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CITY OF OAKLAND

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Mr. Keith Nowell
Hazardous Materials Specialist
Alameda County Department of Environmental Health
1131 Harbor Bay Pkwy
Alameda, California 94502

Subject: Response to Comments, Soil Gas Data Submittal, and Scope of Work for Sub-Slab Soil Gas Sampling
City of Oakland Municipal Service Center (MSC)
7101 Edgewater Drive Oakland California

Reference: ACDEH Fuel Leak Case No. RO0000293; GeoTracker Global ID T0600100375

Dear Mr. Nowell:

The City of Oakland is pleased to submit the attached Response to Comments, Soil Gas Data Submittal, and Scope of Work for Sub-Slab Soil Gas Sampling prepared by Terraphase. I have read and acknowledge the content, recommendations and/or conclusions contained in the attached document submitted on City's behalf to ACDEH's FTP server and the SWRCB's GeoTracker website.

Please contact me at (510) 238-7314 if you have any questions or comments.

Sincerely,

Kayleigh Lim
Environmental Program Specialist

November 3, 2017

Keith Nowell
Hazardous Materials Specialist
Alameda County Department of Environmental Health
1131 Harbor Bay Pkwy
Alameda, California 94502

sent via email to keith.nowell@acgov.org

Subject: Response to Comments, Soil Gas Data Submittal, and Scope of Work for Sub-Slab Soil Gas Sampling
RO0000293- City of Oakland Municipal Service Center
7101 Edgewater Drive, Oakland, California
GeoTracker Global ID T0600100375

Dear Mr. Nowell:

Terraphase Engineering Inc. (Terraphase), has prepared this letter on behalf of the City of Oakland for the City of Oakland Municipal Service Center located at 7101 Edgewater Drive in Oakland California (the Site; Figure 1). The purpose of this letter is to address the following items:

- Response to Comments (RTC) to the Alameda County Department of Environmental Health (ACDEH) letter dated October 4, 2017: *Conditional Work Plan Approval; Fuel Leak Case No. RO0000293 and GeoTracker Global ID T0600100375, City of Oakland Municipal Service Center, 7101 Edgewater Drive, Oakland, CA 94612*.
- Data submittal for soil gas sampling and analysis conducted at the Site in September 2017 in accordance with the *Work Plan for Soil Gas Investigation and Additional 2017 Activities* (the Work Plan; prepared by Terraphase and dated June 15, 2017), and as approved by ACDEH by letter dated July 19, 2017.
- Scope of work materials for proposed sub-slab soil gas investigation utilizing Vapor Pin® technology.
- Proposed implementation schedule for additional Site investigations.

Response to Comments

The following presents our responses to the Technical Comments provided by ACDEH by letter dated October 4, 2017. Each ACDEH comment regarding the proposed MIP and UVOST investigation is presented in italics, below. Our responses follow each comment.

Technical Comment 1:

Analysis Scope - The SWRCB Low Threat Underground Storage Tank Case Closure Policy (LTCP) includes naphthalene as a chemical of potential concern (CPOC) at fuel release sites. Historically, naphthalene has been reported at concentrations of up to 220 micrograms per liter (µg/L) in groundwater at the site. ACDEH requests the addition of naphthalene to the scope of analysis. Note that naphthalene may be reported by the EPA Test Method 8260 analysis; hence, its reporting would not be expected to significantly increase the analysis cost.

Response to Technical Comment 1: Condition accepted; naphthalene will be included in soil and/or groundwater analyses, as appropriate.

Technical Comment 2:

MIP Bore Locations - Based on ACDEH's review of the proposed MIP bore locations, we recommend an additional MIP bore. The location of the bore would be to provide data in the gap between the proposed locations of MIP-10 and MIP-14. Please add the additional bore, or alternatively, please provide ACDEH, by the date specified below, with the rationale why the bore is not needed.

Response to Technical Comment 2: This additional MIP location is acceptable. Terraphase provided email concurrence for this condition on October 18, 2017 as requested. The proposed location for this additional MIP bore is presented on Figure 2, attached.

Technical Comment 3:

UVOST Bore Locations - Please provide ACDEH with a summary of the results of the MIP investigation, including a summary data table of the GGW results, for our review and discussion, prior to implementing the UVOST investigation phase by the date specified below. ACDEH requests a figure which depicts the proposed UVOST locations accompany the data summary. Following our review and approval, the UVOST phase of the investigation may proceed.

