Transmittal

RECEIVED
By Alameda County Environmental Health 12:10 pm, May 16, 201

May 15, 2017

To: Ms. Karel Detterman
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Ref. No.: 062086
From: Kiersten Hoey
GHD Tel: 510-420-3347

Subject: Case No. RO0003098 Technical Response and Data Gap Work Plan

No. of Copies	Description/Title	Drawing No./ Document Ref.	Issue
1	Technical Response and Data Gap Work Plan	14	1

Issued for: ☐ Your information ☒ As requested ☐ Construction ☐ Quotation
☐ Your approval/comments ☐ Returned to you ☐ For re-submission

Sent by: ☐ Overnight courier ☐ Same day courier ☒ Other: ACEH ftp and Geotracker

Remarks:

Copy to: Ms. Carryl MacLeod (electronic)
Mr. Pedro and Ms Maria Pulido

Completed by: Kiersten Hoey [Please Print] Signed: Kiersten Hoey

Filing: Correspondence File

GHD
5900 Hollis Street Suite A Emeryville California 94608 USA
T 510 420 0700 F 510 420 9170 W www.ghd.com

Carryl MacLeod
Project Manager, Marketing Business Unit

Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

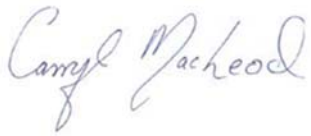
Re: Former Tidewater Service Station No. 359766
2700 23rd Avenue
Oakland, California
ACEH Case RO0003098

I have read and acknowledge the content, recommendations and/or conclusions contained in the attached *Response to Technical Comments and Data Gap Work Plan* submitted on my behalf to ACDEH's FTP server and the SWRCB's GeoTracker website.

This letter is submitted pursuant to the requirements of California Water Code Section 13267(b)(1) and the regulating implementation entitled Appendix A pertaining thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge

Sincerely,



Carryl MacLeod
Project Manager

Attachment: *Response to Technical Comments and Data Gap Work Plan*

Chevron Environmental Management Company
6001 Bollinger Canyon Road, San Ramon, CA 94583
Tel 925 842 3201
CarrylMacLeod@chevron.com

Response to Technical Comments and Data Gap Work Plan

Former Tidewater Service Station 359766
2700 23rd Avenue
Oakland, California
ACEH Case RO0003098

GHD | 5900 Hollis Street Suite A Emeryville California 94608 USA

062086 | 2017.1 | 02.03 | Report No 11 | May 15 2017

Response to Technical Comments and Data Gap Work Plan

Former Tidewater Service Station 359766
2700 23rd Avenue
Oakland, California
ACEH Case RO0003098

Kiersten Hoey

Greg Barclay, PG 6260

GHD | 5900 Hollis Street Suite A Emeryville California 94608 USA

062086 | 2017.1 | 02.03 | Report No 11 | May 15 2017

Table of Contents

Figure Index

Table Index

Appendix Index

1. Introduction

GHD is submitting this *Response to Technical Comments and Data Gap Work Plan* for Former Tidewater Service Station 359766 located at 2700 23rd Avenue in Oakland, California (Figure 1) on behalf of Chevron Environmental Management Company (CEMC) in response to the Alameda County Department of Environmental Health (ACDEH) February 10, 2017 letter (Appendix A). In their letter, ACDEH determined the site does not meet all the State Water Resources Control Board's Low-Threat Underground Storage Tank Case Closure Policy (LTCP) criteria. Presented below are the site background, GHD's response to ACDEH's three technical comments, and data gap work plan.

In their recent letter, ACDEH requests an updated Conceptual Site Model (CSM) be prepared in support of the Data Gap Work Plan. Given an Updated CSM was submitted in April 2015 and additional investigation is proposed at the site, GHD will update the CSM by incorporating the results of the proposed investigation after the proposed work is completed.

2. Site Description and Background

The site is a former Tidewater service station located at the northeast corner of 23rd Avenue and East 27th Street in a mixed commercial and residential area of Oakland, California (Figure 1). According to a previously completed Phase I investigation, the site operated as a Tidewater gasoline service station from 1928 to 1964. Based on historical documents, the former dispenser islands were located at the southwestern corner and the former station's kiosk was located in the northeastern corner. In 1936, an auto repair shop was constructed in the eastern portion of the site. The locations of the former underground storage tanks (USTs) are unknown. In 1964, a demolition permit was issued for all service station facilities.[1] In 1968, the current building was constructed, which is now operated as a liquor store.[2,3] Current and historical site facilities are illustrated on Figure 2.

Conestoga-Rovers and Associates' (CRA) August 29, 2014 *Subsurface Investigation Report and Conceptual Site Model* (CSM) and April 17, 2015 *Subsurface Investigation Report and Updated Conceptual Site Model* (Updated CSM) present cumulative historical site data, boring/well logs, cross sections, and additional background information, which is not repeated herein.

[1] Basics Environmental, Local Regulatory Agency File Review, 2700 23rd Avenue Oakland, California, May 7, 2010

[2] Schutze & Associates, Inc., Historical Research Project: 2700 23rd Avenue Property Ownership and Contamination Responsibility Update, July 21, 2011.

[3] Schutze & Associates, Inc., Summary of Previous Investigations, Installation and Sampling of Four Monitoring Wells, and Excavation of Test Pits, Soil Testing, and Limited Soil Removal, March 16, 2011.

3. Response to Technical Comments

3.1 LTCP Media Specific Criteria for Groundwater

ACDEH notes that CRA's 2014 CSM states that the sewer and storm drain lines in East 27th Street and 23rd Avenue (bounding the subject site on the south and west side respectively), may come in contact with groundwater. While this is true of the 2014 report, CRA's 2015 Updated CSM presented further preferential pathways study results that included groundwater depth data from newly installed monitoring well MW-5 and mapping and construction details of surrounding underground utilities. The Updated CSM concluded that based on groundwater depths, underground utility lines downgradient of the site in 23rd Avenue and East 27th Street appear to be above the groundwater table and are unlikely preferential pathways. Underground water, natural gas, electric, and communication utilities in the vicinity are likely installed shallower than 6.5 feet below grade (fbg) and are not likely preferential pathways for dissolved hydrocarbon migration. Storm drain and sanitary sewer lines are likely located between the surface and 9 fbg. The storm drain adjacent to well MW-5 is estimated to be 6 to 7 fbg based on field observations.

Wells MW-4 and MW-5 are located on the upgradient and downgradient sides of the underground utilities in 23rd Avenue and East 27th Street. Depth to groundwater in well MW-4, located upgradient, has ranged from 6.45 to 11.04 fbg and in offsite well MW-5, located downgradient, has ranged from 8.22 to 17.81 fbg. Groundwater in the two wells has been measured above 7 fbg on only two events; therefore, it is unlikely the underground utilities are acting as preferential pathways for hydrocarbon migration.

ACDEH also concluded that based on data contained in the Ninyo & Moore March 20, 2015 *Limited Phase II Environmental Site Assessment Sanitary Sewer Rehabilitation Project Sub-Basin 60-06 Oakland, CA* (Sewer Report) prepared on behalf of the City of Oakland, the extent of hydrocarbons in groundwater has not been adequately defined and migration of hydrocarbons in groundwater may pose a vapor intrusion risk to downgradient residents and businesses on East 27th Street. The grab-groundwater sample from soil boring SB-2 advanced south of the site in 27th Street contained 12,000 micrograms per liter (μg/L) TPHg, 71 μg/L benzene, and 4.9 μg/l naphthalene. It should be noted that grab-groundwater samples typically yield higher hydrocarbon concentrations than a developed monitoring well at the sample location due to the suspended sediments typically in grab-groundwater samples.

On March 7, 2017, wells MW-1 through MW-4 were monitored and sampled for the first time since 2012. Results of the sampling event are listed in Table 3.1 below. Current and historical groundwater monitoring and sampling data are included in Table 1. The results of the most recent sampling event are presented in GHD's May 5, 2017 *First Quarter 2017 Groundwater Monitoring and Sampling Report*.

Table 3.1: Groundwater Analytical Data – March 2017

Well ID	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
ESLs	100	1	40	30	17	5
MW-1	<100	**4**	0.6J	<1	0.6J	0.9J
MW-2	<100	<1	<1	<1	<1	<1
MW-3	**4,400**	0.5J	0.7J	3	1	<1
MW-4	**16,000**	**1,300**	**220**	**380**	**560**	<10
MW-5	<100	<1	<1	<1	<1	<1

µg/L Micrograms per liter
TPHg Total Petroleum Hydrocarbons as Gasoline
MTBE Methyl Tertiary Butyl Ether
< Indicates constituent was not detected at or above laboratory reporting limit.
J Estimated value
ESL Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Prepared by California Regional Water Quality Control Board San Francisco Bay Region, Interim Final – February 2016, Tier 1 ESLs.
Bold **I**ndicates results above the drinking water environmental screening level (ESL).

Dissolved TPHg and BTEX impacts are centered on well MW-4, immediately downgradient of the presumed source area (former dispensers) and are defined downgradient (southwest) by well MW-5 and upgradient by wells MW-1 and MW-2. Dissolved TPHg and benzene concentrations are illustrated on Figures 3 and 4, respectively. Concentrations detected in wells MW-3 and MW-4 are within the same order of magnitude as historical concentrations. Methyl tertiary butyl ether (MTBE) concentrations are below environmental screening limits and/or laboratory reporting limits in all wells. Additionally, this station stopped operating before MTBE was widely used as an additive in gasoline.

To assess the extent of hydrocarbons south of the site, GHD proposes installing an additional groundwater monitoring well on the south side of East 27th Street (Figure 2).

3.2 LTCP Media Specific Criteria for Vapor Intrusion to Indoor Air

ACDEH concludes this criteria is not met based on soil vapor data collected in July 2010 from temporary soil vapor probes SV-1 through SV-4 and the detection limit of 320 micrograms per cubic meter (µg/m^3) naphthalene in the 2014 sample collected from VP-2, which is above the LTCP criteria of 310 µg/m^3 where there is insufficient oxygen for a bioattenuation zone. However, oxygen volume percentage reported in VP-1 and VP-2 samples was between 8.5 and 10 percent. Therefore a bioattenuation zone exists in the top 5 feet of the subsurface. Using the LTCP soil gas criteria for an existing bioattenuation zone, all concentrations reported in SV-1 through SV-4 and VP-1 and VP-2 are below the criteria. Cumulative soil vapor data is listed in Table 2. Furthermore,

the Ninyo & Moore March 20, 2015 report indicated that there was matrix interference in SV-2 so it is unclear if the concentrations detected in this sample are related to a gasoline/diesel release.

ACDEH also noted utility lines to the liquor store in the vicinity of the soil vapor probes that may act as preferential pathways to vapor migration into the store. Concentrations detected in vapor probes VP-1 and VP-2, located adjacent to the sanitary sewer and undifferentiated utility lines into the liquor store, were below LTCP criteria and/or laboratory detection limits. Concentrations detected in SV-1, located adjacent to the water line into the liquor store were also below the LTCP criteria. To verify there is a low risk of vapor intrusion to the occupants of the liquor store, GHD proposes collecting additional soil vapor samples from VP-1 and VP-2. Additionally, GHD proposes to install a vapor probe in the sidewalk of the south side of East 27th Street to assess vapor intrusion risk to the residences south of the site.

As requested in the ACDEH letter, GHD will attempt to obtain information regarding the foundation of the onsite liquor store and residential and commercial buildings on the south side of East 27th Street.

3.3 General Criteria f – Secondary Source Has Been Removed to the Extent Practicable

ACDEH's review of the case files indicates that insufficient data and analysis has been presented to assess compliance with General Criteria f.

In November 2010, Schutze and Associates , Inc (Schutze) conducted two test pit excavations based on a previous geophysical.[4] Locations of the excavations are illustrated on Figure 2. The Test pit excavation in the southeast area of the parking lot was approximately 6 feet by 4 feet by 5.5 feet deep. Debris observed in the excavation appeared to be pieces of the former dispenser islands. In the L shaped test pit excavations, abandoned product and vent lines were observed at 2 fbg The pipes had been cut at the ends and did not extend past the test pit. The piping and former dispenser pieces were removed and disposed of offsite. The amount of soil excavated was not noted in the Schutze report.

