GROUNDWATER SAMPLING/MONITORING AND ANALYSIS PROCEDURES - LOW FLOW PURGING AND SAMPLING PROCEDURES

SOP Number: 06-06-00
Effective Date: 03/25/99

Technical Approval: _____ Date: 4/28/99

QA Management Approval: _____ Date: 5/11/99

I. SOP Description

This Standard Operating Procedure (SOP) describes the procedure to be used by TechLaw staff for collecting groundwater samples for analysis using low stress (low flow) techniques. This procedure is appropriate for collecting groundwater samples for analysis of both organic and inorganic constituents.

II. General Procedures

Related SOPs

This SOP is to be used in conjunction with other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	General Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures

Related Documentation

The following documents are to be used and/or maintained in conjunction with low flow purging and sampling. Specific guidelines are presented in the individual SOPs.

- Field logbook
- Photographs
- Health and Safety Plan (HASP)
- Groundwater Sampling and Analysis Plan (SAP) and, if applicable, Quality Assurance Project Plan (QAPP)
- Well Logs depicting well construction information including:
  - Location of well(s);
  - Diameter of well(s);
  - Depth of well(s);
  - Screen interval(s);
  - Filter pack interval(s); and
  - Other relevant well construction information.
- Other relevant facility/site information possibly including analytical results from prior sampling visit.

III. Equipment and Apparatus

Equipment used for monitoring well purging and sampling activities must be properly calibrated and tested prior to use. All equipment (e.g., organic vapor analyzer (OVA), pH meter, temperature conductivity meter, etc.,) must be calibrated in accordance with the manufacturer's specifications in a clean area on site. Any instrumentation not meeting the manufacturers performance criteria should be returned for repairs. In addition, instrument calibration schedules, as well as any deviations in performance criteria, must be recorded in the field logbook.

Equipment that may be needed to support low flow purging and sampling include:

- Wrench for opening the well cap.
- Well lock keys and/or lock combination(s).
- Plastic drop cloth.
- Organic vapor analyzer (OVA) to be used to clear the well immediately following the removal of the well cap. The detection of organic vapor by the OVA upon removal of the well cap should be considered for both health and safety reasons and for an indication of gross contamination levels in the well.

- Water level measuring device (e.g., electric water level indicator or interface probe).
- Flow through cell and water quality meter, capable of providing real-time readings of:
  - Temperature in degrees centigrade with an accuracy of ± 1°C (or to the accuracy specified in the SAP),
  - Dissolved oxygen with an accuracy of ± 1 mg/L,
  - pH with an accuracy of ± 0.1 pH units,
  - Conductivity meter, preferably with the capacity to report conductivity (micromhos/cm) corrected to 25°C.
- Power source for pump and meters. Note: Honda generators may be preferred as they protect against electrical surging. Some other generators which use Briggs and Stratton engines may surge resulting in unreliable pumping rates or control box equipment failure.
- Container of known volume (preferably one graduated cylinder with a volume of approximately 1-liter and two containers with a volume of approximately 5-gallons).
- Positive displacement pump. Centrifugal or bladder pump constructed of stainless steel or Teflon. Inertial pumps should not be used. Peristaltic pumps (suction) may be used only when sampling for inorganics.
- Teflon or Teflon-lined polyethylene tubing (1/4 or 3/8 inch inner-diameter is preferred).
- Stopwatch or other time measuring device.
- Disposable chemically inert gloves and other personal protective equipment (PPE) as required by the HASP.
- Decontamination equipment including buckets, laboratory grade soap, deionized water, paper towels, etc.
- Container to store purge water from well(s).
- Bottleware as specified by the SAP, preservatives for samples, FedEx airbills, chain(s) of custody, sample tags, labels for sample containers, and custody seals.

IV. General Considerations

Refer to appropriate TechLaw SOPs for health and safety procedures, clearing the monitoring well(s), decontaminating equipment, calibrating equipment, labeling bottleware, etc. The procedures described below generally satisfy the low flow purging and sampling guidance for U.S. EPA Region I (dated July 30, 1996) and U.S. EPA Region II (dated March 16, 1998). Refer to these or other appropriate U.S. EPA guidance as necessary prior to sampling. This SOP is not appropriate for sampling non-aqueous phase liquids (NAPLs).

V. Pre-Sampling Procedures

Preferably, at least one day prior to sampling, wells should be opened and headspace screened for organic vapors. An interface probe should be used to determine the presence of NAPLs if site information or historical data suggest a potential for its presence. Water level and total depth of each well should then be measured and recorded in the field log book. The reason for collecting these measurements at least one day prior to initiating purging and sampling is to allow any sediment disturbed during these measurements to settle out of the water column.

VI. Sampling Procedures

- Based on previous sampling data and the OVA results collected during the pre-sampling procedures, sample the wells beginning with the least contaminated monitoring well.

- Clear well according to the appropriate Health and Safety SOP Series 09 and redetermine water level and/or presence of light NAPL (LNAPL).

- Prepare sampling equipment including plastic sheeting, flow measurement containers, flow through cell, decontamination equipment/area, and power supply. Note: If a gasoline generator is used, it must be kept at least 30 feet (down wind) from the well so that exhaust fumes do not contaminate the samples.

- Attach tygon or Teflon tubing to pump, lower pump into well to the midpoint of the zone to be sampled, cut tubing to proper length, and re-record the water level inside of the well. The pump intake must be kept at least two feet above the bottom of the well.

- Attach tubing to flow through cell and direct discharge tubing toward large container (Approx. 5-gallon). Place water quality meter probes into the cell.

- Start the pump at its lowest setting and slowly increase pumping rate until discharge occurs. Generally, the pumping rate should be less than one liter per minute.

- Check the water level inside the well. Minimal or no water level drawdown should occur during purging and sampling. Less than 0.3 feet is strongly preferred yet if greater than 0.3 feet occurs yet remains stable, continue purging until indicator field parameters stabilize. During pump start-up, drawdown may exceed 0.3 feet and then recover to 0.3 feet or less after the pump rate has been properly adjusted. Monitor drawdown, pump settings and flow rate frequently upon first removing water from the well and every three to five minutes thereafter. Record these observations in the field log book.

- After the pumping rate has been established such that the water level stays within the required drawdown limits, begin monitoring indicator field parameters. The indicator parameters should be measured every three to five minutes. The well will be considered stabilized and ready for sampling when the field parameters achieve the following for three consecutive readings:

  - Turbidity (10% for values greater than 1 NTU),
  - Dissolved oxygen (10%),
  - Specific conductance (3%),
  - Temperature (3%),
  - pH (± 0.1 unit),
  - ORP/Eh (± 10 millivolts).

- Once the indicator field parameter have stabilized, the groundwater samples may be collected. Disconnect the tubing from the flow-through cell, collect VOC samples first and collect other samples as described in the SAP.

VII. Sample Storage and Shipment

Samples must be maintained at 4°C (±2°C) following collection. The samples must be received by the laboratory within a reasonable amount of time following sample collection (i.e., the samples should typically be received by the laboratory within 24 hours of sample collection). The SAP should be prepared to include procedures which may be warranted for constituents which have a significantly reduced holding time. Refer to SOP Series No 04 for additional information regarding sample handling, packaging and shipment.

VIII. Contamination Control

Sampling containers and tools must be protected from sources of contamination prior to sampling and decontaminated between sampling locations as specified in SOP No. 02-03-XX, Equipment Decontamination. In addition, liquids and other wastes from decontamination operations must be handled in accordance with SOP No. 02-04-XX, Management of Investigation Derived Waste. Sample containers must also be protected from sources of contamination. Sampling personnel must wear chemical-resistant gloves when handling the sampling equipment and samples. Gloves must be decontaminated or disposed of between sampling locations, or if they become soiled or contaminated.

IX. Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hard-hat, hearing protection, full-face respirator, steel-toed safety shoes, and safety glasses. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged items.

A site-specific health and safety checklist/plan must be developed by the field team leader or designee and approved by the TechLaw Health and Safety Director prior to implementation in the field. This checklist/plan must be reviewed with the TechLaw field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety checklist/plan must be documented in the field logbook.

X. QA/QC

The OVA and water quality instrumentation must be calibrated in accordance with the manufacturer's instruction manual, prior to daily use. Thereafter, the equipment is to be checked periodically as recommended by the manufacturer.

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific procedures, any departure from specified requirements must be justified and authorized by the field team leader prior to deviating from the requirements. Deviations are to be sufficiently documented in the field logbook to allow repetition of the activity as actually performed.

XI. Documentation and Records

A permanent record must be maintained for each monitoring well sampled in a field logbook. This record should include, but may not be limited to, the following items.

- Well identification number
- Static water level
- Presence/thickness of immiscible layers and detection method
- Time and date of sampling activity;
- Weather conditions;
- Personnel performing the sampling;
- Sample identification number(s) and location(s) (surveyed if possible);
- Well information including depth to water, total depth, screened interval, draw down during purging and sampling, and indicator parameters;
- Any problems encountered during purging and sampling;
- Disposition of purge water;

XII. Comments and Notes

None at this time.

XIII. Attachments

None at this time.

XIV. References

TechLaw, Inc., Field Equipment Manufacturers' Instruction Manuals Handbook, Winter 1995.

TechLaw, Inc., Health and Safety Program, 1999.

U.S. EPA Region I, *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, Revision 2, July 30, 1996.

U.S. EPA Region II, *Groundwater Sampling Procedure, Low Stress (Low Flow) Purging and Sampling*, Final, March 16, 1998.

SOIL SAMPLING AND ANALYSIS - PREPARATION OF A SOIL SAMPLING AND ANALYSIS PLAN

SOP Number: 07-01-00
Effective Date: 02/08/99

Technical Approval: _____ Date: 6/11/99

QA Management Approval: _____ Date: 6/15/99

SOP Description

This Standard Operating Procedure (SOP) describes the procedures to be followed when preparing a soil sampling and analysis plan (SAP). The SOP can be used by the TechLaw project manager to develop soil SAPs to conduct sampling in support of private clients or regulatory agencies. The SOP describes what each section of the SAP must include, provides guidance for properly completing the plan, and provides considerations for planning and conducting a soil sampling program. Details on the actual soil sampling and analysis procedures can be found in the specific SOPs in the "07-" series.

Each client or EPA Regional office may have very specific requirements for the format and content of the SAP that must be addressed.

When sampling in mixed media (e.g., soil and groundwater; soil and surface water), one SAP can be written to address both activities. See SOP No. 06-01-XX or SOP No. 08-01-XX for the specific procedures for preparation of a groundwater or surface water SAP, respectively.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures

07	Soil/Sediment Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures

Related Documentation and Apparatus

The following documentation can be used in developing a soil SAP:

- Quality assurance project plan (QAPjP);
- Site-specific regulatory documents describing sampling requirements such as permit conditions, consent orders, or related documents (if available);
- Guidance documents developed by regulatory agencies (a partial listing is provided in the Reference section of this SOP); and
- Other relevant facility/site information such as previous soil sampling data, waste characterization data, geologic data, and site utility maps.

Sampling and Analysis Plan Development Procedures

The SAP must address those procedures key to obtaining representative soil samples and reliable appropriate analytical data. The plan itself should include, at a minimum: title page and approval sheet, introduction/objectives, sampling locations and analytical parameters, preliminary activities, field sampling activities, field quality assurance/quality control (QA/QC), field documentation, laboratory QA/QC, and a health and safety plan (HASP). These elements are discussed below on a section-by-section basis. The format presented is not mandatory, but is typical of SAPs; it ensures that all necessary elements are discussed in a logical fashion.

Title Page and Approval Sheet

The title page of the document describes the identity and location of the subject facility, the identity of the client, the TechLaw preparer of the SAP, the engagement/contract and project number, and the date the document was prepared.

The title page also identifies the specific individuals responsible for the review and approval of the SAP and includes a separate line for each person to sign and date the document. Prior to initiation of the SAP, the draft SAP will be forwarded to the client project officer, the client QA representative, and the TechLaw QA officer for review and approval. A copy of the HASP is appended to the SAP, which is reviewed and approved by the Health and Safety Director or designee. The actual number and identity of reviewers will vary by project.

Introduction/Objectives

This section presents an overview of the procedures and rationale for conducting soil sampling activities at a specific site. The major sections of the plan are introduced and a site location map is provided.

The introduction describes the objectives of the soil sampling investigation. The project manager should work together with the client and the end user of the investigation data to determine the objective(s) of the soil sampling investigation. Soil sampling investigations can typically be broken down into four broad categories depending on whether the sampling represents:

- The initial general investigation of a site or area;
- The demonstration of clean closure of a RCRA interim status or permitted unit, or the demonstration of contaminated soil removal;
- The preliminary investigation of the site or area where previous sample data is available; or
- An investigation to fill very specific data needs identified after a preliminary investigation has been conducted.

The objectives of the soil investigations for the scenarios described above will be different; and each will require a different total number of soil samples and different sample locations, depths, and analytes. For instance:

- An initial soil sampling investigation at a site or at an individual unit is usually conducted to determine whether a release of hazardous constituents has occurred at the site or from a unit, or to determine if contamination of some type is present. This type of soil sampling typically focuses on areas which are most likely to have become contaminated due to a release. On a site-wide scale, the soil sampling investigation should focus on outdoor and/or underground waste disposal or waste storage areas and outdoor waste and hazardous material loading/unloading areas. Examples of focal points on an individual unit scale would include the downgradient edge of an outdoor, uncurbed container storage pad, or areas with obvious visual evidence of contamination, such as staining or dead vegetation adjacent to the unit under investigation.

- Soil sampling conducted to verify clean closure of a RCRA permitted unit or to verify that all contaminated soil has been excavated from an area would typically be conducted by collecting composite samples on a random grid pattern set up over the unit or on the walls and floor of an excavation.

- A preliminary soil sampling investigation of a site or unit is typically conducted to determine the characteristics and maximum horizontal and vertical extent of known soil contamination. This type of investigation may focus horizontally and vertically surrounding the area of known contamination. This may be accomplished in several phases.

Sampling Locations and Analytical Parameters

This section of the SAP presents information regarding the sampling locations, number of samples, sample type and analytical parameters, and the data quality objectives for the sampling. The project manager works together with the actual sampling staff, and if possible, a client representative, to prepare this section of the SAP. A large-scale map(s) of the site or investigation area is provided which identifies major site or unit features and the proposed soil sampling locations (including background). Tables are included which provide: (1) a summary of the number and depth of soil (including background) and

QA/QC samples to be taken at each location; and (2) identify the analytical test methods, container types, sample sizes, preservation methods, and holding times for each sample.

- **Sample Locations, Types, and Numbers** - In this section, the facility or property is described. Also included is a description of the reasons for conducting the investigation and identification of any specific concerns (e.g., types of constituents known or suspected). A brief summary of all available analytical or field data from the site or unit to be investigated could be included.

  A description of the location, depths, and number of investigation samples to be collected at each unit or overall for the site is included as well as a brief description of how the samples will be collected and whether the samples will be grab or composite. A justification is included for how the proposed sampling will meet the objectives of the investigation.