Response to Technical Comment 3: The investigation described in the Work Plan was to be completed in phases during one mobilization to the Site. The MIP and UVOST data would be assessed in the field to identify appropriate grab groundwater sample locations and depths. Based on this ACDEH comment, the UVOST portion of the investigation will be implemented in a separate mobilization to allow for the MIP data to be assessed. However, since the MIP measurements are qualitative, it will be necessary to collect grab groundwater samples at each MIP boring location for laboratory analysis to provide quantitative data for ACDEH review. This laboratory analytical data will be necessary to adequately assess the MIP investigation results, and will be used to verify the appropriate locations for UVOST borings.

Therefore, Terraphase proposes to complete the MIP investigation and collect one to two grab groundwater samples from each MIP boring at a depth interval appropriate based on the MIP measurements. Terraphase will share the laboratory and MIP data with the ACDEH within 45 days of the completion of the MIP and grab groundwater sampling activities, to take into account the time required for the laboratory analysis and data validation. The data will be assessed to verify the proposed UVOST locations. UVOST sampling will not be initiated until ADCEH concurrence is provided on UVOST locations.

Technical Comment 4:

UVOST Soil Sampling - ACDEH is of the opinion soil sampling conducted in association with the UVOST phase of the investigation may aid in qualifying residual and free-phase product concentrations. Qualitative and quantitative identification of residual and free-phase product would aid in evaluating the source area as a potential, continuing source of groundwater contamination. Therefore, ACDEH requests recovery of soil samples in the zones of residual and free-phase product identified by the UVOST.

Response to Technical Comment 4: Condition accepted. Confirmation soil sampling will be conducted to satisfy this comment. UVOST response logs will be evaluated to identify locations and target depth intervals which indicate free product may likely be present. These locations will be selected for confirmation soil sample collection. Soil samples will be collected in glass jars and with Terracore (or similar) samplers, and will be analyzed for the following: TPH-g, TPH-d, and TPH-mo (by EPA Method 8015B), BTEX, MTBE, and naphthalene (by EPA Method 8260C).

The UVOST sampling will utilize a cone-penetrometer testing (CPT) rig; this rig is not equipped to retain continuous soil cores and is thus not conducive to soil sample collection during UVOST investigation mobilization. A direct push rig will be utilized to obtain the soil samples, following completion of UVOST sampling and concurrence from ACDEH regarding all confirmation sampling locations.

Technical Comment 5:

Confirmation Groundwater Sampling - Section 3.6- Sampling Methodology- states the "final phase of the proposed investigation will be collection of grab groundwater confirmation samples, following a review of all MIP and UVOST data". ACDEH requests an opportunity to discuss the proposed locations of the GGW confirmation sampling based on the collected MIP and UVOST data. Therefore, ACDEH requests a summary table of the MIP and UVOST data and a figure which depicts the proposed confirmation sampling locations by the date specified below. The GGW confirmation sampling phase of the investigation may be implemented following our data review and approval.

Response to Technical Comment 5: As discussed in the response given to Comment 3, the grab groundwater data collected in support of the MIP investigation will be submitted to the ACDEH 45 days from completion of the sampling activities. Terraphase will provide ACDEH with results of UVOST sampling 30 days following completion of the fieldwork. ACDEH will be provided the UVOST response logs and, if applicable, figures illustrating the depth intervals product was detected at each boring. A figure depicting proposed soil confirmation sampling locations will also be provided for ACDEH review and concurrence.

Technical Comment 6:

Investigation Derived Waste - Terraphase states the wastes generated during the investigation will be profiled for Title 22 metals, TPHg, TPHd, and TPHmo, and BTEX and MTBE compounds. ACDEH requests the waste receiving facility(ies) be contacted to confirm the scope of analysis required by the receiving facility(ies) for waste acceptance.

Response to Technical Comment 1: Condition accepted.

Transmittal of Analytical Data, Soil Gas Sampling

On September 15th, 18th, and 27th, 2017, Terraphase conducted soil gas sampling at existing soil gas wells. A total of nine wells were sampled across the Site in accordance with the *Work Plan for Soil Gas Investigation and Additional 2017 Activities* (prepared by Terraphase and dated June 15, 2017) and as approved by ACDEH by letter dated July 19, 2017. A summary of soil gas well construction and sampling data, and a summary analytical data table, are attached (Tables 1 and 2, respectively). The locations of the soil gas wells are illustrated on Figure 3. The analytical laboratory reports have been uploaded to GeoTracker.

