) of water that is used for rinsing. For estimating purposes this will be assumed to be one per day of field activities involving sampling. Field blanks will only be performed for groundwater sampling activities involving VOC analyses.

2.0 FIELD DOCUMENTATION

2.1 Sample Information Documentation

All information pertinent to the environmental samples, including specific field collection data, names of sampling personnel, and laboratory observations will be recorded in permanently bound notebooks. Sample ID's will be linked to the site where the sample originated. The Contract Laboratory will also employ a specific information management system to assist in tracking the progress of each sample through the analytical process. The FSP will detail procedures for documentation of field and laboratory information that are consistent with the requirements of these specifications.

2.2 Preparation of Field Logbooks

The field logbook will be bound with serially numbered pages, and assigned to a specific person who is responsible for entry of information into the logbook. The logbook will be signed and dated by this person prior to initiation of field work. All entries into the logbook will be executed by this designated person. If it is necessary to transfer the logbook to alternative personnel during the course of field work the person relinquishing the logbook will sign and date the logbook at the time the logbook is transferred and the person receiving the logbook will do likewise. Corrections to erroneous data will be made by crossing a line through the entry and entering the correct information. The correction will be initialed and dated by the person making the entry. Unused portions of logbook pages will be crossed out, signed, and dated at the end of each workday. Logbook entries must be dated, legible, in ink, and contain accurate documentation. Language used will be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded, however, they must be clearly indicated as such and only relate to the subject observation. Field logs will become part of the project records.

2.3 Photographs

When samples are being collected, photographs will be taken to support the written description of sampling activities. In all cases when a photograph is taken the date, time, weather conditions (if applicable), subject, purpose for photographs being taken, number of photograph and identifying number from roll, and the name of the person taking the photograph will be recorded. When photographs are developed the information in the field logbook will be transferred to the back of the photograph. All photographs will become part of the project file and subject to all standard document controls. All photographs will be delivered to the USACE CO at the end of the project.

3.0 SAMPLING EQUIPMENT AND PROCEDURES

3.1 Standard Operating Procedures

Standard Operating Procedures (SOP's) for use by field and administrative personnel are presented as Appendix D. The SOP's represent and supplement the information presented in the CDQMP in a procedural format.

3.2 Drilling and Sampling Activities

3.2.1 Drilling

Collection of soil and groundwater samples may also be collected during drilling operations. Drilling activities will comply with project-specific work plans, including a Health and Safety Plan. Subcontractors are responsible for complying with the Health and Safety Plan. All required permits will be obtained prior to drilling activities. Prior to initiation of drilling activities, the proper notifications for underground utilities (e.g., Underground Service Alert, geophysical clearance, utility map inspection, site inspection) will be completed.

A geologist/engineer with a minimum of 3 years experience in environmental drilling operations will provide continuous oversight of each operating drill rig. Supervision of the drilling operation will be performed by an experienced Geologist.

Four commonly used drilling methods: hollow-stem auger, mud rotary, air rotary, and dual-tube percussion, are described below. Other methods may be utilized as identified in site-specific plans warranted by site conditions.

3.2.2 Hollow-Stem Auger Drilling

The hollow-stem auger method is suitable for unconsolidated and consolidated soils up to a maximum depth of 100 to 200 feet (depending on subsurface conditions). Hollow stem augers achieve faster penetration rates than any other type of drilling methods in soft, sticky clay soils. Some consolidated gravels, consolidated soils, and hard bedrock may be too dense for adequate auger penetration.

Split-spoon samplers are commonly used in conjunction with hollow stem auger drilling, and can provide discrete zone or continuous core soil samples. Grab samples are obtainable, but there is less lithologic control than with other drilling methods. Hollow stem augers may be used to install monitoring wells (limited by diameter) as there is good depth control, and the auger can be progressively pulled as well construction materials are placed in the borehole. Certain auger-type rigs are significantly smaller than other types of rigs, making them the most suitable for use at job sites with significant space constraints. Detailed procedures for hollow stem auger drilling are provided in SOP 14.0.

3.2.3 Mud Rotary Drilling

The mud rotary drilling method is suitable for most hard soils and gravelly soils (very loose soils may cause excessive caving), and for drilling in excess of about 100 feet deep. Some consolidated gravels and hard bedrock may be too dense for adequate or rapid drill penetration. If openhole geophysical logging is required to meet project objectives, mud rotary drilling may be necessary to maintain adequate borehole stability and provide a conductive medium (drilling mud) to run certain electric logs.

