The Home of Truth Spiritual Center

1300 Grand St. Alameda, CA 94501

510-522-3366 ~ administrator@thehomeoftruth.org

http://www.thehomeoftruth.org

Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502-6577

RECEIVED
By Alameda County Environmental Health 2:26 pm, Aug 24, 2017

Re: The Home of Truth Alameda
ACEH LOP RO#3248
1300 Grand Street, Alameda, California

I have read and acknowledge the content, recommendations and/or conclusions contained in the attached document or report submitted on my behalf to ACDEH's FTP server and the SWRCB's GeoTracker website.

Sincerely,

______________ 8-21-17
Judi Friedman
Authorized Representative

Attachment: Report

APPLIED WATER RESOURCES
CORPORATION

2363 Mariner Square Drive, Suite 245, Alameda, CA 94501
925 426 1112

August 24, 2017

Karel Detterman
Alameda County Department of Environmental Health-LOP
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

RE: Site Investigation Work Plan
1300 Grand Street, Alameda, California
Fuel Lake Case No. RO#3248

Dear Ms. Detterman:

On behalf of The Home of Truth Alameda (THOT) and based on Alameda County Environmental Health's (ACEH) June 26, 2017 letter, Applied Water Resources (AWR) has prepared the enclosed Site Investigation Work Plan for 1300 Grand Street, Alameda, California.

Please contact me with questions and comments regarding this report at (510) 671-2085 or email at smichelson@awrcorp.net.

Sincerely,

Steven Michelson, PG
Principal Geologist

cc: Ms. Judi Friedman

Enclosure

Site Investigation Work Plan

1300 Grand Street, Alameda CA

August 2017

APPLIED WATER RESOURCES

Site Investigation Work Plan

1300 Grand Street, Alameda CA

August 2017

Prepared on behalf of:
The Home of Truth Alameda

Prepared by:
Applied Water Resources Corporation
2363 Mariner Square Dr., Alameda, CA 94501

Yola Bayram
Geologist

Steven Michelson, PG
Principal Geologist

PROFESSIONAL GEOLOGIST
STEVEN I. MICHELSON
5165
Exp. 1/31/19
STATE OF CALIFORNIA

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APPENDICES

1. Introduction

AWR has prepared this Site Investigation Work Plan on behalf of The Home of Truth Alameda (THOT) for the property located at 1300 Grand Street, Alameda, CA. This report was prepared pursuant to the Alameda County Department of Environmental Health's (ACEH) letter dated June 26, 2017. This Work Plan describes the investigation to characterize site conditions and delineate the extent of the primary and secondary sources of contamination.

2. Background and Site History

The Site is located in the City of Alameda on the southwest corner of the intersection of Alameda Ave and Grand Street in Alameda, California (Figure 1). The Site is a church with residential units and is located in a residential neighborhood. The nearest significant surface water features are the Alameda Lagoon, 0.35 miles to the south, and the Oakland Estuary, 0.65 miles to the north. The Site is essentially flat at an approximate elevation of 35 feet above mean sea level (ft msl).

Based on boring logs from 2006 Encinal Ave, located approximately 0.28 miles southeast from the Site, subsurface materials generally consist of silty sand to the maximum explored depth of approximately 15 feet below ground surface (ft bgs). Ground water was measured in May 2016 in monitor wells located at 2006 Encinal Ave at approximately 7 ft bgs and the gradient is towards the south-southwest direction. Ground water gradient at the Site is currently unknown.

In the winter of 2017, ground water rose and infiltrated the church's basement and a petroleum sheen was observed on the water's surface. Communications with THOT management reveals that the basement previously contained a boiler fueled with heating oil. A small sump, or pit, is present in the basement that extends approximately 1 foot below the floor, and likely contained the boiler, which is no longer present in the basement. A vent line is presently attached to the exterior of the building. The building is now heated using natural gas.

On April 26, 2017, a geophysical survey was performed (Appendix A) to identify a possible underground storage tank and pipelines. The survey identified a likely 1,000-gallon underground storage tank (UST) underneath the sidewalk along Alameda Ave with piping leading into the basement of the church (Figure 2). The likely UST and its piping were found to be approximately 5 ft bgs and was measured to be approximately 5 to 6 feet in diameter and 8 feet long. On May 1, 2017, a water sample collected from the basement revealed concentrations of petroleum hydrocarbons in the diesel range at 41,400 µg/L (Table 1).

3. Conceptual Site Model and Data Gaps

The Conceptual Site Model (CSM) is a representation of site conditions developed using available data, interpretations, and assumptions based on experience to demonstrate the relationship between contaminants of concern, transport media and mechanisms, and potential receptors.

As requested by ACEH, the major CSM elements are highlighted in tabular format (Table 2). The CSM also identifies data gaps which have guided the development of this Work Plan to characterize site conditions. This CSM will be updated as new information becomes available.

4. PROPOSED SITE INVESTIGATION

The ground water sample collected from the basement revealed elevated concentrations of petroleum hydrocarbons indicating that the UST, its piping, and/or the boiler have likely released into the subsurface. The Site investigation described in this Work Plan are designed to address the data gaps identified in the CSM, as and summarized in Table 3, including:

- delineate the lateral extent of the release into the subsurface in the vicinity of the basement,
- delineate the lateral extent of petroleum in the vicinity of the UST beneath the sidewalk,
- characterize risk to indoor air at the Site and adjacent buildings,
- inform remedial measures to be included or anticipated during the removal of the UST, such as over-excavation of impacted soil and/or removal of petroleum from ground water within the excavation.

The scope of work consists of the following tasks:

- Task 1 – Utility Location and Health and Safety Plan
- Task 2 – Field Investigation
- Task 3 – Reporting

As described below, investigation activities include drilling and collecting soil, ground water, and soil vapor samples as indicated in Figure 3 and the IDs, sample matrix, and rationale for each location is provided below.

Location ID	Rationale	Proposed Total Depth (ft bgs)	Soil	Soil Vapor	Ground Water
SB1	Delineate extent of UST excavation	10-15	X		X
SB2	Delineate extent of UST excavation	10-15	X		X
SB3	Delineate extent of UST excavation	10-15	X		X
SB4	Delineate extent of UST excavation	10-15	X		X
SB5	Investigate ground water quality	10-15			X
SB6	Investigate ground water quality	10-15			X

Location ID	Rationale	Proposed Total Depth (ft bgs)	Soil	Soil Vapor	Ground Water
SS1	Assessment of vapor intrusion risk	Sub-Slab		X	
SV1	Assessment of vapor intrusion risk Optional – Installed if SB6 indicates ground water contamination	5		X	
SV2	Assessment of vapor intrusion risk Optional – Installed if SB5 indicates ground water contamination	5		X	
MW-1	Monitor ground water contamination Optional – Install depends on grab ground water samples	10-15			X
MW-2	Monitor ground water contamination and serve as a possible extraction well Optional – Install depends on grab ground water samples	10-15			X
MW-3	Monitor ground water contamination Optional – Install depends on grab ground water samples	10-15			X

The work proposed in this plan is a guide to the investigation and is subject to change in response to actual field conditions and findings, and access considerations. All fieldwork described below will be performed under the supervision of a Professional Geologist. All drilling will be performed by a licensed drilling contractor using hand equipment or a limited access direct push rig using dual-tube technology.

All samples will be collected in accordance with AWR's Standard Operating Procedures (Appendix B), which includes labeling each sample with a unique ID, date and time of collection, and sampler's initials. Soil and ground water samples will be placed on ice. All soil vapor and sub-slab samples will be sampled in accordance with the July 2015 DTSC Soil Vapor Advisory. All samples will be transported to a NELAP-certified laboratory under standard chain-of-custody procedures.

4.1 Task 1 – Utility Location and Health and Safety Plan

Subsurface investigation permits will be acquired from the appropriate agencies at Alameda County and the City of Alameda. Underground Services Alert (USA) will be notified and the boring locations will be cleared for underground utilities using a private underground utility locator. The proposed drilling locations are contingent upon access limitations (i.e., site features, utilities) and final locations may be moved to the closest accessible location and/or modified by additional information.

As required by the Occupational Health and Safety Administration (OSHA) 29 CFR 1910.120, Hazardous Waste Operations and Emergency Responses, a Site Health and Safety Plan (HSP) will be prepared for use while conducting proposed field sampling activities.

4.2 Task 2- Field Investigation

4.2.1 Soil and Grab Ground Water

Soil will be collected continuously and described with regard to soil type following the Unified Soil Classification System, relative moisture, color, and screened using a Photo Ionization Detector (PID) for volatile organic compounds. Vadose zone soil samples will be collected from borings SB1 through SB4 between 0 to 5 ft bgs in jars as well as in USEPA method 5035 compliant Terracore sampling containers and analyzed for total petroleum hydrocarbons as diesel (TPHd) and TPH as heating oil (TPHho) by EPA method 8015 and benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tert-butyl ether (MTBE), and naphthalene by EPA method 8260. The soil interval selected for analysis will be biased towards higher observed potential contamination based on visual, olfactory, and PID examination, and changes in lithology.

Soil between 5 and 10 ft bgs is likely to be saturated with ground water. Because the bottom of the UST is anticipated to be approximately 10 feet bgs, soil collected from this interval might be collected for analysis if it appears to be contaminated. If contamination is observed or suspected in this interval based on the PID, olfactory, and/or visual information, then the boring will be extended to approximately 15 feet and additional saturated soil samples might be collected to delineate the vertical extent of petroleum. Collection and analysis of these soil samples will be the same as for the vadose zone soil samples.

Grab ground water will be collected from SB1 through SB6 using a 1-inch diameter PVC well casing and screen. The PVC will be inserted into the borehole and the rods will be raised approximately 1 foot to allow ground water to enter the PVC. Ground water will be collected within the casing using dedicated tubing with a peristaltic pump into laboratory-supplied containers for the analysis of TPHd and TPHho by EPA Method 8015 and for the analysis of BTEX, MTBE, and naphthalene by EPA method 8260.

After sample collection, the borings will be tremie-grouted as required by Alameda County Public Works and will be completed to match the surrounding surface.

4.2.2 Sub-Slab VaporPin™

The church's basement is approximately 5 to 6 feet below the surrounding ground surface. The LTCP requires soil vapor samples be collected 5 feet below the foundation of the building, however ground water is likely to be found 6 to 18 inches below the slab of the basement. Instead, it is proposed that a sub-slab VaporPin™ (SS1) be installed in the basement of the church in order to assess vapor intrusion risk. The VaporPin™ will be implanted into a 5/8" diameter hole drilled through the concrete slab using a rotary hammer drill. A protective cap will be placed over the barbed sampling end, the VaporPin™ will be secured into place with a flush-mounted lid and allowed to equilibrate for a minimum of 2 hours. Sub-slab soil vapor will be sampled under a helium shroud and analyzed for volatile organic compounds (VOCs) by EPA Method TO-15 and for naphthalene by EPA Method TO-17. SOPs for the VaporPin™ are provided in Appendix B.

4.2.3 Soil Vapor Wells

If ground water in SB5 and/or SB6 is found to be contaminated then soil vapor wells SV1 and/or SV2 will be installed to approximately 5 ft bgs in order to assess vapor intrusion risk to the nearby buildings. The soil vapor well will be installed in a 2-inch diameter boring and will consist of ¼-inch Teflon tubing with a filter attached at the bottom end. The filter will be installed within a 12 inch thick sand filter pack and beneath 6 inches to 12 inches of dry granular bentonite to prevent moisture from entering the filter pack. Hydrated bentonite will be used to fill the rest of the boring to ground surface. To allow the subsurface to equilibrate back to representative conditions, the sampling of soil vapor will not be conducted until after 24 hours has passed. Soil vapor will be sampled under a helium shroud and analyzed for VOCs by EPA Method TO-15 and for naphthalene by EPA Method TO-17. SOPs for soil vapor sampling using a helium shroud are provided in Appendix B. Upon completion of all sampling and data collection activities, the soil vapor well will be sealed and secured within a traffic-rated monitor well box.

4.2.4 Monitor Wells

The grab ground water data samples collected from SB-1 through SB-6 will characterize the extent, if any, of impacts to ground water quality based on environmental screening levels in a residential land use scenario. After consultation with ACEH, ground water monitor wells MW-1 through MW-3 may be installed to 10 ft bgs in the three locations (Figure 3) to monitor the extent of ground water contamination and measure the ground water gradient. The monitor wells would be installed to intercept the highest anticipated ground water table to facilitate the measurement of and, if necessary, removal of separate phase free product.

4.3 Task 3- Reporting

An Investigation Report will be prepared and submitted presenting the results of activities described above. The report will include the following:

- Descriptions of the methodologies used to collect and analyze the data,
- Significant deviations from this Work Plan,
- Updated to the Conceptual Site Model,
- Boring Logs,
- Appropriately scaled base maps showing the boring locations,
- Comparison of concentrations with Environmental Screening Levels in a residential scenario and LTCP Criteria;

- Summary and interpretation of analytical results and laboratory data certificates, including an assessment of the extent of chemicals in soil gas and potential health risk to humans and the environment,

- Remaining data gaps, if any, and

- Recommendations for additional actions, possibly consisting of addressing remaining significant data gaps and/or development of a remedial action, if warranted.

