Timothy L. Bishop, P.G.
Project Manager
Marketing Business Unit

Chevron Environmental Management Company
6101 Bollinger Canyon Road
Suite 5213
San Ramon, CA 94583
Tel (925) 790-6463
TimBishop@chevron.com

July 1, 2014

Mr. Jerry Wickham
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

RE: Remedial Action Plan Addendum
800, 726, and 706 Harrison Street, Oakland, California 94607
Fuel Leak Case No.: RO0000231, RO0000321, and RO0000484
Comingled Plume Claim No. 6678

Dear Mr. Wickham,

I declare under penalty of perjury that to the best of my knowledge the information and/or recommendations contained in the attached report is/are true and correct.

If you have any questions or need additional information, please contact me at (925) 790-6463.

Sincerely,

Timothy Bishop
Union Oil of California – Project Manager

Attachment
Remedial Action Plan Addendum

ARCADIS
Infrastructure · Water · Environment · Buildings

ARCADIS U.S., Inc.
2000 Powell Street
7th Floor
Emeryville
California 94608
Tel 510.652.4500
Fax 510.652.4906
www.arcadis-us.com

ENVIRONMENT

Mr. Jerry Wickham
Senior Hazardous Materials Specialist
Alameda County Department Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502-6577

Subject:
Remedial Action Plan Addendum
800, 726, and 706 Harrison Street
Oakland, California 94607
Fuel Leak Case No.: RO0000231, RO0000321, and RO0000484
Comingled Plume Claim #6678

Date:
July 1, 2014

Contact:
Katherine Brandt

Phone:
510.596.9675

Email:
Katherine.Brandt@arcadis-us.com

Our ref:
B0047339.2014

Dear Mr. Wickham:

ARCADIS U.S. Inc. (ARCADIS), on behalf of Chevron Environmental Management Company, for itself and as Attorney-in-Fact for Union Oil Company of California (hereinafter "Union Oil"), has prepared this *Remedial Action Plan Addendum* (RAP Addendum). This RAP Addendum presents additional details for the recovery of volatile organic carbon (VOC) vapors and the proposed remediation well configuration associated with the former Unocal Service Station 0752, located at 800 Harrison Street, the former Shell Station located at 726 Harrison Street, and the former Atlantic Richfield Company (ARCO) Service Station located at 706 Harrison Street in Oakland, California (collectively referred to as the site – see Figures 1 and 2).

A RAP was submitted to the Alameda County Department of Environmental Health (ACEH) on April 18, 2014. The RAP presented relevant background information, a summary of pilot test activities completed to evaluate potential remedial action alternatives, and a detailed design basis for the selected remedial action (air sparge [AS]/soil vapor extraction [SVE]). This RAP addendum has been prepared in response to two technical comments regarding VOC vapor recovery and the proposed remediation well network at 706 Harrison Street included in a letter from the ACEH dated May 13, 2014. Correspondence from the ACEH is included as Appendix A. This *RAP Addendum* provides information for estimating the radius of influence (ROI) for SVE wells and additional details for the proposed remediation well configuration at 706 Harrison Street.

Objectives

Union Oil's primary objective for this project is remedial implementation at the site in accordance with ACEH requirements to obtain a low-threat closure determination in accordance with the Low-Threat Underground Storage Tank Case Closure Policy (Low-Threat Closure Policy [SWRCB 2012]). Benzene and MTBE have been detected in groundwater samples at concentrations greater than the Low-Threat Closure Policy Groundwater-Specific Criteria 2 and 4. The AS/SVE remediation system detailed in the RAP targets benzene and MTBE groundwater concentrations to achieve closure under the Low-Threat Closure Policy (SWRCB 2012). The monitoring wells with benzene and MTBE concentrations exceeding Groundwater-Specific Criteria are located at 706 and 726 Harrison Street. Groundwater analytical concentrations of benzene and MTBE are significantly lower at 800 Harrison Street in relation to the other two properties in the co-mingled plume; groundwater analytical concentrations at 800 Harrison are less than Low-Threat Closure Policy Groundwater-Specific Criteria 2. The remedial design presented in the RAP targets dissolved-phase mass in groundwater at 706 and 726 Harrison Street. Proposed remediation well locations are provided on Figure 3.

AECH Comment 1

1. ***Recovery of VOC Vapors. The effective target radius of influence (ROI) for individual SVE wells appears to be 30 feet. Please discuss or provide a diagram to illustrate the expected recovery of VOC vapors from the air sparging system. One area of potential concern for recovery of vapors is recovery of vapors from AS-3, which is approximately 10 feet from the building at 726 Harrison Street. We note that existing well VE-1 is currently not planned for use with the remediation system. Given the proximity to the on-site building at 726 Harrison Street, the use of well VE-1 to extract vapors between AS-3 and the on-site building would provide additional recovery in this area. In the RAP Addendum requested below, please consider the use of existing well VE-1.***

Recovery of VOC Vapors

Pilot test results from the MPE pilot test conducted in September 2013 used to develop the AS/SVE well network configuration were provided in Appendix E of the *Remedial Action Plan*. The SVE well ROI was assessed using a Normalized Vacuum

versus Distance from Extraction Well graph. This graph is developed by plotting the normalized vacuum (vacuum observed at the monitoring wells divided by the vacuum applied to the extraction well) on an arithmetic scale (y-axis) and radial distance from the extraction well on a logarithmic scale (x-axis) for all observation points. A trend line is then fit to the plotted data using linear regression. The fitted line is utilized to interpolate the radial distance corresponding to a value of 0.01. The distance (on the x-axis) represents the Observed Vacuum ROI equal to one percent of the applied vacuum using the spatially averaged vacuum data. A conservative SVE ROI of 15 feet was estimated utilizing vapor extraction data from the September 2013 MPE pilot test. SVE ROI calculations utilizing normalized vacuum are provided in Appendix B. Figure 4 depicts anticipated ROI for SVE well VE-3 and coverage for VOC vapor recovery from AS-3 operations.

The effective ROI was also evaluated utilizing a method that considers the pore volume exchange rate (PVER). Vapor extraction data from the September 2013 MPE pilot test was used to determine intrinsic permeability and pneumatic conductivity parameters of the lithology at the site. This pilot test information was used to calculate the number of pore volumes of air the proposed vapor extraction wells will be capable of flushing through the vadose zone. At a target distance of 30 feet, the proposed system can exchange (flush) approximately 1 pore volume of air through the subsurface per day. This PVER increases exponentially as the radial distance decreases toward the vapor extraction well. An optimal SVE design achieves between 0.5 and 2 PVERs per day, to effectively treat soil vapor in the vadose zone. Under the anticipated operating conditions, the effective ROI where 1 to 2 pore volumes per day would be removed is calculated to be between 30 and 35 feet, respectively. Vapor extraction data from the MPE pilot test, graphs and ROI calculations are provided in Appendix B.

Proposed air sparge well AS-3, located at 726 Harrison Street, is approximately 12 feet from vapor extraction well VE-3. VE-3 will provide sufficient vapor capture in the vadose zone from AS-3, using the conservative estimated system ROI of 15 feet and proximity to VE-3. Vapor extraction well VE-1, discussed in comments received from ACEH, no longer exists at the site. Wells VE-1 and VE-2 are shown on Figure 2 to reflect former remediation well locations in relation to the proposed SVE well network and configuration. The location of VE-3 (installed for pilot test purposes) will be adequate to recover vapors from AS-3 operation.