  A key consideration when determining the number and location of soil samples to be collected is how to meet the objective of the investigation while remaining within the budgetary and time requirements of the client. It is a very rare occurrence when the client is willing to pay for the collection of all of the sample data desired by the personnel conducting the investigation. As a result, the TechLaw project manager must clearly delineate to the client what data are absolutely critical to the project and what data would be useful, but not critical. The creative use of field screening techniques, composite sampling, and/or random grid sampling may result in the collection of data which are adequate to satisfy the end user while maintaining costs within the project budget.

  A description of the location, depth, and number of background soil samples to be collected as part of the soil investigation is included in this section. The collection of adequate background data are important for all soil investigations and crucial to investigations where inorganic constituents are the major concern. This is due to the widely varying natural concentrations of inorganic constituents which can be present in natural soils at a facility. Background samples are collected from areas of the facility which have not been impacted by site or unit activities. The soil at the background location should have similar physical characteristics to those at the investigation site(s). If there are many different soil types present in the investigation site(s), then background samples should be collected which are representative of each of the soil types present. Background soil samples should be

collected from the same depth intervals as the investigation samples. The total number of background soil samples collected will depend on the requirements of the statistical method which will be used to compare the results of the investigation soil samples to the background levels.

- **Analytical Parameters and Analytical Procedures** - This section presents a description of the analytical parameters for each sample, identifies the analytical method which will be used, and identifies the data quality level required for the results (e.g., screening analyses versus full laboratory analyses). A justification is included for choosing both the parameters to be analyzed and the methods which will be used. For an initial investigation or confirmation sampling, the proposed analytical parameters should be chosen conservatively and should include all of the constituents which may possibly be present at the site or the unit. For more focused investigations at units where previous data are available, the scope of the proposed analysis may be reduced to only those parameters which are known to be present; but the SAP must justify why it is acceptable to reduce the list of parameters.

  Analytical methods should be widely accepted and chosen from sources which are approved by the regulatory agency(s) responsible for the facility. Typically, the U.S. Environmental Protection Agency (EPA) document entitled Test Methods For Evaluating Solid Waste, SW-846 is used. The appropriate EPA method(s) should be referenced in the text of the SAP. If an analytical method is to be used which is not "approved" or widely accepted in the industry, then the SAP should include a copy of the actual analytical procedure. Due to the size of the analytical procedures, they are often appended to the SAP, although most are included in the QAPjP. These method descriptions may include: scope and application, summary of method, interferences, apparatus and materials, reagents, sample collection, preservation, and handling procedures, quality control, method performance, and references.

- **Quality Control Samples** - In addition to the environmental and background samples identified above, information on the number and types of QC samples (e.g., duplicate samples, equipment blanks, field rinsate blanks, trip blanks) that will be collected during the soil sampling investigation should be included. The number and type of QC samples to be collected is normally dependent on the data quality objectives of the program, the type of samples being collected, and how the data will be used and is typically specified by the regulatory agencies in guidance

documents. Information pertaining to QA/QC sample collection is presented in a later section of this SOP and should be detailed in the QAPjP.

- **Sample Collection Approach** - This section states how the daily sampling activities will proceed and why the process approach was selected (e.g., from the area of least suspected contamination to the area of highest suspected contamination).

Preliminary Activities

This section provides a listing of the activities that the TechLaw project manager (or his/her designee) must accomplish prior to commencement of field activities. The activities on the list should include the following at a minimum:

- Verification that the client has reviewed, approved, and signed-off on the SAP.

- Notification to the laboratory of the upcoming sampling event so that the laboratory can schedule analysis time and prepare the appropriate type and number of sample containers. The notification will be based on the list of parameters to be measured at each site, the number of sampling locations, and the number of QC samples.

- Notification to all subcontractor personnel, if applicable, involved with the project (e.g., drilling contractor) of the upcoming sampling event to ensure that the appropriate personnel and equipment are available and reserved.

- Procurement of permission for property access to sampling locations. Access to some on-site sample locations may be restricted for safety or security reasons and require special permission to enter. This can often be a time consuming process. Obtaining permission for property access is especially important if samples are to be collected outside the boundaries of the specific facility that the TechLaw field team is representing, or investigating for a regulatory authority. This task may involve obtaining property tax maps and ownership information from the county or city courthouse. The collection of samples from outside the facility property is often a very sensitive issue. If the TechLaw field team is conducting the investigation on behalf of a facility, they must ensure that the appropriate facility representatives are aware of, and approve, the collection of off-site samples.

- Determination of which organization will be the "generator" responsible for the disposition of the investigation derived wastes. Contacting the appropriate person at that facility to determine how the waste is to be managed and to arrange for a supply of waste containers and waste characterization requirements. Note: TechLaw cannot accept responsibility as the generator of the investigation derived waste. See SOP No. 02-04-XX, Management of Investigative Derived Waste, for further details.

- Acquisition of utility clearances for all sample locations where soil samples will be collected with power augering equipment or drilling rigs. See Attachment A, Procedures for Obtaining Utility Clearances, for additional information on this topic.

- Assembly and inspection of all field equipment prior to shipment to the site.

- Assembly of all forms to be used in the field (e.g., field logbook, chain-of-custody sheets, sample seals).

- Distribution of approved copies of the SAP and HASP to all TechLaw field personnel involved in the project.

Field Sampling Activities

This section is to include an outline of the various tasks required for sampling and a brief description of how they will be accomplished.

- **Preparation of Equipment and Supplies** - This section describes what equipment and supplies will be provided by the laboratory and what will be provided and shipped by the TechLaw. For the TechLaw equipment, indicate how the equipment is to be assembled, calibrated, and tested before arrival at the site. See SOP No. 02-02-XX, Equipment Requisition and Return, and the SOPs in the "05-" series, Field Equipment Operation and Maintenance Procedures.

- **Field Inspection of Equipment and Supplies** - This section describes how the equipment and supplies will be unpacked, inventoried, and checked for damage.

- **Pre-labeling of Containers** - This section indicates how containers will be pre-labeled, if possible, during the preliminary phase of the sampling event in order to reduce confusion in the field. Other required information will be written on the label at the time the sample is collected. This activity will be documented in the field notebook.

- **Site Safety and Work Zones** - This section is provided in conjunction with the HASP. It designates who is responsible for delineating the working boundaries (e.g., Exclusion Zone, Contamination Reduction Zone, Support Zone). It also designates the site safety officer (who is responsible for implementing the HASP, including determining the necessary levels of protection and for ensuring the review/acknowledgment of the HASP by the field team).

- **Utility Clearances** - This section typically applies only to soil investigations where subsurface sampling will be conducted using power equipment such as power augers, drill rigs and backhoes. The section designates who is responsible for "clearing" or "approving" each sample location. A representative of the property owner must be responsible for "approving" the location of each boring or excavation conducted on private property. A representative of the appropriate municipality or government agency must be responsible for "approving" each boring or excavation area on public property.

  This section of the document must also describe the procedures which will be followed to ensure that the location of all subsurface public and private utility lines in the vicinity of each boring and excavation are adequately marked. See Attachment A for additional information on this topic.

- **Location of Sampling Points** - This section describes how the field team will identify the precise sampling locations.

- **Soil Sampling Procedures** - This section provides the actual procedures which will be used to collect and handle the soil samples during the investigation. The text should provide either a detailed description of the procedures or a brief description of the procedures and a reference to the appropriate soil sampling SOP which contains the information. All soil sampling SOPs referenced in the SAP should be included as an attachment.

- **Decontamination Procedures** - This section provides TechLaw's commitment to adhere to the decontamination procedures described in the Field QA/QC section of the SAP for the cleaning of all sampling equipment and apparatus used during the project. See SOP No. 02-03-XX, Equipment Decontamination, for further details.

- **Preparation of Samples for Shipment** - This section describes the procedures for labeling and preparing the samples for shipment to the laboratory for analysis. It includes information placed on the label, affixing the labels to the bottles, custody seals, packing, completion of the chain-of-custody and laboratory forms, sealing of the coolers, overnight shipment, and notification to the laboratory. Alternatively, the section should provide a brief description of the procedures and a reference to the appropriate sample preparation and shipment SOP which contains the information. See SOP No. 02-05-XX, Chain-of-Custody, and the SOPs in the "04-" series, Packaging and Shipping Procedures, for further details. All SOPs referenced in the SAP should be included as an attachment.

- **Disposal of Investigation Derived Wastes** - This section identifies which organization will be the "generator" responsible for the disposition of the investigation derived wastes and describes how the waste generated during sampling will be containerized, characterized and disposed. The proper disposition of investigation derived waste is crucial to the sampling program and can have a significant impact on the project budget. For soil investigations involving only surface soil sampling or hand augering, the volume of waste generated is not likely to be very large. However, for soil boring and sampling investigations, all of the auger cuttings and excess soil samples must be containerized and then characterized to determine the appropriate disposal method. This will involve acquiring a large number of drums, or larger containers (e.g., lined dumpsters), and also means additional analytical costs for waste characterization.

  See SOP No. 02-04-XX for the specific procedures to be followed for managing and characterizing investigation-derived wastes. Note that individual state- or facility-specific requirements may take precedent over TechLaw SOPs and that all site-specific procedures must be described in detail.

Field QA/QC

This section provides detailed field QA/QC procedures to ensure the reliability of the data generated by the sample collection activities. The QAPjP (if available) addresses most of this information and should be referenced/appended.

- **Quality Control Sample Collection** - This section identifies the types of QC samples that will be collected, the purpose of the QC samples, and a detailed description of the procedures used to obtain or create the QC sample. The QC samples may include blind duplicate samples, equipment blanks, field blanks, and trip blanks.

- **Sample Containers** - This section describes the sample containers, the supplier, and the shipping protocols.

- **Equipment Decontamination** - This section provides the step-by-step procedures for the decontamination of the field equipment. See SOP No. 02-03-XX, Equipment Decontamination for further details. Personnel decontamination procedures are provided in the HASP. See SOP No. 09-10-XX, Personnel Decontamination, for further details.

Field Documentation

This section of the SAP describes the procedures for documenting the field sampling activities. At a minimum, all field sampling activities and procedures must be recorded in the field logbook and documented through the collection of representative photographs. Additional documentation procedures may be used as required (e.g., sample log, sample management and custody procedures, equipment calibration log, site health and safety log). The SAP should clearly indicate what specific field documentation procedures will be used and how the resulting data will be managed. The SAP should also include a statement that where any deviation(s) from the approved SAP is (are) made, it (they) will be fully documented along with the justification for the deviation(s).

Laboratory QA/QC

If possible, a copy of the laboratory's QA/QC manual is to be attached to the SAP. If the laboratory QA/QC manual is not available, then describe the laboratory qualifications and

cite the appropriate accreditations the facility maintains for the type of analyses to be conducted on the soil samples. Also provide a brief description of how the laboratory will ensure that specific QA protocols are actually followed. Include auditing procedures, laboratory chain-of-custody, internal sample tracking, analytical data documentation, and instrument calibration procedures.

Site-Specific Health and Safety Plan

A site-specific HASP, developed in conformance with TechLaw's Safety and Health Program and approved by the Health and Safety Director or designee, is to be included in or appended to the SAP. Procedures for the development of the HASP can be found in SOP No. 09-02-XX. The specific elements of the plan include:

- Relevant project information;
- Health and safety personnel, including identification of the health and safety officer, site safety officer, and field team;
- Field description, including location, facility operations, adjacent land use;
- Hazard evaluation, including physical hazards, chemical hazards, site work zones;
- Personal protection equipment, including a copy of the medical data sheet;
- Levels of protection.

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include steel-toed shoes, safety glasses, and chemical-resistant gloves.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the TechLaw Health and Safety Director or designee prior to implementation in the field. This plan must be reviewed prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

QA/QC

The site-specific QAPjP details quality assurance/quality control procedures and should be referenced/appended to the SAP, if applicable.

Attachments

Attachment A - Procedures for Obtaining Utility Clearances

References

TechLaw Inc., Field Equipment Manufacturers' Instruction Manuals Handbook, Winter 1995.

TechLaw Inc., Health and Safety Program, 1999.

TechLaw Inc., Quality Assurance Program Plan (as amended for the RCRA Enforcement, Permitting, and Assistance Contract).

A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, U.S. Environmental Protection Agency, Washington, D.C., 1987.

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, Athens, Georgia, May, 1996.

Interim Final RCRA Facility Investigation Guidance, OSWER-9503.00-6D, EPA 530/SW-89-031, U.S. Environmental Protection Agency, May 1989.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Third Edition, SW-846, Washington, D.C., Most Recent Version

ATTACHMENT A
SOP Number: 07-01-00

PROCEDURES FOR OBTAINING UTILITY CLEARANCES

Most states and municipalities require that subsurface public utilities be located and marked prior to conducting subsurface intrusive activities using power equipment, such as power augers, drilling rigs, or backhoes. Note, however, that even shallow hand augering can result in disruption of shallow buried utilities such as telephone and cable television lines. There are stiff fines for damaging public utilities and disrupting services. The following information provides a brief description of how to obtain utility clearances and some important considerations when planning subsurface investigations.

If at all possible, the utility clearance process should begin at least two weeks prior to the planned start of field activities. Most of the large utility companies in metropolitan areas subscribe to a centralized notification service which coordinates utility clearance activities. This notification service is free of charge to the public. The TechLaw project manager should contact one of the primary local utility companies (e.g., electric or telephone) to obtain the name and number of the notification service used in the site area.

The project manager should then contact the notification service and be prepared to provide the name and street address of the facility. In large metro areas, they may ask you to provide coordinates of the facility using local road map books. If the facility is very large, it will be much easier if you can provide a specific location of the investigation area within the facility. The notification service will then notify each of the utility companies which are known to have lines in the vicinity.

If a central notification service is not available, then the project manager will be responsible for contacting each utility and requesting that there utility lines be marked. The local department of public works can be a useful source of information concerning publicly owned utilities such as water and sewer.

The individual utility companies will then locate and mark (with paint and symbols) their utility lines from the street up to the point where they enter the facility buildings.

Several major considerations concerning the utility locating conducted by utility companies that must be kept in mind when conducting subsurface investigations are listed below:

- The companies that actually conduct the locating and marking typically state that the actual location of the buried line may been within a set distance of the markings on the ground (usually 3 to 5 feet on either side of the mark). This can be critical when drilling must be conducted in tight quarters.

- Buried utility lines constructed of concrete, vitrified clay, and/or plastic (e.g., water, sanitary sewers, and storm sewers) are often very difficult to locate.

- The individual utility companies are only responsible for marking their lines from the street to the point where they enter a facility building. The utility companies do not locate utilities which are internal to and owned by the facility such as process lines, process sewers, electric and telephone lines between buildings, steam lines.

