Detterman, Mark, Env. Health

From: Detterman, Mark, Env. Health
Sent: Wednesday, October 30, 2013 10:23 AM
To: 'Russi, Tonya'
Subject: RE: Chevron site 97127 (Tracy, CA):

Tonya,
Thanks for the email; it helps to clarify the site and the areas the LNAPL cores would still be collected in. This "revised work plan addendum" appears to be an appropriate alternative to the previously proposed work scope.

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PDF copies of case files can be downloaded at:

http://www.acgov.org/aceh/lop/ust.htm

From: Russi, Tonya [mailto:Tonya.Russi@arcadis-us.com]
Sent: Wednesday, October 30, 2013 8:58 AM
To: Detterman, Mark, Env. Health
Subject: Chevron site 97127 (Tracy, CA):

Hi Mark,

As discussed on the phone, ARCADIS proposes the collection of four LNAPL soil core samples, instead of LNAPL core samples at every boring location, as depicted on the attached site plan. The LNAPL soil core samples must be an undisturbed soil sample therefore ARCADIS will advance an additional soil boring adjacent to locations with elevated PID soil readings or near the suspected source area. The core sample depth will be determined based on the field observations in the adjacent boring. The cores will aid in characterization of LNAPL migration in the subsurface. The soil core sample will vertically extend approximately one foot above the un-impacted soil zone and extend approximately one foot beyond the impacted soil zone. Samples will be collected in accordance with the ARCADIS LNAPL core collection SOP (attached). The soil core samples will be collected with split spoon barrel samplers and submitted to a California certified laboratory.

Please let me know if you have questions regarding the revised LNAPL soil core sampling plan.

Thank you,

Tonya Russi | Senior Scientist | tonya.russi@arcadis-us.com

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ARCADIS, Imagine the result
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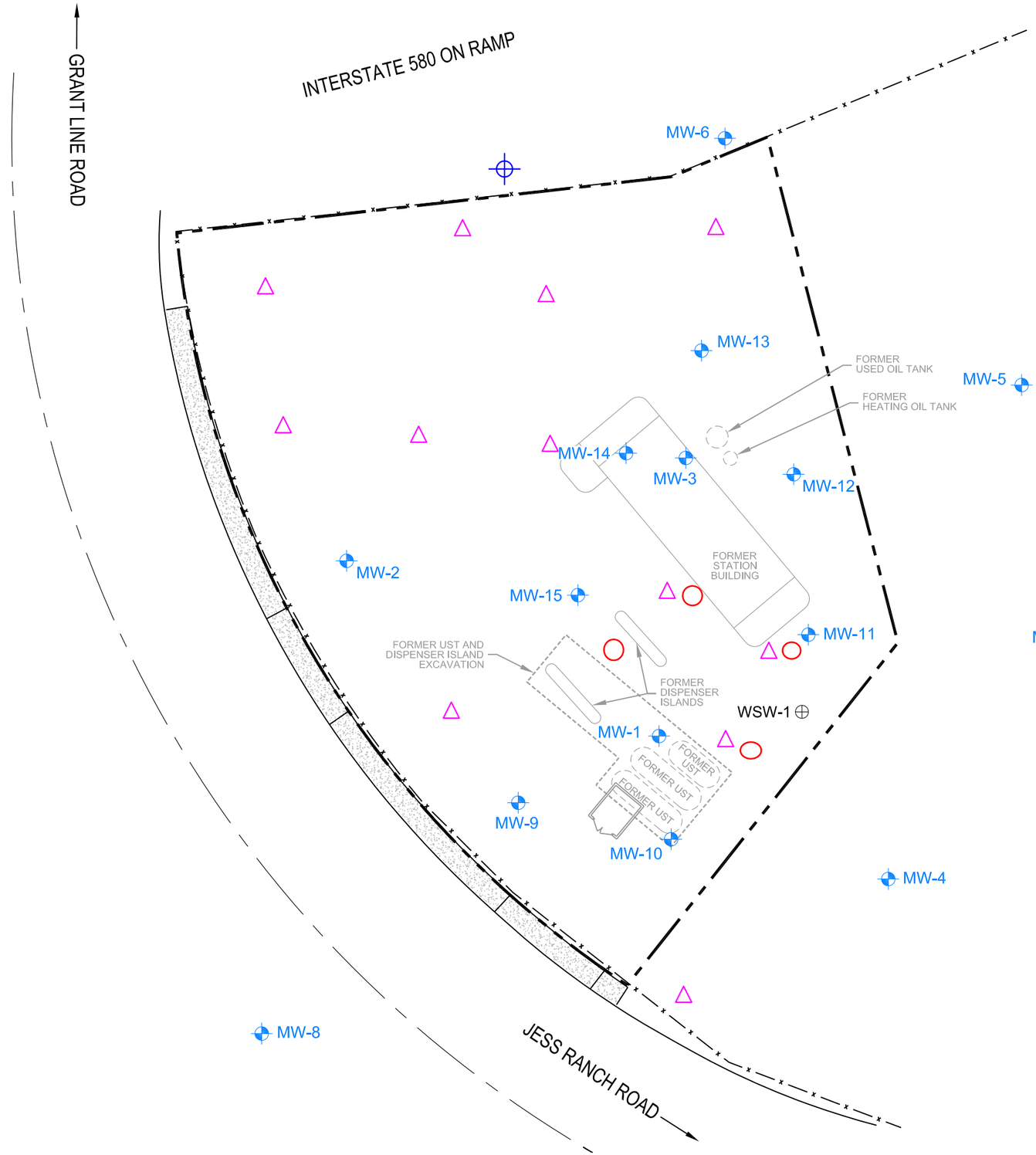