TABLES

Table 1
Grab Ground Water Analytical Results
1300 Grand Street, Alameda, CA

Sample ID	Date Collected	TPHG C5 - C12	C12-C22 HYDROCARBONS	C22-C32 HYDROCARBONS	C32-C40 HYDROCARBONS	BENZENE	TOLUENE	ETHYLBENZENE	XYLENES, TOTAL	METHYL TERT-BUTYL ETHER	NAPHTHALENE
		mg/L									
ESLs		50*	2.5*	2.5*	50*	0.0011	3.6	0.013	1.3	1.2	0.02
THOT-GW	05/01/2017	0.363	41.4	4.05	<1	<0.001	<0.001	<0.001	<0.003	<0.001	<0.005

ESLs: CA SF Bay RWQCB Table GW-3 -Groundwater Vapor Intrusion Human Health Risk Screening Levels (Volatile Chemicals Only) Feb 2016

*Hydrocarbons do not have an ESL for Vapor Intrusion Risk so Groundwater Gross Contamination ESL from Table GW-4 has been used.

Table 2
Conceptual Site Model
1300 Grand Street, Alameda, CA

CSM Element	CSM Sub-Element	Description	Data Gap	How to Address
Background and Setting	Site	The Site is located in the City of Alameda on the southwest corner of the intersection of Alameda Ave and Grand Street in Alameda, California (Figure 1). The Site is a church with residential units and is located in a residential neighborhood. The church's basement previously contained a boiler fueled with heating oil. A small sump, or pit, is present in the basement that extends approximately 1 foot below the floor, and likely contained the boiler, which is no longer present in the basement. A vent line is presently attached to the exterior of the building. The building is now heated using natural gas.	None	NA
	Adjacent Properties	Residences are located adjacent to the Site.	None	NA
	Nearby Properties	The surrounding area is made up of residenital homes and apartments.	None	NA
	Underground Infrastructure	An inactive UST that once held heating oil is likely located beneath the sidewalk on Alameda Ave and its piping leads to the church's basement. A gas line was traced from the church to the street and overlies the UST.	None	NA
Geology and Hydrogeology	Regional	This Site is located on the western margin of the East Bay Plain Subbasin of the Santa Clara Valley Ground Water Basin. The East Bay Plain subbasin aquifer system consists of unconsolidated sediments of Quaternary age. Deposits include the early Pleistocene Santa Clara Formation, the late Pleistocene Alameda Formation, the early Holocene Temescal Formation, and Artificial Fill (DWR 2004). Soil in the vicinity consists of Pleistocene beach and dune deposits (Merritt sand) consisting of loose, well sorted fine to medium sand (Helley and others 1979).	None	NA
	Site	Based on boring logs from 2006 Encinal Ave, a site approximately 0.28 miles to the southeast, subsurface materials generally consist of silty sand to the maximum explored depth of approximately 15 feet below ground surface (ft bgs). Ground water was measured in May 2016 in monitor wells located at 2006 Encinal Ave at approximately 7 ft bgs and the gradient is towards the south-southwest direction.	Subsurface of Site is unknown. Ground water gradient at the Site is currently unknown.	Pending characterization of significant impact to ground water, monitor wells may be installed. Continously collect soil to log subsurface underlying the Site.
Surface Water Bodies		The nearest significant surface water features are the Alameda Lagoon, 0.35 miles to the south, and the Oakland Estuary, 0.65 miles to the north. The Site is essentially flat at an approximate elevation of 35 feet above mean sea level (ft msl).	None	NA
Nearby Wells		According to GeoTracker's Groundwater Ambient Monitoring and Assessment (GAMA) database, the nearest water supply well is approximately 0.7 miles east of the Site. This well is located at Alameda High School at 2201 Central Ave. The well is located upgradient of the Site and there does not appear to be any water supply wells located downgradient of the Site.	A well survey through DWR has not been completed.	Request a well survey through DWR for nearby water supply wells not on GAMA.
Sensitive Receptors		The Site is located in a residential neighborhood surrounded by several residences and apartment buildings. There is a preschool located approximately 650 feet north of the Site and another preschool located 1,150 feet west of the Site. An elementary school is located 900 feet southwest of the Site.	Possible receptors are building occupants and nearby residents.	Evaulate soil vapor and ground water quality.
Sources	On-Site	Likely consisting of the UST beneath the sidewalk, piping to former boiler in basement, and/or former boiler.	Actual source(s)	Collection and analysis of soil, ground water, and soil vapor samples.
	Off-Site	None	None	NA
Distribution of Petroleum Hydrocarbons	Soil	Unknown	Extent of soil contamination is currently unknown.	Borings in the vicinity of the UST and collect soil samples for analysis.
	Ground Water	Distribution unknown, however a sheen was observed on ground water that infilitrated the basement during the winter.	Extent of ground water contamination is currently unknown.	Borings in the vicinity of the UST as well as the surrounding area and collect ground water for analysis.
	Soil Vapor	Unknown	Extent of soil vapor contamination is currently unknown.	Install sub-slab pin in the basement of the church. Depending on grab ground water samples, soil vapor wells may be installed to assess risk to nearby residences.

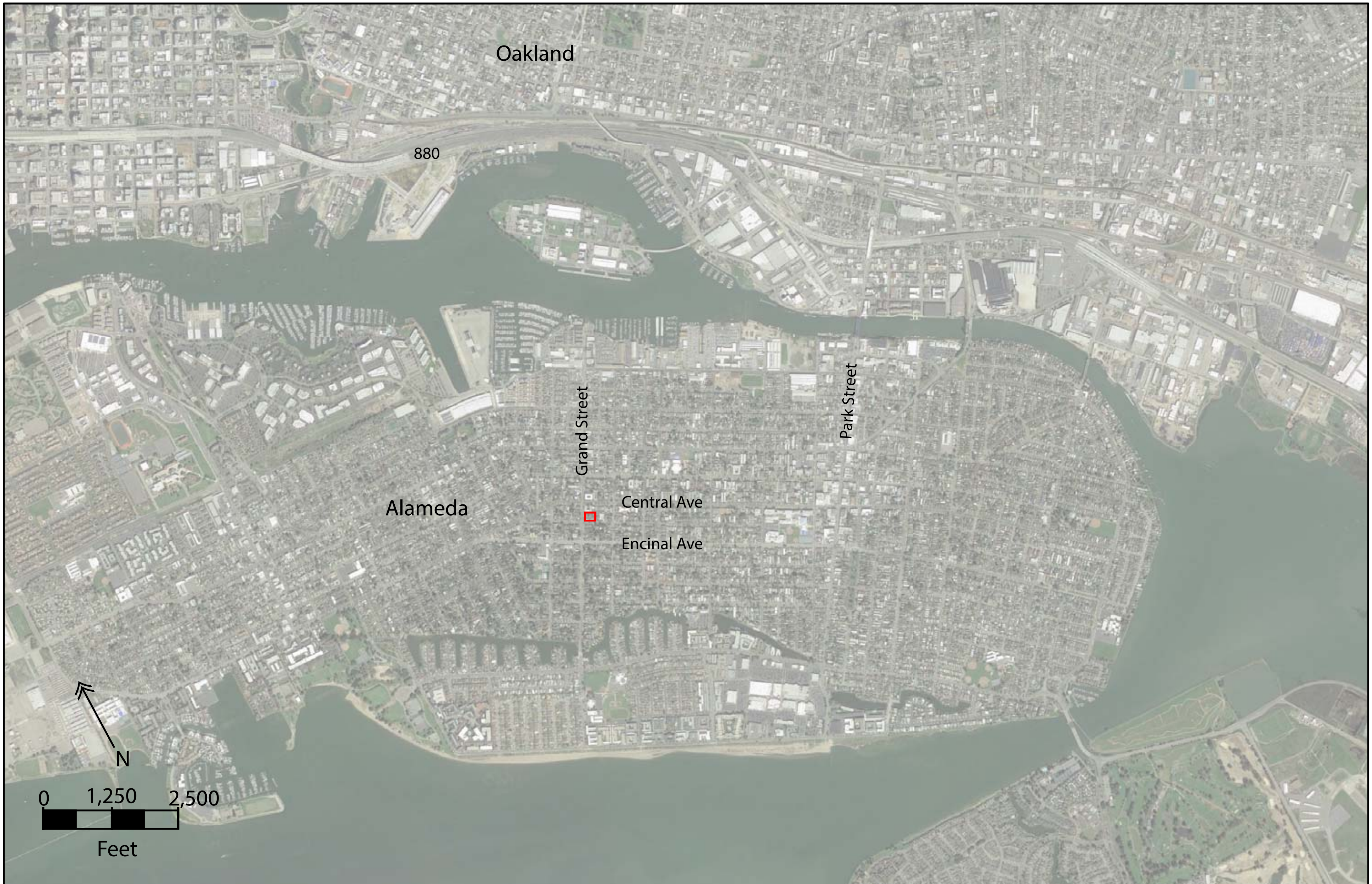
Table 2
Conceptual Site Model
1300 Grand Street, Alameda, CA

CSM Element	CSM Sub-Element	Description	Data Gap	How to Address
Distribution of Risk	Soil	Unknown	Extent of soil contamination is currently unknown.	Borings in the vicinity of the UST and collect soil samples for analysis.
	Ground Water	Concentrations of petroleum hydrocarbons in ground water are significant and indicates that ground water may serve as a source to soil vapor contamination which in turn poses a vapor intrusion risk to indoor air. Risk by direct exposure to ground water is not a concern due to the fact that ground in the vicinity is not used for drinking water purposes and the City of Alameda is served by a municipal water supply.	Extent of ground water contamination is currently unknown.	Borings in the vicinity of the UST as well as the surrounding area and collect ground water for analysis.
	Soil Vapor	Unknown	Extent of soil vapor contamination is currently unknown.	Install sub-slab pin in the basement of the church. Depending on grab ground water samples, soil vapor wells may be installed to assess risk to nearby residences.

Table 3
Data Gaps and Recommended Action
1300 Grand Street, Alameda, CA

Data Gap	Proposed Investigation	Rationale	Analysis
Subsurface of Site is unknown.	Six soil borings will be drilled that AWR will continously collect soil to log subsurface underlying the Site.	Subsurface of Site is unknown.	N/A
A well survey through DWR has not been completed.	Request a well survey through DWR for nearby water supply wells not on GAMA.	Migration pathway studies will be conducted.	N/A
Likely sensitive receptors are occupants and neighboring residences.	Evaulate soil vapor and ground water quality.	Sensitive receptor studies will be conducted.	N/A
Extent of soil contamination is currently unknown.	Four borings in the vicinity of the UST and collect soil samples for analysis.	Define extent of excavation.	TPHd, TPHho, BTEX, MTBE, Napthalene
Extent of ground water contamination is currently unknown.	Borings in the vicinity of the UST as well as the surrounding area and collect ground water for analysis. Pending characterization of significant impact to ground water, monitor wells may be installed.	Delineate extent of plume.	TPHd, TPHho, BTEX, MTBE
Extent of soil vapor contamination is currently unknown.	Install sub-slab pin in the basement of the church. Depending on grab ground water samples, soil vapor wells may be installed as well.	Assess vapor intrusion risk to church as well as surrounding neighbors.	TO-15 for VOCS; TO-17 for Napthalene
Actual source(s) of contamination is unknown.	Collection and analysis of soil, ground water, and soil vapor samples.	Define extent of excavation.	TPHd, TPHho, BTEX, MTBE, Napthalene