The limitation discussed in the third bullet is critical since most soil investigations are conducted within the facility boundaries. There are several options available for locating utilities that are owned by the facility:

- If TechLaw is representing and working directly for the facility, or the regulatory agency TechLaw is representing has a good working relationship with the facility, the TechLaw project manager should contact the facility project manager and have them provide as-built utility maps of the facility (note that these maps are notoriously inaccurate). The TechLaw project manager can then mark preliminary boring locations on the as-built maps and return the map to the facility project manager. At that point, either the facility can locate and mark the lines in the investigation areas, or the TechLaw project manager can conduct a site visit to mark each location where a boring is proposed and have a facility representative "approve" each location prior to drilling.

- If the regulatory agency does not have a good working relationship with the facility, or the sampling will be done during a surprise inspection, then the choices for utility clearing are much less attractive. Techlaw must have a clear understanding with the agency regarding liability for potential utility damage. **[Note that this is a critical issue which must be brought to the attention of the TechLaw program manager (e.g., regional manager) and very possibly the TechLaw Officer in charge prior to conducting any intrusive activities]**. The only viable method of conducting utility clearances under this scenario is to hire a commercial utility locating firm to accompany the field team to the site. The TechLaw project manager would then mark the proposed locations for each boring and have the utility locating company sweep each locations to determine if buried utilities are present. The commercial utility locating companies are very expensive and they are very vague concerning the accuracy of their locating abilities. The wording of their contracts is also very explicit in stating that they will not assume any liability if they miss-mark a line or do not properly locate a line.

Regardless of how utility clearance activities have been conducted, all subsurface excavations or borings with power equipment should proceed very slowly through the maximum depth intervals where utility lines are likely to be situated. This maximum depth varies depending on the maximum frost depth, area geology, and topography. However, the maximum depth of utilities should be known by facility representatives.

Note to TechLaw project managers and field team leaders: It is normally very difficult to convince drilling contractors to drill slowly, especially if they are being paid by the foot. Thus, in very difficult drilling conditions, it may be better to have the contract with the drilling company based on an hourly rate rather than a per-foot of drilling rate.

SOIL SAMPLING AND ANALYSIS PROCEDURE
SURFACE/NEAR SURFACE SOIL SAMPLING

SOP Number 07-03-00
Effective Date: 4/12/99

Technical Approval: _____ Date: 5/24/99

QA Management Approval _____ Date: 6/15/99

SOP Description

This Standard Operating Procedure (SOP) describes the techniques and requirements for collection of surface/near surface soil samples by TechLaw Inc., personnel.

Surface soil samples are collected to determine the concentration, type, and areal extent of contamination. These samples may be collected as part of a facility-wide investigation, a site-specific investigation, to locate source areas, to provide preliminary screening concentrations or evaluate background conditions. Surface soil sampling results are also an important component of risk assessment.

The specific procedure and equipment used to collect surface soil samples will depend on variables such as the depth from which samples are to be collected, the type and consistency of the surface soil and whether the samples are to be collected as a grab or composite sample. Sediments and sludges are collected using the same methods and procedures as those used for surface soil sampling. Surface soils are generally defined as those soils less than two feet below ground surface. Actual sample collection depth must be specifically defined in the site-specific sampling and analysis plan.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the relevant and applicable SOPs identified in the following SOP categories:

Section No.	Section Title
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures

05	Field Equipment Operation and Maintenance Procedures
09	Health and Safety Procedures
11	Quality Assurance Procedures

Equipment and Apparatus

- Site-specific sampling and analysis plan
- Site-specific health and safety plan
- Personal protective equipment required by the health and safety plan
- Monitoring/Screening instrumentation required by the health and safety plan and the sampling plan (e.g., Organic vapor monitor, dust monitor etc.)
- Sample supplies (containers, shipping materials, labels, coolers)
- Decontamination supplies
- Sample documentation supplies (chain-of-custody, custody seals, field logbooks)
- Stainless steel and/or Teflon-lined spatulas, pans, bowls or trays
- Stainless steel and/or Teflon-lined scoops, trowels or spoons
- Stainless steel hand auger/corer (liners optional)
- Plastic Sheeting
- Sample cooler w/ ice
- Measuring tape/compass
- Garbage bags

Preparatory Sampling Procedures

- Locate and mark all potential sampling locations.
- Decontaminate all equipment (SOP 02-03-XX) associated with sample collection (e.g., bowls, spoons, etc.).
- Prepare sampling locations by removing stones, gravel and vegetation (or other ground covering).
- Calibrate all sampling equipment and monitoring equipment.
- Place clean plastic sheeting on the ground near the sampling area and place decontaminated equipment to be used on the plastic (clean, decontaminated equipment must be used for each sample).
- Don appropriate personal protective equipment required by the site-specific health and safety plan.

Sampling Procedures

- Surface soil samples are generally collected from the area of least-contamination to most contamination (if known). Areas in close proximity to sample locations should remain undisturbed until all samples in the area have been collected.
- Volatile Organic Compound (VOC) samples (and other analytes that degrade with aeration) should be collected first and with the least disturbance possible. VOC samples should also be collected as grab samples unless otherwise dictated by the project data quality objectives or the site-specific sampling and analysis plan. Additionally, VOC sample containers should be filled and compacted as much as possible to eliminate and reduce the headspace within the container.
- Nonvolatile Organic or Inorganic Compound Analysis samples should be thoroughly homogenized with a decontaminated spoon, spatula, or trowel in a decontaminated bowl or tray prior to containerization.

Direct Grab Method

- Insert a decontaminated stainless steel spoon, trowel, or spatula into the exposed soil to the appropriate sample depth and remove the soil (sufficient volume should be removed to fill all required sample containers).
- VOC sample material should be placed directly into the sample container. Non-VOC and Inorganic sample material should be placed into a decontaminated stainless steel bowl or tray.
- Remove non-soil material (e.g., roots, stones, leaves, etc.).
- Thoroughly homogenize sample material and place in the appropriate sample containers.

Hand Auger/Hand Corer Method

- Rotate, drive or push a decontaminated hand auger or hand corer into the surface soil to the required depth.
- Retrieve the auger or corer and transfer the collected material into a VOC container or stainless steel bowl, tray or pan as required by the site-specific sampling and analysis plan.
- Repeat process until sufficient sample volume has been retrieved

Post Sampling Procedures

- Document and record all pertinent information associated with the sample collection in a field logbook (SOP 03-01-XX) .
- Label all sample containers and cover the label with clear tape.
- Complete appropriate chain-of-custody forms (SOP 02-05-XX).
- Package and prepare samples for shipping (SOP Series 04).
- Decontaminate all equipment associated with sample collection (e.g., bowls, spoons etc.)(SOP 02-03-XX).

Health and Safety

It is TechLaw policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed shoes, safety glasses, and chemical-resistant gloves. Personnel are required to inspect their personal protective equipment prior to entering any job site and replace any damaged or worn items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the TechLaw Health and Safety Director or designee prior to implementation of the field work. The site-specific health and safety plan must be reviewed and signed by all field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

Quality Assurance/Quality Control (QA/QC)

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific sampling plan and quality assurance project plan requirements or procedures, the minimum QA/QC requirements for these sampling activities are as follows:

Control of Deviations

Any deviations from the planning documents must be fully documented in the field logbook. These deviations shall be sufficiently documented to identify the rationale for the deviation and to allow repetition of the activity as actually performed.

Quality Control Samples

The number and type of QC samples, including duplicate samples, matrix spike/matrix spike duplicate, field blanks, equipment rinsate blanks, and trip blanks will be collected and prepared in accordance with the planning documents and procedures.

QC sample frequencies/requirements will vary dependent on the specific analytical method. Sufficient planning must be made to ensure that the quality control frequency/requirements are met on a per analytical method basis.

Verification

Verification activities are required for the above activities and include surveillances and periodic record audits. These activities are determined by the TechLaw Quality Assurance Director on a project by project basis. All surveillances and record audits will be documented and become part of the completed project records.

Comments/Notes

Soil analysis of compounds that may degrade easily by volatilization due to aeration (e.g., VOCs) require a grab sampling method of collection. Grab sample collection methods reduce the amount of disturbance and therefore the potential analyte loss. The drawback of using the grab sample collection method is determining the sample representativeness since the sample has been disturbed, is not homogenized and was collected from a discrete point.

References

Mason, B.J. Preparation of Soil Sampling Protocol: Techniques and Strategies, EPA-600/4-83-020. 1983.

United States Environmental Protection Agency, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II, 2nd Edition, EPA-600/4-84-076, December 1984.

United States Environmental Protection Agency, Test Methods for Evaluating Solid Waste, SW-846, Nineteenth Edition., Office of Solid Waste and Emergency Response, Most Recent Version.

United States Environmental Protection Agency, Office of Research and Development, Environmental Monitoring Systems Laboratory, Las Vegas, NV and Environmental Research Center, UNLV, Las Vegas, NV, Soil Sampling Quality Assurance User's Guide, Second Edition EPA/600/8-89/046, March 1989.

United States Environmental Protection Agency, Compendium of Superfund Field Operations Methods, EPA/540/P87/001, April 1997.

SOIL/SEDIMENT SAMPLING AND ANALYSIS PROCEDURES - SPLIT-BARREL SAMPLING AND PRESENTATION SHEET

SOP Number: 07-04-01
Effective Date: 02/09/99

Technical Approval: _____ Date: 6/11/99

QA Management Approval: _____ Date: 6/15/99

SOP Description

This Standard Operating Procedure (SOP) describes the collection of samples by TechLaw staff using a split-barrel sampler and how to measure resistance to the penetration of the sampler. It also describes how to properly document (log) the drilling of a soil boring.

Split-barrel sampling is done when the sampler wants to obtain a relatively undisturbed discrete sample from a particular depth interval. This method provides best results in consolidated soils or competent material. It is particularly useful for collecting samples that need to be visually described and/or analyzed for volatile organic constituents.

Split-barrel samplers are also referred to as split-spoon samplers. These sampling devices are routinely attached to the drilling rods of the drill rig. While TechLaw staff do not perform the actual drilling, we often oversee drilling operations contracted by other firms. On occasion, we have contracted drilling companies to conduct drilling. Therefore, understanding the procedures undertaken by these drilling companies is instrumental in the proper collection of split-barrel samples.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures

05	Field Equipment Operation and Maintenance Procedures
07	Soil/Sediment Sampling and Analysis Procedures
09	Health and Safety Procedures
11	Quality Assurance Procedures

Equipment and Apparatus

Drilling equipment, which is used typically to advance a borehole, is provided by a drilling company. A split-barrel sampler is attached to flush-joint steel drill rods and is driven into the bottom of the open borehole using a manual or automatic hammer and anvil. See Attachment A for a diagram of a split-spoon sampler, which is another term for the split-barrel sampler. If samples are collected for chemical analysis, the split-barrel sampler will be made of 304/316 stainless steel. The number of hammer blows required to drive the device into the soil is recorded as a measure of resistance. The device then is retrieved and opened. The sample length and a description of the sample material is recorded by the sampler in a field logbook as described in the sampling and analysis plan (SAP). An aliquot of the sample material is containerized.

The drilling company should provide at a minimum the following: drilling, sampling, and drive-weight equipment.

Drilling Equipment

Any drilling equipment capable of providing a borehole at the required depth. Experience has shown the following types of equipment to be suitable:

- Hollow-Stem Flight Augers
- Drag, Chopping, and Fishtail Bits - used in conjunction with rotary or casing-advance drills.
- Roller-Cone Bits - used in conjunction with rotary or casing-advance drills.
- Solid, Bucket, and Hand Augers
- Sampling Rods - flush-joint steel drill rods.

Sampling Equipment

- Split-Barrel or Split-Spoon Sampler - will have a hardened steel shoe and may be lined. If samples are to be taken for chemical analysis, use 304/326 stainless steel.

- Sample Catcher or Sand Trap - usually used when poorly consolidated soil is sampled. It is inserted into the sampler immediately above the shoe and is designed to prevent the sample material from falling out of the sampler through the shoe.

Drive-Weight Assembly

- Hammer and Anvil - the hammer will be a solid, rigid, metallic mass weighing 140 $\pm$ 2 lbs. (for geotechnical samples) or 300 lbs. if conditions warrant. The hammer falls along a guide and strikes the anvil.

- Hammer Drop System - rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause sampler penetration while re-engaging and lifting the hammer.

The equipment described above is routinely provided by the drilling company. See Attachment B for a field checklist of items that TechLaw staff should take in the field.

Preliminary Sampling Steps

- If sampling within one foot of the surface (as specified in the SAP), remove the surface vegetation and debris and use plastic sheeting as necessary to prevent the equipment from coming in contact with potentially contaminated surfaces. Prepare the soil sampling area as described in SOP No. 07-03-XX, Soil Sampling and Analysis Procedure - Surface/Near Surface Soil Sampling.

- Record the appropriate information and observations about the sample location in the site-specific field logbook. Refer to the SOP "03-series," Field Documentation Procedures, for recording appropriate information and observations.

Specific Sampling Steps

- Advance the borehole to the depth specified in the SAP.
- Remove excess cuttings from the borehole, if possible.
- Attach the sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil or material to be sampled or penetrate the soil or material to any degree.
- Position the hammer and anvil above the sampling rods.
- Rest the dead weight of the sampler, sampling rod, and hammer and anvil assembly on the bottom of the borehole.
- Apply a series of seating blows.
- Mark the drill rods in successive 6-inch increments.
- Drive the sampler into the soil with hammer blows. Apply the hammer blows by using one of the following methods:
    - A trip, automatic, or semi-automatic hammer drop system which lifts the hammer and allows it to drop up to 30 inches unimpeded. If geotechnical samples are taken, allow the full 30-inch drop; or
    - A cathead to pull a rope attached to the hammer, provided the cathead is free of rust, oil, or grease and has a 6- to 10-inch diameter.
- Count the number of blows applied to each 6-inch drill rod increment until one of the following occurs:
    - A total of 50 blows are applied in a single 6-inch increment,
    - A total of 100 blows are applied,
    - Ten (10) successive blows result in no advancement of the sampler, or
    - The sampler is advanced the length of the split-barrel sampler (typically 18 or 24 inches).

For other penetration tests, different penetration criteria will be used.

- Record the number of blows on the presentation sheet and/or in the field logbook. See Attachment C for a copy of the presentation sheet.

- Retrieve and open the sampler. Avoid contact of the sample with the hands of sampling personnel or with tools. If required by the site-specific health and safety plan or the site-specific SAP, sample for the presence of organic vapors emitted from the soil sample by using an organic vapor analyzer (OVA) instrument or a photoionization detector (PID) by passing the detector over the sample and pausing at 2- or 3-inch intervals. Record the results in the field logbook and/or on the presentation sheet. Refer to SOP Nos. 05-03-XX and 05-07-XX for information on the use of the OVA and the PID, respectively.

- Observe and record the soil sample lithology or description of the sample material on the presentation sheet. Be sure to record the following information:

  - Soil class (based on the Unified Soil Classification System [ASTM D-2487]);
  - Moisture condition;
  - Color (including mottling) using Munsell Soil Color Charts;
  - Presence of organic material (e.g., rootlets, peat), nodules, shells, staining, etc., including estimated percentages;
  - Size, grading, and angularity of clasts (including percentage of each); and
  - Plasticity.