As noted on Table 1, SG-2 was unable to be sampled due to shallow groundwater conditions; in order to provide a permanent soil gas monitoring point in this location, Terraphase will install a replacement soil gas well in the immediate vicinity of SG-2, constructed to a slightly shallower depth, at approximately 3 feet bgs. This soil gas well will be sampled concurrently with the sub slab soil gas sampling described below.

As requested by ACDEH in their work plan approval letter dated July 19, 2017, three soil gas wells were re-sampled using sorbent tubes for naphthalene analysis by Method TO-17. Due to physical damage to one of the three sorbent tubes, from unknown causes, only two of the tubes were able to be analyzed by the laboratory. The results of sampling confirmed that naphthalene was not present at detectable levels in any of the soil gas wells, by either analytical testing method.

As shown on Table 2, analytical results of soil gas sampling were compared to screening criteria for the California State Water Quality Control Board's Low Threat Closure Policy (LTCP), and to San Francisco Bay Regional Water Quality Control Board's (SFRWQCB) Human Health Risk Environmental Screening Levels (ESLs) for soil gas at commercial properties. Exceedances of one or more of these criteria were observed at samples from wells SG-6 and SG-9.

Scope of Work for Sub-Slab Soil Gas Sampling

Objective

Based on the results of the September 2017 soil gas sampling, Terraphase recommends installation and sampling of sub-slab soil gas probes in two on-Site buildings, to further assess impacts identified in shallow soil gas in discrete areas of the Site. Soil gas samples SG-6 and SG-9 exhibited elevated concentrations of total petroleum hydrocarbons in the gasoline range (TPH-g), and volatile organic compounds (VOCs), particularly benzene (Table 2). Methane was also detected at elevated concentrations in these two wells.

In order to assess soil gas conditions immediately below the slab of buildings nearby to the encountered impacts at SG-6 and SG-9, Terraphase recommends installation and sampling of four sub-slab soil gas probes, using Vapor Pin® technology. Data from these samples will be utilized to assess the potential for vapor intrusion in buildings at these locations.

Installation and Sampling Procedures

The locations of the proposed sub-slab probes are shown on Figure 3. At these locations, a semi-permanent sub-slab soil gas probe will be installed and sampled as follows. A pilot hole will be drilled to

confirm the thickness of the slab. A 2.0- inch diameter core bit will then be used to bore a hole approximately 1/8-inch deep into the top of the concrete slab; this recess will allow the probe cap to sit flush with the slab surface. Within the 2.0-inch diameter countersink, a 1.0-inch drill bit will be used to core through the concrete slab and 3 to 4 inches into the sub-slab material. The cuttings generated during drilling will be vacuumed from the hole.

The sub-slab soil gas probe will consist of Cox Colvin Soil Gas Vapor Pin®. A technical data sheet for this prefabricated probe is provided in Appendix A. During sample collection, the building will be ventilated normally for the season and time of day, as recommended in the *Soil Gas Advisory* (Advisory) (Department of Toxic Substances Control [DTSC] 2015).

After installation, the new sub-slab soil gas probes will be allowed to equilibrate for a minimum of 2 hours prior to purging and sample collection, in accordance with the Advisory. The sampling Summa cannister will be connected to the probe, and the entire sample train will be placed under a shroud with an atmosphere enriched with helium. The soil gas probe will be purged using a syringe, at a rate between 150 and 200 milliliters per minute. During sample collection, the pressure exerted on the formation, per the Advisory, should be less than 100 inches water (7.4 inches mercury). Subsequent laboratory analysis for helium in the collected sub-slab soil gas samples will be used to confirm that no leaks occurred during sample collection.

Laboratory Analysis and Data Evaluation

Sub-slab soil gas samples will be analyzed for the following VOCs using United States Environmental Protection Agency (U.S. EPA) Method TO-15:

- TPH-g
- BTEX
- Naphthalene

Reporting limits for all target compounds will be below applicable risk-based screening levels (i.e. LTCP criteria for soil gas and ESLs for sub-slab soil gas at commercial properties).

In addition to the target analytes identified above, sub-slab soil gas samples will be analyzed for oxygen, methane, and the leak-check compound, helium, using EPA Method 8015 Modified.

