



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CALIFORNIA 92132-5190

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Ser OPAE.TM/173
June 25, 2013

Ms. Beatrice Griffey
California Environmental Protection Agency
California Regional Water Quality Control Board
Mitigation & Cleanup Unit
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

Mr. Tayseer Mahmoud
California Environmental Protection Agency
Department of Toxic Substances Control
Brownfields and Environmental Restoration Program
5796 Corporate Avenue
Cypress, CA 90630

Mr. Martin Hausladen
U. S. Environmental Protection Agency
Region IX, Code SFD-8-B
75 Hawthorne Street
San Francisco, CA 94105-3901

SUBJECT: MEETING MINUTES FOR THE 110th FEDERAL FACILITIES
AGREEMENT (FFA) MEETING DATED MAY 16th, 2013, MARINE
CORPS BASE CAMP PENDLETON

Dear Ms. Griffey, Mr. Mahmoud, Mr. Hausladen:

Enclosed are the minutes to the Marine Corps Base, Camp Pendleton Federal Facilities Agreement (FFA) Meeting Number 110, held on May 16th, 2013. Should you have questions, please call Ms. Theresa Morley at (619) 532-1502.

Sincerely,

A handwritten signature in black ink, reading "Gaston C. Bordenave, Jr.", is positioned above the typed name.

GASTON C. BORDENAVE, JR.
By direction

Enclosures: (1) 110th FFA Meeting Minutes
(2) 110th FFA Meeting Agenda
(3) Sign in Sheet
(4) Deliverables/Fieldwork Spreadsheets
(5) FFA Schedule
(6) Site 1115 RI/FS Summary
(7) 22/23 Groundwater Well Siting Study
(8) Site 1119 Project Update

Copy to: CG, MCB Camp Pendleton (Attn: ACOS, Environmental
Security - Mr. Joe Murtaugh)

PROJECT NOTE NO. 60

SUBJECT: Marine Corps Base (MCB) Camp Pendleton Federal Facilities Agreement (FFA) Meeting (No. 110)

DATE HELD: May 16, 2013

Attendees:

Theresa Morley (Naval Facilities Engineering Command Southwest [NAVFAC SW]), Joseph Murtaugh (MCB Camp Pendleton), Beatrice Griffey (San Diego Regional Water Quality Control Board [RWQCB or Water Board]), Steve Griswold (Parsons), Josh Sacker (Parsons), Martin Hausladen (United States Environmental Protection Agency [USEPA or EPA])* , Bill Mabey (Tech Law)*, Kimberly Day Gettmann (California [Cal] EPA/Department of Toxic Substances Control [DTSC])*

* denotes attendance by conference call

Introduction and Status of Deliverables and Fieldwork

A meeting was held at MCB Camp Pendleton, California, at the Environmental Security office on Base. The purpose of the meeting was to update the FFA Team on program status. Refer to attached sign-in sheet and agenda (attached). Following introductions, Ms. Morley discussed the deliverables spreadsheet, the fieldwork spreadsheet, and the FFA schedule (all attached).

Ms. Morley summarized the status of each of the items on the deliverables spreadsheet, and noted that the items with “final” status will not be included on the next version of the spreadsheet.

- For Item 2, the 22/23 Groundwater Record of Decision (ROD), there has been a disagreement between the USEPA headquarters and the Department of the Navy (DON) regarding land use control (LUC) language. Ms. Morley said that the latest version of LUC language has been submitted to USEPA for their review.
- Item 7, the Remedial Investigation (RI) Work Plan for Site 1121 (Site 1D Groundwater), will be delivered soon once the Sampling and Analysis Plan cover sheet has been signed by the Navy's Quality Assurance Officer.
- Items 11 through 15 are currently in agency review.

On the Fieldwork Spreadsheet (see attached) the following comments were made:

- Item 2, fieldwork for Site 1118 Environmental Site Inspection (ESI), is currently underway.
- Responses are being prepared for Item 3, the Enhanced In Situ Bioremediation (EISB) Pilot Study. The project is being held up by an issue with the union over parking spaces.

During a discussion of the FFA schedule (attached). Ms. Morley noted that the fiscal year (FY) 13 program has been awarded, and that there was a 10% cut in the FY 13 program. The FY 14 program may have a 20% cut. Furloughs are expected to start July 8 and continue to the end of the fiscal year.

Site 1115 RI/FS Summary

Mr. Griswold provided a summary of the recently-delivered Draft Site 1115 Remedial Investigation/Feasibility Study (RI/FS) Report (see attached slides). The RI/FS Report was prepared by Noreas and Parsons, with the RI portion of the document, and the Site-Wise model, largely prepared by Parsons, and the FS portion of the document largely prepared by Noreas.

An overview of site history, conditions, geology, and sources was provided. The source areas at the site are generally grouped together based on proximity to each other, and are referred to as Site 1, Sites 5/8/9/17, and Sites 6/7. The site is underlain by the Santiago Formation, and the aquifer and vadose zone soils at the site are interpreted to belong to this formation, which generally exhibits low permeability. Groundwater contamination has spread several hundred feet beyond the initial source areas. The shallow water-bearing zone has a noticeable mound, which is the result of surface water infiltration just north of the unpaved crescent-shaped area. The crescent-shaped area is scheduled to be graded and paved to prevent future infiltration.

Chemicals of concern (COCs) are present in groundwater at concentrations that exceed Maximum Contaminant Levels (MCLs) and that also pose a significant human health risk if the groundwater were used for potable purposes. Also, COCs are present in soil gas (as measured in soil gas, and also as calculated to volatilize from underlying groundwater) at concentrations that could pose a risk to people exposed to indoor air in possible future buildings, although such buildings are not currently present at the site.

COCs exceeding regulatory criteria are present within an area of about four acres, or about 30% of the fenced area of Site 1115. The contamination is primarily fuel-related compounds at Site 1, and is a mixture of fuel-related compounds and solvents at Sites 5/8/9/17 and Sites 6/7. The COCs in shallow groundwater are about one order of magnitude greater in the shallow groundwater zone than in the deep groundwater zone.

Light non aqueous phase liquid (LNAPL) is currently present in four of the monitoring wells on site, with the thickest LNAPL in the vicinity of Sites 5/8/9/17. There is residual contamination in soils, but volatile organic compounds (VOCs) in soil do not exceed residential Regional Screening Level (RSLs) in the upper 10 feet. VOCs are present in soil gas at potentially significant concentrations throughout the area of the groundwater plumes.

Although LNAPL is a continuing source of COCs to the groundwater, the plumes do not appear to be expanding beyond their current extent. That is, after years of expanding from the initial source areas, there now appears to be an equilibrium where the continued addition of COCs in the source areas (with LNAPL present) is roughly equivalent to the attenuation of COCs at the edges of the plumes (via dispersion, diffusion, sorption, and/or degradation).

VLEACH vadose zone modeling shows some impact to underlying groundwater from leaching of VOCs from the overlying soils. However, the impact from leaching of COCs from soils is minor compared to the LNAPL acting as a significant secondary source.

There are currently no current complete exposure pathways for human receptors; i.e., the site groundwater is not used, and there are no buildings or immediate plans for construction of buildings at the site. Risk from the hypothetical potable use of groundwater is greater than 1×10^{-4} and the hazard index is greater than one. The site is within San Luis Rey hydrologic unit, and east of Interstate 5. As such, it is classified as beneficial use. However, the aquifer has low yield and high total dissolved solids (TDS), and is unlikely to be used as a potable water source, but the site VOCs in groundwater and soil gas could pose a significant vapor intrusion (VI) risk (i.e., greater than 1×10^{-6} , and up to a max of 2×10^{-3} for a hypothetical resident over S1-MW25). Site soils are not considered to pose a threat to human health via direct contact based on the soil data to date.

Target Treatment Zones (TTZs) were developed for the contaminated areas of Site 1115. The designation of the TTZs is based upon 1) distinctive mixtures of contaminants present; 2) the relative concentrations of contaminants present; and 3) distinct aquifer zones. The TTZs are designated in the FS as follows:

- TTZ-1S: Defined as shallow aquifer groundwater in the vicinity of the former underground storage tank (UST) Site 1 gas station.
- TTZ-1SP: Includes shallow aquifer groundwater adjacent to TTZ-1S, representing a dilute plume of contamination, and excluding groundwater areas adjacent to the east with non-fuel related contamination (trichloroethene [TCE], *cis*-1,2- dichloroethene [DCE]) exceeding respective MCLs .
- TTZ-1D: Defined as deep aquifer groundwater in the vicinity of the former UST Site 1.
- TTZ-1D is addressed as a near-source area with the highest benzene and 1,2-dichloroethane (DCA) concentrations, and a relatively small downgradient dilute plume area.
- TTZ-2L: Groundwater in the vicinity of former UST Site 9 impacted by LNAPL defines the principle treatment area for TTZ-2L; however, additional smaller areas of historically noted LNAPL have been identified in the former UST Sites 5/8/17 and 6/7 areas, and are included in TTZ-2L.
- TTZ-2S: Defined as the shallow groundwater underlying LNAPL areas defined by TTZ-2L. The conceptual site model (CSM) assumes LNAPL is a source of dissolved phase contaminants, including benzene and TCE, among other COCs; therefore,

groundwater in direct contact with or close proximity to LNAPL is considered a source area.

- TTZ-2SP: Includes shallow aquifer groundwater downgradient/cross-gradient from TTZ-2L and TTZ-2S, extending to the edges of the dilute groundwater plume with contaminant concentrations above MCLs.
- TTZ-2D: Represents deep aquifer groundwater, excluding TTZ-1D, at Site 1115. Historical sampling in TTZ-2D reported groundwater concentrations exceeding MCLs; however, recent groundwater sampling, documented in this RI (Section 2) did not indicate continued impacts above MCLs in TTZ-2D. As such, potential remedial technologies, processes and alternatives for TTZ-2D are not developed in this FS.

Each TTZ has a different set of remedial alternatives, depending on the specific characteristics of that TTZ. Refer to the attached slides for a full listing of all the alternatives. Possible alternatives for the various TTZ include the following: Excavation and Groundwater Extraction, In Situ Chemical Oxidation, Biosparging, Excavation of LNAPL and LNAPL Extraction, Dual Phase Extraction, Automated LNAPL Recovery, and Enhanced In Situ Bioremediation (EISB) with sequential Air Sparge/Soil Vapor Extraction (AS-SVE). All of the potential alternatives would include Land Use Controls and Long-Term Monitoring, with Monitored Natural Attenuation (MNA).

Ms. Morley noted that there should be some cost savings at Site 1 if the same technologies are employed at the three TTZs (i.e., TTZ-1S, TTZ-SP and TTZ-D). Likewise, if excavation is employed at TTZ 2L, then there would be potential savings with regard to implementing remedies at TTZ-2S.

The SiteWise model was used to determine the relative environmental and safety impacts of each alternative. The excavation alternatives (1S-3 and 2L-3) are the only ones that have the negative effect of filling up landfill space, but otherwise the excavation alternatives are generally no more detrimental than the other alternatives in the other environmental footprint categories, such as greenhouse gas emissions (GHGs), total energy, air emissions, and fatalities and injuries. The excavation alternatives do use some more water than the other alternatives, but water usage is not particularly high for any one of the alternatives.

The alternatives involving the biosparge barrier (1SP-3) and EISB/AS-SVE (2S-4 and 2SP-3) are generally more detrimental than the other alternatives in several of the environmental footprint metrics, including GHGs, total energy, air emissions, and fatalities and injuries. Generally, these two alternatives are about 20% higher (i.e., worse) than the other alternatives in these environmental criteria.

Land Use Controls, Long-Term Monitoring, with Monitored Natural Attenuation is the alternative, as would be expected, that has generally the lowest impacts in the various environmental footprint criteria.

Dr. Mabey noted that it would have been preferable to meet face-to-face to discuss the various complicated aspects of this site, and also noted that trying to treat the dilute portions of the plumes might be biting off too much. Mr. Hausladen said that it may be prudent to go for the “brass ring” rather than the “gold ring” at this site, and that efforts

may need to be focused on the worst parts of the site and preventing exposure, and that unrestricted land use is unlikely regardless of which remedial approaches are taken.

