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By Alameda County Environmental Health 2:01 pm, May 08, 2017

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May 8, 2017

Kit Soo
Senior Hazardous Materials Specialist
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

RE: Monitoring Well Network Analysis and
Work Plan for Data Gap Investigation
1619 1st Street, Livermore, California
Tesoro No. 67076 (Former Beacon 3604); ACEH Case No. RO0434

Dear Ms. Soo:

Enclosed please find a copy of the ***Monitoring Well Network Analysis and Work Plan for Data Gap Investigation*** for the subject site, dated 8 May 2017. This report is submitted by Arctos Environmental at the request of Tesoro Environmental Resources Company. As requested by Alameda County Environmental Health, a meeting will be scheduled following the investigation to discuss results of the investigation and provide a graphical presentation of the dissolved plume stability analysis.

Based on my inquiry of the person or persons directly responsible for gathering the information contained in this report, I believe the information was prepared by qualified personnel who properly gathered and evaluated the information, and that the information submitted is, to the best of my knowledge and belief, true, correct, and complete. Please feel free to call me at 253/896-8700 or Scott Stromberg of Arctos Environmental at 510/525-2180 with questions.

Sincerely,

Kyle Waldron
Environmental Remediation Administrator

Attachments

CC: Scott Stromberg, Arctos

ARCTOS

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8 May 2017
Project No. 01LV

Kit Soo
Senior Hazardous Materials Specialist
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
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Subject: **Monitoring Well Network Analysis and Work Plan for Data Gap Investigation**
1619 1st Street, Livermore, California
Tesoro No. 67076 (Former Beacon 3604); ACEH Case No. RO0434

Dear Ms. Soo:

Arctos Environmental (Arctos), at the request of Tesoro Environmental Resources Company (Tesoro), is submitting this report containing (1) an analysis of the monitoring well network and (2) a work plan to assess data gaps identified at the subject site (Figure 1).

Executive Summary

An analysis of the groundwater monitoring well network was conducted to confirm if the existing network is effectively monitoring contaminants of concern (COCs). Wells were installed at the site with varying screen intervals to monitor two historical release sources of COCs to the subsurface that occurred during periods of varying groundwater elevations. Overall, wells were screened based on field and laboratory data and effectively monitor the highest-impacted depths.

COC concentration magnitudes and trends have been historically monitored at groundwater wells in the offsite, downgradient areas of the plume. However, as stated in the December 2016 Remedial Action Plan (RAP), dissolved-phase concentrations of benzene may not be delineated to maximum contaminant levels (MCLs) in the downgradient plume. To address this data gap, Arctos is proposing to advance cone penetration testing (CPT) and grab groundwater sample boring pairs along a transect at the northern extent of the plume to better delineate the downgradient extent of the petroleum hydrocarbon plume (Figure 2).

Residual, submerged light non-aqueous phase liquid (LNAPL) may exist in the vicinity of the former underground storage tanks (USTs). Its presence or potential mobility has not been fully investigated. Arctos is proposing to advance up to two CPT and Ultra Violent Optical Screening Tool (UVOST) borings to assess whether submerged LNAPL is present. If present, Arctos will advance an additional boring using a hollow-stem auger (HSA) drill rig to collect soil samples for laboratory testing of LNAPL saturation and potential mobility.

Background and Purpose

The remedial objectives in Arctos's 2008 Interim Remedial Action Plan included (1) additional groundwater assessment to investigate deep groundwater quality, and (2) remediation of hydrocarbon-impacted groundwater and vadose soil near the former source areas (Arctos, 2008). Following completion of the deep groundwater investigation and pilot test studies of multiple remedial technologies, Arctos submitted a RAP to Alameda County Environmental Health (ACEH) in December 2016 (Arctos, 2016).

In the RAP and during a February 2017 meeting with ACEH, the following data gaps were identified that may impact remedial decisions:

1. The downgradient lateral extent of the benzene plume has not been fully delineated.

2. There is potential that submerged LNAPL is present in the vicinity of the former USTs based on measurable LNAPL detected at injection well IP-8 in 2010.

3. ACEH requested an analysis of the monitoring well network to confirm if the existing network is effectively monitoring COCs.

This work plan describes proposed activities to assess the data gaps identified above.

A complete site description and background were included in the RAP (Arctos, 2016).

Monitoring Well Network Analysis

Effectiveness of Monitoring Well Network
As discussed in the RAP, historical investigations on and off site have identified two historical releases of petroleum hydrocarbons to the subsurface. One historical source is the former dispensers, which were located in the northern portion of the site and replaced in 1992 and 2013. This release, characterized historically by higher oxygenate concentrations, likely occurred during periods of high water levels and, therefore, is shallower. The original network of monitoring wells was installed beginning in 1993 and focused on monitoring these shallow impacts (in general approximately 30 to 50 feet

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below ground surface [bgs]). Shallow impacts are bounded laterally by source area wells MW-1, MW-3, MW-7, and TP-2, and downgradient by wells MW-8, MW-9, and MW-10.

The second historical source is the former USTs, located in the southwest corner of the site and replaced in 1992. This release, characterized by higher total petroleum hydrocarbons as gasoline (TPHg) concentrations, likely occurred during periods of low groundwater levels and, therefore, is deeper. Subsequent increases in water levels submerged the impacts associated with the former USTs, and changes in water levels potentially smeared impacts. Deep investigation borings and monitoring wells were installed beginning in 2006 to monitor these deep impacts (in general approximately 50 to 65 feet bgs). Deep impacts are bounded laterally by wells DW-1, IP-9, and IP-10, and downgradient by wells DW-3, DW-4, and DW-6.

Historical soil impacts correlate with historical minimum and maximum groundwater elevations; shallow impacts correspond to near-historical high water levels and deep impacts correspond to near-historical low water levels. The existing monitoring well network consists of wells with shallow and deep screen intervals to monitor these respective impacts. Although well screen intervals vary across the plume, the wells were screened based on field and laboratory data and effectively monitor the highest-impacted depths. Cross sections showing well locations relative to historical soil impacts are shown on Figures 3A through 3C. The soil impacts shown on these cross sections are based on laboratory TPHg soil sampling results or photoionization detector (PID) readings at the time of well installation, and represent historical COC distribution and not the current distribution. Based on subsequent investigation and monitoring, the highest remaining dissolved-phase petroleum hydrocarbon concentrations are associated with the deeper release. Shallow groundwater impacts have been significantly reduced through soil vapor extraction (SVE) remediation during periods of low water levels and enhanced bioremediation.

Dissolved-phase benzene concentrations are also shown on cross sections A-A′ through C-C′. For deep groundwater monitoring wells, benzene results from the most recent period of relatively high groundwater elevations (November 2016) and results from the recent period of historically low groundwater elevations (November 2015) are shown. Most shallow monitoring wells were dry during November 2015 and samples were not collected. In general, deep monitoring well screens were partially-submerged during November 2015.