Resulting data will be evaluated, utilizing appropriate ESLs, to assess whether vapor intrusion at the five sampling locations could potentially pose a risk to indoor air quality.

Proposed Investigation and Reporting Schedule:

Based on contractor availability, and the additional data review requested by ACDEH in their October 4, 2017 letter, Terraphase proposes the following revised investigation and reporting schedule:

- **November 2017 –**
    - Sub-slab soil gas sampling event in two on-Site buildings, pending ACDEH approval.

  - Installation and sampling of the shallower soil gas well installed at SG-2.
  - MIP and UVOST permitting, contractor scheduling, field preparation

- **Early December 2017 –**
  - Utility locating and MIP boring layout finalization based on current Site conditions and accessibility.

- **Mid-late December 2017 –**
  - MIP investigation field program and associated grab groundwater sampling.
  - Grab groundwater sampling near well MW-12
  - Transmittal of sub-slab soil gas analytical data to ACDEH (30 days following receipt of laboratory data)

- **Early February 2018 –** MIP and grab groundwater data receipt, tabulation, and transmittal to ACDEH (45 days following sample collection)
- **Late February 2018 –** Meeting with ACDEH to discuss MIP results and finalize proposed UVOST locations
- **March 2018 –** UVOST investigation field program
- **Late-March 2018 –** Transmittal of UVOST logs to ACDEH and finalization of soil confirmation sampling locations
- **April 2018 –** Soil confirmation sampling field program implementation
- **June 15, 2018 –** Contaminant Plume Delineation Report submittal to ACDEH

Closing

If you have any question or comments regarding this submittal, please contact Andrew Romolo at Andrew.romolo@terraphase.com or 510-645-1850 x34.

For Terraphase Engineering Inc.

Andrew Romolo, P.G.
Vice President and Principal Geologist

cc:
Mark Arinola, City of Oakland, MArniola@oaklandnet.com
Kayleigh Lim, City of Oakland, KLim@oaklandnet.com
Diane Heinz, Port of Oakland, dheinze@portoakland.com

Enclosures:

Table 1 – Soil Gas Well Installation and Sampling Summary
Table 2 – Analytical Results of Soil Gas Sampling
Figure 1 – Site Location
Figure 2 – Revised Proposed MIP, UVOST, and Groundwater Boring Locations
Figure 3 – Proposed Sub-Slab Soil Gas Sample Locations
Appendix A – Vapor Pin® Technical Data Sheet

Table 1 - Soil Gas Well Installation and Sampling Summary
Oakland Municipal Services Center
7101 Edgewater Drive
Oakland, California

Location ID	Date Installed	Total borehole depth (ft bgs)	Sample point depth (ft bgs)	Depth to GW	Sample Collected?
SG-1	7/24/2017	3' 4"	3' 0"	n/a	Yes
SG-2	7/24/2017	4' 0"	3' 6"	n/a	No, due to excess moisture.
SG-3	7/24/2017	5' 0"	4' 6"	n/a	Yes
SG-4	*7/24/2017*	*2' 8"*	*not installed*	*2' 8"*	*Not installed due to shallow GW*
SG-5	7/24/2017	4' 8"	4' 2"	n/a	Yes
SG-6	7/24/2017	3' 5"	3' 0"	n/a	Yes
SG-7	7/25/2017	3' 5"	3' 0"	n/a	No. Formation would not yield sample.
SG-8 (1st attempt)	*7/25/2017*	*2' 6"*	*not installed*	*2' 6"*	*Not installed due to shallow GW*
SG-8 (2nd attempt)	*7/25/2017*	*2' 0"*	*not installed*	*2' 0"*	*Not installed due to shallow GW*
SG-9	7/25/2017	4' 0"	3' 6"	n/a	Yes
SG-10	7/25/2017	3' 11"	3' 5"	n/a	Yes
SG-11	7/25/2017	4' 0"	3' 6"	n/a	Yes
SG-12	7/25/2017	4' 6"	4' 0"	n/a	Yes
SG-13	7/25/2017	4' 10"	4' 4"	n/a	Yes

