



UTAH DEPARTMENT *of*
ENVIRONMENTAL QUALITY

**ENVIRONMENTAL RESPONSE
& REMEDIATION**

Utah
Petroleum Storage Tank
Environmental Media
Sampling Handbook

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Terms and Definitions

Terms used in this document are defined in UAC R311-200 and in Section 19-6-402. Document specific terms and definitions are listed below:

- **COC** – Contaminants of Concern
- **DAQ** – Division of Air Quality
- **DERR** – Division of Environmental Response and Remediation
- **DOT** – Department of Transportation
- **FID** – Flame Ionization Detector
- **Field blank** – Any sample submitted from the field identified as a blank
- **Grab sample** – A single sample of soil or water taken without regard to time and flow and not combined with other samples
- **HASP** – Health and Safety Plan
- **Headspace** – the vapor mixture trapped above a solid or liquid in a sealed vessel
- **HS** – Hazardous Substance
- **ISL** – Initial Screening Levels
- **LEL** – Lower Explosive Limit
- **LUST** – Leaking Underground Storage Tank
- **MBTEXN** – MTBE, Benzene, Toluene, Ethylbenzene, Xylenes, Naphthalene
- **MCL** – Maximum Contaminant Level (Utah Admin. Code R311-211). A standard for drinking water established by the EPA under the Safe Drinking Water Act. The MCL is the maximum permissible level of a COC in water, which is used as a drinking water supply. MCLs are recognized statewide by the Divisions of Water Quality, Waste Management and Radiation Control, Drinking Water, and Environmental Response and Remediation
- **MTBE** – Methyl Tertiary-Butyl Ether
- **NAPL** – Non-Aqueous Phase Liquid. Also known as product, free product, floaters. This is free floating product on the water surface
- **NELAP** – National Environmental Laboratory Accreditation Program
- **O&G** - Oil and Grease
- **OVM** – Organic Vapor Monitor
- **PID** – Photoionization Detector
- **PPE** – Personal Protective Equipment
- **QA/QC** – Quality Assurance/Quality Control
- **Release** - means any spilling, leaking, discharging or disposing of regulated substance into surface waters, groundwater or soil
- **SCBA** – Self-Contained Breathing Apparatus
- **SSCL** – Site Specific Clean-up levels
- **SVE** – Soil Vapor Extraction
- **SVOC** – Semi-Volatile Organic Compound
- **Tier 1 SL** – Tier 1 Screening Level
- **TOC** – Total Organic Carbon
- **TOX** – Total Organic Halides
- **TPH** - Total Petroleum Hydrocarbons

- **TRPH** - Total Recoverable Petroleum Hydrocarbons
- **Trip blank** - a sample prepared by the lab or sampler prior to the field work using actual containers that are kept with the investigative samples throughout the event. They are packaged for shipment with the other samples and sent for analysis.
- **USC** - Unified Soil Classification means soil samples evaluated for soil type in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils or DERR USC guidelines which allow any geotechnical method that defines soil types
- **UST** – Underground Storage Tank **Vadose zone** - the zone between land surface and the water table within which the moisture content is less than saturation (except in the capillary fringe) and pressure is less than atmospheric. Soil pore spaces also typically contain air or other gases. The capillary fringe is included in the vadose zone
- **VOC** - Volatile Organic Compounds

Rules and Regulations

40CFR 280 – Federal Regulation that pertains to Underground Storage Tanks (USTs) UAC
R311 - Utah rules that describe how the Division of Environmental Response and Remediation (DERR) administers the UST program UCA19-6-401-429 - Utah UST Act

What are USTs?

An UST is a tank system, including piping connected to the tank, that has at least 10 percent of its volume underground. Federal and state regulations apply only to those USTs containing petroleum products or certain hazardous chemicals.

USTs that are not regulated by the DERR:

- Farm or residential tanks 1,100 gallons or less, used non-commercially.
- Tanks storing heating oil used on the premises.
- Flow-through process tanks.
- Emergency spill and overflow tanks.
- Tanks holding 110 gallons or less.
- Tanks containing hazardous waste.

Certification Requirements

Any person conducting environmental media sampling to determine levels of contamination which may have occurred from regulated USTs must be certified by the DERR (R311-201).

Training

Training topics must include:

- Chain of custody.
- Decontamination.
- U.S. Environmental Protection Agency (EPA) testing methods.
- Groundwater, soil, and air sampling protocols.
- Preservation of samples during transportation.
- Coordination with National Environmental Laboratory Accreditation Program (NELAP) certified labs.
- State and Federal statutes, rules, and regulations.

Examination

An applicant must successfully pass a certification examination. Examinations are given at the DERR office.

Fees

All applicable fees must be paid prior to certification.

Initial Certification Requirements:

- Application and fees.
Proof of training.
- Proof of citizenship.
- Pass the certification examination.

Renewal Requirements:

- Renew every 2 years.
- Application and fees.
- Pass the certification examination.

Reciprocity

If the Division Director determines that another state's certification program is equivalent to the certification program provided in R31-201, they may issue a Utah certification. The application, certification fees, and citizenship requirements still apply.

Certified Sampler Standards of Performance

The certified sampler:

- Must display the certificate upon request.
- Must comply with all local, state and federal laws and regulations regarding USTs.
- Must report the discovery of any release caused by or encountered in the course of Performing tank handling to the local health district, local public safety office and the DERR within twenty-four hours.
- Must not participate in fraudulent, unethical, deceitful or dishonest activity with respect to USTs.
- Must not participate in any other regulated certification program activities without meeting all requirements of that certification program.

NOTE: For violations of the standards of performance as outlined in R311-201 a sampler could be fined civil penalties of up to \$10,000 per violation per day. See R311-201-6.

Introduction to Environmental Sampling

The primary goal of the UST Branch sampling program is the identification and quantification of Hazardous Substance (HS) or petroleum compounds and derivatives from regulated tanks. Proper quantification of these regulated substances is necessary to identify leaking tanks and the release of HS or petroleum compounds that may threaten human health and the environment.

Sampling for regulated substances may be necessary in a variety of media. Water sampling, including groundwater and surface water, and soil sampling will account for most of the sampling to be conducted. As conditions exist, environmental sampling may also need to be conducted in other matrices which include air, sludge, and free product.

Proper sampling protocol requires all sampling to be conducted by a certified sampler and a chain-of-custody to be maintained from sample collection to final analysis. Sample locations may vary depending on intended use of data. Sample locations associated with tank closure are dictated by the State Site Assessment Protocol found in R311-205-2 (<https://rules.utah.gov/publicat/code/r311/r311-205.htm>). The DERR project manager should be consulted in the location of samples for subsurface investigations and for confirmation samples associated with corrective action.

Parameters for which each sample will be analyzed depend upon the individual project objectives. A number of analytical parameters may be necessary to evaluate different sources of contamination to meet the UST program objectives. These parameters include analysis for petroleum products or petroleum derivatives, HS compounds defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), (Section 101(14)) and any known intermediate breakdown of products or compounds above. It may also be necessary to measure Total Organic Halides (TOX), Total Organic Carbon (TOC), Oil and Grease (O&G), and any other waste analysis as determined by permitted treatment and disposal facilities.

This document is only provided as a condensed summary of protocols and procedures and is not meant to replace any other applicable state or federal rule, regulation, or safety practice commonly used by the environmental industry or regulatory agencies.

Quality Assurance/ Quality Control (QA/QC)

The objective of QA/QC in sampling is to produce data that is accurate, representative, credible, and defensible in a court of law. Proper QA/QC includes, as applicable:

- Duplicates.
- Blanks.
- Split samples.

- Sampling must be conducted in a manner that minimizes loss of volatile organic compounds.
- Samples should have zero headspace.
- Samples should be preserved at 4°C (39.2°F) immediately after sampling and maintained
- At that temperature until received by the lab.

Proper QA/QC for the specific environmental media sampled is addressed in the following protocols. See Appendix A and Appendix B for additional information.

