SOMA
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December 7, 2017

RECEIVED
By Alameda County Environmental Health 8:14 am, Dec 08, 2017

Mr. Mark Detterman, PG, CEG
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Subject: Site Address: 2200 Telegraph Avenue, Oakland, California
Case No. RO0003258

Dear Mr. Detterman:

SOMA's "Workplan for Further Investigation" for the subject property has been uploaded to the State's GeoTracker database and Alameda County's FTP site for your review.

Thank you for your time in reviewing our report. Please do not hesitate to call me at (925) 734-6400, if you have questions or comments.

Sincerely,

REGISTERED PROFESSIONAL ENGINEER
MANSOUR SEPEHR
No. C042928
Exp. 3-31-18
CIVIL
STATE OF CALIFORNIA

Mansour Sepehr, Ph.D.,PE
Principal Hydrogeologist

cc: Mr. Mo Mashhoon
Mr. William Mast, PES Environmental, Inc.

Workplan for Further Investigation

2200 Telegraph Avenue
Oakland, California

December 7, 2017

Project 6460

Prepared for

Mo Mashhoon
Mash Petroleum Inc.
426 13th street, 10th Floor
Oakland, California 94612

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ACKNOWLEDGEMENT STATEMENT

Site Location: 2200 Telegraph Avenue, Oakland, 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.

Mr. Mo Mashhoon
Mash Petroleum
428 13th Street, 10th Floor
Oakland, California 94612

CERTIFICATION

This workplan has been prepared by SOMA Environmental Engineering, Inc. on behalf of Mr. Mo Mashhoon, the property owner of 2200 Telegraph Avenue, Oakland, California for further investigation in order to delineate the extent of contamination.

Mansour Sepehr, PhD, PE
Principal Hydrogeologist

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

SOMA Environmental Engineering, Inc. has prepared this workplan on behalf of Mr. Mo Mashhoon of Mash Petroleum, Inc. for the site located at 2200 Telegraph Avenue and 2201 Valley Street, Oakland, California.

Figure 1 shows the location of the site and vicinity. The site is located at the corner of the intersection of Grand Avenue and Telegraph Avenue in a commercial/residential area (Figure 2).

The property has been operated as a vehicle fuel service station and a parking lot since mid-1940s. A portion of the site at 2200 Telegraph Ave previously operated as a Chevron Station #9-3600 and is currently an active independent gasoline service station under "A&A Gas and Mart". Currently, there are three 10,000-gallon underground storage tanks (USTs) at the site. An underground Bay Area Rapid Transit (BART) railway is present beneath the subject property. The BART railway is comprised of three separate and parallel tunnels that run beneath the northwestern to southeastern portions of the site (see Figure 2). The tunnels are about 12 feet deep. Appendix A includes previous activities for the site.

During a site investigation conducted by PES in April 2017, high lead concentrations were detected at 2200 Telegraph Ave in soil samples collected from SB-9, HA-3, and HA-7 at shallow depths ranging from between 2 to 6 feet bgs. Lead was detected at 360 mg/kg in SB-9@6 feet bgs, 730 mg/kg in HA-3@2 feet bgs, and 820 mg/kg in HA-7@4 feet bgs. These concentrations are higher than 80 mg/Kg which is the ESL (environmental screening level set forth by San Francisco Bay Regional Water Quality Control Board, SF-RWQCB) for residential land use shallow soil exposure and 160 mg/kg which is the ESL for construction worker exposure.

SOMA installed three extraction (EX-1 through EX-3) and three observation (OB-2, OB-4, OB-5) wells at the site in August 2017. An MPE pilot test was conducted at the site utilizing EX-1, EX-2, and EX-3 as extraction wells and OB-2, OB-4, and OB-5 as observation wells. This MPE test ran from September 14, 2017 through October 13, 2017. During this pilot test a total of 135 pounds of petroleum hydrocarbons (calculated as hexane) were removed from the subsurface at an average of 13 pounds per day. Results of the post MPE groundwater monitoring event showed that TPH-g and Naphthalene concentrations increased in groundwater samples collected from EX-3 and OB-5 as compared to the concentrations prior to the pilot test.

During this event, Naphthalene in OB-5 was detected at 69 ug/L which is significantly higher that the ESL for Naphthalene in groundwater for residential land use-drinking water (0.17 ug/L) and for residential land use vapor intrusion (20 ug/L). Also, during the investigation conducted by PES in April 2017, elevated naphthalene concentrations were observed in SB-3, SB-5, SB-8, and SB-10.

2. SCOPE OF WORK

Based on the data collected during recent investigations, it appears that further investigation is necessary in order to delineate the extent of naphthalene contamination. Therefore, SOMA proposes to advance seven borings at 2200 Telegraph Ave and 2201 Valley St, in the vicinity of high TPH-g and naphthalene concentrations observed in the past.