Status of Chappo Subbasin Investigation

A summary of the current status of the Chappo Subbasin investigation was provided by Mr. Griswold (see attached slides). This work is being conducted in a portion of the Santa Margarita River designated as the Chappo Subbasin. Field sampling has been proceeding in phases, including sampling of previously-existing wells, and installing and sampling of new wells in the subbasin, as outlined in the December 2012 Sampling and Analysis Plan. Data obtained from the new wells is being finalized. Once the Base reviews the new data, a new test well will be installed in order to obtain hydraulic properties of the aquifer. Following that step, all site data will be compiled in a technical memorandum.

Site 1119 Fieldwork Status

The slides used for this presentation are attached. The site is defined as groundwater in the vicinity of Base wells 26016 and 26018. These wells had previous detections of chemicals of potential concern (COPCs), as follows:

Well 26016: 11 micrograms per liter ($\mu\text{g/L}$) of TCE during a constant discharge test conducted by CDM in 2008, and 0.51 $\mu\text{g/L}$ of TCE in a United States Geological Survey (USGS) sample at 65 ft bgs collected in 2009. USGS testing at 26016 also reported 1,2,3- trichloropropane (TCP) at 0.0064 $\mu\text{g/L}$ in the 80-foot depth specific sample. Low level *cis*-1,2-DCE was also detected at 65 ft bgs (0.45 $\mu\text{g/L}$). No other analytical results have indicated the presence of 1,2,3-TCP in wells 26016 or 26018.

Well 26018: TCE detections, with a maximum detection of 2.6 $\mu\text{g/L}$ collected by MCB Camp Pendleton Facilities Maintenance Division (FMD) in 2009, and multiple detections of approximately 2 $\mu\text{g/L}$, including recent samples tested as part of the liquid-phase granular activated carbon (LGAC) operations at well 26018. These detections were consistent with test results (2.1 $\mu\text{g/L}$) from a surface discharge sample collected by the USGS in 2009.

Recent field work has included sampling of existing wells at multiple depths throughout the Upper Ysidora subbasin, and installation and sampling of 26 new wells at 8 locations.

Results to date have shown that TCE is present in groundwater along the southeast edge of valley (i.e., southeast edge of aquifer), downstream of Rattlesnake Canyon and the former train depot area. The observed TCE concentrations increase with depth (closer to bedrock). In order to further define the area of contamination identified in the first mobilization, additional investigation includes a soil gas survey and installation of multi-depth wells at two locations.

Soil gas purge testing was recently completed, and the full soil gas survey will be carried out from May 20 to 24. When preliminary soil gas results are reviewed, a

determination will be made regarding whether the well locations should be adjusted, and the FFA Team will be informed via email.

Schedule for Next FFA Meeting

The next FFA Meeting is scheduled to be held in the San Francisco Bay Area on September 19, 2013.

**MCB Camp Pendleton
110th FFA Meeting Agenda
Environmental Security Conference Room
Building 22165
Camp Pendleton, CA 92055-5008**

May 16th, 2013

- | | |
|--------------------|---|
| 0900 – 0915 | Welcome and Introductions (Navy) |
| 0915 – 0945 | Project Deliverables, FFA Schedule Update and Planned/In Progress Field Work Status (Navy) |
| 0945 – 1045 | Site 1115 RI/FS Summary |
| 1045 – 1100 | Status of Chappo Subbasin Investigation |
| 1100 – 1130 | Site 1119 Fieldwork Status |

CLIENT Sign-In Sheet JOB NO. _____ SHEET _____ OF _____
SUBJECT _____ BY _____ DATE _____
CKD. _____ REVISION _____

FFA Meeting @ Camp Pendleton, CA
May 16, 2013

<u>Name</u>	<u>Org</u>	<u>Phone / Email</u>
Steve Griswold	Parsons	626 440 6076 steve.griswold@parsons.com
Josh Sacker	Parsons	josh.sacker@parsons.com
Joseph Murtang	CPEN ES	Joseph.murtang@usmc.mil
Theresa Morley	Navy	(619) 532-1502 / Theresa.Morley@navy.mil
Beatrice Griffey	RWQCB	(858) 467-2728 BGriffey@waterboards.ca.gov

- Martin Hausladen USEPA (on phone)
 - Kimberly Day DTSL (on phone)
 - Bill Mabey (Tech Law)
- } via conference call

MCB Camp Pendleton Deliverables Spreadsheet

Date: 5/16/13

Item	Document	Contractor	Status	Date Due to Agencies	Agency Comments Due By	Response Received From:		
						EPA	DTSC	RWQCB
1	ROD for NFA at Site 1111	SDV	Signature page in transit	12/22/11	2/20/12	28-Mar	15-Feb	17-Feb
2	ROD for 22/23 Area Groundwater	Parsons	Discussing EPA LUC comments	5/8/12	7/9/12	25-Jun	27-Jun	9-Jul
3	Data Gap Analysis Report for Site 1D - Burn Ash Site	SDV	FINAL	7/23/12	9/21/12	21-Sep	10-Sep	21-Sep
4	EE/CA and AM for Site 1114 - 41 Area Arroyo	Battelle	FINAL	8/22/12	10/22/12	23-Oct	11-Oct	27-Sep
5	Project Completion Report - 12 Area Site 13	SDV	FINAL	9/12/12	11/12/12	NC	8-Nov	5-Nov
6	ESI Work Plan for Site 1118 - 21/26/52 Area Groundwater	ECM	FINAL	9/17/12	11/16/12	NC	14-Nov	16-Nov
7	RI Work Plan - Site 1121 - 1D Groundwater	SDV	Finalizing	10/10/12	12/10/12	NC	10-Dec	10-Dec
8	RI Work Plan Addendum for Site 1119 - 26 Area Groundwater	Parsons	FINAL	12/19/13	2/18/13	NC	12-Feb	30-Jan
9	Annual Post Closure Maintenance Report (for CY12) - Site 7	Trevet	Finalizing	2/14/13	4/15/13	NC	4-Apr	17-Apr
10	Work Plan to Install Wells & Monitor Groundwater - Site 33	Trevet	Responding to agency comments	3/15/13	5/14/13	NC	30-Apr	8-May
11	Removal Action Work Plan - Site 1116 14 Area Groundwater (incl ESI Report as an appendix)	ECM	With agencies	3/23/13	5/24/13		8-May	
12	RAWP for Site 1114 - 41 Area Arroyo	Trevet	With agencies	4/1/13	5/31/13			
13	RI Work Plan for Site 150 - 21 Area Boat Basin	Trevet	With agencies	4/22/13	6/21/13			
14	RI/FS for Site 1115 - FSSG Lot	Noreas/Parsons	With agencies	4/30/13	7/1/13			
15	RI Work Plan for Site 1117 - 16/17 Area Groundwater	Trevet	With agencies	5/6/13	7/5/13			
16	Annual Groundwater Monitoring Report - Site 7 Box Canyon	Trevet	Navy reviewing pre-draft	7/3/13				
17	Work Plan to Install Wells & Monitor Groundwater - 22/23 Area GW	Tidewater	Preparing pre-draft	8/30/13				
18	EE/CA and AM for 12 Area Site 13	SDVJV	Preparing pre-draft	9/11/13				
19	Work Plan for Performance Monitoring - Site 1114 (41 Area Arroyo)	TriEco	Preparing pre-draft	9/27/13				
20	Work Plan for Additional Investigation - Site 11116 (14 Area GW)	TriEco	Preparing pre-draft	10/13/13				
21	Plume Removal Action Completion Report - Site 33 (52 Area Armory)	Shaw	Preparing pre-draft	10/25/13				
22	Source Removal Action Work Plan - Site 33 (52 Area Armory)	ECM	Preparing pre-draft	11/30/13				
23	Extended Site Inspection Report - Site 1118 (21, 26, 52 Area GW)	ECM	Once field work is complete	12/16/13				
24	Remedial Investigation/Feasibility Study Report - Site 1119	Parsons	Once field work is complete	12/19/13				
25	Extended Site Inspection Report - Site 62 (Asphalt Batch Plant)	SDVJV	Once field work is complete	12/20/13				

Agencies have commented

MCB Camp Pendleton Fieldwork Spreadsheet

Date: 5/16/13

Item	Field Work	Planned Start Date	Planned Completion Date
1	Field Work for 22/23 Area Groundwater ZVZ Pilot Study	2/6 - 2/8: Well Installations 2/13 - 2/15: Well Develop/Survey 2/20 - 2/24: Baseline GW Event/Slug Test April - Install PRB	on hold
2	Field Work for Site 1118 ESI	remobilize for phase II 8 May	19-Jun-13
3	EISB Pilot Study - 22/23 Area GW	2/11 - 2/18 Pre-design Study Soil Borings; 3/25 - 4/1 Pre-design groundwater wells:	6/10 - 6/15 Injection Well Installation
4	Well Siting Study - 22/23 Area Groundwater	12/3/2012 for sampling	complete for sampling
5	RI Field Work - Site 1119	4/30 - 5/3 - install SG probes 5/8 - purge test 5/21 - 5/27 - sample probes 6/17 install/develop/sample wells	3-Jul-13
6	RI Field Work - Site 1D		

Date: 5/16/13

Item	Document	Contractor	RTCs to agencies	RTC Approved		
				EPA	DTSC	RWQCB
1	ROD for NFA at Site 1111	SDV		18-Mar	26-Nov	26-Nov
2	ROD for 22/23 Area Groundwater	Parsons	addl RTCs sent 3/18		31-Aug	4-Sep
3	RI Work Plan Site 1121 - 1D Groundwater	SDV		N/A	26-Mar	12-Feb
4	CY12 Post Closure Maintenance Report - Site 7	Trevet		N/A	23-Apr	22-Apr
5	WP to Install GW Monitoring Wells & Monitor Site 33	Trevet				
6	Removal Action Work Plan - Site 1116 14 Area GW	ECM				
7	Removal Action Work Plan - Site 1114 41 Area Arroyo	Trevet				
8	RI Work Plan for Site 150 - 21 Area Boat Basin	Trevet				
9	RI/FS for Site 1115 - FSSG Lot	Parsons				
10	Removal Action Work Plan - Site 1116 14 Area GW	ECM				
11						

FFA Schedule for Draft Documents – May 16, 2013

Original schedule was agreed to by all FFA signatories at the May 17, 2011 FFA meeting. Updates are made every four months, prior to the FFA meetings. Dates marked with an asterisk are tentative, based on funding and subject to change. Once funding becomes available for a site, the date will be updated and the asterisk removed. Items in italics represent field work and are not enforceable.

Site 6 (Site number is for funding purposes only) – 22/23 Area Groundwater

This site consists of VOC plumes in the groundwater under the 22 and 23 Areas. Various industrial activities have historically taken place in the 22 and 23 Areas. An RI/FS was completed in January 2011. The Proposed Plan outlined the various alternatives from the FS and proposed the preferred alternative which is a combination of alternatives 2, 3 and 4. Alternative 2 includes Land Use Controls and Long-Term Monitoring, Alternative 3 involves an Alternate Water Supply and Alternative 4 is Source Area Treatment via In-Situ Technologies. A public comment period and public meeting for the Proposed Plan were held in July/August 2011. A Record of Decision is being reviewed by the agencies. To evaluate the effectiveness of the remedies proposed for Alternative 4, two pilot studies are planned: a Zero Valent Zinc (ZVZ) Permeable Reactive Barrier is planned for the TCP plume; and, Enhanced InSitu Bioremediation (EISB) is planned for the TCE plume. The DoN has finalized work plans for both pilot studies and to test locations to cite the replacement production well.

- | | |
|---|--------------------|
| – Proposed Plan | complete |
| – Geotechnical and Design Information for ZVZ PRB Pilot Study | complete |
| – <i>Implementation of ZVZ PRB Pilot Study</i> | <i>in progress</i> |
| – Record of Decision | 5/8/2012 |
| – Well Siting Study Sampling and Analysis Plan | complete |
| – <i>Field Work for Well Siting Study</i> | <i>in progress</i> |
| – Work Plan for Enhanced InSitu Bioremediation (EISB) | complete |
| – <i>Field Work for EISB Pilot Study</i> | <i>in progress</i> |
| – Work Plan to Install Wells and Conduct Groundwater Monitoring | 8/30/2013 |
- Extension for Record of Decision requested to incorporate multiple Navy and Marine Corps comments and for Sampling and Analysis Plan to accommodate changes in Navy Quality Assurance Officer**

**POST ROD Site 7 – Box Canyon Landfill

This site is a CAMU situated above an old municipal landfill. This site is post-ROD. The selected remedy was an EvapoTranspiration (ET) cap with land use controls. The site must be fenced and signed. Annual inspections are made in relation to the monitoring systems, cover maintenance, drainage/erosion control, cracks, settlement and movement and vegetation growth. Additionally, groundwater monitoring wells are sampled every year and gas probes are sampled according to the percent of methane in the probe. The groundwater monitoring results and the annual maintenance activities are summarized in annual reports. The

methane results are emailed to the FFA team monthly. A Gas Collection and Control System (GCCS) was recently installed and has reduced methane concentrations to below compliance standards.