- Place samples in containers defined according to the analytical needs. If required by the site-specific SAP, perform jar headspace screening at this time. (Jar headspace screening is used to screen soil/sediment samples for volatile organics using a PID or OVA.)

  Half-fill one 16-ounce glass jar with the sample to be analyzed. Quickly cover the top of the jar with one to two sheets of clean aluminum foil and apply the screw lid to tightly seal the jar. Vigorously shake the jar for approximately 15 seconds. Allow headspace development for a minimum of ten minutes (this time may be longer depending on the time of day and the climatic conditions). Again, vigorously shake the jar for approximately 15 seconds. Remove the screw lid and expose the aluminum foil seal. Quickly puncture the foil seal with the instrument sampling probe to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particles. Alternatively, use a syringe to withdraw a headspace sample and inject the

sample directly into an instrument probe or septum fitted inlet. Following the probe insertion or the syringe injection, record the highest meter response as the headspace concentration. The maximum response should occur between two and five seconds. An erratic meter response may occur at high organic vapor concentration or conditions of elevated headspace moisture, in which case headspace sampling should be discontinued.

When appropriate, pack samples with ice in coolers as soon as practical. Package, label, and prepare samples for shipment following procedures specified in the SOP "04-series."

- Complete the field documentation and chain-of-custody forms in accordance with SOP Nos. 03-01-XX through 03-04-XX and 02-05-XX. Enter sample information in the field logbook and presentation sheet.

Contamination Control

Sampling tools and equipment must be protected from sources of contamination prior to sampling and decontaminated prior to and between sampling as specified in SOP No. 02-03-XX. In addition, liquids and materials from decontamination operations must be handled in accordance with SOP No. 02-04-XX, Management of Investigation-Derived Waste. Sample containers must also be protected from sources of contamination. Sampling personnel must wear chemical-resistant gloves when handling the sampling equipment and samples. The gloves must be decontaminated or disposed between samples.

Because the drilling company's split-barrel sampler will directly contact the sample collected for chemical analysis, the split-barrel sampler should be decontaminated prior to and between each use. Also, to prevent the spread of contamination, all drilling flights and drill rods should be decontaminated between each sampling location by drilling company personnel. Provisions for the decontamination of drilling equipment between sampling locations is usually specified contractually between the TechLaw field manager and the drilling company.

Field Documentation

A permanent record must be maintained for each sampling location. This permanent record is the field logbook, photographs, and in some instances, surveyed locations. Field documentation of soil sampling with a split-barrel sampler is also required where personnel are conducting field oversight of other contractors on behalf of the EPA, DOE, state agencies, or industrial clients. Photographs should also be taken to document the sampling procedures used in the field. The record/logbook must include the following items in addition to the documentation specified in SOP Nos. 03-01-XX through 03-04-XX and SOP No. 02-05-XX.

- Personnel performing the sampling,
- Record of utility clearance,
- Sample identification number(s) and location(s) (surveyed if possible),
- Depths of soil samples,
- Any problems encountered during soil boring, and
- Disposition of removed soil not collected as sample.

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed safety shoes, and safety glasses. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the Health and Safety Director prior to implementation in the field. This plan must be reviewed with the TechLaw field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

QA/QC

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific procedures, the minimum QA/QC requirements for this activity are the following:

Control of Deviations

Any deviations from the SAP must be fully documented in the field logbook. These deviations shall be sufficiently documented to allow repetition of the activity as actually performed.

QC Samples

The number and types of QC samples, including duplicate samples, field blanks, equipment blanks, and trip blanks, will be collected or prepared as specified in the governing plans and procedures.

Equipment blanks should be collected from the split-barrel sampler as well as any other sampling equipment which may come in direct contact with samples collected.

Verification

Verification activities are required for the above practices including surveillance and periodic record audits. These activities will be documented and become part of the completed project records.

Comments/Notes

Sampling for geotechnical analysis will follow procedures outlined in the U. S. Environmental Protection Agency, Office of Research and Development, Subsurface Characterization and Monitoring Techniques: A Desk Reference Guide, Volume 1: Solids and Groundwater Appendices A and B. Sampling for chemical analysis will require attention to cleaning and use of stainless steel samplers.

Attachments

Attachment A - Diagram of a Split-Spoon Sampler

Attachment B - Field Checklist

Attachment C - Presentation Sheet

References

American Society for Testing and Materials, ASTM Standard Method D1586-99 Penetration Test and Split-Barrel Sampling of Soils.

American Society for Testing and Materials, ASTM Standard Method D2487-98 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

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U.S. Environmental Protection Agency Region 4, Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, Athens, GA, May 1996.

U.S. Environmental Protection Agency, Quality Assurance Management Staff, Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process Interim Final, EPA QA/G-4, Washington, D.C., 1993.

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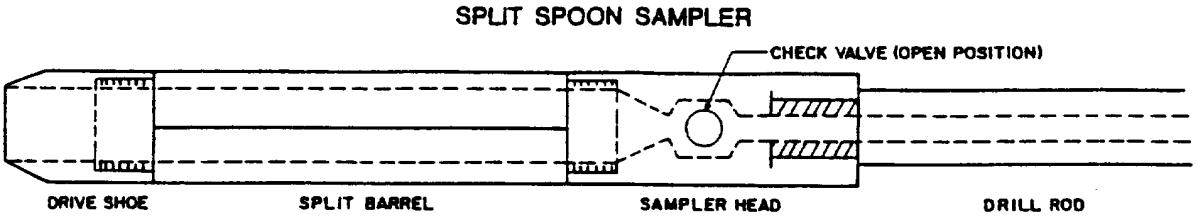
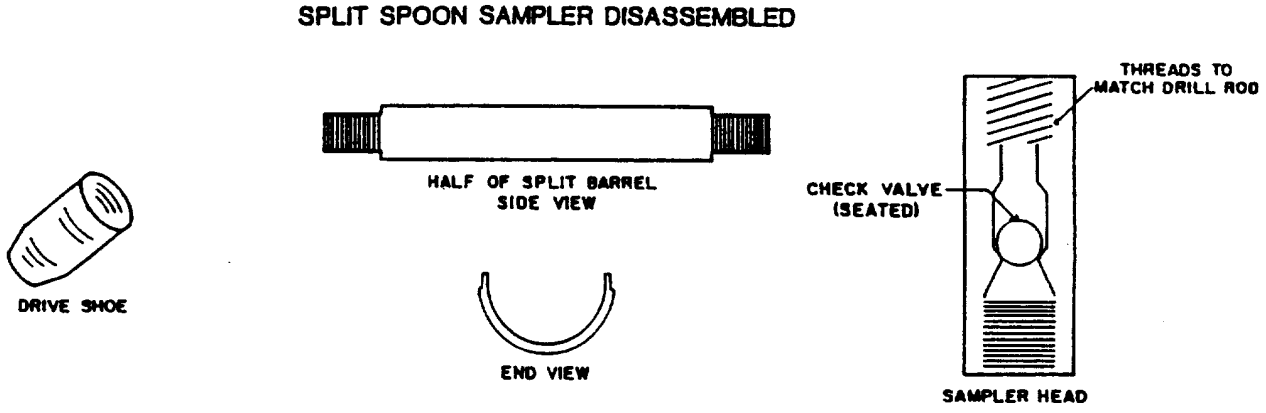
ATTACHMENT A
SOP Number: 07-04-01

DIAGRAM OF A SPLIT-SPOON SAMPLER





ATTACHMENT B
SOP Number: 07-04-01

FIELD CHECKLIST

___ Split Barrel Sampler*

___ Stainless Steel Spatulas**

___ Field Logbook

___ Sample Containers with Lids

___ Safety Shoes

___ Gloves

___ Safety Glasses or Monogoggles

___ Hard Hats

___ Ice/Cooler, as required

___ Custody Seals or Evidence Tape

___ Chain-of-Custody Forms

___ Black Indelible Ink

___ Labels

___ Sampling and Analysis Plan

___ Health and Safety Plan

___ Appropriate Containers for Waste and Waste Equipment

___ Decontamination Equipment***

___ Lab Wipes

___ Plastic Sheet

___ Health and Safety Monitoring Equipment (per HASP)

___ Camera and Film

* This is routinely provided by the drilling company.

** Acquire sufficient quantity to minimize field decontamination procedures.

*** See SOP No. 02-03-XX for equipment decontamination procedures.

ATTACHMENT C
SOP Number: 07-04-01

PRESENTATION SHEET

TechLaw Inc.

Boring #: _____

Date(s) Drilled: _____ Project: _____

Geologist/Engineer: _____ Location: _____

Surface Elevation: _____ Water Level: _____

Drilling Subcontractor: _____ Total Depth of Hole: _____

Depth (ft.)	Recovery (%)	Blows/6 in.	Meter Reading	Sample I.D.	Samples	General Lithology	Materials Description	Well Diagram
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								

SOIL/SEDIMENT SAMPLING AND ANALYSIS PROCEDURES - SOIL SAMPLING WITH AN AUGER

SOP Number: 07-05-01
Effective Date: 02/09/99

Technical Approval: _____ Date: 6/11/99

QA Management Approval: _____ Date: 6/14/99

SOP Description

This Standard Operating Procedure (SOP) describes the procedure and equipment used by TechLaw staff when collecting soil samples at the surface (i.e., zero to six inches) or in shallow excavations (i.e., approximately six inches to six feet). The procedure is a simple technique which provides a disturbed sample. The procedure is applicable to a wide variety of soil conditions and textures, including sands, clays, and silts. However, application of this procedure is of limited value in rocky soil. The procedure is not appropriate for taking samples at a discrete depth, but may be used to an approximate depth.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
07	Soil/Sediment Sampling and Analysis Procedures
09	Health and Safety Procedures
11	Quality Assurance Procedures

Equipment and Apparatus

Equipment required is simple and readily available and may include the following types of augers: manually operated (e.g., spiral-type, ship-type, open tubular, orchard-barrel, open spiral, closed spiral, post hole, and clam shell) and machine operated.

- **Manually-Operated Auger** - A small, lightweight, metal auger. Diameters typically range between 1 and 4 inches. Augers normally are used in conjunction with 3- to 4-foot metal shafts and T-handles.

- **Machine-Operated Auger** - A metal auger attached to a shaft and powered by a small internal combustion engine or electric motor. Typical auger diameters range from 1 to 48 inches. This auger may be hand held.

See Attachment A for a field checklist of equipment to be used.

General Considerations

The following two paragraphs provide information for determining when to use a Shelby tube versus an auger. Attachment B provides a summary of hand-held soil augers, including their applications and limitations; and Attachment C provides pictures of a screw auger, bucket augers, and a spiral or ram's horn auger.

A Shelby tube is used to collect a relatively undisturbed soil sample compared to an auger which imparts some destruction to the sample. If you have a choice between the two devices consider the following disadvantages of a Shelby tube:

- It may not be strong enough to penetrate compact sediments;

- It is difficult to collect continuous samples since this process is very time consuming, especially when the depth exceeds 100 feet; and

- Gravel or cobbles can disturb sample during the collection, or can damage the walls of the sampler.

Augers are used to collect disturbed samples compared to the Shelby tube which collects undisturbed samples. Ideally, both types can be used at a sample location. The auger can be

used to obtain the desired depth and the Shelby tube can be used at the desired sample depth to collect the undisturbed sample. See SOP No. 07-06-XX, Soil Sampling with a Shelby Tube, for further details.

It is important to determine if volatile organic compounds (VOCs) are a class of the chemicals of concern for this sampling event. If they are, alternative sampling devices should be considered since the auger is not the preferred sampler of choice for the collection of samples for VOC analyses.

Auger selection must be based on local soil conditions and requirements of the Sampling and Analysis Plan (SAP). Depending on the analyte of interest, certain coatings (e.g., plastic, chromium, and aluminum) may result in analytical interference. Augers plated with chromium or other materials must be cleaned of those materials prior to use. Stainless steel is preferred, but may not always be available.

Pre-Sampling Procedures

- Remove surface vegetation and debris from the area to be sampled. Use plastic sheeting as necessary to prevent equipment from coming in contact with potentially contaminated surfaces. Prepare the soil sampling area as described in SOP No. 07-03-XX, Soil Sampling and Analysis Procedure - Surface/Near Surface Soil Sampling.

- Record appropriate information and observations about the sample location in the site-specific field logbook. Refer to SOP No. 03-01-XX, Maintenance of a Field Logbook and SOP No. 03-02-XX, Taking and Documenting Photographs, for appropriate information and observations to be recorded.

Sampling Procedures

- Advance the clean auger into the soil to the desired depth.

- Slowly withdraw the auger from the soil.

- If a sample is not desired from that depth, remove the soil from the auger and repeat the first two steps. Once the desired sampling depth is reached, replace the auger bucket with a precleaned bucket and use the clean bucket to collect the desired sample.

- Slowly withdraw the auger from the soil and place the soil in a stainless steel bowl or a glass tray. Mix or composite soil as directed by the SAP.

- Using a clean stainless steel or Teflon spoon, spatula, or disposable scoop, as appropriate, place the soil samples in appropriate containers.

- Seal the sample containers and affix labels. Package, label, and prepare for shipment as specified in SOP No. 02-05-XX, Chain-of-Custody.

- Complete the field logbook and chain-of-custody forms in accordance with the SAP and appropriate SOPs as stated above.

- Backfill the area to grade. Excavated material should not be used for backfilling but should be containerized until analytical results dictate the appropriate deposition method. Use bentonite, sand, or clean, native soil to backfill.

Contamination Control

Sampling tools and equipment must be protected from sources of contamination prior to sampling and decontaminated prior to and between sampling locations as specified in SOP No. 02-03-XX, Equipment Decontamination. In addition, liquids and materials from decontamination operations must be handled in accordance with SOP No. 02-04-XX, Management of Investigation Derived Waste. Sample containers must also be protected from sources of contamination. Sampling personnel must wear chemical-resistant gloves when handling the sampling equipment and samples. Gloves must be decontaminated or disposed between samples.

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator,

steel-toed safety shoes, and safety glasses. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the HSD prior to implementation in the field. This plan must be reviewed with the TechLaw field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

QA/QC

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific procedures, the minimum QA/QC requirements for this sampling activity are the following.

Control of Deviations

When feasible, any departure from specified requirements will be justified and authorized prior to deviating from the requirements. Deviation shall be documented sufficiently to allow repetition of the activity as actually performed.

QC Samples

The number and types of QC samples including duplicate samples, field blanks, equipment blanks, and trip blanks will be collected or prepared as specified in the SAP.

Verification

Verification activities are required for the above practices including surveillance and periodic record audits. These activities will be documented and become part of the completed project records.