Furthermore, based on the high lead concentrations observed during the investigation of April 2017, SOMA proposes to conduct an investigation in order to delineate the extent of lead contamination at the site.

The scope of work has been organized into the following tasks:

1. Permit acquisitions, preparation of health and safety plan, and field preparation
2. Further investigation for delineation of contamination;
3. Hand auger to collect soil samples for lead contamination;
4. Laboratory analysis;
5. Prepare report;

Following are the description of above tasks.

2.1 Permit Acquisition and Other Preparatory Work

Prior to initiating field activities, SOMA will obtain required drilling permits from Alameda County Public Works Agency and submit all the required drilling notifications.

SOMA will also contact BART in order to obtain permits for advancing hand augered borings within the BART right-of-way.

SOMA will prepare a site-specific Health and Safety Plan (HASP). The HASP is a requirement of the Occupational Safety and Health Administration (OSHA), “Hazardous Waste Operation and Emergency Response” guidelines (29 CFR 1910.120) and the California Occupational Safety and Health Administration (Cal/OSHA) “Hazardous Waste Operation and Emergency Response” guidelines (CCR Title 8, section 5192). The HASP is designed to address safety provisions during field activities and protect the field crew from physical and chemical hazards resulting from drilling and sampling. It establishes personnel responsibilities, general safe work practices, field procedures, personal protective equipment standards, decontamination procedures, and emergency action plans. The HASP will be reviewed and signed by field staff and contractors prior to beginning field operations.

SOMA will visit the site and mark boring locations using chalk-based white paint and then contact Underground Service Alert (USA) to verify that drilling areas are clear of underground utilities. Following USA clearance, SOMA will retain a private utility locator to survey proposed drilling areas and locate any additional subsurface conduits.

2.2 Further Investigation to Delineate Extent of Contamination

The objectives of this investigation are to confirm the high concentrations of naphthalene and petroleum hydrocarbons as reported by PES in April 2017 and to delineate the extent of the contamination.

SOMA proposes to advance seven direct push borings at 2201 Valley St (DPT-2 through DPT-8). Proposed boring locations are illustrated on Figure 3. The borings will be hand cleared to 5 feet bgs, and drilled to total depth utilizing Direct Push Technology (DPT). DPT is an efficient method, proven to be effective at this site, of collecting continuous soil cores while preventing cross-contamination. It involves hydraulically hammering a set of steel rods into the subsurface with the lead section consisting of a polyethylene-lined sampler. The proposed dual tube sampling uses two sets of probe rods to collect continuous soil cores. One set of rods is driven into the ground as an outer casing. These rods receive the driving force from the hammer and provide a sealed hole from which soil samples may be recovered without the threat of cross contamination.

During the drilling operation the soil borings will be cored to the maximum depth of 25 feet bgs, and cored soil will be described in accordance with the Unified Soil Classification System (USCS). In addition, cored soil will be checked for hydrocarbon odors, visual staining, and liquid phase hydrocarbons (free product), and screened using a photoionization detector (PID). PID readings will be noted on boring logs.

Soil samples for laboratory analysis will be collected from areas of elevated PID readings or where substantial staining or discoloration is observed during drilling. In the absence of visible soil contamination, one soil sample will be collected at each soil- groundwater interface. General Field procedures are summarized in Appendix B.

Each soil sample will be collected using a 4-foot-long by 2-inch-diameter sampling rod lined with a sleeve. The sampler will be advanced to the desired depth, the sampling point on the sampler tip disengaged, and the sampler driven 4 feet to fill the liner. The sampler is then retrieved and the liner removed. SOMA will use a handsaw to cut the retrieved plastic liner into small sections for laboratory submittal. The collected sleeves will be covered at both ends with Teflon sheeting, sealed at both ends with polyethylene end caps, labeled, logged on a chain-of-custody form, placed in an ice-filled cooler, and kept at 4^0C for transport to a state-certified laboratory for analysis.

Dual-tube samplers are typically advanced to collect continuous soil cores; however, groundwater samples can be collected at the end of each core run (US EPA, 2005). Depth-discrete groundwater samples will be collected by driving a 4-foot-long Hydropunch tip attached to the end of the inner drive DP rod to the desired depth-discrete interval. The outer drive casing will be retracted, exposing the 4-foot-long screen interval of the Hydropunch tip. Groundwater samples will be collected with a stainless steel bailer lowered through and beneath the outer drive casing into the Hydropunch screen. Prior to downhole collection events and between borings, the Hydropunch and stainless steel bailer will be field decontaminated to avoid cross-contaminating groundwater samples. Two samples will be collected from each boring at (approximately 10 feet bgs and bottom of the boring) sampling depths similar to the investigation conducted in April 2017 by PES.

Depth to the first encountered and stabilized groundwater will be recorded along with the total boring depth at each groundwater sampling interval. Boring logs will be included in SOMA's report.