The site was historically used as a commercial fueling facility from 1928 to 1964 and was demolished around 1964. There are no records in the case file documenting the location(s) and number of underground storage tanks. The former dispenser islands were located in the southwestern corner of the site, and based on soil and groundwater data collected from site borings, vapor probes, and wells, appear to be the source of hydrocarbons beneath the site. Residual benzene, toluene, ethylbenzene, and xylenes in soil are minimal and no MTBE is detected in soil. The highest residual TPHg concentrations are detected in offsite well MW-4 at 3.5 fbg. After the stability and lateral extent of the dissolved hydrocarbon plume has been established, and additional soil vapor samples have been collected, the need for remediation of a secondary source will be evaluated.

[4] Schutze & Associates, Inc., Summary of Previous Investigations, Installation and Sampling of Four Monitoring Wells, and Excavation of Test Pits, Soil Testing, and Limited Soil Removal, March 16, 2011.

4. Recommendations

Based on the discussions above, the following work is recommended:

- Install a vapor probe in the sidewalk on the south side of East 27th Street, upgradient of the residences (Figure 2).
- Collect soil vapor samples from all existing and new soil vapor probes.
- Attempt to obtain information regarding the foundation of the onsite liquor store and residential and commercial buildings on the south side of East 27th Street.
- Install an additional groundwater monitoring well on the south side of East 27th Street to assess the extent of hydrocarbons south of the site (Figure 2).
- Continue to quarterly monitor and sample wells MW-1 through MW-5 to assess the stability of the dissolved hydrocarbon plume.

5. Work Plan for Additional Subsurface Investigation

GHD recommends installing one offsite vapor probe and one offsite groundwater monitoring well (Figure 2). The vapor probe is proposed in the sidewalk and the well is proposed in the parking lot of a restaurant. The well is proposed in the parking lot due to overhead electrical lines above the sidewalk preventing a drill rig safely drilling a well boring at this location.

5.1 Permits

GHD will obtain drilling permits from Alameda County Public Works Agency, an encroachment permit from the City of Oakland, and an access agreement with the offsite property owner.

5.2 Site-Specific Health and Safety Plan

GHD will prepare a site-specific health and safety plan to protect site workers. The plan will be reviewed and signed by all site workers and visitors and remain onsite during all field activities.

5.3 Utility Location and Clearance

GHD will contact Underground Service Alert (USA) to coordinate locations of subsurface utilities no less than 48 hours prior to the start of field activities. GHD will subcontract a licensed geophysicist to confirm the locations of underground utilities. In accordance with Chevron and GHD safety standards, a hand auger will be utilized to clear the locations to a depth of 8 fbg.

5.4 Groundwater Monitoring Well Installation

To assess the extent of dissolved hydrocarbons in groundwater south of the site, GHD will install one monitoring well as shown on Figure 2. The well boring will be advanced using 8-inch outside diameter hollow-stem augers to approximately 20 fbg with an approximate screened interval of 10 to 20 fbg; the screen interval may be modified based on field observation of water levels encountered during drilling activities. The monitoring well will be constructed using 2-inch diameter

Schedule 40 PVC with a 0.020-inch slotted screen. The well screen will be surrounded by a sand pack consisting of #2/12 sand to approximately 2 feet above the top of the screened interval. Two feet of hydrated bentonite will be placed above the sand pack. Portland II/V cement will be placed above the bentonite to approximately 1 fbg. A traffic-rated well vault will be placed on the surface and will match the existing grade. A licensed land surveyor will survey the top-of-casing elevation and well location. GHD's Standard Field Procedure for Soil Boring and Monitoring Well Installation is presented in Appendix B. Following installation, GHD will complete and submit a Department of Water Resources (DWR) Well Completion Report to the DWR and Alameda County Public Works Department.

5.5 Soil Vapor Probe Installation and Construction

The proposed soil vapor probe will be installed according to the Department of Toxic Substances Control (DTSC)'s Active Soil Gas Investigation Advisory dated April 2012 and the Vapor Intrusion Guidance dated October 2011 using a 3-inch diameter hand auger to approximately 6 fbg. The vapor probe will be constructed of a permeable stainless steel filter with a ¼-inch push-to-connect fitting to ¼-inch Teflon tubing. A probe will be placed at approximately 5 fbg and surrounded by a 12-inch sand pack. Above the sand pack, 12 inches of dry granulated bentonite will be topped with at least 12 inches of hydrated granular bentonite. The soil vapor well will be finished at the surface using a well vault.

5.6 Soil Vapor Sampling Protocol

Vapor samples will be collected at least 48 hours after the placement of the probe using 1-liter Summa™ canisters in a manifold system, connected to the sampling tubing at each vapor point. Using the same flow rate as is used during sampling, approximately three purge volumes will be purged from the sampling tubing before sampling begins. While sampling, the vacuum of the Summa™ canister will be used to draw the soil vapor through the flow controller until a negative pressure of approximately 5 inches of Hg is observed on the vacuum gauge. In accordance with the Department of Toxic Substances Control (DTSC) Advisor Active Soil Gas Investigations guidance document, leak testing using laboratory grade helium and a shroud will be performed during sampling. After sampling, the Summa™ canisters will be packaged and sent to Eurofins Air Toxics laboratory under chain of custody for analysis.

5.7 Soil Sampling

GHD will collect soil samples from the well boring and vapor probe boring at 3 and 5 fbg and 5-foot intervals thereafter to total depth. Soil samples will also be collected at the soil/groundwater interface, at obvious changes in soil types, and where indications of hydrocarbons are observed to the total depth explored. Soils will be logged using the ASTM D2488-06 Unified Soil Classification System. The 3 and 5 fbg samples will be collected using a slide hammer lined with clean stainless steel sleeves. Soil samples beyond 8 feet will be collected using a direct-push sampler, lined with polyethylene sampling tubes. Soil samples will be screened using a PID and all PID measurements will be recorded on the boring log. Samples will be sealed, labeled, logged on a chain-of-custody, placed on ice, and transported to a Chevron and California State-approved laboratory for analysis.

5.8 Well Development and Sampling

The well will be developed using standard surge agitation and pumping. The well will be developed no sooner than 72 hours after installation and will be sampled at least 48 hours after well development is complete.

5.9 Chemical Analysis

Select soil and groundwater samples will be analyzed for the following with a standard turnaround time of 10 working days:

- Total petroleum hydrocarbons as diesel (TPHd), as motor oil (TPHmo), and TPHg by EPA Method 8015.
- BTEX, MTBE, and naphthalene by EPA Method 8260B (groundwater will not be analyzed for naphthalene).

Soil vapor samples will be analyzed for the following with a standard turnaround time of 10 working days:

- TPHg, BTEX, methyl-tertiary butyl ether (MTBE), and naphthalene by EPA Method TO-15
- Naphthalene by EPA Method TO-17
- Oxygen (O2), carbon dioxide (CO2), nitrogen (N2), methane (CH4), and helium by ASTM D-1946 (GC/TCD)

5.10 Waste Disposal

Soil cuttings and rinsate water generated during well and vapor probe installation will be placed in DOT-approved drums, labeled appropriately, and temporarily stored onsite. The waste will be transported by licensed waste haulers to a Chevron-approved, California licensed disposal facility following receipt of an analytical profile.

5.11 Reporting

Upon completion of field activities and review of the analytical results, GHD will prepare a report incorporating all available data that, at a minimum, will contain:

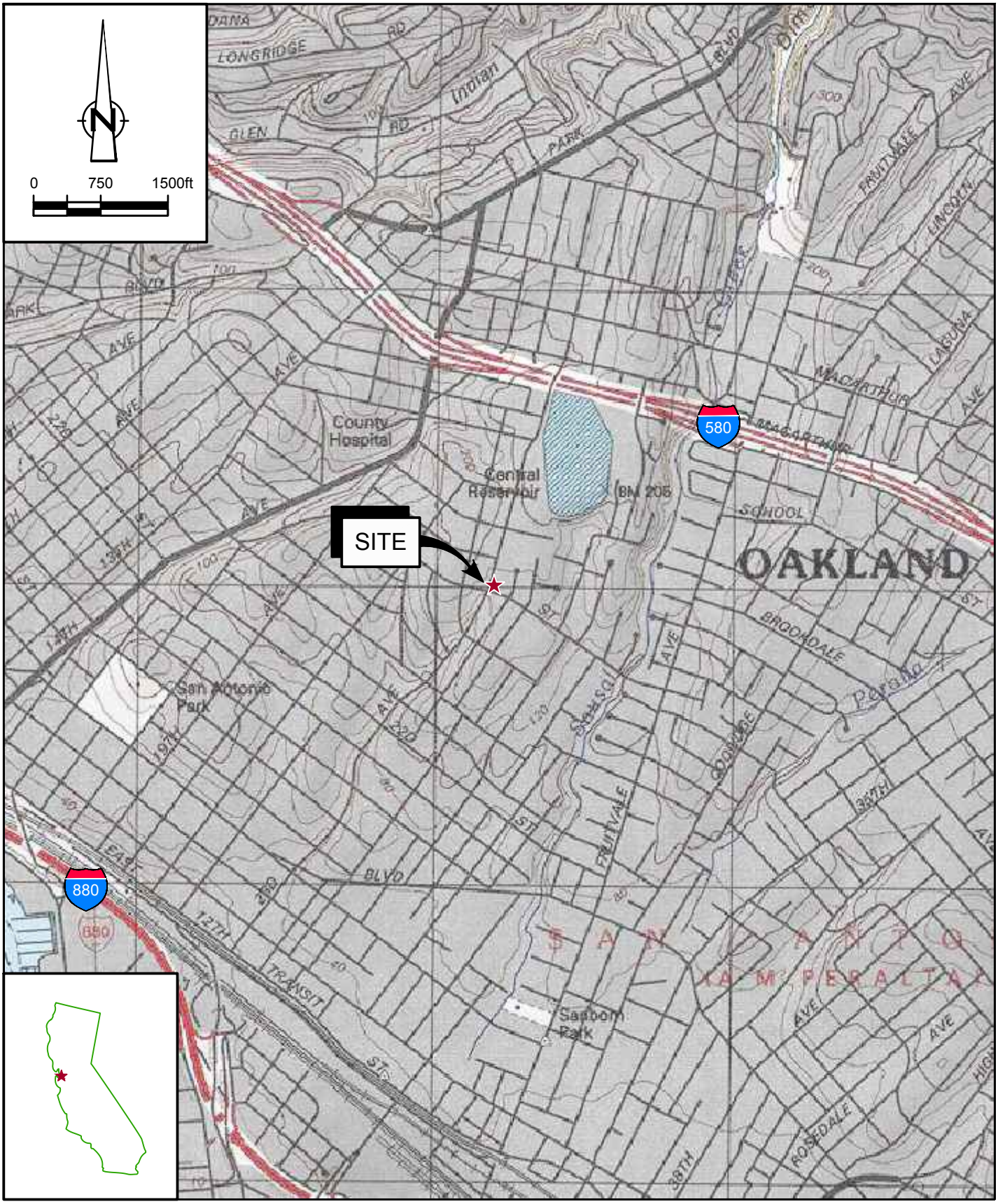
- Description of the drilling and sampling
- Soil boring and well logs
- Tabulated soil, groundwater, and soil vapor analytical results
- Analytical reports and chain-of-custody forms
- Waste disposal details
- Updated figures if needed
- Updated Conceptual Site Model
- Updated preferential pathway analysis
- Conclusions and recommendations, including a data gap work plan, if needed

6. Closing

The surveyed elevation measurements to the top of well casings (GEO_Z) and latitude and longitude (GEO_XY) files for the five monitoring wells were uploaded to Geotracker on April 28, 2017.

GHD will proceed with the proposed scope of work upon receipt of written approval from ACDEH. CEMC will obtain an access agreement to the restaurant parking lot and GHD will obtain all required drilling and encroachment permits and schedule the subcontractors at their earliest availability.