Chain-of-Custody

The chain-of-custody form is used to track the possession of a sample from the time it is collected until the time it is analyzed. The individual in custody of the sample must remain in direct control of its security until it is released to the next chain-of-custody recipient or to the analytical laboratory. The chain-of-custody form must include:

- Sample identification number.
- Date and time of collection.
- Place of collection (borehole, well number, etc.).
- Type of material (soil, water, air, etc.).
- Sample container type (VOA vial, 1-liter bottle, etc.).
- Preservation method (acidified, cooled, etc.).
- Signature and printed name and company of the sample collector.
- Signatures and printed names and dates/times of persons involved in the transportation and handling of the sample.

UST Closure Protocol

Introduction

There are two types of UST closures: temporary or permanent. All regulated USTs must meet state and federal regulations or must be permanently closed. Regulated USTs that meet state and federal regulations may be temporarily closed for periods when the tanks are not in operation.

Temporary Closure

There are typically two reasons for temporarily closing a UST; seasonal closures, and circumstances when a tank will be out of use for a period of time less than a year (the time limit imposed by fire code). Seasonal temporary closures occur in settings like resorts or marinas where weather or economics prohibit their use for some period during each year. In the other scenario, USTs are not in operation but are expected to return to service or permanently closed.

Temporary closures less than three months, owners must:

- operate and maintain cathodic protection (if any); and,
- perform leak detection or empty the tank to less than one inch of product.

Temporary closures three months or more, owners must:

- operate and maintain cathodic protection (if any);
- perform leak detection or empty the tank to less than one inch of product;
- submit a Temporary Closure Notice;
- leave vent lines open but cap and secure all other lines, pumps, manways and ancillary equipment; and,
- fire codes may limit temporary closure to one year.

Permanent Closure

Regulated USTs that do not meet state and federal regulations must be permanently closed. Permanent closure entails either the removal of the UST from the ground or closure in place. Closure in place must be approved by the local fire department and the DEQ. To properly close an UST in Utah, an owner must:

- Use a Utah Certified Remover;
- File a Closure Plan at least 30 days prior to closure activities and obtain approval from the DERR;
- Notify the local fire department, local health department, and the DEQ 72 hours prior to closing the tank;
- Close the tank either by removing it or by filling it with an inert substance, like sand or cement slurry;

- Have a certified sampler collect the necessary environmental samples and have the samples analyzed at a NELAP certified laboratory;
- If contamination is present, notify the DEQ within 24 hours; and,
- In the case of in-place closures, meet the requirements of the Division of Waste Management and Radiation Control (DWMRC) by placing a notice on the title of the property.

Closure Plan

A completed Closure Plan must be submitted by the Owner/Operator and approved by the director before commencing closure of the UST. A contractor may prepare the Closure Plan; however, the Owner/Operator is responsible for compliance with all rules and regulations. Changes to an approved plan must be submitted in writing to the DERR and approved before closing the UST. A copy of the approved Closure Plan must be on-site during closure activities. Once approved, the Closure Plan is valid for one year.

Closure Notice

Within 90 days of closing the UST, the Owner/Operator must submit the following:

- completed Closure Notice signed by the Owner/Operator and the certified sampler;
- site plat;
- analytical results of all samples; and,
- chain-of-custody form, which tracks the samples from the time they were collected until they were delivered to the laboratory.

The closure notice site plat **MUST** include:

- excavations, test pits, groundwater monitoring wells, soil stockpiles, sample locations, and collection depths;
- buildings, fences, property boundaries or other adjacent structures, and type of ground cover such as dirt, grass, gravel, asphalt, concrete, etc;
- information regarding land use around the site, such as residential, industrial or commercial;
- a north arrow and scale, the location of utilities conduits and exposure pathways such as sewers, storm drains, water lines, gas lines, etc; and,
- UST system including tanks, lines, dispensers, etc.

NOTE: Submit the Closure Notice with the sample analytical results within 90 days of closure.

Sampling at UST Closures

The appropriate number of environmental samples must be collected in native soil, below the backfill material and close to the tank, piping, or dispenser islands. Soil samples must be collected from a depth of zero to two feet below the backfill and native soil interface. If groundwater is encountered, soil samples must be collected from the unsaturated zone immediately above the capillary fringe. All environmental samples must be analyzed using the appropriate methods as provided by the DERR. Additional samples must be taken when contamination is found, suspected, or as requested by the DERR.

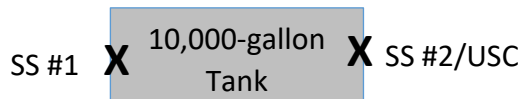
Unified Soil Classification (USC) Samples

USC samples must be analyzed according to ASTM D2488 Standard Practice for Description and Identification of Soils, and the DERR USC guidelines which include any geotechnical method which defines soil types. One USC sample must be collected at the same depth as environmental samples at each tank and piping area. For all dispenser islands, only one USC is required

Single Tank Excavation

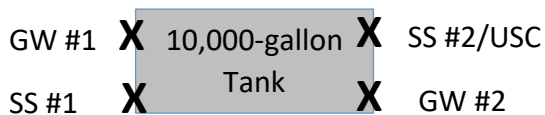
For an excavation containing one UST:

- collect one soil environmental sample at each end of the tank; and,
- collect one USC sample.



If groundwater is contacted during the process of collecting soil samples:

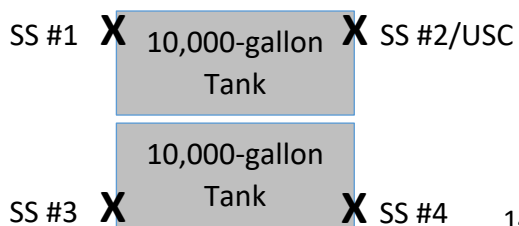
- collect a minimum of one groundwater at each end of the tank in addition to the soil samples.



Multiple Tank Excavation

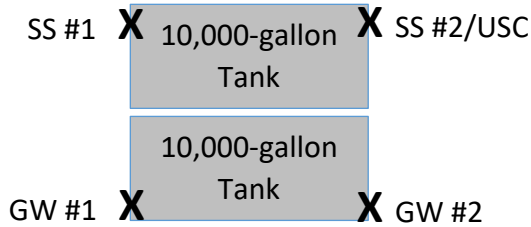
For a tank area containing more than one UST:

- collect one soil sample at each corner of the tank excavation; and,
- collect one USC sample.



If groundwater is contacted during the process of collection soil samples:

- collect two groundwater samples and two soil samples at the end of the tank excavation; and,
- collect one USC sample at the same depth as environmental samples.



Piping

Collect samples at each product piping area, at locations where leaking is most likely to occur, such as joints, connections, and fittings. Samples must be collected at intervals which do not allow more than 50 feet of linear piping to go unsampled. If groundwater is encountered, collect a minimum of one groundwater sample and one soil sample from each sampling area. Collect one USC sample at the same depth as environmental samples.

Dispensers

Collect environmental samples from the middle of each dispenser island. Must be collected at intervals which do not allow more than 25 linear feet to go unsampled. If groundwater is encountered, collect a minimum of one soil sample and one water sample at each dispenser island. Only one USC sample is required for all the dispenser islands, collected at the same depth as environmental samples.

Soil Sampling Protocol

Introduction

Investigations at tank sites usually require chemical and physical analyses of soil samples that are collected at the sites. The data obtained serve as the basis for decisions regarding impacts to soil and potential drinking water supplies, and assessing actual and potential impacts to human health and the environment. Data obtained from soil samples at tank sites must, to the greatest extent possible, be accurate and representative of site conditions.

Soil sample types includes: grab, composite, tank closure, cleanup confirmation, and QA/QC (duplicate, split, blank, etc.). Typical sampling features include the following: excavations, test pits, soil borings, land farms, and stockpiles. Additional samples may be requested by the DERR project manager.

Field Screening

Field screening is generally conducted using a headspace analysis. To conduct headspace analysis, place a sample of soil in a plastic zip bag and allow the soil gas to volatilize.

NOTE: Headspace soil is not to be used for laboratory analytical samples.

Consider the following for field instruments:

- readings of a photoionization detector (PID), organic vapor monitor (OVM), or flame ionization detector (FID) should not be used to replace laboratory analytical results;
- PID/OVM/FID should be calibrated against a standard calibration gas before each use;
- a filter may be used with PID/OVM/FID when the soil moisture is high and/or the readings are hard to stabilize;
- readings measured at different depths of a soil boring should be recorded in the soil boring log; and,
- PID used for hydrocarbons should have a lamp voltage of 10.6 ev.