Each sample will be labeled with a unique sample identifier, date and time of sample collection, recorded on a chain-of-custody form, and placed in a cooled ice chest pending transport to a California state-certified environmental laboratory for analysis.

Following sampling, the borehole will be decommissioned according to Cal/EPA guidelines with a neat-cement grout mixture tremmied through the DPT rods and completed at the surface to match existing grade.

2.3 Investigation for Extent of Lead Contamination

SOMA proposes to drill nine boreholes in the vicinity of the locations where high lead concentrations where detected during the investigation of April 2017 (SB-9@6', HA-3@2' and HA-7@4'). These boreholes will be advanced using a hand auger. Figure 3 shows the proposed locations. B-1 through B-6 will be advanced to a maximum depth of 10 feet bgs and B-7 through B-9 will be advanced to a maximum depth of 4 feet bgs because these locations are within the BART right-of-way.

Two additional boreholes, (B-10 and B-11 to a maximum depth of 4') are being proposed to the north of SB-9. However, these locations will only be drilled if any other borings in the vicinity of SB-9 show elevated lead concentrations.

SOMA field personnel will collect upto three soil samples per boring. Each soil sample will be collected in a 6-inch sleeve, the ends of the sample will be sealed with Teflon foil and plastic end caps and the soil-filled sleeve will be labeled. The samples will then be placed into a chilled cooler with the appropriate chain of custody documentation.

2.4 Laboratory Analysis

Collected soil and groundwater samples from DPT-2 through DPT-6 will be submitted to a California state-certified environmental laboratory for chemical analysis of the following:

- Total petroleum hydrocarbons as gasoline (TPH-g) by USEPA Methods 8015 or 8260B
- Naphthalene, BTEX (Benzene, toluene, ethylbenzene, and total xylenes) and Methyl tertiary Butyl Ether (MtBE) by USEPA Method 8260B
- Full VOC list by USEPA Method 8260B

Soil samples from B-1 through B-11 will be analyzed for Title 22 California Code of Regulations list of 17 metals (CAM-17) by US Environmental protection Agency (USEPA) method 6010B. If elevated lead concentrations are identified, SOMA will request the analytical laboratory to run WET or TCLP analysis on soil samples.

2.5 Waste Disposal

Soil cuttings and waste water generated during soil boring advancement will be temporarily stored on-site in a secure area in DOT-rated 55-gallon steel drums pending characterization, profiling, and transport to an approved disposal-recycling facility. Each drum will be labeled with site address, contents, date of accumulation, and contact phone number.

3. SCHEDULE AND REPORT PREPARATION

SOMA anticipates that the proposed work will be completed in six to eight weeks following receipt of necessary approvals, authorizations, and permits. Field activities will be scheduled according to availability of necessary equipment and field personnel. Upon completion of above mention tasks, SOMA will prepare a written report containing a detailed description of the procedures, present the results of the field investigation, and discuss our recommendations.