Overall, benzene concentrations did not change significantly at deep monitoring wells between periods of low and high groundwater elevations. Benzene concentrations at well DW-8 were 2,010 micrograms per liter (µg/l) in November 2015 and 2,000 µg/l in November 2016. Concentrations at offsite wells DW-2 and DW-7 increased during the higher groundwater level period, though remained relatively low (77 and 260 µg/l, respectively). This indicates that submerged well screens at deep monitoring wells during periods of high groundwater elevations remain effective at monitoring the petroleum hydrocarbon plume.

Hydraulic Gradients

Cross sections A-A′ through C-C′ show November 2016, historical minimum, and historical maximum groundwater elevations (Figures 3A through 3C). Despite fluctuations in groundwater elevations, the horizontal gradient has overall remained consistent (Figure 3A).

Arctos analyzed historical groundwater elevation data at three locations with existing adjacent shallow and deep wells to assess whether vertical gradients exist. Lithologic sampling has not shown any laterally expansive fine-grained units between the shallow and deep well screen intervals to suggest the shallow and deep wells are screened in separate water-bearing zones. The following table summarizes vertical gradient data:

Well Cluster	**Average Vertical Gradient[a] (foot/foot)**	**Minimum Vertical Gradient (foot/foot)**	**Maximum Vertical Gradient (foot/foot)**
MW-2 and DW-1	0.16	-1.0	1.4
MW-9 and DW-3	0.41	-0.030	0.72
MW-12 and DW-9	-0.13	-0.42	-0.040
Total	0.20	-1.0	1.4

(a) Vertical gradient calculated by dividing hydraulic head between wells by vertical separation of well screened intervals.

The low magnitude and variability in average vertical gradient at different locations along the plume, along with lithologic observations, indicate that the shallow and deep wells are screened within a continuous water-bearing zone. As stated above, the network consists of shallow and deep wells to monitor COCs that were released to the subsurface during periods of varying groundwater elevations.

Submerged Well Screens

As requested by ACEH, groundwater monitoring data that is presented in semiannual regulatory status update reports will tabulate (1) the percentage of each monitoring well screen that is saturated based on groundwater elevations during the reporting period, and (2) the overall percentage of historical monitoring events during which each well screen was completely submerged. These data were included in the most recent monitoring report submitted to ACEH and will continue to be included in future reports (Arctos, 2017). In general, shallow monitoring wells have historically been submerged during 0 to 50 percent of monitoring events and deep monitoring wells have historically been submerged during 80 to 90 percent of monitoring events.

As stated above and shown on Figures 3A through 3C, hydrocarbon concentrations at deep monitoring wells were not significantly different during periods of partially-penetrating or submerged well screen conditions.

Conceptual Site Model and Data Gaps

Data collected during historical investigation and remedial pilot studies provided the basis for the conceptual site model (CSM) presented in the RAP. Additional data collection proposed in this work plan will focus on addressing the following data gaps identified in the CSM.

Downgradient Plume Delineation

The downgradient toe of the plume has not been delineated to MCLs. To address this data gap, depth-discrete grab groundwater samples will be collected at borings advanced in a transect along the downgradient extent of the plume.

LNAPL Presence and Mobility

The highest remaining dissolved-phase impacts are located in the vicinity of the former USTs from approximately 55 to 70 feet bgs. Depth to water at the site has historically ranged from approximately 15 to 60 feet bgs, with an average of approximately 35 feet bgs. This indicates that the highest impacts are, on average, submerged approximately 20 feet below the water table (Arctos, 2016).

After start up of oxygen injection activities in October 2010, approximately 1-foot of LNAPL was measured and bailed from injection well IP-8 located near the former USTs and screened from 60 to 65 feet bgs. Measureable LNAPL was not detected at well IP-8 after the initial LNAPL was bailed, indicating that residual submerged LNAPL was temporarily mobilized as a result of oxygen injection startup. Dissolved-phase concentrations at well IP-8 have decreased over 98 percent through remedial activities and TPHg was detected at 1,430 µg/l in 2016. This indicates that submerged LNAPL is no longer present in the vicinity of well IP-8 and is not acting as a secondary source to groundwater impacts on site.

Subsequent investigation activities delineated the highest impacts downgradient of well IP-8, and well DW-8 was installed with a screen interval corresponding to (1) the highest impacts encountered (55 to 65 feet bgs) and (2) the interval at which LNAPL was identified at well IP-8. Well DW-8 is located approximately 20 feet west of injection well IP-8 (Figure 2). Elevated petroleum hydrocarbon concentrations remain at well DW-8, although decreasing trends are observed. During November 2015, water levels decreased below the top of the screened interval of well DW-8. LNAPL has not been detected at well DW-8, including during November 2015 when the screened interval was partially-penetrating groundwater.

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There is potential that submerged, residual LNAPL is present near well DW-8, but based on the lack of LNAPL detected at the well when the screen was not fully submerged, any potential residual LNAPL is likely not mobile. Proposed investigation activities described below will assess whether submerged LNAPL is present near well DW-8, and if so, assess its potential mobility.

Objective and Scope of Work

The objectives of the planned activities are to assess (1) the downgradient lateral extent of the plume, and (2) the potential presence or mobility of LNAPL in the vicinity of the former USTs. To meet these objectives, Arctos will perform the following scope of work:

- ☐ Obtain approval of this work plan from ACEH
- ☐ Mobilize for field activities including (1) marking for Underground Service Alert, (2) obtaining well permits from Zone 7 Water Agency, (3) obtaining an encroachment permit from the City of Livermore, and (4) updating the site-specific Health and Safety Plan
- ☐ Air-knife boring locations to a depth of 5 feet below grade
- ☐ Advance up to two borings in the vicinity of well DW-8 using a direct-push drill rig equipped to measure CPT and UVOST response
- ☐ If necessary, advance an additional boring adjacent to DW-8 using a HSA drill rig and collect at least one soil sample at the depth of the highest UVOST response for laboratory analysis of LNAPL saturation and potential mobility
- ☐ Advance up to five CPT borings in the downgradient area of the plume and attempt to collect grab groundwater samples based on lithology logged by CPT
- ☐ Submit groundwater samples to a State-certified laboratory for analysis of TPHg, benzene, toluene, ethylbenzene, xylenes, methyl tert-butyl ether, tert-butyl alcohol, and other oxygenates using U.S. Environmental Protection Agency Method 8260B
- ☐ Evaluate UVOST and grab groundwater sampling data and incorporate the results into an investigation report.

LNAPL Presence and Mobility
CPT/UVOST borings will be attempted adjacent to well DW-8 in P Street (designated as UVOST-1 and UVOST-2 on Figure 4). CPT/UVOST borings will be advanced to the depth

at which refusal is met with a minimum depth of 70 feet bgs. Two CPT/UVOST borings will be attempted, although gravelly soils in the vicinity of DW-8 may limit the investigation to one CPT/UVOST boring.

UVOST technology was selected for this assessment because it provides a vertical profile of residual LNAPL. If residual submerged LNAPL is identified in the vicinity of well DW-8, an additional boring will be advanced using a HSA rig to collect at least one soil sample at the depth correlating to the highest UVOST response. The sample(s) will be sent to PTS Laboratories of Santa Fe Springs, California, for LNAPL saturation and mobility testing. These data will be used to assess the potential presence of LNAPL that may be a continuing secondary source of impacts to the dissolved-phase plume.