Soil samples can be obtained from the bottom of the hole but it typically requires removing the entire drill string and tripping the sampler through drilling mud; therefore, this method is not recommended when substantial soil sampling or sampling for analytical parameters are required. This method can be used to install monitoring wells; however, wells installed in mud rotary holes require lengthy and comprehensive development to remove drilling fluids and mud solids from the gravel pack and formation.

Additional considerations of using mud rotary include the potential of cross contamination, through the drilling mud column, between different aquifer units, and increased volumes of contaminated drilling mud and cuttings requiring management and disposal. The drilling mud should be composed of water from a source of known chemical composition and mud solids and additives approved by the appropriate lead regulatory agency for the site. Mud rotary rigs are typically larger than auger-type rigs and may be subject to size constraints, including overhead clearance.

3.2.4 Air Rotary Drilling

This method is suitable for consolidated soils and rock. When used in conjunction with drive casing (called air rotary casing hammer), this methods is also suitable for unconsolidated soils. Some consolidated boulders and hard bedrock may be too dense for rapid or adequate drill penetration.

Soil samples can be obtained from the bottom of the hole but it typically requires removing the entire drill string. A wireline punch barrel may be used with this drilling method. Air rotary casing hammer drilling is commonly applied to install monitoring wells as there is good depth control, and the drive casing can be progressively pulled as well construction materials are jet in the borehole.

Additional considerations of using air rotary casing hammer drilling includes the potential of flushing vapor phase contaminants through the surrounding soil, the possibility of vapors exiting the hole, and the generation and containment of large volumes of contaminated formation water at the drill site. Air rotary casing hammer rigs are typically larger than auger-type rigs and may be physically restricted by site facilities, including overhead clearance.

3.2.5 Dual Tube Percussion Drilling

This method is most useful in unconsolidated, coarse-grained soils. Some consolidated cobble beds, thick clay or silt beds, and hard bedrock may be too dense for adequate drill penetration. Loose or soft soil cuttings are disaggregated, but consolidated materials and gravel are often retrieved in sizable pieces (up to 6 inches in diameter), making filter pack determination possible.

An advantage of the dual tube percussion method is that soil samples can be readily obtained from the bottom of the hole without requiring the removal of drill pipe (unlike rotary methods). This method is also commonly used to install monitoring wells as there is good depth control, and the drive casing can be progressively pulled as well construction materials are set in the borehole.

Additional considerations of using dual tube percussion drilling include the potential of flushing vapor phase contaminants through the surrounding soil, the possibility of vapors exiting the hole, and the generation and containment of large volumes of contaminated formation water at the drill site. Dual tube percussion rigs are typically larger than auger-type rigs and may be physically restricted by site facilities, including overhead clearance. The impact of the casing hammer is loud and sharp and should be taken into consideration when drilling in a populated surrounding.

3.2.6 Drilling and Development Equipment Decontamination

All downhole drilling equipment (including but not limited to drill pipe, drive casing, drill rods, augers, bits, tools, etc.) will be thoroughly decontaminated before mobilization onto each site and between borings or wells at each site or as required in the project work plans. Detailed procedures for equipment decontamination are provided in SOP 6.1.

All containerized solids and fluids derived from drilling and development equipment will be segregated, stored, labeled, and managed as per the project work plans. Sampling will be performed as required, followed by proper disposal as stated in the project work plans.
Appropriate personal protective equipment (as specified in the project work plans) will be worn by all personnel involved in the task, in order to limit personal exposure.

3.2.7 Lithologic Logging

All boreholes will be logged under the supervision of a experienced Geologist. All boring and well construction logs will be signed by the field geologist and the supervising Geologist.

Drilling and logging information for engineering soils will be recorded in the field using Engineering Form 1836R or equivalent. Details of the format and content of soil and rock descriptions, including headings, sampling, and construction information is provided in SOP 10.0.

3.2.8 Cone Penetrometer Test (CPT)

Cone penetrometer testing and soil sampling will be performed by an experienced contractor. All CPT soil sampling will be performed in accordance with the project work plans. Detailed procedures describing the preparation, drilling, and sampling of the CPT method is provided in SOP 9.2.