FIGURES



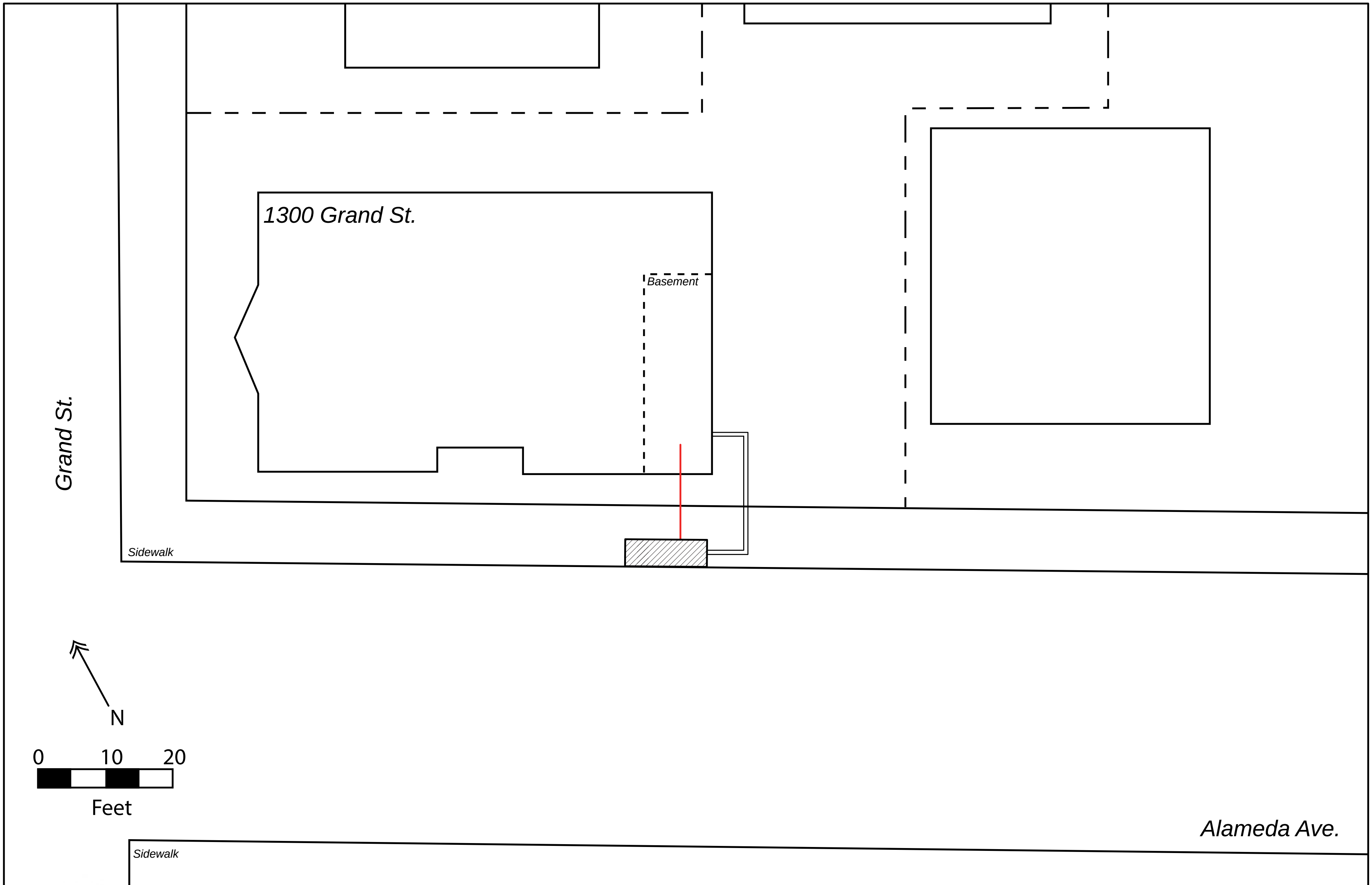
APPLIED WATER RESOURCES

Figure 1

Vicinity Map

1300 Grand St. Alameda, CA

Site



APPLIED WATER RESOURCES

Figure 2

Site Map

1300 Grand St. Alameda, CA

UST		Product Line	
Fence			
Vent Pipe			

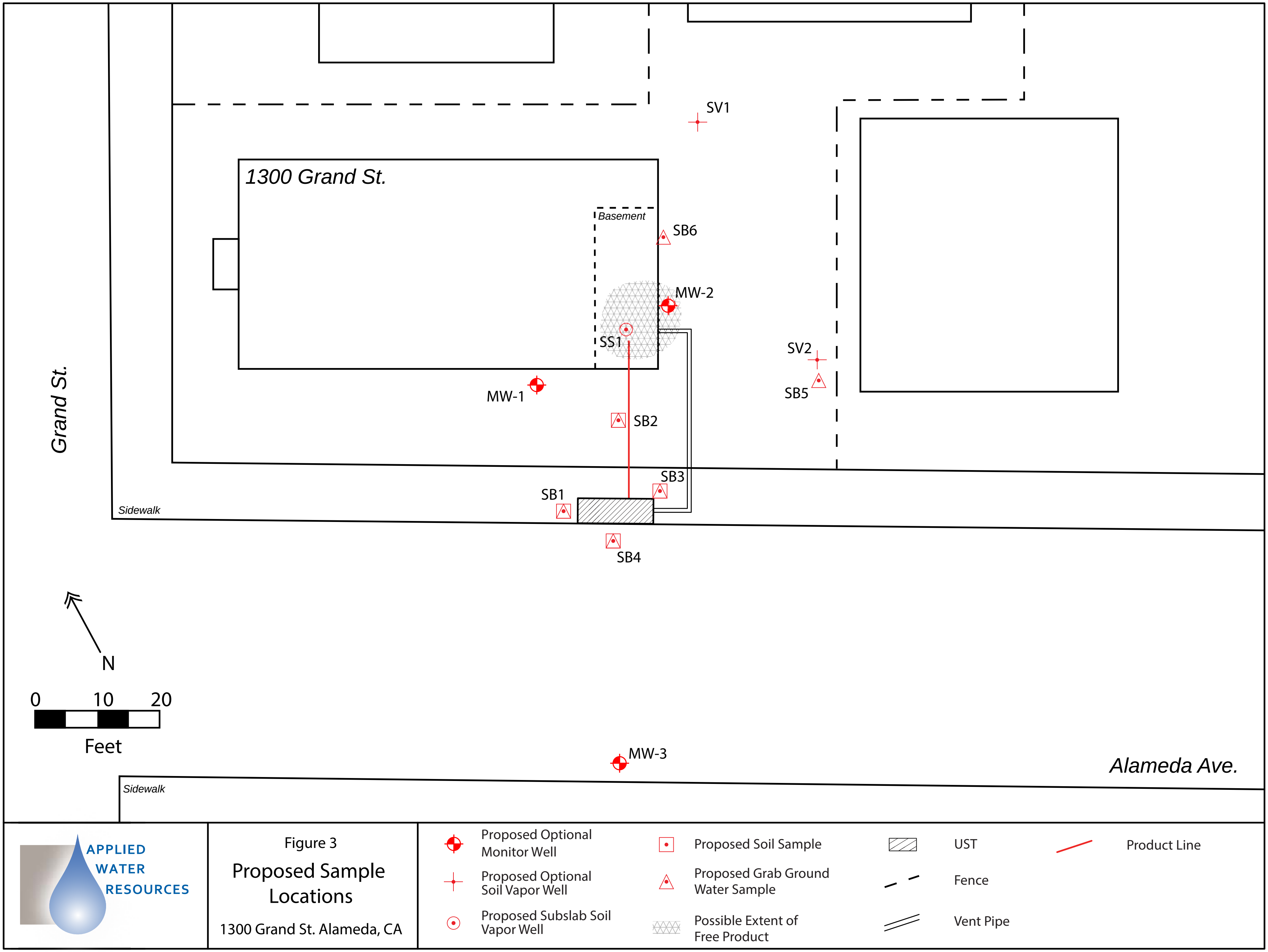


Figure 3

Proposed Sample Locations

1300 Grand St. Alameda, CA

APPENDIX A

SUBTRONIC
CORPORATION

National Utility Location
Contractors Association Member

5031 Blum Road, Suite 2
Martinez, California 94553
Telephone: (925) 228-8771
Fax No: (925) 228-8737
www.subtronic.com

GEOPHYSICAL SUBSURFACE INVESTIGATION
for
Applied Water Resources
at
1300 Grand Street
Alameda, California

April 28, 2017

SURVEY OBJECTIVE:

On April, 26, 2017, Subtronic conducted a geophysical survey to find an underground storage tank (UST) at 1300 Grand Street. Two ½ inch product lines were observed in the basement and a vent pipe was found on the south wall of the house.

GEOPHYSICAL EQUIPMENT

The specialized equipment used at the site includes a RD8000 pipe locator and the GSSI system 4000 ground penetrating radar (GPR) with a 400 MHz antenna.

RD8000

The RD8000 is a multi frequency pipe locator. Pipes can be traced by placing a tone on the pipe. Pipe locations are marked on the ground with paint.

GSSI SIR-4000

A ground penetrating radar system graphically records subsurface structures. Both geological and manmade structures are recorded by the introduction of a pulse of electromagnetic energy into the ground. Reflected pulses received by the antenna are then processed for measurable contrast in electrical properties. The result is a visual pseudo-cross-sectional profile.

Primary applications of the GPR are detecting UST's, foundations, buried drums, previously excavated areas and detecting metallic and non-metallic utilities. The GPR depth penetration is severely limited by clay-rich soil. Radar waves can penetrate deeper in sandy and gravelly soils.

SURVEY RESULTS:

From the walk through two product line pipes were found in the basement and a vent pipe was found on the south wall of the building at grade level. The product lines traced directly toward the sidewalk on Alameda Avenue and maintained a depth of 5 feet deep. The vent pipe traced 8 feet southward then turned 90° to the Alameda Avenue.

Radargrams over the sidewalk in between the vent pipe and the product lines indicated a UST at approximately 5 feet deep. See photograph below. The tank is approximately 10'-12' feet long and possibly 5'- 6' in diameter.

CONCLUSIONS:
Tracing of the product lines and the vent pipe lead to a possible UST location in the sidewalk. GPR traverses in the area of the vent and product lines showed the indication of a buried fuel storage tank at approximately 5 feet deep.

LIMITATIONS:
The identification of geophysical anomalies is affected by clayey soils, object size, composition and burial depth. The effects of shallow buried metal may shadow an underground storage tank buried deeper.

Report prepared by: ______________________
Pierre Armand, RGP 1021

Subtronic Corporation

Report checked by: ______________________
Jonathan Taylor. C.E.O.

APPENDIX B

2363 Mariner Square Dr., Suite 245, Alameda CA, 94501
510-671-2090

GRAB GROUND WATER SAMPLING -
STANDARD OPERATING PROCEDURES (SOP)

Table of Contents

1. Purpose

This document focuses on the equipment, field procedures, and level of accuracy and quality control measures required for grab ground sampling. This SOP will be used to guide AWR field staff to perform the grab ground water sampling efforts properly, to maintain consistency of field procedures, and to facilitate the assurance of the quality and reliability of data obtained from all grab ground water sampling events.

2. Equipment

Ground water monitoring and sampling need, at a minimum, the following equipment and supplies:

- Sampling Sheets, Logs and Site Information
  - Project description, site maps, chain-of-custody, SOP, QAPP, Work Plan, field data forms, activity logs, camera, GPS unit, clipboard, well condition checklist, indelible ink pen.
  - Health & Safety Plan (HASP)
  - Site information including previous monitoring data and boring logs as applicable.
  - Permission /notification to access land/home owner/tenant and contact information.
- Safety Equipment
  - Hardhat, boots, safety vest/suit, and latex or nitrile gloves or appropriate Personal Protective Equipment (PPE) as specified in the HASP.
  - Sun and heat protection (at least 1 liter of water per hour and sunblock)
  - Traffic control cones and tapes
  - Cellular phone with contact numbers
  - Flashlight
  - Hearing protection
- Soil Logging Equipment
  - 10x or 15x magnifying hand lens
  - Munsell Soil chart
  - Putty knife
  - Photo ionization detector (PID)
- Sampling Equipment
  - Depth to Water level indicator (sounder)
  - Pump or bailer rope/cable (no cotton or cloth)

- Calibrated buckets or similar device for purge water
- Purging pump or bailers
- Water quality meter(s) capable measuring the parameters identified in the work plan,
- Sampling pump or bailers
- Tools for opening soil liners, string, tubing, and duck or Teflon tapes
- Multi-phase sounder, if needed.

- Sampling Supplies
  - Laboratory-supplied sample bottles/containers
  - QA/QC sample bottles (trip blanks, field blanks, etc.)
  - Filtering apparatus and all accessories if sampling in field
  - Ice chest(s) with water ice
  - Ziploc® or similar plastic sampling bags
  - Encore or Terracore samplers for gasoline and VOC sampling
- Decontamination Equipment
  - Decon water, soap such as Liquinox® or similar solution
  - Rinse buckets for decontamination
  - Waste storage drums and buckets
  - Deionized (DI) water

3. PROCEDURES

Ground water monitoring and sampling include the following procedures, and should be performed in the following order:

1. Project preparation
2. Equipment decontamination
3. Soil Boring
4. Collect the ground water sample and measure field parameters
5. Follow QA/QC sampling procedures and handling of ground water samples

4. PROJECT PREPARATION

The following work should be conducted prior to arriving the site:

- Contact project manager

- Review project description, site direction, site maps, list of chemicals to be analyzed, HASP
- Determine the extent of the sampling effort, the sampling methods to be employed, and required equipment and supplies according to the sampling Work Plan or Quality Assurance Project Plan (QAPP) plans for the site.
- Obtain necessary permits, utility clearance and access agreements.
- Obtain an Underground Service Alert (USA) ticket at least 48 hours prior to drilling activities and schedule a private utility locator as needed.
- Obtain appropriate sampling and monitoring equipment.
- Decontaminate or pre-clean equipment, and ensure that it is in working order.
- Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
- As needed, perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
- Prepare chain-of-custody and sample labels
- Use stakes, flags, or other identifiers and mark all sampling locations. Specific site characteristics including morphology, water table, nature and extent of contaminant should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.
- Contact analytical lab to coordinate and bottle order preparation and delivery and sample courier pickup or drop off point.
- Notify site manager/site contact, project manager, grout inspectors, and encroachment permit inspectors (if necessary) at least 48 hours prior to field effort.

5. Equipment Decontamination

After checking in with the project manager, a decontamination area and traffic control cones should be setup prior to well gauging and sampling, if necessary. Any non-dedicated downhole gauging, purging or sampling equipment should be decontaminated prior to use in a Liquinox® (or similar) solution wash. Wash solution is also pumped through purging pumps and rinsed with potable water. The same equipment should be rinsed again with potable water or de-ionized water to remove residual soap.

6. Soil Boring

Soil borings will be advanced by a licensed C-57 drilling contractor as specified in the work plan. A trained geologist will be present to log the soil samples as they are produced from the borehole. The geologist is instructed to remain a safe distance from the drill rig during operation to avoid potential injury. Based on the site data, to the extent possible, borings should be advanced in the order from cleanest to dirtiest to avoid potential for cross contamination. Sampling equipment should be either dedicated or decontaminated between each sampling location as described above.

6.1. Fugitive Data

Establish communication with the driller to obtain fugitive data to be noted in the comments section of the borelog. Attention should be paid to relative differences in the drilling behavior, the depth of these observations, and fugitive data should be compared to observations in the recovered soil sample. Relevant fugitive data may include the following:

- Rig chatter
- Tip resistance
- Pull down force
- Duration for sample collection
- Swelling of soil sample (packed or blown liners)

6.2. Dual Tube Sampling Method

To avoid potential cross contamination with soil lying above the water bearing zone, the dual tube direct push drilling method should be employed prior to ground water and soil sample collection. This method ensures the hole is cased off to the total depth during soil sample collection and recovery to prevent contact between shallow soil and the ground water bearing zone or mixing of ground water between two separate ground water-bearing zones. Once the target ground water sampling zone is reached, the outer casing is retracted to expose the desired ground water sampling interval. 1-inch or less diameter PVC should be inserted in the borehole at this point with a screened section at the base to decrease the amount of sediment collected in the grab ground water samples.