Field screening is a useful tool for determining sample locations, however, laboratory analytical samples should be placed in sampling containers within 30 seconds to 1 minute to avoid loss of analytes due to volatilization.

Subsurface Investigation Soil Sampling

Soil borings and/or monitoring wells are installed as part of the subsurface investigation at a leaking storage tank site to delineate the lateral and vertical extent of contamination. A decision on the locations and number of soil borings should be made in consultation with the DERR

project manager and should be determined based on site-specific information. If no contamination is evident in a boring, regardless of depth, a minimum of one soil sample should be collected. When contamination is suspected or evident in a boring, a minimum of one sample should be collected from above the impacted zone, from the impacted zone, and from below the impacted zone. Depending on site conditions, additional samples may be requested by the DERR project manager. If soil contamination is observed/registered (stains, odor, field instrumentation, etc.) at the bottom of a soil boring, the soil boring process should be continued until impacts are no longer evident and a “clean” soil sample is collected. The most common field instrumentation includes PID/OVM/FID. A sufficient number of soil samples from each boring should be analyzed to determine the vertical extent of contamination.

Corrective Action Confirmation Sampling

Confirmation samples are environmental samples that are collected to demonstrate that cleanup goals have been achieved after corrective action at the site is complete. The number and locations of samples should be determined in consultation with and approved by the DERR based on site-specific information.

When in-situ remediation is applied as a corrective action, the procedures of confirmation soil sampling are similar to those of subsurface investigation soil sampling. Multiple confirmation samples are to be collected in locations of known historic impacts.

If soil excavation is chosen as a corrective action option, at least one soil sample should be collected and analyzed from each sidewall and the bottom of an excavation pit after over excavation is complete.

Recommendations for confirmation sample collection include:

- sample intervals should not exceed 25 lateral feet;
- when contamination is suspected or evident, a minimum of one sample should be collected from above the impacted zone, from the impacted zone, and from below the impacted zone; and,
- samples should be taken from the location of the highest reading from a PID/OVM/FID.

NOTE: A sampling plan must be submitted with the corrective action plan. Additional samples may be requested by the DERR.

A backhoe can be used to collect samples from an excavation pit. During the sampling, the depth of sampling location should be measured and recorded. Soil samples should be collected away from the edges of the backhoe bucket to avoid cross contamination. A clean pair of nitrile gloves should be used for each sample.

Land Farm Sampling

Landfarming is frequently used to treat petroleum impacted soils on-site by enhancing volatilization and biodegradation. After a landfarming process is completed, confirmation soil sampling is needed to evaluate the effectiveness of the landfarming treatment. The general procedure of this type of soil sampling are summarized below:

1. Prepare a land farm map including a North arrow, a scale, and any relevant site landmarks.
2. Divide the land farm into a numbered grid
 - a. size of the grid and number of confirmation soil samples should be determined in consultation with the DERR project manager.
3. Randomly select the sections that need to be sampled.
4. Collect grab samples from these chosen sections and submit the samples to a lab for analysis.

Proper Waste Disposal

Soil waste associated with sampling activities is likely to come from drilling activities or direct-push sampling events. The waste associated with excessive material from a soil sampling device may contain petroleum contamination and must be disposed in a manner that satisfies federal, state, and local laws. Soil may be segregated into clean and contaminated based on field instrumentation readings or observations.

Facilities that accept petroleum affected soils do exist throughout the state, but many of them require a waste profile evaluation prior to acceptance at the facility. Other options for disposal include land farming the soil until properly aerated, and staging the soil on site or at an approved location prior to disposal or aerating. Applicable permits and approvals are necessary prior to implementation of any alternative cleanup plan.

Gallon steel drums may be used to store petroleum-contaminated soil. Drums should be properly labeled as either hazardous or non-hazardous. Materials in the drum, certified sampler's name and company, date and time of generation should be clearly marked on the label. The drums should be transported and properly disposed of at a certified facility in a timely manner. Applicable manifests must be submitted to the DERR.

Soil Sampling QA/QC

The objective of quality control and assurance in the field of environmental sampling is to obtain defensible data of known quality and origin. In regards to environmental sampling and maintaining quality assurance and data quality objectives, see Appendix A.

Sample collection must be conducted in a manner that minimizes the loss of volatile organic compounds:

- transfer soil samples to sample containers as soon as they are collected (avoid sample exposure to sunlight/air);
- separate soil vapor screening and sample collection to avoid Volatile Organic Carbon (VOC) loss during sampling e.g. as soon as a split spoon is open or a plastic sampling tube is cut, soil samples must be collected and transferred to a sampling container immediately;
- eliminate headspace in sample containers unless sampling method dictates otherwise;
- preserve samples at 4° Celsius (39.2° Fahrenheit) during storage and delivery; and,
- collected samples should be properly preserved and stored, and analyzed by the laboratory within applicable holding times.

NOTE: Laboratory analytical detection limits must be sufficiently low in order to detect contaminant concentrations at or below Utah Initial Screening Levels (ISLs), Utah Tier 1 Screening Levels (Tier 1 SLs), or EPA Maximum Contaminant Levels (MCL) as applicable (see Appendix E.)

Chain-of-Custody

In order for analytical results to be defensible, a chain-of-custody must be established for all samples collected. Chain-of-custody must demonstrate that samples have not been tampered with during collection, transfer, storage, or analysis. This requires custody of the samples to be documented from the time the samples are collected.

A sample is under custody if:

- it is in the person's possession;
- it is in the person's view, after being in the person's possession;
- it was in the person's possession and then it was locked up or placed in a sealed container to prevent tampering; or,
- it is in a designated secure area.

NOTE: The sample is in a person's custody until the sample has physically been relinquished and the chain-of-custody form has been signed by both parties.

Chain-of-custody documentation must be maintained and provided for all samples collected. The chain-of-custody must include:

- unique sample identification (number or name);
- date and time of collection;
- place of collection;
- type of material, sample container, and preservation;
- signature of the certified sampler; and,
- signature and dates of persons involved in the transportation and handling of the sample.

NOTE: All sample identifications, names and numbers must be consistent throughout the Chain-of-custody documentation, laboratory analytical results, site map, data tables, and the report text. The depth at which a soil sample is collected must be measured, labeled, and recorded. Sample locations should be shown on a properly scaled and oriented site map.

In addition, field sampling information should be maintained in facility files and in field log books which should contain all information pertinent to each sampling event. The information recorded by the certified sampler should include but not be limited to:

- date;
- site name and location;
- site description and photo documentation;
- name of certified sampler, certification number, and date of expiration;
- purpose of sampling;
- sample identification, types, location, depth, time, and facility identification numbers; and,
- field measurements including instrument model and calibration specifications.

Containers, Preservation, and Holding Times

When possible, environmental samples should be transported directly to the laboratory by the certified sampler or representative. When shipping is required, the environmental samples must be placed in a container acceptable to both the laboratory and the carrier. Dry ice should not be used when shipping water samples to prevent the samples from freezing and breaking the glass containers.

The certified sampler should contact a NELAP certified laboratory in advance of sampling to determine that the lab is capable of conducting the sample analysis within the specified holding time. See Appendix B for maximum holding times. Certified samplers should also verify the number of containers and volume of sample needed in order to achieve appropriate detection levels prior to conducting the field sampling. Each laboratory should specify their required containers for each specific method and should be willing to supply their own certified containers for sample collection.

Field Equipment Decontamination Procedures.

The following procedures shall be used, at a minimum, for all reusable sampling equipment used to collect routine samples:

1. Clean with tap water and phosphate-free laboratory detergent using a brush if necessary to remove particulate matter and surface films. Equipment may be cleaned by using a

phosphate-free laboratory detergent and high-pressure water rinse (high-pressure wash) as an alternative to brushing.

2. Rinse thoroughly with tap water.
3. Rinse thoroughly with isopropanol. Do not rinse PVC or plastic items with isopropanol.
4. Rinse thoroughly with deionized water.