Field Documentation

A permanent record must be maintained for each sampling location. This permanent record is the field logbook, photographs, and in some instances, surveyed locations. Field documentation of soil sampling with an auger also is required where personnel are conducting field oversight of other contractors on behalf of the client (e.g., EPA, DOE, or state agencies). Photographs should also be taken to document the sampling procedures used in the field. The record/logbook must include the following items:

- Time and date of sampling activity;
- Weather conditions;
- Personnel performing the sampling;
- Record of utility clearance;
- Sample identification number(s) and location(s) (surveyed if possible);
- Depths of soil samples;
- Any problems encountered during soil boring;
- Disposition of removed soil not collected as sample;
- Description of soil color, grain size, texture (e.g., sand, silt, or clay), soil moisture; and
- Documentation of the presence or absence of:

  - Organic material (e.g., leaves, roots, peat);
  - Anthropogenic (man-made) material; and
  - Odors (e.g., organic, petroleum, solvent, putrid).

Comments/Notes

None at this time.

Attachments

Attachment A - Field Checklist

Attachment B - Summary of Types of Hand-Held Soil Augers

Attachment C - Illustrations of Hand-Held Augers (Screw Auger, Bucket Augers, Spiral or Ram's Horn Auger

References

American Society for Testing and Materials, ASTM Standard Method D1452-80 (Reapproved 1995), Soil Investigation and Sampling by Auger Borings, 1995.

TechLaw Inc., Field Equipment Manufacturers' Instruction Manuals Handbook, Winter 1995.

TechLaw Inc., Health and Safety Program, 1999.

TechLaw, Inc., Quality Assurance Program Plan (as amended for the RCRA Enforcement, Permitting, and Assistance Contract).

U. S. Environmental Protection Agency A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14, Washington, D.C., 1987.

U.S. Environmental Protection Agency, Data Quality Objectives for Remedial Response Activities, EPA/540/G-87/003, Washington, D.C., 1987.

U.S. Environmental Protection Agency Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, Athens, GA, May 1996.

U. S. Environmental Protection Agency, Office of Research and Development, Subsurface Characterization and Monitoring Techniques: A Desk Reference Guide, Vol I, Solids and Groundwater Appendices A and B, EPA/625/R-93/003a, Washington, DC, May 1993.

ATTACHMENT A
SOP Number: 07-05-01

FIELD CHECKLIST

___ Auger *
___ Auger Shafts and Handles
___ Wrench
___ Logbook
___ Sample Containers with Lids
___ Safety Glasses or Monogoggles
___ Gloves
___ Safety Shoes
___ Ice/Cooler, as required
___ Black Indelible Ink Pen
___ Labels
___ Bowls/Trays (Stainless Steel or Glass)
___ Spoons, Scoops, etc.
___ Buckets
___ Plastic Sheets
___ Lab Wipes
___ Decontamination Equipment **
___ Chain-of-Custody forms
___ Custody Seals, or Evidence Tape
___ Sampling and Analysis Plan
___ Health and Safety Plan
___ Appropriate Containers for Waste and Equipment
___ Camera and Film
___ Health and Safety Monitoring Equipment (per HASP)

* If possible, provide sufficient numbers to minimize decontamination activities in the field.

** See SOP No. 02-03-XX for decontamination of sampling equipment.

ATTACHMENT B
SOP Number: 07-05-01

Summary of Hand-Held Soil Augers[a]

Auger Type	Applications	Limitations
Screw Auger	Cohesive, soft, or hard soils or residue	Will not retain dry, loose, or granular material
Standard Bucket Auger	General soil or residue	Might not retain dry, loose, or granular material
Sand Bucket Auger	Bit designed to retain dry, loose, or granular material (silt, sand, and gravel)	Difficult to advance boring in cohesive soils
Mud Bucket Auger	Bit and bucket designed for wet silt and clay soil or residue	Will not retain dry, loose, or granular material
Dutch Auger	Designed specifically for wet clayey, fibrous, or rooted soils (marshes)	
In-Situ Soil Recovery Auger	Collection of soil samples in reusable liners; closed top reduces contamination from caving sidewalls	Similar to standard bucket auger
Eijkelcamp Stony Soil Auger	Stony soils and asphalt	
Planer Auger	Used to clean out and flatten the bottom of predrilled holes	
Post-Hole/Iwan Auger	Cohesive, soft, or hard soils; readily available	Will not retain loose material
Silage Auger	Silage pits and peat bogs	
Spiral Auger	Used to remove rock from auger holes so that borings can continue with other auger-type	

[a]Suitable for soils with limited coarse fragments; only the stony soil auger will work well in very gravelly soil.

Soi

ATTACHMENT C
SOP Number: 07-05-01

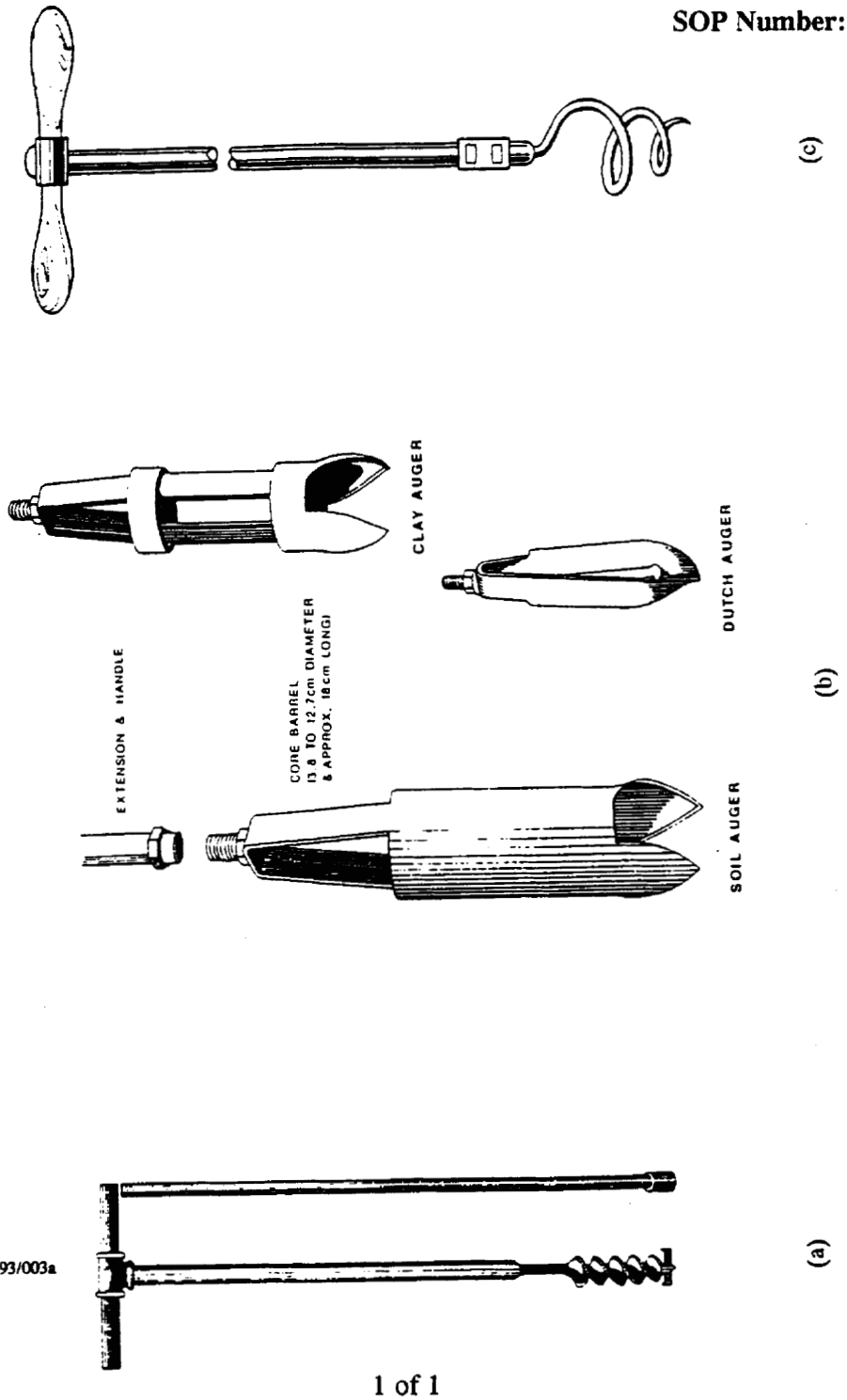


Figure 2.3.2 Hand-held augers: (a) Screw auger (Rehm et al., 1985, Copyright © 1985, Electric Power Research Institute, EPRI EA-4301, *Field Measurement Methods for Hydrogeologic Investigations: A Critical Review of the Literature*, reprinted with permission); (b) Examples of bucket augers (Rehm et al., 1985, Copyright © 1985, Electric Power Research Institute, EPRI EA-4301, *Field Measurement Methods for Hydrogeologic Investigations: A Critical Review of the Literature*, reprinted with permission); (c) Spiral or ram's horn auger (U.S. Army, 1981).

Source: EPA/625/R-93/003a

SOIL/SEDIMENT SAMPLING AND ANALYSIS PROCEDURES - SOIL SAMPLING WITH A SHELBY TUBE

SOP Number: 07-06-01
Effective Date: 02/09/99

Technical Approval: _____ Date: 5/24/99

QA Management Approval: _____ Date: 6/14/99

SOP Description

This Standard Operating Procedure (SOP) describes the procedures to be used by TechLaw staff when using a Shelby tube (a thin-wall hollow cylindrical tube) to collect a relatively undisturbed sample of consolidated soils from a discrete interval. The procedure is well suited to clays, clayey silts, and silts; but its applicability is limited in rocky soils and sands. As a general rule, a Shelby tube can be used in most soils except cohesion less materials below the water table and hard or cemented soils.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
07	Soil/Sediment Sampling and Analysis Procedures
09	Health and Safety Procedures
11	Quality Assurance Procedures

Equipment and Apparatus

Any equipment that can open a bore hole without disturbing the soil interval to be sampled may be used. Drilling rigs equipped with hollow-stem augers are preferred for this method when sampling deeper than approximately two feet. However, a sharpshooter shovel (i.e., spade) can also be used at shallower depths.

- **Sampler Insertion Equipment** - Apparatus used to provide penetration force to the Shelby tube. Typically, hydraulic (e.g., backhoe, drill rigs) equipment is used. Hammer-driven equipment may be acceptable under certain circumstances, such as in sampling shallow intervals.

- **Thin-Walled Metal Shelby Tubes** - Tubes, typically stainless steel with liners where appropriate, with outside diameters of 2 to 5 inches and lengths between 12 and 54 inches. They will be sufficiently strong to withstand penetration pressures without bending.

- **Sampler Head** - A coupling between the Shelby tube and sampler insertion equipment is required.

- **Tube Liner** (optional) - Disposable tube liner as specified in the SAP.

See Attachment A for a field checklist of equipment to be used.

General Considerations

The following two paragraphs provide information for determining when to use a Shelby tube versus an auger. Attachment B provides a diagram of a Shelby tube and a continuous sampling tube system.

A Shelby tube is used to collect a relatively undisturbed soil sample compared to an auger which imparts some destruction to the sample. If you have a choice between the two devices, consider the following disadvantages of a Shelby tube:

- It may not be strong enough to penetrate compact sediments;

- It is difficult to collect continuous samples since this process is very time consuming, especially when the depth exceeds 100 feet; and

- Gravel or cobbles can disturb sample during the collection, or can damage the walls of the sampler.

Augers are used to collect disturbed samples compared to the Shelby tube which collects undisturbed samples. The Shelby tube is especially amenable to the collection of samples for volatile organice compounds (VOCs) analyses. Ideally, both types of equipment can be used at a sample location. The auger can be used to obtain the desired depth and the Shelby tube can be used at the desired sample depth to collect the undisturbed sample. See SOP No. 07-05-XX, Soil Sampling with an Auger, for further details.

Shelby tubes must be stainless steel (304/316) and cleaned prior to use if samples are for chemical analysis. Liners, if used, should be of a chemically resistant, relatively inert material. Ideally, an equipment rinsate blank of the decontaminated liner should be collected during the sampling event.

Pre-Sampling Procedures

- Remove surface vegetation and debris from the area to be sampled. Use plastic sheeting as necessary to prevent the equipment from coming in contact with potentially contaminated surfaces. Prepare the area as described in SOP No. 07-03-XX, Soil Sampling and Analysis Procedure - Surface/Near Surface Soil Sampling.

- If the sample will be near the surface, you may push the Shelby tube directly. However, if the sample will be taken at depth, advance the borehole to the desired sample depth using a screw-type auger, shovel, or drill rig; then using an extension flight (if needed), push the Shelby tube into the interval to be sampled.

- Remove excess cuttings from the borehole, avoiding disturbance of the interval to be sampled.

- Attach the clean Shelby tube, with liner if used, to the sampler insertion equipment using the sampler head, and place the tube assembly in the bottom of the borehole.

- Mark sampler insertion equipment for a reference point (e.g., if the tube is one foot long, the equipment should be marked such that it is apparent when the tube has penetrated one foot).

Sampling Procedures

- Advance the Shelby tube by applying minimum constant downward pressure or by hammering. Do not rotate the sampler.
- Slowly withdraw the tube from the borehole and mark to indicate the top.
- If required by the SAP, remove disturbed material in the upper end of the sample tube.
- Trim off excess material from the bottom of the tube, using a clean stainless steel spatula, until it is flush with the end of the tube. If liners are used, unscrew the nose plug, withdraw the sample, and cap the liner.
- Seal both ends of the tube or liner with a cap, non-reactive wax (e.g., Parafilm™), or other seal; or remove the sample from the tube and place it in appropriate containers as specified in the SAP.
- Transport and store (if necessary) the Shelby tube in a vertical position.
- Backfill the hole to grade with clean soil or other approved material.
- Package, label, and prepare samples for shipment following procedures as specified in SOP No. Series 04.
- Complete the field logbook and chain-of-custody forms in accordance with the SAP; SOP No. 03-01-XX, Maintenance of a Field Logbook; and SOP No. 02-05-XX, Chain-of-Custody.

Contamination Control

Sampling tools and equipment must be protected from sources of contamination prior to sampling and decontaminated prior to and between sampling as specified in SOP No. 02-03-XX, Equipment Decontamination. In addition, liquids and materials from decontamination

operations must be handled in accordance with SOP No. 02-04-XX, Management of Investigation-Derived Waste. Sample containers must also be protected from sources of contamination. Sampling personnel must wear chemical-resistant gloves when handling the sampling equipment and samples. Gloves will be decontaminated or disposed between samples.

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hard hat, hearing protection, full-face respirator, steel-toed safety shoes, and safety glasses. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the TechLaw Health and Safety Director prior to implementation in the field. This plan must be reviewed with the TechLaw field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

QA/QC

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific procedures, the minimum QA/QC requirements for this sampling activity are the following:

Control of Deviations

When feasible, any departure from specified requirements will be justified and authorized prior to deviation from the requirements. Deviations are to be documented sufficiently to allow repetition of the activity as actually performed.