If there is minimal potential for cross contamination, the continuous core drilling method may be used. Under this sampling method, the drill rods are removed from the boring after each soil sample is collected and the grab ground water sample would be collected from an open hole.

7. Logging soil samples

7.1. Lithologic Descriptions

The site lithology should be described according to the United Soil Classification System (USCS) ASTM D2487. At a minimum the description should include the following

- Soil type

- Color (Munsel)
- Sorting
- Grain size with percentages most to least
- Any modifiers
- Soil consistency
- Moisture content

Changes in lithology shall be indicated with a solid line if the contact is sharp, a dashed line if there is a gradational contact, and a dashed line with question marks if the contact depth is unknown. For consolidated, hard rock soil lithologic descriptions, refer to Soil Rock Logging and Classification and Presentation Manual, California Department of Transportation (CalTrans), 2010.

When drilling through contaminated soil, observations regarding the nature of contamination should be recorded in the notes section of the bore log. These observations should include at a minimum a description of the following:

- Odors
- Staining or soil discoloration
- Photo ionization detector (PID) readings, every 6" and at significant changes in lithology.
- Contaminant migration observations (i.e. maximum contamination is observed at the base of the sand layer or contamination is migrating through fissures in the clay layer)

7.2. Measure Depth to Water

Prior to sample collection, measure the depth to water using an electric water level meter as described below.

- Lower the electrode probe slowly into the well until the indicator shows that the circuit is closed and contact with the water surface is made.
- Place the nail of the index finger on the insulated wire at the MP and read the depth to water. Raise the electrode to a height that is slightly above the depth to water to see if the water is rising in the boring.
- Make a note of the depth to water and whether the depth to water has stabilized in the well. Note the initial depth to water will be indicated based on the first significant water bearing zone as noted in the lithologic description. The static water level will be based on the measured depth to water in the soil boring.

7.3. Ground water Sampling Methods

7.3.1. Sample Collection with Dedicated Tubing and a Ball Check Valve

- Cut an appropriately sized length of HDPE tubing to extend to the base of the bore hole leaving at least two feet above the top of casing.
- Attach the ball check valve to the dedicated tubing and insert the tube into the PVC casing installed in the borehole. The check valve should be located in the middle of the screen zone.
- Rapidly raise and lower the dedicated tubing a distance of approximately six inches until water is observed at the top of the dedicated tubing and repeat the motion until sample bottles are filled.
- Either decontaminate tubing between locations, or dispose and dedicate new tubing for additional locations.

7.3.2. Sample Collection with a Bailer

- Attach a stainless or disposable polyethylene bailer with a ball check valve to a string and lower downhole to the base of the screen zone.
- Fill the bailer with water and retrieve using the dedicated string.
- Decant water from the bailer into the sample bottles and repeat until all sample bottles are filled.
- Either decontaminate tubing between locations, or dispose and dedicate new tubing for additional locations.

7.3.3. Sample Collection with a Peristaltic Pump

- Cut an appropriately sized length of HDPE tubing to extend to the base of the bore hole leaving at least two feet above the top of casing.
- Insert the tube into the PVC casing installed in the borehole. The pump intake should be located in the middle of the screen zone.
- Attach approximately 6 inches of silicone tubing to the top of the HDPE tubing and place the silicone tubing in the peristaltic pump head. There should be approximately 2 feet of HDPE tubing attached to the other end of the silicone tubing.
- Connect the pump to a power source, check to make sure the flow direction of the pump is in the right position, turn the pump on and adjust flow rate accordingly and fill sample bottles.

8. QA/QC Sampling Procedures and Sample Handling

Collected samples are placed in appropriate laboratory-supplied containers, labeled, documented on a chain of custody form, and placed on ice in a chilled cooler for transport to a NELAP certified analytical laboratory. Analytical detection limits should match or surpass standards required by relevant local or regional guidelines.

8.1. Quality Control Samples

To prevent contamination of the samples in the field, the following measures should be taken:

- Put on a clean pair of latex gloves prior to sampling each well;
- Advance and sample borings in the order of increasing degree of contamination based on available site data; and
- Based on the site conditions, regulatory requirements, or clients' request, include trip blanks and equipment blanks to QC the sample handling and transportation procedures, and include duplicate samples to QC the lab procedures.

The collection of blank and duplicate samples required by the project are specified in the Work Plan. All blank and duplicate samples, with the exception of the temperature blank, will be analyzed by the same analytical methods as the original sample unless otherwise specified in the Work Plan or QAPP:

- Trip blank samples will be prepared by the laboratory using DI water. Samples will accompany the bottles from the lab to the field and back to the lab for analysis without being opened. The bottles will be from the same package used for the sample collection. Trip blanks are prepared by the laboratory. They are transported to the site in the same manner along with other laboratory-supplied sample bottles/containers. The trip blank are not opened in the field, and are returned to the laboratory with the collected ground water samples.
- Duplicate samples will be collected in the same manner and directly after the original sample is collected. The sample label and COC will not reference the original sample in the sample name. The field technician will indicate in the well sampling data sheet the well the duplicate sample was collected from. Duplicate samples are collected to verify the repeatability of laboratory procedures. The number of duplicates is determined based on the number of monitoring wells and the size of the monitoring program.
- Field blank samples will be filled with a laboratory provided DI water in the field using the same equipment and sample design that is used to collect the monitor well samples. Anything that comes into contact with the actual sample will come into contact with the field blank. Field blank samples are different from the equipment blank samples because they are collected without using the field equipment. Field blanks can be poured into laboratory bottles or siphoned using dedicated tubing.
- Temperature blank samples will be filled with DI water provided by the laboratory. These samples will be stored in the base of the cooler and delivered to the lab for a temperature check

upon receipt. A temperature blank can be made in the field using a 250ml polyethylene container and DI water.

- Equipment blanks are obtained in the field to determine if the non-dedicated field sampling equipment has been effectively decontaminated. For sampling equipment used to collect samples (i.e. sampling pumps, valves, etc.), laboratory provided DI water is collected with the equipment to generate an equipment blank. For any non-dedicated equipment that comes into contact with the sample (i.e water level meter, water parameter probes, etc.) equipment rinsate blanks are collected from DI water that is poured over the field equipment that comes into contact with the sample. The rinsate water is poured through a funnel that will be decontaminated between each rinsate sample collection. Depending on the method used to collect the sample, the sample may be a combination of the rinsate and equipment blanks. The equipment blanks are transported to the laboratory in the same manner along with other collected ground water samples, and are analyzed for the same chemical constituents as the ground water samples collected at the site.

9. Close Monitoring Event

The following work should be performed prior to leaving the site:

- Decon the equipment
- Seal the drums that store soil cuttings, and place them in a secure area
- Remove the cones/tapes and clean the ground
- Checkout with the site manager and call the project manager in the office

References

ASTM 2002. *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations.* Designation: D 6771-02

Wilde, F.D., ed., 2004, Cleaning of equipment for water sampling (version 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A3, accessed July 17, 2006, at *http://pubs.water.usgs.gov/twri9A3/*.

USGS, Cunningham, W.L., Schalk, C.W., Groundwater Technical Procedures of the US Geological Survey, Techniques and Methods 1-A1, US Department of the Interior, 2011

USEPA, *Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels,* July 1996

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SOIL SAMPLING -

STANDARD OPERATING PROCEDURES (SOP)

Table of Contents

1. Purpose

This document focuses on the equipment, field procedures, and level of accuracy and quality control measures required for soil sampling. This SOP will be used to guide AWR field staff to perform soil sampling, maintain consistency of field procedures, and facilitate the assurance of the quality and reliability of data obtained from all soil sampling events monitoring events. This SOP is designed to facilitate the collection of soil samples from a drill or direct push rig or the collection of shallow soil samples with hand tools. This SOP is not intended to direct sediment sampling from a river, lake or seafloor.

2. Equipment

Soil sampling efforts need the following equipment and supplies:

- Sampling Sheets, Logs and Site Information
  - Project description, site maps, chain-of-custody, SOP, QAPP, Work Plan, field data forms, activity logs, camera, GPS unit, clipboard, well condition checklist, indelible ink pen.
  - Health and Safety Plan (HASP)
  - Site information including previous investigation and monitoring data with boring logs and cross-sections if available
  - Permission /notification to access land/home owner/tenant and contact information.
- Safety Equipment
  - Hardhat, boots, safety vest/suit, and gloves or appropriate Personal Protective Equipment (PPE) as specified in the HASP
  - Traffic control cones and tapes
  - Sun and heat protection (at least 1 liter of water per hour and sunblock)
  - Cellular phone with Contact Numbers
- Soil Sampling and Lithology Logging Equipment
  - Tape measure
  - Lithology Description aids: Munsell color chart, hand lens, grain size chart, USCS definitions
  - Survey stakes, flags, or buoys and anchors
  - GPS device
  - Camera and film
  - Stainless steel, plastic, or other appropriate composition bucket
  - Cooler(s) with wet ice
  - Spade or shovel, putty knife

  - Hand auger if necessary with extension rods
  - T-handle sampler for collection by EPA Method 5035
  - Backhoes or excavator as needed
  - Direct Push or Augur drilling rig as needed
- Sampling Supplies and Containers
  - 4/8/16oz, wide-mouth jars w/Teflon-lined lids
  - Ziploc or similar plastic bags
  - Sample jar labels
  - Chain of custody forms
  - Custody seals
- Decontamination Equipment
  - Decontamination supplies/equipment: Bucket with Alcoanox® or similar detergent and water
  - Rinse buckets for decontamination
  - Waste storage drums and buckets
  - Deionized (DI) water

3. Procedures

Each soil sampling project will include the following procedures, and should be performed in the designated order:

1. Project Preparation
2. Equipment Decontamination
3. Soil Sample Methods
4. QA/QC Sampling Procedures
5. Close Monitoring Event

4. Project Preparation

- Coordinate with project manager
- Review project description, site direction, site maps, list of chemicals to be analyzed, HASP
- Review the sampling methods to be employed, and the equipment and supplies required according to the Work Plan and/or Quality Assurance Project Plan (QAPP)
- Obtain necessary permits, utility clearance and access agreements.

- Obtain appropriate sampling and monitoring equipment.
- Decontaminate sampling equipment and ensure that it is in working order.
- Prepare schedules, and coordinate with staff, client, land owner/operator, and regulatory agencies, if appropriate.
- As needed, perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
- Prepare chain-of-custody and sample labels
- Use stakes, flags, or other identifiers and mark all sampling locations. Specific site characteristics including morphology, water table, nature and extent of contaminant should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.
- Contact analytical lab to coordinate and bottle order preparation and delivery and sample courier pickup or drop off point.
- Notify site manager/site contact at least 24 hours prior to field effort.

5. Equipment Decontamination

After checking in with the site manager, a decontamination area and traffic control cones should be setup prior to well gauging and sampling. Any non-dedicated sampling equipment should be decontaminated prior to use. Equipment should be scrubbed in a Liquinox® solution wash. Wash solution is also pumped through purging pumps and rinsed with potable water. The same equipment should be rinsed again with potable water or de-ionized water if the latter is required.

6. Soil Sample Methods

Soil samples may be collected using a variety of methods and equipment, depending on the portion of the soil profile required (surface versus subsurface), and the type of sample required (disturbed versus undisturbed) and the soil type. SOPs are described in this section for soil sampling using a trowel or hand Scoop, a hand augur, a backhoe or excavator, or a direct push or hollow stem augur drill rig

6.1. Soil Sample Handling and Laboratory Conveyance

Regardless of the means used to collect soil, samples will be handled and conveyed to the laboratory as described below.

- For composite sample, either direct the laboratory to homogenize the sample, or in the field homogenize grab samples in a plastic, glass or stainless steel mixing container using the appropriate tool (stainless steel spoon, trowel, or pestle).
- Chemical preservation of solids is generally not recommended, but check with the laboratory for proper preservation methods and sample hold times.

- If collecting into a glass or plastic jar, fill container at a minimum to the volume/weight specified per the analytical method and secure the cap tightly.
- If collecting samples from an acetate brass tube or other core barrel liner, cap the ends with the manufacturer recommended end caps with Teflon tape as specified per the Sampling Work Plan or QAPP. Acetate and plastic liners may be cut at the desired interval using a clean saw blade.
- Unless otherwise specified in the Work Plan or QAPP, soil samples analyzed for volatile organic compounds (VOCs) will be collected to comply with the USEPA Method 5035. This is described in further detail in Section qqq.
- Label and tag sample containers, and record appropriate data on soil sample data sheets (depth, location, color, lithology description, other relevant observations).
- Mark all sampling locations with marking paint, flagging, stakes, as determined by field conditions. If sufficient satellite contact can be obtained, use a handheld GPS device, to generate coordinates for the sample locations. If minimal or no satellite connection can be established, indicate on a site map the locations of all sample collection points and approximate distances to building or other recognizable features. Sample locations will be professionally surveyed per specification in the Work Plan or QAPP.
- Place sample containers in sealable plastic bags, and if required, place containers into an iced shipping container. If required by the laboratory analysis, samples should be cooled to 4°C or frozen as soon as possible.
- Complete chain of custody forms and deliver to laboratory as soon as possible to minimize sample holding time.
- Follow required decontamination and disposal procedures

6.2. Sample Recovery with a Trowel or Hand Scoop

Collection of surface soil can be accomplished with tools such as stainless steel or polycarbonate spades, shovels, and scoops. Surface soil can be removed to the required depth with a garden spade, then use a stainless steel or plastic scoop to collect the sample. A stainless steel or plastic scoop or lab spoon will suffice in most applications, and if possible the sample can be collected using the sample container. The following procedures are intended for soil samples collection with a scoop or trowel:

- Using a pre-cleaned shovel or trowel to remove the vegetation and top layer of soil, then loosen the desired volume of soil from the sampling area.
- Transfer the discrete sample into an appropriate sample container.