Figures



FORMER TIDEWATER 359766 (ED's LIQUORS)
2700 23rd AVENUE
OAKLAND, CALIFORNIA

LEGEND

★ SITE LOCATION

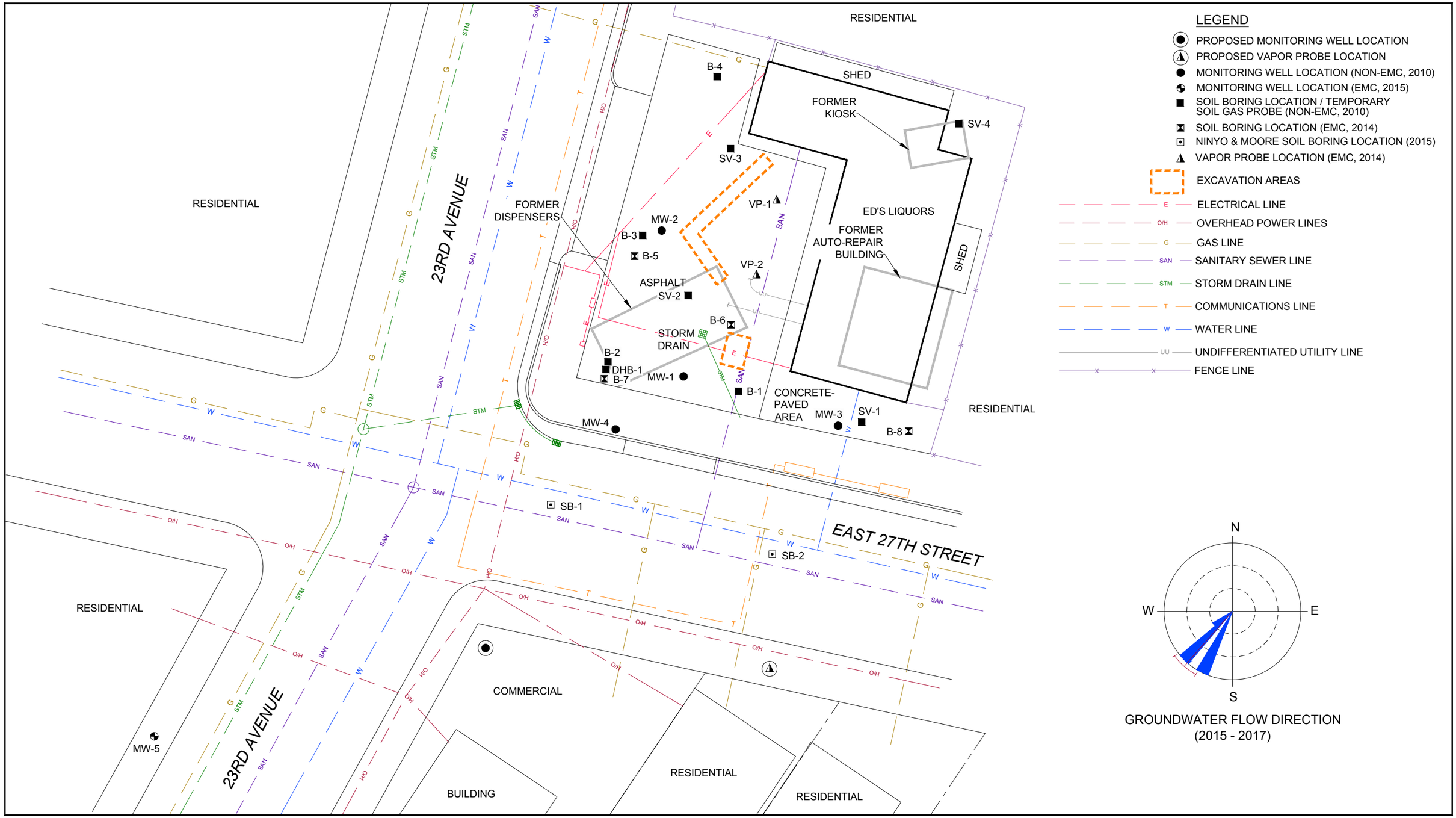
062086-2017

May 3, 2017

VICINITY MAP

FIGURE 1

CAD File: 062086-2017(014)GN-SO001.DWG



SOURCE: WELL LOCATIONS BASED ON GEO COORDINATES CONVERTED TO US SURVEY FEET STATE PLAN CA ZONE 3, BY MORROW SURVEYING IN FEB 24, 2015. SOURCE: NINYO & MOORE SUB-BASIN 60-06 FIGURE 3 DATED 3/2015.

0 10 20ft

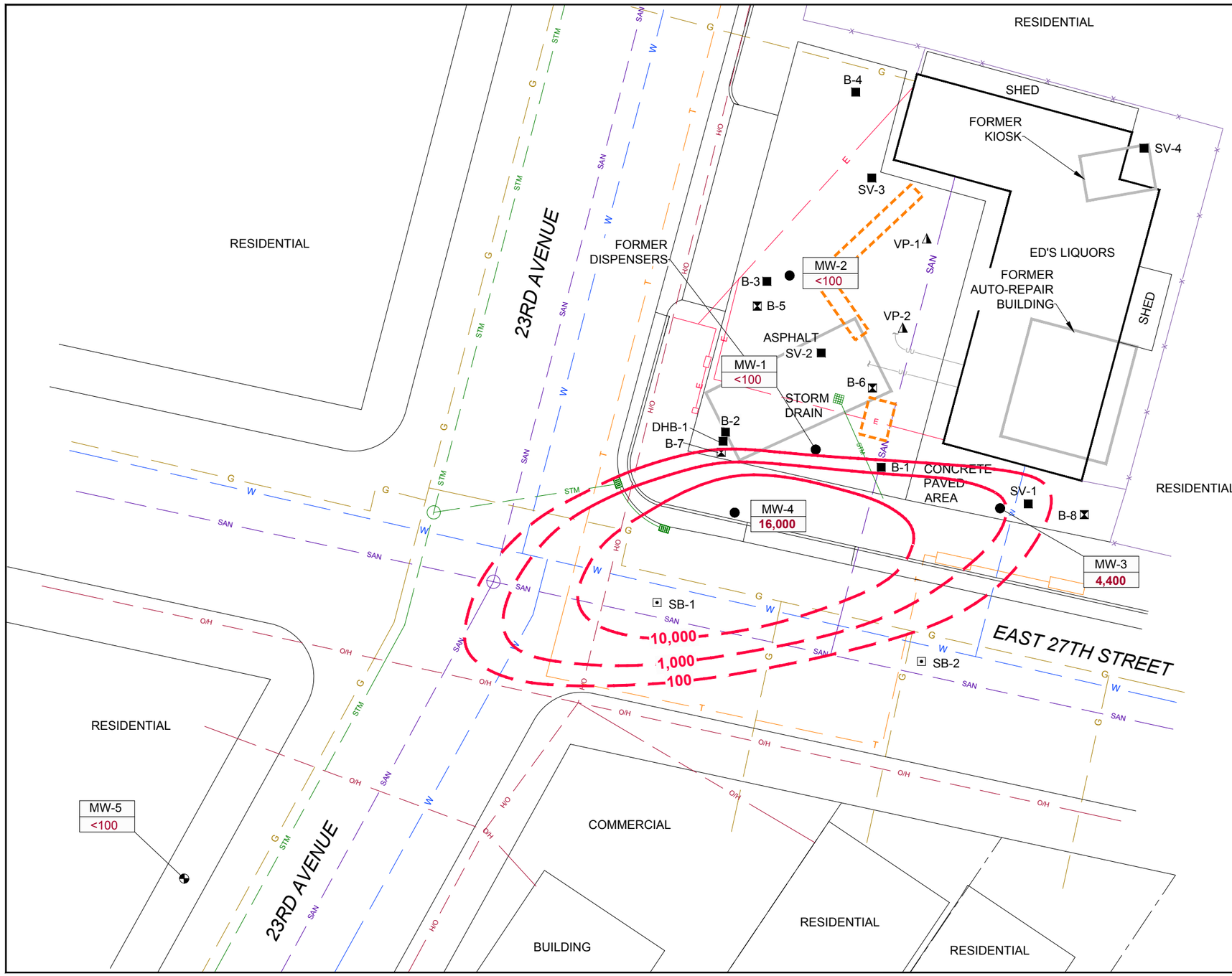
FORMER TIDEWATER STATION 359766
2700 23rd AVENUE
OAKLAND, CALIFORNIA

SITE PLAN

062086-2017
May 8, 2017

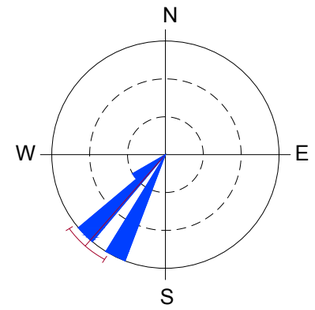
FIGURE 2

CAD File: 062086-2017(014)GN-SO002.DWG



LEGEND

- MONITORING WELL LOCATION (NON-EMC, 2010)
- MONITORING WELL LOCATION (EMC, 2015)
- SOIL BORING LOCATION / TEMPORARY SOIL GAS PROBE (NON-EMC, 2010)
- SOIL BORING LOCATION (EMC, 2014)
- NINYO & MOORE SOIL BORING LOCATION (2015)
- VAPOR PROBE LOCATION (EMC, 2014)
- EXCAVATION AREAS
- E — ELECTRICAL LINE
- O/H — OVERHEAD POWER LINES
- G — GAS LINE
- SAN — SANITARY SEWER LINE
- STM — STORM DRAIN LINE
- T — COMMUNICATIONS LINE
- W — WATER LINE
- UU — UNDIFFERENTIATED UTILITY LINE
- FENCE LINE
- µg/L — MICROGRAMS PER LITER
- <X — NOT DETECTED AT REPORTING LIMIT X
- MW-3 / 4,400 — WELL ID / TPHg CONCENTRATION (µg/L)
- 1,000 — TPHg GROUNDWATER CONCENTRATION CONTOUR LINE IN µg/L, DASHED WHERE INFERRED



GROUNDWATER FLOW DIRECTION
(2015 - 2017)

SOURCE: WELL LOCATIONS BASED ON GEO COORDINATES CONVERTED TO US SURVEY FEET STATE PLAN CA ZONE 3, BY MORROW SURVEYING IN FEB 24, 2015. SOURCE: NINYO & MOORE SUB-BASIN 60-06 FIGURE 3 DATED 3/2015.

0 10 20ft

N

FORMER TIDEWATER STATION 359766
2700 23rd AVENUE
OAKLAND, CALIFORNIA

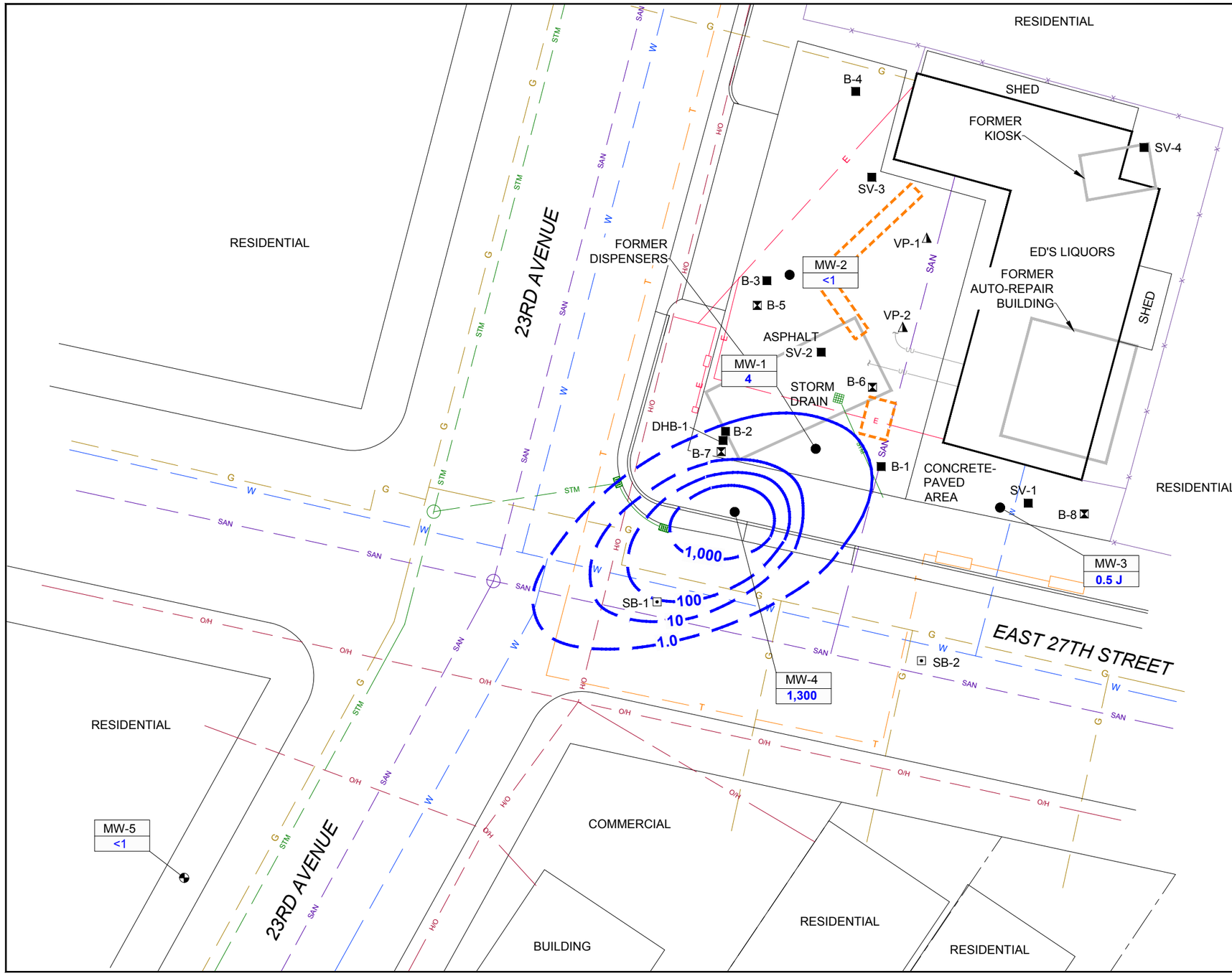
TPHg CONCENTRATIONS IN GROUNDWATER
MARCH 7, 2017