- Memo to File for Site 7 (pv panels) complete
- *Field Work for Non Methane Organic Compounds* complete
- Memo To File complete
- Report for Non Methane Organic Compounds complete
- Annual Post Closure Maintenance Report (for CY12) 2/15/2013
- Annual Groundwater Monitoring Report 7/3/2013

12 Area Site 13 – Former Building 1280 and 1283

This site is the site of a former UST and has some low level concentrations of VOCs in groundwater. An RI/FS has been completed. Due to an impending construction project through the site, contaminated soil and groundwater were removed from the area to be impacted by construction. A year of groundwater monitoring has been completed and a Project Completion Report is complete. The report recommends further action for the site. An EE/CA and AM is currently being prepared.

- Groundwater Monitoring Report complete
 - **Project Completion Report for Soil and Groundwater** complete
 - **Engineering Evaluation/Cost Analysis** 9/11/2013
 - **Action Memorandum** 5/30/2013*
 - **Proposed Plan** 5/30/2014*
 - **Record of Decision** 5/30/2014*
- Dates changed as a result of the May 10, 2012 FFA Meeting**

Site 21 – 14 Area Surface Area Impoundment

This site was a former oxidation pond near a maintenance facility which has some low levels of VOCs in groundwater. A Remedial Investigation has been completed for the site, but not a Feasibility Study. Currently a pilot study to evaluate the effectiveness of in-situ bioremediation of chlorinated solvents at low concentrations in groundwater is complete. A Technical Memorandum reporting on the effectiveness of the first year of the pilot study was finalized, as was the Pilot Study Addendum for the second phase of work, currently underway.

- Pilot Study Tech Memo complete
 - Site 21 Pilot Study Work Plan Addendum complete
 - *Second Phase of Pilot Study Field Work* in progress
 - **Feasibility Study** 5/26/2014
 - **Proposed Plan** 11/15/2014*
 - **Record of Decision** 11/15/2015*
- Dates were changed as a result of the September 15, 2011 FFA meeting**

Site 33 – 52 Area Armory

Gun cleaning in the armory contributed to a PCE plume downgradient of the armory. A Remedial Investigation and Feasibility Study have been completed for this site. An Engineering Evaluation/Cost Analysis and Non-Time Critical Action Memorandum have also been completed. The selected remedy was excavation of the source material, including groundwater which would then be treated and disposed of in the sanitary sewer system. An interim Removal Action was completed, concentrating on the worst part of the plume. An additional Removal Action is planned for the source area.

- | | |
|--|------------------|
| – Removal Action Work Plan for plume | complete |
| – <i>Plume Removal Action (geophysical work started 15 Nov 11)</i> | <i>complete</i> |
| – Plume Removal Action Completion Report | 10/25/2013 |
| – Removal Action Work Plan for source | 11/30/2013 |
| – <i>Source Removal Action</i> | <i>5/7/2014*</i> |
| – Source Removal Action Completion Report | 2014* |
| – Proposed Plan | 2015* |
| – Record of Decision | 2016* |

Site 150 – 21 Area, Location 1

This site became an IR site after a discovery investigation conducted based on information gained from a former Marine stationed at Camp Pendleton. During the discovery investigation, one location had vinyl chloride in soil gas that exceeded risk screening criteria. Field work for the Site Inspection has located groundwater contamination. This site is in the Remedial Investigation phase.

- | | |
|---|-------------------------|
| – <i>Site Inspection Field Work</i> | <i>complete</i> |
| – Site Inspection Report | complete |
| – Remedial Investigation Work Plan | 4/21/2013 |
| – <i>Field Work for Remedial Investigation</i> | <i>4/21/2014</i> |
| – Remedial Investigation Report | 2015* |
| – Proposed Plan | 2016* |
| – Record of Decision | 2017* |
- Dates changed (RI added) as a result of the SI field work**

SITE CLOSED Site 1003 (Site number is for funding purposes only) – Site 1D Groundwater

This site was a former burn ash site and has undergone a Remedial Investigation and Feasibility Study for soil only. A ROD was signed documenting the selected remedy consisting of excavation and off-base disposal of contaminated soil. During the remedial action a cell with 90 drums and drum fragments containing liquid and solid chemicals was discovered. The drums were removed but the material in the drums had reached groundwater. A Remedial Action Closure Report (RACR) was completed to close out the soil portion of the site, but the groundwater contamination remains to be addressed. As an interim measure, until funding could

be secured for further investigation, 650,000 gallons of the groundwater was pumped from the site, treated and disposed of in the base sanitary sewer system. This lowered the concentrations of contaminants in groundwater, however, additional work is planned under a new site, IR Site 1121 Site 1D Groundwater. This site is for soil only; and was closed through the ROD and the RACR.

- Data Gap Analysis for Groundwater Work Plan complete
- *Data Gap Analysis Field Work* complete
- Data Gap Analysis Report complete

Site 1111 – 26 Area Ash and Debris Disposal Area

This burn ash site was remediated and four quarters of groundwater monitoring have been completed. The site was revegetated and a report was written summarizing the actions that had been completed to date, and why the site qualified for unrestricted land use.

- Proposed Plan for No Further Action complete
- Record of Decision for NFA signature page in transit

Site 1114 – 41 Area Arroyo

This site was created to investigate the PCE concentrations in one well that used to be associated with IR Site 9 (closed). A Site Inspection was carried out and described low-level concentrations of TPH and vinyl chlorides in soil gas and groundwater. A Remedial Investigation was conducted to validate the findings of the SI and to complete a risk assessment for the site. The EPA did not agree with the proposed NFA, therefore the site will move to the remediation phase.

- Remedial Investigation Report complete
- **Engineering Evaluation/Cost Analysis & Action Memorandum** complete
- **Removal Action Work Plan** 4/1/2013
- **Removal Action** 8/15/2013
- Work Plan for Performance Monitoring 9/27/2013
- **Removal Action Completion Report** 2014*
- Performance Monitoring Report 2015*
- Proposed Plan 2015*
- Record of Decision 2016*

Dates were changed as a result of EPA rejection of AM

Site 1115 – 13 Area FSSG Lot

There are two plumes underneath the parking lot at this site, one shallow and one deep, containing chlorinated solvents and benzene. A pilot study to evaluate the effectiveness of in-situ bioremediation of chlorinated solvents in groundwater was completed. The technology was successful at reducing contaminant

concentrations, but the site geology limited its effectiveness. A Technical Memorandum detailing the pilot study is complete. A work plan to collect more data is final and the results have been included in a Remedial Investigation/Feasibility Study.

- Tech Memo complete
 - **Work Plan to collect additional data for site complete**
 - **Field Work to collect additional data complete**
 - **Remedial Investigation/Feasibility Study 4/30/2013**
 - **Proposed Plan 2014***
 - **Record of Decision 2015***
- Dates were changed as a result of the September 15, 2011 FFA meeting**

Site 1116 – 14 Area Groundwater

Nine USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. A Site Inspection was completed and six of the sites do not warrant further action under the IR Program. The three other sites will be remediated. An EE/CA and Action Memo has been completed for this site. A Removal Action Work Plan, with a report detailing the results of a limited investigation to close data gaps as an appendix, is with the agencies for review.

- Engineering Evaluation/Cost Analysis(3 subsites – Moving Forward) appendix to Action Memo
- Action Memorandum (3 subsites – Moving Forward) complete
- Expanded Site Inspection WP (3 subsites – Moving Forward) complete
- *Field Work for Site Inspection* (3 subsites – Moving Forward) complete
- **Expanded Site Inspection Report (3 subsites – Moving Forward) appendix to RAWP**
- **Removal Action Work Plan (RAWP) (3 subsites – Moving Forward) 3/23/2013**
- **Interim Removal Action (3 subsites – Moving Forward) 8/14/2013**
- Additional Investigation Work Plan (3 subsites – Moving Forward) 10/13/2013
- Removal Action Completion Report (3 subsites – Moving Forward) 2014*
- Additional Investigation Report (3 subsites – Moving Forward) 2014*
- Proposed Plan for No Further Action (6 subsites – NFA) 2015*
- Record of Decision (6 subsites – NFA) 2016*

Dates were changed as a result of the September 17, 2012 FFA meeting.

Site 1117 – 15/16 Area Groundwater

Six USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. The agencies have reviewed the Site Inspection Report recommending the site move into the Remedial Investigation phase. A Remedial Investigation Work Plan is with the agencies for review.

- *Field Work for Site Inspection* complete
- Site Inspection Report complete

- Remedial Investigation Work Plan 5/6/2013
 - Remedial Investigation Field Work 9/27/2013*
 - Remedial Investigation Report 2014*
 - Proposed Plan 2015*
 - Record of Decision 2016*
- Remedial Investigation added based on agency comments on Site Inspection

Site 1118 – 21/26/52 Area Groundwater

Three USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. The Site Inspection report was reviewed by the regulatory agencies and additional work, including a soil gas investigation, is needed to verify if no further action is appropriate for these sites. Field work for an Extended Site Inspection Work Plan is in progress.

- Extended Site Inspection (ESI) Work Plan complete
- Field Work for Site Inspection in progress
- Extended Site Inspection Report 12/16/2013
- Proposed Plan 2015*
- Record of Decision 2016*

Dates changed as a result of document quality issues

Site 1119 – 26 Area Groundwater

This site was created to investigate the source or sources of chlorinated solvents in the 26 Area production wells. Field work for the Remedial Investigation has been completed. TCE had been discovered at two of the wells and further investigation is needed to delineate extent of contamination and to locate the source, if possible. An addendum to the Remedial Investigation Work Plan is complete and field work is in progress.

- Field Work for Remedial Investigation complete
- Work Plan Addendum to Delineate Source complete
- Additional RI Field Work in progress
- RI/FS Report 12/19/2013
- Proposed Plan 2014*
- Record of Decision 2015*

Dates changed as a result of the Jan 19, 2011 FFA meeting

Site 62 – Asphalt Batch Plant

This site was created when a transformer containing PCBs tipped over and spilled. A Site Inspection was performed, however data was missing and further investigation was needed. An Extended Site Inspection Work Plan was completed. Field work hasn't been completed and is due to begin soon.

- Extended Site Inspection Work Plan complete

- *Field Work for Extended Site Inspection* 8/7/2013
 - Extended Site Inspection Report 12/20/2013
 - Proposed Plan 5/1/2013*
 - Record of Decision 5/1/2014*
- Dates changed as a result of the September 17, 2012 meeting

Site 1120 – Stuart Mesa Pesticide Maintenance Areas

This site was created in 2012 to address pesticide contamination due to agricultural maintenance activities. A Phase II Environmental Assessment was completed for this site in support of real estate agreement closure. The Environmental Assessment is analogous to a Site Inspection, so this site enters the Installation Restoration Program at the Remedial Investigation stage.

- Remedial Investigation Work Plan 2014*
- *Remedial Investigation Field Work* 2015*
- Remedial Investigation Report 2016*
- Proposed Plan 2017*
- Record of Decision 2018*

Site 1121 – Site 1D Groundwater

This site was created in 2012 to differentiate Site 1D groundwater from Site 1D soil, which was closed with a previous remedial action and Record of Decision. There is a plume consisting of elevated concentrations of VOCs, metals, and pesticides.

- Remedial Investigation Work Plan in progress
- *Remedial Investigation Field Work* 7/15/2013
- Remedial Investigation Report 2014*
- Proposed Plan 2015*
- Record of Decision 2016*

Site 1122 – Shot Fall Zone

This site was created in 2013 to address lead and Polycyclic Aromatic Hydrocarbon contamination due to overshot from skeet range activities off base. Limited soil samples were collected that indicated elevated levels of lead, so the site will come into the Installation Restoration Program at the Site Inspection stage.