The following procedures shall be used, at a minimum, for field measurement devices used to collect field data:

1. Wash with phosphate-free laboratory detergent and tap water.
2. Rinse with tap water.
3. Rinse with isopropanol.
4. Rinse with deionized water.

NOTE: Do not reuse disposable equipment.

Groundwater Sampling Protocol

Introduction

Groundwater samples are usually obtained from groundwater monitoring wells. They can also be obtained from anywhere groundwater is accessible, such as from a porewater sampler, a pit, or a dug or drilled hole. Groundwater samples are generally collected using bailers, pumps or a variety of no purge grab sample and passive diffusion devices. Certified consultants and the DERR project managers are responsible for choosing the most appropriate sampling method for a given sample location.

Groundwater sampling procedures can be divided into two general categories: purge and no purge methods.

Total Well Depth Measurement

An electronic water level indicator or weighted tape can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is resting on the bottom of the well. In deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well. Care must be taken in these situations to ensure accurate measurements. All total well depth measurements must be taken at the same reference point on the well casing during each sampling event and recorded to the nearest 0.01 foot.

Well Depth and Non-Aqueous Phase Liquids

Before sampling a monitoring well, the column of water in the well casing must be checked for the presence of nonaqueous phase liquids (NAPL), including free petroleum products that might be floating on top of the water or in a separate layer at the bottom of the casing. NAPL are identified by:

- carefully lowering a clean bailer, in a manner that will create minimum disturbance, into the well before purging and observing the liquids removed from the top and the bottom of the water column;
- using a paste type of detector with ingredients that will not lead to cross-contamination; or
- using an electronic device designed to detect NAPL and to measure the thickness of the NAPL layer.

NOTE: A photograph of the NAPL must be taken and provided in a report to the DERR.

Purging with Bailers

Monitoring wells must be purged before sampling unless otherwise approved by the DERR. Two general methods are used to purge monitoring wells before sampling: low flow/ low stress purging, where a well is purged at a low flow rate until physical and chemical parameters indicate that purge water is representative of conditions in the aquifer; and well volume purging, where a predetermined volume of water is removed prior to sampling.

NOTE: All purging methods can lead to over-purging if done incorrectly, so an awareness of drawdown and recharge rate during purging is important regardless of the technique that is employed. Over-purging may cause bias in sample laboratory analytical results. See overpurging section below.

Purge monitoring wells using the following procedure (or an equivalent):

1. Prior to handling any purging or sampling equipment, clean disposable nitrile gloves must be worn.
2. The depth of water, any NAPL, and the total well depth must be determined before purging. *NOTE: Groundwater samples shall not be collected from monitoring wells containing more than 0.01 feet of NAPL.*
3. Determine depth measurements using an electronic water level indicator or weighted tape.
 - a. all depth measurements must be made and recorded to the nearest 0.01 foot.
4. Prior to initiating the purge, the amount of water standing in the water column (water inside the well riser and screen) must be calculated.
 - a. the water level is subtracted from the total depth, providing the length of the water column
 - b. the volume of water to be purged can be determined using the equation:

$$V = (h)(x)$$

Where,

h = height of water column in feet (total well depth minus depth to water)

x = volume in gal/ft

V = volume of water in gallons

For 1-inch well: x = 0.041

For 2-inch well: x = 0.163

For 4-inch well: x = 0.652

5. For well volume purging, at least three well casing volumes of water must be removed from the well before sample collection; or
 - a. for low yield wells, until the well bore is evacuated.

6. For low flow purging, measure the purge water temperature, pH, and conductivity until these parameters are stable to within 10% variability between the last two measurements.
7. All purged water must be properly containerized or disposed.
8. Purge and sample from the farthest down gradient well to the most up gradient well or from the least contaminated well to the most contaminated well if previous sample results are available.
9. Record applicable information on DERR's "Field Data Information Sheet- Groundwater Sampling Log" (see Appendix D).

Groundwater Sampling with Bailers

1. After purging the well, allow sufficient time for the well to equilibrate and suspended solids to settle.
 - a. If full recovery exceeds two hours, samples must be extracted as soon as sufficient volume is available.
2. The water level must be remeasured after purging has occurred and water level has returned to at least 70% of the static level.
3. If *decontaminated* equipment is used to collect the water sample, the equipment must be rinsed with analyte-free distilled or deionized water.
 - a. a portion of this rinsate must be collected into a container appropriate for the most volatile analyte suspected (typically BTEX); this equipment blank must be contained, preserved, and analyzed according to the procedures outlined in this chapter for that analyte.
4. Reusable bailers must be made of glass, Teflon, stainless steel, or other suitable materials. Disposable bailers must be made of suitable materials for sampling VOCs/SVOCs.
5. Use new bailer line for each well sampled; wear clean disposable gloves when handling the bailer and line;
6. The bailer should be slowly lowered to minimize disturbance of the well and water column. NOTE: Do not allow the bailing line to contact with the outside of the well, ground surface, equipment, and clothing.
7. Obtain samples as close as possible to the water level/air interface, unless analysis indicates that contamination is at a different depth.
8. Slowly lift and transfer the contents of the bailer to a clean sample container with minimum disturbance and agitation to prevent loss of volatile compounds.
 - a. if different analytes are sampled, transfer samples to containers in the order of their volatility.
 - b. minimize headspace and bubbles in the sample container by filling the sample container until a positive meniscus is present.
9. Quickly and adequately seal sample containers.
10. Label all sample containers according to required information on chain-of-custody form.
 11. Immediately following sample collection, preserve samples to

4°C. This temperature must be maintained in the field and through delivery to the laboratory until analysis. *NOTE: Samples may not be accepted by the laboratory above this temperature.*

Purging with Sampling Pump

Pumps are used for purging and sampling when low flow techniques are required or when wells are too deep or contain volumes of water too great to be effectively sampled with bailers. Immediately following purging, samples must be collected using the techniques which are described below:

Peristaltic Pumps - When peristaltic pumps are used, only the intake tubing is placed into the water column.

1. Sample tubing should be lowered until it is midway within the saturated portion of the screened interval of the well, but at least two feet above the bottom of the well to avoid agitating any particulates present at the bottom of the well.
2. When purging is complete, the downhole tubing should be filled and disconnected from the flexible pump tubing.
3. After donning a new nitrile glove, the certified sampler should place a finger over the tubing, which is removed from the well.
4. Water is then poured from the tubing into the sample containers with minimal contact with air entrained in the tubing.
5. Do not collect samples directly from the silicone tubing attached to the pump's rotor.

Submersible Pumps - Several types of submersible pumps are commonly used for groundwater purging and sampling, including bladder pumps, piston pumps and gear driven pumps. After purging has been accomplished with a submersible pump, the sample may be obtained directly from the pump discharge or with a bailer. The discharge rate of the pump must be minimized during sampling to diminish sampling disturbance. This is especially important for the collection of VOC and metals samples.

Over-Purging

Even when purge rates are minimized, a well may be pumped or bailed until it is effectively dewatered or dry. In these situations, dewatering constitutes the effective limit of purging. If a well is over-purged, it may result in the sample being comprised partially of water contained in the sand pack, which is not representative of groundwater in the soil. In addition, as water re-enters the well, it may cascade down the sand pack or the well screen, leading to the removal of volatile organic constituents that may be present. It is important to evaluate drawdown during purging to ensure that wells are not dewatered, and the resulting samples compromised.

NOTE: For wells that are dewatered, it is not necessary that the well be bailed dry additional times before sampling. The well should be allowed to equilibrate for at least two hours or until the water level has reached 75% of its level prior to purging before sampling. Resampling may be required if the well is sampled before it reaches at least 75% recovery. All associated QA/QC sampling must also be collected. If resampling is required, the costs related to the resampling may not be reimbursable from the Petroleum Storage Tank Trust (PST) Fund. Options for sampling wells that do not meet recharge requirements should be discussed with the DERR project manager.

If it appears that a well is being over-purged, i.e. the groundwater table has been drawn down more than a foot when it is within the screened interval, it may be preferable for a sample to be collected after the well is allowed to recharge without additional purging. The DERR project manager should be notified when poor recharge in monitoring wells may affect the quality of groundwater data. Approximate recharge rates, final depth to groundwater, and indicator parameters during or immediately following sampling must be recorded.