062086-2017

May 8, 2017

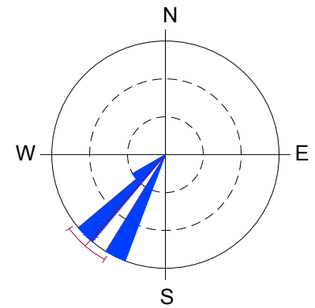
FIGURE 3

CAD File: 062086-2017(014)GN-SO003.DWG



LEGEND

- MONITORING WELL LOCATION (NON-EMC, 2010)
- MONITORING WELL LOCATION (EMC, 2015)
- SOIL BORING LOCATION / TEMPORARY SOIL GAS PROBE (NON-EMC, 2010)
- SOIL BORING LOCATION (EMC, 2014)
- NINYO & MOORE SOIL BORING LOCATION (2015)
- VAPOR PROBE LOCATION (EMC, 2014)
- EXCAVATION AREAS
- E — ELECTRICAL LINE
- O/H — OVERHEAD POWER LINES
- G — GAS LINE
- SAN — SANITARY SEWER LINE
- STM — STORM DRAIN LINE
- T — COMMUNICATIONS LINE
- W — WATER LINE
- UU — UNDIFFERENTIATED UTILITY LINE
- FENCE LINE
- µg/L — MICROGRAMS PER LITER
- <X — NOT DETECTED AT REPORTING LIMIT X
- J — ESTIMATED VALUE
- MW-3 / 0.5 J — WELL ID / BENZENE CONCENTRATION (µg/L)
- 1,000 — BENZENE GROUNDWATER CONCENTRATION CONTOUR LINE IN µg/L, DASHED WHERE INFERRED



GROUNDWATER FLOW DIRECTION
(2015 - 2017)

SOURCE: WELL LOCATIONS BASED ON GEO COORDINATES CONVERTED TO US SURVEY FEET STATE PLAN CA ZONE 3, BY MORROW SURVEYING IN FEB 24, 2015. SOURCE: NINYO & MOORE SUB-BASIN 60-06 FIGURE 3 DATED 3/2015.

0 10 20ft

N

FORMER TIDEWATER STATION 359766
2700 23rd AVENUE
OAKLAND, CALIFORNIA

BENZENE CONCENTRATIONS IN GROUNDWATER
MARCH 7, 2017

062086-2017

May 8, 2017

FIGURE 4

CAD File: 062086-2017(014)GN-SO004.DWG

Tables

Table 1

Groundwater Monitoring and Sampling Data
Former Tidewater Service Station 359766 (Ed's Liquors)
2700 23rd Avenue
Oakland, California

					HYDROCARBONS			VOCS												
Location	Date	TOC[a]	DTW	GWE	TPH-MO	TPH-DRO	TPH-GRO	B	T	E	X	MTBE by SW8260	Naphthalene	TBA	DIPE	ETBE	TAME	1,2-DCA	EDB	ADDITIONAL
	Units	ft	ft	ft-amsl	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-1	11/18/2010[1]	168.84	7.93	160.91	<250	<50	--	--	--	--	--	1.3	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	ND
	02/14/2012[1]	168.84	7.31	161.53	--	<50	<50	<0.50	<0.50	<0.50	<0.50	1.2	--	--	--	--	--	--	--	--
	03/13/2015	168.90	12.11	156.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2015	168.90	11.31	157.59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/29/2015	168.90	10.83	158.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/22/2015	168.90	6.44	162.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/28/2016	168.90	6.08	162.82	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2016	168.90	5.41	163.49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/08/2016	168.90	5.79	163.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/16/2016	**168.90**	**7.72**	**161.18**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	03/07/2017	**168.90**	**5.20**	**163.70**	**--**	**--**	**<100**	**4**	**0.6 J**	**<1**	**0.6 J**	**0.9 J**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	
MW-2	11/18/2010[1]	170.33	7.52	162.81	<250	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	ND
	02/14/2012[1]	170.33	6.37	163.96	--	<50	<50	<0.50	<0.50	<0.50	<0.50	<0.50	--	--	--	--	--	--	--	--
	03/13/2015	170.41	8.10	162.31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2015	170.41	6.92	163.49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/29/2015	170.41	7.95	162.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/22/2015	170.41	4.49	165.92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/28/2016	170.41	3.83	166.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2016	170.41	3.71	166.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/08/2016	170.41	4.77	165.64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/16/2016	170.41	5.92	164.49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/07/2017	**170.41**	**2.94**	**167.47**	**--**	**--**	**<100**	**<1**	**<1**	**<1**	**<1**	**<1**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	
MW-3	11/18/2010[1]	168.67	5.14	161.15	<250	2,100	3,700	<0.5	<0.5	<0.5	0.84	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	3.0[g] 0.68[d] 2.0[e] 2.2[h] 6.6[f]
	02/14/2012[1]	168.67	4.98	163.69	--	<1,500	3,400	<0.50	<0.50	1.2	<0.50	<0.50	--	--	--	--	--	--	--	--
	03/13/2015	168.71	6.50	162.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2015	168.71	5.93	162.78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/29/2015	168.71	6.98	161.73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/22/2015	168.71	8.01	160.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/28/2016	168.71	7.04	161.67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2016	168.71	7.14	161.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/08/2016	168.71	9.81	158.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/16/2016	168.71	8.97	159.74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/07/2017	**168.71**	**5.13**	**163.58**	**--**	**--**	**4,400**	**0.5 J**	**0.7 J**	**3**	**1**	**<1**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	

Table 1

Groundwater Monitoring and Sampling Data
Former Tidewater Service Station 359766 (Ed's Liquors)
2700 23rd Avenue
Oakland, California

					HYDROCARBONS			VOCS												
Location	Date	TOC[a]	DTW	GWE	TPH-MO	TPH-DRO	TPH-GRO	B	T	E	X	MTBE by SW8260	Naphthalene	TBA	DIPE	ETBE	TAME	1,2-DCA	EDB	ADDITIONAL
	Units	ft	ft	ft-amsl	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-4	11/18/2010[1]	168.40	--	--	<250	2,800	26,000	2,800	1,500	550	3,100	<0.5	210	<200	<50	<50	<50	<50	<50	790[i] 210[i]
	02/14/2012[1]	168.40	6.45	161.95	--	<3,000	27,000	1,500	660	520	1,500	<5.0	--	--	--	--	--	--	--	--
	03/13/2015	168.47	10.70	157.77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2015	168.47	9.63	158.84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/29/2015	168.47	11.04	157.43	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/22/2015	168.47	10.31	158.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	03/28/2016	168.47	9.32	159.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2016	168.47	8.38	160.09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/08/2016	168.47	8.60	159.87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/16/2016	168.47	10.21	158.26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	03/07/2017	**168.47**	**6.70**	**161.77**	**--**	**--**	**16,000**	**1,300**	**220**	**380**	**560**	**<10**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	
MW-5	02/26/2015[2]	162.42	17.81	144.61	--	--	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--	--	--	--
	03/13/2015	162.42	16.48	145.94	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/19/2015	162.42	10.92	151.50	--	--	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--	--	--	--
	09/29/2015	162.42	12.29	150.13	--	--	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--	--	--	--
	12/22/2015	162.42	13.46	148.96	--	--	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--	--	--	--
	03/28/2016	162.42	8.22	154.20	--	--	<100	<1	<1	<1	<1	<1	--	--	--	--	--	--	--	--
	06/19/2016	162.42	9.18	153.24	--	--	<100	<1	<1	<1	<1	<1	--	--	--	--	--	--	--	--
	09/08/2016	162.42	10.78	151.64	--	--	<100	<1	<1	<1	<1	<1	--	--	--	--	--	--	--	--
	12/16/2016	162.42	10.99	151.43	--	--	<100	<1	<1	<1	<1	<1	--	--	--	--	--	--	--	--
	03/07/2017	**162.42**	**10.85**	**151.57**	**--**	**--**	**<100**	**<1**	**<1**	**<1**	**<1**	**<1**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	

Table 1

Groundwater Monitoring and Sampling Data
Former Tidewater Service Station 359766 (Ed's Liquors)
2700 23rd Avenue
Oakland, California

					HYDROCARBONS			VOCS												
Location	Date	TOC[a]	DTW	GWE	TPH-MO	TPH-DRO	TPH-GRO	B	T	E	X	MTBE by SW8260	Naphthalene	TBA	DIPE	ETBE	TAME	1,2-DCA	EDB	ADDITIONAL
	Units	ft	ft	ft-amsl	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L

Abbreviations and Notes:

-- = Not analyzed

<x and ND = Not detected above the method detection limit x.

Total purgeable petroleum hydrocarbons (TPPH) by EPA Method 8260B

Total petroleum hydrocarbons as motor oil (TPHmo), TPH as diesel (TPHd), and TPH as gasoline (TPHg) by modified EPA Method 8015B

Benzene, Toluene, Ethylbenzene, Xylenes by EPA Method 8260B

Methyl tertiary butyl ether (MTBE), di-isopropyl ether (DIPE), ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME), 1,2 dichloroethane (1,2-DCA), 1,2-dibromoethane (EDB), tertiary butyl alcohol (TBA), naphthalene by EPA Method 8260B

Volatile organic copmounds (VOCs) by EPA Method 8260B

a = Top of casing elevation was surveyed by Morrow Surveying on February 24, 2015; coordinates are California State Plan Zone 3, from GPS observation using CSDS virtual survey network, coordinate datum is NAD 83, reference geoid is GEOID03, and vertical datus is NAVD 88 from GPS observations. Prior to 2015, a survey was completed by licensed surveyor Ty Hawkins on December 20, 2010; based on California Coordinate System NAD 83, Zone III (2002.00), and elevations based on NAVD 88.

b = n-butyl benzene

c = 4-isopropyl toluene

d = Sec-butyl benzene

e = Isopropylbenzene

f = n-propyl benzene

g = 2-butanone

h = 4-methyl-2-pentanone

i = 1,2,4-trimethylbenzene

j = 1,3,5-trimethylbenzene

1 = Sampled by previous consultant

2 = Well development

Table 2

Cumulative Soil Gas Analytical Data
Former Tidewater Station 359766 (Ed's Liquors)
2700 23rd Avenue
Oakland, California