LEGEND

- PROPERTY BOUNDARY
- FENCE
- MW-1 MONITORING WELL LOCATION
- WSW-1 WATER SUPPLY WELL (LIVESTOCK)
- PROPOSED BORING
- PROPOSED MONITORING WELL

Approximate location of LNAPL core boring

NOTES:

1. MONITORING WELL LOCATIONS BASED ON SURVEY DATA PROVIDED BY VIRGIL CHAVEZ LAND SURVEYING (SEPTEMBER 2011) DRAWING FILE 305620cad.dwg. MW-6 LOCATION WAS NOT SURVEYED AND IS APPROXIMATE.
2. MAP MODIFIED FROM CONESTOGA-ROVERS & ASSOCIATES (CRA) FIGURE ENTITLED "FIGURE 2 CONCENTRATION MAP" DATED FEBRUARY 21, 2012, DRAWING FILE xsite.dwg. ALL SITE FEATURES AND LOCATIONS ARE APPROXIMATE.
3. MONITORING WELL MW-8 DISCONTINUED FROM MONITORING AND SAMPLING PROGRAM.

0 40' 80'

GRAPHIC SCALE

CHEVRON SITE ID 97127
GRANT LINE ROAD AND INTERSTATE 580
TRACY, CALIFORNIA

ADDITIONAL SITE ASSESSMENT WORK PLAN

SITE PLAN WITH PROPOSED BORING AND MONITORING WELL LOCATIONS

ARCADIS

FIGURE 2

CITY: PETALUMA, CA DIV/GROUP: ENV DB: J. HARRIS PM: DAVID EVANS
Y:\ENVCAD\Petaluma\ACTIB\00479590001\GWR\011Q13\DWG\47959C01.dwg LAYOUT: 2 SAVED: 6/14/2013 9:19 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: SETUP1 PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 6/14/2013 9:20 AM BY: ROBITAILLE, BEVERLY
XREFS: 47959X01
IMAGES: B0047959.0000.00100 google 2790x.jpg
PROJECTNAME: 09-5201-SD1 SD1 (1).jpg

ARCADIS
Infrastructure, environment, buildings

Imagine the result

Standard Operating Procedure for Light Nonaqueous Phase Liquid Soil Core Collection

Rev. #: 1

Rev Date: March 25, 2009

Approval Signatures

Prepared by: Toni L. Schoen Date: 3/25/09

Toni Schoen

Reviewed by: Date: 3/25/09

Brad Koons (Technical Expert)

I. Scope and Application

The collection of undisturbed soil cores is often required to support Light Nonaqueous Phase Liquid (LNAPL) mobility assessments at petroleum-impacted sites. The undisturbed soil cores are submitted to an analytical laboratory for specialized air/water drainage capillarity and fluid saturation testing. These data are used to support site-specific LNAPL mobility calculations.