- Site Inspection Work Plan 2014*
- *Site Inspection Field Work* 2015*
- Site Inspection Report 2016*
- Proposed Plan 2017*
- Record of Decision 2018*

MCB CAMP PENDLETON SITE 1115 RI/FS SUMMARY

16 May 2013
110th FFA Meeting



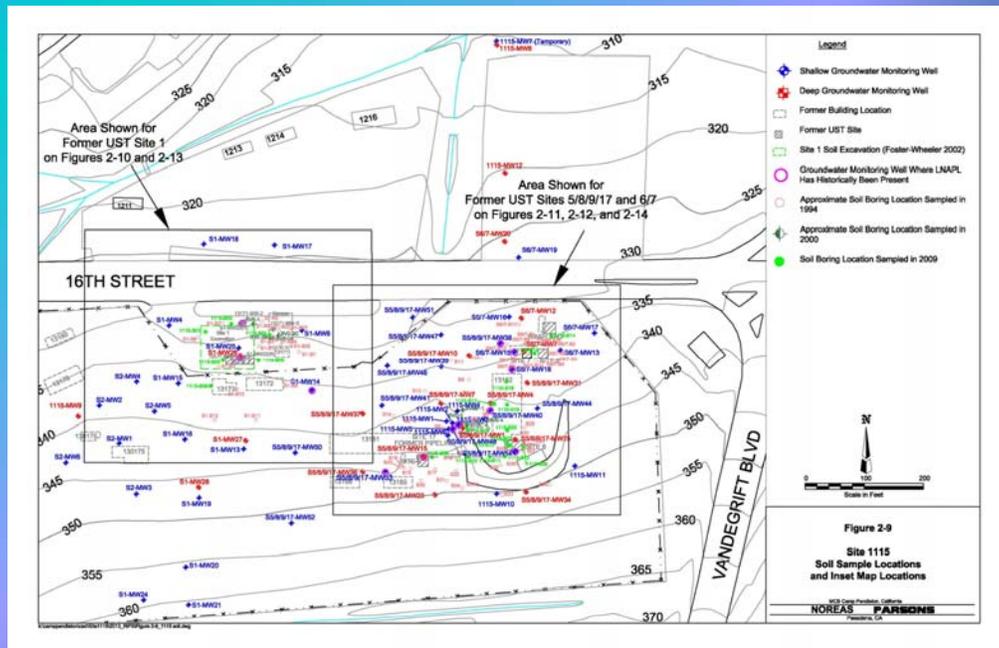
SITE 1115 REMEDIAL INVESTIGATION

RI Overview

- ❖ Multiple UST and IR Program investigation phases since 1986
- ❖ Soil removal action at Former UST Site 1 in 2002, pilot scale testing of SVE in 1997, and pilot scale testing of in situ bioremediation 2010/2011
- ❖ Shallow and deep groundwater zones
- ❖ Dissolved-phase COPCs generally higher in the shallow zone
- ❖ LNAPL present in portions of the shallow groundwater
- ❖ Residual COPCs also present in the vadose zone
- ❖ Former UST locations and one pipeline (former Site 17) are grouped together based on proximity; the three source areas are former UST Site 1, former UST Sites 5/8/9/17, and former UST Sites 6/7



SITE 1115 REMEDIAL INVESTIGATION



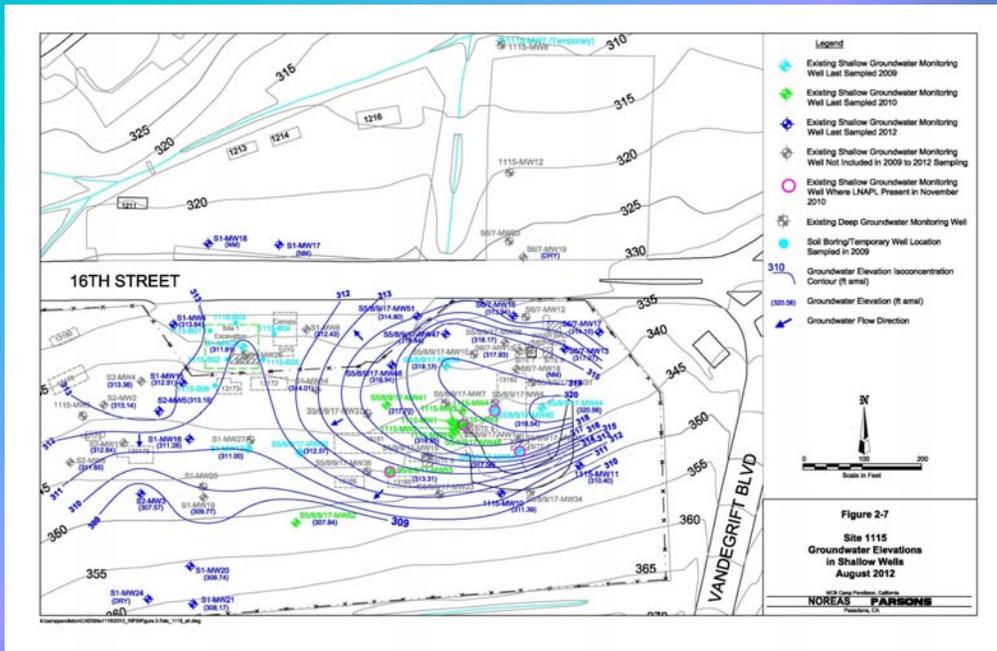
SITE 1115 REMEDIAL INVESTIGATION

RI Overview (continued)

- ❖ Santiago Formation - low-permeability siltstone/sandstone; slow flow
- ❖ Groundwater contamination has spread several hundred feet beyond the three initial source areas
- ❖ Surface water collects and infiltrates north of the unpaved crescent-shaped area, resulting in a groundwater mound with a radial flow pattern

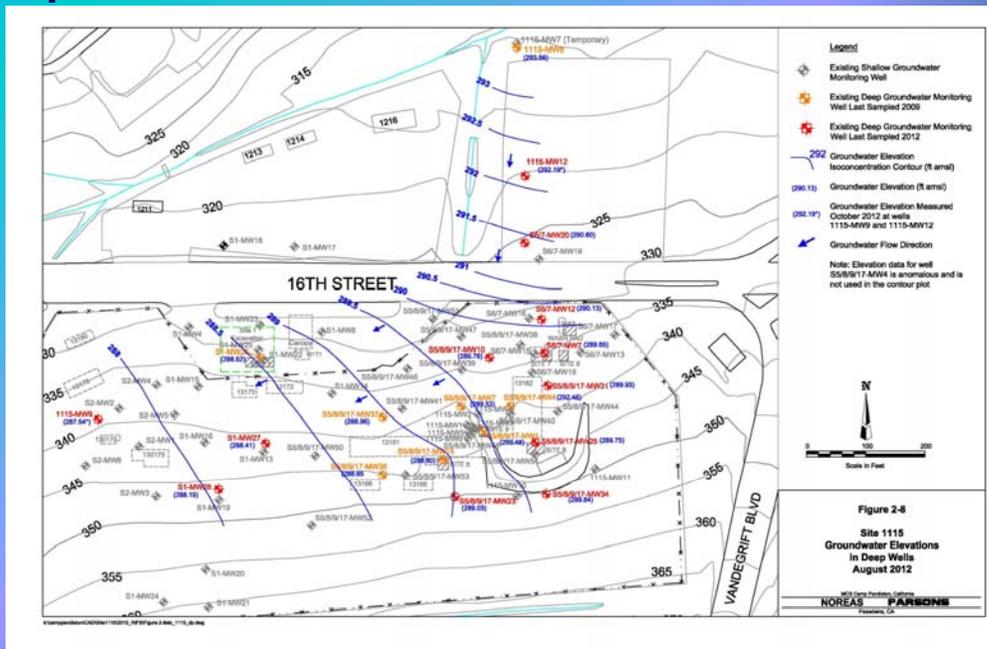
SITE 1115 REMEDIAL INVESTIGATION

Shallow Groundwater Elevations



SITE 1115 REMEDIAL INVESTIGATION

Deep Groundwater Elevations



SITE 1115 REMEDIAL INVESTIGATION

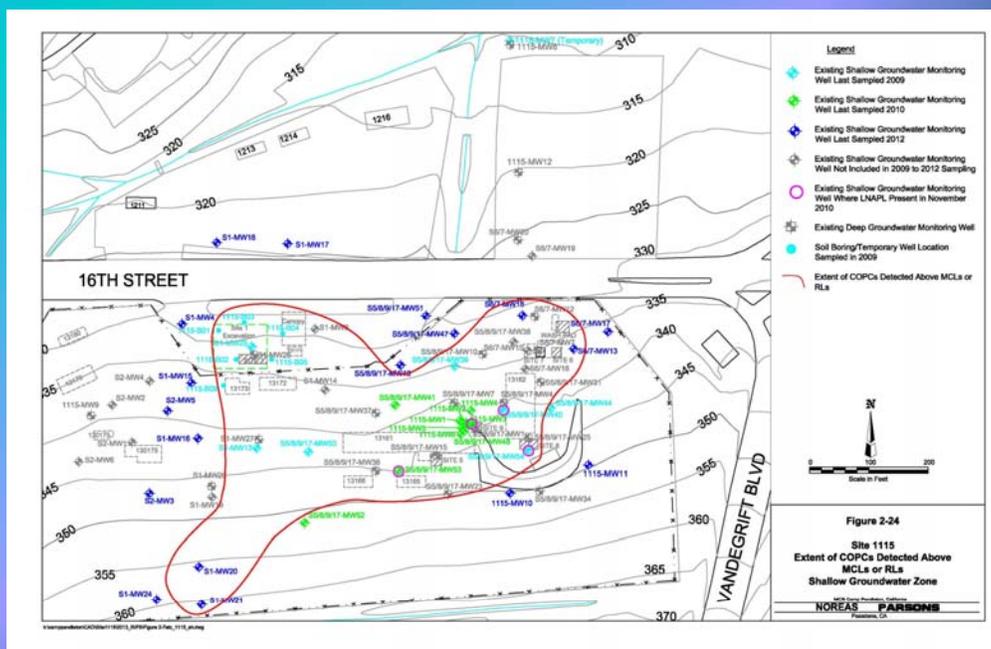
Chemicals of Concern (continued)

❖ Twenty-six total COCs derived per the following criteria:

1. Groundwater - above MCLs/California RLs or risk greater than 1×10^{-6} or HI greater than 1 from potable residential use or VI
2. Soil Gas - exceeding the residential CHSSLs for shallow soil gas or USEPA (2012) Air Regional Screening Levels (RSLs) divided by DTSC's (2011) default attenuation factors
3. Soils - exceeding the USEPA (2012a) residential soil RSLs, as modified by DTSC (2012)

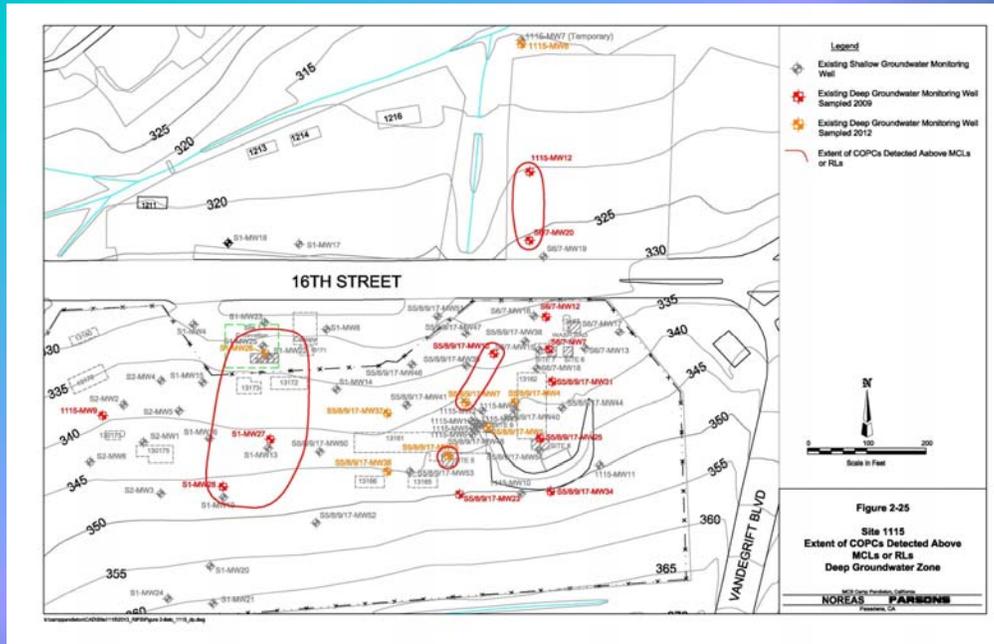
SITE 1115 REMEDIAL INVESTIGATION

Shallow Groundwater Contamination Above COPCs



SITE 1115 REMEDIAL INVESTIGATION

Deep Groundwater Contamination Above COPCs



SITE 1115 REMEDIAL INVESTIGATION

Nature and Extent

- ❖ Approximately 4 acres, or 30%, is underlain by groundwater having COCs exceeding MCLs or RLs
- ❖ Primarily Fuel-related compounds at former UST Site 1, whereas a mixture of fuel-related compounds and solvents are at former UST Sites 6/7 and 5/8/9/17
- ❖ COCs in shallow groundwater zone about an order of magnitude greater than in the deep groundwater