3.2.9 Soil Organic Vapor Sampling

Soil Organic Vapor (commonly refereed as soil gas) sampling locations will be marked prior to the beginning of field work and utility clearances performed prior to sampling. The purposes of the soil gas surveys is to identify the source areas of VOC contamination in trenches, disposal areas, and landfills; to locate leaks along sewer lines; and to delineate the extent of groundwater contamination. Targeted compounds will be identified in the SAP. If compounds are detected isopleth maps will be constructed to visualize the areas of contamination. Detailed procedures for soil gas sampling are to be provided in the site specific Work Plan and SAP contained in the project specific SAP.

3.2.10 Hydropunch Sampling

Cone Penetrometer and Hydropunch methods are used to acquire physical data for classification of subsurface lithologies and to collect groundwater and soil gas samples from most permeable zones (sand, gravel layers and lenses) without generating soil cuttings. The CPT and hydropunch activities will follow the requirements in the SOP or procedures supplied by the subcontractor. CPT surveys will be made to explore subsurface geology and locate permeable zones. The hydropunch will be used to collect groundwater and/or soil gas from these zones. Chemical analysis of the hydropunch samples will provide information about the distribution of contamination in the aquifer and will aid in well placement. Detailed procedures describing the preparation, drilling, and sampling of the CPT method is provided in SOP 9.2.

3.2.11 Closed System Purge and Trap Sampling/EnCore™ Sampling

Soil samples are collected in such a manor as to minimize the loss of volatile compounds. The low concentration sample vials are filled and weighed in the field and are never opened during the analytical process. Alternatively, the EnCore™ sampler is used as the storage medium with the appropriate analysis holding time observed, based on the preservation technique.

3.2.12 Rotosonic Drilling

Rotosonic (sonic) drilling uses high frequency mechanical vibration to acquire continuous core samples of overburden while advancing steel casing into the ground. These vibrations are generated at a frequency rate between 50 and 150 hertz or cycles per second. As this frequency falls within the lower range that can be detected by the human ear, the term "sonic" is used to describe this drilling method.

A hydraulically powered drill head or oscillator generates the adjustable high frequency vibrational forces. The sonic head is attached directly to the drill rods and core barrel sending the high frequency vibrations down through the drill steel to the face of the drill bit (shoe). During drilling, the core barrel is advanced ahead of an outer casing in one to 20 foot increments, depending on the type of geologic material, the degree of subsurface contamination, and the sampling objectives. The subsurface material is then returned to the surface in the corebarrel as a continuous geologic core, which may be cohesive to loose, depending upon the physical properties of the sediment. The material is then vibrated from the core barrel into plastic sleeves, typically two to three-feet in length. This provides an effective means of describing the sediment lithology, and collecting samples for chemical or physical analyses. The outer casing is then advanced to the depth the core barrel penetrated and the slough produced is removed with the corebarrel prior to advancing the hole further. The corebarrel and outer casing can be advanced under dry conditions in most situations, or they can be advanced with water, air, or a drilling fluid containing additives. The decision of whether to use a drilling fluid depends upon the nature of the formation being drilled and the depth and diameter of the borehole. Once in place the outer casing prevents cross contamination and formation material sloughing and allows for very controlled placement of wells or any type of down-hole instrumentation. Sonic drilling is capable of advancing borings ranging from about 5 to 12-inches in diameter and provides superior speed, safety, logging accuracy, and less waste generation compared to conventional drilling equipment.

3.3 Monitoring Well Installation and Development Procedures

The installation of monitoring wells and associated testing can provide lithologic information (during drilling), potentiometric surface data, groundwater chemistry data, and aquifer parameters. Project-specific work plans may modify established procedures as site-specific conditions warrant.

3.3.1 Monitoring Well Installation

The installation of monitoring wells will be performed in compliance with applicable state and local agency requirements and regulations. Drilling contractors possessing a valid state licenses should be used to perform this task. Permits for well installation may also be required for a particular site. If so, the permits should be obtained from the appropriate agency at least 24 hours before drilling and installation of monitoring wells.

Monitoring wells are commonly installed through boreholes drilled by auger, rotary, and dual tube percussion methods. Shallow wells are often installed in auger holes in fine grained, unconsolidated soils. Deeper wells are most suitably installed through boreholes drilled by air rotary with casing advance or dual tube percussion methods. The mud rotary method may be used as a last resort. Detailed procedures for monitoring well installation are provided in SOP 8.1.