Sample ID	Date	Sample Depth (fbg)	TPHg ($\mu g/m^3$)	Benzene ($\mu g/m^3$)	Toluene ($\mu g/m^3$)	Ethyl-benzene ($\mu g/m^3$)	m,p-Xylene ($\mu g/m^3$)	o-Xylene ($\mu g/m^3$)	MTBE ($\mu g/m^3$)	Naphthalene ($\mu g/m^3$)	Oxygen (% Vol)	N_2 (% Vol)	CO_2 (% Vol)	Methane (% Vol)	He (% Vol)
LTC - Soil Gas Criteria No Bioattenuation Zone (02<4%)		***Residential***	***NE***	***85***	***NE***	***1,100***	***NE***	***NE***	***NE***	***93***	***NE***	***NE***	***NE***	***NE***	***NE***
		Commercial	***NE***	***280***	***NE***	***3,600***	***NE***	***NE***	***NE***	***310***	***NE***	***NE***	***NE***	***NE***	***NE***
LTC - Soil Gas Criteria Bioattenuation Zone (02>4%)		***Residential***	***NE***	***85,000***	***NE***	***1,100,000***	***NE***	***NE***	***NE***	***93,000***	***NE***	***NE***	***NE***	***NE***	***NE***
		Commercial	***NE***	***280,000***	***NE***	***3,600,000***	***NE***	***NE***	***NE***	***310,000***	***NE***	***NE***	***NE***	***NE***	***NE***
SV-1	7/29/2010	5	--	44	270	28	100	100	<7.3	<11	--	--	--	--	--
SV-2	7/29/2010	5	--	<500	3,100	8,100	28,000	28,000	<500	850	--	--	--	--	--
SV-3	7/29/2010	5	--	50	220	25	69	69	<7.3	<11	--	--	--	--	--
SV-4	7/29/2010	5	--	17	120	<8.8	<27	<27	<7.3	<11	--	--	--	--	--
VP-1	7/14/2014	4.5	2,100	9.0	34	11	35	13	<5.0	<29	8.5	85	6.7	<0.00028	<0.14
VP-1 DUP	7/14/2014	4.5	2,200	7.6	140	11	37	16	<4.8	<28	8.6	85	6.5	<0.00027	<0.13
VP-2	7/14/2014	4.5	740,000	79	<58	<67	89	<67	<56	<320	10	79	10	0.12	<0.19

Abbreviations/Notes:

Total petroleum hydrocarbons as gasoline (TPHg) by EPA Method TO-15 or EPA Method TO-15 SIM

Benzene, toluene, ethylbenzene, xylenes (BTEX), and methyl tertiary butyl ether (MTBE) by EPA Method TO-15 or EPA Method TO-15 SIM

Naphthalene by EPA Method TO-15 or EPA Method TO-15 SIM or EPA Method TO-17 (VI Tubes)

Oxygen, nitrogen (N_2), carbon dioxide (CO_2), methane, and helium (He) by ASTM D-1946.

fbg = Feet below grade.

Micrograms per cubic meter ($\mu g/m^3$).

Percent Volume (%).

<x = Not detected above stated laboratory method detection limit x.

-- = not analyzed or not applicable.

b = Low-Threat Underground Storage Tank Case Closure Policy - Soil Gas Criteria No Bioattenuation Zone - prepared by the California State Water Resources Control Board, August 17, 2012

Appendix A
Regulatory Letter

ALAMEDA COUNTY
HEALTH CARE SERVICE AGENCY
REBECCA GEBHART, Interim Agency Director

DEPARTMENT OF ENVIRONMENTAL HEALTH
LOCAL OVERSIGHT PROGRAM (LOP)
For Hazardous Materials Releases
1131 HARBOR BAY PARKWAY, SUITE 250
ALAMEDA, CA 94502
(510) 567-6700
FAX (510) 337-9335

February 10, 2017

Mr. Loyal and Ms. Mary Moore
30689 Prestwick Avenue
Hayward, CA 94544-7331
(Sent via e-mail to: loyalmary75@yahoo.com

Mr. Pedro and Ms. Maria Pulido
22762 Moura Court
Hayward, CA 94541-3279
(Sent via e-mail to: edsliquor@yahoo.com)

Mr. Mark Horne
Chevron Environmental Management Co.
6101 Bollinger Canyon Road
San Ramon, CA 94583-5177 (Sent via e-mail to: MarkHorne@chevron.com)

Subject: Fuel Leak Case No. RO0003098 and GeoTracker Global IDT10000004218, Ed's Liquor Store, 2700 23rd Avenue, Oakland, CA 94606-3530

Ladies and Gentlemen:

Alameda County Department of Environmental Health (ACDEH) has reviewed the December 2, 2016 *Low Threat Case Closure Request* (RFC) prepared on Chevron's behalf by GHD for the referenced case. ACDEH has evaluated the data in conjunction with the case files and the State Water Resources Control Board's (SWRCBs) Low Threat Underground Storage Tank Case Closure Policy (LTCP) general and media specific criteria. Based on ACDEH staff review, we have determined that the site does not meet the following criteria, and consequently, ACDEH must deny closure:

- General Criteria f (Secondary Source Removal)
- Media-Specific Criteria for Groundwater
- Media-Specific Criteria for Vapor Intrusion to Indoor Air

At this juncture ACDEH requests that you address the Technical Comments below and submit a Data Gap Work Plan to advance the case to closure.

TECHNICAL COMMENTS

A summary of the each of the general and media specific LTCP criteria that are not met is provided below, followed by an italicized description of justification provided by GHD in the RFC of how the criteria is met, and ACDEH's response.

1. **LTCP Media Specific Criteria for Groundwater** – To satisfy the media-specific criteria for groundwater, the contaminant plume that exceeds water quality objectives must be stable or decreasing in areal extent, and meet all of the additional characteristics of one of the five classes of sites listed in the policy.

   RFC Justification: *The site satisfies Class 2 criteria as follows:*

   - *The dissolved hydrocarbon plume from the source area (the southwestern corner of the site, near MW-4) that exceeds Water Quality Objectives (WQOs) is less than 250 feet in length in all directions. Downgradient well MW-5, where no hydrocarbons are detected is approximately 120 feet from the plume center (MW-4).*

- *Onsite well MW-1 through MW-4 were previously sampled twice in 2010 and 2012. Methyl tert-butyl ether (MTBE) concentrations were below 1,000 micrograms per liter (ug/L); only 1.3 ug/L detected. It should be noted that operation of a service station at the site (up to 1964) predates the widespread use of MTBE in gasoline. Benzene was only detected in well MW-4; in 2010 it was detected at 2,800 ug/L, then in 2012 at 1,500 ug/L, which are both below 3,000 ug/L. Additionally, based on the concentration reduction in two years and the lack of residual hydrocarbon and natural attenuation processes, concentrations have likely continued to decrease over the past 4 years.*

ADCEH's Response: ACDEH's review of the case files indicates that insufficient data and analysis has been presented to assess compliance with Media Specific Criteria for Groundwater. The RFC concludes that groundwater flow direction is to the southwest and has been defined by downgradient monitoring well MW-5. Samples collected from monitoring well MW-5 have consistently been non-detect and thus GHD concludes the contaminant plume has been defined. However, the *Subsurface Investigation Report and Conceptual Site Model* dated August 29, 2014 prepared by Conestoga-Rovers & Associated (CRA) on behalf of Chevron stated that the sewer and storm drain lines in E. 27th Street and 23rd Avenue (bounding the subject site on the south and west side respectively), may come in contact with groundwater. CRA also concludes that it is uncertain whether these lines act as preferential pathways for hydrocarbon migration. ACDEH concurs with the CRA assessment that if the sewer and storm drain lines are in contact with groundwater, these lines may act as preferential pathways for hydrocarbon migration off site to the residential and commercial properties across E. 27th Street. Please refer to the groundwater gradient utility survey figures included in Attachment A to this letter.

Additionally, based on a review of data from nine quarters of monitoring events between 2010 and 2016 of five groundwater monitoring wells, the groundwater flow direction has components to the south and southeast in addition to the southwest. The groundwater flow components in the south and southeast direction are supported by data contained in a *Limited Phase II Environmental Site Assessment Sanitary Sewer Rehabilitation Project Sub-Basin 60-06 Oakland, CA* (Sewer Report) dated March 20, 2015 prepared by Ninyo & Moore on behalf of the City of Oakland. ACDEH provided a copy of the Sewer Report to Chevron on April 14, 2015. The Sewer Report was prepared for the City of Oakland in preparation for sanity sewer rehabilitation work in the site vicinity. Soil and grab groundwater samples were collected adjacent to a sanitary sewer line segment located under E. 27th Street south of the case due to the City of Oakland's concern with potential environmental impact associated with the former USTs at the subject property. A grab groundwater sample collected from SB-2 located approximately 16 feet south of MW-3 and in E. 27th Street detected 12,000 ug/L TPHg, 4,000 ug/L TPHd, 330 ug/L TPHmo, 71 ug/L benzene, and 4.9 ug/L naphthalene, indicating TPH, benzene and naphthalene impact under E. 27th Street and south of the site. Please refer to the Figure and Tables from the Sewer Report provided in Attachment B to this letter.

Based on this data it appears the extent of the contaminant plume has not been adequately defined. Contaminant migration in groundwater may pose a vapor intrusion risk to downgradient residents and businesses on E. 27th Street.

Therefore, please present a strategy in the Data Gap Work Plan to evaluate the extent of the contaminant plume including, but not limited to, groundwater monitoring and sampling of all five groundwater monitoring wells for TPHg, TPHd, TPHmo, benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, fuel oxygenates and collection of soil and grab groundwater samples

from borings located upgradient of the residential and commercial businesses on the south side of E-27th Street.

2. **LTCP Media Specific Criteria for Vapor Intrusion to Indoor Air** – The LTCP describes conditions, including bioattenuation (unsaturated) zones, which if met will assure that exposure to petroleum vapors in indoor air will not pose unacceptable health risks to human occupants of existing or future site buildings, and adjacent parcels. Appendices 1 through 4 of the LTCP criteria illustrate four potential exposure scenarios and describe characteristics and criteria associated with each scenario.

RFC Justification: *LTCP Media Specific Criteria for Vapor Intrusion to Indoor Air: Site conditions meet criteria (a), Scenario 4, 1 of 2, of the Policy (direct measurements of soil gas concentrations – soil gas sampling – with no bioattenuation zone). Soil vapor analytical results indicate a bioattenuation zone, with oxygen levels between 8.5% and 10%; however, detected concentrations are below the more stringent criteria of Scenario 1 of 2 with no bioattenuation zone.*

ADCEH's Response: ACDEH's review of the case files indicates that the Media Specific Criteria for Vapor Intrusion to Indoor Air is not met at the site. Data from a soil vapor survey performed in July 2010, but not included with the RFC, consisted of collection of four soil vapor samples SV-1 through SV-4 from a depth of five feet below ground surface (bgs) on the site. A soil vapor sample collected at SV-2 (located approximately 25 feet from the edge of the liquor store building) detected concentration of 8,100 micrograms per cubic meter (ug/m^3) ethylbenzene, 850 ug/m^3 naphthalene, and benzene at less than the laboratory reporting limit of 500 ug/m^3, a detection level exceeding the commercial benzene LTCP level of less than 280 ug/m^3. A second soil vapor survey conducted in July 2014 consisted of collection of soil vapor samples from two locations, VP-1 and VP-2 at a depth of 4.5 feet bgs. A soil vapor sample collected at VP-2, located approximately 12 feet from the liquor store building and 10 feet east northeast of SV-2 detected concentrations of 79 ug/m^3 benzene, less than 67 ug/m^3 ethylbenzene, and naphthalene at less than the laboratory reporting limit of 320 ug/m^3, a detection level exceeding the commercial naphthalene LTCP level of less than 310 ug/m^3. Additionally, a review of Figure 2 included in Attachment A shows utility lines to the liquor store in the vicinity of these soil vapor probes that may act as preferential pathways to vapor migration into the store.

Therefore, please present a strategy in the Data Gap Work Plan to collect additional onsite data to verify that there is a low risk to occupants of the liquor store from vapor intrusion to indoor air. Please ensure if soil vapor collection is proposed, laboratory detection limits below the LTCP criteria are used. Please note, that if direct measurement of soil gas is proposed, ensure that your strategy is consistent with the field sampling protocols described in the Department of Toxic Substances Control's Final Vapor Intrusion Guidance (October 2011).

Additionally, please collect information on the foundation of the onsite liquor store and the residential and commercial buildings downgradient of the undefined contaminant plume on E. 27th street to assess the potential risk to occupants from vapor intrusion to indoor air. Subsequent to plume delineation (requested in Technical Comment 1) and a review of foundation information for the downgradient residences and commercial structures on E. 27th Street, a decision will be made whether further evaluation is required to assess vapor intrusion risk to indoor. Please refer to Attachment C of this letter for google maps showing the adjacent downgradient residential and commercial properties.