6.3. Sample Recovery with a Hand Auger

A hand auger bores a hole to a desired sampling depth and then is withdrawn. Be sure to use the appropriate hand augur tip based on the anticipated soil conditions. The auger tip is then replaced with a split tube core sampler that is attached to a slide hammer, which is lowered down the borehole, and driven into the soil at the completion depth. The split sampler can be lined with an acetate or similar material liner to aid in sample collection and reduce sample exposure. The core is then withdrawn and the sample collected from the split sampler. Use the following procedure to collect soil samples with a hand auger:

- Insert the auger into the material to be sampled at a 0° to 45° from vertical. This orientation minimizes spillage of the sample from the sampler. Extraction of samples may require tilting of the sampler.
- Rotate the auger once or twice to cut a core of material.
- Slowly withdraw the auger, making sure that the slot is facing upward.
- An acetate core may be inserted into the auger prior to sampling, if characteristics of the soils or body of water warrant. By using this technique, an intact core can be extracted.
- Transfer the sample into an appropriate sample or homogenization container.

6.4. Soil Sample Collection Using an Excavator or Backhoe

Soil sample collection can be made easier with the aid of heavy earth moving equipment. The following instructions are to assist in the collection of representative soil samples from trenches advanced with excavation equipment.

- Prior to advancing trenches with heavy earth moving equipment, conduct a tailgate meeting with the excavation operator to discuss related communication and all health and safety protocols for heavy equipment operation.
- Advance excavation trench to the desired depth interval for sample collection per the Work Plan or QAPP.
- Collect soil sample from the bucket of the excavator per the methods described in Section 6.1 and 6.2.
- If necessary to enter the trench to collect samples, assure compliance with all OSHA related confined space protocols per California Code of Regulations (CCR 5157), prior to entering excavation pit. Collect samples from the pit sidewall per Section 6.1 and 6.2.

6.5. Sample Recovery from a Drill Rig

For soil sample recovery using a direct push or drill rig, follow these procedures to ensure accurate and representative sample collection. While the drilling contractor will generally prepare and advance the sampler, *it is the responsibility of the field geologist to assure that samples are collected per the specifications in this SOP*. If the drilling contractor has failed to furnish the proper equipment, or refuses to advance the sampler as instructed, stop work and contact the Project Manager.

The methods described below serves as a general guide for soil sample collection from a drill rig. Sample collection methods may change depending on the field drilling conditions or equipment limitations. Any variations or deviations from the Work Plan and/or QAPP will be discussed with the Technical Project Manager prior to sample collection and noted in the field data sheets.

- Prior to advancement of any boring with power equipment, verify that Underground Service Alert (USA) has responded to the ticket and marked their facilities, and if specified, a private utility locator has cleared the site. If possible, hand clear the upper 5-feet of the boring location to check for utilities.

- Conduct a tailgate meeting with the drilling contractor to discuss related communication and health and safety protocols.
- Pay special attention to the orientation of the sample barrel and the top of the soil sample. It is common for material (slough) to fall to the total depth of the hole and be collected in the sample liner. Refer to the lithologic log to determine where the in situ material begins.
- Confined sand layers under certain hydrologic conditions are prone to traveling up the borehole to seek the static water level (flowing or heaving sands). Pay special attention to the base of the sample hole to determine the presence of heaving sands. Drilling and soil sample collection methods may change depending on the presence of heaving sands.

6.5.1. Direct Push Rig (Geoprobe or similar)

- Advance to the top of the desired sampling depth. Per the specifications in the Work Plan or QAPP, assure that the proper barrel size and technique (i.e. macrocore, dual tube, closed piston) is used.
- Assemble the coring device by inserting the acetate core (liner) into the sample barrel sampler and placing the "shoe" at the end of the sample barrel.
- For loose sandy materials place a "sand catcher" into the tip of the liner with the convex surface positioned inside the acetate core to ensure adequate sample recovery.
- Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
- Drive or push the sampler into the subsurface to the desired sample collection depth.
- Record the length of the tube that penetrated the sample material.
- Pull or "trip out" the drilling rods out of the subsurface.
- Unscrew the "shoe" and slide the acetate core out of the sampler tube, cut and cap as described in section 4.1.

6.5.2. Hollow Stem Auger Drilling Rig

- Advance to the top of the desired sampling depth. Per the specifications in the Work Plan or QAPP, assure that the proper augur diameter and drilling technique are used.
- Assemble the sample barrel (split spoon sampler or similar) and insert liners (acetate, brass, etc.) as specified. Use a sand catcher for loose sandy materials to ensure sample recovery.
- Insert the sample barrel into the hollow stem hole and attach rods to lower to the total depth of the hole.
- Push or hammer the sample barrel to the desired sample depth. Record the number of hammer blows for every 6-inch sample interval.
- Open the shoe at the base of the sample barrel and collect samples as described in Section 4.1.

6.6. EPA Method 5035 Compliant Soil Sample Collection

Unless specified otherwise in the Work Plan or QAPP soil samples for VOCs will be collected consistent with 5035 soil sampling guidance (DTSC, 2004). Soil samples will be collected with Pre-cleaned and sealed sample containers provided by the laboratory or manufacturer. The "T"-handle used to collect samples will either be: 1) certified pre-cleaned and dedicated to each sample location, 2.) Not come into contact with the sample container, or 3) be thoroughly decontaminated between each sample location.

To minimize volatilization during sample collection, VOC samples will be collected immediately after the soil core has been exposed to atmospheric conditions, put on ice and delivered to the laboratory as soon as possible. All other specifications and sampling details are provided in the Guidance document (DTSC, 2004).

6.7. Sampling Soil for Mercury Analysis

Mercury Low level and methyl mercury sampling for water will be compliant with the specifications in Method 1669 (USEPA, 1996). This method requires the "clean hands dirty hands" approach to field sampling. Therefore a minimum of two trained sampling personnel must be on site to collect low leve and methyl mercury samples.

7. Quality Assurance (QC) Measures

To prevent contamination of the samples in the field, the following measures should be taken:

- Put on a clean pair of latex gloves prior to sampling each well;
- Collect soil samples order of increasing degree of contamination based on historical analytical results. However, if the purpose of the soil sampling is to delineate the extent of contamination, this guidance does not apply.
- Based on the site conditions, regulatory requirements, or clients' request, include duplicate and other QA/QC samples per the specifications in the Work Plan or Quality Assurance Project Plan (QAPP).

8. Closing of Monitoring Event

The following work should be performed prior to leaving the site:

- Decontaminate the equipment
- Stake and record GPS location coordinates for all soil sampling locations
- Seal the drums, if any that store waste soil, and place them in a secure area
- Remove the cones/tapes and clean the ground
- Checkout with the site manager and call the project manager in the office

9. References

ASTM 2002. *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations.* Designation: D 6771-02

DTSC , Guidance Document for the Implementation of United states environmental protection agency Method 5035: Methodologies for Collection, Preservation, storage, and preparation of soils To be analyzed for volatile organic compounds, 2004

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SOIL VAPOR WELL INSTALLATION AND SAMPLING

STANDARD OPERATING PROCEDURES (SOP)

Table of Contents

1. Purpose

This document focuses on the equipment, field procedures, and level of accuracy and quality control measures required for performing soil vapor monitoring. This SOP will be used to guide AWR field staff to perform the soil vapor monitoring and sampling efforts properly, to maintain consistency of field procedures, and to facilitate the assurance of the quality and reliability of data obtained from all events. These procedures are based on guidance from DTSC's Soil Gas Investigation Advisory (DTSC, 2015), but are also subject to local regulatory requirements.

2. Equipment

- Safety Equipment
  - Hardhat, boots, safety vest/suit, and latex or nitrile gloves or appropriate Personal Protective Equipment (PPE) as specified in the HASP.

- Sun and heat protection (at least 1 liter of water per hour and sunblock for hot days)
- Traffic control cones and tapes
- Cellular phone, fully charged, with contact numbers
- Flashlight

Installation of soil vapor wells requires the following depending on depth and whether it will be installed permanently or temporarily:

- Soil Vapor Well Installation
    - 3/4" PVC casing (length dependent on depth of proposed well)
    - Tape measure
    - #2/12 Monterey sand
    - Bentonite crumbles #8
    - Portland cement
    - Concrete mix
    - Teflon tubing
    - Aquarium filters
    - Gas-tight valve or end cap for tubing
    - Traffic-rated well box

Soil vapor monitoring requires, at a minimum, the following equipment and supplies:

- Sampling Sheets, Logs and Site Information
    - Project description, site maps, chain-of-custody, SOP, QAPP, Work Plan, field data forms, activity logs, camera, GPS unit, clipboard, indelible ink pen.
    - Health & Safety Plan (HASP)
    - Site information including previous monitoring data and boring logs as applicable.
    - Permission /notification to access land/home owner/tenant and contact information.
- Sampling Equipment
    - Helium shroud
    - Helium analyzer
    - Helium canister
    - 9/16" wrench
    - 1/2" wrench
    - Swagelok nuts and ferrules
    - Timer
    - Air sampling pump

- 50mL or higher syringe
- Isopropyl alcohol and paper towels (if needed)
- Laboratory-supplied summa canisters
- Laboratory-supplied manifolds
- Laboratory-supplied sorbent tubes
- Tools for opening well lids, string, tubing, and duct or Teflon tapes
- Keys for site
- Cooler and/or boxes

3. Procedures

Soil vapor monitoring include the following procedures, and should be performed in the following order:

1. Project preparation
2. Soil vapor well construction
3. Shut-in test
4. Downhole integrity test
5. Well purging and record field data
6. Well sampling and record field data
7. Follow QA/QC sampling procedures and handling of samples
8. Close the monitoring event

4. Project Preparation

The following work should be conducted prior to arriving the site:

- Contact project manager
- Review project description, site direction, site maps, list of chemicals to be analyzed, HASP
- Determine the extent of the sampling effort, the sampling methods to be employed, and required equipment and supplies according to the sampling Work Plan or Quality Assurance Project Plan (QAPP) plans for the site.
- Obtain necessary permits, utility clearance and access agreements.
- Obtain appropriate sampling and monitoring equipment.
- Pre-clean equipment, and ensure that it is in working order.
- Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
- As needed, perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

- Prepare chain-of-custody and sample labels
- Contact analytical lab to coordinate order preparation, delivery, and sample courier pickup or drop off point.
- Notify site manager/site contact and regulator at least 48 hours prior to field effort.

5. Soil Vapor Well Construction

Construction of permanent or temporary soil vapor wells is the preferred method for collecting soil vapor samples to assess potential vapor intrusion. Permanent sampling wells are installed so that repeated sampling can be conducted, as necessary. Temporary sampling wells are typically used for one or two sampling events and then decommissioned in accordance with the local regulating agency requirements and the methods described in the Well Abandonment Section. Construction methods, as described below, are the same for permanent and temporary wells. All permanent sampling wells will be installed in traffic rated well boxes designed to shed surface water, or above grade monuments.

Soil vapor wells are installed within a boring that is created by direct push drilling equipment, hollow or solid stem augers, or a hand auger. Borehole diameter for soil vapor well construction will be a minimum of 2 inches. The soil vapor well can be constructed in an open hole only when soil conditions are structurally stable. If soil conditions are unstable, the hole will be cased prior to well construction. The following steps are implemented once the boring has been advanced to the desired soil vapor sampling depth:

1. A bed of sand is poured in the bottom of the boring prior to placement of the tubing to ensure the minimum 2" from the bottom of the boring.
2. PVC casing is placed from ground surface to the base of the boring to ensure placement of the sample tubing in the center of the borehole. This casing will be removed as the sand pack, and transition seal are being placed, and will be fully removed before the annular seal is placed.
3. Tubing with a filter or screen at the bottom of the tubing is placed through the PVC casing to the bottom of the boring. At least 1 foot of tubing will remain above ground surface to enable sample collection.
    a. Tubing will be made of material that will not react with site contaminants (i.e. Teflon, stainless steel).
    b. Standard tubing size is 1/8 to 1/4 inch, but for sites where fine-grained materials are present, larger diameter tubing, up to 3/4 inch may be used.
4. A sand pack is installed around and over the bottom of the tubing and filter, with a total thickness of about 1 foot. For soil vapor wells deeper than 15 feet, the sand pack will be placed using tremie pipe to avoid bridging. The sand will be clean, and sized as RMC Lonestar Number 2/12, or similar.

5. A dry bentonite transition seal is installed with a total thickness of about 1 foot, and no less than 6 inches. For soil vapor wells deeper than 15 feet, the bentonite will be placed using tremie pipe to avoid bridging.

6. The annular seal is placed above the bentonite transition seal:

    a. **If the well is to be used for more than one year (permanent well)**, following the dry bentonite, the borehole is filled to the surface with neat cement containing 1-5% bentonite to create the annular seal.

    b. **If the well is temporary or will be abandoned within a year (temporary well)**, following the dry bentonite the borehole is filled with a thick, yet pourable, hydrated bentonite slurry.

    c. As the annular seal is being placed the soil vapor tubing will be held vertical to keep the tubing centered in the borehole.