3.3.2 Filter Pack and Well Screen Slot Size Determinations

Filter packs and well screen slot sizes should be designed to minimize the entry of formational sand, silt and clay into the well without severely reducing the well's yield. Details of the filter pack design and slot size determination are to be provided in the site specific Work Plan and SAP.

3.3.3 Monitoring Well Development

Within seven days of completion of the well, but not sooner than 48 hours after grouting is completed, each monitoring well will be thoroughly developed to remove residual drilling fluids and fines from the casing and filter pack, and from the adjacent formation. Detailed procedures for monitoring well development are provided in SOP 8.2.

3.4 Borehole and Well Abandonment Procedures

3.4.1 Borehole Abandonment

All boreholes that are not to be completed as wells will be properly abandoned to eliminate the potential for enhanced vertical transport of contaminants. Procedures will be in compliance with all applicable State of Utah requirements and detailed procedures are to be provided in the site specific Work Plan and SAP.

3.4.2 Well Abandonment

The formal abandonment of wells will be performed in compliance with all applicable regulations and state requirements. Permits will be obtained from any agency which requires one, at least 24 hours (more if specified in the work plans) prior to well abandonment. Details of well abandonment procedures, including pre-abandonment activities, are to be provided in the project Work Plan and SAP.

Any groundwater that was displaced by grouting of the borehole will be stored at the site in containers specified in SOP 16.0 and in the project work plans. The groundwater will be sampled and analyzed as appropriate to determine the proper method of disposal.

3.5 Split-Spoon Sampling

A variety of sampling techniques are available to collect soil samples from borings. These include split-spoon sampling, collective auger cuttings, Shelby tube sampling, and continuous coring. Split-spoon sampling is the most commonly used technique. It is an effective means of obtaining discrete, representative soil samples for chemical and geotechnical analysis. Detailed procedures for split-spoon sampling are provided in SOP 3.1. Procedures for logging split-spoon sample information, including blow counts, are provided in SOP 10.0. Additional sample handling procedures are provided in SOP 2.0.

3.6 Shallow Subsurface Sampling

Shallow soil borings (0 to 6 feet deep) are generally drilled with a hand auger. Soil samples may be collected from the bottom of a boring using a sample sleeve attached to a hand-held impact sampler. This technique is useful for subsurface soil sampling in areas that are inaccessible to mechanized drill rigs, and drilling in areas that are suspected to contain uncharted or unmarked utilities. Detailed procedures for shallow subsurface soil sampling are provided in SOP 3.0.

3.7 Grab Sampling

Grab sampling is a soil sampling technique used in projects involving, but not limited to, excavation and sampling of potentially contaminated soil, surface sampling, and stockpile sampling.

During collection of grab samples, the soil is available as brought up from an excavation in a backhoe bucket or in a soil stockpile. The location in the bucket or pile where the sample is to be obtained will be determined by the Project Geologist or Sampling Team Leader, an onsite regulatory agency officer, or by predetermined locations indicated in approved workplans. Before the sample is obtained, the sampling area is monitored with an OVA.

If granular or loose soils and/or uniform materials are encountered, the sample can be obtained directly from the bucket or pile. The sample is obtained by scooping the soil using a decontaminated stainless steel trowel or spatula, and depositing the soil in a glass jar or other appropriate container.

If a composite sample is desired, several depths or locations are sampled and accessed. Soil in the sample jars from each of the locations to be composited is emptied into a decontaminated stainless steel mixing container. The soil is thoroughly mixed and placed into sample jars, sealed, labeled, and logged on a COC. Composite samples are not appropriate for VOC analysis. All sample compositing will follow the procedures outlined in SOP 3.2.

3.8 Stockpile Soil Sampling

Stockpiled soil is any soil which has been disturbed at a site after excavation, unauthorized release, spill, or other release of hazardous substances. It does not literally have to be a “pile”. For purposes of this section, disturbed soil is any soil which has had its geologic structure and contaminant distribution patterns altered by grading, excavation, or drilling. Examples of stockpiled soil include:

- Excavated soil from a tank removal
- Excavated soil placed back into a tank pit
- Graded soil
- Soil cuttings from borings or well construction
- Imported clean soil mixed with contaminated soil.