FIGURES

Image Provided By EDR Aerials

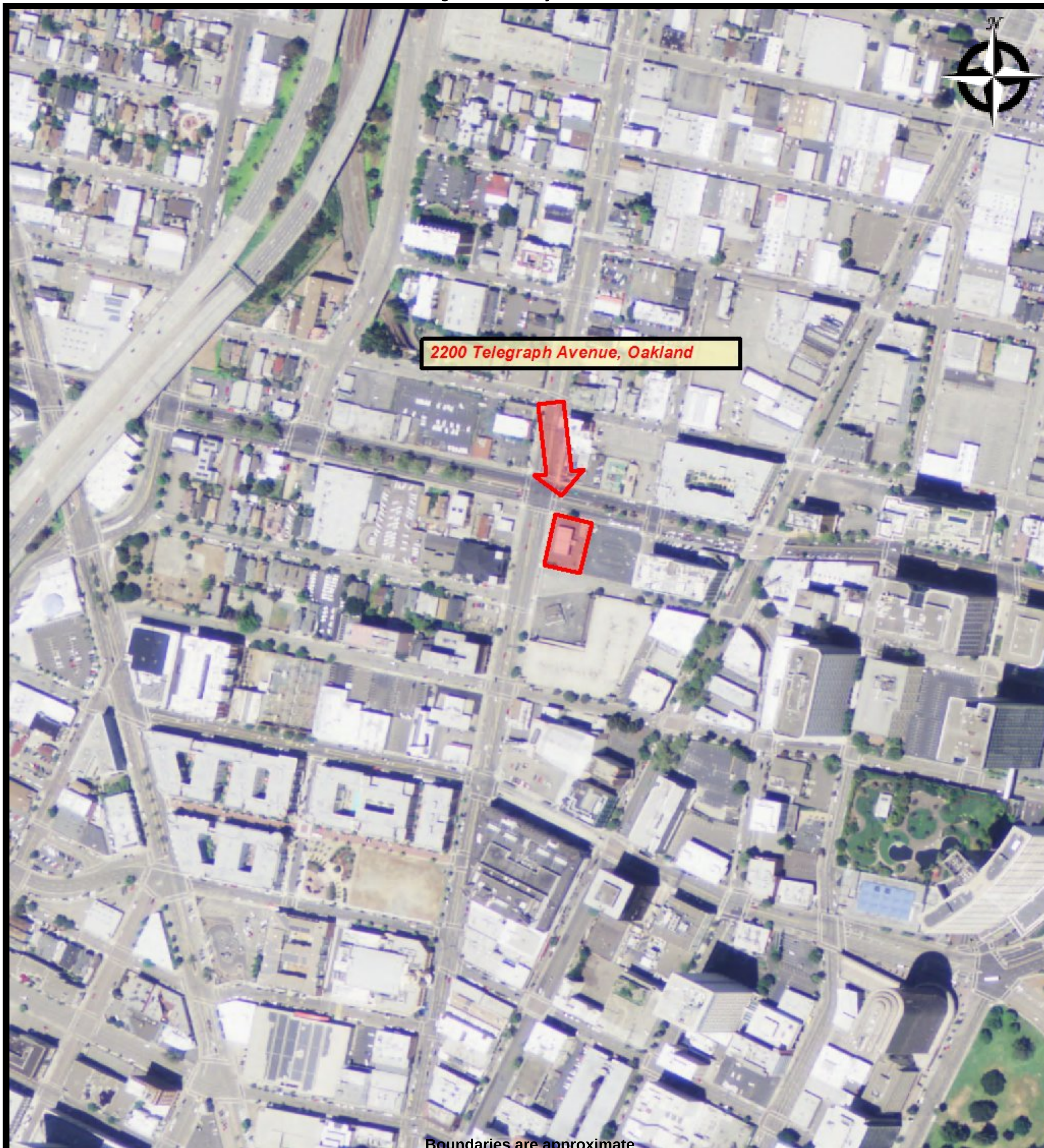

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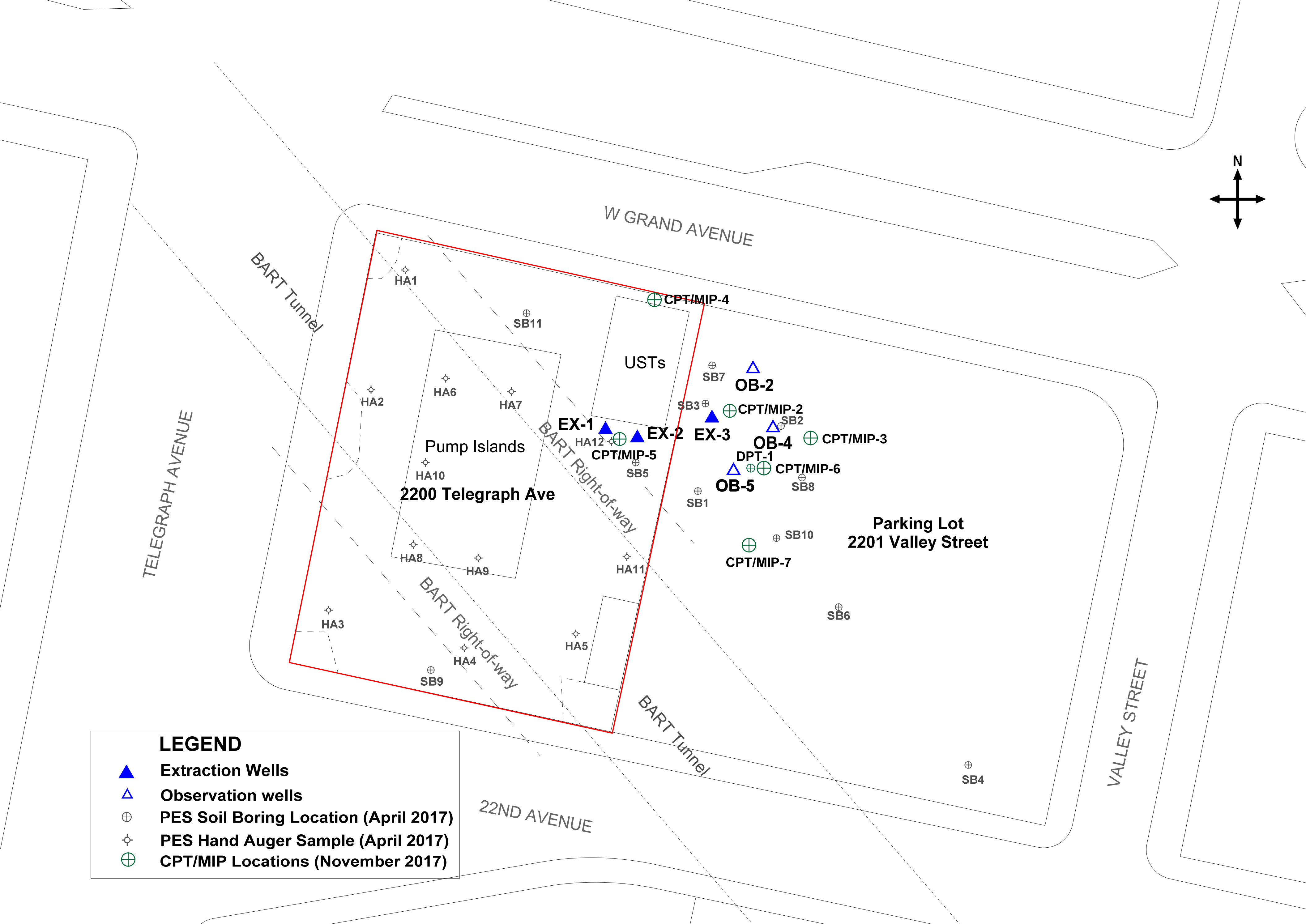
Figure 1: Site Vicinity Map