The objective of the core collection procedure is to collect samples that are representative of the in-situ conditions that control LNAPL migration. Therefore, the following procedure outlines soil core collection methods that are optimal for:

- Maintaining soil pore structure
- Retaining aquifer fluids (LNAPL and groundwater) within the core

The soil cores are flash frozen in the field prior to shipment to maintain core integrity until it can be analyzed by the receiving laboratory.

This SOP does not address details of soil description or laboratory analysis. Refer to other ARCADIS SOPs and the project work plan, as appropriate.

II. Personnel Qualifications

ARCADIS personnel overseeing, directing, or supervising soil core collection using drilling equipment shall have a previous related experience (minimum of 2 years) under the supervision of an experienced drilling oversight person and a degree in hydrogeology or geology.

III. Equipment List

Below is a list of the equipment and materials that are required for the collection of LNAPL soil cores. Required equipment and materials include:

- personal protective equipment (PPE) including gloves rated for flash freezing, and other items specified by the site Health and Safety Plan (HASP),
- drill rig and other associated equipment based on soil core collection methodology,
- measuring tape,
- indelible ink pens,
- plastic baggies,
- graduated cylinder;
- duct tape,

- saran wrap,
- cleaning equipment/supplies,
- transport container with dry ice,
- foam, bubble wrap, or styrofoam peanuts,
- shippable cooler with inside length greater than soil core sampler,
- 6-inch wide polyvinyl chloride pipe with end cap (length based on length of soil core sampler), and
- logbook.

IV. Cautions

Drilling and drilling-related hazards including subsurface utilities are discussed in other SOPs and site specific HASPs and are not discussed herein.

The drilling Contractor is responsible for underground and aboveground utilities clearance by local “Dig Safe,” the owner of easements, and the property owner per the HASP.

V. Health and Safety Considerations

Field activities associated with collection of nonaqueous phase liquid soil cores will be performed in accordance with a site specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and nonaqueous phase liquids and understand their hazards.

Prior to mobilization, select an appropriate monitoring device (flame ionization detector, photo-ionization detector, or other detector) based on a review of the sensitivity of the device to the potential constituents of concern.

Dry ice is extremely cold, sublimates into carbon dioxide, and is an asphyxiant (precludes access to oxygen). The site HASP shall contain a copy of the Material Safety Data Sheet (MSDS) for dry ice. Below is a list of health and safety conditions when handling dry ice:

- Store the dry ice in a dry, well ventilated area like a truck bed,
- Wear protective gloves rated for extreme cold/flash freezing,
- Avoid contact with water or other liquid, and
- Dispose of dry ice in a secure ventilated area. Dry ice will create an appearance of “smoke”, which may cause undue attention by site workers or pedestrians.

Communication with the drilling crew is essential to the successful collection of the LNAPL soil cores. The goal of the collection process ("push" sample, smooth steady retrieval by avoiding jarring or jerking during retrieval of the tube from the subsurface, and handling the core in a vertical position until frozen) should be discussed in detail to ensure the drilling crew and geologist are working as a team.

VI. Procedure

The primary objective for the collection of a LNAPL soil core is to collect an undisturbed soil sample with the water and LNAPL entrained in the pore spaces representative of subsurface conditions. This is accomplished by mechanically pushing the core collection device into the subsurface. Avoid using rotation, hammer or vibration when collecting the core. The use of air or drilling water during borehole advancement should be avoided if possible to prevent inadvertently affecting the in-situ fluid saturation profile at or near the coring interval.

The undisturbed soil cores are submitted to a petrophysical laboratory for analysis of soil characteristics such as porosity, capillarity, and LNAPL and water fluid saturations. The lab processes subsamples from the cores that are as small as 1 inch by 1 inch. The scale of the lab analyses and the sensitivity of the parameters being analyzed are two specific reasons why such importance is placed on obtaining cores that are as undisturbed as possible and as representative of in-situ conditions as possible.

The sampler diameter shall not be less than 3-inches in diameter (minimum of 2.5-inch diameter for split barrel sampler). Any sampler will disturb the perimeter of a soil core to some degree. The minimum diameter of 3 inches is based on the need for at least 2 inches in diameter of undisturbed core for the laboratory analysis procedures mentioned above.