3.8.1 Engineering Controls For Stockpiled Soil

The following engineering controls should be implemented to minimize the potential for public exposure. Stockpiled soil should be:

- Placed on a relatively impervious surface such as asphalt, concrete, or plastic sheeting.
- Moistened to minimize dust emissions during stockpiling. No runoff is to be created during this process.
- Securely covered by heavy plastic sheeting to minimize vapor emissions and prevent runoff from rain (sheeting must be maintained in good condition).
- Configured such that surface water runoff is diverted around the stockpile and does not carry soil and/or contamination beyond the stockpile perimeter.
- Any stockpiled soil demonstrated by sampling and laboratory analysis, or determined by the generator to be hazardous waste, must be removed from a satellite storage site within 72 hours after a volume of 55 gals. is exceeded. The hazardous waste must be moved to a 90-day yard from which it must be removed within 90 days of excavation.

3.8.2 Stockpiled Soil Characterization

Stockpiled soil which will be taken to a permitted hazardous waste or designated waste facility for disposal, at a minimum must be sampled and analyzed in accordance with the requirements of TEAD and the receiving facility.

Composite soil samples are not acceptable for characterizing contaminated soil stockpiles for disposal to Class III landfills in any case where volatiles are contaminants of concern. Due to the losses of volatile contaminants during sample handling and the dilution of non-volatile contaminants, only discrete samples for VOC analysis will be accepted.

One protocol that can be utilized for stockpiled soil associated with an unauthorized release, spill, or other release that is not intended to be transported off site to a permitted facility, or has not been previously characterized through in-situ sampling is outlined below. This protocol provides a uniform approach for demonstrating the contaminant level within a soil mass.

Random sample points must be selected from locations on a three-dimensional grid established for each stockpile. The number of samples to be obtained from each stockpile will be described in the site-specific SAP or work plan. It is recognized that the presence of materials such as boulders and debris may make strict application of this requirement impractical. In such cases, it is appropriate to obtain the sample as close as possible to the randomly selected point without altering the spirit of the random selection process. For hydrocarbon contaminants, sample collection in either metal tubes or glass jars is acceptable, provided every effort is made to minimize the loss of volatile constituents. Metal tubes are preferred since they will minimize aeration of the samples. Containers should be completely filled, capped, and placed in a cooler with ice and maintained at 4°C ±2°C.

Stockpiled soil is assumed to have a nonhomogeneous distribution of contaminants. If a stockpile previously characterized by this protocol is split for any reason, the remaining mass must be resampled as a new stockpile, per the previously described protocol, to establish its mean contaminant concentration. Note that it is necessary to consider each individual stockpile separately. Detailed procedures for stockpiled soil are provided in SOP 12.0.

3.9 Groundwater Sampling

The following guidelines are designed for the consistent sampling of groundwater monitoring wells. It is assumed that the wells to be sampled are currently in place and have been properly constructed and developed. These guidelines focus on sampling groundwater for dissolved organic chemicals (e.g., fuel hydrocarbons, VOCs and SVOCs). Phase-separated product and its impact on obtaining representative groundwater samples are not considered in these guidelines at this time.

Sample results are influenced by site hydrogeology, well construction, well development, well purging, chemical characteristics, and sampling protocols. This guideline addresses only well purging and sampling.

3.9.1 Definition of Terms

Purging: The removal of stale water from a well to allow fresh formation water to enter the well casing.

Recovery: The measure of a well's return to its static condition after purging. The following equation my be used to calculate the percent recovery after purging:

$$PR = \left(1 - \frac{RD}{MD}\right) \times 100$$

where:
PR= Percent recovery
RD= Residual drawdown- the difference between the static water level prior to purging and the measured water level at any given time after cessation of purging.
MD= Maximum drawdown- the difference between the static water level prior to purging and the measured water level upon cessation of purging.

Representative Sample: A sample that approximates the formation water as closely as possible.

Well Volume: The volume of water that is contained in the well casing plus the volume of water contained in the pore spaces of the filter pack in the annulus.

Stability: The consistency of field water quality measurements. Generally temperature, pH and specific conductance of the purged water are measured to evaluate the efficiency of the purging. Stabilization criteria will be three consecutive measurements for which:

- pH is within +/- 0.1 units,
- temperature is within +/- 1 degree Celsius,
- conductivity is within 10%.

Turbidity will be monitored in all cases but will not be used as a measure of stability.

Fast Recharging Well: A well is considered to be fast recharging if recovery to 80 percent or more of its static condition occurs within two hours.

Slow Recharging Well: A well is considered to be slow recharging if recovery to 80 percent of its static condition takes longer than two hours.