NOTE: If the water column in a screened interval is less than 6 inches, consult the DERR project manager before collecting a sample. The well may need to be rehabilitated or drilled to a greater depth. If the well needs to be rehabilitated, do not collect a sample until the water table equilibrates.

No-Purge Sampling

Sample collection methods without purging must be approved by the DERR. No-purge samples may be collected when the following conditions are met:

1. The water level in the well is within the screened interval;
2. The primary contaminants are petroleum constituents; and
3. There is no NAPL present.

Depth to water, before and after sample collection, depth to bottom, and indicator parameters: pH, conductivity, dissolved oxygen, and turbidity, must be measured and recorded for no purge samples.

Alternate No-Purge Sampling Techniques

Alternate methods for collecting no-purge samples are presented below.

Passive Diffusion Bag Samplers - Diffusion sampling is a method of groundwater sampling for certain VOCs.

1. Proper QA/QC on the quality of the deionized water needs to be obtained in order to adequately interpret sample results.

2. The sampler must be positioned within the screened interval of the well and allowed to equilibrate for a period of two weeks.
3. The sampler is then removed and the water is emptied into a standard sampling container.

SNAP Sampler[®] - SNAP Samplers[®] may be used to collect no-purge groundwater at discreet depths.

1. The sampler is deployed at a predetermined depth within the screened interval of the well, and the water within the well is allowed to equilibrate for a minimum of two weeks.
2. The device and sealed containers are retrieved, and any required preservative is injected into the container prior to being sealed with a screw-on cap for transport to the laboratory.

*HydraSleeve*TM Sampler - may be used to collect groundwater at discreet depths.

1. Disposable colorless nylon rope and a decontaminated weight must be attached to the sampler.
2. The sampler must be positioned at the depth of interest and allowed to equilibrate for a sufficient amount of time per manufacturers recommendations.
3. The sampler is removed and the water is emptied into a standard sampling container.

Surface Water Sampling

Consultants are responsible for providing SOPs for sampling, the DERR requires that the following requirements are met:

1. Surface water samples should be collected in a manner that minimizes the potential for cross contamination caused by contact with sampling equipment or sediment suspended during collection.
2. Surface water sample collection should not allow preservative to be washed out of the sample container.
3. Surface water temperature, pH, dissolved oxygen, and conductivity should be measured and recorded on a field form or log book immediately following the collection of samples.
4. Samples should be collected from the portion of the water body closest to the release sites.
5. Surface water sample locations should be recorded using GPS coordinates and/or photographs and marked with flagging tape hung at eye level or an equivalent marker to allow the location to be accurately resampled.

Culinary Water Sampling

Culinary water samples collected from chlorine treated water, such as household tap water, should be collected from the cold-water supply and be preserved with approximately 3mg sodium thiosulfate. This powdery chemical is typically added to the sampling vial by the issuing laboratory. The tap should be allowed to run for a minimum of one minute prior to collecting the sample. There are no additional procedures to follow other than ensuring that no headspace exists between the surface of the sample and the vial's cap.

Proper Waste Disposal

Petroleum affected water associated with sampling is typically generated from development, purging, or sample collection. This waste can be managed in several ways depending upon site conditions or the availability of disposal/treatment sites. After the sample is collected, the purge water may be poured into the monitoring well from which it came. This process eliminates the need to transfer water away from the site.

Disposing the water at an approved treatment facility is also an option, but some facilities require a laboratory evaluation of the wastewater prior to acceptance. In this case the certified sampler will have to arrange for chemical analysis of the waste water, and for the storage and transportation of it. Other disposal methods may be appropriate based upon site-specific conditions.

NOTE: If more than 0.01 feet NAPL is present in the well, the water waste should be containerized and disposed of appropriately.

Water Sampling QA/QC

The objective of quality control and assurance in the field of environmental sampling is to obtain defensible data of known quality and origin. In regards to environmental sampling and maintaining quality assurance and data quality objectives, see Appendix A.

Sample collection must be conducted in a manner that minimizes the loss of volatile organic compounds:

1. Transfer water samples to sample containers as soon as they are collected. Avoid sample exposure to sunlight/air.
2. Eliminate headspace in sample containers unless sampling method dictates otherwise.
3. Preserve samples at 4° Celsius (39.2° Fahrenheit) during storage and delivery.
4. Collected samples should be properly preserved and stored, and analyzed by the laboratory within applicable holding times.

NOTE: Laboratory analytical detection limits must be sufficiently low in order to detect contaminant concentrations at or below Utah ISLs, Utah Tier 1 SLs, or EPA MCL as applicable (see Appendix E.)

Chain-of-Custody

In order for analytical results to be defensible, a chain-of-custody must be established for all samples collected. Chain-of-custody must demonstrate that samples have not been tampered with during collection, transfer, storage, or analysis. This requires custody of the samples to be documented from the time the samples are collected.

A sample is under custody if:

- it is in the person's possession;
- it is in the person's view, after being in the person's possession;
- it was in the person's possession and then it was locked up or placed in a sealed container to prevent tampering; or,
- it is in a designated secure area.

NOTE: The sample is in a person's custody until the sample has physically been relinquished and the chain-of-custody form has been signed by both parties.

Chain-of-custody documentation must be maintained and provided for all samples collected. The chain-of-custody must include:

- unique sample identification (number or name);
- date and time of collection;
- place of collection;
- type of material, sample container, and preservation;
- signature of the certified sampler; and,
- signature and dates of persons involved in the transportation and handling of the sample.

NOTE: All sample identifications, names, and numbers must be consistent throughout the Chain-of-custody documentation, laboratory analytical results, site map, data tables, and the report text. The groundwater depth below ground surface must be measured and recorded. Sample locations should be shown on a properly scaled and oriented site map.

In addition, field sampling information should be maintained in facility files and in field log books which should contain all information pertinent to each sampling event. The information recorded by the certified sampler should include but not be limited to:

- date;
- site name and location;
- site description and photo documentation;
- name of certified sampler, certification number, and date of expiration;

- purpose of sampling;
- sample identification, types, location, depth, time, and facility identification numbers; and,
- field measurements including instrument model and calibration specifications.

Containers, Preservation, and Holding Times

When possible, environmental samples should be transported directly to the laboratory by the certified sampler or representative. When shipping is required, the environmental samples must be placed in a container acceptable to both the laboratory and the carrier. Dry ice should not be used when shipping water samples to prevent the samples from freezing and breaking the glass containers.

The certified sampler should contact a NELAP certified laboratory in advance of sampling to determine that the lab is capable of conducting the sample analysis within the specified holding time. See Appendix B for maximum holding times. Certified samplers should also verify the number of containers and volume of sample needed in order to achieve appropriate detection levels prior to conducting the field sampling. Each laboratory should specify their required containers for each specific method and should be willing to supply their own certified containers for sample collection.

Field Equipment Decontamination Procedures

The following procedures shall be used, at a minimum, for all reusable sampling equipment used to collect routine samples:

1. Clean with tap water and phosphate-free laboratory detergent using a brush if necessary to remove particulate matter and surface films. Equipment may be cleaned by using a phosphate-free laboratory detergent and high-pressure water rinse (high-pressure wash) as an alternative to brushing.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with isopropanol. Do not rinse PVC or plastic items with isopropanol.
4. Rinse thoroughly with deionized water.

The following procedures shall be used, at a minimum, for field measurement devices used to collect field data:

1. Wash with phosphate-free laboratory detergent and tap water.
2. Rinse with tap water.
3. Rinse with isopropanol.
4. Rinse with deionized water.

NOTE: Do not reuse disposable equipment.

Air Sampling Protocol

Introduction

Air sampling is necessary when petroleum vapors are reported to the DERR. The petroleum vapors may be reported in and around buildings, utilities conduits, etc. Air sampling may also be necessary when subsurface investigations and corrective actions are unable to demonstrate incomplete exposure pathways for indoor air and outdoor air. Evaluation of these exposure pathways can be done by using Utah's Site-Specific Cleanup Level (SSCL) Calculator v1.2. EPA's Vapor Intrusion Screening Level calculator and/or EPA's PVIScreen software may also be used for screening purposes. Exceedances of action levels in these screening tools may necessitate soil vapor sampling. The DERR SSCL Calculator will be used to establish vapor cleanup levels. According to Division of Air Quality (DAQ) requirements, air sampling may be necessary during corrective action, such as off-gas sampling in soil vapor extraction (SVE) systems.