Site geology and hydrogeology must be considered to select the most appropriate core collection method. The geology should be evaluated to determine the type of material that will be drilled through to obtain the samples. For example, loose sands or interbedded silt and clay require different sampling methods. Since samples are collected near the groundwater table, an understanding of the depth to water and probability of heaving sands will also influence the selection of a sampling method. Use of rotation, hammer, or vibration will only be utilized if mechanical pushing results in refusal, and the use of these alternative advancement methods should be prioritized as follows: push, rotate, then hammer. Several potential sampling methods are discussed below.

- Split spoon or split barrel samplers are used to collect soil samples across a wide variety of unconsolidated soils (ASTM D-1586). The split spoon consists of a 2-foot to 5-foot long tubular barrel that is split longitudinally into two equal halves. A 3-inch diameter split spoon sampler should be used with a 2.5-inch diameter liner. A retainer at the bottom will

limit soils and fluids from falling out the bottom during sample retrieval from the subsurface. The split spoon sampler is attached to the drill rod and advanced into the undisturbed soil approximately the length of the split spoon sampler.

- Standard stationary piston sampler (ASTM D-6519) is a liner attached to a head assembly with a piston at the bottom to prevent soil from entering as the assembly is lowered into the hole. A rod is connected to the piston, and the liner is pressed past the piston into the soil. With a well fitted piston, a vacuum is created that holds the soil and fluids in the liner during core withdrawal.
- Osterberg hydraulic piston sampler is similar to the standard stationary piston sampler but has an actuating piston and a fixed piston. An opening at the head assembly allows for fluid pressure to be applied to the actuating piston which will cause the liner to be pushed past the fixed piston into the soil. This helps eliminate the possibility of over pushing.
- Denison core barrel consists of a rotating outer barrel, a bit with an inner fixed barrel, a liner, and a retainer at the end. During drilling, pressure is applied to the inner barrel while the outer barrel cuts the soil. For this purpose of collecting LNAPL soil cores, a 3.5" diameter by 24" sampler is preferred.
- Shelby tubes consist of a single thin-walled steel tube (ASTM D-1587-08)). The Shelby tube is attached to the lead auger and should be mechanically pushed into the undisturbed soil.

The length of soil core samples can be determined based on the expected height of capillary rise in the soil of interest. By matching core length to the height of capillary rise, drainage of fluids from the samples as they are collected will be minimized. API's technical document 4711 presents the relationship shown in Figure 1, based on an empirical approach developed by McWhorter in 1996. The values shown in the table below are approximations taken from Figure 1 and can be used as a guide to determine core length as a function of site-specific hydraulic conductivity.

Hydraulic Conductivity	0-2.5 ft/day (0-7.5x10^{-4} cm/s)	2.5-10 ft/day (7.5x10^{-4}-3.5x10^{-3} cm/s)	>10 ft/day (>3.5x10^{-3} cm/s)
Core Length	2 ft (70 cm)	1ft (30 cm)	0.5 ft (15 cm)