7. A traffic rated well box is installed at ground surface to protect permanent soil vapor wells and minimize the intrusion of storm water.

8. The top of the tubing is capped with a gas-tight valve or fitting and the well lid is secured and completed to prevent water infiltration into the subsurface.

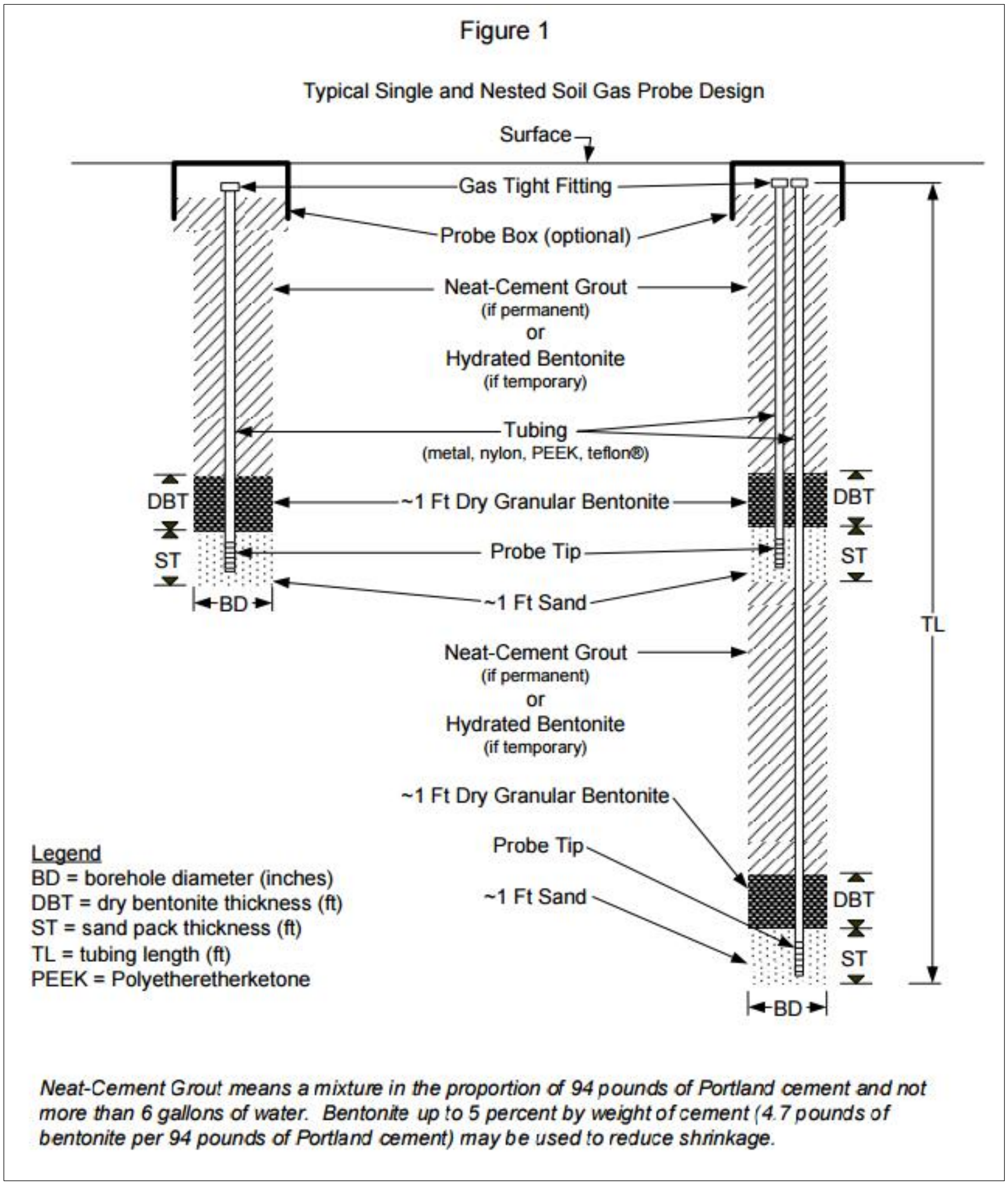
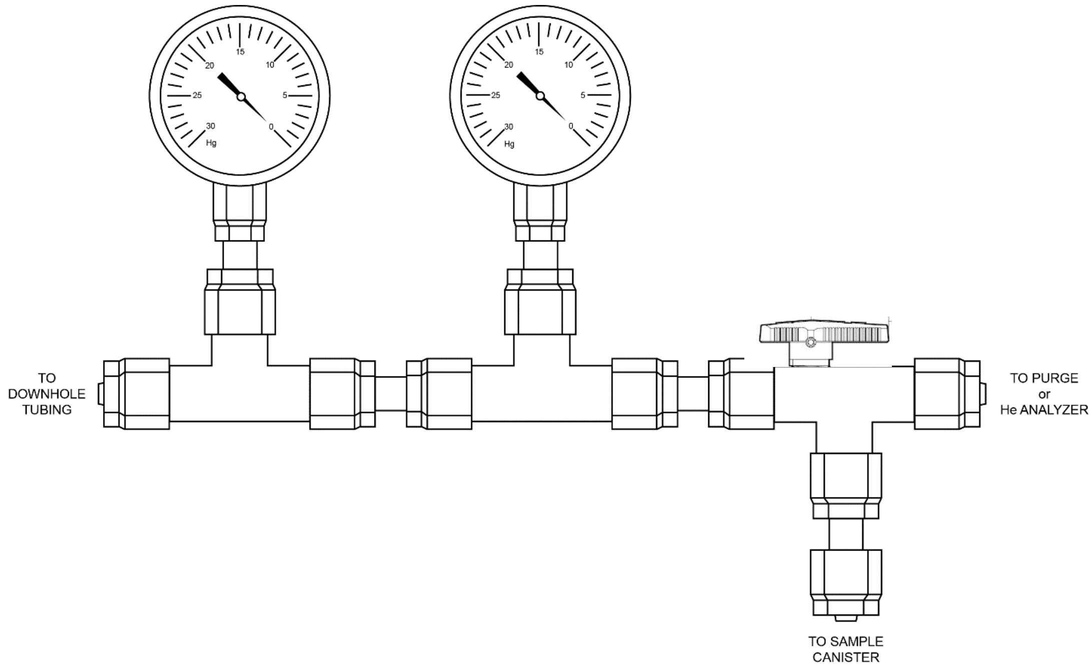


Figure from the 2015 DTSC Active Soil Gas Investigations Advisory

6. Soil Vapor Sampling

Drilling and well installation disturbs the subsurface conditions. To allow for the subsurface to equilibrate back to representative conditions, the purge volume test, leak test, and soil vapor sampling will be conducted at least two hours after soil vapor well installation with direct push. For soil vapor wells installed with hollow stem or hand auguring equipment, the equilibration time will be at least 48 hours. Soil vapor sampling will not be conducted during a rainfall event and not until at least five days after a significant rainfall event (greater than ½ inches of rain over 24 hours). Soil vapor samples will be free of water, and no sample will be collected if water is observed during purging. Leak tests, purge methods, and soil vapor sampling methods are based on DTSC's soil gas investigation advisory (DTSC, 2015).

Soil Vapor Sample Manifold – Typical Example



Purge Volume

For both permanent and temporary soil vapor wells, three purge volumes will be removed prior to obtaining a sample that is representative of subsurface conditions.

One purge volume is the sum of the following volumes:

- The internal volume of tubing;
- The void space of the sand pack; and
- The void space of the dry bentonite.

Shut in Test – Sample Canister and Sampling Manifold

A dedicated pressure gauge is used to record pressure in each 1.4L sample canister for a minimum of five minutes prior to sampling. If a significant change in pressure is observed, a different sample canister will be used for sample collection.

A shut-in test is conducted to assess the tightness of the sampling manifold and before connecting the manifold to the downhole soil vapor well tubing.

1. After confirming that the 6L purge canister and 1.4L sampling canister valves are closed, the brass caps from each will be removed and the manifold will be attached to each canister.
2. The manifold center will be attached to a 1.4L summa canister and a 6L summa canister will be attached to the purge valve end of the manifold using Teflon tubing.

3. A brass cap will be secured at the inlet of the manifold creating an air tight system. The manifold valve and purge canister valve will be quickly opened and closed to perform the shut-in test.

4. The needle on the gauge on the manifold will be observed for at least two minutes for any possible leaks in the manifold or connections.

5. If a change in pressure is observed, fittings will be tightened and the manifold re-tested for leaks following steps 1-4 above. A new sample manifold will be used if a change in pressure continues.

6. If no change in pressure is observed, then the sample manifold is considered tight and the purging and sampling process continues.

Helium Shroud Purging and Sampling Procedures

Helium is used as a tracer to evaluate whether ambient air is introduced into the soil vapor sample during the collection process.

Downhole Integrity Test

1. Connect the downhole tubing to the manifold, place the manifold and sampling canister into the helium shroud, seal the shroud, and open the valve on the helium canister to allow a small amount of helium into the shroud.

2. Use a syringe to pull air using the tubing in the shroud's port through the in-line helium analyzer. Once the analyzer reads 10%, lower the flow of helium entering the shroud. Maintain 10% helium inside the shroud.

3. Disconnect the tubing from the purge canister and connect to the inlet of the in-line helium analyzer.

4. Purge approximately one case volume through the in-line helium analyzer using tubing in the outlet and a syringe to ensure no helium is present downhole. If there is helium present, rehydrate bentonite/cement mixture, and let rest. Retest after at least 30 minutes.

5. If there is no helium present, then proceed with purging.

Well Purging

The soil vapor well will be purged using a 6-liter summa canister, centrifugal air pump, syringe, or vacuum pump. Purge volume will be calculated based on the flow rate indicated on the air pump or summa can flow reducer, or the change in pressure observed in the summa canister. The soil vapor well can be field screened for leaks by drawing purge vapor through the manifold and through the in-line helium analyzer.

1. Connect the purge tubing to the in-line helium analyzer and then connect the purging device through the in-line helium analyzer and observe if any helium is detected while purging.

2. During purging and prior to sample collection, utilize the analyzer to indicate if helium is present in the manifold or if the well seal is compromised.

a. If the analyzer detects helium above 0%, implement corrective measures such as hydrating the bentonite seal, tightening the fittings, or replacing the tubing. Retest accordingly.

b. If helium is not detected above 0%, then continue with purging until the appropriate purge volume has been removed.

3. Proceed with sampling.

Soil Vapor Sampling

1. Once the appropriate volume has been purged and the set does not reveal leaks (e.g. helium is not detected), close the manifold valve and purge canister valve and open the sample canister.

2. Record helium readings in the shroud every 1-2 minutes during sampling.

3. Once the vacuum gauge reaches 4 inches of mercury or less, sampling is completed, and the 1.4L summa canister is considered full.

Helium per ASTM method D1946 will be analyzed in all samples to determine if the leak tracer (e.g. helium) is present in the sample.

Unshrouded Soil Vapor Sampling with Leak Check Compound

The soil vapor sampling manifold is connected to the downhole tubing with a nut and ferrule fitting. Once the sample canister is connected and air is flowing based on the manifold pressure readings, a clean paper towel soaked in the liquid leak check compound (e.g. acetone, isopropyl alcohol) is applied to the fittings and the top of the well seal. Once the manifold pressure gauge reads less than 4 inches of mercury, disconnect the sample canister from the manifold and store as described in the following section.

The leak check compound will be selected based on the target analytical compounds for the site. The compound should not interfere with the target analytes. Verify with the proposed analytical laboratory the appropriateness of a leak check compound prior to sampling and request that the compound is reported in addition to the target analytes.

Sampling for TO-17 Using Sorbent Tubes

Method TO-17 is used to analyze for naphthalene or for soil vapor wells that are likely to have significantly elevated concentrations. If the sorbent tube is being used as a method of collection for all volatile organic compounds, then the sorbent tube can be used in-line with a sample canister in the methods described above in order to allow for a leak check. The following describes the method collection for naphthalene:

1. Using clean gloves, the sample tubes are unwrapped from the foil and the brass caps are removed.
2. The downhole tubing is attached to the upstream end of the sorbent tube and tubing attached to a syringe or a purging pump set to 150mL/min is attached to the downstream end.
3. While sampling, push outflow air through helium detector to ensure helium is not entering the sorbent tube and record on field sheet.

4. Sample volume pulled through the sorbent tube depends on the required dilution for appropriate reporting limits. Sample volume will be noted on field sheets and the COC.
   a. If high concentrations are expected, two sorbent tubes will be collected: The first tube will have 1 liter of air pulled through and the second tube will have 100mL pulled through.
5. Replace the end caps of the sorbent tube, wrap in foil, and place in a cooler with ice.

7. Recording, Labeling, Storage, Handling, and Transport

All samples will be labeled with a unique sample identification, the location of the sample, date and time of collection. Purge and sample volume, flow rates, helium concentrations, vacuum check and shut in test data shall be recorded in the field form for soil vapor sampling. Samples will be stored away from direct sunlight in coolers or boxes and transported under standard chain of custody procedures to a NELAP certified analytical laboratory.

8. Well Abandonment

When sample collection ceases at a soil vapor well, the well will be abandoned with concurrence from the local regulating agency. Unless otherwise directed by the regulatory agency, the following steps will be followed when decommissioning a soil vapor well:

1. Either pull or cut the well tubing as far below grade as possible;
2. Fill any void space hole with either hydrated bentonite or neat cement to within one foot of the surface grade;
3. Fill the last foot of the hole with compacted native material; and,
4. Restore pavement and vegetation to original conditions, or as requested by the land owner.