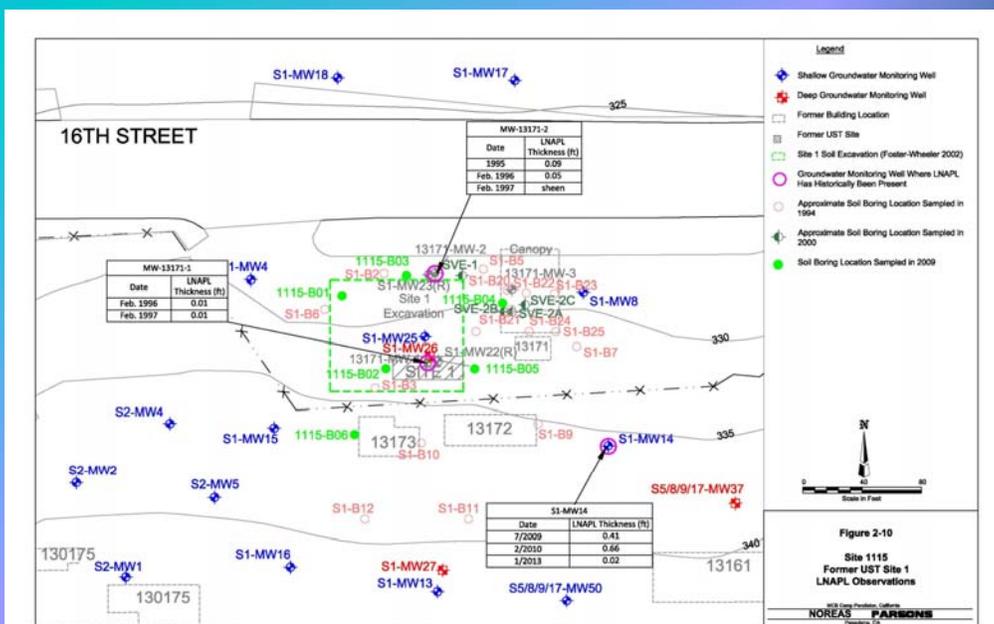
SITE 1115 REMEDIAL INVESTIGATION

Nature and Extent

- ❖ LNAPL is currently present in four wells (at Sites 5/8/9/17), historically at 13 wells
- ❖ Thickest LNAPL in vicinity of Sites 5/8/9/17; product recovery has reduced thicknesses substantially
- ❖ Residual soil contamination - VOCs and TPH at each source area. VOCs in soil did not exceed residential RSLs, except for two samples deeper than 10 feet bgs at Sites 5/8/9/17
- ❖ VOCs in soil gas at potentially significant concentrations over groundwater plume area

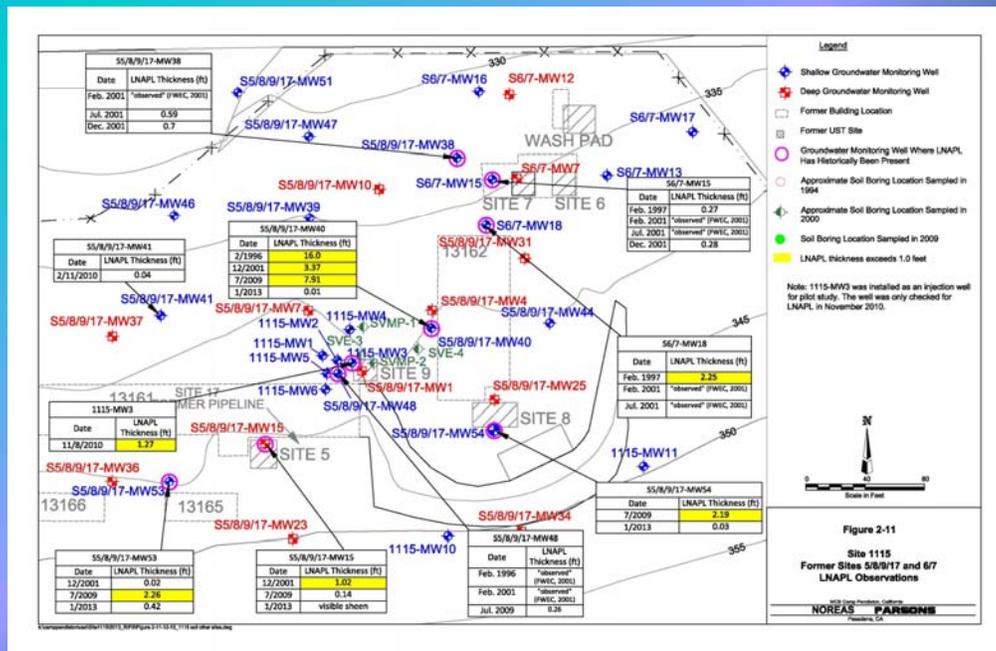
SITE 1115 REMEDIAL INVESTIGATION

Former UST Site 1 LNAPL



SITE 1115 REMEDIAL INVESTIGATION

Former Sites 5/8/9/17 and 6/7 LNAPL

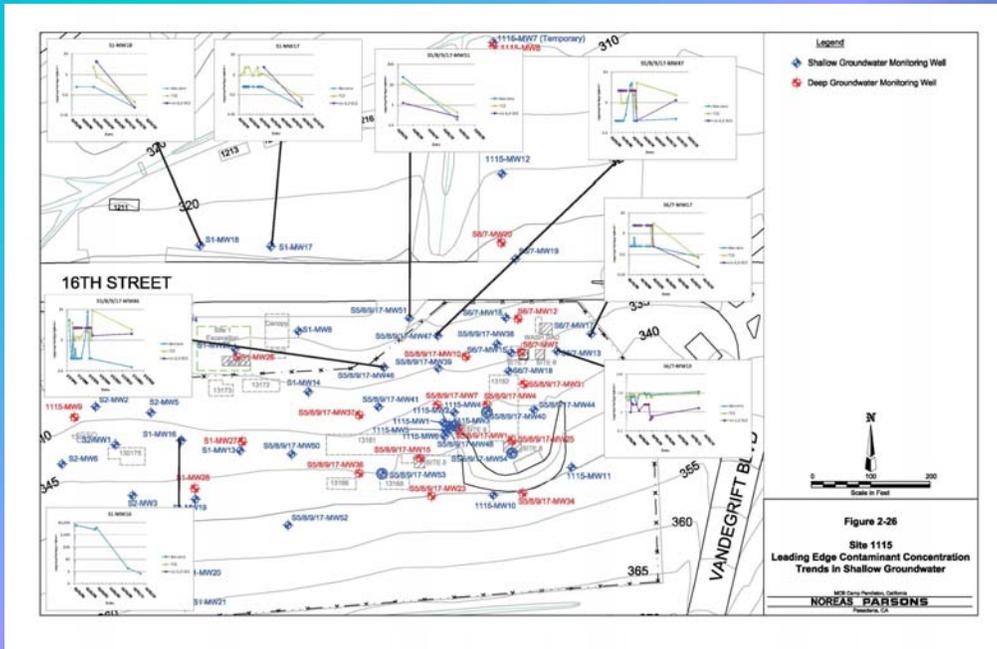


SITE 1115 REMEDIAL INVESTIGATION

Fate and Transport

- ❖ Based on data to date, groundwater plumes generally not expanding beyond their current extent
- ❖ LNAPL is a continuing source of COCs to the underlying groundwater
- ❖ Geochemical conditions within the source areas are generally anaerobic
- ❖ Geochemical conditions at the outer edges of the plume are predominantly aerobic

SITE 1115 REMEDIAL INVESTIGATION



SITE 1115 REMEDIAL INVESTIGATION

Fate and Transport

- ❖ VLEACH vadose zone modeling shows some impact to underlying groundwater from leaching of VOCs from the overlying soils. Accounting for mixing in the aquifer, VOCs in soil are estimated to not incrementally increase VOCs in groundwater by MCLs or RLs at any of the three modeled locations, except for benzene at one location for the first 14 years of the model run. Over time, volatilization is expected to remove more VOC mass from groundwater than VOCs migrating downward (i.e., net loss of COPC mass in groundwater)
- ❖ Modeling predicts that VOC concentrations in groundwater will gradually decrease over the next several decades if site soils were the only contributing source to groundwater. The modeling also does not account for the presence of LNAPL, which is a significant secondary source.
- ❖ Leaching of residual COPCs from soils is a much less significant source of groundwater contamination than the presence of LNAPL

SITE 1115 REMEDIAL INVESTIGATION

Risk Assessment

- ❖ No current complete exposure pathways for human receptors; groundwater is not used, no buildings, and no plans for development or construction.
- ❖ Risk from the hypothetical potable use of groundwater is greater than 1×10^{-4} and the hazard index is greater than one. Aquifer has low yield and TDS, but GW is within San Luis Rey hydrologic unit, and east of Interstate 5, classified as having beneficial uses for municipal, agricultural, and industrial supply
- ❖ VOCs in groundwater and soil gas could pose a significant VI risk (i.e., greater than 1×10^{-6} and up to a max of 2×10^{-3} for a hypothetical resident over S1-MW25)
- ❖ Soils not considered to pose a threat to human health via direct contact (i.e., incidental ingestion and dermal contact) based on the soil data to date.

SITE 1115 REMEDIAL INVESTIGATION

Risk Assessment

- ❖ TPH (in both the diesel and gasoline range) is present in soils at the former source areas. TPH does not provide concentrations of specific compounds, but instead a total concentration within a range of hydrocarbons; not possible to use TPH data to quantify the potential risk posed by specific compounds of TPH components. Instead, the potential risks to human health and to underlying groundwater were evaluated using specific detected compounds (in the risk assessment and in the leaching model). However, TPH data useful for indicating where prior releases passed through the vadose zone, leaving behind residual fuel-related compounds.
- ❖ For informational purposes, the locations of TPH concentrations above two different levels (100 milligrams per kilogram [mg/kg] and 1,000 mg/kg) in the vadose zone are shown in this document.
- ❖ The threat to ecological receptors from COPCs at Site 1115 is negligible. Not a suitable habitat for ecological receptors, and no evidence of discharge of contaminants to the ground surface or surface waters, either on site or off site.

SITE 1115 FEASIBILITY STUDY

Remedial Action Objectives

- ❖ The following RAOs were developed for Site 1115 contamination to address the protection of human health and the environment:
 - Prevent ingestion, dermal contact, and inhalation of contaminated groundwater containing COCs at concentrations in excess of cleanup levels.
 - Prevent inhalation of vapor containing COCs in excess of levels that pose a significant risk to potential future indoor air receptors.
 - Preserve and protect the watershed of the Lower San Luis Rey Hydrologic Area.

SITE 1115 FEASIBILITY STUDY

Target Treatment Zones

- ❖ Contaminated areas of Site 1115 are presented in the FS as Target Treatment Zones (TTZs). The designation of the TTZs is based upon 1) distinctive mixtures of contaminants present; 2) the relative concentrations of contaminants present; and, 3) distinct aquifer zones. TTZs are designated in this FS to facilitate the identification of appropriate technologies, processes, and remedial alternatives specific to origin, nature, extent, and location of contamination in select portions of the larger Site 1115.