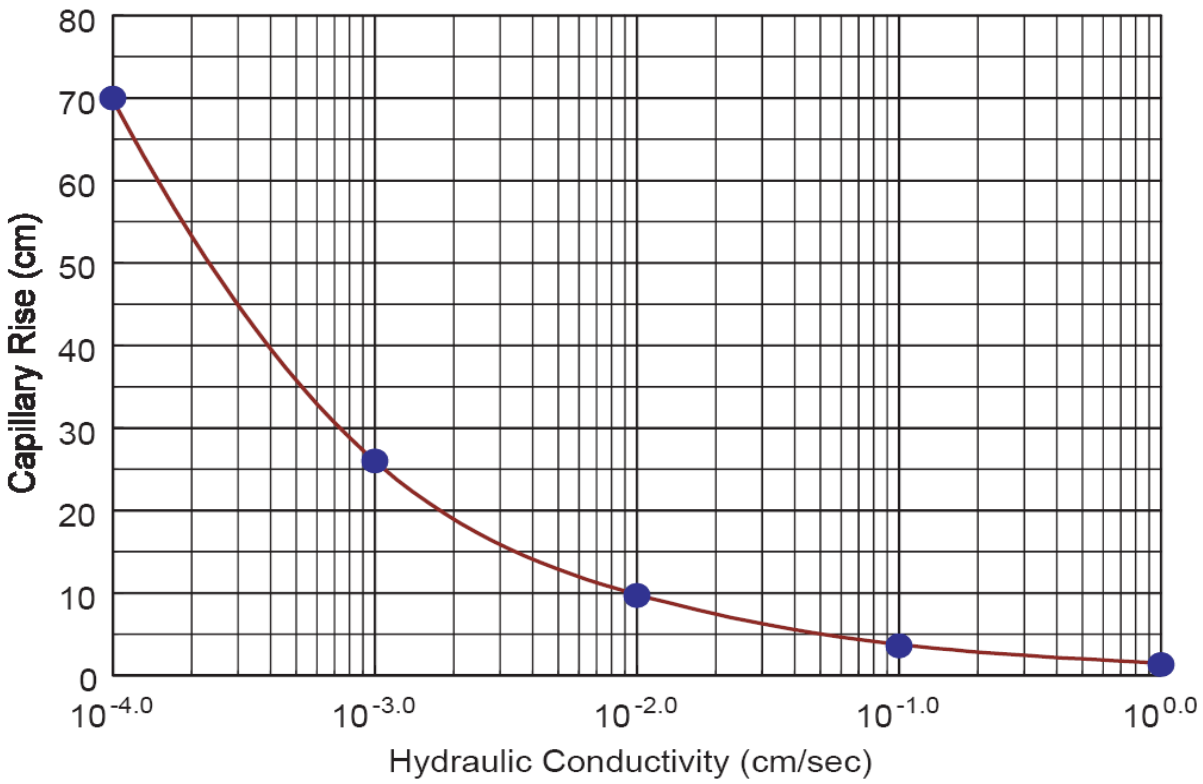


Figure 1 — Capillary rise as function of hydraulic conductivity (API 4711)

Below is the procedure for collection of a LNAPL soil core.

- Gauge a well near the proposed soil boring location for LNAPL soil core collection for depth to LNAPL and depth to water using an interface probe. The proposed soil boring location shall be near the well gauged for LNAPL (approximately 3 to 5 feet).
- Collect soil samples continuously from ground surface to the project-specified distance above the air-LNAPL/water interface using the selected drilling method (typically 1 foot above the groundwater table). Do not use air or water during sampling or drilling advancement.
- Advance the sampler to collect soil from the project-specified vertical extent (typically 1-foot of soil from the vadose zone (unsaturated soil) and approximately 3 feet of LNAPL/water-saturated soil). The sampler shall be mechanically pushed (no rotation, hammer, or vibration shall be applied to the split-barrel). If refusal is encountered using mechanical pushing before advancing the length of the sampler, then hammer or rotation may be applied to advance the sampler.

- Retrieve the sampler at a smooth, steady pace (avoid jarring or jerking of sampler) from the subsurface to minimize loss of fluid from the sampler.
- Maintain the sampler in an **upright position** for the following steps:

  - o Place the bottom of the sampler in a plastic bag for collection of fluids while the driller removes any mechanism holding drilling tube holding the sample. Once the soil core sample is released, cap both ends of the liner or tube with water-tight end caps. Capping the top of the liner/tube first will create a vacuum to minimize fluid loss from the soil.
  - o Pour liquid from the plastic bag to a graduated cylinder. Measure and record the volume of water and LNAPL loss.
  - o If there are any voids in the sample liner/tube, fill with plastic (Saran) wrap to minimize core movement.
  - o Wipe the outside of the sample liner/tube and duct tape the end caps (overlap tape a minimum of 2 layers).
  - o Label the liner/tube with the boring ID, interval sampled (fractions of a foot should be recorded in tenths), and an arrow pointing toward the top of liner/tube with a permanent marker (do not label duct tape). Each subsequent liner/tube shall be labeled sequentially with A, B, C… etc starting with A on the top (shallowest) sleeve. Also, each liner/tube shall have an arrow pointing toward the top of the tube. (See Figure 2.)