If the soil vapor well penetrates a confining clay unit, overdrilling rather than abandoning in place is recommended to prevent potential contaminant migration across distinct lithologic zones. During overdrilling of deeper soil vapor wells (greater than 10 feet bgs) appropriate measure will be applied to prevent lateral drifting of the drill bit while advancing down hole. All overdrilled holes will be grouted in accordance with local regulatory specifications.

9. References

DTSC, California EPA, and RWQCB San Francisco and Los Angeles, *Advisory Active Soil Gas Investigations*, July 2015

2363 Mariner Square Dr., Suite 245, Alameda CA, 94501

GROUND WATER MONITORING AND SAMPLING - LOW-FLOW STANDARD OPERATING PROCEDURES (SOP)

Table of Contents

1. PURPOSE

This document focuses on the equipment, field procedures, and level of accuracy and quality control measures required for the ground water monitoring and sampling program using low-flow techniques. This SOP will be used to guide AWR field staff to perform the ground water monitoring and sampling efforts properly, to maintain consistency of field procedures, and to facilitate the assurance of the quality and reliability of data obtained from all ground water monitoring events.

2. EQUIPMENT

Ground water monitoring and sampling require, at a minimum, the following equipment and supplies:

- Sampling Sheets, Logs and Site Information
  - Project description, site maps, chain-of-custody, SOP, QAPP, Work Plan, field data forms, activity logs, camera, GPS unit, clipboard, well condition checklist, indelible ink pen.
  - Health & Safety Plan (HASP)
  - Site information including previous monitoring data and well construction logs as applicable.
  - Permission /notification to access land/home owner/tenant and contact information.
- Safety Equipment
  - Hardhat, boots, safety vest/suit, and latex or nitrile gloves or appropriate Personal Protective Equipment (PPE) as specified in the HASP.
  - Sun and heat protection (at least 1 liter of water per hour and sunblock on hot days)
  - Traffic control cones and tapes
  - Cellular phone with contact numbers, fully charged
  - Flashlight
- Sampling Equipment
  - Depth to water level indicator (sounder)
  - Calibrated buckets or similar device for purge water
  - Peristaltic or submersible pump
  - Tubing
  - Water quality meter(s) with flow-thru cell capable measuring the parameters identified in the work plan, typically at a minimum temperature, pH, EC, ORP, and DO.
  - Tools for opening well caps, string, tubing, and duct or Teflon tapes
  - Multi-phase sounder, if needed.
  - Keys for site and well locks

- Sampling Supplies
  - Laboratory-supplied sample bottles/containers
  - QA/QC sample bottles (trip blanks, field blanks, etc.)
  - Filtering apparatus and all accessories if sampling in field
  - Ice chest(s) with water ice
  - Ziploc® or similar plastic sampling bags
- Decontamination Equipment
  - Water with soap such as Liquinox® or similar solution
  - Rinse buckets for decontamination
  - Waste storage drums and buckets for purge water
  - Deionized (DI) water

3. Procedures

Ground water monitoring and sampling include the following procedures, and should be performed in the following order:

1. Project preparation
2. Equipment decontamination
3. Measure depth to ground water and bottom of well
4. Purge ground water from the monitor well and measure field parameters
5. Collect ground water sample
6. Label, store, and transport ground water samples under chain of custody to laboratory
7. Close the monitoring event

4. Project Preparation

The following work should be conducted prior to arriving the site:

- Contact project manager
- Review project description, site direction, site maps, list of chemicals to be analyzed, HASP
- Determine the extent of the sampling effort, the sampling methods to be employed, and required equipment and supplies according to the sampling Work Plan or Quality Assurance Project Plan (QAPP) plans for the site.
- Obtain necessary permits, utility clearance and access agreements.

- Obtain appropriate sampling and monitoring equipment.
- Decontaminate equipment and ensure that it is in working order.
- Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
- Contact analytical lab to coordinate and bottle order preparation and delivery and sample courier pickup or drop off point.
- As needed, perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
- Prepare chain-of-custody and sample labels
- As required, notify site manager/site contact and regulator at least 24 hours prior to field effort.

5. Equipment Decontamination and Calibration

Set up the decontamination and overall staging area. Utilize traffic cones or other barriers for safety, as necessary.

Decontaminate all non-dedicated downhole gauging, purging and sampling equipment prior to use with a Liquinox® (or similar) solution wash. Pump wash solution through the purging pumps and rinse with potable water. The same equipment should be rinsed again with potable water or deionized water to remove residual soap.

Calibrate all instruments in accordance with the manufacturer's manual and the site-specific sampling plan. During sampling, field probes should be checked for drift every four hours and at the end of the day at a minimum.

6. Measuring Depth to Ground Water and Depth of Well

If local ground water is under confined or semi-confined conditions, remove caps from the monitor wells to allow hydrostatic pressure to equalize with atmospheric pressure for at least 15 minutes prior to gauging. The static water level is measured to the nearest 0.01 feet with an electronic water level indicator. The following steps are based on the Groundwater Technical Procedures of the U.S. Geological Survey (USGS, 2011).

1. Measure from the least to the most contaminated monitor wells, based of prior information and site knowledge.
2. Check the circuitry of the sounder before lowering the probe into the well by pressing the test button and observing whether the light and (or) beeper (collectively termed the "indicator" in this document) are functioning properly.
3. Lower the probe slowly into the well until the indicator shows that contact with the water surface is made. Read the depth to water by observing where the tape exits the well. The tape

should be read where the surveyor marked the top of casing on the well or at the north side of the well casing.

4. Record the date, time, and the initial depth to water measurement on the field data sheet.

5. Pull the tape up and remeasure the measurement by repeating steps 3 and 4. If the measurement does not agree with the original measurement within 0.02 foot, wait at least 5 minutes for equilibration and recheck the measurement until the results are shown to be reliable. Complete the "Final DTW" portion of the field form.

6. After completing the water-level measurement, turn off the volume on the sounder and send the probe to the bottom of the well to measure the total depth. Depending on the placement of the zero measurement point (see photos below), it may be necessary to add to the measurement recorded for the total depth of the well. Record the total depth on the field sheet.

7. Measure the depth to bottom in each well at least once every year or more frequently, if needed, by lowering the depth to water probe to the bottom of the well. If the total depth to bottom is less than 1 foot than what was expected or if the sounder tape can not reach ground water, debris or well failure may be possible. Call the project manager and develop a proper plan of action.

8. Decontaminate the electronic sounder tape between wells.

7. Purging and Sampling of Monitor Wells Using Low-Flow Technique

The objective of the purging process is to remove sufficient water from within the screen zone to ensure that a sample representative of ground water conditions is collected. The following sampling methods are derived from the *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* (EPA 2002).

Prior to ground water sampling, each monitor well is purged using either a submersible pump or a peristaltic pump using low-flow techniques. All wells should be purged and sampled in the order from least contaminated to most contaminated.

Measure and record water quality parameters of the purged water, as specified in the work plan, which typically include pH, temperature, dissolved oxygen, and electrical conductivity (and may also include oxidation-reduction potential, total dissolved solids, and turbidity). A YSI® 556 MPS Multiparameter or similar instrument with a flow-through cell shall be used to measure these parameters.

7.1. Purging

1. Use a peristaltic pump or a submersible pump with the ability to pump at less than 500mL/min.

2. Place the bottom of the intake tubing to the peristaltic pump or submersible pump intake near the approximate center of the screened interval.

    a. Cut the tubing to the correct length based on the well construction details and the depth to the center of the screen zone. In wells where the total tubing length is greater than 40 feet bgs or if the tubing is not entering the well properly, attach a stainless weight to the bottom of the tubing by cutting a small hole in the tubing and stringing it using nylon twine.

    b. If the potentiometric surface is below the top of the well screen, place the peristaltic tubing (or submersible pump) midway within the water column but no closer than about 8-12 inches from the bottom of the well to avoid picking up any settled solids.

    c. The intake tubing to the peristaltic pump shall be comprised of polyethylene, and shall be new, or dedicated to the well. If dedicated to the well, the intake tubing should be left within the well for use in subsequent sampling events.

    d. The discharge tubing from the submersible pump shall be comprised of silicone tubing placed in the peristaltic pump head with polyethylene tubing exiting to the flow-through cell, and shall be new, or dedicated to the well. If dedicated to the well, the discharge tubing should be left within the well for use in subsequent sampling events.

3. Connect the discharge tubing from the peristaltic or submersible pump to the flow through cell, which is designed to minimize aeration of the water. Contain the purge water by discharging the flow through cell into a bucket.

4. Measure and record the initial water level measurement prior to the commencement of pumping. Note that the tubing and submersible pump will displace water in the well, which may raise the water level in the well above the level measured in Section 6.0 above.

5. Begin pumping at a flow rate no greater than 100-200ml/min.

    a. Adjust the flow rate (pump speed) until there is little or no water level drawdown. If drawdown is occurring, reduce the pump speed to the lowest rate to limit drawdown to the lowest minimum possible. Puls and Barcelona suggest a limit of less than 0.33 feet (1996).

    b. If drawdown cannot be stabilized by reducing the pumping rate and the water level is above the screened interval and approaching the top of the well screen, reduce the flow rate or turn off the pump for 15 minutes and allow for recovery. Be sure that the purged water is not returned back into the monitor well.

        - Begin pumping at a lower rate and if the water level again approaches the top of the screen, turn the pump off and allow for recovery.
        - If two tubing and flow-through cell volumes have been removed by purging, then sampling can begin after sufficient water returns to the well.

c. Attempts should be made to avoid purging the well dry, due to potential aeration of volatiles. However, if the well is screened across the water table in a low permeability zone, the well may be purged dry.

6. During well purging, record the required water quality field parameters every three to five minutes. Stabilization achieved when three consecutive readings are within the following limits:
   - DO (10% or ± 0.3 mg/L, whichever is greater)
   - Specific Conductance (3%),
   - Temperature (3%),
   - pH (± 0.1 units),
   - ORP (± 10 millivolts)

7. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized.

8. Decontaminate all purging equipment thoroughly between each well.

9. Transfer all purge and rinsate water to a sealed and labeled D.O.T.-approved 55-gallon drum unless otherwise specified in the Work Plan. Following proper chemical profiling and manifesting, these drums are picked up by a properly licensed liquid waste transporter for off-site disposal.

7.2. Sampling

1. Collect ground water samples

   a. immediately after purging in wells that have stabilized water levels and water quality parameters.

   b. no sooner than two hours after purging wells that either went dry or did not have stabilized water levels and after a sufficient volume of water has recovered within the well casing.

   c. Alternative sampling methods should be considered if a well consistently is low-yielding.

2. Disconnect the flow through cell and collect the ground water sample so that it is collected directly from the tubing discharging from the peristaltic or submersible pump.

3. Start the pump so that flow rate is the same or lower than the purging rate.

   a. First collect ground water samples that will be analyzed for volatile chemicals.

      - Fill the sample bottles by directing the water to run down the side of the bottle until there is a convex meniscus over the mouth of the bottle.

      - Carefully screw the lid onto the bottle such that no air bubbles are present within the bottle.

   - If a bubble is present, removed the cap and add more water to the sample container. If, after resealing the sample container, bubbles still are present inside the bottle, discard the sample container repeat the collection using a new container.

   b. Collect samples for analysis of non-volatiles by filling the bottle directly from the discharge tubing.

   c. Collect all samples in the appropriate laboratory recommended sampling containers with the recommended preservative and head-space requirements.

4. Label each sample with the

   - Sample ID
   - Site name
   - Sampler's initials
   - Time and date sample was collected
   - Analytical methods

5. Log each sample on the Chain-of-Custody and indicate the analytical method.

6. As soon as possible, place each sample within an ice chest containing ice to maintain the sample temperature at approximately 4 degrees Celsius.

7. Transport, or arrange for the transport, of the ice chest containing the samples and the chain of custody documentation, to the laboratory.

8. Quality Control Samples

To prevent contamination of the samples in the field, the following measures should be taken:

- Put on a clean pair of latex gloves prior to sampling each well;

- Gauge, purge and sample wells in the determined order of increasing degree of contamination based on historical analytical results; and

- Based on the site conditions, regulatory requirements, or clients' request, include trip blanks and equipment blanks to QC the sample handling and transportation procedures, and include duplicate samples to QC the lab procedures.

The collection of blank and duplicate samples required by the project are specified in the Work Plan. All blank and duplicate samples, with the exception of the temperature blank, will be analyzed by the same analytical methods as the original sample unless otherwise specified in the Work Plan or QAPP:

- Trip blank samples will be prepared by the laboratory using DI water. Samples will accompany the bottles from the lab to the field and back to the lab for analysis without being opened. The bottles will be from the same package used for the sample collection. Trip blanks are prepared by the laboratory. They are transported to the site in the same manner along with other laboratory-supplied sample bottles/containers. The trip blank is not opened in the field, and are returned to the laboratory with the collected ground water samples.

- Duplicate samples will be collected in the same manner and directly after the original sample is collected. The sample label and COC will not reference the original sample in the sample name. The field technician will indicate in the well sampling data sheet the well the duplicate sample was collected from. Duplicate samples are collected to verify the repeatability of laboratory procedures. The number of duplicates is determined based on the number of monitor wells and the size of the monitoring program.

- Field blank samples will be filled with a laboratory provided DI water in the field using the same equipment and sample design that is used to collect the monitor well samples. Anything that comes into contact with the actual sample will come into contact with the field blank. Field blank samples are different from the equipment blank samples because they are collected without using the field equipment. Field blanks can be poured into laboratory bottles or siphoned using dedicated tubing.