3. **General Criteria f – Secondary Source Has Been Removed to the Extent Practicable –** "Secondary source" is defined as petroleum-impacted soil or groundwater located at or immediately beneath the point of release from the primary source. Unless site attributes prevent secondary source removal (e.g. physical or infrastructural constraints exist whose removal or relocation would be technically or economically infeasible), petroleum-release sites are required to undergo secondary source removal to the extent practicable as described in the policy. "To the extent practicable" means implementing a cost-effective corrective action which removes or destroys-in-place the most readily recoverable fraction of source-area mass. It is expected that most secondary mass removal efforts will be completed in one year or less. Following removal or destruction of the secondary source, additional removal or active remedial actions shall not be required by regulatory agencies unless (1) necessary to abate a demonstrated threat to human health or (2) the groundwater plume does not meet the definition of low threat as described in this policy.

RFC Justification: *In 2010, a geophysical survey revealed a metallic utility line in the central area of the parking lot and miscellaneous debris at the southwest corner of the parking lot. These areas were subsequently excavated and the utility lines and debris were removed.*

ADCEH's Response: ACDEH's review of the case files indicates that insufficient data and analysis has been presented to assess compliance with General Criteria f. The site was historically used as a commercial fueling facility from 1928 to 1964. The facility was demolished around 1964 and redeveloped with liquor store in 1968. There are no records in the case file documenting the location(s) and number of underground storage tanks (USTs) and associated piping and dispenser islands. In 2010 two areas were excavated at the site; however, as indicated by concentrations of Total Petroleum Hydrocarbon (TPH) as gasoline, diesel and motor oil, benzene and naphthalene detected in soil samples collected between 0 and 5 feet below ground surface (bgs) and between 5 to 10 feet bgs in areas outside the two excavations, significant secondary or residual sources remain at the site.

On-site TPH/Benzene/Naphthalene detected in soil less than 5 feet in depth in milligrams per kilogram (mg/kg)

Field Point	Sample Date	Depth feet	TPHg	TPHd	TPHmo	Benzene	Naphthalene
DHB-1	2/2012	3.25	490	140	NA	0.16	NA
B-6	7/2014	5	22	<4.0	<9.9	<0.005	<0.013
B-7	7/2014	5	130	10	<10	0.086	0.16
MW-4	10/2010	3.5	1,400	220	16	<0.5	<0.5
SV-2	7/2010	5	420	370	1,500	<0.2	<2.0
VP-2	7/2014	5	<1	42	85	<0.005	0.014

NA Not analyzed

On-site TPH/Benzene/Naphthalene detected in soil between 5 and 10 feet depth (mg/kg)

Field Point	Sample Date	Depth feet	TPHg	TPHd	TPHmo	Benzene	Naphthalene
DHB-1	2/2012	6.25	360	360	NA	1.05	NA
B-6	7/2014	10	130	33	<10	<0.028	0.029
MW-4	10/2010	8.5	270	18	<5.0	<0.20	0.27
B-1	7/2014	8	43	33	<5.0	<0.010	<0.010

NA Not analyzed

Subsequent to collection of data to support the stability and lateral extent of the groundwater contaminant plume and the risk of vapor intrusion risk to indoor air of occupants in both on and offsite buildings, a decision will be made whether further remediation of secondary source (or residual source) material is required.

TECHNICAL REPORT REQUEST

Please upload the following technical reports to the ACDEH ftp site (Attention: Karel Detterman) and to the State Water Resources Control Board's GeoTracker website:

1. **Data Gap Investigation Work Plan and Updated Site Conceptual Model** – Please prepare a Data Gap Investigation Work Plan to address the technical comments listed above. Please support the scope of work in the Data Gap Investigation Work Plan with a focused Site Conceptual Model (SCM) and Data Quality Objectives (DQOs) that relate the data collection to each LTCP criteria. Please sequence activities in the proposed Data Gap Investigation scope of work to enable efficient data collection in the fewest mobilizations possible.

   As a part of the updated SCM, please identify on the aerial photograph-based site vicinity figure buildings with basements, half-basements, or potential dewatering structures (such as sump pumps, which have the potential to bring contaminated groundwater to the surface for discharge to the street or storm drain). Please submit the Data Gap Work Plan in accordance with the following schedule and file naming convention:

   April 14, 2017 Data Gap Work Plan and Updated Site Conceptual Model
   RO0003098_WP_SCM_R_yyyy-mm-dd

2. **Electronic Submittal of Information (ESI) Compliance:** A review of the case file indicates that the SWRCB Geotracker database and/or the ACDEH database is not complete, thus rendering the site to a non-compliant status pursuant to California Code of Regulations, Title 23, Division 3, Chapter 30, Articles 1 and 2, Sections 3890 to 3895. At present missing data and documents include, but may not be limited to:

   - surveyed elevation measurements to the top of well casings (GEO_Z files);
   - the latitude and longitude (GEO_XY files) of any permanent monitoring well for which data is reported in EDF format.

   Please submit documentation of ESI compliance in accordance with the following schedule and file naming convention:

   April 14, 2017 ESI Compliance Documentation
   RO0003098_ESI_COMP_yyyy-mm-dd

These reports are being requested pursuant to California Health and Safety Code Section 25296.10. 23 CCR Sections 2652 through 2654, and 2721 through 2728 outline the responsibilities of a responsible party in response to an unauthorized release from a petroleum UST system, and require your compliance with this request.

SUBMITTAL ACKNOWLEDGEMENT STATEMENT (FORMER PERJURY STATEMENT)

Please note that ACDEH has updated Attachment 1 and will now require a *Submittal Acknowledgement Statement*, instead of a *Perjury Statement* as a cover letter signed by the responsible Party (RP). Please make this change to your submittals to ACDEH with the next deliverable.

The language for the *Submittal Acknowledgement Statement* is as follows:

"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."

Should you have any questions, please contact me at (510) 567-6708 or send me an electronic mail message at karel.detterman@acgov.org

Sincerely,

Karel Detterman

Digitally signed by Karel Detterman
DN: cn=Karel Detterman, o, ou, email=karel.detterman@acgov.org, c=US
Date: 2017.02.10 14:51:23 -08'00'

Karel Detterman, PG
Hazardous Materials Specialist

Enclosures: Attachment 1 - Responsible Party(ies) Legal Requirements / Obligations
Electronic Report Upload (ftp) Instructions

Attachment A – Figure 2 (Utility Survey) and Figure 2 (Groundwater Gradient)

Attachment B – Figure 3, Table 2 and Table 4 from the *Limited Phase II Environmental Site Assessment Sanitary Sewer Rehabilitation Project Sub-Basin 60-06 Oakland, CA*, March 20, 2015 prepared by Ninyo & Moore for the City of Oakland

Attachment C – Google maps of downgradient adjacent properties

cc: Kiersten Hoey, GHD, 5900 Hollis Street, Emeryville, CA 94608, (Sent via E-mail to: Kiersten.Hoey@ghd.com)

Karel Detterman, ACDEH, (Sent via E-mail to: karel.detterman@acgov.org)
Dilan Roe, ACDEH, (Sent via E-mail to: dilan.roe@acgov.org)
Paresh Khatri, ACDEH, (Sent via E-mail to: paresh.khatri@acgov.org)
Electronic File, GeoTracker

Attachment 1

Responsible Party(ies) Legal Requirements / Obligations

REPORT REQUESTS

These reports are being requested pursuant to California Health and Safety Code Section 25296.10. 23 CCR Sections 2652 through 2654, and 2721 through 2728 outline the responsibilities of a responsible party in response to an unauthorized release from a petroleum UST system, and require your compliance with this request.

ELECTRONIC SUBMITTAL OF REPORTS

Alameda County Department of Environmental Health's (ACDEH) Environmental Cleanup Oversight Programs, Local Oversight Program (LOP) and Site Cleanup Program (SCP) require submission of reports in electronic form. The electronic copy replaces paper copies and is expected to be used for all public information requests, regulatory review, and compliance/enforcement activities. Instructions for submission of electronic documents to the Alameda County Environmental Cleanup Oversight Program File Transfer Protocol (FTP) site are provided on the attached "Electronic Report Upload Instructions." Submission of reports to the Alameda County FTP site is an addition to existing requirements for electronic submittal of information to the State Water Resources Control Board (SWRCB) GeoTracker website. In September 2004, the SWRCB adopted regulations that require electronic submittal of information for all groundwater cleanup programs. For several years, responsible parties for cleanup of leaks from underground storage tanks (USTs) have been required to submit groundwater analytical data, surveyed locations of monitoring wells, and other data to the GeoTracker database over the Internet. Beginning July 1, 2005, these same reporting requirements were added to SCP sites. Beginning July 1, 2005, electronic submittal of a complete copy of all reports for all sites is required in GeoTracker (in PDF format). Please visit the SWRCB website (http://www.waterboards.ca.gov/water_issues/programs/ust/electronic_submittal/) for more information on these requirements.

ACKNOWLEDGEMENT STATEMENT

All work plans, technical reports, or technical documents submitted to ACDEH must be accompanied by a cover letter from the responsible party that states, at a minimum, the following: "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." This letter must be signed by an officer or legally authorized representative of your company. Please include a cover letter satisfying these requirements with all future reports and technical documents submitted for this fuel leak case.

PROFESSIONAL CERTIFICATION & CONCLUSIONS/RECOMMENDATIONS

The California Business and Professions Code (Sections 6731, 6735, and 7835) requires that work plans and technical or implementation reports containing geologic or engineering evaluations and/or judgments be performed under the direction of an appropriately licensed or certified professional. For your submittal to be considered a valid technical report, you are to present site-specific data, data interpretations, and recommendations prepared by an appropriately licensed professional and include the professional registration stamp, signature, and statement of professional certification. Please ensure all that all technical reports submitted for this case meet this requirement. Additional information is available on the Board of Professional Engineers, Land Surveyors, and Geologists website at: http://www.bpelsg.ca.gov/laws/index.shtml.

UNDERGROUND STORAGE TANK CLEANUP FUND

Please note that delays in investigation, late reports, or enforcement actions may result in your becoming ineligible to receive grant money from the state's Underground Storage Tank Cleanup Fund (Senate Bill 2004) to reimburse you for the cost of cleanup.

AGENCY OVERSIGHT

If it appears as though significant delays are occurring or reports are not submitted as requested, we will consider referring your case to the Regional Board or other appropriate agency, including the County District Attorney, for possible enforcement actions. California Health and Safety Code, Section 25299.76 authorizes enforcement including administrative action or monetary penalties of up to $10,000 per day for each day of violation.

Alameda County Environmental Cleanup Oversight Programs (LOP and SCP)	**REVISION DATE:** December 1, 2016
	ISSUE DATE: July 5, 2005
	PREVIOUS REVISIONS: October 31, 2005; December 16, 2005; March 27, 2009; July 8, 2010, July 25, 2010; May 15, 2014, November 29, 2016
SECTION: Miscellaneous Administrative Topics & Procedures	**SUBJECT:** Electronic Report Upload (ftp) Instructions

The Alameda County Environmental Cleanup Oversight Programs (LOP and SCP) require submission of all reports in electronic form to the county's ftp site. Paper copies of reports will no longer be accepted. The electronic copy replaces the paper copy and will be used for all public information requests, regulatory review, and compliance/enforcement activities.