2200 Telegraph Avenue
Oakland CA 94612

PREPARED FOR:
PROJ. MGR:
DRAWN BY: Ruchi Mathur



approximate scale in feet

0 40 80

Figure 2: Site Map Showing Locations of Extraction/Observation Wells, CPTs, and Soil Borings

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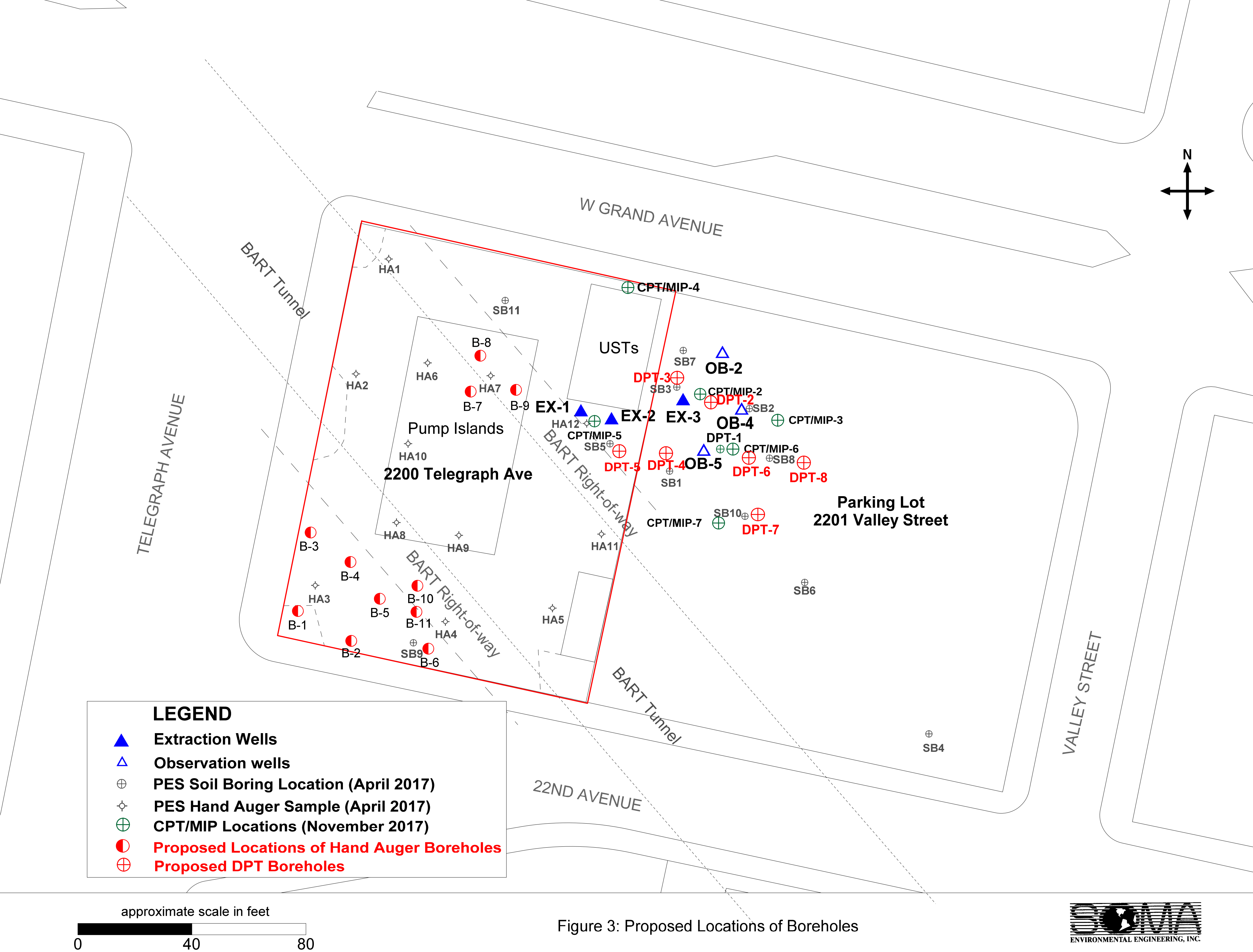