Notes:
ft bgs = feet below ground surface
GW = groundwater

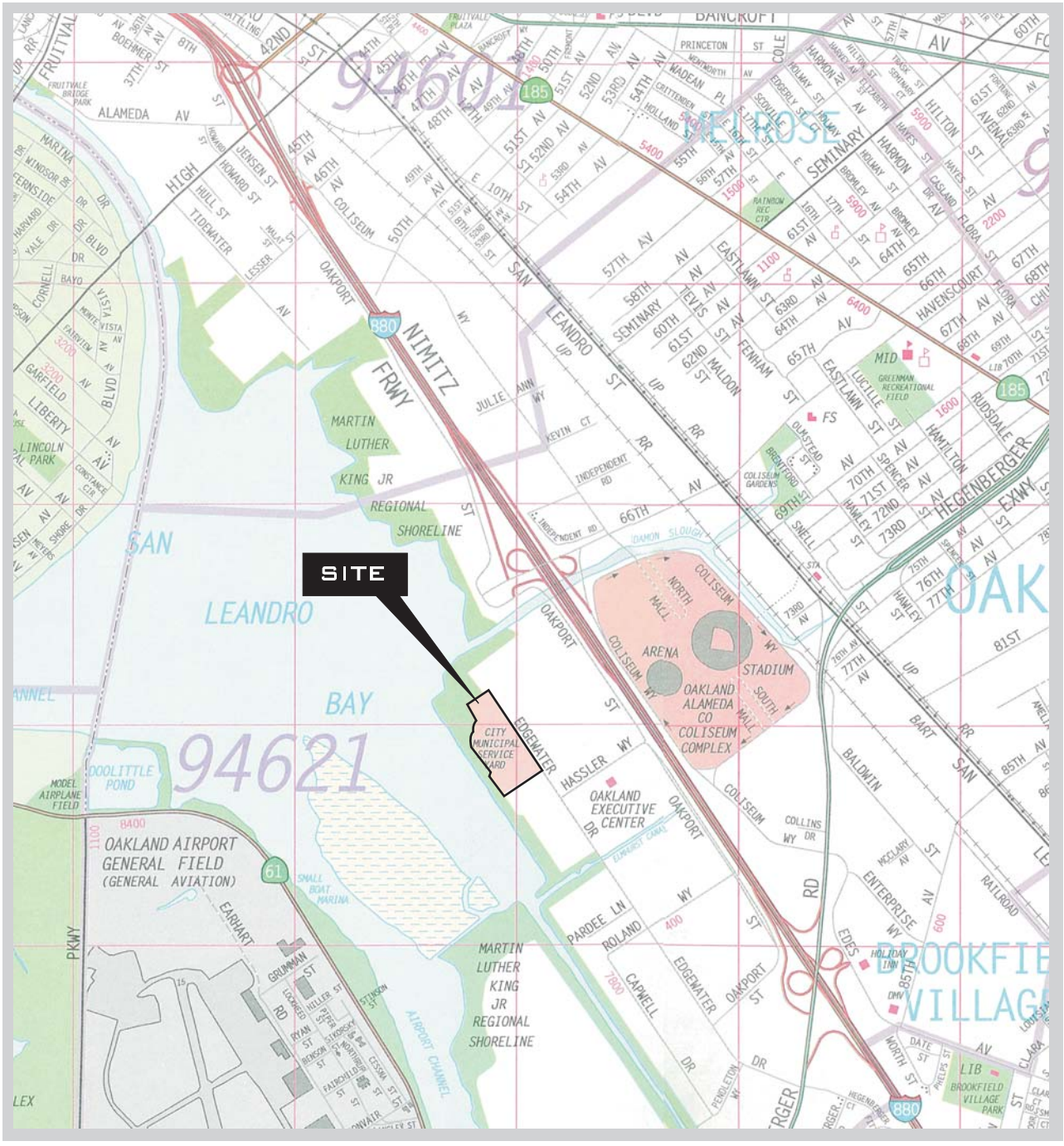
Table 2
Analytical Results of Soil Gas Sampling
September 2017
Oakland Municipal Service Center
7101 Edgewater Drive
Oakland, California