QC Samples

The number and types of QC samples including duplicate samples, field blanks, equipment blanks, and trip blanks will be collected or prepared as specified in the SAP.

Verification

Verification activities are required for the above practices including surveillance and periodic record audits. These activities will be documented and will become part of the complete project records.

Field Documentation

A permanent record must be maintained for each sampling location. This permanent record is the field logbook, photographs, and in some instances surveyed locations. Field documentation of soil sampling with a Shelby tube also is required where personnel are conducting field oversight of other contractors on behalf of the client (e.g., EPA, DOE, or state agencies). Photographs should also be taken to document the sampling procedures used in the field. The record/logbook must include the following items:

- Time and date of sampling activity;
- Weather conditions;
- Personnel performing the sampling;
- Record of utility clearance;
- Sample identification number(s) and location(s) (surveyed if possible);
- Depths of soil samples;
- Any problems encountered during soil boring;
- Disposition of removed soil not collected as sample;
- Description of soil color, grain size, texture (e.g., sand, silt, or clay), soil moisture; and

- Documentation of the presence or absence of:

  - Organic material (e.g., leaves, roots, peat);
  - Anthropogenic (man-made) material; and
  - Odors (e.g., organic, petroleum, solvent, putrid).

Comments/Notes

- The Shelby tube ends are to be adequately sealed if physical parameters dependent on moisture content, are desired.

- If samples are for chemical analysis, oil or solvents must not to be used on the tubes or liners.

Attachments

Attachment A - Field Checklist System

Attachment B - Diagram of Shelby Tube and Continuous Sampling Tube

References

American Society for Testing and Materials, ASTM Standard Method D1587-94, Standard Practice for Thin-Walled Tube Sampling of Soils, 1994.

TechLaw Inc., Field Equipment Manufacturers' Instruction Manuals Handbook, Winter 1995.

TechLaw Inc., Health and Safety Program, 1999

TechLaw Inc., Quality Assurance Program Plan (as amended for the RCRA Enforcement, Permitting, and Assistance Contract).

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U.S. Environmental Protection Agency, Data Quality Objectives for Remedial Response Activities, EPA/540/G-87/003, Washington, D.C., 1987.

U.S. Environmental Protection Agency Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, Athens, GA, May 1996.

U. S. Environmental Protection Agency, Office of Research and Development, Subsurface Characterization and Monitoring Techniques: A Desk Reference Guide, Volume 1: Solids and Groundwater Appendices A and B, EPA/625/R-93/003a, Washington D.C., May 1993.

ATTACHMENT A
SOP Number: 07-06-01

FIELD CHECKLIST

___ Shelby Tubes and End Caps*

___ Non-reactive wax (i.e., parafilm)

___ Liners*

___ Sample Insertion Equipment

___ Sampler Head

___ Field Logbook

___ Sample Containers with Lids

___ Safety Shoes

___ Hard Hat

___ Safety Glasses or Monogoggles

___ Ice/Cooler, as required

___ Custody Seals, as required

___ Black Indelible Ink Pen

___ Labels

___ Sampling and Analysis Plan

___ Health and Safety Plan

___ Decontamination Equipment**

___ Stainless Steel Spatulas

___ Lab Wipes

___ Appropriate Containers for Waste and Equipment

___ Plastic Sheeting

___ Chain-of-Custody forms

___ Camera and Film

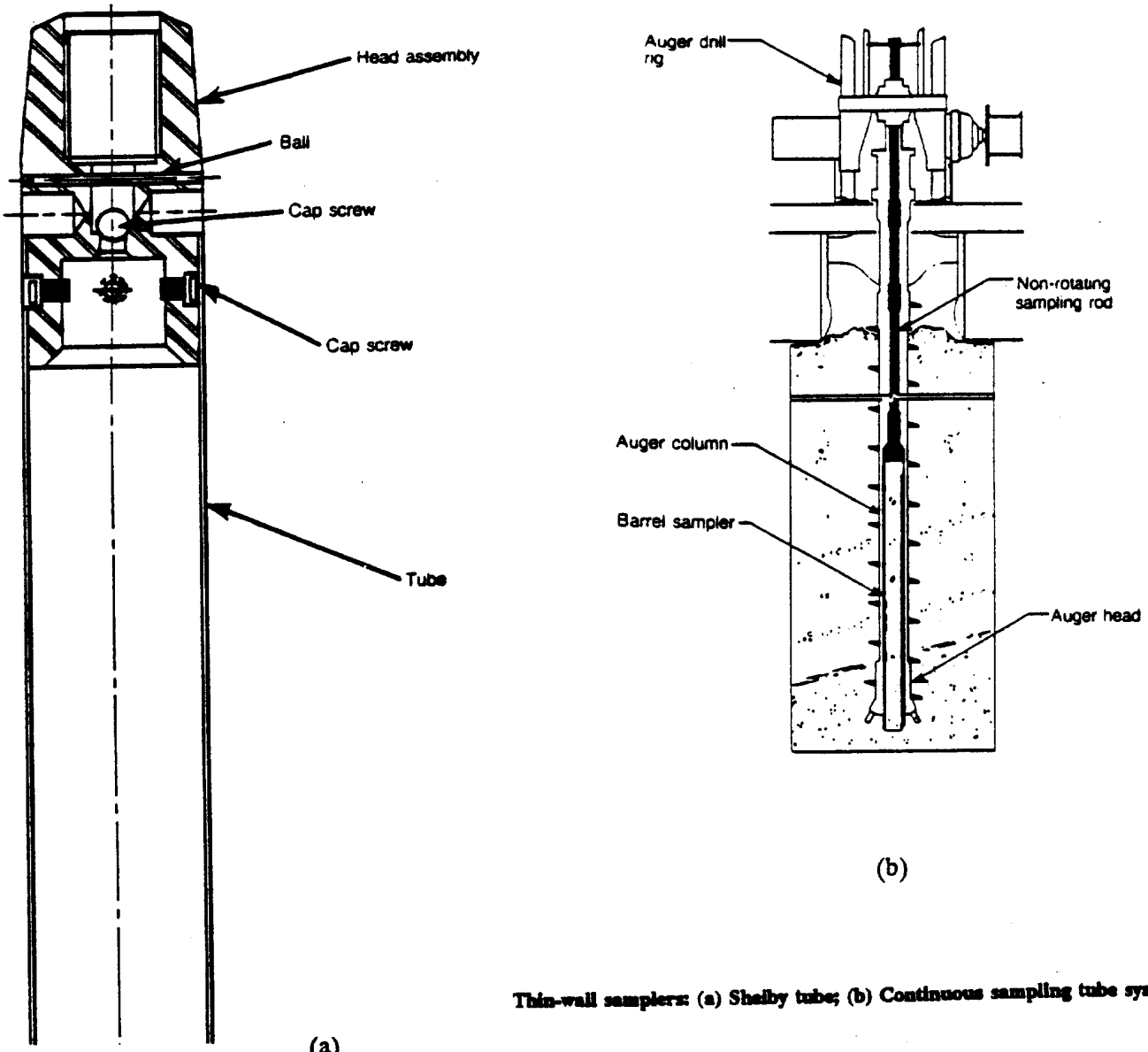
___ Health and Safety Monitoring Equipment (per HASP)

* If possible, provide sufficient numbers to minimize decontamination activities in the field.

** See SOP for decontamination of sampling devices.

ATTACHMENT B
SOP Number: 07-06-01

DIAGRAM OF SHELBY TUBE AND CONTINUOUS SAMPLING TUBE SYSTEM



Thin-wall samplers: (a) Shelby tube; (b) Continuous sampling tube system

Source: EPA/625/R-93/003a (see References)

SOIL, SOIL GAS, AND GROUNDWATER SAMPLING USING DIRECT PUSH TECHNOLOGY (DPT)

SOP Number 07-07-00
Effective Date: 4/12/99

Technical Approval: _____ Date: 5/24/99

QA Management Approval: _____ Date: 6/14/99

SOP Description

This Standard Operating Procedure (SOP) describes the collection of soil, soil gas and groundwater samples by TechLaw Inc., personnel using Direct Push Technology (DPT).

DPT consists of a rugged, lightweight hydraulic drive point system mounted on a vehicle, trailer, or smaller hand held portable unit. The DPT system has the capability to drive sampling equipment for the collection of soil, soil gas, and groundwater samples. The DPT unit hydraulically advances hollow rods to a predetermined sampling depth. The media specific (e.g., soil, vapor, water) type of DPT equipment is then employed.

The use of DPT may be a cost-effective alternative to conventional drilling methods for the collection of subsurface soils, soil gas, and groundwater samples. Prior to selecting DPT as a method for sample collection, consideration of the site geology, depth to groundwater, type of soils, site access, and topography must be made. Additionally, the project data quality objectives, and analytical requirements must be considered. Generally, DPT is used to collect screening-level data.

The use of DPT provides advantages over conventional methods. These advantages include:

- Low mast height enables the unit to work safely and effectively at low clearance locations.
- Smaller unit size enables access to areas where size constraints and slope are prohibitive.
- Investigation derived wastes (IDW) (e.g., soil cuttings and purge water) are greatly reduced due to the smaller diameter push rods and soil displacement in the horizontal direction versus the vertical direction towards the surface.
- Cost savings may be realized from the reduction of IDW disposal, daily/weekly/monthly leases versus per foot charges and efficiency/speed of work completed. A cost-benefit

evaluation should be conducted on a project-specific basis.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the relevant and applicable SOPs identified in the following SOP categories:

Section No.	Section Title
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
09	Health and Safety Procedures
11	Quality Assurance Procedures

Equipment and Apparatus

Common

- Site-specific sampling and analysis plan
- Site-specific health and safety plan
- Personal protective equipment required by the health and safety plan
- Monitoring/Screening instrumentation required by the health and safety plan and the sampling plan (organic vapor monitor, pH, temperature, conductivity, dissolved oxygen and turbidity meters)
- Sample supplies (containers, preservatives, shipping materials, labels, coolers)
- Decontamination supplies
- Sample documentation supplies (chain-of-custody, field logbooks)
- DPT unit with the following supplies:
  - Push rods
  - Drive caps and pull caps
  - Carbide-tipped drill bit for drilling pilot holes in asphalt and concrete

- O-rings
- Powdered bentonite/concrete

DPT Soil Sampling Equipment

- Steel or stainless steel core sampler
- Steel or stainless steel piston sampler
- Steel or stainless steel split barrel sampler
- Acetate, brass or stainless steel liners
- Extension rods (chase rods)

DPT Soil Gas Sampling Equipment

- Expendable drive points (one per sample at a minimum)
- Polyethylene tubing or Teflon® lined polyethylene tubing
- Silicone tubing
- Vacuum or sampling system (syringe, peristaltic pump)
- Post Run Tubing (PRT) adapter
- PRT expendable point holder
- Vacuum gauges
- 3-way valves

DPT Groundwater Sampling Equipment

- Expendable drive points (one per sample at a minimum)
- Screen Point groundwater sampler or mill-slotted well point sampler
- Polyethylene tubing or Teflon® lined polyethylene tubing
- Silicone tubing
- Check valves (for Waterra system)
- Peristaltic pump
- Small diameter bailer (mini-bailer)
- Nylon line
- Extension rods (chase rods)
- 1" diameter polyvinyl chloride 0.010 slot screen and riser (casing)

Common Procedures to Soil, Soil Gas and Groundwater Sample Collection

Prior to sampling:

- Locate and mark all potential sampling locations.
- Arrange and complete all necessary utility clearances.
- Decontaminate all equipment (SOP 02-03-XX) associated with sample collection (e.g., rods, tips, etc.).
- Prepare sampling locations for equipment access (e.g., clear brush, drill holes in concrete).
- Calibrate all sampling equipment and monitoring equipment.
- Don appropriate personal protective equipment required by the site-specific health and safety plan.

After sampling:

- Remove all push rods from the ground.
- Completely fill the borehole with neat cement or bentonite grout, as required if necessary.
- Document and record all pertinent information associated with the sample collection in a field logbook (SOP 03-01-XX) .
- Label all sample containers and cover the label with clear tape.
- Complete appropriate chain-of-custody forms (SOP 02-05-XX).
- Package and prepare samples for shipping (SOP 04-02-XX).
- Decontaminate all equipment associated with sample collection (e.g., rods, tips, etc.).

Soil Sampling

- Assemble the sampling device by screwing the cutting shoe onto the bottom of the sampler (unless it is built-in). If using liners or sleeves, they should be placed in the sampler prior to assemblage.
- Thread the piston tip onto the piston rod.
- Thread the drive head onto the top end of the sampler.
- Slide the piston rod into the sampler (the tip of the piston should slightly protrude from the cutting shoe) and reverse thread the piston stop pin onto the top of the piston rod.

- Thread the assembled sampler onto the lead push rod.
- Thread the drive cap onto the lead push rod and advance the sampler with the hydraulic hammer.
- Advance the sampler to the top of the predetermined sample interval by adding necessary push rods and then advancing them with the hydraulic hammer.
- Upon reaching the sample interval, remove the drive cap and lower extension rods down the inside of the push rods until encountering the top of the piston stop pin.
- Rotate the extension rods clockwise until the piston stop pin is removed from the sampler.
- Remove the extension rods with the attached piston stop pin.
- Replace the drive cap and advance the push rods and sampler through the sample interval.
- Remove the drive cap and replace it with the pull cap.
- Retract the push rods and sampler from the borehole (take care to secure the push rods remaining in the hole when removing a push rod to prevent them from falling back down the borehole).
- Detach the sampler from the lead push rod upon retrieval.
- Disassemble the sampler, remove the liner or sleeves and seal both ends with teflon or plastic caps. If logging lithology, mark each end with top or bottom orientation.

Soil Gas Sampling

- Test fit the post run tubing (PRT) adapter with the PRT expendable point holder or retractable point holder to ensure the threads are compatible and thread together smoothly.
- Attach and secure the PRT adapter to the flexible tubing with wire (flexible tubing must be at least the length of the depth of the sample interval plus approximately 2 feet to work with at the surface).
- Check the condition and placement of the O-ring at the down hole end of the PRT adapter.
- Thread the PRT expendable point holder into the lead push rod.
- Place the expendable drive point into the expendable drive point holder.
- Attach the drive cap to the lead push rod and advance using the hydraulic hammer to a depth approximately one (1) foot past the predetermined sample depth.
- Remove the drive cap and replace it with the pull cap.
- Retract the push rods approximately one (1) foot.