REQUIREMENTS

- **Please do not submit reports as attachments to electronic mail.**
- Entire report including cover letter must be submitted to the ftp site as **a single portable document format (PDF) with no password protection**.
- It is **preferable** that reports be converted to PDF format from their original format, (e.g., Microsoft Word) rather than scanned.
- **Signature pages and perjury statements must be included and have either original or electronic signature.**
- **Do not password protect the document**. Once indexed and inserted into the correct electronic case file, the document will be secured in compliance with the County's current security standards and a password. **Documents with password protection will not be accepted**.
- Each page in the PDF document should be rotated in the direction that will make it easiest to read on a computer monitor.
- Reports must be named and saved using the following naming convention:

  RO#_Report Name_Year-Month-Date (e.g., RO#5555_WorkPlan_2005-06-14)

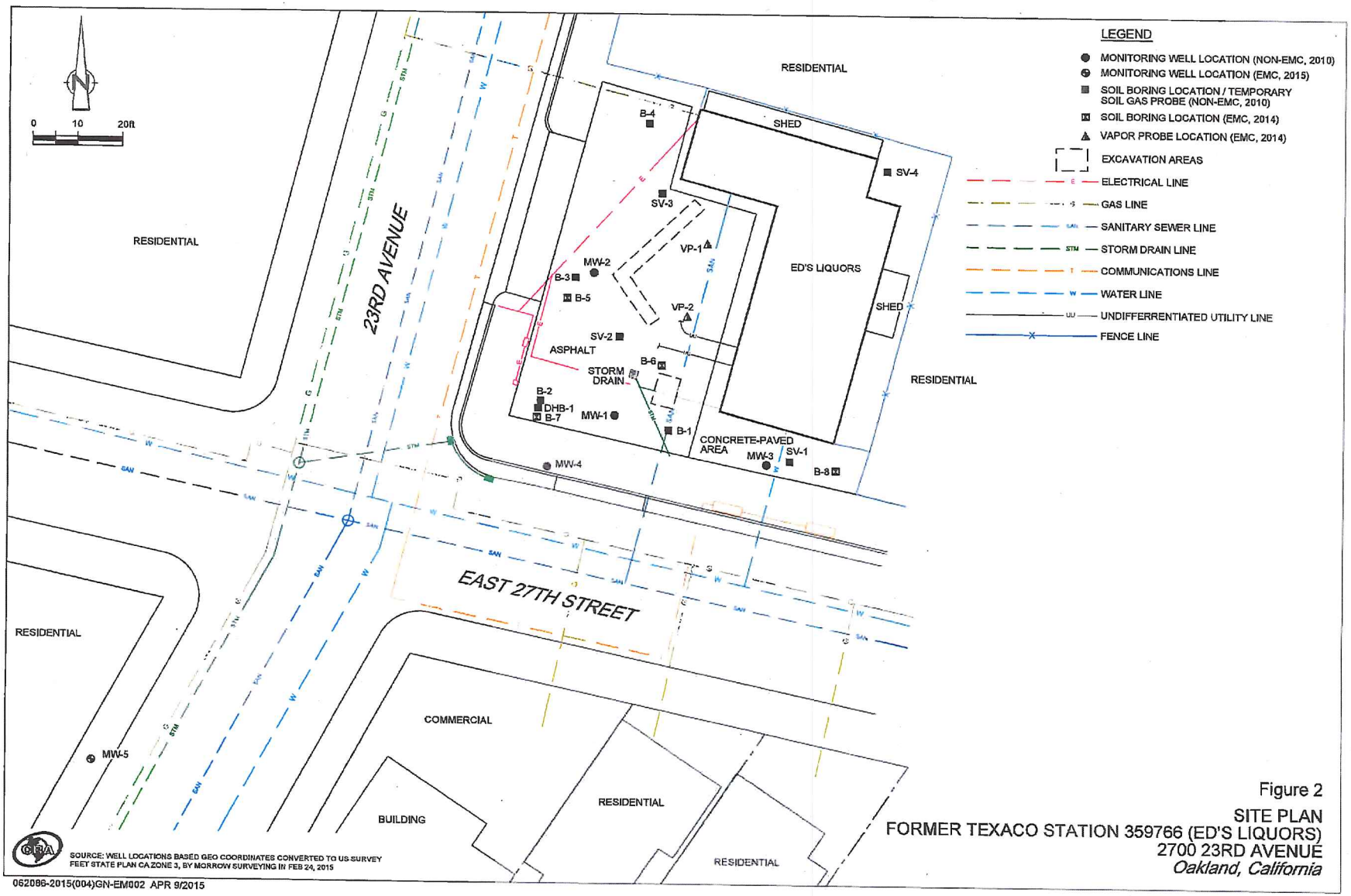
Submission Instructions

1) Obtain User Name and Password
   a) Contact the Alameda County Environmental Health Department to obtain a User Name and Password to upload files to the ftp site.
      i) Send an e-mail to deh.loptoxic@acgov.org.
   b) In the subject line of your request, be sure to include **"ftp PASSWORD REQUEST"** and in the body of your request, include the **Contact Information, Site Addresses**, and the **Case Numbers (RO# available in Geotracker) you will be posting for**.

2) Upload Files to the ftp Site
   a) Open File Explorer using the Windows  key + E keyboard shortcut.
      i) Note: Netscape, Safari, and Firefox browsers will not open the FTP site as they are NOT being supported at this time.
   b) On the address bar, type in ftp://alcoftp1.acgov.org.
   c) Enter your User Name and Password. (Note: Both are Case Sensitive)
   d) Click Log On.
   e) Open "My Computer" on your computer and navigate to the file(s) you wish to upload to the ftp site.
   f) With both "My Computer" and the ftp site open in separate windows, drag and drop the file(s) from "My Computer" to the ftp window.

3) Send E-mail Notifications to the Environmental Cleanup Oversight Programs
   a) Send email to deh.loptoxic@acgov.org notify us that you have placed a report on our ftp site.
   b) Copy your Caseworker on the e-mail. Your Caseworker's e-mail address is the entire first name then a period and entire last name @acgov.org. (e.g., firstname.lastname@acgov.org)
   c) The subject line of the e-mail must start with the RO# followed by **Report Upload**. (e.g., Subject: RO1234 Report Upload) If site is a new case without an RO#, use the street address instead.
   d) If your document meets the above requirements and you follow the submission instructions, you will receive a notification by email indicating that your document was successfully uploaded to the ftp site.

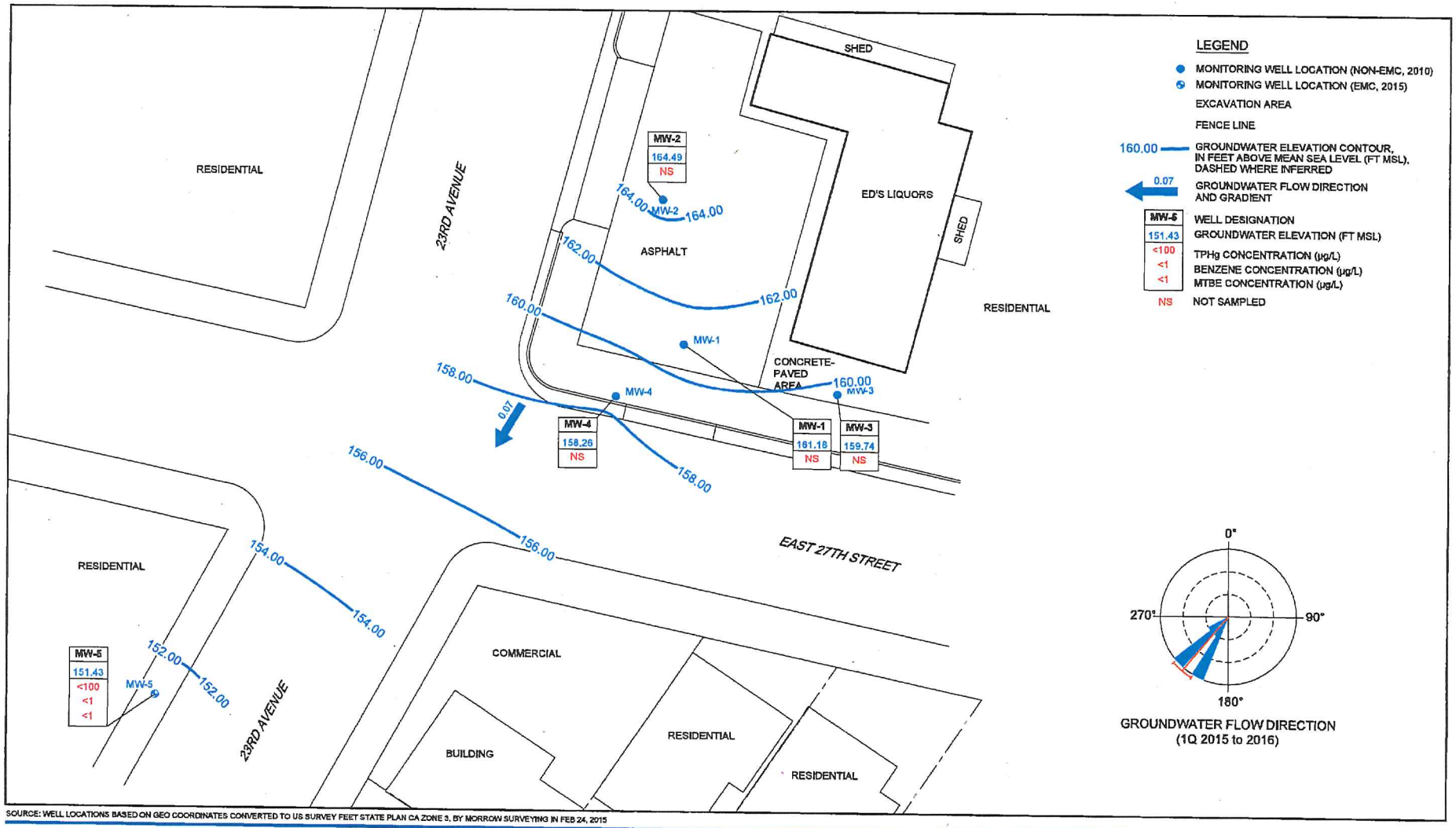
ATTACHMENT A



062086-2015(004)GN-EM002 APR 9/2015

Figure 2

SITE PLAN
FORMER TEXACO STATION 359766 (ED'S LIQUORS)
2700 23RD AVENUE
Oakland, California



SOURCE: WELL LOCATIONS BASED ON GEO COORDINATES CONVERTED TO US SURVEY FEET STATE PLAN CA ZONE 3, BY MORROW SURVEYING IN FEB 24, 2015

0 10 20ft

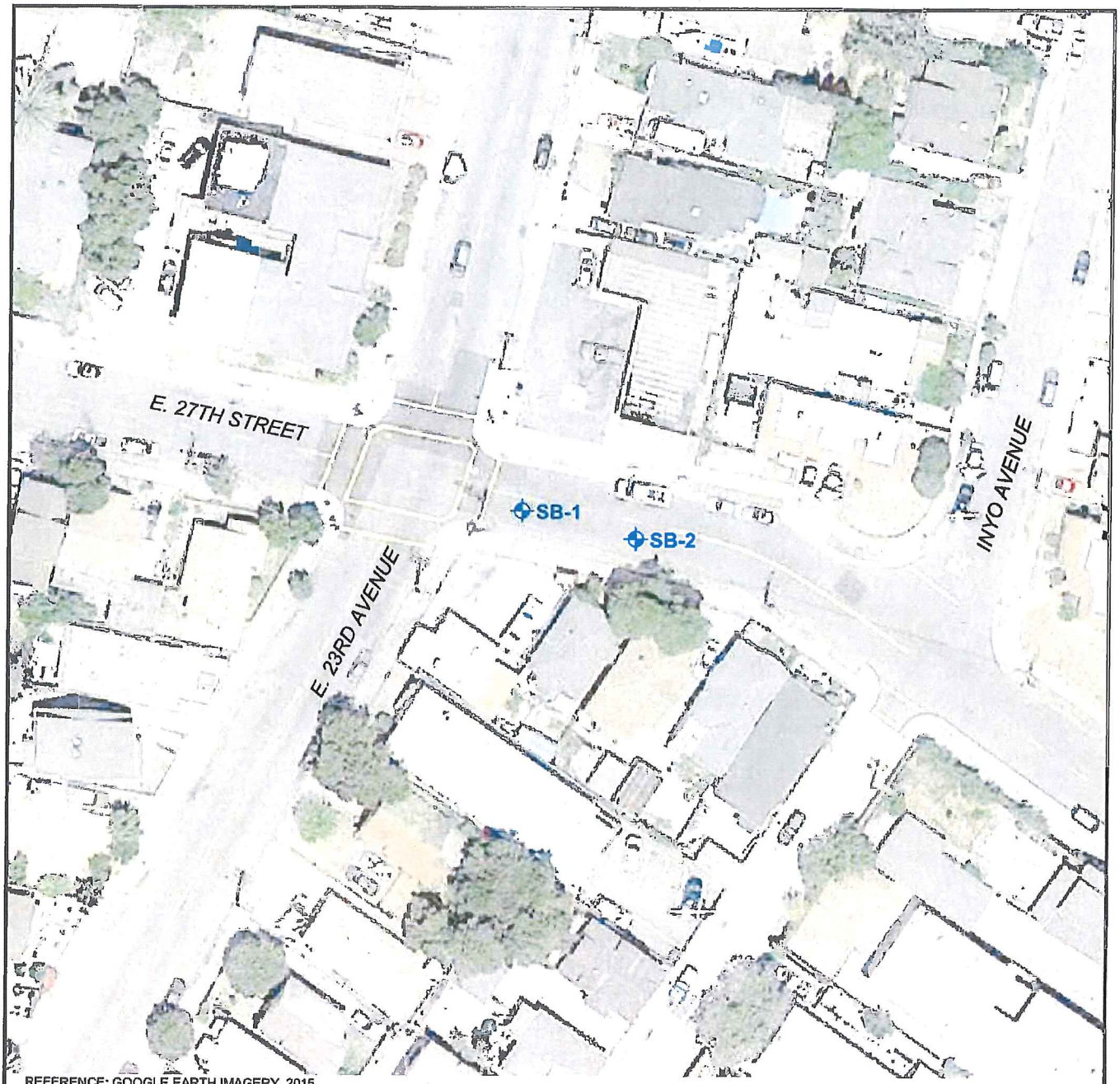
FORMER TEXACO STATION 359766
2700 23rd AVENUE
OAKLAND, CALIFORNIA

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP - DECEMBER 16, 2016 FIGURE 2

62086-95
Feb 1, 2017

CAD File: P:\drawings\62000s\62086\62086-REPORTS\62086-95(012)\62086-95(012)GN\62086-95(012)GN-WA002.DWG

ATTACHMENT B



REFERENCE: GOOGLE EARTH IMAGERY, 2015.