3.9.2 Well Sampling Procedure

Prior to groundwater sampling operations the sampling team will examine each well for signs of tampering or well deterioration. Any observations will be noted in the field notebook. After the well has been opened the air in the well head area will be tested for organic vapors with a PID or FID and for explosive atmospheres with the oxygen/combustible gas indicator. Results of these observations will be recorded in the field notebook. A plastic sheet will be placed around the well head beneath all sampling equipment to prevent contamination of surficial soils during purging and sampling. The depth to standing water in each of the wells and total depth of the well to the bottom of the screened interval will be determined and recorded in the field notebook. This information is required to calculate the volume of stagnant water in the well and to provide a check on the integrity of the well If DNAPLs are suspected the presence and thickness of floating product (if any) will be determined using an oil/water interface probe. The top of the casing will serve as a permanent reference point from which water level measurements will be taken.

Using information on the diameter, total depth, and depth to water for the well, three casing and filter pack volumes will be calculated and that amount of water will be purged from the well. The pH, temperature and electrical conductivity of the water will be monitored as well. The pH and conductivity meters will be calibrated prior to use at each well using ASTM traceable standards. The calibration will be checked after measurements for all samples have been completed to ensure that the field instruments have remained in calibration throughout the process. Results of calibrations and final calibration checks will be recorded in the field notebook. If after three well volumes these three parameters have stabilized as defined above the well will be sampled. At least six measurements will be obtained (one for each half casing volume). Measurements for well parameters will also be obtained after sampling is completed with the results recorded in the field notes. If these three parameters have not stabilized after three volumes the purging will continue to a maximum of five volumes before sampling commences. Turbidity will be monitored with results recorded in the field notes but not used as a stabilization parameter. If purging is accomplished using a submersible pump the pump will be set just below water level so that all standing water is removed from the well. Placement of the pump for purging should take into consideration the anticipated depth to which water will be drawn down during pumping. The volume of water purged and the withdrawal rates will be recorded. Purge rates will be sustainable and executed at a rate such that drawdown is minimized to prevent cascading of water into the well. Alternatively, the wells may be purged by bailing. During the evacuation period, the appearance of the discharge water will be noted and periodic entries will be made in the sampling notebook. Use of a well purging data sheet for recording the information described above is acceptable. Detailed procedures for groundwater sampling are provided in SOP 9.0.

A complete set of sampling containers will be prepared for each sample in advance of the sampling event. Containers will be labeled with the date, time, sample number, project name, sampler's name or initials, parameters for analysis (method numbers where possible), and preservation. All samples will be collected within the screened interval in each well to ensure that the sample is representative of formation water. The bailer will be carefully lowered beneath the top of the screened interval after purging of the well. A water sample is collected. The water from the bailer is then carefully transferred to sample containers using a valved bottom discharging device. Pouring from the top of the bailer will not be allowed. Volatile water samples will be taken with a valved bottom emptying device so that no air passes through the sample (to prevent volatiles from being stripped from the samples); the bottles will be filled by inserting the spout from the bailer to the bottom of the VOA vial with discharge of the bailer contents into the vial such that the tip of the spout is kept beneath the surface of the liquid in the vial as it is filled until there is a convex meniscus over the neck of the bottle. The Teflon side of septum (in cap) will be positioned against the meniscus, and the cap screwed on tightly; the sample will be inverted, and the bottle tapped lightly to check for air bubbles. The absence of an air bubble indicates a successful seal; if a bubble is evident the sample will be discarded. Refilling of VOA vials will not be allowed. After these sampling procedures are completed, each sample collected is entered into the field logbook and logged on a COC. All sample containers will be individually enclosed in resealable plastic bags and properly packed in coolers maintained at $4^{o}C$ for shipment to the laboratory.

All sample bottles and equipment will be kept away from fuels and solvents. Gasoline (used in generators) will be transported in a different vehicle from bailers, sample bottles, purging pumps, etc. If possible, one person should be designated to handle samples, and another person should work generators and the gas truck. Disposable gloves will be worn for each separate activity and then disposed of. Care will be taken not to spill any fuels on clothing.

3.10 Surface Water Sampling

3.10.1 Sampling for VOC Analysis

The following steps are taken when collecting samples of near-shore surface water for volatile organic compound analysis:

- A VOA vial is slowly submerged completely into water and filled. Care is taken not to disturb bottom sediments. Open ends of the vial is pointed upstream in undisturbed, gently flowing water.
- If the vial does not require preservatives, it is capped while submerged. Care is

taken to remove any air bubbles from the vials before sealing.