- Lower the extension rods down the inside of the push rods and ensure that the drive point has dropped off the expendable drive point holder. If not, push the drive point off of the expendable point holder.
- Remove the extension rods.
- Insert the PRT adapter end of the flexible tubing down the inside of the push rods until the PRT adapter comes in contact with the expendable point holder.
- Apply a gentle downward pressure to the flexible tubing while rotating in a counter-clockwise direction to thread the PRT adapter into the expendable point holder (Hint: When collecting soil gas from depths greater than 20 feet below ground surface, using a larger diameter tubing will allow for more control when attaching the PRT adapter to the expendable point holder).
- Rotate the tubing until the PRT adapter is snugly threaded into the expendable point holder.
- Pull gently on the tubing to ensure the PRT adapter has been fully threaded into the expendable point holder.
- Connect the tubing to a vacuum pump or sampling system. Insert a short section of silicone tubing between the vacuum pump and down hole tubing if a syringe will be used to collect the sample.
- Start the vacuum pump or sampling system to remove a minimum of three volumes of soil gas from the tubing. Tight formations (clays) may not allow soil gas to pass through resulting in insufficient purge and sample volumes. Prior to sample collection, the sampling tubing and container configuration must be tested for leaks. Leak detection may be accomplished by pinching off the down hole tubing and applying a vacuum to the system and observing the vacuum gauge.
- Collect the soil gas sample according to one of the following methods:
  - Syringe - Insert the needle attached to a 60 cc syringe into the silicone tubing. Pull the plunger back until the syringe is filled with soil gas. Make sure that the negative pressure within the syringe has equalized prior to removing the syringe from the silicone tubing. If the pressure within the syringe will not equalize, the system is either plugged or the formation is tight and the push rods must be removed, decontaminated (expendable point holder at a minimum) and redriven.
  - Peristaltic Pump/Tedlar Bag - Attach a peristaltic pump (using silicone tubing) to the down hole tubing and purge a sufficient volume (three times the total system volume consisting of the soil gas tool + tubing inside diameter + open hole interval + in line sampling containers) of soil gas. Attach a Tedlar bag to the exhaust side of the peristaltic pump and fill the

Tedlar bag with soil gas. If the system is plugged or the formation will not allow soil gas to permeate, the Tedlar bag will not inflate.

- Summa Canister - Attach a summa canister in line with a vacuum pump/tank to the down hole tubing using a T-fitting or three-way valve. After completion of an appropriate purge (three times system volume) using the vacuum pump/tank, open the summa canister valve to collect the sample into the evacuated canister.

- After sample collection, pull the down hole tubing off the PRT adapter.
- After removal of the push rods, inspect the PRT adapter and expendable point holder to ensure a complete seal was achieved. If it is apparent that the PRT adapter and expendable point holder connection was not adequate (e.g., PRT adapter o-ring not properly seated on expendable point holder), the samples must be recollected.

Groundwater Sampling

DPT groundwater sample collection can be completed by using one of three different methods:

- Hydropunch ™ Method - The Hydropunch™ consists of advancing a split barrel tube containing a retracted stainless steel well screen with an expendable drive point into the aquifer. Upon reaching terminal depth, the push rods are pulled up approximately two (2) feet and the screen is exposed to the aquifer. The screen may need to be pushed out of the split barrel tube using the extension rods.
- Mill-slotted Well Point Method - The mill-slotted well point method consists of advancing a mill-slotted push rod (lead rod) and expendable drive point into the aquifer. Upon reaching terminal depth, the groundwater flows through the mill-slotted well point for sampling. Note: The mill-slotted well point can become clogged through smearing during advancement to the sampling depth.
- Mini-Well Sampling Method - A temporary mini-well can be placed for sampling. The DPT push rods used for this method are generally a larger diameter and must at least be large enough to lower 1" diameter screen and riser through. To place the mini-well, drive the push rods with an expendable drive point to the desired depth. Lower the 1" riser and 1" well screen (screened intervals may be of varying length) through the annulus of the push rods. Retract all push rods from the borehole leaving the riser and well screen in place.

- Measure the depth to groundwater.
- Collect the groundwater sample using either a decontaminated mini-bailer, peristaltic pump with flexible tubing or a inertial pump (Waterra™ type check valve system).

Health and Safety

It is TechLaw policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed shoes, safety glasses, and chemical-resistant gloves. Personnel are required to inspect their personal protective equipment prior to entering any job site and replace any damaged or worn items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the TechLaw Health and Safety Director or designee prior to implementation of the field work. The site-specific health and safety plan must be reviewed and signed by all field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

Quality Assurance/Quality Control (QA/QC)

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific sampling plan and quality assurance project plan requirements or procedures, the minimum QA/QC requirements for these sampling activities are as follows:

Control of Deviations

Any deviations from the planning documents must be fully documented in the field logbook. These deviations shall be sufficiently documented to identify the rationale for the deviation and to allow repetition of the activity as actually performed.

Quality Control Samples

The number and type of QC samples, including duplicate samples, matrix spike/matrix spike duplicate, field blanks, equipment rinsate blanks, and trip blanks will be collected and prepared in accordance with the planning documents and procedures.

QC sample frequencies/requirements will vary dependent on the specific analytical method. Sufficient planning must be made to ensure that the quality requirements are met on a per method basis.

Verification

Verification activities are required for the above activities and include surveillances and periodic record audits. These activities are determined by TechLaw Quality Assurance Director on a project by project basis. All surveillances and record audits will be documented and become part of the completed project records.

Comments/Notes

DPT sampling systems are not designed for the collection of large sample volumes. This can impact the number and type of analytical parameters collected for during a sampling effort. Dependent upon the type of soils, recovery rates can vary greatly. Aquifer characteristics can also have a tremendous impact on the volume of water that can be retrieved. Depending on the sample depths, sample volumes, experience of personnel, geologic and hydrogeologic conditions and analytical parameters, a typical number of samples which can be collected per day of effort ranges from six (6) to twelve (12).

Practical depths of application for DPT range from the surface to 50 feet below ground surface. However, sampling depths using DPT have been in excess of 100 feet below ground surface in unconsolidated, homogeneous sandy soils.

Prior to conducting DPT activities it is imperative that underground utilities and structures be located on the ground surface with paint or flags. To ensure that all sample locations are clear of underground utilities and structures, all sample locations should be located prior to having the utility clearance completed and a representative of TechLaw should be present during the utility clearance.

Collection of groundwater samples to be analyzed for VOCs using a peristaltic pump is generally not recommended. Collect VOC samples using a stainless steel bailer first and then use the peristaltic pump to collect the remainder of the required sample volume. If a stainless steel bailer is not available, it is acceptable to collect VOC samples with a peristaltic pump by filling the tubing with water, turning the peristaltic pump off, removing the tubing from the push rods and filling the VOA vial from the bottom of the tubing taking care not to collect the water in the initial five feet of tubing (tubing closest to the pump). Repeat this process as necessary to fill the required glassware for the VOC analysis. This method is acceptable since the vacuum caused by the peristaltic pump is only presented to approximately the initial one or two feet of tubing and thus, the water beyond that point is not as subject to the disturbing effects of the vacuum.

References

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Transglobal Environmental Geochemistry, The Stratoprobe™ System, Direct Push Technology for Soil, Water and Soil Vapor Sampling, 1996.

Transglobal Environmental Geochemistry Rocky Mountain, Soil Gas/Vapor Sampling Using Retractable Soil Gas Point and Post-Run Tubing (PRT) Adapter With Collection, June 1998.

United States Environmental Protection Agency, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II, Available Sampling Methods, 2nd Edition, EPA-600/4-84-076, December 1984.

United States Environmental Protection Agency, Test Methods for Evaluating Solid Waste, SW-846, Nineteenth Edition., Office of Solid Waste and Emergency Response, Most Recent Version.

STANDARD OPERATING PROCEDURES
SURFACE WATER SAMPLING
AND ANALYSIS PROCEDURES

SOP Number: 08-02-00
Effective Date: 2/08/99

Technical Approval: _____ Date: 3/29/99

QA Management Approval _____ Date: 4/7/99

SOP Description

This Standard Operating Procedures (SOP) document establishes the procedures for collecting and preparing surface water samples for analysis, and should be used in conjunction with the surface water sampling and analysis plan (SAP), written in accordance with SOP 08-01-XX. The goal of this SOP is to ensure that standardized procedures will be used during surface water sample collection. Specific protocols for the collection of surface, or aqueous samples from a variety of media (e.g., streams, ponds, lakes, bogs) using a variety of collection methods (e.g., direct sample collection, transfer device, Kemmerer sampler or equivalent) are provided in the following sections of this SOP.

These sampling procedures should be reviewed in order to best select the proper sampling method, and be considered in association with necessary prepatory activities. These activities should be completed prior to the initiation of any field event, and are as follows: 1) laboratory support should be arranged, 2) permission from land owners and trustees should be obtained, if applicable, 3) a site reconnaissance should be performed to better determine and/or verify the appropriate sampling methodologies, if prescribed by the project, and 4) all site-specific sampling equipment, supplies, and instrumentation should be assembled and inspected. Such steps are best undertaken after certain site-specific planning documents, described in the following section, have been completed and approved.

General Procedures

Related SOPs

This SOP is to be used in conjunction with the other relevant or applicable SOPs found in the following SOP categories:

Section No.	Section Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures

04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures

Related Documentation

The following documentation should be used to assist in preparing for and conducting surface water sampling activities.

- Site-specific Sampling and Analysis Plan (SAP), prepared by the sampling team
- QAPjP, prepared by the sampling team
- Health and Safety Plan (HASP), prepared by the sampling team
- Site-specific regulatory documents describing sampling requirements such as permit conditions, consent orders, or related documents (if available)
- Site-specific environmental investigation reports and analytic data
- RFI Guidance Documents
- Media and activity-specific Standard Operating Procedures (SOPs).

At a minimum, the SAP, QAPjP and the relevant SOPs should be available on-site during the performance of the sampling activity.

Equipment and Apparatus

The equipment required will depend upon the type of surface water media to be sampled, site-specific conditions such as depth within the water column, and access restrictions. Equipment choice should take into account parameters for which the samples are being analyzed. One consideration would be to verify that the sampling equipment is constructed of an inert material to prevent the possibility of influencing sample results. Parameters that may be analyzed for include inorganic compounds (including mercury and cyanide), volatile organic compounds (VOC), and semi-volatile organic compounds (SVOC), as well as general water quality parameters such as total dissolved and total suspended solids, alkalinity, salinity, and pH. At a minimum, the following equipment should be available in the field when performing surface water sampling:

- Transfer devices, which include but are not limited to, stainless steel or glass beakers, and pond samplers.

- Sampling equipment such as Kemmerer samplers, Coliwasa samplers, Bacon Bombs, or equivalent.

- Water quality instruments capable of measuring temperature, pH and conductivity for all surface waters. A dissolved oxygen meter should also be used if the surface water media is expected to be stagnant or relatively non-turbulent. In addition, appropriate calibration standards and solutions should also be included.

- A full suite of the appropriate sample containers for each sampling location, with additional spare bottles for use as replacements or for field parameter assessment. Also include sample labels, custody seals and forms, pens, permanent markers, and sample preservation chemicals where needed.

- Appropriate personal protective equipment (PPE) as directed by the site-specific HASP, garbage bags for used PPE, and any necessary personal gear to aid in sampling such as hip or chest waders and water-proof boots.

- Equipment and supplies necessary for decontamination of sampling equipment and ancillary equipment (e.g., buckets, brushes, detergent, deionized or distilled water).

- Equipment and supplies necessary for preparing the samples for shipment to the laboratory (e.g., coolers, packing materials, ziplock bags, ice/ice substitute, tape, etc.). The samples must be shipped to the laboratory according to the procedures outlined in SOP 04-02-XX or SOP 04-03-XX.

- Miscellaneous items such as un-dyed nylon (not cotton) rope or string, measuring tape, plastic or visqueen sheeting, stopwatch, and most importantly, the field logbook in which to record all field activity details.

In addition, all appropriate equipment operating manuals, health and safety plans (HASP), sampling and analysis plans (SAP) and/or SOP's related to the field operation and field equipment to be used should be brought to the site.

Field Activities

Surface Water Sample Collection

Although titled Surface Water Sampling, this SOP provides procedures for collecting aqueous samples from both the surface and at depth, and from a number of open water sources such as streams, lakes, rivers, ponds, bogs, lagoons,and surface impoundments, using a variety of collection methods. Sample collection directly into the sample container is the preferred method, primarily because it has the least potential for disturbing the sample. Essentially, there are several questions that need to be answered before deciding on one particular method, including:

1. What type of sample will need to be collected (e.g., water or non-aqueous liquid)?

2. Is it possible to collect the sample from the shore, or will a boat or platform be needed?

3. Will any sub-surface samples need to be collected, if so, at what depth? Will samples from several discrete depths need to be collected?

4. Is it necessary to determine if phases or layers are present within the water column (if sampling a lagoon or surface impoundment)?

5. Will a grab or composite sample be collected?

The following subsections provide details necessary for proper surface water sample collection: (1) General Sampling Requirements, (2) Direct Sample Collection, (3) Sampling Using a Transfer Device (Stainless Steel Bucket or Scoop), and (4) Sampling with Kemmerer Sampler or equivalent. However, if a deviation is necessary due to changed/changing field conditions, the sampler must contact the client project manager (and regulatory authorities, as necessary) and obtain approval for the deviation prior to initiating sampling. This deviation must also be documented in the field logbook.

1. General Sampling Requirements: There are several requirements that will apply to surface water sampling, regardless of either the method of sample collection or surface water media involved. These requirements include:

- Samples will be collected in the following order (if analyte is applicable): VOCs, SVOCs, Pesticide/PCB's, Herbicides, Dioxin/Furans, TOX/TOC, Inorganics, Cyanide, Sulfides.

- As appropriate, QA/QC samples will be prepared in the following manner: (1) duplicate samples will be collected immediately after the primary environmental sample, for each analyte; (2) field blanks will be prepared upwind of the sampling site; (3) equipment blanks will be collected by pouring deionized water over/through the utilized sampling device (e.g., kemmerer sampler, bucket, scoop) unless all samples are collected directly into the sample containers and no sampling device is used, then equipment blanks are not applicable; and (4) if VOCs are a requested analyte, trip blanks will accompany each cooler of samples (for aqueous samples only).

- Surface water samples from non-flowing surface water media (e.g., lakes, ponds, bogs, or stagnant streams) will be collected from sampling locations in the order of the lowest magnitude of known or suspected contamination to the highest concentrations. For lotic aquatic conditions, (e.g. flowing in a specific direction such as rivers, streams, canals, or overland flow) samples will first be collected from downstream locations, then moving sampling activities upstream.

- When collecting both surface and sediment samples from the same location, collect the water samples first, or prior to disturbing the sediments which could mix into the water column to be sampled.

- Pertinant field water quality parameters should be documented at each sample location prior to sample collection, if appropriate. These measurements may include temperature, pH, turbidity, and dissolved oxygen levels. Such parameters can indicate if stratification within the water column exists and help in the selection of sampling locations and depths. Dissolved oxygen levels are usually measured for low flow conditions only, when there is little mixing and aeration within the water column, and help determine conditions for supporting aquatic life (see SOP 05-08-XX, for details for the dissolved oxygen meter).

- Document all sample locations so that it is possible to return to and identify sample sites in the future. This may be done by photographing unique nearby landmarks with the sample location in conjunction with either noting the distance to the location from two nearby fixed points (such as a utility pole or fence post),

or using a hand held Global Positioning System (GPS) unit that can determine the coordinates with a built-in error of about +/- 100 feet.