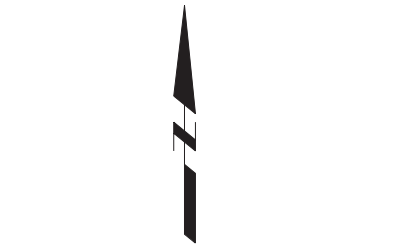
					Location	SG-01	SG-03	SG-05	SG-06	SG-09	SG-10	SG-11	SG-12	SG-13
					Sample Date	9/15/2017	9/15/2017	9/15/2017	9/27/2017	9/27/2017	9/18/2017	9/18/2017	9/18/2017	9/18/2017
			LTCP no Bioattenuation Zone, Commercial	LTCP with Bioattenuation Zone, Commercial	SFRWQCB 2016 rev3 Vapor ESL -Subslab Soil Gas Com-Ind Human Health Risk Levels									
		Units												
Gen Min														
	Oxygen	% by Vol	-	-	-	19	4.5	15	7.8	7	8.2	5.5	8	13
Organic														
	Methane	%	-	-	-	<0.001	0.14	<0.001	31	43	0.053	0.0038	0.18	<0.001
Other														
	Helium	% by Vol	-	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Carbon Dioxide	% by Vol	-	-	-	1.4	1.1	3.5	9	4.8	6.2	4.7	7.5	13
PAH														
	Naphthalene (TO-15)	µg/m3	***310***	310000	360	<5.3	<5.3	<5.3	<100	***<1000***	<5.3	<5.3	<5.3	<5.3
	Naphthalene (TO-17)	µg/m3	***310***	310000	360	-	-	<10	-	**-**	<10	-	-	-
TPH														
	TPH as Gasoline	µg/m3	-	-	2500000	500	250	430	4,800,000	33,000,000	5700	200	20,000	430
VOCs														
	Benzene	µg/m3	***280***	280000	420	<3.2	<3.2	<3.2	***570***	***6500***	4.4	<3.2	4.4	<3.2
	Ethylbenzene	µg/m3	***3600***	3600000	4900	<4.4	<4.4	<4.4	<500	***<5000***	<4.4	<4.4	<4.4	<4.4
	Toluene	µg/m3	-	-	1300000	20	31	63	<1000	<10,000	19	15	19	12
	Xylene (m & p)	µg/m3	-	-		<8.8	<8.8	<8.8	<500	<5000	<8.8	<8.8	<8.8	<8.8
	Xylene (o)	µg/m3	-	-		<4.4	<4.4	<4.4	<500	<5000	<4.4	<4.4	<4.4	<4.4
	Xylene Total	µg/m3	-	-	440000	-	-	-	-	-	-	-	-	-

Notes

	Shaded Concentrations exceed the SFRWQCB Commercial-Industrial subslab soil-gas human health risk level
Underline	Underlined concentrations exceed the LTCP levels for soil gas in a bioattenuation zone (commercial land-use scenario)
bold italic	Bold and italic concentrations exceed the LTCP levels for soil gas in a commercial land-use scenario, with no bioattenuation zone

µg/m3 = microgram per cubic meter
ESL = Enironmental Screening Level
LTCP = Low Threat Closure Policy screening criteria, California State Water Resources Control Board
PAH = polycyclic aromatic hydrocarbons
SFBRWQCB = San Francisco Bay Regional Water Quality Control Board
TO-15 = EPA method, Toxic Organics - 15
TO-17 = EPA method, Toxic Organics - 17 (Collected to confirm Naphthalene concentrations per Alameda County Department of Environmental Health request)
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
- = Not analyzed or not applicable





SOURCE: 2002 THOMAS GUIDE FOR ALAMEDA AND CONTRA COSTA COUNTIES

SITE LOCATION

Oakland Municipal Service Center
7101 Edgewater Drive, Oakland, California

terraphase engineering

FIGURE
1

DESIGN\09225\11\000\09225 MSC SiteVicinity.CDR

Edgewater Dr

Public Works Building

911 Center

Admin Building

Crafts and Storage

Storage

Building No. 5

San Leandro Bay

MIP-18 location added per ACDEH request

Legend

- Proposed MIP & Grab Groundwater Sample Location
- Proposed UVOST
- Grab Groundwater Sample Location
- Data Gap Sample Location (Arcadis 2016)
- Soil Gas Well Location (Terraphase 2017)
- Monitoring Well Location
- Fence
- Building

Notes: Aerial imagery source - NAIP June 2014.