- Temperature blank samples will be filled with DI water provided by the laboratory. These samples will be stored in the base of the cooler and delivered to the lab for a temperature check upon receipt.

- Equipment blanks are obtained in the field to determine if the non-dedicated field sampling equipment has been effectively decontaminated. For sampling equipment used to collect samples (i.e. sampling pumps, valves, etc.), laboratory provided DI water is collected with the equipment to generate an equipment blank. For any non-dedicated equipment that comes into contact with the sample (i.e water level meter, water parameter probes, etc.) equipment rinsate blanks are collected from DI water that is poured over the field equipment that comes into contact with the sample. The rinsate water is poured through a funnel that will be decontaminated between each rinsate sample collection. Depending on the method used to collect the sample, the sample may be a combination of the rinsate and equipment blanks. The equipment blanks are transported to the laboratory in the same manner along with other collected ground water samples, and are analyzed for the same chemical constituents as the ground water samples collected at the site.

9. Close Monitoring Event

The following work should be performed prior to leaving the site:

- Decontaminate the sampling equipment
- Cover/lock all wells
- Seal the drums that store purged water, and place them in a secure area
- Remove the cones/tapes and clean the ground
- Checkout with the site manager and call the project manager in the office

REFERENCES

ASTM 2009. *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations.* Designation: D 6771-02

Puls, R.W. and M.J. Barcelona*, GROUND-WATER ISSUE PAPER: Low-Flow (Minimal Draw-down) Ground-Water Sampling Procedures; U.S. Environmental Protection Agency, EPA/540/S-95/504, 1996.*

Wilde, F.D., ed., 2004, Cleaning of equipment for water sampling (version 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A3, accessed July 17, 2006, at *http://pubs.water.usgs.gov/twri9A3/*.

USGS, Cunningham, W.L., Schalk, C.W., Groundwater Technical Procedures of the US Geological Survey, Techniques and Methods 1-A1, US Department of the Interior, 2011

Yeskis, D and B. Zavala, *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers; U.S. Environmental Protection Agency, EPA/542-S-02-001. May 2002*

APPENDIX C

ANALYTICAL REPORT

May 10, 2017

Applied Water Resources - Alameda, CA

Sample Delivery Group:	L906724
Samples Received:	05/03/2017
Project Number:	
Description:	THOT
Report To:	Yola Bayram 2363 Mariner Square Dr Suite 245 Alameda, CA 94501

Entire Report Reviewed By:

Brian Ford
Technical Service Representative

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.esclabsciences.com

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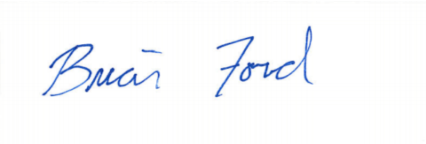
	Collected by	Collected date/time	Received date/time
THOT-GW L906724-01 GW	Yola Bayram	05/01/17 16:00	05/03/17 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Volatile Organic Compounds (GC) by Method 8015	WG976418	1	05/04/17 21:17	05/04/17 21:17	LRL
Volatile Organic Compounds (GC/MS) by Method 8260B	WG977211	1	05/07/17 01:25	05/07/17 01:25	BMB
Semi-Volatile Organic Compounds (GC) by Method 3511/8015	WG976661	10	05/04/17 21:21	05/05/17 16:48	DMG

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Brian Ford
Technical Service Representative

Volatile Organic Compounds (GC) by Method 8015

Analyte	Result ug/l	Qualifier	RDL ug/l	Dilution	Analysis date / time	Batch
TPHG C5 - C12	363		100	1	05/04/2017 21:17	WG976418
(S) a,a,a-Trifluorotoluene(FID)	*102*		*77.0-122*		*05/04/2017 21:17*	WG976418

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result ug/l	Qualifier	RDL ug/l	Dilution	Analysis date / time	Batch
Benzene	ND		1.00	1	05/07/2017 01:25	WG977211
Toluene	ND		1.00	1	05/07/2017 01:25	WG977211
Ethylbenzene	ND		1.00	1	05/07/2017 01:25	WG977211
Total Xylenes	ND		3.00	1	05/07/2017 01:25	WG977211
Methyl tert-butyl ether	ND		1.00	1	05/07/2017 01:25	WG977211
Naphthalene	ND		5.00	1	05/07/2017 01:25	WG977211
(S) Toluene-d8	*104*		*80.0-120*		*05/07/2017 01:25*	WG977211
(S) Dibromofluoromethane	*103*		*76.0-123*		*05/07/2017 01:25*	WG977211
(S) a,a,a-Trifluorotoluene	*102*		*80.0-120*		*05/07/2017 01:25*	WG977211
(S) 4-Bromofluorobenzene	*106*		*80.0-120*		*05/07/2017 01:25*	WG977211

Semi-Volatile Organic Compounds (GC) by Method 3511/8015

Analyte	Result ug/l	Qualifier	RDL ug/l	Dilution	Analysis date / time	Batch
C12-C22 Hydrocarbons	41400		1000	10	05/05/2017 16:48	WG976661
C22-C32 Hydrocarbons	4050		1000	10	05/05/2017 16:48	WG976661
C32-C40 Hydrocarbons	ND		1000	10	05/05/2017 16:48	WG976661
(S) o-Terphenyl	*5.86*	J2	*52.0-156*		*05/05/2017 16:48*	WG976661

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3216822-3 05/04/17 12:07

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
TPHG C5 - C12	U		30.4	100
(S) a,a,a-Trifluorotoluene(FID)	*101*			*77.0-122*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3216822-1 05/04/17 11:00 • (LCSD) R3216822-2 05/04/17 11:23

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
TPHG C5 - C12	5500	4990	4960	90.7	90.1	71.0-130			0.710	20
(S) a,a,a-Trifluorotoluene(FID)				*106*	*106*	*77.0-122*				

L906597-09 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L906597-09 05/04/17 13:06 • (MS) R3216822-4 05/04/17 13:28 • (MSD) R3216822-5 05/04/17 13:51

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
TPHG C5 - C12	5500	ND	5170	5960	93.4	108	1	18.0-158			14.0	20
(S) a,a,a-Trifluorotoluene(FID)					*103*	*104*		*77.0-122*				

Method Blank (MB)

(MB) R3216090-3 05/06/17 15:46

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Benzene	U		0.331	1.00
Ethylbenzene	U		0.384	1.00
Methyl tert-butyl ether	U		0.367	1.00
Naphthalene	U		1.00	5.00
Toluene	U		0.412	1.00
Xylenes, Total	U		1.06	3.00
(S) Toluene-d8	*103*			*80.0-120*
(S) Dibromofluoromethane	*102*			*76.0-123*
(S) a,a,a-Trifluorotoluene	*101*			*80.0-120*
(S) 4-Bromofluorobenzene	*104*			*80.0-120*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3216090-1 05/06/17 13:51 • (LCSD) R3216090-2 05/06/17 14:14

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Benzene	25.0	22.8	23.0	91.0	92.0	69.0-123			1.10	20
Ethylbenzene	25.0	22.5	23.1	90.0	92.5	77.0-120			2.80	20
Methyl tert-butyl ether	25.0	23.2	23.6	92.9	94.3	64.0-123			1.49	20
Naphthalene	25.0	25.1	26.3	100	105	62.0-128			4.52	20
Toluene	25.0	22.3	22.8	89.0	91.1	77.0-120			2.36	20
Xylenes, Total	75.0	69.2	69.8	92.3	93.1	77.0-120			0.860	20
(S) Toluene-d8				*105*	*106*	*80.0-120*				
(S) Dibromofluoromethane				*103*	*102*	*76.0-123*				
(S) a,a,a-Trifluorotoluene				*103*	*102*	*80.0-120*				
(S) 4-Bromofluorobenzene				*101*	*103*	*80.0-120*				

Method Blank (MB)

(MB) R3216050-1 05/05/17 13:16

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
C12-C22 Hydrocarbons	U		33.0	100
C22-C32 Hydrocarbons	U		33.0	100
C32-C40 Hydrocarbons	U		33.0	100
(S) o-Terphenyl	*93.4*			*31.0-160*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3216050-2 05/05/17 13:33 • (LCSD) R3216050-3 05/05/17 13:49

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
C22-C32 Hydrocarbons	750	927	937	124	125	50.0-150			1.14	20
C12-C22 Hydrocarbons	750	1030	1050	138	140	50.0-150			1.78	20
(S) o-Terphenyl				*82.9*	*83.3*	*31.0-160*				

Abbreviations and Definitions

SDG	Sample Delivery Group.
MDL	Method Detection Limit.
RDL	Reported Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
U	Not detected at the Reporting Limit (or MDL where applicable).
RPD	Relative Percent Difference.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Rec.	Recovery.

Qualifier	Description
J2	Surrogate recovery limits have been exceeded; values are outside lower control limits.

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660
Alaska	UST-080
Arizona	AZ0612
Arkansas	88-0469
California	01157CA
Colorado	TN00003
Conneticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1]	90010
Kentucky [2]	16
Louisiana	AI30792
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086
Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico	TN00003
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [2]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	221
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T 104704245-07-TX
Texas [5]	LAB0152
Utah	6157585858
Vermont	VT2006
Virginia	109
Washington	C1915
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

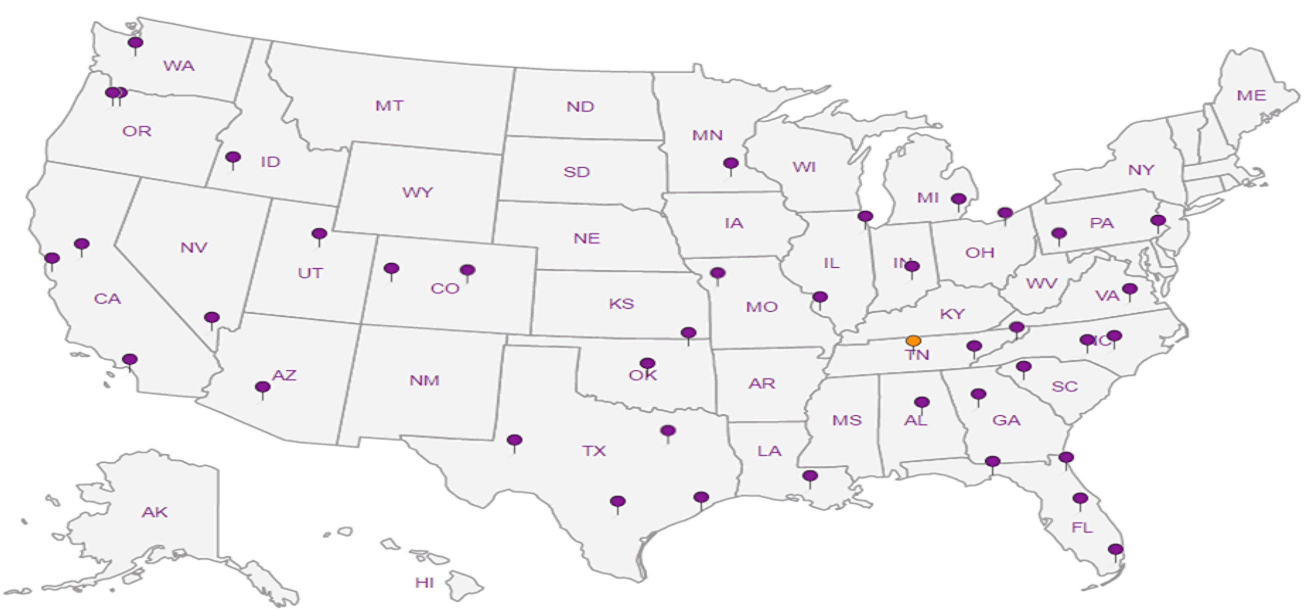
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003
AIHA-LAP,LLC	100789
DOD	1461.01
USDA	S-67674

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Chain of Custody Page ___ of ___

ESC LAB SCIENCES — YOUR LAB OF CHOICE

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L# 906774

D056

Acctnum:
Template:
Prelogin:
TSR:
PB:
Shipped Via:

Billing Information:
AWR Corp
2363 Mariner Square Dr
Alameda, CA 94501

Pres Chk

Email To: ybayram@awrcorp.net

Report to: Yola Bayram

City/State Collected: Alameda, CA

Project Description: THOT

Client Project #

Lab Project #

Phone: 510 671 2088
Fax:

Collected by (print): Yola Bayram

Site/Facility ID #

P.O. # THOT

Quote #

Collected by (signature): [signature]

Rush? (Lab MUST Be Notified)
___ Same Day X Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Date Results Needed

Immediately Packed on Ice N ___ Y ___

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	TPHg (8015)	BTEX, Naphthalene, MTBE (8260)	TPHd (8015)	TPHmo (8015)						Remarks	Sample # (lab only)
THOT-GW	Grab	GW	—	5-1-17	1600	6	X	X	X	X							-01

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks: 4 VOAS Have HCL
2 VOAS don't have HCL preservative

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
___ UPS ___ FedEx ___ Courier ___ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: ✓NP ___Y ___N
COC Signed/Accurate: ✓Y ___N
Bottles arrive intact: ✓Y ___N
Correct bottles used: ✓Y ___N
Sufficient volume sent: ✓Y ___N
If Applicable
VOA Zero Headspace: ✓Y ___N
Preservation Correct/Checked: ___Y ___N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / (No) HCL / MeoH TBR
[signature]	5-2-17	1132	[signature]	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 1.2° °C TDH Bottles Received: 6
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 5-3-17 Time: 0900

If preservation required by Login: Date/Time

Hold:

Condition: NCF / (OK)