Figure 3: Proposed Locations of Boreholes

APPENDIX A
Previous Activities

Environmental evaluation of the site began in 1986 when new USTs replaced the older USTs and petroleum contamination was discovered. In 1994 the product lines also were replaced by a new piping system. Between 1986 and 2012, numerous soil and groundwater investigations were conducted at the subject site. Elevated concentrations of total petroleum hydrocarbon as gasoline (TPH-g), benzene, toluene, ethylbenzene and xylenes (BTEX) and methyl tertiary butyl ether (MtBE) were identified in a dissolved groundwater plume migrating to the southeast.

The subsurface analytical data collected at the site was evaluated with respect to the State Water Resources Control Board (SWRCB) Low-Threat Closure Policy (LTCP). Based on the results of the sampling and monitoring activities and conditions set forth by the LTCP criteria, in a letter dated January 27, 2015 the site received no further action (NFA) status by the RWQCB and Alameda County Department of Environmental Health (ACDEH).

ACDEH conditioned the closure of the site by stating that if a change in land use occurs during site redevelopment, ACDEH must be notified and the case will be re-evaluated upon receipt of approved development plans. In addition the case closure documentation states that excavation or reconstruction activities in areas of residual contamination require planning and implementation of appropriate health and safety procedures. Lastly, the closure documentation states that the former Chevron facility was to be included in the City of Oakland Permit Tracking System due to the residual contamination that remained at the property.

The results of previous site investigation activities revealed the presence of TPH-g and MtBE in off-site areas located hydraulically down-gradient of the site at 2201 Valley Street. Due to the recent economic growth in downtown Oakland, and a significant demand for housing and commercial redevelopment, Mr. Mo Mashhoon, the current site owner has received an acceptable offer to sell his property to a prospective buyer. Due to the past activities at the site and fact that residual levels of petroleum hydrocarbons still remains in the subsurface, in late 2016 the prospective buyer retained PES Environmental, Inc. (PES) to conduct additional site investigation for further delineation of remaining petroleum hydrocarbons in soil and groundwater beneath the site and at 2201 Valley Street properties.

The results of PES investigation showed elevated levels of TPH-g in groundwater which might be indicative of floating product in the subsurface. Subsequently, SOMA installed three 4-inch diameter groundwater remediation wells and three 2-inch diameter observation wells to conduct a multiphase extraction (MPE) pilot test. Prior to conducting the MPE pilot test, SOMA conducted a groundwater monitoring event to evaluate the groundwater chemical plume. MPE pilot test was conducted from September 14 through October 13, 2017. At the end of the pilot test, a groundwater monitoring event was conducted. Field procedures and results were documented in SOMA's report dated November 21, 2017.

Based on the results of a subsurface investigation conducted by Conestoga-Rover & Associates (CRA), PES (2016) and SOMA (2017) subsurface soils at the site generally consists of poorly graded sand and clayey sands to approximately 7 feet below ground surface (bgs), underlain by silt and clay to a depth of approximately 20 feet bgs. Groundwater was encountered at approximately 11 feet bgs. Groundwater flow at the site and vicinity has been observed to be to the southeast (CRA 2012, SOMA 2017).

APPENDIX B
General Field Procedures

GENERAL FIELD PROCEDURES

Hydraulic Push (GEOPROBE) Drilling

Utility Locating

Prior to drilling, boring locations are marked with white paint or other discernible marking and cleared for underground utilities through Underground Service Alert (USA). In addition, the first five feet of each borehole are air-knifed, or carefully advanced with a hand auger if shallow soil samples are necessary, to help evaluate the borehole location for underground structures or utilities.

Borehole Advancement

Pre-cleaned push rods (typically one to two inches in diameter) are advanced using a hydraulic push type rig for the purpose of collecting samples and evaluating subsurface conditions. The drill rod serves as a soil sampler, and an acetate liner is inserted into the annulus of the drill rod prior to advancement. Once the sample is collected, the rods and sampler are retracted and the sample tubes are removed from the sampler head. The sampler head is then cleaned, filled with clean sample tubes, inserted into the borehole and advanced to the next sampling point where the sample collection process is repeated.