N

SCALE IN FEET

0 60 120

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

LEGEND
BORING LOCATION

Ninyo & Moore	2700 23RD AVENUE BORING LOCATIONS	FIGURE
PROJECT NO. 402231012 / DATE 3/15	SUB-BASIN 60-06 OAKLAND, CALIFORNIA	3

TABLE 2
SOIL SAMPLE LABORATORY ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS AS GASOLINE, DIESEL, MOTOR OIL AND VOLATILE ORGANIC COMPOUNDS

Sample I.D.	Sample Collection Date	Sample Depth (ft bgs)	TPH (mg/kg)			VOCs (mg/kg)				
			Gasoline C7-C-12	Diesel C10-C24	Motor Oil C24-C36	Ethyl-benzene	m, p-Xylenes	Isopropyl-benzene (Cumene)	Propyl-benzene	n-butyl-benzene
SB-1-10	2/26/2015	10	2.2Y	2.7Y	ND<5.0	ND<0.0042	ND<0.0042	ND<0.0042	ND<0.0042	ND<0.0042
SB-2-10	2/26/2015	10	220Y	82Y	8.0	0.610	0.250	0.280	0.590	0.510
SB-3-10	2/26/2015	10	ND<1.0	ND<1.0	ND<5.0	ND<0.0047	ND<0.0047	ND<0.0047	ND<0.0047	ND<0.0047
SB-4-7	2/26/2015	7	ND<1.1	ND<1.0	ND<5.0	ND<0.0042	ND<0.0042	ND<0.0042	ND<0.0042	ND<0.0042
Construction/Trench Worker ESL[1]			2,700	900	28,000	490	2,500	NL	NL	NL
Commercial/Industrial Worker ESL[2]			4,000	1,100	100,000	24	2,600	NL	NL	NL

Notes and Abbreviations:
TPH (total petroleum hydrocarbons) as gasoline, diesel and motor oil analyzed by EPA Method 8015B
VOCs = Volatile Organic Compounds analyzed by EPA Method 8260B
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilograms
ft bgs = feet below ground surface
< X = concentration not detected above laboratory reporting limits of X
NA = Not Applicable
ND = Not Detected
NL = Not listed
Y - Sample exhibits chromatographic pattern which does not resemble standard

[1] -Construction/Trench worker ESLs = San Francisco Bay RWQCB Environmental Screening Levels - Table K-3 Construction/Trench Worker Exposure, Revised December 2013

[2] - Commercial/Industrial worker ESLs = San Francisco Bay RWQCB Environmental Screening Levels - Table K-2 Direct Exposure Soil Screening Levels, Commercial/Industrail Worker Exposure Senario, Revised December 2013

Bold indicates exceedence of Commercial/Industrial Worker ESL

TABLE 4
GROUNDWATER SAMPLE LABORATORY ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS AND DETECTED VOLATILE ORGANIC COMPOUNDS

Sample ID	Sample Collection Date	Sample Depth (ft bgs)	Analytes												
			Gasoline C7-C12	Diesel C10-C24	Motor Oil C24-C3	Benzene	Toluene	Ethylbenzene	Total Xylenes (m,p + o)	Isopropylbenzene	Propylbenzene	1,3,5-Trimethylbenzene	sec-butylbenzene	para-Isopropyl Toluene	Naphthalene
			Groundwater Sample Analytical Results (µg/L)												
SB-2-GW	2/26/2015	10	**12,000**	**4,000**	**330**	**71**	**42**	110	**62**	71	130	22	9.3	11	4.9
Trip Blank	2/26/2015	10	ND<50	ND<50	ND<300	ND<0.50	ND<0.50	ND<0.50	ND<1.0	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<2.0
General Waste Discharge Requirement[1]			50	50	NE	1	5	5	5	NE	NE	NE	NE	NE	NE
Groundwater Screening Level ESLs[2]			100	100	100	1.0	40	30	20	NE	NE	NE	NE	NE	6.1

Notes:
Total Petroleum Hydrocarbons analyzed using EPA Method 8015I
Title 22 metals analyzed by 6010B
Volatile Organic Compounds Analyzed using EPA Method 6010I

-- not applicable
µg/L - micrograms per Liter
ESL- Environmental Screening Level
NA - Not analyzed
ND<X - not detected at a concentration greater than the laboratory reporting limit of X
NE- Not Established
Boldtype indicates concentration exceeds Groundwater Screening Level ESLs
[1] - General Waste Discharge Requirements for Discharge or Reuse of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Volatile Organic Compounds (VOC), Fu
Leaks and Other Related Wastes (VOC and Fuel General Permit) RWQCB 02-08-12
[2] - Groundwater Screening Levels (groundwater IS a current or potential drinking water resource) from Table F1-A; SFRWQCB ESLs

ATTACHMENT C

2301 E 27th St - Google Maps

Google Maps 2301 E 27th St

Oakland, California
Street View - Oct 2016

Image capture: Oct 2016 © 2017 Google

https://www.google.com/maps/@37.7935214,-122.2266408,3a,75y,41.86h,73.34t/data=!3m6!1e1!3m4!1sGEvLFSwRJ_Rz-g0XBzJobQ!... 2/6/2017

Google Maps 2700 23rd Ave

Oakland, California
Street View - Jun 2016

Image capture: Jun 2016 © 2017 Google

2311 E 27th St - Google Maps

Google Maps 2311 E 27th St

Oakland, California
Street View - Oct 2016

Image capture: Oct 2016 © 2017 Google

2315 E 27th St - Google Maps

Google Maps 2315 E 27th St

Oakland, California
Street View - Oct 2016

Image capture: Oct 2016 © 2017 Google

https://www.google.com/maps/@37.7934636,-122.226265,3a,75y,279.12h,73.95t/data=!3m6!1e1!3m4!1sSrQpnaRw_sU-uu1WaR0hpw!... 2/6/2017

Appendix B
GHD's Standard Field Procedures for Soil Boring and Monitoring Well Installation

Appendix B STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

This document presents standard field methods for drilling and sampling soil borings and installing, developing, and sampling groundwater monitoring wells. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

SOIL BORINGS

Objectives

Soil samples are collected to characterize subsurface lithology, assess whether the soils exhibit obvious hydrocarbon or other compound vapor or staining, and to collect samples for analysis at a State-certified laboratory. All borings are logged using the ASTM D2488-06 Unified Soil Classification System by a trained geologist working under the supervision of a California Professional Geologist (PG).

Soil Boring and Sampling

Prior to drilling, the first 8 feet of the boring are cleared using an air or water knife and vacuum extraction or hand auger. This minimizes the potential for impacting utilities. Soil borings are typically drilled using hollow-stem augers or direct-push technologies such as the Geoprobe®. Soil samples are collected at least every five ft to characterize the subsurface sediments and for possible chemical analysis. Additional soil samples are collected near the water table and at lithologic changes. Samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments at the bottom of the borehole.

Drilling and sampling equipment is steam-cleaned prior to drilling and between borings to prevent cross-contamination. Sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent.

Sample Analysis

Sampling tubes chosen for analysis are trimmed of excess soil and capped with Teflon tape and plastic end caps. Soil samples are labeled and stored at or below 4^{o} C on either crushed or dry ice, depending upon local regulations. Samples are transported under chain-of-custody to a State-certified analytic laboratory.

Field Screening

One of the remaining tubes is partially emptied leaving about one-third of the soil in the tube. The tube is capped with plastic end caps and set aside to allow hydrocarbons to volatilize from the soil. After ten to fifteen minutes, a portable volatile vapor analyzer measures volatile hydrocarbon vapor concentrations in the tube headspace, extracting the vapor through a slit in the cap. Volatile vapor analyzer measurements are used along with the field observations, odors, stratigraphy and groundwater depth to select soil samples for analysis.

Water Sampling

Water samples, if they are collected from the boring, are either collected using a driven Hydropunch® type sampler or are collected from the open borehole using bailers. The groundwater samples are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in

protective foam sleeves, stored on crushed ice at or below 4^{o}C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Grouting

If the borings are not completed as wells, the borings are filled to the ground surface with cement grout poured or pumped through a tremie pipe.

MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

Well Construction and Surveying

Groundwater monitoring wells are installed to monitor groundwater quality and determine the groundwater elevation, flow direction and gradient. Well depths and screen lengths are based on groundwater depth, occurrence of hydrocarbons or other compounds in the borehole, stratigraphy and State and local regulatory guidelines. Well screens typically extend 10 to 15 feet below and 5 feet above the static water level at the time of drilling. However, the well screen will generally not extend into or through a clay layer that is at least three feet thick.

Well casing and screen are flush-threaded, Schedule 40 PVC. Screen slot size varies according to the sediments screened, but slots are generally 0.010 or 0.020 inches wide. A rinsed and graded sand occupies the annular space between the boring and the well screen to about one to two feet above the well screen. A two feet thick hydrated bentonite seal separates the sand from the overlying sanitary surface seal composed of Portland type I, II cement.

Well-heads are secured by locking well-caps inside traffic-rated vaults finished flush with the ground surface. A stovepipe may be installed between the well-head and the vault cap for additional security.

The well top-of-casing elevation is surveyed with respect to mean sea level and the well is surveyed for horizontal location with respect to an onsite or nearby offsite landmark.

Well Development

Wells are generally developed using a combination of groundwater surging and extraction. Surging agitates the groundwater and dislodges fine sediments from the sand pack. After about ten minutes of surging, groundwater is extracted from the well using bailing, pumping and/or reverse air-lifting through an eductor pipe to remove the sediments from the well. Surging and extraction continue until at least ten well-casing volumes of groundwater are extracted and the sediment volume in the groundwater is negligible. This process usually occurs prior to installing the sanitary surface seal to ensure sand pack stabilization. If development occurs after surface seal installation, then development occurs 24 to 72 hours after seal installation to ensure that the Portland cement has set up correctly.

All equipment is steam-cleaned prior to use and air used for air-lifting is filtered to prevent oil entrained in the compressed air from entering the well. Wells that are developed using air-lift evacuation are not sampled until at least 24 hours after they are developed.

Groundwater Sampling

Depending on local regulatory guidelines, three to four well-casing volumes of groundwater are purged prior to sampling. Purging continues until groundwater pH, conductivity, and temperature have stabilized.

Groundwater samples are collected using bailers or pumps and are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4^{o}C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Waste Handling and Disposal

Soil cuttings from drilling activities are usually stockpiled onsite and covered by plastic sheeting. At least three individual soil samples are collected from the stockpiles and composited at the analytic laboratory. The composite sample is analyzed for the same constituents analyzed in the borehole samples in addition to any analytes required by the receiving disposal facility. Soil cuttings are transported by licensed waste haulers and disposed in secure, licensed facilities based on the composite analytic results.

Groundwater removed during development and sampling is typically stored onsite in sealed 55-gallon drums. Each drum is labeled with the drum number, date of generation, suspected contents, generator identification and consultant contact. Upon receipt of analytic results, the water is either pumped out using a vacuum truck for transport to a licensed waste treatment/disposal facility or the individual drums are picked up and transported to the waste facility where the drum contents are removed and appropriately disposed.