The types of air sampling discussed in this protocol are: hand held direct measurement, concurrent indoor/outdoor, sub-slab/near-slab, and soil gas, sorbent tubes, and off-gas.

Vapor Probe Installation

Temporary Vapor Probe

- Self-Sealing Vapor Probe - Installation and removal performed by qualified drilling contractor.
- Traditional Vapor Probe
 - install a stainless-steel hollow rod specifically manufactured for vapor sampling, according to manufacturer specifications.
 - properly abandon the sampling points after sampling has concluded.

Permanent Vapor Probe

- Direct push (self-sealing vapor probe) – Installation performed by qualified drilling contractor.
- Probes in building foundations - Hand Placement
 - use an appropriate hammer drill to create a hole large enough for a vapor probe to be inserted.
 - the final vapor probe placement must be flush with the surrounding surface to avoid creating a trip hazard.
 - seal the surface of the vapor probe.
- Probe in ground surface – Hand Placement
 - remove soil to desired sample depth.
 - place sample probe at desired sampling depth.

- flexible tubing should connect the probe to the ground surface.
- fill with sand pack and place bentonite seal.
- if placing nested vapor probes in the same hole, place the next probe above the bentonite seal at the desired depth.
- sand pack and bentonite seal the probe.
- repeat these steps as needed according to work plan.
- seal the surface of the sampling location. If necessary, place a well monument to protect the probe from damage.

Leak Testing

DERR recommends proprietary self-sealing vapor probes installed to manufacturer specifications for ease of installation and minimized leak risk. However, other types of probe installations are permissible when installed properly to prevent leaks. Before taking a sample from the probe, allow for appropriate equilibration time, at least 30 minutes.

Leak testing should be conducted after installation and each time a sample probe is used. A simple leak test is done by soaking paper towels in isopropanol and placing them on the ground surrounding the vapor probe during sample collection. Isopropanol (or other tracer gas) should then be included in the laboratory analytical results. Companies or laboratories may also use their own protocols for leak testing. The chosen method of leak detection should be communicated to DERR.

NOTE: If laboratory results indicate a leak in the sample train, the DERR will not accept the sample results. Seal the leak(s) and resample.

Hand Held Direct Measurement Sampling

Suitable only for screening (not quantitative.) Potential uses include storm and sanitary sewer manholes, locating areas of higher concentrations in buildings, etc. Potentially used to inform further vapor investigations.

- Use a PID/FID/OVM calibrated to manufacturer specifications.
- Place the tip of device in desired location and take a reading.
 - ensure tip is not placed in location where debris will get inside the tip.
 - ensure tip is not placed in a location with potential for bias, ex: an abnormally windy location, near a geoprobe/field vehicle, etc.
 - record reading and location in field log.

Indoor/Outdoor Air Sampling

- Record the starting pressure of the canister.
- Set the system up to run for the specified amount of time as approved by DERR. *NOTE: Do not let the pressure gauge go to zero. Record end*

canister pressure. The ending canister pressure allows the laboratory to know if the valve functioned correctly.

- record sample start time in log book.
- ensure sample setup is in a protected location, unlikely to be disturbed.
- Return to collect the sample after the time has elapsed.
 - close the valve and place the cap over the inlet.
- Follow all laboratory chain of custody guidelines.
- Follow all Department of Transportation (DOT) hazardous materials shipping guidelines if sending samples to laboratory through mail.

NOTE: Do not take samples near possible sources of bias. There are many common household products that can bias samples. Prior to conducting indoor air sampling, consult with DERR project manager and DERR toxicologist.

Sub-Slab/Near Slab/Soil Gas Sampling

- If sampling a vapor probe, purge three volumes of the sample train and vapor probe prior to sampling. This can be done using a disposable plastic syringe or other method as approved by the DERR.
- Record the starting pressure of the canister.
- Connect canister inlet to the vapor probe using nylon or Teflon tubing.
- Open valve.
- Allow the canister to nearly fill.
 - do not let the pressure gauge go to zero. Record end canister pressure. The ending canister pressure allows the laboratory to know if the valve functioned correctly. The canister is full when you can no longer hear the gas entering.
- Close the valve and place a cap over the inlet.
- Follow all laboratory chain of custody guidelines.
- Follow all DOT hazardous materials shipping guidelines if sending samples to laboratory through mail.

NOTE: Ensure the canister is not near a field vehicle, geoprobe rig, or other source of bias in sample.

Sorbent Tube Sampling

Sorbent tube sampling can be used for off-gas sampling and for screening purposes. Other uses for sorbent tube sampling need to be approved by DERR. DERR recommends canisters for use in sub-slab, near-slab, soil-gas, indoor air, and outdoor air.

- Allow the pump to run according to laboratory specifications.
- Following the run time:
 - place caps on tubes

- o wrap the tubes in foil
- o keep $\leq 4^{\circ}\text{C}$
- Follow all laboratory chain of custody guidelines.
- Follow all DOT hazardous materials shipping guidelines if sending samples to the laboratory through mail.

Soil Vapor Extraction Off-Gas Sampling

SVE systems are designed to allow for off-gas samples. Samples should be collected according to requirements by permitting agency.

- PID/FID//OVM
 - insert PID/FID/OVM into sample port
 - record reading in log book.
- Tedlar[®] bag
 - attach the bag inlet by flexible tubing to sample port.
 - open the valve for the SVE system and open the valve for the bag.
 - allow to fill (usually takes seconds.)

NOTE: Do not allow bags to overfill. Do not chill Tedlar[®] bags.

- Sorbent Tubes – Follow procedures for sorbent tube samples above.
- Repeat sampling as often as is required by DERR approved Corrective Action Plan (CAP) or DAQ permit.

Air Sampling QA/QC

The objective of quality control and assurance in the field of environmental sampling is to obtain defensible data of known quality and origin. In regards to environmental sampling and maintaining quality assurance and data quality objectives. See Appendix A.

Sample collection must be conducted in a manner that minimizes the loss of volatile organic compounds:

1. Transfer samples to sample containers as soon as they are collected. Avoid sample exposure to sunlight/air.
2. Preserve samples as directed by the analytical laboratory during storage and delivery.
3. Collected samples should be properly preserved and stored, and analyzed by the laboratory within applicable holding times.

NOTE: Laboratory analytical detection limits must be sufficiently low in order to detect contaminant concentrations at or below applicable output from SSCL.

Chain-of-Custody

In order for analytical results to be defensible, a chain-of-custody must be established for all samples collected. Chain-of-custody must demonstrate that samples have not been tampered with during collection, transfer, storage, or analysis. This requires custody of the samples to be documented from the time the samples are collected.

A sample is under custody if:

- it is in the person's possession;
- it is in the person's view, after being in the person's possession;
- it was in the person's possession and then it was locked up or placed in a sealed container to prevent tampering; or,
- it is in a designated secure area.

NOTE: The sample is in a person's custody until the sample has physically been relinquished and the chain-of-custody form has been signed by both parties

Chain-of-custody documentation must be maintained and provided for all samples collected. The chain-of-custody must include:

- unique sample identification (number or name);
- date and time of collection;
- place of collection;
- type of material, sample container, and preservation;
- signature of the certified sampler; and,
- signature and dates of persons involved in the transportation and handling of the sample.

NOTE: All sample identifications, names and numbers must be consistent throughout the chain-of-custody documentation, laboratory analytical results, site map, data tables, and the report text. The groundwater depth below ground surface must be measured and recorded. Sample locations should be shown on a properly scaled and oriented site map.

In addition, field sampling information should be maintained in facility files and in field log books which should contain all information pertinent to each sampling event. The information recorded by the certified sampler should include but not be limited to:

- date;
- site name and location;
- site description and photo documentation;
- name of certified sampler, certification number, and date of expiration;
- purpose of sampling;
- sample identification, types, location, depth, time, and facility identification numbers; and,
- field measurements including instrument model and calibration specifications.