Soil Sample Collection

The undisturbed soil samples intended for laboratory analysis are cut away from the acetate sample liner using a hacksaw, or equivalent tool, in sections approximately 6 inches in length. The 6-inch samples are lined at each end with Teflon® sheets and capped with plastic caps. Labels documenting job number, borehole identification, collection date, and depth are affixed to each sample. The samples are then placed into an ice-filled cooler for delivery under chain-of-custody to a laboratory certified by the State of California to perform the specified tests. The remaining collected soil that has not been selected for laboratory analysis is logged using the United Soil Classification System (USCS) under the direction of a State Registered Professional Geologist, and is field screened for organic vapors using a photo-ionization detector (PID), or an equivalent tool. Soil cuttings generated are stored in Department of Transportation (DOT) approved 55-gallon steel drums, or an equivalent storage container.

Groundwater Sample Collection

Once the desired groundwater sampling depth has been reached, a Hydropunch tip is affixed to the head of the sampling rods. The Hydropunch tip is advanced between approximately 6 inches to one foot within the desired groundwater sampling zone (effort is made to emplace the Hydropunch screen across the center and lower portion of the water table), and retracted to expose the Hydropunch screen.

Grab groundwater samples are collected by lowering a pre-cleaned, single-sample polypropylene, disposable bailer down the annulus of the sampler rod. The groundwater sample is discharged from the bailer to the sample container through a bottom emptying flow control valve to minimize volatilization.

Because the sampling section of the non-discrete groundwater sampler is not protected or sealed, this sampler should only be used where cross contamination from overlying materials is not a concern. Discrete groundwater samplers are driven to the sample interval, and then o-rings, a protective tube/sheath, and an expendable point provide a watertight seal.

Collected water samples are discharged directly into laboratory-provided, pre-cleaned vials or containers and sealed with Teflon-lined septum, screw-on lids. Labels documenting sample number, well identification, collection date, and type of preservative (if applicable, e.g., HCI for TPPH, BTEX, and fuel oxygenates) are affixed to each sample. The samples are then placed into an ice-filled cooler for delivery under chain-of-custody to a laboratory certified by the State of California to perform the specified tests.

Borehole Completion

Upon completion of drilling and sampling, the rods are retracted. Neat cement grout, mixed at a ratio of 6 gallons of water per 94 pounds of Portland cement, is introduced, *via* a tremmie pipe, and pumped to displace standing water in the borehole. Displaced groundwater is collected at the surface into DOT approved 55-gallon steel drums, or an equivalent storage container. In areas where the borehole penetrates asphalt or concrete, the borehole is capped with an equivalent thickness of asphalt or concrete patch to match finished grade.

Organic Vapor Procedures

Soil samples are collected for analysis in the field for ionizable organic compounds using a PID with a 10.2 eV lamp. The test procedure *involves* measuring approximately 30 grams from an undisturbed soil sample, placing this subsample in a Ziploc--type bag or in a clean glass jar, and sealing the jar with aluminum foil secured under a ring-type threaded lid. The container is warmed for approximately 20 minutes (in the sun); then the headspace within the container is tested for total organic *vapor,* measured in parts per million as benzene (ppm; volume/volume). The instrument is calibrated prior to drilling. The results of the field-testing are noted on the boring logs. PID readings are useful for indicating relative levels of contamination, but cannot be used to evaluate petroleum hydrocarbon levels with the confidence of laboratory analyses.

Equipment Decontamination

Equipment that could potentially contact subsurface media and compromise the integrity of the samples is carefully decontaminated prior to drilling and sampling. Drill augers and other large pieces of equipment are decontaminated using high-pressure hot water spray. Samplers, groundwater pumps, liners and other equipment are decontaminated in an Alconox scrub solution and double rinsed in clean tap water rinse followed by a final distilled water rinse.

The rinsate and other wastewater are contained in 55-gallon DOT-approved drums, labeled (to identify the contents, generation date and project) and stored on-site pending waste profiling and disposal.

Soil Cuttings and Rinsate/Purge Water

Soil cuttings and rinsate/purge water generated during drilling and sampling are stored onsite in DOT-approved 55-gallon steel drums pending characterization. A label is affixed to the drums indicating the contents of the drum, suspected contaminants, date of generation, and the boring number from which the waste is generated. The drums are removed from the site by a licensed waste disposal contractor under manifest to an appropriate facility for treatment/recycling.

<u>Hollow Stem Auger Drilling/Monitoring Well Installation</u>

Utility Locating

Prior to drilling, boring locations are marked with white paint or other discernible marking, and cleared for underground utilities through Underground Service Alert (USA). In addition, the first five feet of each borehole are air-knifed, or carefully advanced with a hand auger if shallow soil samples are necessary, to help evaluate the presence of underground structures or utilities.