Downgradient Plume Delineation
CPT borings will be advanced in approximately 60-foot spacing along a transect at the northernmost accessible extent of the Safeway parking lot, located downgradient of the site (designated as DB-11 through DB-15 on Figure 4). CPT borings will be advanced to the depth at which refusal is met. Based on previous CPT investigations in this area, the boring depths will likely terminate between 90 and 120 feet bgs (Arctos, 2012).

Based on lithology logged by CPT, a second adjacent soil boring will be advanced at each location to attempt grab groundwater samples. Grab groundwater samples will be collected using a 5-foot-long discrete sampler within the shallow saturated interval (approximately 40 to 45 feet bgs) and the deep interval (approximately 55 to 60 feet bgs). Historical monitoring off site has indicated that the highest impacts are located in the deep interval (approximately 50 to 60 feet bgs; Arctos, 2016).

Field Procedures and Reporting

Details of Arctos's field procedures for the proposed field program are described in Attachment A. Arctos will evaluate the field and analytical data and incorporate the results into an investigation report. The report will include the following:

- ☐ Field activities and sampling procedures including boring logs, sampling logs, and a figure showing the boring locations
- ☐ Laboratory analytical results presented in tables.

Schedule

Arctos is requesting approval to conduct the investigation during the second quarter 2017. As requested by ACEH, a meeting will be scheduled following the investigation to discuss results. In addition, plume stability analyses will be evaluated using the Ricker Method to evaluate the contaminant plumes using a variety of metrics including plume area, plume mass, center of mass, and plume spread. The results will be presented in a visual

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presentation to ACEH as part of the meeting to discuss the field investigation results. The final investigation report will be submitted within 90 days of receiving final laboratory results.

If you have questions or comments, please call Mike Purchase or Scott Stromberg at 510/525-2180.

Very truly yours,

ARCTOS ENVIRONMENTAL

REGISTERED PROFESSIONAL ENGINEER
MICHAEL PAUL PURCHASE
C71230
CIVIL
STATE OF CALIFORNIA

Scott Stromberg, P.G.
Project Geologist

Michael P. Purchase, P.E.
Principal Engineer

Copy: Kyle Waldron – Tesoro Companies, Inc.
Colleen Winey – Zone 7 Water Agency

Attachments: Figure 1 – Site Location Map
Figure 2 – 4Q16 TPHg Concentration Contours with Cross Section Lines
Figure 3A – Cross Section A-A′ with Historical Soil Impacts
Figure 3B – Cross Section B-B′ with Historical Soil Impacts
Figure 3C – Cross Section C-C′ with Historical Soil Impacts
Figure 4 – Benzene Concentration Contours with Proposed Boring Locations
Attachment A –Quality Assurance/Quality Control (QA/QC) Procedures

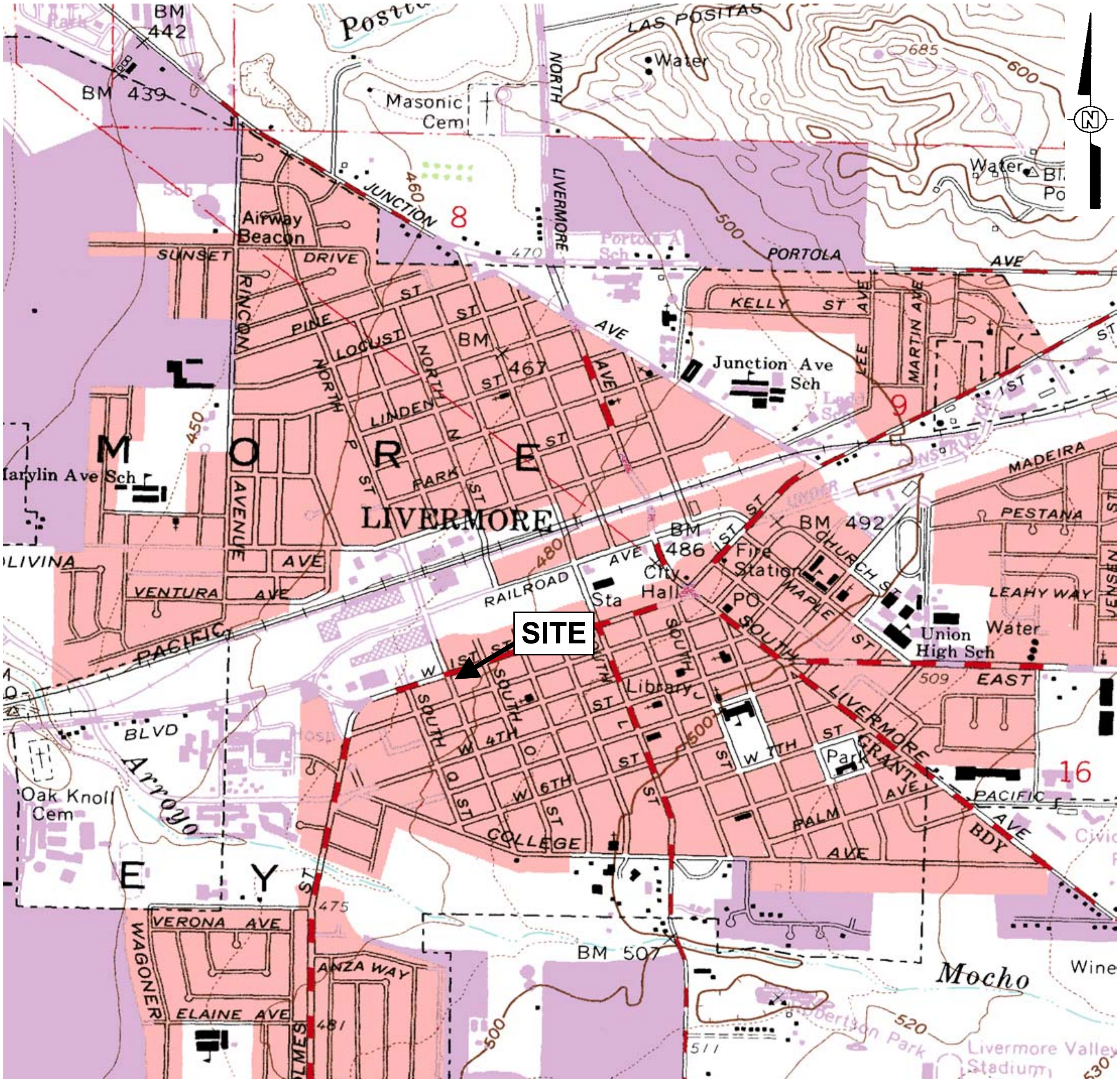
References

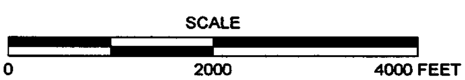
Arctos Environmental, 2008. "Interim Remedial Action Plan for Groundwater, 1619 1st Street, Livermore, California, Tesoro No. 67076 (Former Beacon 3604), ACEH Case No. RO0000434," 21 March.