Containers, Preservation, and Holding Times

When possible, environmental samples should be transported directly to the laboratory by the certified sampler or representative. When shipping is required, the environmental samples must be placed in a container acceptable to both the laboratory and the carrier. Dry ice should not be used when shipping water samples to prevent the samples from freezing and breaking the glass containers.

The certified sampler should contact a NELAP certified laboratory in advance of sampling to determine that the lab is capable of conducting the sample analysis within the specified holding time. See Appendix C for maximum holding times. Certified samplers should also verify the number of containers and volume of sample needed in order to achieve appropriate detection levels prior to conducting the field sampling. Each laboratory should specify their required containers for each specific method and should be willing to supply their own certified containers for sample collection.

Health and Safety

General

Personal safety is paramount at tank sites. Petroleum products are toxic and present fire and explosion hazards. Personal safety in the collection of environmental samples at tank facilities must meet the standards required by federal and state regulatory agencies.

Health and Safety at tank facilities:

- prevents work-related injuries, illnesses, and property damage;
- prevents public exposure to harmful substances; and,
- increases overall productivity and maintains project schedules.

Petroleum products are toxic, carcinogenic, and flammable. Therefore, these products should be handled with a great deal of care. Petroleum products can enter the body through the following exposure pathways:

- inhalation;
- ingestion;
- injection; and,
- skin or eye absorption.

Exposure

There are two types of exposure duration:

- acute – short term, high level exposure; and,
- chronic –long term low-level exposure.

Acute effects are typically immediate, and chronic effects typically manifest over time. Both are dangerous. Because petroleum products are a mixture of chemicals, the different components may enhance the hazardous effects of others.

NOTE: All exposures should be minimized as much as possible.

Signs and symptoms of petroleum constituent exposure are often vague and easily missed. The onset of symptoms may even be delayed up to 8 days after exposure and include:

- weakness;
- fatigue;
- headache;
- nausea;
- vomiting;
- diarrhea;

- insomnia; and,
- weight loss.

Personal Protective Equipment (PPE)

PPE protects personnel from vapors, gases, and particulates from hazardous materials. Certified samplers must wear appropriate personal protective clothing and equipment whenever they are at or near the site. The more that is known about the hazards at a release site, the easier it becomes to select PPE. There are four levels of PPE: Level A, Level B, Level C, and Level D.

Level A protection is required when the greatest potential for exposure to hazards exists, and when the greatest level of skin, respiratory, and eye protection is required. Examples of Level A clothing and equipment include positive-pressure, full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA, totally encapsulated chemical- and vapor-protective suit, inner and outer chemical-resistant gloves, and disposable protective suit, gloves, and boots.

Level B protection is required under circumstances requiring the highest level of respiratory protection, with lesser level of skin protection. At most abandoned outdoor hazardous waste sites, ambient atmospheric vapors or gas levels have not approached sufficiently high concentrations to warrant level A protection – Level B protection is often adequate. Examples of Level B protection include positive-pressure, full face-piece SCBA or positive pressure supplied air respirator with escape SCBA, inner and outer chemical-resistant gloves, face shield, hooded chemical resistant clothing, coveralls, and outer chemical-resistant boots.

Level C protection is required when the concentration and type of airborne substances is known and the criteria for using air purifying respirators is met. Typical Level C equipment includes full-face air purifying respirators, inner and outer chemical-resistant gloves, hard hat, escape mask, and disposable chemical-resistant outer boots. The difference between Level C and Level B protection is the type of equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main criterion for Level C is that atmospheric concentrations and other selection criteria permit wearing an air-purifying respirator.

Level D protection is the minimum protection required. Level D protection may be sufficient when no contaminants are present or work operations preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of chemicals. Appropriate Level D protective equipment may include gloves, coveralls, safety glasses, face shield, and chemical-resistant, steel-toe boots or shoes.

Health and Safety Plan

The HAZWOPER Standard requires employers working on sites with hazardous substances and wastes to develop site-specific health and safety plans (HASPs). The HASP is composed of various sections that outline the work and the address the associated hazards. The following topics must be addressed in the site HASP:

- general information;
- planned site activities;
- contaminant characteristics;
- site description;
- hazard evaluation and mitigation;
- site safety work plan;
- excavations and trenching;
- map with scale;
- hospital locations; and,
- emergency phone numbers.

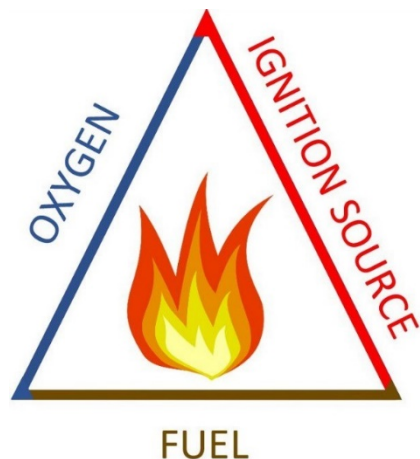
Combustion Hazards

Fire Triangle

Most UST removals will involve flammable vapors from products stored in the tank and from accumulated residues left in the tank even after it has been pumped dry.

Certified samplers must be aware of the basic fire triangle:

- fuel
- oxygen; and,
- heat or ignition source



Source: <http://umich.edu/~safeche/firetriangle.html>

All three points of the triangle are necessary to support combustion. These three elements need to be recognized, evaluated, and controlled to make a safe work place and avoid disaster. Safe tank removal requires continuous attention to these potential hazards to eliminate or reduce the risk of explosion.

Risks can be minimized by removing at least one point from the fire triangle. This is done by purging or inerting the potentially explosive atmosphere in the tank

Purging or ventilating the tank replaces or dilutes the flammable vapors in the tank with air, reducing the flammable mixture of fuel and oxygen by eliminating the fuel point of the triangle. Purging is considered complete when the atmosphere inside the tank is 10% or less of the Lower Explosive Limit (LEL). The LEL is the lowest concentration of a flammable gas or vapor (percent by volume in air) in which an explosion can occur upon ignition in a confined area

Inerting displaces the oxygen (and some of the fuel vapor) in the tank with an inert or non-reactive gas such as nitrogen or carbon dioxide. This reduces the flammable mixture of fuel and oxygen by dealing with the oxygen point of the triangle. Inerting is considered complete when the atmosphere inside the tank has an oxygen reading of 5% or less.

References

- *Collecting and Interpreting Soil Gas Samples from the Vadose Zone: A practical Strategy for Assessing the Subsurface Vapor-to-Indoor Air Migration Pathway at Petroleum Hydrocarbon Sites*. API. November 2005.
- *Compendium of ERT Surface Water and Sediment Sampling Procedures*, (EPA/540/P-91/005, January 1991)
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition. Compendium Method TO-15. Determination of Volatile Organic Compounds in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography / Mass Spectrometry*. January 1999.
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition. Compendium Method TO-17. Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling onto Sorbent Tubes*. January 1999.
- *Contract Laboratory Program Guidance for Field Samplers*, (EPA-540-R-014-013, October 2014)
- *Cost Guidelines for Utah Underground Storage Tank Sites* (DEQ, February 22, 2021)
- *Description and Sampling of Contaminated Soils, A Field Pocket Guide*, (EPA/625/12-91/002, November 1991)
- *Samplers and Sampling Procedures for Hazardous Waste Streams*, (EPA 600/2-80-018, January 1980)
- *Sampling for Hazardous Materials (165.9) Student Manual*, (EPA/540/R-96/035, December 1996)
- *Soil Gas Sampling Operating Procedure. EPA Region 4*. February 2020.
- *Soil Vapor & Indoor Air Sampling Technical Toolkit, Version 1.9. Chevron Environmental Management & Real Estate Company*. October 2019.
- *Standard Operating Procedures for Field Samplers*, (EPA Region VIII ESD, March 1986)

Appendix A

Table 1. Quality Control Reference Table for Environmental Sampling

Type of sample	Number of samples needed	Notes
Duplicate (Real sample with fictitious label. Ex: MW-1 thru MW-3 sampled with duplicate taken from MW-1 and labeled as MW-1A or MW-4)	5% frequency (e.g., 1 duplicate for every 20 lab samples collected). Minimum of 1 needed per sampling event.	Results w/in 10% of the relative deviation between the real sample and the duplicate sample.
Field blanks (DI water prepared in the field)	1 per day per site.	Only use DI water. Results must be less than laboratory MDL's.
Trip blanks (DI water prepared by lab or sampler prior to field work)	1 for each VOC sampling event per site.	Only use DI water. Results must be less than laboratory MDL's.
Rinsate blanks (not typically needed based on new or "dedicated" bailers routinely used at each sampling event)	1 per day per sampling device if not using dedicated or new one-time use disposable bailer.	Not needed if dedicated or new one-time use disposable bailers are used at each sampling location
Split samples (not typically needed for routine LUST sites)	At least 2 collected per sampling site, if deemed necessary.	Same sampling location, but two samples are obtained and "split" between two different laboratories to compare analytical results.