0 75 150 225 300 Feet

1 inch = 150 feet

N

SAFETY FIRST

terraphase engineering

CLIENT: Municipal Service Center

PROJECT: Data Gap Analysis
7101 Edgewater Drive, Oakland CA

PROJECT NUMBER: 0064.007.001

Revised Proposed MIP, UVOST and Groundwater Boring Locations

FIGURE 2

File: K:\GIS\Prj\0064.007 Oakland Municipal Service Center\MXDs\Fig. 3_MIP_Phases_0064-007-001.mxd 10/18/2017 Created by: JL Checked by: AB Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet

Edgewater Dr

911 Center

Admin Building

Public Works Building

Building No. 5

Crafts and Storage

Storage

MW-1
MW-2
MW-5
MW-6
MW-7
MW-8
MW-9
MW-10
MW-11
MW-12
MW-13
MW-14
MW-15
MW-16
MW-17
MW-18

TBW-5
TBW-6

SG-1
SG-2
SG-3
SG-5
SG-6
SG-7
SG-9
SG-10
SG-11
SG-12
SG-13

SSV-1
SSV-2
SSV-3
SSV-4

RW-1
RW-A1
RW-A2
RW-B1
RW-B2
RW-B3
RW-B4
RW-C1
RW-C2
RW-C3
RW-C4
RW-C5
RW-C6
RW-C7
RW-D1
RW-D2
RW-D3
RW-D4
RW-D5
RW-D6
RW-D7
RW-D8
RW-D9
RW-D10
RW-D11

OB-A1
OB-C1
OBD-1
OB-D2

San Leandro Bay

Legend

- Proposed Sub-Slab Soil Gas Sample Location and ID
- Soil Gas Well Location
- Monitoring Well Location
- Fence
- Building

Notes: Aerial imagery source - NAIP June 2014.

0 75 150 225 300 Feet

1 inch = 150 feet

N

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terraphase engineering

CLIENT:	Municipal Service Center
PROJECT:	Data Gap Analysis 7101 Edgewater Drive, Oakland CA
PROJECT NUMBER:	0064.007.001

Proposed Sub-Slab Soil Gas Sample Locations

FIGURE 3

File: K:\GIS\Prj\0064.007 Oakland Municipal Service Center\MXDs\Prop_Soil_Gas_0064-007-001.mxd 10/18/2017 Created by: JL Checked by: AB Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet

Standard Operating Procedure Installation and Extraction of the Vapor Pin™

Updated April 3, 2015

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™ for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples or pressure readings.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve(Figure 1)]; Because of sharp edges, gloves are recommended for sleeve installation;
- Hammer drill;
- 5/8-inch (16mm) diameter hammer bit (hole **must** be 5/8-inch (16mm) diameter to ensure seal. It is recommended that you use the drill guide). (Hilti™ TE-YX 5/8" x 22" (400 mm) #00206514 or equivalent);
- 1½-inch (38mm) diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch (19mm) diameter bottle brush;
- Wet/Dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, if desired;
- Vapor Pin™ drilling guide, if desired;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel for repairing the hole following the extraction of the Vapor Pin™.

Figure 1. Assembled Vapor Pin™

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch (38mm) diameter hole at least 1¾-inches (45mm) into the slab. Use of a Vapor Pin™ drilling guide is recommended.

4) Drill a 5/8-inch (16mm) diameter hole through the slab and approximately 1-inch (25mm) into the underlying soil to form a void. Hole **must** be 5/8-inch (16mm) in diameter to ensure seal. It is recommended that you use the drill guide.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the Vapor Pin™ to protect the barb fitting, and tap the Vapor Pin™ into place using a dead blow hammer (Figure 2). Make sure the installation/extraction tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 3).

Figure 3. Installed Vapor Pin™

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover (Figure 4).

Figure 4. Secure Cover Installed

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to re-equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™. This connection can be made using a short piece of Tygon™ tubing to join the Vapor Pin™ with the Nylaflow

tubing (Figure 5). Put the Nylaflow tubing as close to the Vapor Pin as possible to minimize contact between soil gas and Tygon™ tubing.

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the Vapor Pin™ via Mechanical Means (Figure 6). For flush-mount installations, distilled water can be poured directly into the 1 1/2 inch (38mm) hole.

Figure 6. Water dam used for leak detection

11) Collect sub-slab soil gas sample or pressure reading. When finished, replace the protective cap and flush mount cover until the next event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue turning the tool clockwise to pull the Vapor Pin™ from the hole into the installation/extraction tool.

2) Fill the void with hydraulic cement and smooth with a trowel or putty knife.

Figure 7. Removing the Vapor Pin™.

3) Prior to reuse, remove the silicone sleeve and protective cap and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 265° F (130° C) for 15 to 30 minutes.

The Vapor Pin™ to designed be used repeatedly, however, replacement parts and supplies will be required periodically. These parts are available on-line at VaporPin.CoxColvin.com.