SITE 1115 FEASIBILITY STUDY

Target Treatment Zones (continued)

- ❖ **TTZ-1S:** Defined as shallow aquifer groundwater in the vicinity of the former UST Site 1 gas station.
- ❖ **TTZ-1SP:** Includes shallow aquifer groundwater adjacent to TTZ-1S, representing a dilute plume of contamination, and excluding groundwater areas adjacent to the east with non-fuel related contamination (TCE, 1,2-DCE) exceeding respective MCLs .
- ❖ **TTZ-1D:** Defined as deep aquifer groundwater in the vicinity of the former UST Site 1. TTZ-1D is addressed as a near-source area with the highest benzene and 1,2-DCA concentrations, and a relatively small downgradient dilute plume area.
- ❖ **TTZ-2L:** Groundwater in the vicinity of former UST Site 9 impacted by LNAPL defines the principle treatment area for TTZ-2L; however, additional smaller areas of historically noted LNAPL have been identified in the UST Sites 5/8/17 and 6/7 areas, and are included in TTZ-2L.

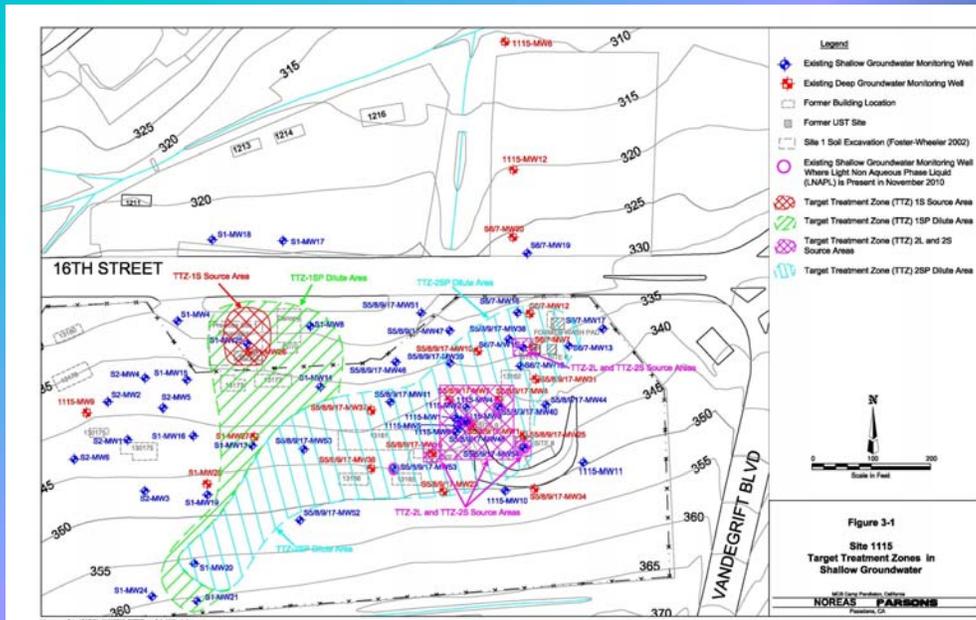
SITE 1115 FEASIBILITY STUDY

Target Treatment Zones (continued)

- ❖ **TTZ-2S:** Defined as the shallow groundwater underlying LNAPL areas defined by TTZ-2L. The CSM assumes LNAPL is a source of dissolved phase contaminants, including benzene and TCE, among other COCs; therefore, groundwater in direct contact with or close proximity to LNAPL is considered a source area.
- ❖ **TTZ-2SP:** Includes shallow aquifer groundwater downgradient/cross-gradient from TTZ-2L and TTZ-2S, extending to the edges of the dilute groundwater plume with contaminant concentrations above MCLs.
- ❖ **TTZ-2D:** Represents deep aquifer groundwater, excluding TTZ-1D, at Site 1115. Historical sampling in TTZ-2D reported groundwater concentrations exceeding MCLs; however, recent groundwater sampling, documented in this RI (Section 2) did not indicate continued impacts above MCLs in TTZ-2D. As such, potential remedial technologies, processes and alternatives for TTZ-2D are not developed in this FS.

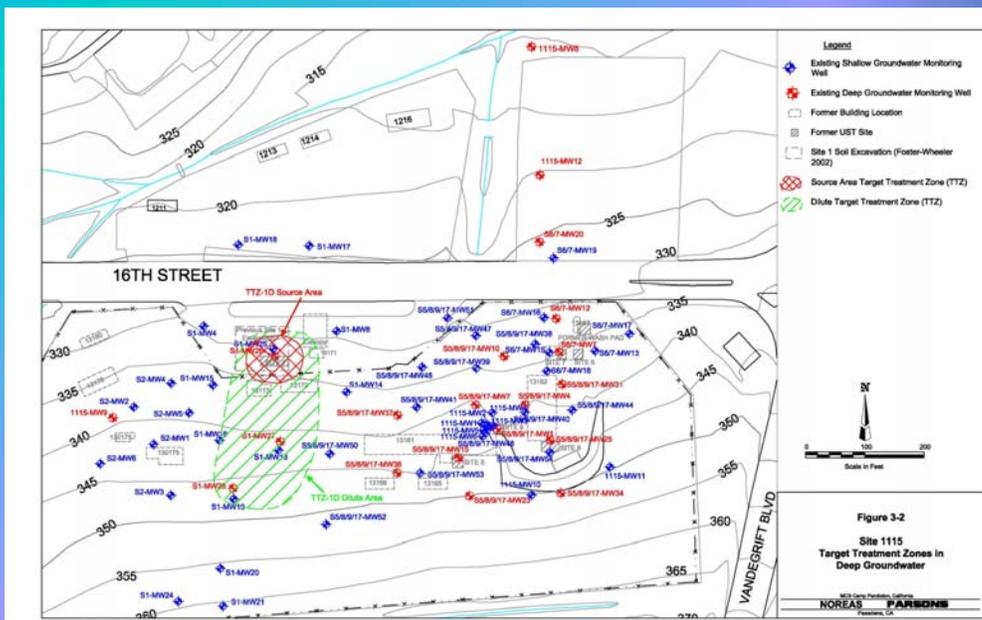
SITE 1115 FEASIBILITY STUDY

Shallow Groundwater Target Treatment Zones



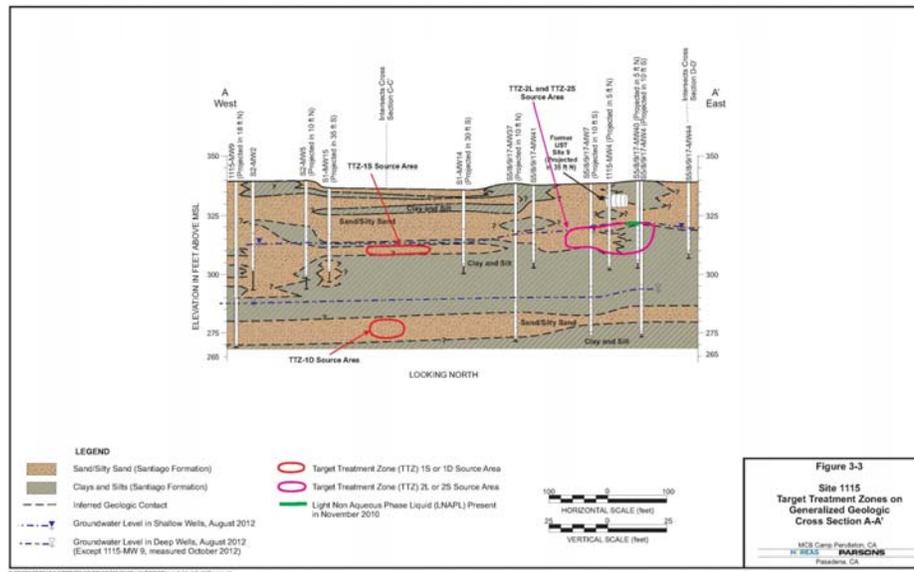
SITE 1115 FEASIBILITY STUDY

Deep Groundwater Target Treatment Zones



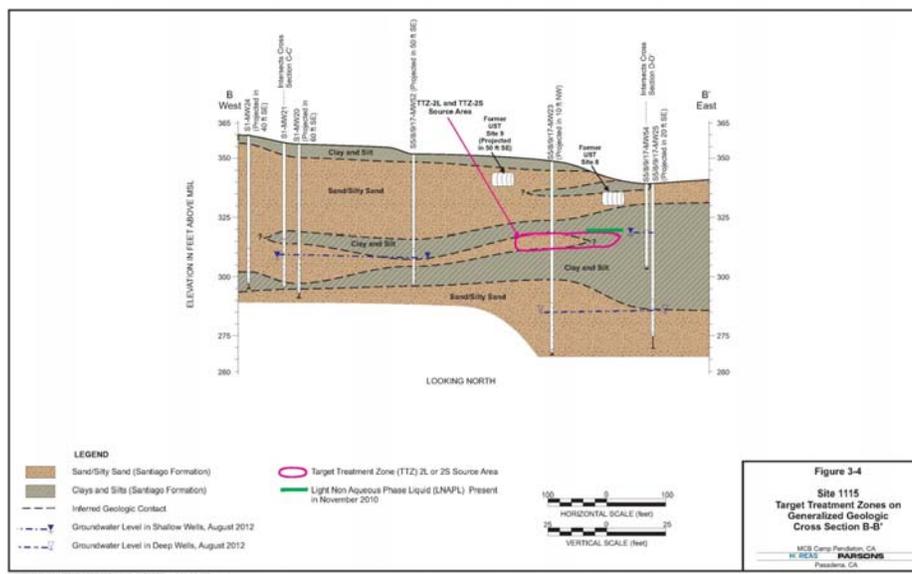
SITE 1115 FEASIBILITY STUDY

Target Treatment Zones on Cross Section A-A'



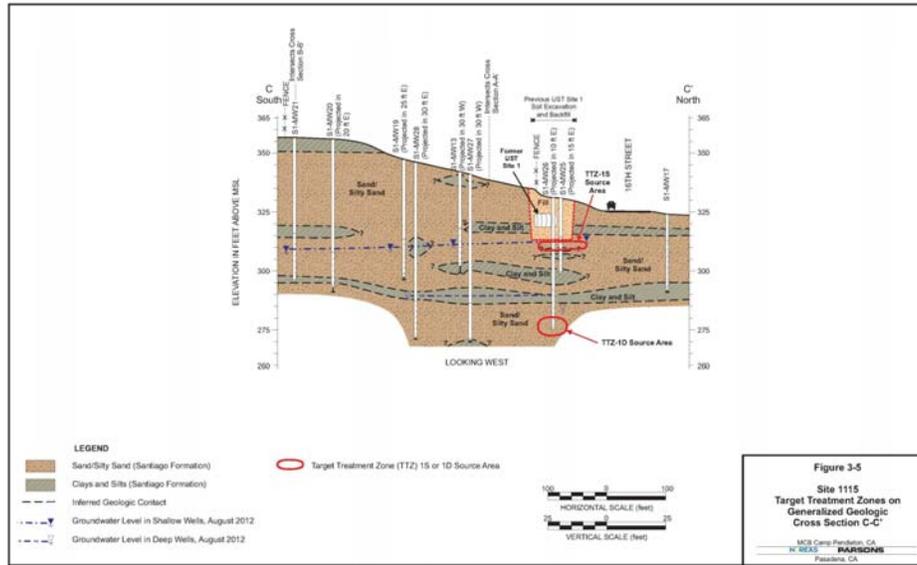
SITE 1115 FEASIBILITY STUDY

Target Treatment Zones on Cross Section B-B'