Appendix B

Table 2. Containers, Preservatives, Holding Times for Soil and Groundwater Reference Table

Volatile Organic-Soil					
Analysis	Method	Container	Volume	Preservative	Holding Time
Gasoline/TPH	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days
Gasoline/BTEX	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days
Diesel/TPH	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days**
Diesel/BTEXN	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days
Halocarbons	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days
Aromatics	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days
Purgeables	See Analytical Method Table	Glass	4 oz.	Cool 4°C	14 days

** 14 days to extraction, 40 days after extraction to analysis


Semi-Volatile Organics-Soil					
Analysis	Method	Container	Volume	Preservative	Holding Time
TRPH	See Analytical Method Table	Glass	4 or 9 oz.	Cool 4°C	28 days
Oil & Grease	See Analytical Method Table	Glass	4 or 9 oz.	Cool 4°C	28 days

Appendix C

Table 3. Preservation and Holding Times for Air Samples

EPA Laboratory Method	Description	Holding Time
TO-15	Analysis of VOC's collected in canisters by gas chromatography/mass spectrometry. Laboratory report should be generated for MBTEXN, TPH, Oxygen, Carbon Dioxide, Methane, and the tracer gas used unless otherwise approved by the DERR.	30 days; do not chill
TO-17	Analysis of VOC's collected in active sorbent tubes by gas chromatography/mass spectrometry. Laboratory report should be generated for MBTEXN, TPH, Oxygen, Carbon Dioxide, and Methane unless otherwise approved by the DERR.	30 days; must be kept at 4°C

Appendix D

 <p style="font-size: small; margin: 0;">UTAH DEPARTMENT of ENVIRONMENTAL QUALITY</p> <p style="font-weight: bold; margin: 0;">ENVIRONMENTAL RESPONSE & REMEDIATION</p>	<h2 style="margin: 0;">FIELD DATA INFORMATION SHEET – GROUNDWATER SAMPLING LOG</h2>													
SITE INFORMATION														
Facility Name & Address:										Facility ID:				
Release ID:				Date(s) in Field:						DERR Project Manager:				
WELL SAMPLING INFORMATION														
Well ID	Casing Diameter (in)	Measured Well Depth (ft)	Screened Interval (ft bgs)	Depth to Product	Depth to Water	Length of Water Column (ft)	Calculated Purge Vol. (gal)*	Vol. Purged (gal)**	D.O. (mg/L)	Temp (°C)	Specific Conductivity (µmohs/cm)	pH (SU)	Turbidity (NTU)	Purge Method
Notes (e.g., odor, sheen, slow recharge, well dry,														

etc.):

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* Well Dia. (in)	2" 3" 4" 6"	Certified Sampler Signature:
Vol. (gal/ft)	0.163 0.367 0.652 1.468	
Printed Name:		

Appendix E

Initial Screening Levels November 1, 2005

Contaminants*	Groundwater (mg/L)	Soil (mg/kg)
Benzene	0.005	0.2
Toluene	1.0	9
Ethylbenzene	0.7	5
Xylenes	10.0	142
Naphthalene	0.7	51
Methyl t-butyl ether (MTBE)	0.2	0.3
Total Petroleum Hydrocarbons (TPH) as gasoline	1	150
Total Petroleum Hydrocarbons (TPH) as diesel	1	500
Oil and Grease or Total Recoverable Petroleum Hydrocarbons (TRPH)	10	1000

Tier 1 Screening Criteria November 1, 2005

Tier 1 Screening Levels are applicable only when the following site conditions are met:

- 1.) No buildings, property boundaries or utility lines within 30 feet of the highest measured concentration of any contaminant that is greater than the initial screening levels but less than or equal to the Tier 1 screening levels AND,*
- 2.) No water wells or surface water within 500 feet of highest measured concentration of any contaminant that is greater than the initial screening levels but less than or equal to the Tier 1 screening levels.*

Contaminants *	Groundwater (mg/L)	Soil (mg/kg)
Benzene	0.3	0.9
Toluene	3	25
Ethylbenzene	4	23
Xylenes	10	142
Naphthalene	0.7	51
Methyl t-butyl ether (MTBE)	0.2	0.3
Total Petroleum Hydrocarbons (TPH) as gasoline	10	1500
Total Petroleum Hydrocarbons (TPH) as diesel	10	5000
Oil and Grease or Total Recoverable Petroleum Hydrocarbons (TRPH)	10	10000

Appendix F

Analytical Methods for Environmental Sampling at Underground Storage Tank Sites in Utah (July 2013)

Substance or Product Type	Contaminant Compounds to be Analyzed for Each Substance or Product Type	ANALYTICAL METHODS:
		Groundwater or Surface Water
Gasoline	Total Petroleum Hydrocarbons (<u>purgeable</u> TPH as gasoline range organics C6 - C10)	EPA 8015 <u>or</u> EPA 8260
	Benzene, Toluene, Ethyl benzene, Xylenes, Naphthalene, (BTEXN) and MTBE	EPA 8021 <u>or</u> EPA 8260
Diesel	Total Petroleum Hydrocarbons (<u>extractable</u> TPH as diesel range organics C10 – C28)	EPA 8015
	Benzene, Toluene, Ethyl benzene, Xylenes, and Naphthalene (BTEXN)	EPA 8021 <u>or</u> EPA 8260
Used Oil	Oil and Grease (O&G) or Total Recoverable Petroleum Hydrocarbons (TRPH)	EPA 1664 <u>or</u> EPA 1664 (SGT*)
	Benzene, Toluene, Ethyl benzene, Xylenes, Naphthalene (BTEXN) & MTBE; <u>and</u> Halogenated Volatile Organic Compounds (VOX)	EPA 8021 <u>or</u> EPA 8260
New Oil	Oil and Grease (O&G) or Total Recoverable Petroleum Hydrocarbons (TRPH)	EPA 1664 <u>or</u> EPA 1664 (SGT*)
Other	Type of analyses will be based upon the substance or product stored, and as approved by the DERR Division Director	Method will be based upon the substance or product type
Unknown	Total Petroleum Hydrocarbons (<u>purgeable</u> TPH as gasoline range organics C6 - C10)	EPA 8015 <u>or</u> EPA 8260
	Total Petroleum Hydrocarbons (<u>extractable</u> TPH as diesel range organics C10 – C28)	EPA 8015
	Oil and Grease (O&G) or Total Recoverable Petroleum Hydrocarbons (TRPH)	EPA 1664 <u>or</u> EPA 1664 (SGT*)
	Benzene, Toluene, Ethyl benzene, Xylenes, and Naphthalene (BTEXN) and MTBE; <u>and</u> Halogenated Volatile Organic Compounds (VOX)	EPA 8021 <u>or</u> EPA 8260

The following modifications to these certified methods are considered acceptable by the DERR Division Director:

- Dual column confirmation may not be required for TPH and BTEXN/MTBE analysis.
- A micro-extraction or scale-down technique may be used for aqueous samples, but only for the determination of extractable TPH as diesel range organics (C10 – C28).
- Hexane may be used as an extraction solvent.
- *Silica Gel Treatment (SGT) may be used in the determination of Total Recoverable Petroleum Hydrocarbons.

NOTE: The sample preparation method and any modification(s) to a certified method must be reported by the laboratory.