AECH Comment 2

2. ***SVE and Air Sparge Well Configuration for 706 Harrison. Existing nested AS/SVE wells VW-3/SP-3, VW-4/SP-4, and VW-5, SP-5 are apparently currently covered by concrete and will be evaluated for use in the AS/SVE system at a later date. The RAP indicates that if existing well VW-5/SW-5 is not usable, a replacement AS/SVE well will be installed near VW-5/SP-5 but if existing wells VW-3/SP-3 and VW-4/SP-4 are not usable, no replacement wells will be installed. Proposed wells AS-10 through AS-14 are assumed to adequately address the portion of the site covered by existing wells VW-3/SP-3 and VW-4/SP-4. In the RAP Addendum requested below, please provide further information including a diagram to illustrate the expected performance of AS/SVE system to help assess whether replacement wells may be required if existing wells VW-3/SP-3 and VW-4/SP-4 are not usable.***

AS/SVE Well Configuration and Network

The proposed AS/SVE remediation well network targets dissolved-phase source mass, centralized near the northern boundary of 706 Harrison Street and the southern boundary of 726 Harrison Street. Proposed AS wells AS-10 through AS-12 will target dissolved phase source mass in this area. These AS wells will target groundwater where dissolved phase constituents remain at concentrations greater than site cleanup goals, directly upgradient of historical remediation wells VW-3/SP-3 and VW-4/SP-4.

Figures 5 and 6 depict concentration contours with proposed AS/SVE well locations for benzene and MTBE, respectively. The remediation well network is shown with the concentration contours to demonstrate the targeted approach for AS well network configuration to treat groundwater impacts above cleanup goal standards.

A former AS/SVE system operated at 706 Harrison Street from May 1998 through February 2003. The SVE portion was shut down in 2001, while the AS system continued to inject air to increase oxygen concentrations to enhance aerobic biodegradation. The AS system was subsequently shut down in 2003 when decreasing groundwater concentrations were observed. Wells VW-3/SP-3 and VW-4/SP-4 were among the wells utilized as remediation wells throughout this time. Replacement wells in the vicinity of wells VW-3/SP-3 and VW-4/SP-4 were not planned because historical AS/SVE operations have likely addressed groundwater impacts in the vicinity of former remediation wells VW-3/SP-3 and VW-4/SP-4.

Proposed well AS-12 will provide adequate treatment coverage for former well VW-3/SP-3. One replacement well, AS-15, will be installed if VW-4/SP-4 is inoperable, to ensure sufficient coverage of any potential remaining groundwater impacts in this area of the site.

If VW-5/SP-5 is inoperable a replacement well will be installed at this location to capture vapors at the downgradient edge of the site, recover vapors from AS-13 and AS-14, and mitigate potential offsite migration of hydrocarbons. Overall, the proposed AS/SVE well network configuration will focus on remaining dissolved-phase source mass centralized near the northern boundary of 706 Harrison Street and the southern boundary of 726 Harrison Street, and will include wells intended to mitigate potential offsite migration by providing treatment and capturing vapors at the downgradient edge of 706 Harrison Street.

If you have any questions or comments regarding the contents of this document, please contact Mr. Tim Bishop of Chevron at (925) 790-6463 or by e-mail at TimBishop@Chevron.com. Alternatively, you may contact Katherine Brandt of ARCADIS at 510.596.9675 or by e-mail at Katherine.Brandt@arcadis-us.com.

Sincerely,

ARCADIS

Tyler Sale
Environmental Engineer II

Katherine Brandt
Project Manager, Professional Geologist

Enclosures:

Figure 1	Site Location Map
Figure 2	Site Plan
Figure 3	Proposed Remediation Well and Treatment Enclosure Locations
Figure 4	Proposed Remediation Well Locations with SVE Radius of Influence
Figure 5	Benzene Concentrations with Proposed Remediation Well Locations
Figure 6	MTBE Concentrations with Proposed Remediation Well Locations

Appendix A	Correspondence
Appendix B	SVE Radius of Influence Calculations

Copies:

Mr. Tim Bishop, Chevron Environmental Management Company (Electronic Copy)
Mr. Ed Ralston, Phillips 66 Company (Electronic Copy)
Ms. Cherie McCaulou, San Francisco Bay Region RWQCB (Geotracker)
Mr. Muhammad Usman and Mr. Mahmood M. Ali, Property Owners – 800 Harrison Street
Mr. Peter Yee and Mr. Kin Chan, Property Owners – 726 Harrison Street
Mr. Bo Gin, Property Owner – 706 Harrison Street

ARCADIS

Figures

REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., OAKLAND WEST, CALIFORNIA, 1993.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.

UNION OIL OF CALIFORNIA
STATION NO. 0752/YEE/GIN COMMINGLED
706/726/800 HARRISON STREET
OAKLAND, CALIFORNIA

SITE LOCATION MAP

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FIGURE 1

LEGEND

- PROPERTY BOUNDARY
- PRODUCT PIPING
- MW-1 GROUNDWATER MONITORING WELL (UNOCAL)
- MW-1 GROUNDWATER MONITORING WELL (GIN)
- VW-3/SP-3 SOIL VAPOR/SPARGE WELL (UNABLE TO LOCATE) (GIN)
- MW-1 GROUNDWATER MONITORING WELL (YEE)
- AS-1 AIR SPARGE WELL (YEE)
- EW-1 EXTRACTION WELL (YEE)
- GP-2 GEOPROBE™ (JUNE 2011)
- MPE-1 MULTI-PHASE EXTRACTION PILOT TEST WELL (PZ-1 IS LOCATED IN THE SAME BOREHOLE)
- MP-1 PILOT TEST MONITORING POINT
- VE-1 VAPOR EXTRACTION WELL
- VE-3 PILOT TEST VAPOR EXTRACTION WELL

NOTE:

1. BASE MAP PROVIDED BY MID COAST ENGINEERS, DATED 06/29/11, AT A SCALE OF 1"=50'. ADDITIONAL SITE FEATURES PROVIDED BY STANTEC, INC., DATED 03/05/10, AT A SCALE OF 1"=50'.
2. COORDINATES ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM, ZONE III, NAD 83.

0 50' 100'

GRAPHIC SCALE

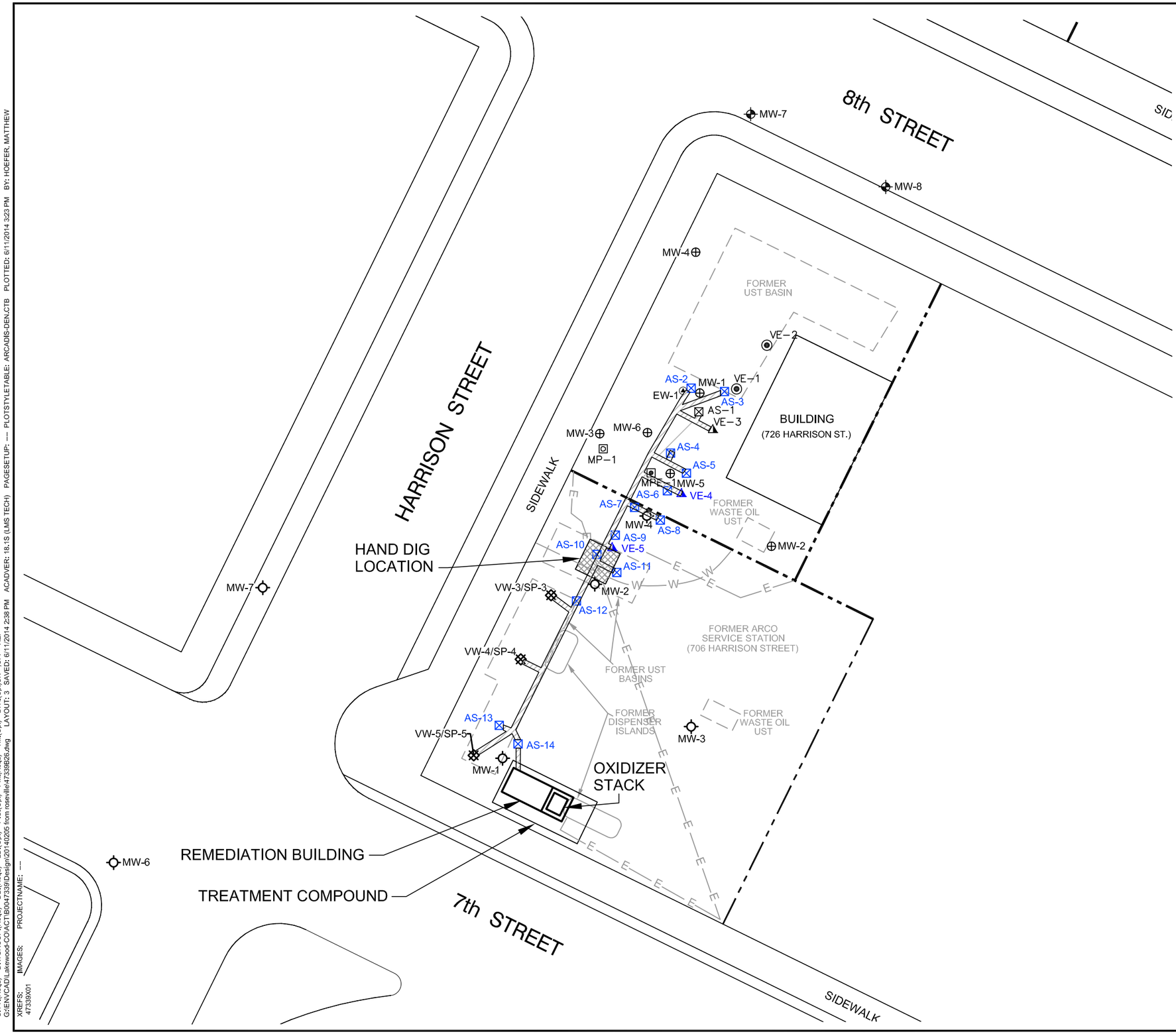
UNION OIL OF CALIFORNIA
STATION NO. 0752/YEE/GIN COMMINGLED
706/726/800 HARRISON STREET
OAKLAND, CALIFORNIA

SITE PLAN

ARCADIS

FIGURE 2

CITY: PETALUMA, CA DIV/GROUP: ENV DB: J. HARRIS
G:\ENVCAD\Lakewood-COVACT\B00473392\20134733901B01.dwg LAYOUT: 2 SAVED: 10/2/2013 11:22 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: ARCADIS-DEN.CTB PLOTTED: 10/2/2013 4:16 PM BY: HOEFER, MATTHEW
XREFS: IMAGES: PROJECTNAME: ---
47339X01



LEGEND

- PROPERTY BOUNDARY
- PRODUCT PIPING
- MW-1 GROUNDWATER MONITORING WELL (UNOCAL)
- MW-1 GROUNDWATER MONITORING WELL (GIN)
- VW-3/SP-3 SOIL VAPOR/SPARGE WELL (GIN)
- MW-1 GROUNDWATER MONITORING WELL (YEE)
- AS-1 AIR SPARGE WELL (YEE)
- EW-1 EXTRACTION WELL (YEE)
- MPE-1 MULTI-PHASE EXTRACTION PILOT TEST WELL (PZ-1 IS LOCATED IN THE SAME BOREHOLE)
- MP-1 PILOT TEST MONITORING POINT
- VE-1 VAPOR EXTRACTION WELL (DESTROYED)
- VE-3 PILOT TEST VAPOR EXTRACTION WELL
- AS-2 PROPOSED AIR SPARGE WELL
- VE-4 PROPOSED VAPOR EXTRACTION WELL
- PROPOSED SYSTEM TRENCHING
- W WATER UTILITY LINE
- E ELECTRICAL UTILITY LINE

NOTE:

1. BASE MAP PROVIDED BY MID COAST ENGINEERS, DATED 06/29/11, AT A SCALE OF 1"=50'. ADDITIONAL SITE FEATURES PROVIDED BY STANTEC, INC., DATED 03/05/10, AT A SCALE OF 1"=50'.
2. COORDINATES ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM, ZONE III, NAD 83.

0 30' 60'

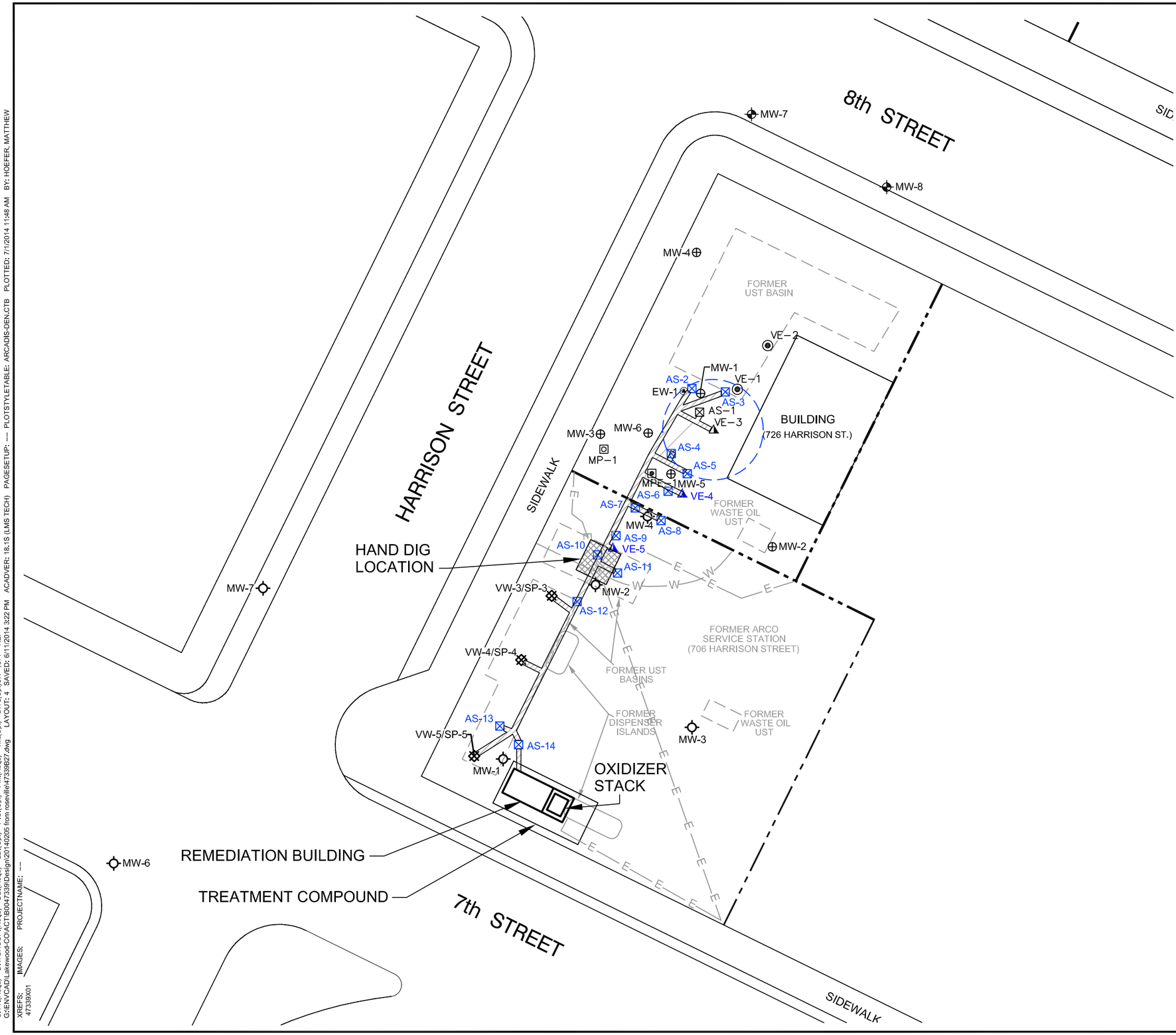
SCALE 1"=30'

UNION OIL OF CALIFORNIA
STATION NO. 0752/YEE/GIN COMMINGLED
706/726/800 HARRISON STREET
OAKLAND, CALIFORNIA

PROPOSED REMEDIATION WELL AND TREATMENT ENCLOSURE LOCATIONS

ARCADIS

FIGURE 3



LEGEND

- PROPERTY BOUNDARY
- PRODUCT PIPING
- MW-1 GROUNDWATER MONITORING WELL (UNOCAL)
- MW-1 GROUNDWATER MONITORING WELL (GIN)
- VW-3/SP-3 SOIL VAPOR/SPARGE WELL (GIN)
- MW-1 GROUNDWATER MONITORING WELL (YEE)
- AS–1 AIR SPARGE WELL (YEE)
- EW-1 EXTRACTION WELL (YEE)
- MPE–1 MULTI-PHASE EXTRACTION PILOT TEST WELL (PZ-1 IS LOCATED IN THE SAME BOREHOLE)
- MP–1 PILOT TEST MONITORING POINT
- VE–1 VAPOR EXTRACTION WELL (DESTROYED)
- VE–3 PILOT TEST VAPOR EXTRACTION WELL
- AS-2 PROPOSED AIR SPARGE WELL
- VE–4 PROPOSED VAPOR EXTRACTION WELL
- VAPOR EXTRACTION WELL ANTICIPATED RADIUS OF INFLUENCE
- PROPOSED SYSTEM TRENCHING
- W WATER UTILITY LINE
- E ELECTRICAL UTILITY LINE

NOTE:

1. BASE MAP PROVIDED BY MID COAST ENGINEERS, DATED 06/29/11, AT A SCALE OF 1"=50'. ADDITIONAL SITE FEATURES PROVIDED BY STANTEC, INC., DATED 03/05/10, AT A SCALE OF 1"=50'.
2. COORDINATES ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM, ZONE III, NAD 83.

0 30' 60'

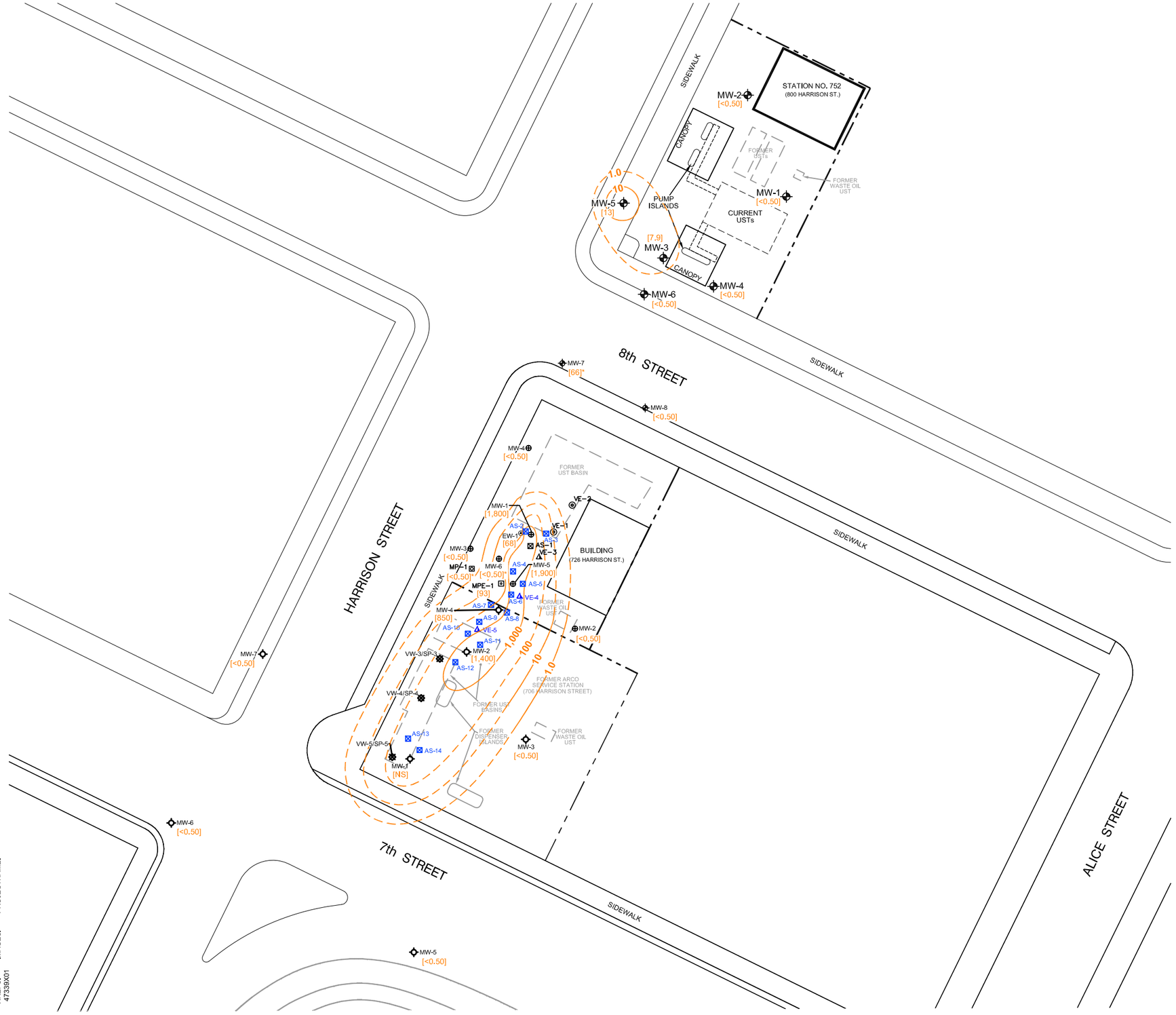
SCALE 1"=30'

UNION OIL OF CALIFORNIA
STATION NO. 0752/YEE/GIN COMMINGLED
706/726/800 HARRISON STREET
OAKLAND, CALIFORNIA

PROPOSED REMEDIATION WELL LOCATIONS WITH SVE RADIUS OF INFLUENCE

ARCADIS

FIGURE 4



LEGEND

- PROPERTY BOUNDARY
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- MW-1 GROUNDWATER MONITORING WELL (UNOCAL)
- MW-1 GROUNDWATER MONITORING WELL (GIN)
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- MW-1 GROUNDWATER MONITORING WELL (YEE)
- AS-1 AIR SPARGE WELL (YEE)
- EW-1 EXTRACTION WELL (YEE)
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- MP-1 PILOT TEST MONITORING POINT
- VE-1 VAPOR EXTRACTION WELL (DESTROYED)
- VE-3 PILOT TEST VAPOR EXTRACTION WELL
- AS-2 PROPOSED AIR SPARGE WELL
- VE-4 PROPOSED VAPOR EXTRACTION WELL
- [13] BENZENE CONCENTRATION IN MICROGRAMS PER LITER (µg/L)
- 100 BENZENE ISOCONCENTRATION CONTOUR (µg/L; DASHED WHERE INFERRED)
- < DENOTES LESS THAN LABORATORY REPORTING LIMIT
- [NS] NOT SAMPLED
- * WELL NOT USED IN CONCENTRATION CONTOURING

NOTE:

1. BASE MAP PROVIDED BY MID COAST ENGINEERS, DATED 06/29/11, AT A SCALE OF 1"=50'. ADDITIONAL SITE FEATURES PROVIDED BY STANTEC, INC., DATED 03/05/10, AT A SCALE OF 1"=50'.
2. COORDINATES ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM, ZONE III, NAD 83.

0 50' 100'

SCALE 1"=100'

UNION OIL OF CALIFORNIA
STATION NO. 0752/YEE/GIN COMMINGLED
706/726/800 HARRISON STREET
OAKLAND, CALIFORNIA

BENZENE CONCENTRATION MAP WITH PROPOSED REMEDIATION WELLS

ARCADIS

FIGURE 5

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Lakewood-CO\ACT\B0047339\Design\20140205 from roseville\47339B28.dwg LAYOUT: 3 SAVED: 6/17/2014 9:15 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: ARCADIS-DEN.CTB PLOTTED: 6/17/2014 9:51 AM BY: HOEFER, MATTHEW
XREFS: IMAGES: PROJECTNAME: ---
47339X01

LEGEND

- PROPERTY BOUNDARY
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- MW-1 GROUNDWATER MONITORING WELL (UNOCAL)
- MW-1 GROUNDWATER MONITORING WELL (GIN)
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- AS-1 AIR SPARGE WELL (YEE)
- EW-1 EXTRACTION WELL (YEE)
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- VE-3 PILOT TEST VAPOR EXTRACTION WELL
- AS-2 PROPOSED AIR SPARGE WELL
- VE-4 PROPOSED VAPOR EXTRACTION WELL
- [1.6] METHYL TERTIARY BUTYL ETHER CONCENTRATION IN MICROGRAMS PER LITER (µg/L)
- 500 MTBE ISOCONCENTRATION CONTOUR (µg/L; DASHED WHERE INFERRED)
- < DENOTES LESS THAN LABORATORY REPORTING LIMIT
- [NS] NOT SAMPLED
- * WELL NOT USED IN CONCENTRATION CONTOURING

NOTE:

1. BASE MAP PROVIDED BY MID COAST ENGINEERS, DATED 06/29/11, AT A SCALE OF 1"=50'. ADDITIONAL SITE FEATURES PROVIDED BY STANTEC, INC., DATED 03/05/10, AT A SCALE OF 1"=50'.
2. COORDINATES ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM, ZONE III, NAD 83.

0 50' 100'

SCALE 1"=100'

UNION OIL OF CALIFORNIA
STATION NO. 0752/YEE/GIN COMMINGLED
706/726/800 HARRISON STREET
OAKLAND, CALIFORNIA

MTBE CONCENTRATION MAP WITH PROPOSED REMEDIATION WELLS

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FIGURE 6

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Appendix **A**

Correspondence

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
ALEX BRISCOE, Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

May 13, 2014

RO0000231 Responsible Parties:

Timothy Bishop
Chevron Environmental Management Company
6101 Bollinger Canyon Road
San Ramon, CA 94583
(*Sent via E-mail to:* *TimBishop@Chevron.com*)

Ed Ralston
Phillips 66 Company
76 Broadway
Sacramento, CA 95818
(*Sent via E-mail to: Ed.C.Ralston@p66.com*)

Muhammad Usman
800 Harrison Street
Oakland, CA 94607

Mahmood M Ali
Armsco, Inc.
P.O. Box 5427
Novato, CA 94948-5427

RO0000321 Responsible Parties:

Peter Yee
1000 San Antonio Avenue
Alameda, CA 94501

Kin Chan
4328 Edgewood Avenue
Oakland, CA 94602-1316

RO0000484 Responsible Parties:

Bo Gin
342 Lester Avenue
Oakland, CA 94606-1317

Subject: Review of Remedial Action Plan for Commingled Plume for Fuel Leak Case No. RO0000231 (GeoTracker Global ID T0600101486), Unocal #0752, 800 Harrison Street, Oakland, CA 94607; Fuel Leak Case No. RO0000321 (GeoTracker Global ID T0600102122), Chan's Service Station/Shell, 726 Harrison Street, Oakland, CA 94607; and Fuel Leak Case No. RO0000484 (GeoTracker Global ID T0600100985), Oakland Auto Parts, 706 Harrison Street, Oakland, CA 94607

Dear Responsible Parties:

Alameda County Environmental Health (ACEH) staff has reviewed the fuel leak case files for the above referenced sites including the document entitled, "*Remedial Action Plan, 706/726/800 Harrison Street, Oakland, California*," dated April 18, 2014 (RAP). The RAP, which was prepared on your behalf by ARCADIS, presents plans to install and operate an air sparging/soil vapor extraction (AS/SVE) system at 706 and 726 Harrison Street.

The proposed scope of work presented in the RAP is generally acceptable for public review and comment. We have two technical comments regarding the AS/SVE system that will require preparation of a RAP Addendum. However, the scope of the technical comments is limited and does not warrant delay of public comment for the RAP. Therefore, we request that you prepare a RAP Addendum to address the two technical comments below.

Public participation is a requirement for the Corrective Action Plan process and is required prior to implementation of the remedial alternative. In order to notify potentially affected members of the public of the proposed action, ACEH will distribute the attached public notification to nearby residents and

landowners at the addresses shown on the attached mailing list. If you are aware of any other residents, landowners, or other interested persons, corporations, or government agencies that are not on the mailing list but may have an interest in this fuel leak case, please provide their names and addresses as soon as possible. The attached *Invitation to Comment – Remedial Action Plan* requests that landowners or residents submit any comments or questions to ACEH regarding the proposed cleanup action. Comments on the proposed alternative will be accepted for a 60-day period. ACEH will consider all comments from the public prior to final approval of the RAP.

TECHNICAL COMMENTS

1. **Recovery of VOC Vapors.** The effective target radius of influence (ROI) for individual SVE wells appears to be 30 feet. Please discuss or provide a diagram to illustrate the expected recovery of VOC vapors from the air sparging system. One area of potential concern for recovery of vapors is recovery of vapors from AS-3, which is approximately 10 feet from the building at 726 Harrison Street. We note that existing well VE-1 is currently not planned for use with the remediation system. Given the proximity to the on-site building at 726 Harrison Street, the use of well VE-1 to extract vapors between AS-3 and the on-site building would provide additional recovery in this area. In the RAP Addendum requested below, please consider the use of existing well VE-1.

2. **SVE and Air Sparge Well Configuration for 706 Harrison.** Existing nested AS/SVE wells VW-3/SP-3, VW-4/SP-4, and VW-5, SP-5 are apparently currently covered by concrete and will be evaluated for use in the AS/SVE system at a later date. The RAP indicates that if existing well VW-5/SW-5 is not usable, a replacement AS/SVE well will be installed near VW-5/SP-5 but if existing wells VW-3/SP-3 and VW-4/SP-4 are not usable, no replacement wells will be installed. Proposed wells AS-10 through AS-14 are assumed to adequately address the portion of the site covered by existing wells VW-3/SP-3 and VW-4/SP-4. In the RAP Addendum requested below, please provide further information including a diagram to illustrate the expected performance of AS/SVE system to help assess whether replacement wells may be required if existing wells VW-3/SP-3 and VW-4/SP-4 are not usable.

TECHNICAL REPORT REQUEST

Please upload technical reports to the ACEH ftp site (Attention: Jerry Wickham), and to the State Water Resources Control Board's GeoTracker website according to the following schedule and file-naming convention:

- **July 1, 2014** – RAP Addendum
  File to be named: WP_R_yyyy-mm-dd RO231, RO321, RO484

- **July 1, 2014** – Public comment period for RAP ends

- **October 17, 2014** – Semi-Annual Groundwater Monitoring Report – Third Quarter 2014
  File to be named: GWM_R_yyyy-mm-dd RO231, RO321, RO484

If you have any questions, please call me at (510) 567-6791 or send me an electronic mail message at jerry.wickham@acgov.org. Case files can be reviewed online at the following website: http://www.acgov.org/aceh/index.htm. As your email address does not appear on the cover page of this notification ACEH is requesting you provide your email address so that we can correspond with you quickly and efficiently regarding your case.

Sincerely,

Jerry Wickham, California PG 3766, CEG 1177, and CHG 297
Senior Hazardous Materials Specialist

Attachments: Mailing List
Invitation to Comment – Remedial Action Plan
Responsible Party(ies) Legal Requirements/Obligations

Enclosure: ACEH Electronic Report Upload (ftp) Instructions

cc: Leroy Griffin, Oakland Fire Department, 250 Frank H. Ogawa Plaza, Ste. 3341, Oakland, CA 94612-2032 (*Sent via E-mail to: lgriffin@oaklandnet.com*)

Katherine Brandt, ARCADIS, 1900 Powell Street, 11th Floor, Emeryville, CA 94608 (*Sent via E-mail to: Katherine.Brandt@arcadis-us.com*)

Robert Foss, Conestoga-Rovers & Associates, 5900 Hollis Street, Suite A, Emeryville, CA 94608 2032 (*Sent via E-mail to: bfoss@craworld.com)*

Robert Kitay, Aqua Science Engineers, Inc., 55 Oak Ct., Suite 220, Danville, CA 94526 (*Sent via E-mail to: rkitay@aquascienceengineers.com*)

Jerry Wickham, ACEH (*Sent via E-mail to: jerry.wickham@acgov.org*)

GeoTracker, eFile

275 NINTH STREET LLC
Parcel #: 1-185-34
3343 21ST ST
SAN FRANCISCO CA 94110-2316

9TH STREET INVESTORS LLC
Parcel #: 1-185-32
P.O. BOX 460171
SAN FRANCISCO CA 94146-0171

9TH STREET INVESTORS LLC
Parcel #: 1-185-33
P.O. BOX 460171
SAN FRANCISCO CA 94146-0171

ADVANCE CO L P
Parcel #: 1-185-27
33 TYSON CIR
PIEDMONT CA 94611-3536

AU DAT V
Parcel #: 1-185-29
3417 LINDY ST
ROSEMEAD CA 91770-2201

CHENG KEVIN W
Parcel #: 1-185-30
P.O. BOX 460171
SAN FRANCISCO CA 94146-0171

CHINESE AMERICAN CITIZENS ALLIANCE OAKL
Parcel #: 1-187-16
303 8TH ST
OAKLAND CA 94607-4209

CHINESE COMMUNITY UNITED METHODIST CHI
Parcel #: 1-187-13-1
321 8TH ST
OAKLAND CA 94607-4209

CHINESE INDEPENDENT BAPTIST CHURCH OF
Parcel #: 1-185-12-2
280 8TH ST
OAKLAND CA 94607-4445

EAST BAY ASIAN LOCAL DEVELOPMENT CORP(
Parcel #: 1-187-6-1
310 8TH ST #200
OAKLAND CA 94607-6527

ENGINEHOUSE11 LLC
Parcel #: 1-185-10
PO BOX 31114
WALNUT CREEK CA 94598-8114

FONG NOM & WANDA L TRS
Parcel #: 1-185-23
270 7TH ST
OAKLAND CA 94607-4442

GIN BO K & CHI Y
Parcel #: 1-185-25
342 LESTER AVE
OAKLAND CA 94606-1317

GIN BO K & CHI Y TRS
Parcel #: 1-185-26
342 LESTER AVE
OAKLAND CA 94606-1317

HYPOLITE RONALD J
Parcel #: 1-185-31
275 NINTH ST #3
OAKLAND CA 94607-4411

KONG SUN W & YIN C
Parcel #: 2-71-4
4210 SKYPOINT CT
OAKLAND CA 94619-3142

LIM MAY L TR & ALICE TR
Parcel #: 1-185-11
1028 ANNERLEY RD
PIEDMONT CA 94610-1110

LOUIE LORETTA F & FONG KEVIN ETAL
Parcel #: 2-71-9
276 9TH ST
OAKLAND CA 94607-4434

MILTON SHOONG CHINESE CULTURAL CENTER
Parcel #: 2-61-17-1
316 9TH ST
OAKLAND CA 94607-4212

OAKLAND UNIFIED SCHOOL DISTRICT
Parcel #: 2-71-2
1025 2ND AVE #316
OAKLAND CA 94606-2212

OAKLAND UNIFIED SCHOOL DISTRICT
Parcel #: 2-71-10
1025 2ND AVE #316
OAKLAND CA 94606-2212

OAKLAND UNIFIED SCHOOL DISTRICT
Parcel #: 2-71-11
1025 2ND AVE #316
OAKLAND CA 94606-2212

OAKLAND UNIFIED SCHOOL DISTRICT
Parcel #: 2-71-3
1025 2ND AVE #316
OAKLAND CA 94606-2212

OAKLAND UNIFIED SCHOOL DISTRICT
Parcel #: 2-71-12
1025 2ND AVE #316
OAKLAND CA 94606-2212

OCCUPANT
Parcel #: 1-185-15
281 8TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-25
278 7TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-2
297 10TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-10
278 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-10
817 ALICE ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-27
273 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-1
828 HARRISON ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-34
275 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-11
284 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-61-15
307 10TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-187-6-1
807 HARRISON ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-24
272 7TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-4
283 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-12-2
291 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-11
250 8TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-16
277 8TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-9
268 9TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-61-16
917 HARRISON ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-3
281 10TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-12
900 HARRISON ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-26
706 HARRISON ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-187-18
715 HARRISON ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 2-71-4
259 10TH ST
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-29
275 9TH ST #1
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-30
275 9TH ST #2
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-31
275 9TH ST #3
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-32
275 9TH ST #4
OAKLAND CA 94607

OCCUPANT
Parcel #: 1-185-33
275 9TH ST #5
OAKLAND CA 94607

PRESBYTERY OF S F
Parcel #: 1-185-17
265 8TH ST
OAKLAND CA 94607-4400

USMAN MUHAMMAD
Parcel #: 1-185-13
800 HARRISON ST
OAKLAND CA 94607-4423

WONG BENTON
Parcel #: 1-187-17
725 HARRISON ST #1
OAKLAND CA 94607-4464

WONG BRUCE & RANDALL
Parcel #: 1-185-4
900 JACKSON ST #104
OAKLAND CA 94607-4833

WONG BRUCE D & RANDALL H
Parcel #: 1-185-24
503 CYPRESS AVE
MILLBRAE CA 94030-1208

WONG ROBERT R TR
Parcel #: 1-185-1
33 MANOR DR
PIEDMONT CA 94611-4143

WOO HELEN L TR
Parcel #: 1-185-22
262 7TH ST
OAKLAND CA 94607-4442

WOON LAM & LAM SUSAN TRS & LAM JAMES P
Parcel #: 2-61-15
349 PORTLAND AVE
OAKLAND CA 94606-1425

YEE PETER K & JUDY Y TRS
Parcel #: 1-185-14
726 HARRISON ST
OAKLAND CA 94607-4433

YEE SUSAN N TR
Parcel #: 2-61-16
2727 PLEASANT ST
OAKLAND CA 94602-2808

YU VINCENT T & MARY TRS
Parcel #: 1-187-18
1801 SAN JOSE AVE
BRENTWOOD CA 94513

ZHAO ZHI H & HE YAN Y TRS
Parcel #: 1-185-15
5040 WICKS LN
CASTRO VALLEY CA 94546-1463

ZHAO ZHI H & HE YAN Y TRS
Parcel #: 1-185-16
5040 WICKS LN
CASTRO VALLEY CA 94546-1463

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
ALEX BRISCOE, Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

INVITATION TO COMMENT – REMEDIAL ACTION PLAN

COMMINGLED PLUME
706, 726, AND 800 HARRISON STREET
FUEL LEAK CASES RO0000231, RO0000321, AND RO0000484
GEOTRACKER GLOBAL ID T0600101486, T0600102122, AND T0600100985

MAY 13, 2014

The above referenced site is a fuel leak case that is under the regulatory oversight of the Alameda County Environmental Health (ACEH) Local Oversight Program for the investigation and cleanup of a release of petroleum hydrocarbons from an underground storage tank system. Chevron Environmental Management Company, the active responsible party for the case, has proposed subsurface air sparging and soil vapor extraction to treat soil and groundwater at 706 and 726 Harrison Street. A compound for the cleanup system will be installed at the southern end of the 706 Harrison Street property. Subsurface piping for the cleanup system would extend north to the 726 Harrison Street property. The performance of the cleanup action will be monitored over time using the estimated mass of petroleum hydrocarbons recovered and groundwater monitoring results. ACEH conditionally concurs with the proposed cleanup action with some requested revisions.

This notice is being sent to the current landowners in compliance with Health and Safety Code Section 25295.40 and the current occupants and landowners of adjacent properties and known interested parties for this site.

The public is invited to review and comment on the proposed cleanup action for the fuel leak case, which is described in a document entitled, "*Remedial Action Plan*," dated April 18, 2014. The entire case file can be viewed over the Internet on the ACEH website (http://www.acgov.org/aceh/lop/ust.htm) or the State of California Water Resources Control Board GeoTracker website (http://geotracker.waterboards.ca.gov). Please send written comments to Jerry Wickham at the address below; all comments will be forwarded to the responsible parties. Comments **received by July 13, 2014** will be considered and responded to prior to a final determination on the proposed case closure.

If you have comments or questions regarding this site, please contact the ACEH caseworker, Jerry Wickham at 510-567-6791 or by email at jerry.wickham@acgov.org. Please refer to ACEH case RO0000231 in any correspondence.

Attachment 1

Responsible Party(ies) Legal Requirements/Obligations

REPORT/DATA REQUESTS

These reports/data are being requested pursuant to Division 7 of the California Water Code (Water Quality), Chapter 6.7 of Division 20 of the California Health and Safety Code (Underground Storage of Hazardous Substances), and Chapter 16 of Division 3 of Title 23 of the California Code of Regulations (Underground Storage Tank Regulations).

ELECTRONIC SUBMITTAL OF REPORTS

ACEH's Environmental Cleanup Oversight Programs (Local Oversight Program [LOP] for unauthorized releases from petroleum Underground Storage Tanks [USTs], and Site Cleanup Program [SCP] for unauthorized releases of non-petroleum hazardous substances) require submission of reports in electronic format pursuant to Chapter 3 of Division 7, Sections 13195 and 13197.5 of the California Water Code, and Chapter 30, Articles 1 and 2, Sections 3890 to 3895 of Division 3 of Title 23 of the California Code of Regulations (23 CCR). Instructions for submission of electronic documents to the ACEH FTP site are provided on the attached "Electronic Report Upload Instructions."

Submission of reports to the ACEH FTP site is in addition to requirements for electronic submittal of information (ESI) to the State Water Resources Control Board's (SWRCB) Geotracker website. In April 2001, the SWRCB adopted 23 CCR, Division 3, Chapter 16, Article 12, Sections 2729 and 2729.1 (Electronic Submission of Laboratory Data for UST Reports). Article 12 required electronic submittal of analytical laboratory data submitted in a report to a regulatory agency (effective September 1, 2001), and surveyed locations (latitude, longitude and elevation) of groundwater monitoring wells (effective January 1, 2002) in Electronic Deliverable Format (EDF) to Geotracker. Article 12 was subsequently repealed in 2004 and replaced with Article 30 (Electronic Submittal of Information) which expanded the ESI requirements to include electronic submittal of any report or data required by a regulatory agency from a cleanup site. The expanded ESI submittal requirements for petroleum UST sites subject to the requirements of 23 CCR, Division, 3, Chapter 16, Article 11, became effective December 16, 2004. All other electronic submittals required pursuant to Chapter 30 became effective January 1, 2005. Please visit the SWRCB website for more information on these requirements. (http://www.waterboards.ca.gov/water_issues/programs/ust/electronic_submittal/)

PERJURY STATEMENT

All work plans, technical reports, or technical documents submitted to ACEH must be accompanied by a cover letter from the responsible party that states, at a minimum, the following: "I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge." 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 6735, 7835, and 7835.1) 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 registered 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 fuel leak case meet this requirement.

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:** July 25, 2012
	ISSUE DATE: July 5, 2005
	PREVIOUS REVISIONS: October 31, 2005; December 16, 2005; March 27, 2009; July 8, 2010
SECTION: Miscellaneous Administrative Topics & Procedures	**SUBJECT:** Electronic Report Upload (ftp) Instructions

The Alameda County Environmental Cleanup Oversight Programs (petroleum UST 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 .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) Using Internet Explorer (IE4+), go to ://alcoftp1.acgov.org
      (i) Note: Netscape, Safari, and Firefox browsers will not open the FTP site as they are NOT being supported at this time.
   b) Click on Page located on the Command bar on upper right side of window, and then scroll down to Open FTP Site in Windows Explorer.
   c) Enter your User Name and Password. (Note: Both are Case Sensitive.)
   d) Open "My Computer" on your computer and navigate to the file(s) you wish to upload to the ftp site.
   e) 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 .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.

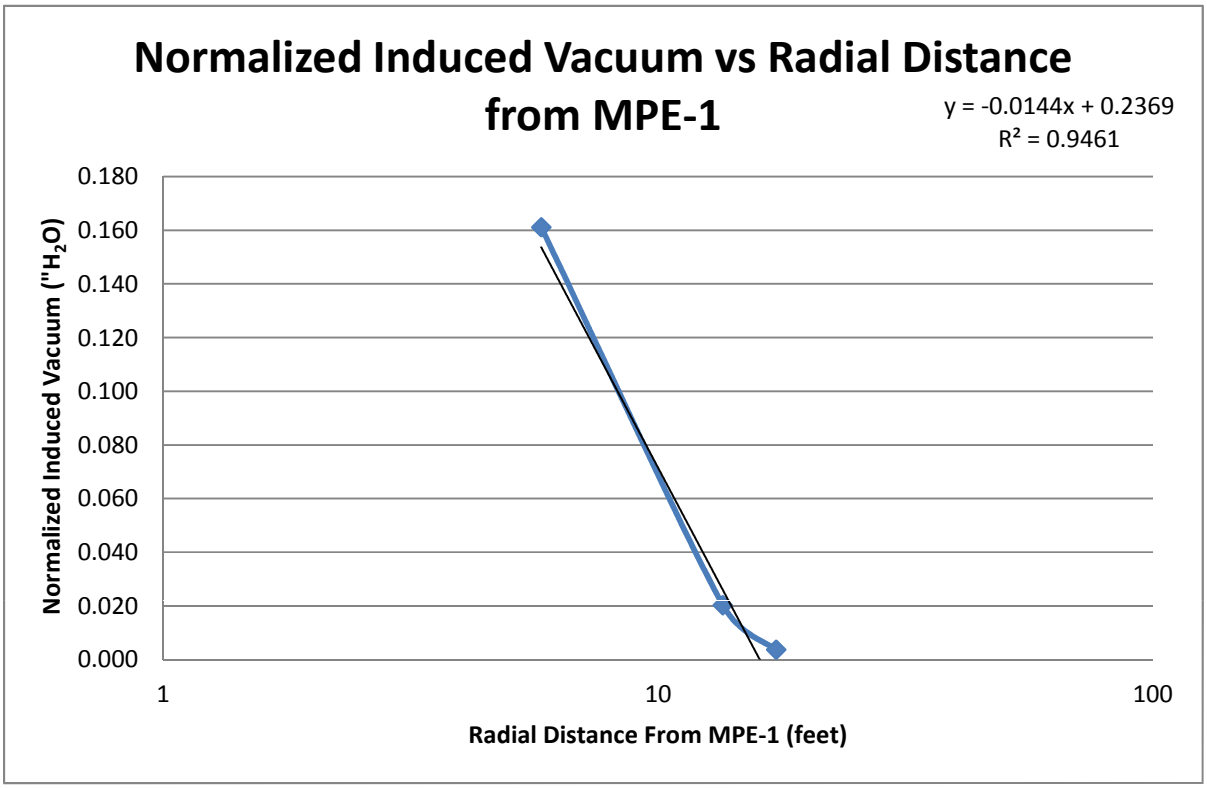
ARCADIS

Appendix B

SVE Radius of Influence Calculations

SVE Pilot Test ROI Calculation - Normalized Vacuum
Chevron Site ID 351646
706, 726, and 800 Harrison Street, Oakland, California

Operational SVE Well	Wellhead Vacuum ("H_2O)	Monitoring Well	Radial Distance from MPE-1 (feet)	Measured Induced Vacuum ("H2O)	Normalized Vacuum
MPE-1	61.0	MW-5	5.8	9.83	0.161
MPE-1	61.0	MW-4	13.5	1.24	0.020
MPE-1	61.0	MP-1	17.3	0.23	0.004



Resulting linear equation for normalized induced vacuum:

$$V = -0.0144 * D(feet) + 0.2369$$

Where:

V= Normalized applied vacuum at wellhead
D= Radial distance from wellhead

Percentage of applied wellhead vacuum:	1%
Radial distance (feet) corresponding to 1% of applied wellhead vacuum:	**15.76**

SVE Pilot Test ROI Calculation - Pneumatic Conductivity
Chevron Site ID 351646
706, 726, and 800 Harrison Street, Oakland, California
MPE Operational Data -- Subsurface Pneumatic Conductivty K_{air} Determination

RED = Parameter/ User Input

MPE-1

SVE Well Tested: MPE-1

Test Date: 9/10/13 & 9/11/13

Operational SVEWell	Row Lookup	Monitoring Well	Distance from well tested, ft	Vac, "w.c	Backgrond Vac, "w.c	Notes	Input Vac, "w.c.
MPE-1	-	MW-5	5.8	9.83	0		1.2
MPE-1	-	MW-4	13.5	1.24	0		9.8
MPE-1	-	MP-1	17.3	0.23	0		0.2

Notes:
61 "H_2O, 12.3 SCFM

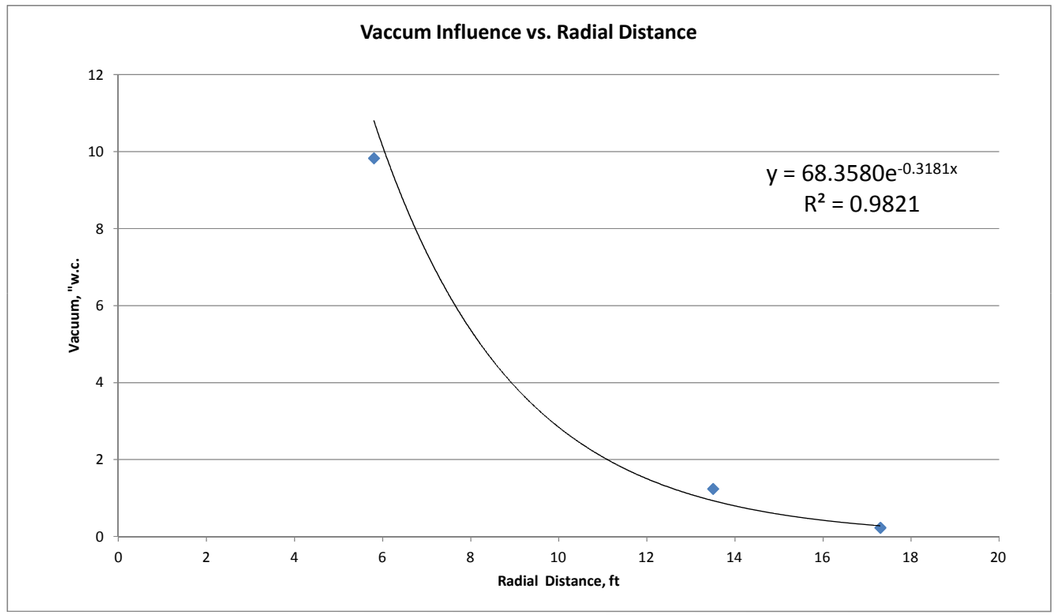
Parameter	Value	Units	Notes
Tested Flowrate, Q	14.4	acfm	
Tested Wellhead Vacuum	61	"w.c.	
Total/Bottom of Screen Depth	15	ft bgs	
Length of Screen	10	ft	
Casing Diameter	0.17	ft	
Depth to Water (enter total depth if well is dry)	15	ft bgs	
Depth to Top of Screen	5	ft bgs	
Depth to Permeable Material	5	ft bgs	Confining Layer
Footage of Open Screen	4.92	ft	
Short circuit warning			
Air Permeable Zone Height/Unsat Thickness, h	10	ft	
Borehole Radius, a	0.67	ft	auger
Outer Measurment point, b	14	ft	
Pressure @ a, P_a	50.41	"H2O	
Pressure @ b, P_b	6.49	"H2O	

$$K_{air} = \frac{Q}{(P_b - P_a)\cdot 2\cdot \pi \cdot h}\cdot \ln\left(\frac{b}{a}\right)$$

From graph at right…
C_1= 55.9179 in the form
C_2= -0.1556

$$y = C_1 \cdot e^{(C_2 \cdot x)}$$

Pneumatic Conductivity, K_{air} **1.230E-07** **sec^{-1}**



SVE Pilot Test ROI Calculation - Pore Volume Exchange Rate
Chevron Site ID 351646
706, 726, and 800 Harrison Street, Oakland, California

Soil Vapor Extraction System PVER Design Calcuations

This worksheet calculates requsite flow and DP expectations for a range of outer radius points.

Soil Parameters

Parameter	Value	Units
Total Porosity, η	0.3	cm^3/cm^3
Density Air, ρ_{air}	0.00127	g/cm^3
Percent open area S.S. wrapped screen	6%	

RED = user changable input parameters
BLUE = entrance velocity that exceeds 3 ft/sec

Design Equations

$$Q = \frac{ER \cdot \pi \cdot (b^2 - a^2) \cdot h \cdot \eta \cdot \rho_{air}}{1440 \cdot 60}$$

$$\Delta P = \frac{Q}{K_{air} \cdot 2 \cdot \pi \cdot h} \cdot \ln\left(\frac{b}{a}\right) \cdot 2490^{-1}$$

where
ER = Extraction Rate, Pore Volumes Removed per Day
b= Design Radius of Influence, cm
a= Well Casing Diameter, cm
h= Saturated Thickness, cm
Q= Flow Rate, g/sec

Table 1. MPE-1 Pore Volume Exchange Rate Calculations

	K_{air}	h	a		b			A_{screen}	Pore Volume Exchange Rate per Day								
									0.5			1			1.5			2		
Tested Well	Pneumatic Conductivity	Unsataturated Thickness	Borehole Radius	Well Casing Radius	Design ROI	Tested WL	Screen Length above WT	Effective Open Screen Area	Requisite Flow	Requisite ΔP	Entrance Velocity	Requisite Flow	Requisite ΔP	Entrance Velocity	Requisite Flow	Requisite ΔP	Entrance Velocity	Requisite Flow	Requisite ΔP	Entrance Velocity
	sec	feet	feet	feet	feet	ft bTOC	feet	ft^2	SCFM	"w.c.	ft/sec	SCFM	"w.c.	ft/sec	SCFM	"w.c.	ft/sec	SCFM	"w.c.	ft/sec
MPE-1	1.23007E-07	15	0.67	0.17	**5**	15	10	0.64	0	0.2	0.00	0	0.3	0.01	0	0.5	0.01	0	0.7	0.01
MPE-1	1.23007E-07	15	0.67	0.17	**10**	15	10	0.64	0	0.9	0.01	1	1.8	0.03	1	2.7	0.04	2	3.6	0.05
MPE-1	1.23007E-07	15	0.67	0.17	**15**	15	10	0.64	1	2.3	0.03	2	4.7	0.06	3	7.0	0.09	4	9.3	0.12
MPE-1	1.23007E-07	15	0.67	0.17	**20**	15	10	0.64	2	4.5	0.05	4.0	9.1	0.10	6	13.6	0.16	8	18.2	0.21
MPE-1	1.23007E-07	15	0.67	0.17	**25**	15	10	0.64	3	7.6	0.08	6	15.1	0.16	9	22.7	0.24	12	30.2	0.33
MPE-1	1.23007E-07	15	0.67	0.17	**30**	15	10	0.64	4	11.4	0.12	9	22.9	0.23	13	34.3	0.35	18	45.7	0.47
MPE-1	1.23007E-07	15	0.67	0.17	**35**	15	10	0.64	6	16.2	0.16	12	32.4	0.32	18	48.6	0.48	24	64.8	0.64
MPE-1	1.23007E-07	15	0.67	0.17	**40**	15	10	0.64	8	21.9	0.21	16	43.7	0.42	24	65.6	0.62	32	87.5	0.83
MPE-1	1.23007E-07	15	0.67	0.17	**45**	15	10	0.64	10	28.5	0.26	20	57.0	0.53	30	85.4	0.79	40	113.9	1.05
MPE-1	1.23007E-07	15	0.67	0.17	**50**	15	10	0.64	12	36.0	0.33	25	72.1	0.65	37	108.1	0.98	50	144.2	1.30

Chart 1. MPE-1 Pore Volume Exchange Rate Curves