- If possible, all site equipment, including measurement instruments, sample containers, and sampling devices, should be staged on a clean plastic sheet in order to reduce chances of cross contamination.

- All sampling and ancillary equipment must be decontaminated before initiating use and between each subsequent use using the procedures outlined in SOP 02-03-XX.

2. Direct Sample Collection: Surface water samples may be collected directly into the appropriate sample containers in areas where access restrictions or flow (e.g., slow-moving stream, shallow pond, lake or bog) allow, and when samples are collected at or close to the air/water interface. Circumstances such as fast moving and/or very shallow streams, steep slopes, deep water, or excessive vegetation, may prevent the direct collection of a sample into the container. These circumstances may require the collection of the surface water sample through the use of a stainless steel bucket and/or scoop or Kemmerer sampler, as outlined in the following sections. In addition, this procedure should not be used if samples are to be collected at depths deeper than six inches from the surface, or from shallower depths if a surface sheen is present, or when sample preservatives have already been added to the container. The procedures for direct sample collection are:

- Get close to the sample collection point by either entering the water body and wading to the designated location, or by positioning yourself in the appropriate on-shore area near the sampling location(s). If entering a stream, approach the sample location from the downstream direction (e.g., go against the current) and use care to minimize the disturbance of sediments in the sample location.

- Collect a water sample for measuring field parameters by submerging a sample container or beaker into the water below the surface until it is full. Remove the container from the water body and evaluate the field parameters in accordance with the SOPs 05-XX-XX series (e.g., pH, conductivity, dissolved oxygen, temperature).

- If applicable, prepare the field blank prior to initiating sampling and leave the field blank upwind of the surface water sampling site until sampling is complete.

- Collect the surface water samples requested for analysis by submerging the appropriate sample container(s) into the water body below the surface of the water until the desired volume is obtained. The container opening should be facing upstream (if applicable) and should be gently lowered at an angle (with the mouth oriented toward the top) to a few inches below the surface of the water. If samples are required to be collected below the air/water interface, the container can be lowered below the surface with the lid firmly in place, then slowly removed and the container allowed to fill, and firmly capped while submerged.

- Samples collected for VOC analysis should always be collected first, as mentioned above, and filled completely to eliminate air bubbles within the sample. The meniscus should extend above the lip of the vial prior to capping in order reduce the possibility of air bubbles.

- Repeat the sample collection procedures for all appropriate sample containers. If a duplicate sample is to be collected, the duplicate sample container is to be filled immediately after the primary sample container is filled. Identical sample containers and procedures must be used when collecting duplicate samples.

- Upon completion of all sample collection, preservatives are added as appropriate, sampling containers are sealed tightly, and all containers should be affixed with a completed sample label or sample tag, see SOP 02-05-XX. Samples should then be placed in a cooler maintained at 4°C. Repeat this procedure if a duplicate sample is collected.

- All remaining QA/QC samples may be prepared after all samples are collected. The field blank (if applicable) should be prepared for shipment and laboratory prepared VOC vials (i.e., Trip blank - if applicable) should be included in the cooler if VOC samples are collected.

- After completing the tasks above, the samples should be handled in accordance with the procedures outlined in Sample Handling section of this SOP.

3. Sampling Using Transfer Devices (Stainless Steel Bucket, Dip Sampler, or Scoop): If the sampler is not able to directly collect the samples from the surface water body, the shore of the surface water body, or from a boat or structure over the surface water body, then a transfer device constructed of an inert material, should be used. Inert, or non-reactive, materials usually include glass, stainless steel or Teflon. Material choice

will depend upon parameters to be analyzed for. Such devices can include but are not limited to, buckets, bailers, scoops, or a dip sampler which, general speaking, is a beaker attached to a varaible length handle. A volume of water can be collected, then transferred to the appropriate sampling containers. In some instances a peristaltic pump may be used; however, these devices, usually used for well sampling, are bulky and not often used for surface water sampling. The procedures for surface water sample collection with a bucket, dip, or scoop are:

- Access the desired sample collection point by boat, platform, bridge, or other available means. Since this procedure is likely to disturb the surface water and/or sediment, sample collection should be performed to minimize the impact on future samples. The device should be carefully submerged into the water facing upstream and allowed to fill slowly. Collect samples downstream first, then work upstream.

- If applicable, collect a water sample for field parameters testing in accordance with the SOP 05-XX-XX series (e.g., pH, conductivity, dissolved oxygen, temperature). Use care in retrieving the bucket from the water as it will likely be heavy and awkward.

- Collect the surface water samples requested for analysis by submerging the device into the surface water, removing the device, and filling the appropriate sample container(s) until the desired volume is obtained.

- If VOCs are a desired analyte, then collect the sample directly into the container if possible; otherwise, the VOC sample MUST be the first sample collected from the device. It is critical that these samples be disturbed as little as possible during collection. Therefore, when collecting for VOC analysis, pour the liquid slowly and evenly down the sides within the vial to reduce aeration. Allow the meniscus to extend over the lip before capping the vial.

- If applicable, prepare the field blank prior to initiating sampling and leave the field blank upwind of the surface water sampling site until sampling is complete.

- Repeat the sample collection procedures for all appropriate sample containers. If a duplicate sample is to be collected, the appropriate duplicate sample container is to be filled immediately after the primary sample container is filled. Identical

sample containers and procedures must be used when collecting duplicate samples.

- Upon completion of all sample collection, preservatives are added as appropriate (if not already added to containers prior to collection), sampling containers are sealed tightly, and all containers should be affixed with a completed sample label or sample tag. Samples should then be placed in a cooler maintained at 4°C. Repeat this procedure if a duplicate sample is collected.

- All remaining QA/QC samples may be completed at this point. The field blank (if applicable) should be prepared for shipment and laboratory prepared VOC vials (i.e., Trip blank - if applicable) should be included in the cooler if samples for VOCs analysis were collected.

- After completing the tasks above, the samples should be handled in accordance with the procedures outlined in Sample Handling section of this SOP.

- Decontamination should be performed using the procedures outlined in SOP 02-03-XX. As necessary, collect an equipment (rinsate) blank by pouring deionized/organic free water into the device and transfer the water from the device into the appropriate sample containers. Prepare this sample for shipment using the procedures listed above.

4. Sampling with Kemmerer Sampler (or Equivalent): If surface water samples are to be collected from a discrete interval within the surface water body, a Kemmerer sampler (or equivalent) can be used. Equivalent samplers also include the Bacon Bomb and Van Dorn sampler. These devices generally are comprised of a container assembly which is open on both ends and is submerged below the water surface to a specific depth. The sampler has spring loaded rubber stoppers at each end. When the sampler reaches the desired depth, a weighted messenger is sent down the line to trigger the sampler to close. The resulting water is used to fill sample containers and the process is repeated as necessary. The Coliwassa, or drum sampler, may also be used. The procedures for sampling with a Kemmerer sampler or equivalent are:

- Access the surface water body by boat, bridge, platform, or other available means and position yourself in the appropriate sampling location. If a sample from a discrete interval is desired, use care in submerging the sampler to minimize disturbance of the water or sediments.

- If applicable, prepare the field blank prior to initiating sampling and leave the field blank upwind of the surface water sampling site until sampling is complete.

- Measure the depths of the water in the desired sampling area to indicate whether there is sufficient water to collect a sample and/or sufficient water to collect a sample from a specific (desired) depth.

- Following the manufacturer's specifications, lock the sampler in the open position, attach to a rope or cable marked with graduated depth intervals, then lower and submerge the Kemmerer sampler (or equivalent) to the desired depth. Attach the weighted messenger to the line holding the sampler and release. The messenger will travel down the line and trigger the spring closure mechanism on the sampler, causing the rubber stoppers to spring closed. When the sampler is full, remove the sampler from the water and drain the contents into the sample container (bottle, beaker, etc.) for field parameters testing in accordance with the SOPs 05-XX-XX series (e.g., pH, conductivity, dissolved oxygen, temperature).

- Collect the surface water samples by repeating the step above. When the sampler is full, remove the sampler from the water and drain the contents into the appropriate sample container for laboratory analysis. Repeat this procedure, as necessary, to fill all applicable sample containers.

- Repeat the sample collection procedures for all appropriate sample containers. If a duplicate sample is to be collected, the appropriate duplicate sample container is to be filled immediately after the primary sample container is filled. Identical sample containers and procedures must be used when collecting duplicate samples.

- Upon completion of all sample collection, preservatives are added as appropriate (if not already added to containers prior to collection), sampling containers are sealed tightly, and all containers should be affixed with a completed sample label or sample tag. Samples should then be placed in a cooler maintained at 4°C. Repeat this procedure if a duplicate sample is collected.

- All applicable QA/QC samples may be completed at this point. The field blank (if applicable) should be prepared for shipment and laboratory prepared VOC vials (i.e., Trip blank - if applicable) should be included in the cooler if samples were collected for VOC analysis.

- After completing the tasks above, the samples should be handled in accordance with the procedures outlined in Sample Handling section of this SOP.

- Decontamination should be performed using the procedures outlined in SOP 02-03-XX. As necessary, collect an equipment (rinsate) blank by pouring deionized/organic free water into the Kemmerer sampler (or equivalent) and transferring the water from the sampler into the appropriate sample containers. Prepare this sample for shipment using the procedures listed above.

Sample Handling

The following sample handling requirements will be adhered to during the course of the sampling activity and following the collection of surface water samples. Much of the requested information should already be documented in the field logbook.

Chain-of-custody: The standard chain-of-custody (COC) form(s) must be completed for each sampling event or each sample shipping container sent out. All samples collected (i.e., each container) must be represented on the COCs. The COC(s) must be completed according to the procedures outlined in SOP 02-05-XX.

Sample Labels and Sample Tags: Sample labels must be completed for each sample container collected. Sample tags may be used, depending upon the specific client or governmental requirements in effect in the state or region where sampling occurs. Sample labels and sample tags (if applicable) must include the following information: sample identification; date and time of collection; sampling personnel; analytes requested; preservatives (yes/no); sampling location; and type of sample (grab vs. composite).

Sample Packaging and Shipment: The samples must be packaged and shipped in accordance with SOPs 04-XX (Packaging and Shipping Procedures Series). A completed and released (signed and dated) COC must accompany each shipping container.

Decontamination Procedures and Waste Management

All equipment used in the collection of surface water samples must be decontaminated after use following the procedures outlined in SOP 02-03-XX. Any wastes resulting from this decontamination and wastes generated during the performance of the surface water sampling must be collected and handled according to the procedures in SOP 02-04-XX.

Documentation and Records

A permanent record must be maintained for all sampling activities. Usually, this permanent record is the field logbook; however, other documents may be utilized on an as-needed basis. Field documentation for surface water sampling activities is also required where personnel are conducting field oversight of other contractors on behalf of either the client, the EPA or other state agencies. Photographs should also be taken to document the surface water sampling and associated activities. The record/logbook must include, but not be limited to, the following items:

- Time and date of sampling activities;
- General weather conditions at the time of sampling;
- Personnel performing the sampling activities;
- Photograph details (number, date, time, direction, significance of photograph)
- Sampling site identification, type and location;
- General condition of the site and surrounding area;
- Site and surface water body conditions including: water condition, flow patterns and approximate velocity (i.e., slow, moderate, fast, very fast, etc.), obstructions, depth of water;
- Sample collection procedures and equipment;
- Date and time of collection;
- Sample collection sequence (i.e., VOCs, SVOCs, etc.);
- Type of sample containers used and sample identification numbers;
- Sample preservatives used;
- Whether pH of samples were checked to ensure proper preservation;
- Parameters requested for analysis;
- Whether samples were stored on ice after collection;
- Sample packaging and Chain-Of-Custody procedures;
- Shipping papers (e.g., Federal Express or DOT label);
- QA/QC samples collected/prepared (e.g., equipment rinsates, trip blanks, duplicates, laboratory spikes);

- Whether split samples were collected (e.g., for the facility, EPA, or state agencies);
- Identification of any equipment placed on the ground where it could become contaminated prior to use;
- Any field decontamination procedures used;
- Disposition of field decontamination solutions;
- Field observations of sampling event;
- Any deviations from the sampling and analysis plan (e.g., deviations in the type of equipment used, cleaning procedures, packaging and shipping procedures, and sample collection/preservation/handling procedures);
- Any deviations from the health and safety plan; and
- All equipment calibration and maintenance performed in the field, including improper cleaning of nondedicated sampling equipment.

Contamination Control

Sampling tools, instruments, and equipment must be protected from sources of contamination prior to their use. In addition, sample containers must be protected from sources of contamination. Sampling personnel are to wear chemical-resistant gloves when using instrumentation and handling any samples. Gloves will be decontaminated or disposed between samples.

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with the EPA, DOE, and OSHA established standards and requirements. All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include steel-toed shoes, safety glasses, and chemical-resistant gloves. If the surface water sampling is likely to occur from a boat or potentially precarious position, the samplers will be outfitted with life preservers and/or safety lines as discussed in the site-specific HASP.

A site-specific health and safety plan must be developed in accordance with procedures in SOP 09-02-XX by the Field Team Leader or designee and approved by the TechLaw Health and Safety Director prior to implementation in the field. This plan must be reviewed prior to beginning work.

Field QA/QC

This section provides detailed field QA/QC procedures to ensure the acquisition of accurate and reliable data throughout the sample collection activities. The QAPjP addresses this information and should be referenced where appropriate.

- **Equipment Calibration:** All field equipment (i.e., pH, conductivity, temperature, dissolved oxygen, etc. meters) will be operated and calibrated in accordance with the manufacturer's operating instructions, prior to daily use. The QAPjP and all appropriate SOPs will be used to ensure correct operation and calibration of field equipment. Thereafter, the meters will be checked periodically against the appropriate standards to ensure accuracy. See SOP series 05-XX-XX Field Equipment Operation and Maintenance Procedures.

- **Quality Control Sample Collection:** The collection of QC samples is required during the sampling event and specific requirements are outlined in the SAP. QC samples include duplicate samples, trip blanks, field blanks, equipment blanks, and Matrix Spike/Matrix Spike Duplicate (if applicable) samples. These QC samples will be collected as appropriate in accordance with the site-specific QAPjP.

- **Control of Deviations:** When feasible, any departure(s) from specified requirements will be justified and authorized by the field team leader prior to deviating from the requirements. Deviations will be sufficiently documented in the field logbook to allow repetition of the activity as performed. For site or region-specific activities, the generic QAPjP provides specific procedures for corrective actions that will be adhered to.

Attachments

None at this time.

Comments and Notes

Wastes generated from this procedure must be handled in accordance to Field Procedures - Management of Investigation Derived Waste No. 02-05-XX. The various field parameter meters must be accompanied in the field by the complete instruction and operation manuals.

References

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U.S. Environmental Protection Agency, Interim Final, RCRA Facility Investigation (RFI) Guidance, Volume III of IV, May, 1989.