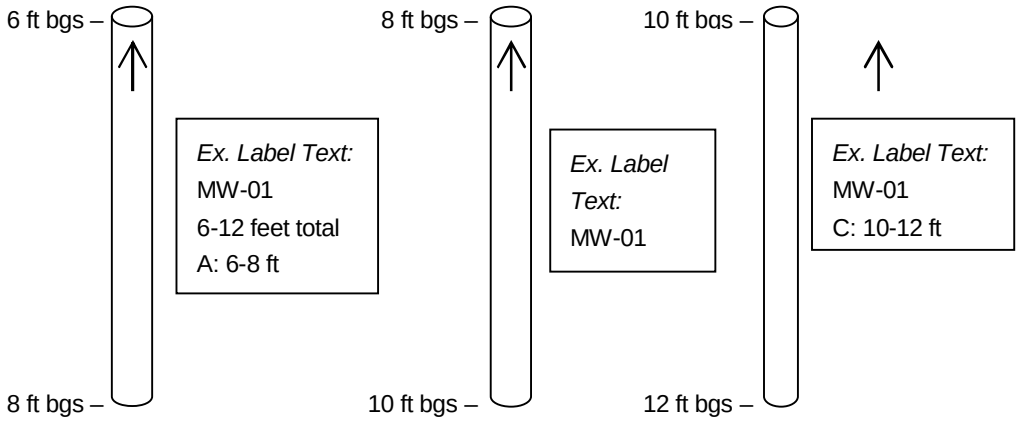


Figure 2 – Schematic showing example of how to label multiple cores per well.

- Evaluate the integrity of the soil sample, noticing if the soil sample appears undisturbed and how much recovery was achieved. A disturbed soil sample or sample with poor recovery should be discarded. If the first soil core is acceptable, proceed to the core freezing procedure below. If the first soil core is disturbed or had poor recovery, discard it and select a different nearby drilling location for a second attempt. Communicate the change in sampling plan to the project manager.
- Set the capped, taped, and labeled liner/tube in a vertically-aligned 6-inch Schedule 80 PVC tube or steel pipe surrounded by dry ice for a minimum of 30 minutes. The soil sample should remain in the same vertical direction as it was in the subsurface during freezing. Stabilize the PVC tube or steel pipe to avoid tipping over during the freezing process.
- Once frozen, wrap core in several layers of plastic bags or 1-2 layers of bubble wrap before placing it into a cooler. A thin, insulative layer is needed between the core and the dry ice.

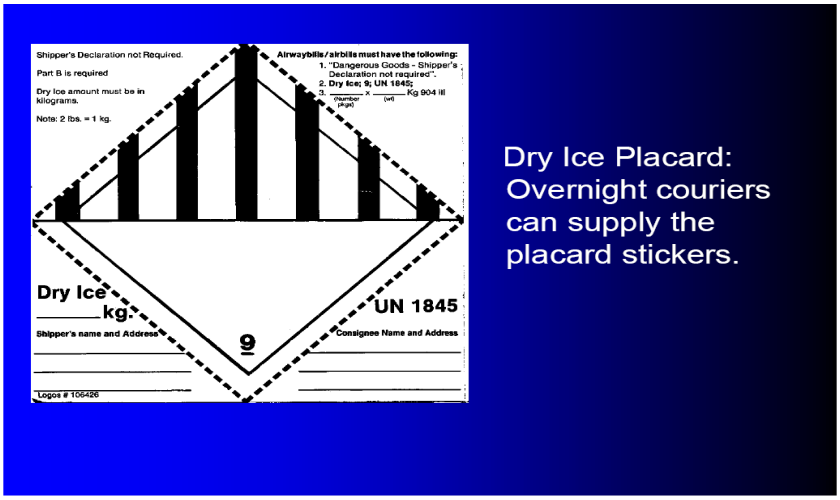
VII. Cooler Preparation and Shipping

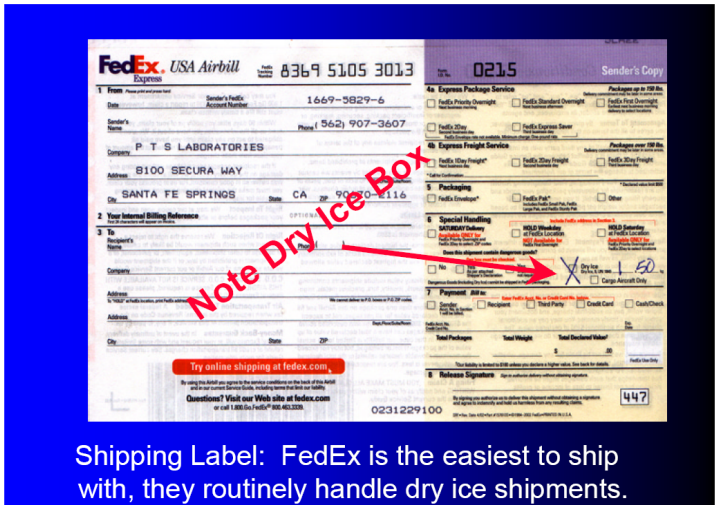
Below is a generalized procedure for packing and shipping of frozen LNAPL soil cores. A Shipping Determination must be performed, by DOT-trained personnel, for all environmental and geotechnical samples that are to be shipped, as well as some types of environmental equipment/supplies that are to be shipped.