- When preservatives are required, the water is decanted into a VOA vial containing preservatives. The vial is slightly tipped while filling until nearly filled. The vial is then straightened during topping-off, forming a meniscus above the lip of the vial.
- The vial is sealed using a cap with Teflon septa.
- The vial is then turned upside down and tapped to dislodge any bubbles remaining in the vial. If bubbles are present, the sample is discarded and proper filling is reattempted using new vials.
- The vials are rinsed on the outside with deionized water, wiped dry, and labeled.
- A sample label is then filled out and attached to the vial and assigned a sample number per SOP's 2.1 and 2.2.
- The vial is placed in a Ziplock bag for protection, and stored in a cooler at $4^{o}C \pm 2^{o}C$.

3.10.2 Sampling for Other Analyses

The following steps are taken when collecting shallow-surface water samples for nonvolatile compound and metal analyses:

- An appropriate flask, dipper, pail, or pond sampler with extension handle is used to collect the water. If wading is required, the sampling area is approached from downstream and not actually entered.
- The sampling device is immersed into the water and filled. Care is taken to not disturb underlying sediments.
- A sufficient volume of water is collected to fill all sample containers. The water is placed in a stainless steel bowl and stirred to ensure homogeneity.
- If required, the water will be filtered on site for metal analysis.
- The water is decanted into the required containers. Preservatives, if required, should be added to the containers before the water is decanted into the containers.
- The containers are rinsed on the outside with deionized water, wiped dry, and labeled.
- A sample label is then filled out and attached to the vial and assigned a sample number per SOP's 2.1 and 2.2.
- The containers are placed in Ziplock bags for protection, and stored in coolers at $4^{o}C \pm 2^{o}C$.

3.10.3 Deep Surface-water Sampling

The following steps are taken when collecting deep surface-water samples using a weighted bottle sampler:

- The weighted sampler is lowered into the water to the specified depth.
- The stopper is removed by pulling on the sampler line.
- After the sampler is filled, the line is released to reseat the stopper, and the sampler is lifted to the surface.
- The sampler is wiped dry.
- The cap is slowly removed. The specified number of sample containers are filled by slightly tipping the sampler against the sample bottle. Multiple sampler runs may be composited in a stainless steel or Teflon container to obtain the necessary volumes. VOC and SVOC samples are not composited, but decanted directly from the sampler.
- The container is sealed with a Teflon-lined cap. VOC and SVOC samples are checked for air bubbles. If bubbles are present, the sample is discarded and new containers are filled.
- The outside of the containers are rinsed with deionized water and wiped dry.
- A sample label is then filled out and attached to the vial and assigned a sample number per SOP's 2.1 and 2.2.
- The containers are placed in Zip-lock bags for protection, and stored in a cooler at $4^{o}C \pm 2^{o}C$.

After sampling is completed, each sample collected is entered into the field logbook and logged on a COC record.

3.11 Field Measurements

Field measurements are also collected during soil and groundwater sampling. Parameters that are normally measured during sampling include the following:

- Water-level measurements in wells during purging and sampling to evaluate recovery, as part of a monitoring program to evaluate groundwater flow rates and directions.
- Conductivity, temperature, pH, and turbidity measurements of groundwater

samples during pumping, well purging, and sampling.

- Volatile organic vapor analysis of ambient air quality and soil sample headspace using an organic vapor monitor (PID or equivalent).

Procedures for each of these measurements are presented below.

3.11.1 Water-Level Measurements

Water levels in wells may be measured using a steel tape, electric sounder and/or petroleum product probe. If a pump or other equipment is in the well, measurement devices will be lowered slowly to avoid entanglements. Water-level measurements in completed wells will be made from a permanently marked reference point on the well casing. The elevation of this point will be established by survey and referenced to mean sea level. Water levels measured in boreholes or wells during construction will be made relative to the ground surface. Measurements will be made and recorded to the nearest hundredth of a foot. Detailed procedures for water-level measurements are provided in SOP 5.1.

3.11.2 Analytical Measurements

Electrical conductivity (EC), water temperature, pH, and turbidity measurements will be made in the field during well development, purging, and before each water sample collection. Water is collected at the well head and placed in a bottle or jar used solely for field testing. A field conductivity and pH meter with a combination electrode or equivalent will be used for EC and pH measurements. Temperature measurements will be performed using standard thermometers or equivalent temperature meters. Combination instruments capable of measuring all three of these parameters may also be used. Turbidity of water samples will be measured using a turbidity meter.