Borehole Advancement

Pre-cleaned hollow stem augers (typically 8 to 10 inches in diameter) are advanced using a drill rig for the purpose of collecting samples and evaluating subsurface conditions. Upon completion of drilling and sampling, if no well is to be constructed, the augers are retracted, and the borehole is filled with neat cement grout, mixed at a ratio of 6 gallons of water per 94 pounds of Portland cement, through a tremmie pipe to displace standing water in the borehole. In areas where the borehole penetrates asphalt or concrete, the borehole is capped with an equivalent thickness of asphalt or concrete patch to match finish grade.

During the drilling process, a physical description of the encountered soil characteristics (i.e. moisture content, consistency or density, odor, color, and plasticity), drilling difficulty, and soil type as a function of depth are described on boring logs. The soil cuttings are classified in accordance with the uses.

Split-Spoon Sampling

The precleaned split spoon sampler lined with three 6-inch long brass or stainless steel tubes is driven 18 inches into the underlying soils at the desired sample depth interval. The sampler is driven by repeatedly dropping a 140-pound hammer a free fall distance of 30 inches. The number of blows (blow count) to advance the sampler for each six-inch drive length is recorded on the field logs. Once the sampler is driven the 18-inch drive length or the sampler has met refusal (typically 50 blows per six inches), the sampler is retrieved.

Of the three sample tubes, the bottom sample is generally selected for laboratory analysis. The sample is carefully packaged for chemical analysis by capping each end of the sample with a Teflon sheet followed by a tight-fitting plastic cap, and sealing the cap with nonvolatile organic compound (VOC), self-adhering silicon tape. A label is affixed to the sample indicating the sample identification number, borehole number, sampling depth, sample collection date and time, and job number. The sample is then annotated on a chain-of custody form and placed in an ice-filled cooler for transport to the laboratory.

The remaining soil samples are used for soil classification and field evaluation of headspace volatile organic vapors, where applicable, using a photo ionization or flame ionization detector calibrated to a calibration gas (typically isobutylene or hexane). VOC vapor concentrations are recorded on the boring logs.

Grab Groundwater Sample Collection

Grab groundwater samples are collected by lowering a pre-cleaned, single-sample polypropylene, disposable bailer down the borehole or temporary casing. The groundwater sample is discharged from the bailer to the sample container through a bottom emptying flow control valve to minimize volatilization.

Collected water samples are discharged directly into laboratory provided, pre-cleaned, vials or containers and sealed with Teflon-lined septum, screw-on lids. Labels documenting sample number, well identification, collection date and time, type of sample and type of preservative (if applicable, i.e. HCI for TPPH, BTEX, and fuel oxygenates) are affixed to each sample. The samples are then placed into an ice-filled cooler for delivery under chain-of-custody to a laboratory certified by the State of California to perform the specified tests.

Groundwater Monitoring Well Installation and Development

Groundwater monitoring wells are constructed by inserting or tremmieing well materials through the annulus of the hollow stem auger. The groundwater monitoring wells are constructed with a screen interval determined from the encountered soil stratigraphy, to maintain a proper seal at the surface (minimum three feet), to allow flow from permeable zones into the well, and to avoid penetrating aquicludes. Groundwater wells are installed in accordance with the conditions of the well construction permit issued by the regulatory agency exercising jurisdiction over the project site.

The well screen generally consists of schedule 40 polyvinyl chloride (PVC) casing with 0.01 to 0.02-inch factory slots. As a general rule, 0.01-inch slots are used in fine-grained silts and clays, and 0.02-inch slots are used in coarse-grained materials. The screen is then filter packed with #2/12 or #3 sand, or equivalent, for the 0.01 and 0.02 inch slots, respectively.

Once the borehole has been drilled to the desired depth, the well screen and blank well casing are inserted through the annulus of the hollow stem augers. The well screen is sand packed by tremmieing the appropriate filter sand through the annulus between the casing and augers while slowly retracting the augers. During this operation, the depth of the sand pack in the auger is continuously sounded to make sure that the sand remains in the auger annulus during auger retraction to avoid short-circuiting the well. The sand pack is tremmied to approximately two feet above the screen, at which time pre-development surging is performed to consolidate the sand pack. Additional sand is added as necessary so that the sand pack extends approximately two feet above top of screen. Following construction of the sand pack, a one to two foot thick bentonite seal is tremmied over the sand and hydrated in place. The remainder of the borehole is backfilled with Portland neat cement grout (or the equivalent), mixed at ratio of 6 gallons of water per 94 pounds of neat cement. The well head is then capped with a locking cap and secured with a lock to protect the well from surface water intrusion and vandalism.

The well head is further protected from damage with traffic a rated well box in paved areas or locking steel riser in undeveloped areas. The protective boxes or risers are set in concrete. The details of well construction are recorded on well construction logs.

Following well construction, the wells are developed in accordance with agency protocols by intermittently surging and bailing the wells. Development is determined to be sufficient once pH, conductivity, and temperature stabilize to within s 0.1, s 3%, and s 10%, respectively.