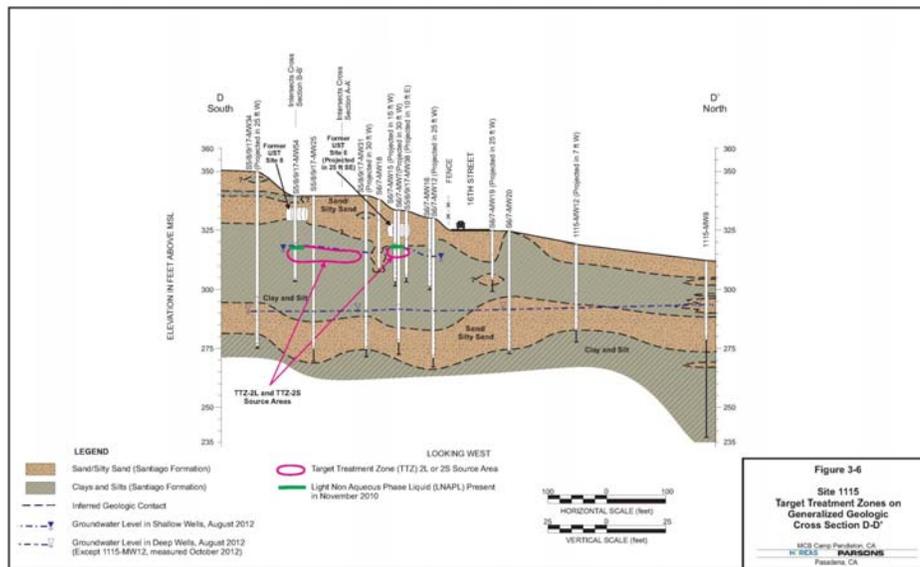
SITE 1115 FEASIBILITY STUDY

Target Treatment Zones on Cross Section C-C'



SITE 1115 FEASIBILITY STUDY

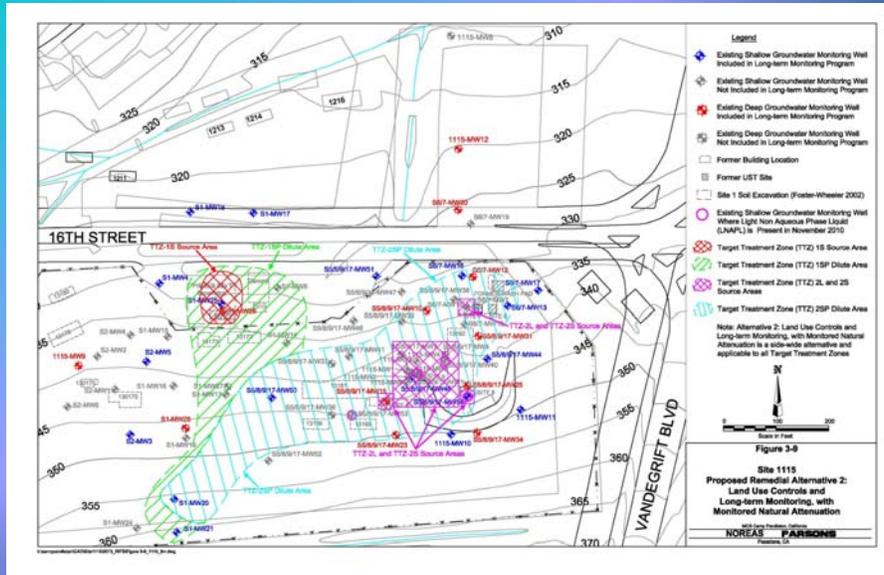
Target Treatment Zones on Cross Section D-D'



SITE 1115 FEASIBILITY STUDY

Site Wide Alternatives

- ❖ Alternative 1: No Action
- ❖ Alternative 2: Land Use Controls and Long-Term Monitoring, with Monitored Natural Attenuation



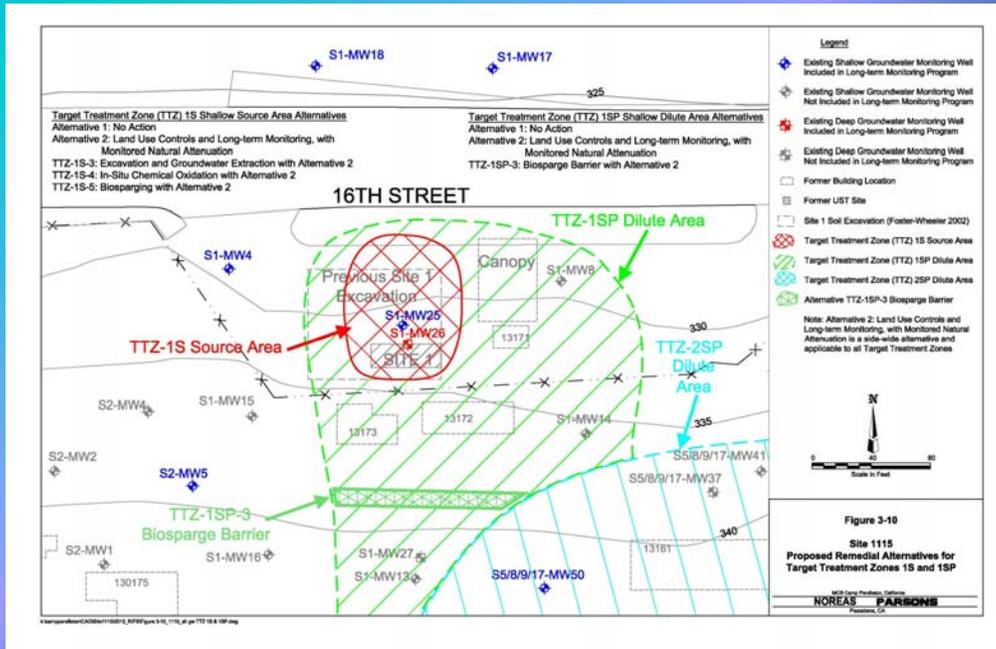
SITE 1115 FEASIBILITY STUDY

TTZ-1S Shallow Groundwater, Former UST Site 1 Area Alternatives

- ❖ Alternative 1: No Action
- ❖ Alternative 2: Land Use Controls and Long-Term Monitoring, with MNA
- ❖ Alternative TTZ-1S-3: Excavation and Groundwater Extraction with Alternative 2
- ❖ Alternative TTZ-1S-4: In Situ Chemical Oxidation with Alternative 2
- ❖ Alternative TTZ-1S-5: Biosparging with Alternative 2

SITE 1115 FEASIBILITY STUDY

TTZ-1S Shallow Groundwater, Former UST Site 1 Area Alternatives



SITE 1115 FEASIBILITY STUDY

TTZ-1S Shallow Groundwater Alternatives Rating

Summary of Comparative Analysis for Site 1115 TTZ-1S
(Shallow Aquifer Source Area Near Former UST Site 1)

Criteria	Alternative				
	Alternative 1 No Action	Alternative 2 Land Use Controls and Long Term Monitoring with MNA	TTZ-1S-3 Excavation and Groundwater Extraction with Alternative 2	TTZ-1S-4 In-Situ Chemical Oxidation with Alternative 2	TTZ-1S-5 Biosparging with Alternative 2
Threshold Criteria					
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes	Yes
Balancing Criteria					
Long-Term Effectiveness and Permanence	○	○ to ●	●	●	●
Reduction of Toxicity, Mobility, or Volume by Treatment	○	○	●	● to ●	●
Short-Term Effectiveness	Not Rated	●	● to ●	● to ●	●
Implementability	Not Rated	●	●	●	●
Cost (\$ million)	0	\$2.0	\$2.4 + Alt 2	\$2.2 + Alt 2	\$2.0 + Alt 2

○ Low ● Moderate ● High

SITE 1115 FEASIBILITY STUDY

TTZ-1SP Shallow Groundwater Dilute Plume Alternatives

- ❖ **Alternative 1: No Action**
- ❖ **Alternative 2: Land Use Controls and Long-Term Monitoring, with MNA**
- ❖ **Alternative TTZ-1SP-3: Biosparge Barrier with Alternative 2**

SITE 1115 FEASIBILITY STUDY

TTZ-1SP Shallow Groundwater Dilute Plume Alternatives Rating

**Summary of Comparative Analysis for Site 1115 TTZ-1SP
(Shallow Aquifer Dilute Plume From Former UST Site 1)**

Criteria	Alternative		
	Alternative 1 No Action	Alternative 2 Land Use Controls and Long Term Monitoring with MNA	TTZ-1SP-3 Biosparge Barrier with Alternative 2
Threshold Criteria			
Overall Protection of Human Health and the Environment	No	Yes	Yes
Compliance with ARARs	No	Yes	Yes
Balancing Criteria			
Long-Term Effectiveness and Permanence	○	○ ●	○ to ●
Reduction of Toxicity, Mobility, or Volume by Treatment	○	○	○ to ●
Short-Term Effectiveness	Not Rated	●	●
Implementability	Not Rated	●	●
Cost (\$ million)	0	\$2.2	\$2.3 + Alt 2

○ Low ● Moderate ● High

All TTZ-25 Alternatives assume implementation of TTZ-15 Source Zone Remediation

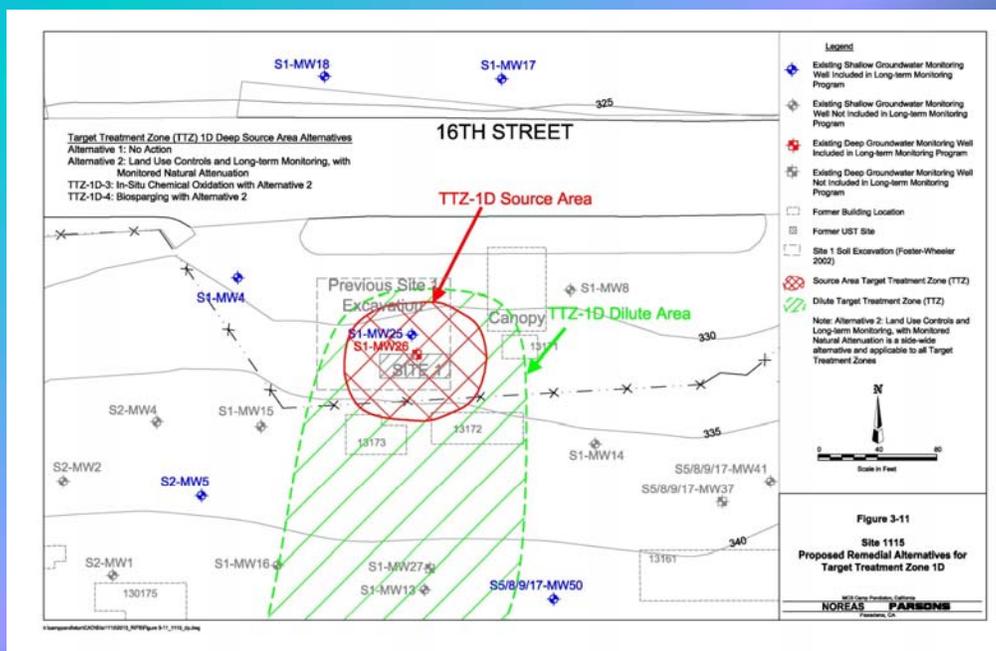
SITE 1115 FEASIBILITY STUDY

TTZ-1D Deep Groundwater, Former UST Site 1 Area Alternatives

- ❖ Alternative 1: No Action
- ❖ Alternative 2: Land Use Controls and Long-Term Monitoring, with MNA
- ❖ Alternative TTZ-1D-3: In Situ Chemical Oxidation with Alternative 2
- ❖ Alternative TTZ-1D-4: Biosparge with Alternative 2

SITE 1115 FEASIBILITY STUDY

TTZ-1D Deep Groundwater, Former UST Site 1 Area Alternatives



SITE 1115 FEASIBILITY STUDY

TTZ-1D Deep Groundwater Alternatives Rating

**Summary of Comparative Analysis for Site 1115 TTZ-1D
(Deep Aquifer Source Zone Near Former UST Site 1)**

Criteria	Alternative			
	Alternative 1 No Action	Alternative 2 Land Use Controls and Long Term Monitoring with MNA	TTZ-1D-3 In-Situ Chemical Oxidation with Alternative 2	TTZ-1D-4 Biosparging with Alternative 2
Threshold Criteria				
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes
Balancing Criteria				
Long-Term Effectiveness and Permanence	○	○ to ①	●	①
Reduction of Toxicity, Mobility, or Volume by Treatment	○	○	① to ●	①
Short-Term Effectiveness	Not Rated	①	① to ●	①
Implementability	Not Rated	●	①	①
Cost (\$ million)	0	\$2.2	\$2.3 + Alt 2	\$2.0 + Alt 2

○ Low ① Moderate ● High

Note: Implementation of either ISCO or biosparging alternatives simultaneously in the shallow and deep aquifer source zones (TTZ-1S, TTZ-1D) would result in cost efficiency savings of approximately \$0.3M