Arctos Environmental, 2012. "Second Quarter 2012 Status Report, 1619 1st Street, Livermore, California, Tesoro No. 67076 (Former Beacon 3604); ACEH Case No. RO04343," 15 August.

Arctos Environmental, 2016. "Remedial Action Plan, Tesoro Site No. 67076 (Former Beacon 3604), 1619 1st Street, Livermore, California," 4 December.

Arctos Environmental, 2017. "Third and Fourth Quarters 2016 Semiannual Status Report, 1619 1st Street, Livermore, California, Tesoro No. 67076 (Former Beacon 3604); ACEH Case No. RO04343," 3 March.

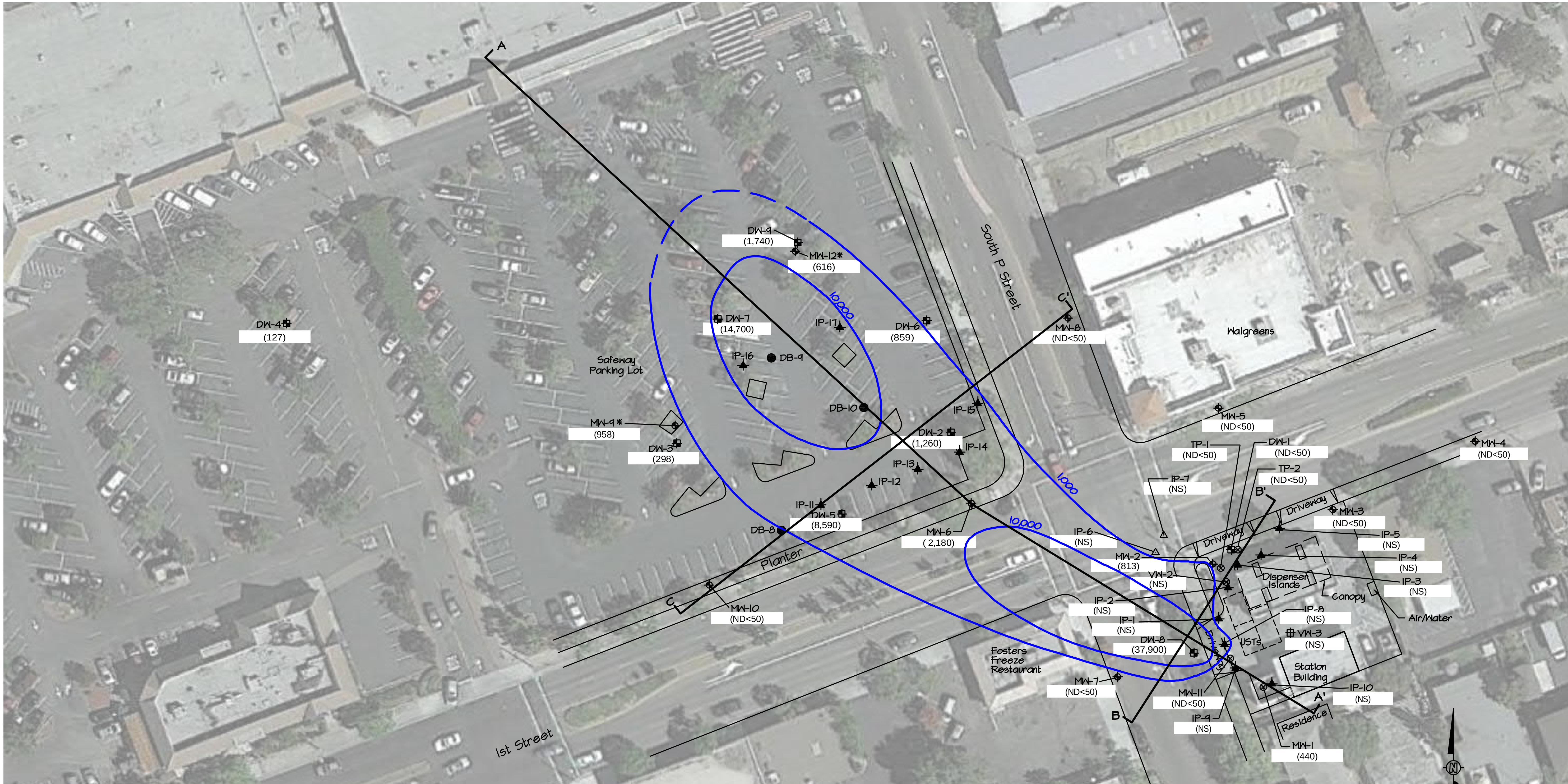




REFERENCE

7.5 MINUTE USGS TOPOGRAPHIC MAP OF LIVERMORE, CALIFORNIA QUADRANGLE
DATE: 1961, PHOTOREVISED 1980
SCALE = 1:24,000

ARCTOS ENVIRONMENTAL			
TESORO - LIVERMORE			
SITE LOCATION MAP			
PROJECT NO. 01LV	DRAWN BY MP	CHECKED BY MP	APPROVED BY JG
FILE NO. Site Map.xls		FIGURE 1	



Legend

MW-7	Groundwater Monitoring Well	(ND<50)	Fourth Quarter 2016 Total Petroleum Hydrocarbons as Gasoline (TPHg) Results in µg/L
DW-1	Deep Groundwater Monitoring Well	1,000	TPHg Concentration Contour (µg/L), Dashed Where Uncertain
IP-1	Injection Well	ND	Not Detected at Laboratory Reporting Limit
IP-6	Angled Injection Well Screen	NS	Not Sampled
VW-3	Vapor Extraction Well	DB-8	June 2012 Soil Boring
TP-1	Monitoring Well/Vapor Extraction Well	*	Shallow Well Data Not Used for Contours
		A A'	Cross Section Line

0 30' 60'
SCALE

REVISION	NO.	BY	DATE	DESCRIPTION
0	0	MY	3/2/17	Well Network Analysis

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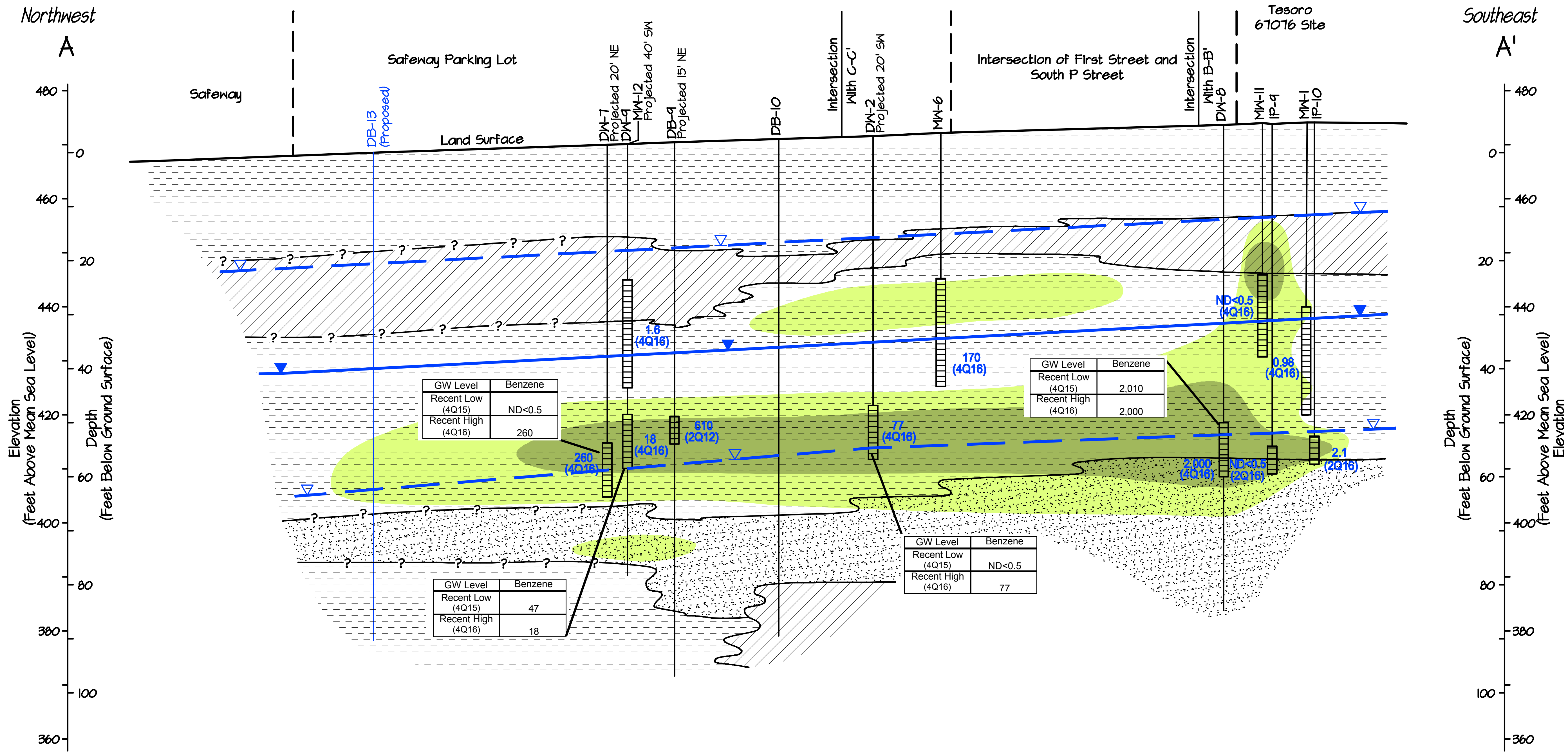
4Q16 TPHg CONCENTRATION CONTOURS WITH CROSS SECTION LINES

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	SS	MP

FILE NO. 01LV11B-21000.DWG

FIGURE 2

3/10/2017 1:47PM 01LV11B-21000.dwg



LEGEND

MW-1 Well or Boring Identification

Screened Interval

DB-13 Proposed Boring

▼ Water Level Elevation November 2016

▽ Historical Maximum Water Level Elevation March 1996 or Historical Minimum Water Level Elevation November 2015

SOIL CLASSIFICATION

- Silts and Clays
- Sands and Silty Sands
- Cemented Sands or Silts

HISTORICAL SOIL IMPACTS (1993 TO 2012)

- TPHg > 10 mg/kg or PID > 100 ppm
- TPHg > 100 mg/kg or PID > 1,000 ppm

DISSOLVED-PHASE IMPACTS

260 (4Q16) Benzene Concentration (µg/l) Sample Date

GW Level	Benzene
Recent Low (4Q15)	ND<0.5
Recent High (4Q16)	260

Benzene Concentration (µg/l) During Recent Period of Low Groundwater Elevation (4Q15) and High Groundwater Elevation (4Q16)

0 — 20' Vertical Scale (feet)

0 — 60' Horizontal Scale (feet)

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TESORO LIVERMORE SITE

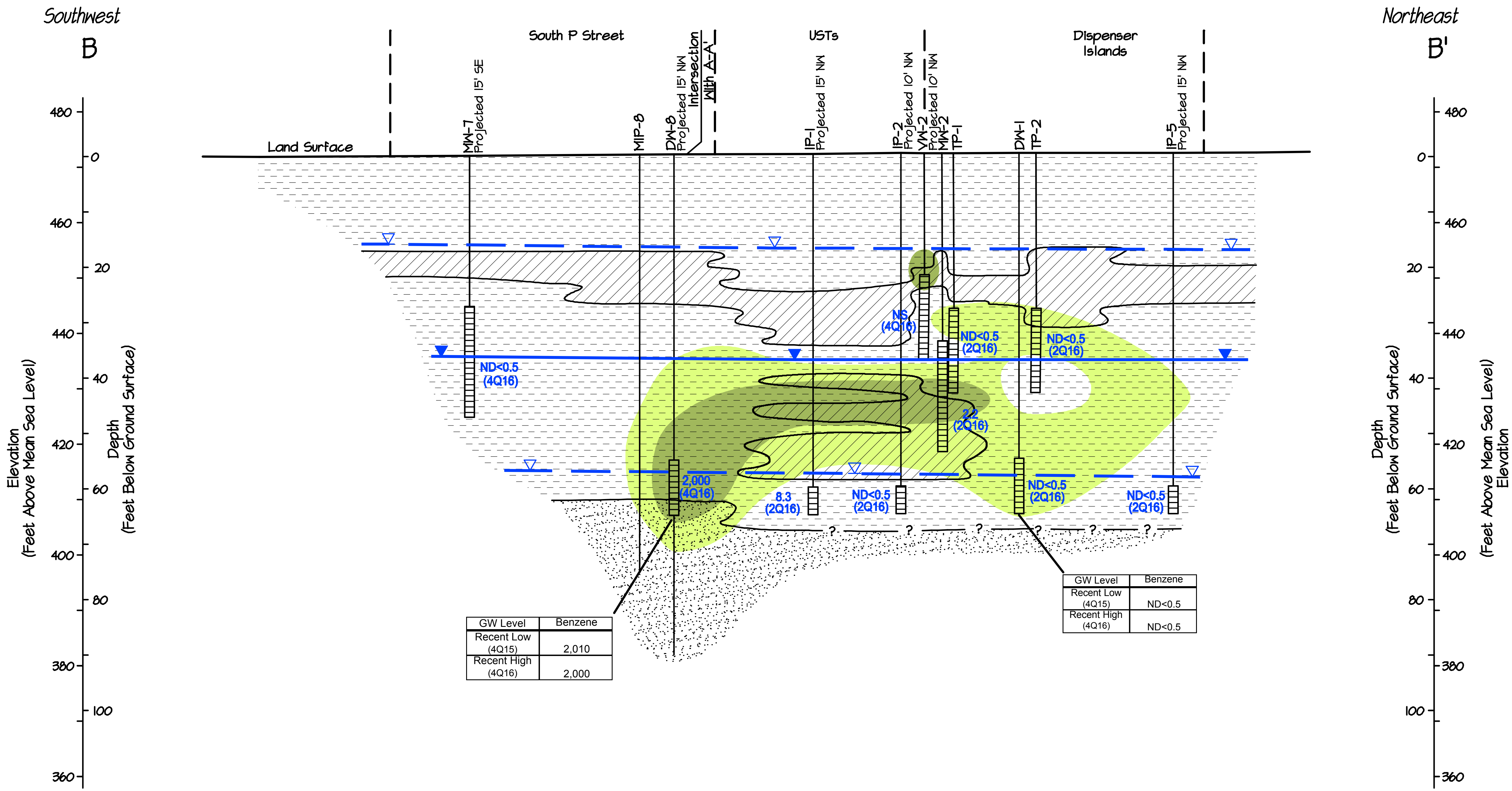
CROSS SECTION A–A' WITH HISTORICAL SOIL IMPACTS

PROJECT 01LV–11B

XS–AA.dwg

FIGURE 3A

May 01, 2017 3:55 pm



GW Level	Benzene
Recent Low (4Q15)	2,010
Recent High (4Q16)	2,000

GW Level	Benzene
Recent Low (4Q15)	ND<0.5
Recent High (4Q16)	ND<0.5

LEGEND

MW-1 Well or Boring Identification

Screened Interval

DB-13 Proposed Boring

▼ Water Level Elevation November 2016

▽ Historical Maximum Water Level Elevation March 1996 or Historical Minimum Water Level Elevation November 2015

SOIL CLASSIFICATION

Silts and Clays

Sands and Silty Sands

Cemented Sands or Silts

Vertical Scale (feet): 0 – 20'

Horizontal Scale (feet): 0 – 20'

HISTORICAL SOIL IMPACTS (1993 TO 2012)

TPHg > 10 mg/kg or PID > 100 ppm

TPHg > 100 mg/kg or PID > 1,000 ppm

DISSOLVED-PHASE IMPACTS

2,000 Benzene Concentration (µg/l)
(4Q16) Sample Date

GW Level	Benzene
Recent Low (4Q15)	ND<0.5
Recent High (4Q16)	ND<0.5

Benzene Concentration (µg/l) During Recent Period of Low Groundwater Elevation (4Q15) and High Groundwater Elevation (4Q16)

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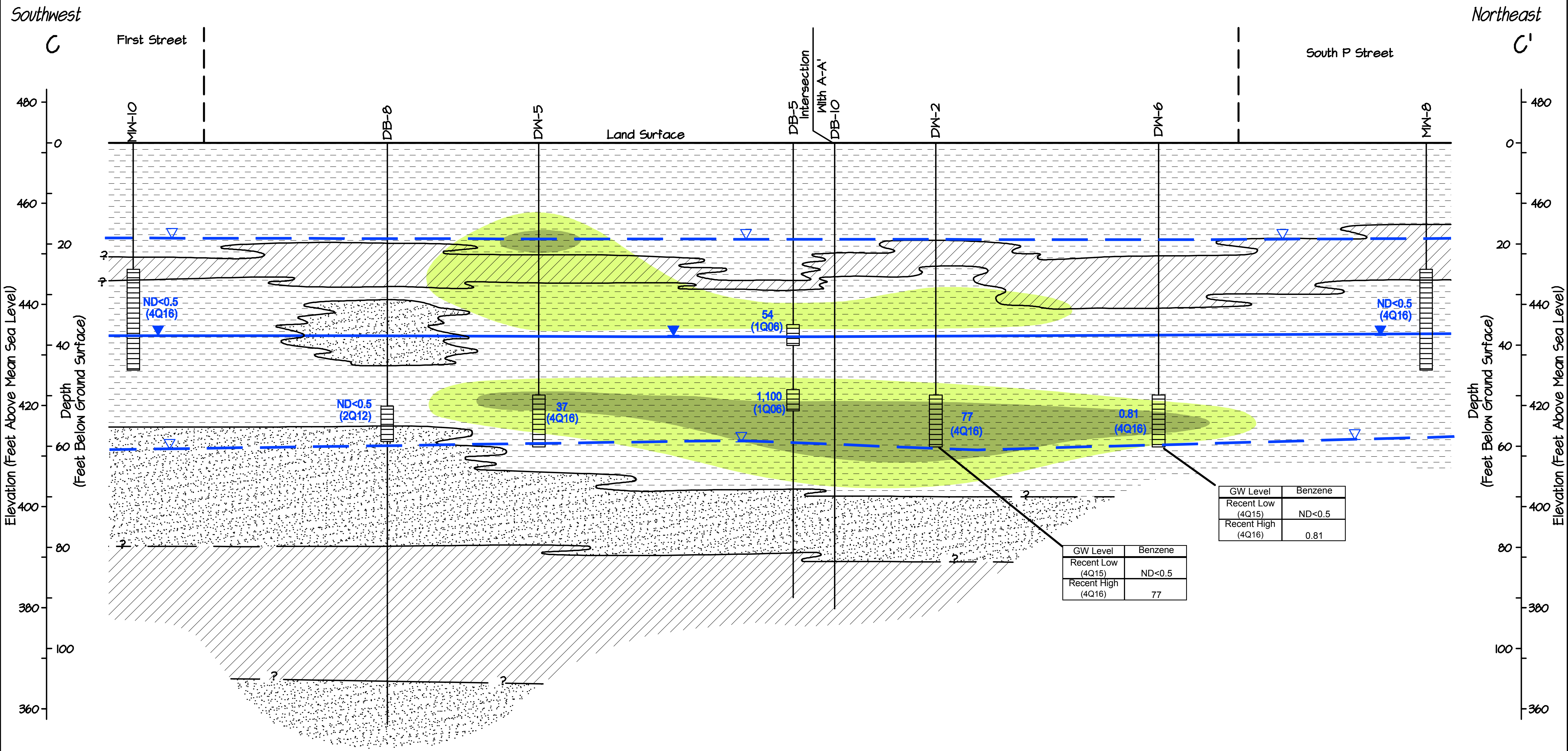
CROSS SECTION B-B' WITH HISTORICAL SOIL IMPACTS

PROJECT 01LV-11B

XS-BB.dwg

FIGURE 3B

May 01, 2017 4:25 pm



LEGEND

MW-1 — Well or Boring Identification

Screened Interval

DB-13 — Proposed Boring

▼ Water Level Elevation November 2016

▽ Historical Maximum Water Level Elevation March 1996 or Historical Minimum Water Level Elevation November 2015

SOIL CLASSIFICATION

Silts and Clays

Sands and Silty Sands

Cemented Sands or Silts

0 — 20' Vertical Scale (feet)

0 — 20' Horizontal Scale (feet)

HISTORICAL SOIL IMPACTS (1993 TO 2012)

TPHg > 10 mg/kg or PID > 100 ppm

TPHg > 100 mg/kg or PID > 1,000 ppm

DISSOLVED-PHASE IMPACTS

37 (4Q16) — Benzene Concentration (µg/l) Sample Date

GW Level	Benzene
Recent Low (4Q15)	ND<0.5
Recent High (4Q16)	77

Benzene Concentration (µg/l) During Recent Period of Low Groundwater Elevation (4Q15) and High Groundwater Elevation (4Q16)

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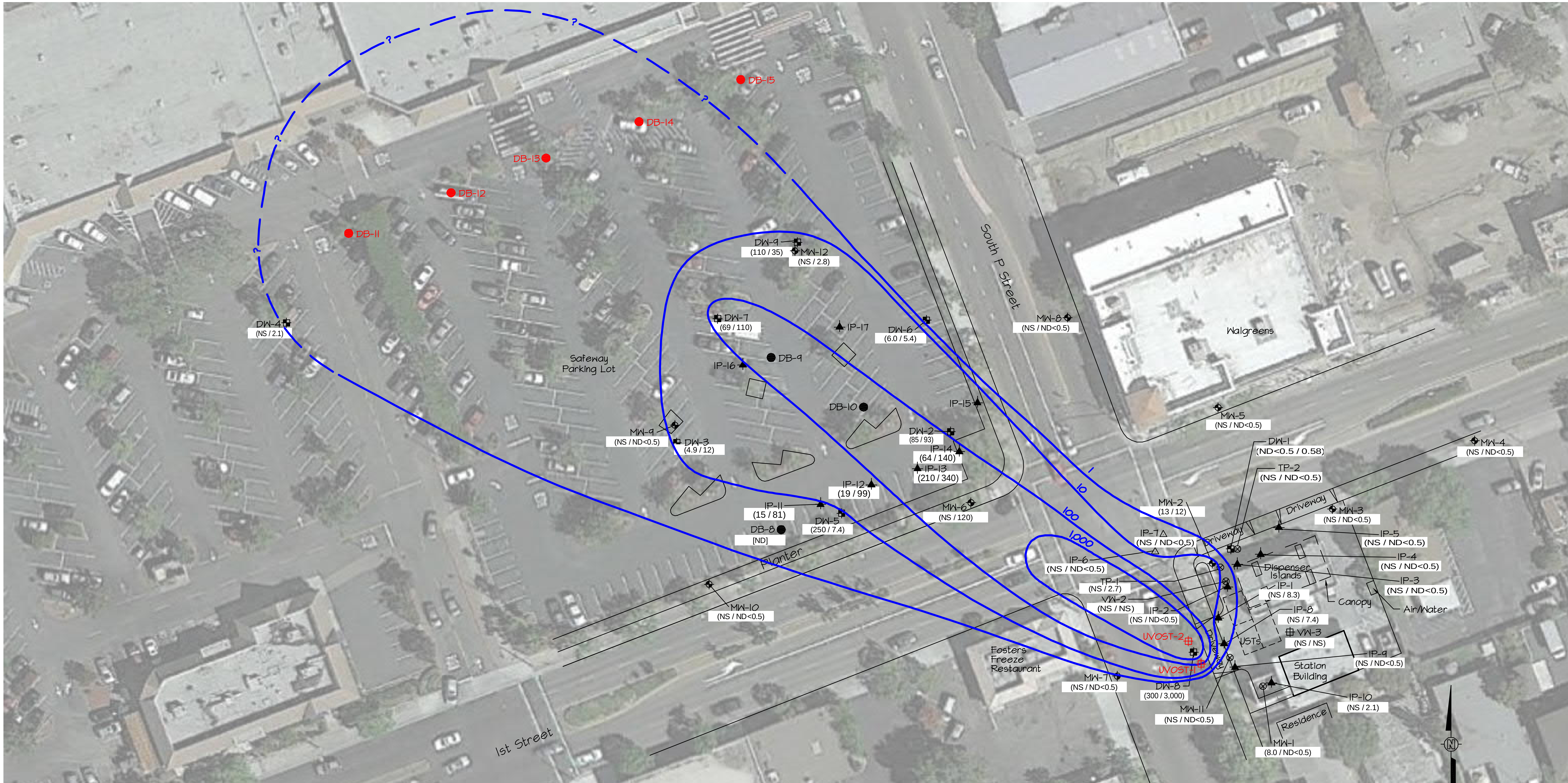
CROSS SECTION C–C' WITH HISTORICAL SOIL IMPACTS

PROJECT 01LV-11B

XS-CC.dwg

FIGURE 3C

May 01, 2017 4:31 pm



Legend

MW-7	Groundwater Monitoring Well
DW-1	Deep Groundwater Monitoring Well
IP-1	Injection Well
IP-6	Angled Injection Well Screen
VW-3	Vapor Extraction Well
TP-1	Monitoring Well/Vapor Extraction Well
(ND<0.5/NS)	1Q16/2Q16 Benzene Results in µg/L
1000	Benzene Concentration Contour (µg/L), Queried Where Uncertain
ND	Not Detected at Laboratory Reporting Limit
NS	Not Sampled
DB-8	June 2012 Soil Boring
*	Well Data Not Used for Contours
DB-11	Proposed CPT/Grab GW Sampling Boring
UVOST-1	Proposed CPT/UVOST Boring

REVISIONS

NO.	BY	DATE	DESCRIPTION
0	MY	12/15/16	Work Plan for Offsite Investigation
1	MY	3/30/17	Work Plan for Offsite Investigation

REVISION 1

ARCTOS ENVIRONMENTAL

TESORO - LIVERMORE

BENZENE CONCENTRATION CONTOURS WITH PROPOSED BORING LOCATIONS

PROJECT NO.	DRAWN BY	CHECKED BY	APPROVED BY
01LV	MY	SS	MP

FILE NO. 01LV11B3301.DWG

FIGURE 4

4/4/2017 4:44PM 01LV11B3301.dwg

ATTACHMENT A

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

ATTACHMENT A
QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

Health and Safety

Arctos will modify the site-specific Health and Safety Plan (HSP) for the field program outlined in this work plan. The HSP presents procedures for personnel and equipment safety, medical surveillance, personal protection, air-quality monitoring, exposure control, emergency response procedures, and general work practices.

Before beginning work at the site, a site safety meeting will be conducted. Field personnel will review the HSP and sign the accompanying acknowledgment form. Field personnel will be required to comply with the HSP throughout performance of site assessment activities.

Based on the site history and potential chemicals of concern, field activities will be initiated in Level D personal protective equipment (PPE). During field activities, the breathing zone of field personnel will be monitored using a field photoionization detector (PID). If breathing zone PID readings indicate elevated levels of organic vapors, PPE will be upgraded accordingly. Breathing zone readings will be recorded on the boring log.

The following sections provide a description of Arctos's proposed drilling, soil sampling, and well installation program.

Utility Locating and Permitting

Before initiating drilling activities, Arctos will mark the well locations and contact Underground Service Alert to clear the area of subsurface lines and utilities. Arctos will also obtain boring and well permits from Zone 7 Water Agency.

Cone Penetration Testing (CPT) Drilling

Soil borings will be advanced using a truck-mounted cone penetration testing (CPT) rig with direct-push technology. The approximately 1.5-inch diameter stainless steel drill rods will be advanced into the subsurface with hydraulic pressure. The drill rods will be equipped with an electronic cone tip.

The electronic cone tip is capable of taking measurements including resistance, sleeve friction, induced pore pressure, pore pressure dissipation, shear wave velocity, soil resistivity, inclination, and temperature, in accordance with American Society for Testing and Materials Standard D5778. CPT measurements are utilized to produce a nearly continuous hydrogeologic log, including interpretation of parameters to classify soil using Soil Behavior Type (SBT).

Borings will be backfilled after reaching total depth with cement/bentonite grout using the rods as a tremie pipe. In paved areas, borings will be capped with concrete to match the surrounding pavement.

Discrete Grab Groundwater Sampling

After completing each CPT boring and identifying potential coarse-grained, saturated intervals, an adjacent boring will be advanced using a Hydropunch-type discrete grab groundwater sampling tool. The sampler consists of an approximately 1.75-inch-diameter, 5-foot-long steel casing. The bottom of the steel sleeve has a cone-shaped tip to facilitate soil penetration. Once the sampler reaches the desired depth, the steel casing is lifted to expose a 1-inch diameter, 5-foot long polyvinyl chloride (PVC) screen with 0.01- or 0.02-inch slots. The PVC screen and drilling rods are then allowed to fill with groundwater from the discrete exposed interval.

Groundwater sampling will be performed with a new disposable PVC or decontaminated stainless steel bailer equipped with a bottom-release device and suspended from new nylon line. Water samples will be collected from the bailer in new 40-milliliter glass bottles provided by the analytical laboratory. Sample vials will be filled completely so that the water forms a convex meniscus at the top and capped so that no air space or bubbles exist in the vial. The preservatives necessary for the analyses performed will be provided in the glass bottles by the analytical laboratory.

The collected water samples will be placed in sealable plastic bags or polystyrene holders, and packed on ice in a portable ice chest immediately after collection. Samples will be delivered within 24 hours to the analytical laboratory. Additional QA/QC procedures, including the use of sample identification labels and chain-of-custody forms, will be followed to track sample collection and delivery.

Hollow-Stem Auger Drilling and Sampling

Soil borings will be advanced with 6- to 12-inch-diameter, hollow-stem, continuous-flight augers. Soil samples will be collected using a split-spoon sampler (California-modified or similar) containing three brass tubes, each 2 inches in diameter and 6 inches in length. The sampler will be driven to the sampling depth by dropping a 140-pound hammer approximately 30 inches. Samples will be collected for visual logging at various depth intervals with the objectives of observing and describing the locations of lithologic units and obtaining representative samples for physical and/or chemical analysis. Soil samples are typically collected at the ground surface and at 5-foot intervals.

After the sampler is retrieved from the auger, it will be placed on a portable field stand near the boring and the tubes will be removed. The ends of one of the tubes will be covered with Teflon sheeting, capped with PVC end caps, and placed in a sealable plastic bag. A portion of the soil from one of the tubes will be extruded and placed in a sealable plastic bag, which will be closed and allowed to equilibrate for approximately 10 minutes. The organic vapor levels in the headspace will be measured using a PID or FID.

The same sample will be visually examined and the results of the visual observation and headspace reading will be recorded on the boring logs. Soil samples will be examined for staining or odors. Soils will be classified following the Unified Soil Classification System (USCS). If warranted by PID screening, one of the sealed tubes per sampling run will be placed in a portable ice chest and cooled with ice for delivery to a laboratory for analysis. Standard chain-of-custody procedures will be used during sample handling, transportation, and delivery.

The sealed tubes will be labeled or marked and placed on ice in a cooler. A permanent pen will be used to complete the label or mark directly on the tube. The information recorded will include project identification, sample number (including boring number and sample depth), date, time, and the initials of the person preparing the samples.

The soil samples will be stored on ice in the field and transported in a portable ice chest to the analytical laboratory. The samples will be delivered within 24 to 48 hours after sampling to the laboratory by the sampling crew or a courier.

General Field QA/QC Procedures

Chain-of-Custody Records
Chain-of-custody records will be completed before samples are packaged for shipment. One copy of these records will be placed in the project file. A second copy will accompany samples during transportation to the laboratory. The individual in the analytical laboratory who accepts responsibility for samples will sign and date the chain-of-custody record.

Equipment Decontamination Procedures
Field equipment will be decontaminated between sampling events using the following procedures:

1. Rinse with water using a brush to remove soil and mud.

2. Wash with non-phosphate detergent and water using a brush.

3. Rinse with deionized or distilled water.

4. Rinse again with deionized or distilled water.

5. Air dry.

Additional decontamination procedures are presented below:

1. Personnel will dress in suitable personal protective equipment (PPE) to reduce personal exposure.

2. Equipment that may be damaged by water (such as the battery portion of water level indicator or the pH and conductivity meters) will be carefully wiped clean using a sponge and dried with new paper towels. Care will be taken to prevent damage to the equipment.

3. When conducting a groundwater sampling event, evacuation and sampling equipment will be decontaminated before sampling operations, between each well, and at the end of the sampling event. If dedicated equipment is used, it will be rinsed with deionized water.

4. Detergent waters and rinse waters will be replaced periodically depending on level of contamination. Used detergent and rinse waters will be contained in 55-gallon drums approved by the Department of Transportation (DOT) or holding tanks for storage.

Personal Decontamination Procedures
At a minimum, field personnel will follow the following decontamination procedures:

1. Wear appropriate gloves.

2. Wash hands thoroughly with soap and water.

3. Avoid unnecessary contact with groundwater.

The site health and safety plan will be reviewed for site-specific personal decontamination procedures.

Wastewater and Solid Waste Storage and Disposal
Small volumes of used wash and rinse solutions will be collected during field work and transported to a central decontamination area. This wastewater will be containerized in labeled 55-gallon DOT drums or holding tanks and stored in a secured area at the site. At the completion of field investigation activities or a groundwater sampling event, samples from the 55-gallon drums or holding tanks will be collected and analyzed in accordance with the work or sampling plans. Once the analytical results are obtained, the Project Manager will determine the appropriate disposal method for this wastewater.

Solid wastes such as used personal protective equipment, paper towels, trash bags, and any other solid debris will be collected for disposal.

Field Investigation Documentation Procedures
Field personnel will follow documentation procedures developed for site investigation work. The procedures serve to (1) provide a record of the activities performed in the field and (2) permit identification of samples and tracking of their status in the field, during shipment, and at the laboratory. All documentation will be recorded with waterproof ink.

Groundwater sampling activities will be documented on daily field reports and on the well purge and sample log.

Analytical QA/QC Procedures
Laboratory analytical QA/QC procedures will include (1) preparing and analyzing laboratory samples to assess the performance of the analytical laboratory and (2) conducting data validation in accordance with the protocols described below. QC samples prepared by the laboratory will include method blanks, matrix spike and matrix spike duplicates, and laboratory control samples.

The laboratory results will be reviewed in general accordance with EPA guidelines for data validation. The data validation process included reviewing laboratory results for the following parameters:

- ☐ Completeness of the data package
- ☐ Compliance with EPA-required holding times
- ☐ Agreement of dilution factors with reported detection limits
- ☐ Presence or absence of analytes in the method blanks
- ☐ Agreement of duplicate samples
- ☐ Percent recovery and relative percent difference results for matrix spike and matrix spike duplicate analyses
- ☐ Percent recovery results for laboratory control samples.