All instruments will be calibrated as necessary per manufacturer instructions prior to taking sample readings. If conductivity standards or pH buffers are used in field calibration, their values, lot numbers, and expiration dates will be recorded in the field logbook. The sample-testing bottle and all probes will be cleaned and rinsed with distilled water prior to any measurements.

3.11.3 Soil Organic Vapor Analyses

Volatile organic vapor present in the headspace of soil samples will be measured using an organic vapor monitor. These measurements will be obtained from soil samples in the following manner:

- A portion of the soil sample collected will be placed in a new resealable plastic bag and the bag sealed.
- The samples will be allowed to sit for at approximately 15 minutes so soil gases can equilibrate with the air in the headspace.
- The headspace will be tested for volatile organic vapors with an organic vapor monitor.

Headspace and background readings will be recorded in parts per million (ppm) and incorporated into boring logs.

3.12 Decontamination Procedures

During sampling activities, appropriate decontamination measures will be taken to minimize sample contamination between samples. These procedures will be consistent with those outlined in "Test Methods for Evaluating Solid Waste-Physical/Chemical Methods" (U.S. EPA SW-846, 3rd ed.). The decontamination procedure for sampling equipment will incorporate the washing steps outlined below.

All non-disposable sampling equipment used in the collection of samples will be decontaminated. Decontamination should be executed immediately prior to equipment use if possible. Whenever this is not possible or practical, measures will be taken to assure that contamination of clean equipment will not occur. Clean, disposable gloves that do not degrade when exposed to the selected decontamination solvent(s) will be worn while decontaminating sampling equipment and tools. Clean sampling equipment will not be placed on the ground or other contaminated surfaces prior to use.

The waste decontamination fluids will be collected. A composite sample will be analyzed for each parameter to determine the appropriate method of disposal. Decontamination procedures are presented in SOP 6.0 and 6.1.

4.0 SAMPLE HANDLING PROCEDURES

4.1 Sample Containers

The types of containers and procedures used for cleaning these containers will consistent with EPA and USACE requirements for the specific parameters of interest. The sample container label must include location, time and date of sampling, grab or composite, analyses to be performed, and sampler's signature. Sample containers planned for use will be described in the FSP. Table 2-1 lists applicable sample containers and preservation.

4.2 Sample Preservation

All samples collected will be preserved according to EPA and/or USACE protocols established for the parameters of interest as specified in Appendix F of ER-1110-1-263. Methods not specified by Appendix F will use the appropriate guidance, EPA SW-846 or other. Appropriate measures will be taken to ensure that storage requirements with respect to temperature are maintained in the field, during transport to the laboratory, and during storage at the laboratory. Temperature blanks will be used for all coolers containing samples requiring preservation at reduced temperature. Reference to the QAPP will prove sufficient to detail sample preservation methods for all analyses to be used for the project.

4.3 Sample Transportation

Environmental samples will be transported to the Contract Laboratory and QA laboratory via the most rapid means. Samples will be packaged and transported according to EPA, USACE, and DOT regulations. The FSP will describe the planned mode of sample transport. Detailed packing procedures are provided in SOP 2.0.

4.4 Chain of Custody Procedures

Samples will be collected, transported, and received under strict chain of custody protocols consistent with procedures established by the EPA for litigation-related materials. On receiving samples at the Contract Laboratory the air temperature inside the cooler and of the temperature blank will be measured immediately after the cooler is opened with the results recorded on the Cooler Receipt Form. Water samples requiring acidic or basic preservation will also be checked for pH on arrival at the Contract Laboratory. VOA samples will be checked for preservation just prior to sample analysis. Chain of custody procedures are detailed in SOP 1.1. Copies of chain of custody forms will be provided to the Project Chemist whenever samples are shipped from the field site (facsimile transmission). Upon receipt at the laboratory, the laboratory will provide a specific mechanism through which the disposition and custody of the samples are accurately documented during each phase of the analytical process. Cooler Receipt Forms will be used to document the condition of samples on arrival at the laboratory. The results of all checks for preservation of samples will be recorded on the Cooler Receipt Form. Examples of chain of custody forms and cooler receipt forms are provided in the QAPP.