From the bottom of the cooler up, pack the cooler as follows:

- Place a layer of foam, bubble wrap, or styrofoam peanuts in the bottom of the cooler to absorb shock during transport.
- Place a layer of dry ice over the foam, bubble wrap, or styrofoam peanuts. Do not pack the dry ice in sealable containers.
- Place the core(s) horizontally over the layer of dry ice.
- Place a layer of dry ice over the core. The cooler should contain approximately 30 to 50 pounds of dry ice for shipping. FedEx has a weight limit of 150 pounds for coolers. Up to 22.5 feet of cores can fit into the large marine ice chests with 50-75 feet of ice.
- Fill remainder of cooler with foam, bubble wrap, or styrofoam peanuts.
- Seal the completed chain of custody into a plastic bag and affix to the inside of the lid of the cooler.
- Tape the cooler closed by wrapping two bands of tape around the cooler (overlap tape a minimum of 2 layers). Do not seal the cooler with tape. As the dry ice sublimates to carbon dioxide, the gas needs to escape the cooler.

- Core samples shall not be held overnight onsite. Collect samples early enough to allow time for same-day vertical core freezing, cooler packaging, and FedEx shipping.
- Complete the FedEx airway bill and dry ice placard (see attached examples). Samples shall be shipped for overnight delivery. Arrange shipment so that coolers do not sit in a warehouse or truck for days.
- Use the buddy system for lifting these coolers. The size of the coolers used and volume of dry ice used to maintain a frozen state for the soil cores will result in heavy coolers.
- Notify the laboratory of shipment arrival time and FedEx tracking number(s).





VIII. Data Recording and Management

The supervising geologist will be responsible for documenting drilling events using a logbook to record all relevant information in a clear and concise format. The drilling event record shall include:

- Name and location of project,
- Project number, client, and site location,
- Names of Contractor, Contractor personnel, inspectors, and other people onsite,
- Weather conditions,
- Depth to water and depth to LNAPL from nearby well and distance from sample location,
- Type of drilling method,
- Soil core collection method and sampler dimensions,
- Procedure (noting use or no use of rotation, hammer, or vibration for sample collection),
- Start and finish dates and times of drilling,
- Sample interval, length of unsaturated and saturated soil, and total recovery length,
- Volume of water and LNAPL loss as measured in a graduated cylinder,
- Condition of sampler pre- and post-retrieval from subsurface, and
- Photo document the soil cores, freezing technique, and cooler packaging.

IX. Quality Assurance

Equipment will be cleaned prior to use onsite, between each drilling location, and prior to leaving the site. All drilling equipment and associated tools, including augers, drill rods, sampling equipment, wrenches, and other equipment or tools, that may have come in contact with soils will be cleaned with high-pressure steam cleaning equipment using a clean potable water source. The drilling equipment will be cleaned in an area designated by the supervising geologist that is located outside of the work zone.

X. Waste Management

All dry ice not utilized for freezing the soil cores will be stored in an open container in a well ventilated, secured area and permitted to volatilize. Personal protective equipment (such as gloves, disposable clothing, and other disposable equipment) resulting from cleaning procedures

and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or disposed of in a designated debris box for disposal. All decontamination water and soil will be placed in separate sealed 55-gallon steel drums and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

XI. References

API 4711. Methods for Determining Inputs to Environmental Petroleum Hydrocarbon Mobility and Recovery Models. American Petroleum Institute Publication Number 4711. July 2001.

ASTM. D-1587-08 Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.

ASTM. D-6282 Standard Guide for Direct Push Soil Sampling for Environmental Site Characterization.

ASTM Method D-1586 Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM D-3550 Practice for Thick-Walled, Ring-Lined. Split Barrel, Drive Sampling of Soils.

ASTM D-6519 Standard Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler.