

Atlantic Richfield Company

Shannon Couch
Project Manager

PO Box 1257
San Ramon, CA 94583
Phone: (925) 275-3804
Fax: (925) 275-3815
E-Mail: shannon.couch@bp.com

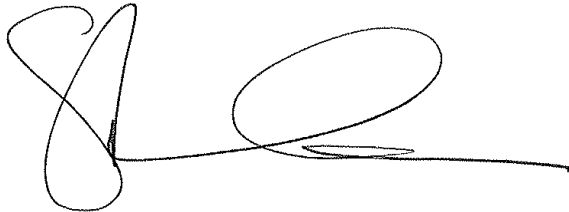
December 7, 2012

Re: Soil and Groundwater Investigation Work Plan
Atlantic Richfield Company Station #498
286 South Livermore Avenue, Livermore, California
ACEH Case No. RO0002873

RECEIVED
10:20 am, Dec 11, 2012
Alameda County
Environmental Health

"I declare, that to the best of my knowledge at the present time, that the information and/or recommendations contained in the attached document are true and correct.

Submitted by,



Shannon Couch
Project Manager

Attachment



SOIL AND GROUNDWATER INVESTIGATION WORK PLAN
Atlantic Richfield Company Station #498
286 South Livermore Ave.
Livermore, Alameda County, California

Prepared for:

Ms. Shannon Couch
Atlantic Richfield Company
P.O. Box 1257
San Ramon, CA 94583

Prepared by:

Broadbent & Associates, Inc.
1324 Mangrove Avenue, Suite 212
Chico, California 95926
(530) 566-1400

December 7, 2012

No. 08-82-603



BROADBENT

1324 Mangrove Ave., Suite 212, Chico, CA 95926

[T] 530-566-1400 [F] 530-566-1401

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Creating Solutions. Building Trust.

December 7, 2012

Project No. 08-82-603

Atlantic Richfield Company
P.O. Box 1257
San Ramon, California 94583
Submitted via ENFOS

Attn.: Ms. Shannon Couch

Re: Soil and Groundwater Investigation Work Plan, Atlantic Richfield Company (a BP affiliated company) Station #498, 286 South Livermore Avenue, Livermore, California;
ACEH Case #RO0002873

Dear Ms. Couch:

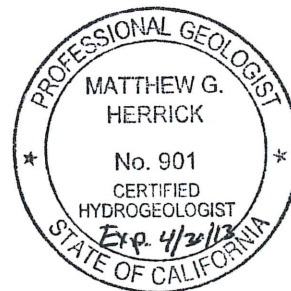
Broadbent & Associates, Inc. (Broadbent) is pleased to submit this Work Plan to conduct a soil and groundwater investigation at Atlantic Richfield Company Station #498 (herein referred to as Station #498) located at 286 South Livermore Avenue, Livermore, California (Property). This Work Plan has been prepared in accordance with the Alameda County Environmental Health (ACEH) letter dated September 18, 2012.

Should you have any questions concerning this Work Plan, please do not hesitate to contact us at (530) 566-1400.

Sincerely,
BROADBENT & ASSOCIATES, INC.

Jason R. Duda
Project Scientist

Matthew G. Herrick, P.G., C.H.G.
Senior Hydrogeologist



cc: Mr. Jerry Wickham, ACEH (Submitted via ACEH ftp Site)
GeoTracker

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- Drawing 1: Site Location Map, Station #498, Livermore, CA
- Drawing 2: Site Map with Historic Sample and Proposed Boring Locations, Station #498, Livermore, CA

APPENDICES

- Appendix A: Historic Soil Analytical Data
- Appendix B: Historic Groundwater Monitoring and Analytical Data

1.0 Background

Provided herein is a Work Plan to conduct a soil and groundwater investigation at Station #498 located at 286 South Livermore Ave., Livermore, California. The Property is currently an operational gas station located in an area of mixed commercial and residential use. The property consists of a convenience store and one gasoline dispensing island with associated underground storage tanks (USTs) and product piping. A site location map is provided as Drawing 1.

During product line and dispenser upgrade activities completed in June 2001, Delta Environmental Consultants, Inc. (Delta) collected soil samples beneath the product lines and dispenser islands. Total purgeable hydrocarbons as gasoline (TPHg) were detected in two of the four dispenser island samples at 1.8 milligrams per kilogram (mg/kg) in sample DP-1 and 87 mg/kg in sample DP-3. Benzene, toluene, ethylbenzene, and total xylenes (BTEX), and methyl tertiary butyl ether (MTBE) were also detected in dispenser island sample DP-3. Toluene and total xylenes were detected in product line sample PL-2 at relatively low concentrations. Historic soil analytical data are provided in Appendix A. Historic soil sample locations are depicted in Drawing 2. Product line and dispenser island sampling activities are summarized in the Delta September 19, 2001 *Product Line and Dispenser Island Sampling Results* report.

In January 2005, URS completed a site assessment to fulfill a due diligence audit as part of the sale of the Property. Field activities were conducted to assess whether subsurface soils in the vicinity of the USTs and fuel dispensers had been impacted by petroleum hydrocarbons. The work was not required as part of a regulatory agency directive. Eight soil borings were advanced using a direct push Geoprobe® 6600 drill rig. URS stated in the February 15, 2005 *Site Assessment Report* that the proposed total depth of all borings was 30 feet below ground surface (bgs); however, due to difficult drilling conditions encountered, the borings were only advanced to depths ranging from 15 to 25 feet bgs. Groundwater was not encountered in the borings advanced. MTBE and tert-butyl alcohol (TBA) were detected in four of the collected soil samples (SB-1-22', SB-1-24', SB-3-25', and SB-8-25') at maximum concentrations of 0.022 mg/kg (SB-8-25') and 0.031 mg/kg (SB-1-22'), respectively. Historic soil analytical data are provided in Appendix A and sample locations are depicted on Drawing 2.

In November 2008, a soil and groundwater investigation was completed, which included installation of monitor wells MW-1 through MW-4. Field activities were conducted to further define the vertical and lateral extent of impacted soil and complete an initial groundwater investigation. Soil sample analytical results showed the presence of petroleum hydrocarbon impacted soil at all four sample locations (MW-1 through MW-4) at depths ranging from 15 to 35 feet bgs. Historic soil analytical data are provided in Appendix A. Elevated groundwater concentrations were detected in well MW-3 and moderately elevated concentrations were detected in wells MW-1 and MW-2. Well MW-4 was found to be dry. The February 6, 2009 *Soil and Ground-Water Investigation and Fourth Quarter, 2008 Quarterly Monitoring Report* recommended that two additional quarters (First and Second Quarter, 2009) of groundwater monitoring/sampling be completed to better understand the hydrogeology before additional investigative work activities were proposed.

Broadbent prepared the *Soil and Groundwater Investigation Work Plan* on August 28, 2009, which proposed installation of three additional groundwater monitoring wells (MW-5, MW-6, and MW-7). The purpose of locating proposed well MW-5 adjacent to MW-1 was to determine if anomalous water levels observed in MW-1 were potentially due to a localized perched water-bearing zone. Proposed wells MW-6 and MW-7 were located off-Site and to the northwest of the station in order to further delineate the down-gradient extent of groundwater contamination. In a letter dated February 10, 2010, ACEH requested a Work Plan Addendum to address concerns regarding the proposed locations of wells MW-6 and MW-7, which may not have adequately characterized the extent of impacted groundwater due to the calculated groundwater flow direction on November 9, 2009, which was south-southwest instead of northwest as was calculated on March 20, 2009. On April 12, 2010, Broadbent submitted the *Soil and Groundwater Investigation Work Plan Addendum*, which stated that the locations of MW-6 and MW-7 were based on the flow directions calculated at the Shell Station located across 3rd Street and data collected from the Site during the First Quarter 2009 groundwater monitoring event. In a letter dated August 12, 2010, ACEH approved the proposed scope of work.

Numerous attempts to obtain off-Site property access in order to complete the installation of off-Site wells have been made. However, off-Site property owners have been unresponsive and/or uncooperative in allowing access, which has delayed commencement of the proposed scope of work. On August 29, 2012, ACEH, Atlantic Richfield Company, and Broadbent met to discuss the possibility of advancing borings along the northwestern property boundary in lieu of the off-Site borings. In a letter dated September 18, 2012, ACEH accepted advancing borings along the northwestern property boundary to define the site stratigraphy and vertical and lateral distribution of contamination and requested submittal of a Work Plan by November 30, 2012. ACEH also recommended use of Cone Penetration Testing (CPT) drilling procedures to adequately characterize subsurface hydro-geologic features.

Quarterly groundwater monitoring and sampling has been conducted on wells MW-1, MW-2, MW-3, and MW-4 at the Site since November 2008. The monitoring and sampling schedule was modified to be conducted semi-annually during the second and fourth quarters of each calendar year in June 2009. Historic groundwater monitoring and analytical data are provided in Appendix B.

2.0 Scope of Work

In order to further characterize petroleum hydrocarbon impact to soil and groundwater associated with Station #498 and accurately assess subsurface hydro-geologic conditions, it is proposed to advance eight soil borings (SB-9 through SB-16) using CPT drilling technology to an approximate depth of 55 feet bgs in order to facilitate collection of soil and groundwater samples on-Site and obtain detailed lithologic data. An attempt to determine the presence of multiple water-bearing zones will also be conducted during CPT drilling activities. In the event that distinct zones are observed, discrete groundwater samples will be collected from each zone in order to compare potential concentration differences. Use of an Ultra-Violet Optical Screening Tool (UVOST) will be coupled with the CPT attachment on the drill rig in order to assist with recognition of subsurface soils impacted by petroleum hydrocarbons and determination of appropriate depths for soil sample collection.

Proposed borings SB-9 through SB-11 are located along the northwestern property boundary to further assess potential impact to soil and groundwater in the down-gradient direction. Boring SB-12 is situated adjacent to existing well MW-1 in order to evaluate the potential presence of a localized perched water zone within its vicinity, as anomalous water levels have consistently been observed during gauging and sampling events conducted at MW-1. Borings SB-13 through SB-16 are located within close proximity to previous borings installed in 2005 by URS. The purpose of these borings is to re-evaluate subsurface conditions at the proposed locations and obtain grab groundwater samples, as groundwater was not encountered during the 2005 investigation. The proposed boring locations are depicted on Drawing 2. Potential installation of additional groundwater monitor wells or abandonment of existing wells, if warranted, will be postponed until results of the CPT investigation can be properly reviewed. Following completion of the proposed work, Broadbent will generate a report for submittal to ACEH summarizing the soil and groundwater investigation including data interpretation, discussion, and recommendations.

3.0 Preliminary Field Activities

Prior to initiating field activities, Broadbent will obtain the necessary well drilling permits from the Zone 7 Water Agency, prepare a Site health and safety plan specific to the scope of work, and clear the Site for subsurface utilities. The utility clearance will include notifying Underground Service Alert of the work a minimum of 48 hours prior to initiating the field investigation, and additionally securing the services of a private underground utility locating company to confirm the absence of underground utilities at each boring location. Borehole locations will also be cleared to a depth of 6.5 feet bgs using an air knife rig prior to borehole advancement.

The Site-specific HASP will be prepared for use by personnel implementing the work plan. A copy of the HASP will be available on-site during work. The subcontractor(s) performing field activities will be provided with a copy of the HASP prior to initiating work. A safety tailgate meeting will also be conducted daily to review potential hazards and scope of work.

4.0 Soil Investigation

Soil borings will be advanced to a total depth of approximately 55 feet bgs using a CPT drilling technique. A log based on CPT measurements will be created for each boring. Metal rods equipped with a cone penetrometer (cone) will be advanced into the subsurface at each proposed location. This cone will measure parameters in the subsurface. These parameters include tip friction, sleeve friction, and pore pressure. The CPT will measure these parameters in real time with depth, allowing for a vertical soil profile to be created based on these measurements. Depth to groundwater measurements will also be calculated using CPT technology by performing pore dissipation tests (PDTs). A PDT is conducted when the cone is halted at specific intervals. The variation in the penetration pore pressure with time is measured behind the tip of the cone. These logs will be created by the drilling contractor and used for determining groundwater collection intervals. Soil borings will be completed under the supervision of a Broadbent field representative.

In addition to the proposed CPT technology, laser induced fluorescence utilizing an Ultra-Violet Optical Screening Tool (UVOST) is proposed for in-situ measurement of petroleum hydrocarbons during drilling activities. The laser induced fluorescence cone works on the principle that hydrocarbons, mixed with soil and/or groundwater, fluoresce when irradiated by ultra violet light. Therefore, by measuring the intensity of the fluorescence, the lateral and vertical extent of hydrocarbon contamination in the ground can be determined. The UVOST module uses principles of fluorescence spectrometry by irradiating the soil with ultra violet light, which is produced by a laser and transmitted to the cone through fiber optic cables. The light then passes through a small window in the side of the cone into the soil. Hydrocarbon molecules present in the soil absorb the light energy during radiation and immediately re-emit the light at a longer wavelength. This re-emission is termed fluorescence and the amount of fluorescence measured by the UVOST module can be used to estimate hydrocarbon concentrations. Software analysis can also determine the type of contaminant present within the subsurface.

Following completion of the CPT/UVOST borings, a second borehole immediately adjacent to the first will be installed in order to collect soil and groundwater samples. Soil samples will be collected from depths correlating to the highest observed concentrations as determined by the UVOST readings. Collection of soil samples within potential water-bearing zones will not be conducted. A minimum of one soil sample will be submitted for analysis from each boring. The soil samples will be transported under chain-of-custody protocol to a California State-certified analytical laboratory and analyzed for the following:

- Gasoline range organics (GRO, C6-C12) via EPA Method 8015B and BTEX via EPA Method 8260B; and
- Fuel additives MTBE, TBA, ethyl tert-butyl ether (ETBE), tert-amyl methyl ether (TAME), di-isopropyl ether (DIPE), 1,2-dichloroethane (1,2-DCA), 1,2-dibromoethane (EDB), and ethanol via EPA Method 8260B.

Additional soil samples from select borings will also be collected for analysis of bulk and grain density, total porosity, moisture content, volumetric moisture and air, total organic carbon, fractional organic carbon, and grain size distribution. These parameters may be used in the future for additional Site evaluation activities. Upon completion of borehole advancement and sampling activities, each boring will be abandoned using neat cement grout and completed at the surface to match the surrounding area.

5.0 Groundwater Investigation

One to two groundwater samples will be collected from each boring depending on the number of water-bearing zones identified during CPT advancement. A groundwater sample shall be collected from the shallowest zone observed and the deepest zone, if two distinct zones are identified between ground surface and the total proposed borehole depth of 55 feet.

Groundwater samples will be collected using a Hydropunch-type sampler equipped with a retrievable stainless steel or disposable PVC screen with an expendable tip. The groundwater sampler operates by advancing 1 ¾ - inch hollow-push rods with the filter tip in a closed

configuration to the base of the desired sampling interval. Once at the desired depth, the push rods are retracted, exposing the encased filter screen allowing groundwater to infiltrate hydrostatically from the formation to the inlet screen. A small diameter bailer will then be lowered through the push rod into the screened interval for sample collection.

Groundwater samples will be collected in appropriate sampling containers, labeled and chilled prior to transport under chain-of-custody protocol to a California State-certified analytical laboratory and analyzed for the following:

- GRO (C6-C12) via EPA Method 8015B and BTEX via EPA Method 8260B; and
- Fuel additives MTBE, TBA, ETBE, TAME, DIPE, 1,2-DCA, EDB, and ethanol via EPA Method 8260B.

6.0 Investigation-Derived Residuals Management

Residual solids and liquids generated during the Site investigation activities will be stored temporarily onsite in Department of Transportation-approved 55-gallon drums pending analytical results and profiling. Following characterization and profiling, Belshire Environmental Services will be scheduled to transport the investigation-derived residuals to an Atlantic Richfield Company-approved facility for treatment or disposal.

7.0 Schedule and Reporting

Broadbent will execute the scope of work within 90 days following receipt of ACEH approval. A soil and groundwater investigation report will be submitted to ACEH approximately 60 days following completion of field work and receipt of laboratory analytical data.

8.0 Limitations

Our services will be performed in accordance with the generally accepted standard of practice at the time work commences. Results and recommendations will be based on review of available documentation and written or verbal correspondence with appropriate regulatory agencies, laboratory results, observations of field personnel, and the points investigated. No other warranty, expressed or implied is made.

9.0 References

Alameda County Environmental Health, February 10, 2010. Case No. RO0002873, ARCO #0498, 286 South Livermore Avenue, Livermore, CA. Letter from Mr. Paresh Khatri (ACEH) to Mr. Chuck Carmel (Atlantic Richfield Company).

Alameda County Environmental Health, August 12, 2010. Case No. RO0002873, ARCO #0498, 286 South Livermore Avenue, Livermore, CA. Letter from Mr. Paresh Khatri (ACEH) to Mr. Chuck Carmel (Atlantic Richfield Company).

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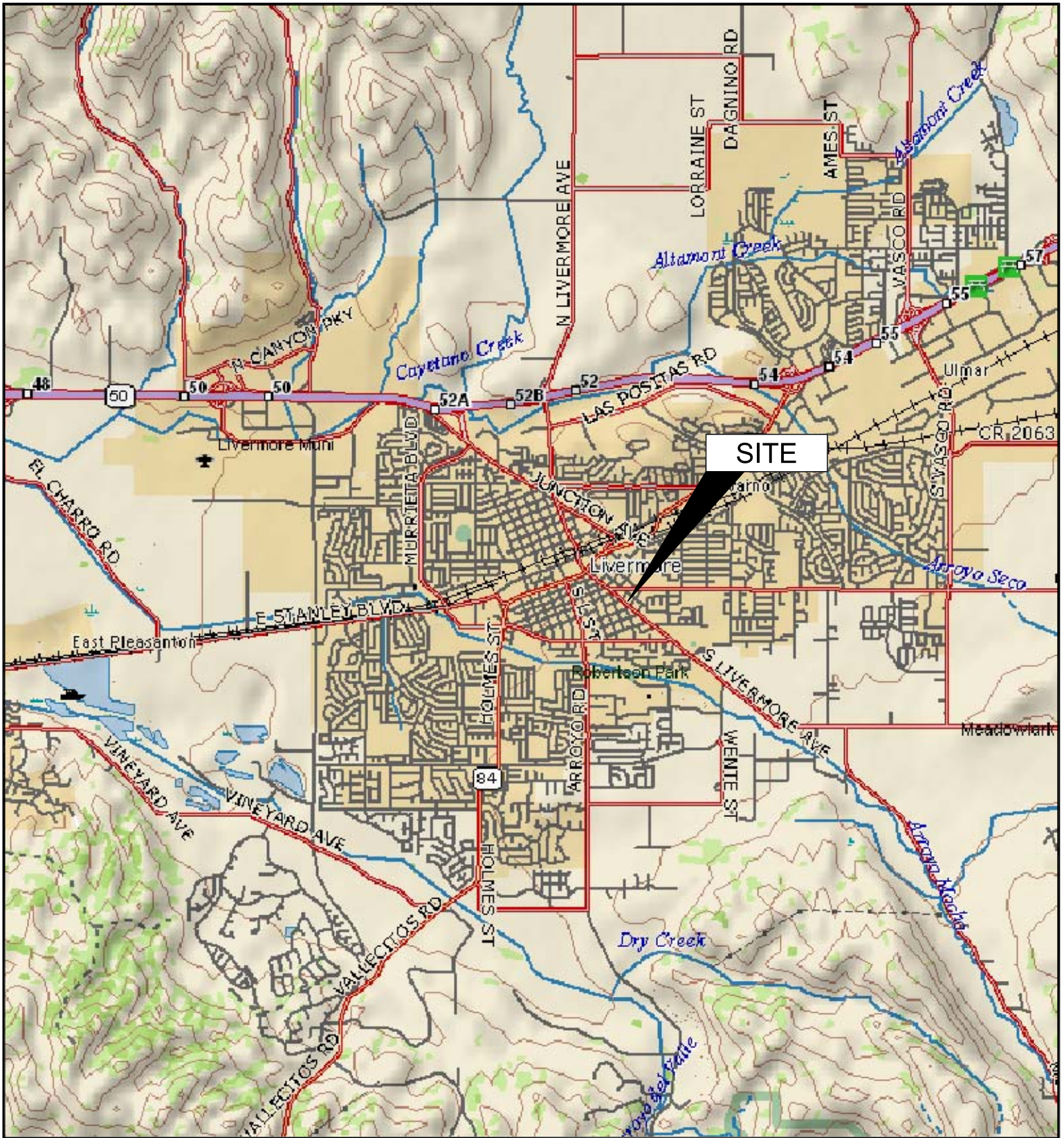
Broadbent & Associates, Inc., February 6, 2009. *Soil and Ground-Water Investigation and Fourth Quarter, 2008 Quarterly Monitoring Report*, Atlantic Richfield Company Station #498, 286 South Livermore Avenue, Livermore, CA.

Broadbent & Associates, Inc., August 28, 2009. *Soil and Groundwater Investigation Work Plan*, Atlantic Richfield Company Station #498, 286 South Livermore Avenue, Livermore, CA.

Broadbent & Associates, Inc., April 12, 2010. *Soil and Groundwater Investigation Work Plan Addendum*, Atlantic Richfield Company Station #498, 286 South Livermore Avenue, Livermore, CA.

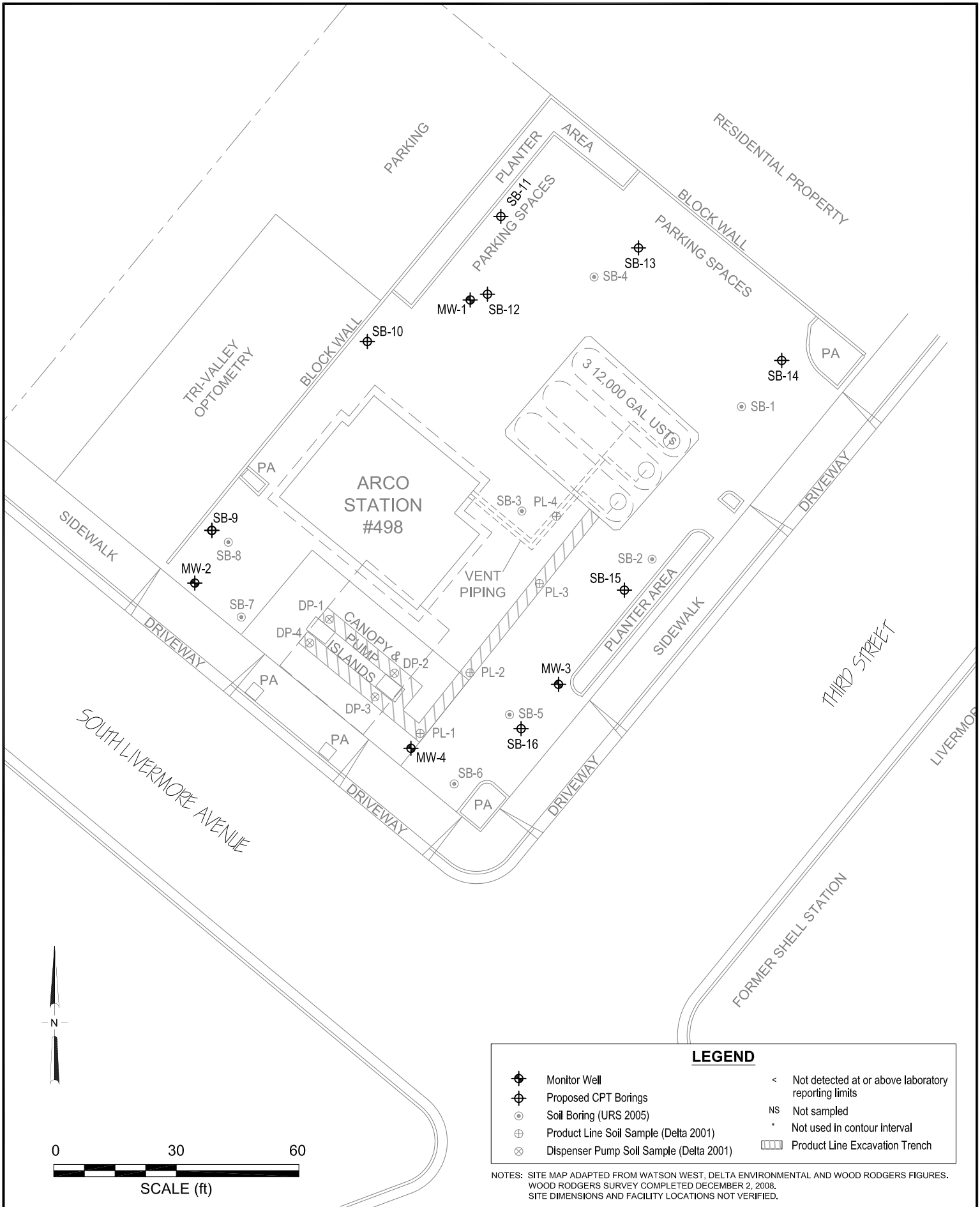
Delta, September 19, 2001. *Product Line and Dispenser Island Sampling Results*, ARCO Station No. 498, 286 South Livermore Avenue, Livermore, California.

URS, February 15, 2005. *Site Assessment Report*, ARCO Service Station #0498, 286 South Livermore Avenue, Livermore, California.



APPROXIMATE SCALE (mi)

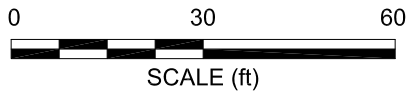
IMAGE SOURCE: DELORME



LEGEND

- ⊕ Monitor Well
- ⊕ Proposed CPT Borings
- ⊙ Soil Boring (URS 2005)
- ⊕ Product Line Soil Sample (Delta 2001)
- ⊗ Dispenser Pump Soil Sample (Delta 2001)
- < Not detected at or above laboratory reporting limits
- NS Not sampled
- * Not used in contour interval
- ▭ Product Line Excavation Trench

NOTES: SITE MAP ADAPTED FROM WATSON WEST, DELTA ENVIRONMENTAL AND WOOD RODGERS FIGURES. WOOD RODGERS SURVEY COMPLETED DECEMBER 2, 2008. SITE DIMENSIONS AND FACILITY LOCATIONS NOT VERIFIED.



Appendix A

Historic Soil Analytical Data

TABLE 1

SOIL SAMPLE LABORATORY ANALYTICAL RESULTS

ARCO Service Station No. 498
286 South Livermore Avenue
Livermore, California

Sample ID	Date	Depth (ft)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl- benzene (mg/kg)	Total Xylenes (mg/kg)	TPH as gasoline (mg/kg)	MTBE (mg/kg)	Total Lead (mg/kg)
<u>Dispenser Island Samples</u>									
DP-1	06/01/01	3.0	<0.0050	<0.0050	<0.0050	0.019	1.8	<0.050	23
DP-2	06/01/01	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<0.050	3.7
DP-3	06/01/01	3.5	0.11	2.8	1.2	8.9	87	3.7	17
DP-4	06/01/01	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<0.050	4.2
<u>Product Line Samples</u>									
PL-1	06/01/01	3.8	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<0.050	2.3
PL-2	06/01/01	4.5	<0.0050	0.011	<0.0050	0.010	<1.0	<0.050	13
PL-3	06/01/01	5.0	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<0.050	5.4
PL-4	06/01/01	2.5	<0.0050	<0.0050	<0.0050	<0.0050	<1.0	<0.050	190
<u>Soil Stockpile Results</u>									
SP-1,2,3,4	06/01/01	Composite	<0.0050	<0.0050	<0.0050	0.13	5.6	<0.050	32

TPH = Total purgeable hydrocarbons.

MTBE = Methyl tertiary butyl ether (analyzed by DHS LUFT Methods)

NA = Not Analyzed

Table 1 - Soil Analytical Data
ARCO Service Station #0498
286 South Livermore Avenue, Livermore California

Sample Name	Sample Depth (ft)	Date Sampled	TPH-GRO (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
SB-1-7'	7.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-12'	12.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-17'	17.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-22'	22.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-24'	24.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-2-10'	10.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-2-15'	15.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-2-18.5'	18.5	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-10'	10.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-15'	15.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-20'	20.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-25'	25.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-7'	7.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-12'	12.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-17'	17.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-22'	22.0	01/19/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-5-10'	10.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-5-15'	15.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-6-10'	10.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-6-15'	15.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-6-22'	22.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-7-10'	10.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-7-14.5'	14.5	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-7-20'	20.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-10'	10.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-15'	15.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-20'	20.0	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-25'	25	01/20/05	ND <1.0	ND <0.005	ND <0.005	ND <0.005	ND <0.005

Notes:

- ND = Not Detected at or above the laboratory reporting limit
- mg/kg = milligrams per kilogram
- TPH-GRO = Total Petroleum Hydrocarbons gasoline range organics
- BTEX = Benzene, toluene, ethylbenzene, and xylenes

Table 2 Soil Analytical Data-Oxygenates
ARCO Service Station #0498
286 South Livermore Avenue, Livermore California

Sample Name	Sample Depth (ft)	Date Sampled	Ethanol (mg/kg)	TBA (mg/kg)	MTBE (mg/kg)	DIPE (mg/kg)	ETBE (mg/kg)	TAME (mg/kg)	1,2-DCA (mg/kg)	EDB (mg/kg)
SB-1-7'	7.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-12'	12.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-17'	17.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-22'	22.0	01/20/05	ND <0.1	0.031	0.015	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-1-24'	24.0	01/20/05	ND <0.1	0.025	0.006	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-2-10'	10.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-2-15'	15.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-2-18.5'	18.5	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-10'	10.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-15'	15.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-20'	20.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-3-25'	25.0	01/19/05	ND <0.1	0.021	0.011	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-7'	7.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-12'	12.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-17'	17.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-4-22'	22.0	01/19/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-5-10'	10.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-5-15'	15.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-6-10'	10.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-6-15'	15.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-6-22'	22.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-7-10'	10.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-7-14.5'	14.5	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-7-20'	20.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-10'	10.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-15'	15.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-20'	20.0	01/20/05	ND <0.1	ND <0.01	ND <0.005	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005
SB-8-25'	25	01/20/05	ND <0.1	0.012	0.022	ND <0.01	ND <0.005	ND <0.005	ND <0.005	ND <0.005

Notes:

- ND = Not Detected at or above the laboratory reporting limit
- mg/kg = milligrams per kilogram
- TBA = Tert-butyl alcohol
- MTBE = Methyl tertiary butyl ether
- DIPE = Di-isopropyl ether
- ETBE = Ethyl tertiary butyl ether
- TAME = Tert-amyl methyl ether
- 1,2-DCA = 1,2-Dichloroethane
- EDB = 1,2-Dibromoethane

Table 1. Summary of Soil Sample Analytical Data
Station #498, 286 South Livermore Avenue, Livermore, CA

Boring and Sample Date	Sample ID	Concentrations in (mg/kg)								Comments
		GRO/TPHg	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	MTBE	Ethanol	TBA	
MW-1										
11/24/2008	MW-1 25'	45	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	<0.010	
11/24/2008	MW-1 30'	0.86	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	<0.010	
11/24/2008	MW-1 40'	<0.50	<0.0010	<0.0010	<0.0010	<0.0010	0.16	0.23	0.036	
MW-2										
11/24/2008	MW-2 40'	<0.50	<0.0010	<0.0010	<0.0010	<0.0010	0.010	<0.10	0.022	
11/24/2008	MW-2 45'	18	<0.0010	<0.0010	<0.0010	<0.0010	0.0019	0.44	0.022	
11/24/2008	MW-2 50'	<0.50	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	<0.010	
MW-3										
11/26/2008	MW-3 15'	6.7	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	0.14	
11/26/2008	MW-3 20'	210	<0.0010	<0.0010	0.88	<0.0010	<0.0010	<0.10	<0.010	
11/26/2008	MW-3 25'	530	<0.10	<0.10	1.5	0.17	<0.10	<10	<1.0	
11/26/2008	MW-3 30'	0.84	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	<0.010	
11/26/2008	MW-3 35'	<0.50	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	0.028	
11/26/2008	MW-3 40'	<0.50	<0.0010	<0.0010	<0.0010	<0.0010	0.013	<0.10	0.014	
MW-4										
11/25/2008	MW-4 30'	2.0	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.35	0.054	
11/25/2008	MW-4 35'	75	<0.0010	<0.0010	<0.0010	<0.0010	0.0030	<0.10	0.65	
11/25/2008	MW-4 40'	<0.50	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.10	0.14	

SYMBOLS AND ABBREVIATIONS:

< = Not detected at or above specified laboratory reporting limit

GRO = Gasoline range organics

MTBE = Methyl tert-butyl ether

TBA = Tert-Butyl Alcohol

mg/kg = Milligrams per Kilogram

NOTES:

1,2-dibromoethane (EDB), 1,2-dichloroethane (1,2 DCA), Di-isopropyl ether (DIPE), ethyl tert-butyl ether (ETBE) and ter-amyl methyl ether (TAME) were not detected at or above their respective laboratory reporting limits.

GRO (C6-C12) analyzed using EPA method 8015B.

Benzene, toluene, ethylbenzene, total xylenes, MTBE, ethanol and TBA analyzed using EPA method 8260B.

The number after space in Sample ID denotes the depth at which the sample was collected in feet bls.

Appendix B

Historic Groundwater Monitoring and Analytical Data

Table 1. Summary of Groundwater Monitoring Data: Relative Water Elevations and Laboratory Analyses
ARCO Service Station #498, 286 South Livermore Avenue, Livermore, CA

Well ID and Date Monitored	P/NP	TOC (feet)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	DTW (feet)	Product Thickness (feet)	Water Level Elevation (feet)	Concentrations in µg/L						DO (mg/L)	pH	Footnote
								GRO/TPHg	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	MTBE			
MW-1																
12/29/2008	P	496.72	20.00	40.00	28.81	0.00	467.91	1,100	38	1.2	4.0	3.3	17	2.72	6.83	
3/20/2009	P		20.00	40.00	28.95	0.00	467.77	640	9.1	<0.50	4.1	<0.50	21	0.35	7.28	
6/2/2009	P		20.00	40.00	30.90	0.00	465.82	600	1.6	<0.50	<0.50	<0.50	32	0.59	7.17	
9/2/2009	P		20.00	40.00	32.00	0.00	464.72	570	<0.50	<0.50	<0.50	<0.50	5.3	1.02	7.38	
11/9/2009	P		20.00	40.00	31.82	0.00	464.90	1,000	130	12	35	39	140	1.39	7.02	
5/20/2010	P		20.00	40.00	28.94	0.00	467.78	1,000	4.4	<0.50	0.76	0.73	22	0.59	6.6	
11/2/2010	P		20.00	40.00	32.03	0.00	464.69	1,300	83	20	40	61	39	0.72	6.0	b (GRO), c
5/25/2011	P		20.00	40.00	26.69	0.00	470.03	2,900	32	3.1	20	2.9	<0.50	0.68	7.0	1w (GRO)
10/25/2011	P		20.00	40.00	30.11	0.00	466.61	1,100	20	3.7	<0.50	5.4	21	0.78	7.4	1w (GRO)
4/10/2012	P		20.00	40.00	30.35	0.00	466.37	1,300	13	2.0	7.0	7.1	5.0	0.20	6.71	1w (GRO)
MW-2																
12/29/2008	P	495.35	37.00	57.00	48.76	0.00	446.59	110	7.1	<0.50	<0.50	0.76	16	1.04	7.67	
3/20/2009	P		37.00	57.00	38.78	0.00	456.57	200	3.9	<1.0	<1.0	<1.0	56	0.41	7.51	
6/2/2009	P		37.00	57.00	43.98	0.00	451.37	110	5.1	<1.0	<1.0	<1.0	44	1.87	7.42	
9/2/2009	P		37.00	57.00	50.25	0.00	445.10	88	0.79	<0.50	<0.50	<0.50	12	1.55	6.91	
11/9/2009	P		37.00	57.00	43.79	0.00	451.56	58	2.0	<0.50	<0.50	<0.50	13	0.86	7.14	
5/20/2010	P		37.00	57.00	32.07	0.00	463.28	<50	<0.50	<0.50	<0.50	<0.50	27	0.61	6.8	
11/2/2010	P		37.00	57.00	39.23	0.00	456.12	<50	<0.50	<0.50	<0.50	<0.50	57	1.34	6.8	
5/25/2011	P		37.00	57.00	28.19	0.00	467.16	<50	<0.50	<0.50	<0.50	<0.50	15	3.74	7.1	
10/25/2011	P		37.00	57.00	33.33	0.00	462.02	<50	<0.50	<0.50	<0.50	<0.50	5.7	1.28	7.8	
4/10/2012	P		37.00	57.00	39.25	0.00	456.10	<50	<0.50	<0.50	<0.50	<0.50	1.1	1.04	7.13	
MW-3																
12/29/2008	P	496.32	37.00	57.00	48.21	0.00	448.11	28,000	310	200	840	6,200	71	1.95	7.39	
3/20/2009	P		37.00	57.00	38.48	0.00	457.84	11,000	360	84	600	1,500	71	0.56	7.25	
6/2/2009	P		37.00	57.00	43.33	0.00	452.99	5,100	310	14	180	310	66	2.06	7.18	a
9/2/2009	P		37.00	57.00	49.60	0.00	446.72	25,000	380	150	930	2,900	75	1.35	6.93	
11/9/2009	P		37.00	57.00	43.25	0.00	453.07	6,900	390	27	480	680	69	0.54	6.9	
5/20/2010	P		37.00	57.00	31.56	0.00	464.76	9,400	690	<10	300	83	77	0.36	6.8	
11/2/2010	P		37.00	57.00	38.68	0.00	457.64	4,400	420	<10	110	33	70	0.59	6.8	b (GRO)

Table 1. Summary of Groundwater Monitoring Data: Relative Water Elevations and Laboratory Analyses
ARCO Service Station #498, 286 South Livermore Avenue, Livermore, CA

Well ID and Date Monitored	P/NP	TOC (feet)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	DTW (feet)	Product Thickness (feet)	Water Level Elevation (feet)	Concentrations in µg/L						DO (mg/L)	pH	Footnote
								GRO/TPHg	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	MTBE			
MW-3 Cont.																
5/25/2011	P	496.32	37.00	57.00	27.56	0.00	468.76	4,500	560	<10	210	22	74	0.70	9.8	lw (GRO)
10/25/2011	P		37.00	57.00	32.77	0.00	463.55	2,700	190	<4.0	82	51	33	0.69	7.6	
4/10/2012	P		37.00	57.00	38.69	0.00	457.63	3,000	440	<4.0	69	10	46	0.28	6.57	lw (GRO)
MW-4																
12/29/2008	--	496.01	20.00	40.00	--	--	--	--	--	--	--	--	--	--	--	Dry
3/20/2009	P		20.00	40.00	37.82	0.00	458.19	410	0.78	<0.50	<0.50	0.64	16	0.52	7.16	
6/2/2009	--		20.00	40.00	--	--	--	--	--	--	--	--	--	--	--	Dry
9/2/2009	--		20.00	40.00	--	--	--	--	--	--	--	--	--	--	--	Dry
11/9/2009	--		20.00	40.00	--	--	--	--	--	--	--	--	--	--	--	Dry
5/20/2010	P		20.00	40.00	31.29	0.00	464.72	290	<2.0	<2.0	<2.0	<2.0	10	0.82	6.6	
11/2/2010	NP		20.00	40.00	38.42	0.00	457.59	51	<2.0	<2.0	<2.0	<2.0	5.1	1.12	6.4	b (GRO), c
5/25/2011	P		20.00	40.00	27.58	0.00	468.43	94	<1.0	<1.0	<1.0	<1.0	6.2	0.86	6.9	lw (GRO)
10/25/2011	P		20.00	40.00	32.51	0.00	463.50	73	<0.50	<0.50	<0.50	<0.50	4.3	0.49	7.4	lw (GRO)
4/10/2012	--		20.00	40.00	38.47	0.00	457.54	<50	<0.50	<0.50	<0.50	<0.50	0.85	--	7.06	

Symbols & Abbreviations:

-- = Not sampled/analyzed/applicable/measured/ available
< = Not detected at or above specified laboratory reporting limit
DO = Dissolved oxygen
DTW = Depth to water in ft bgs
ft bgs= feet below ground surface
ft MSL= feet above mean sea level
GRO = Gasoline range organics
GWE = Groundwater elevation measured in ft MSL
mg/L = Milligrams per liter
MTBE = Methyl tert-butyl ether
NP = Not purged before sampling
P = Purged before sampling
TOC = Top of casing measured in ft MSL
µg/L = Micrograms per liter

Footnotes:

a = Sample preserved improperly
b = Quantitation of unknown hydrocarbon(s) in sample based on gasoline
c = Hydrocarbon odor
lw = Quantitated against gasoline

Table 2. Summary of Fuel Additives Analytical Data
ARCO Service Station #498, 286 South Livermore Avenue, Livermore, CA

Well ID and Date Monitored	Concentrations in µg/L								Footnote
	Ethanol	TBA	MTBE	DIPE	ETBE	TAME	1,2-DCA	EDB	
MW-1									
12/29/2008	<300	<10	17	<0.50	<0.50	<0.50	<0.50	<0.50	
3/20/2009	<300	25	21	<0.50	<0.50	<0.50	<0.50	<0.50	
6/2/2009	<300	28	32	<0.50	<0.50	<0.50	<0.50	<0.50	
9/2/2009	<300	17	5.3	<0.50	<0.50	<0.50	<0.50	<0.50	
11/9/2009	<300	47	140	<0.50	<0.50	3.1	<0.50	<0.50	
5/20/2010	<300	75	22	<0.50	<0.50	<0.50	<0.50	<0.50	
11/2/2010	<300	50	39	<0.50	<0.50	<0.50	<0.50	<0.50	
5/25/2011	<300	32	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	
10/25/2011	<300	78	21	<0.50	<0.50	0.72	<0.50	<0.50	
4/10/2012	<300	49	5.0	<0.50	<0.50	<0.50	<0.50	<0.50	
MW-2									
12/29/2008	<300	22	16	<0.50	<0.50	<0.50	<0.50	<0.50	
3/20/2009	<600	62	56	<1.0	<1.0	<1.0	<1.0	<1.0	
6/2/2009	<600	83	44	<1.0	<1.0	<1.0	<1.0	<1.0	
9/2/2009	<300	37	12	<0.50	<0.50	<0.50	<0.50	<0.50	
11/9/2009	<300	41	13	<0.50	<0.50	<0.50	<0.50	<0.50	
5/20/2010	<300	22	27	<0.50	<0.50	<0.50	<0.50	<0.50	
11/2/2010	<300	26	57	<0.50	<0.50	<0.50	<0.50	<0.50	
5/25/2011	<300	<10	15	<0.50	<0.50	<0.50	<0.50	<0.50	
10/25/2011	<300	<10	5.7	<0.50	<0.50	<0.50	<0.50	<0.50	
4/10/2012	<300	<10	1.1	<0.50	<0.50	<0.50	<0.50	<0.50	
MW-3									
12/29/2008	<30,000	<1,000	71	<50	<50	<50	<50	<50	
3/20/2009	<7,500	<250	71	<12	<12	<12	<12	<12	
6/2/2009	<3,000	100	66	<5.0	<5.0	<5.0	<5.0	<5.0	
9/2/2009	<7,500	<250	75	<12	<12	<12	<12	<12	
11/9/2009	<3,000	<100	69	<5.0	<5.0	<5.0	<5.0	<5.0	
5/20/2010	<6,000	<200	77	<10	<10	<10	<10	<10	
11/2/2010	<6,000	<200	70	<10	<10	<10	<10	<10	
5/25/2011	<6000	<200	74	<10	<10	<10	<10	<10	

Table 2. Summary of Fuel Additives Analytical Data
ARCO Service Station #498, 286 South Livermore Avenue, Livermore, CA

Well ID and Date Monitored	Concentrations in µg/L								Footnote
	Ethanol	TBA	MTBE	DIPE	ETBE	TAME	1,2-DCA	EDB	
MW-3 Cont.									
10/25/2011	<2,400	<80	33	<4.0	<4.0	<4.0	<4.0	<4.0	
4/10/2012	<2,400	<80	46	<4.0	<4.0	<4.0	<4.0	<4.0	
MW-4									
3/20/2009	<300	2,000	16	<0.50	<0.50	<0.50	<0.50	<0.50	
5/20/2010	<1,200	1,000	10	<2.0	<2.0	<2.0	<2.0	<2.0	
11/2/2010	<1,200	500	5.1	<2.0	<2.0	<2.0	<2.0	<2.0	
5/25/2011	<600	230	6.2	<1.0	<1.0	<1.0	<1.0	<1.0	
10/25/2011	<300	150	4.3	<0.50	<0.50	<0.50	<0.50	<0.50	
4/10/2012	<300	<10	0.85	<0.50	<0.50	<0.50	<0.50	<0.50	

Symbols & Abbreviations:

--/-- = Not sampled/analyzed/applicable/measured/available
< = Not detected at or above specified laboratory reporting limit
1,2-DCA = 1,2-Dichloroethane
DIPE = Diisopropyl ether
EDB= 1,2-Dibromoethane
ETBE = Ethyl tert-butyl ether
MTBE = Methyl tert-butyl ether
TAME = tert-Amyl methyl ether
TBA = tert-Butyl alcohol
µg/L = Micrograms per liter

Table 3. Historical Groundwater Gradient - Direction and Magnitude
ARCO Service Station #498, 286 South Livermore Avenue, Livermore, CA

Date Measured	Approximate Gradient Direction	Approximate Gradient Magnitude (ft/ft)
12/29/2008	NA	NA
3/20/2009	North-Northwest	0.02
6/2/2009	NA	NA
9/2/2009	NA	NA
11/9/2009	NA	NA
5/20/2010	West-Northwest	0.02
11/2/2010	West-Northwest	0.02
5/25/2011	West-Northwest	0.02
10/25/2011	West-Northwest	0.02
4/10/2012	West-Northwest	0.01

Symbols & Abbreviations:
 NA = Not Available