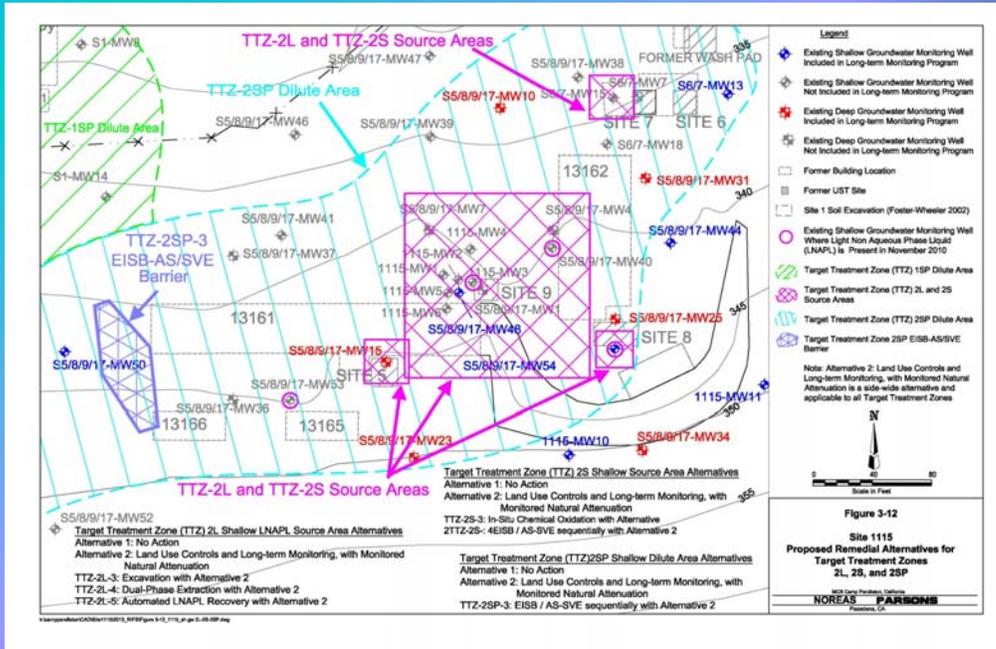
SITE 1115 FEASIBILITY STUDY

TTZ-2L LNAPL Source Zone Alternatives

- ❖ **Alternative 1: No Action**
- ❖ **Alternative 2: Land Use Controls and Long-Term Monitoring, with MNA**
- ❖ **Alternative TTZ-2L-3: Excavation and LNAPL Extraction with Alternative 2**
- ❖ **Alternative TTZ-2L-4: Dual Phase Extraction with Alternative 2**
- ❖ **Alternative TTZ-2L-5: Automated LNAPL Recovery with Alternative 2**

SITE 1115 FEASIBILITY STUDY

TTZ-2L LNAPL Source Zone Alternatives



SITE 1115 FEASIBILITY STUDY

TTZ-2L LNAPL Source Zone Alternatives Rating

Summary of Comparative Analysis for Site 1115 TTZ-2L
(Soil/LNAPL Source Zones Near Former UST Sites 5/8/9/17 and 6/7)

Criteria	Alternative				
	Alternative 1 No Action	Alternative 2 Land Use Controls and Long Term Monitoring with MNA	TTZ-2L-3 Excavation with Alternative 2	TTZ-2L-4 Dual-Phase Extraction with Alternative 2	TTZ-2L-5 Automated LNAPL Recovery with Alternative 2
Threshold Criteria					
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes	Yes
Balancing Criteria					
Long-Term Effectiveness and Permanence	○	○ to ●	●	● to ●	● to ●
Reduction of Toxicity, Mobility, or Volume by Treatment	○	○	●	● to ●	●
Short-Term Effectiveness	Not Rated	●	● to ●	● to ●	●
Implementability	Not Rated	●	●	●	●
Cost (\$ million)	0	\$2.2	\$2.6 + Alt 2	\$1.6 + Alt 2	\$1.9 + Alt 2

○ Low ● Moderate ● High

SITE 1115 FEASIBILITY STUDY

TTZ-2S Shallow Source Groundwater Alternatives

- ❖ Alternative 1: No Action
- ❖ Alternative 2: Land Use Controls and Long-Term Monitoring, with MNA
- ❖ Alternative TTZ-2S-3: In Situ Chemical Oxidation with Alternative 2
- ❖ Alternative TTZ-2S-4: Enhanced In Situ Bioremediation and Air Sparge/Soil Vapor Extraction (Sequentially), with Alternative 2

SITE 1115 FEASIBILITY STUDY

TTZ-2S Shallow Source Groundwater Alternatives Rating

Summary of Comparative Analysis for Site 1115 TTZ-2S
(Shallow Aquifer Source Zones Below LNAPL at Former UST Sites 5/8/9/17 and 6/7)

Criteria	Alternative			
	Alternative 1 No Action	Alternative 2 Land Use Controls and Long Term Monitoring with MNA	TTZ-2S-3 In-Situ Chemical Oxidation with Alternative 2	TTZ-2S-4 EISB / AS-SVE Sequentially* with Alternative 2
Threshold Criteria				
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes
Balancing Criteria				
Long-Term Effectiveness and Permanence	○	○ to ●	●	● to ●
Reduction of Toxicity, Mobility, or Volume by Treatment	○	○	●	● to ●
Short-Term Effectiveness	Not Rated	●	● to ●	●
Implementability	Not Rated	●	●	○ to ●
Cost (\$ million)	0	\$2.2	\$2.2 + Alt 2	\$3.3 EISB + \$2.5 AS-SVE

○ Low ● Moderate ● High

* Alternative TTZ-2S-4: AS-SVE would be implemented following EISB if monitoring results indicate aerobic groundwater conditions are required to sufficiently reduce residual contaminants (e.g. elevated benzene concentrations).

TTZ-2S-3 and TTZ-2S-4 assume substantial completion of LNAPL removal from TTZ-2L prior to implementation.

SITE 1115 FEASIBILITY STUDY

TTZ-2SP Shallow Groundwater Dilute Plume Alternatives

- ❖ **Alternative 1: No Action**
- ❖ **Alternative 2: Land Use Controls and Long-Term Monitoring, with MNA**
- ❖ **Alternative TTZ-2SP-3: Enhanced In Situ Bioremediation and Air Sparge/Soil Vapor Extraction Barriers (Sequentially), with Alternative 2**

SITE 1115 FEASIBILITY STUDY

TTZ-2SP Shallow Groundwater Dilute Plume Alternatives Rating

Summary of Comparative Analysis for Site 1115 TTZ-2SP
(Shallow Aquifer Dilute Plume From Former UST Sites 5/8/9/17)

Criteria	Alternative		
	Alternative 1 No Action	Alternative 2 Land Use Controls and Long Term Monitoring with MNA	TTZ-2SP-3 EISB / AS-SVE Sequentially* with Alternative 2
Threshold Criteria			
Overall Protection of Human Health and the Environment	No	Yes	Yes
Compliance with ARARs	No	Yes	Yes
Balancing Criteria			
Long-Term Effectiveness and Permanence	○	○ to ●	○ to ●
Reduction of Toxicity, Mobility, or Volume by Treatment	○	○	●
Short-Term Effectiveness	Not Rated	●	●
Implementability	Not Rated	●	○ to ●
Cost (\$ million)	0	\$2.2	\$1.0 EISB + \$1.9 AS-SVE + Alt 2

○ Low ● Moderate ● High

* Alternative TTZ-2S-4: AS-SVE would be implemented following EISB if monitoring results indicate aerobic groundwater conditions are required to sufficiently reduce residual contaminants (e.g. elevated benzene concentrations).

SITE 1115 FEASIBILITY STUDY

Cost Summary



**Table J1
Summary of Costs for Site 1115 Alternatives
MCB Camp Pendleton, CA**

Alternative	Description	Estimated Duration (Years)	Capital Cost (\$)	O&M Cost (\$)	Total Cost (\$)
1	No Action	0	\$0	\$0	\$0
2	Land Use Controls and Long-term Monitoring, with Monitored Natural Attenuation	30	\$1,020,600	\$99,253	\$2,019,853
TTZ-1S-3	Excavation and Groundwater Extraction with Alternative 2	30	\$2,430,515	\$0	\$2,430,515
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$3,451,115	\$99,253	\$4,480,388
TTZ-1S-4	In-Situ Chemical Oxidation with Alternative 2	30	\$1,980,881	\$217,854	\$2,198,735
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$3,001,481	\$1,217,107	\$4,218,588
TTZ-1S-5	Biosparging with Alternative 2	30	\$1,337,285	\$616,295	\$1,953,580
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$2,357,885	\$1,615,548	\$3,973,433
TTZ-1SP-3	Biosparge Barrier with Alternative 2	30	\$1,455,980	\$856,368	\$2,312,348
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$2,476,580	\$1,855,621	\$4,332,201
TTZ-1D-3	In-Situ Chemical Oxidation with Alternative 2	30	\$2,020,401	\$228,740	\$2,249,141
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$3,041,001	\$1,227,993	\$4,268,994
TTZ-1D-4	Biosparging with Alternative 2	30	\$1,460,516	\$473,600	\$1,934,116
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$2,481,116	\$1,472,853	\$3,953,969
TTZ-2L-3	Excavation with Alternative 2	30	\$2,589,724	\$0	\$2,589,724
	Alternative 2		\$1,020,600	\$99,253	\$2,019,853
	TOTAL		\$3,610,324	\$99,253	\$4,609,577

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SITE 1115 FEASIBILITY STUDY

SiteWise™ Green Remediation Tool

**Table K-1
Site 1115
Sustainable Remediation - Environmental Footprint Summary
MCB Camp Pendleton**

Alternative	GHG Emissions (metric tons)	Total Energy Used (MMBtu)	Water Consumption (gallons)	NOx emissions (metric tons)	SOx Emissions (metric tons)	PM10 Emissions (metric tons)	Accident Risk Fatality	Accident Risk Injury	Lost Hours - Injury	Non-Hazardous Waste Landfill (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Alternative Cost (\$)	Cost with Alternative 2 (\$)	Total Cost with Footprint Reduction (\$)
GO Target Treatment Zones															
Alternative 2: Land Use Controls and Long-term Monitoring, with Monitored Natural Attenuation	2.9E+03	4.3E+04	9.7E+04	9.4E+00	6.2E+00	2.5E-01	7.6E-03	1.9E+00	1.4E+01	9.0E+00	9.0E+00	9.0E+00	\$2,019,853	\$2,019,853	\$2,019,853
Target Treatment Zone 1S															
Alternative TTZ-1S-3: Excavation and Groundwater Extraction with Alternative 2	3.3E+03	4.8E+04	1.0E+05	1.0E+01	6.5E+00	1.5E+00	6.9E-03	2.0E+00	1.4E+01	6.1E+03	8.8E+02	3.6E+03	\$2,430,515	\$4,450,388	\$4,450,388
Alternative TTZ-1S-4: In-Situ Chemical Oxidation with Alternative 2	3.3E+03	4.9E+04	9.8E+04	9.8E+00	6.3E+00	2.7E-01	7.9E-03	1.8E+00	1.5E+01	9.4E+01	9.0E+00	9.0E+00	\$2,198,735	\$4,218,588	\$4,218,588
Alternative TTZ-1S-5: Source Area Treatment via Biosparging with Alternative 2	3.3E+03	4.9E+04	1.0E+05	1.1E+01	6.9E+00	3.0E-01	9.3E-03	2.0E+00	1.5E+01	9.4E+01	9.0E+00	9.0E+00	\$1,953,580	\$3,973,433	\$3,973,433
Target Treatment Zone 1SP															
Alternative TTZ-1SP-3: Biosparge Barrier with Alternative 2	4.6E+03	6.6E+04	1.1E+05	1.3E+01	8.8E+00	3.8E-01	1.3E-02	2.5E+00	2.8E+01	9.4E+01	9.0E+00	9.0E+00	\$2,312,348	\$4,332,201	\$4,332,201
Target Treatment Zone 1D															
Alternative TTZ-1D-3: In-Situ Chemical Oxidation with Alternative 2	3.1E+03	4.7E+04	9.8E+04	9.8E+00	6.3E+00	2.8E-01	7.9E-03	1.8E+00	1.5E+01	1.6E+02	9.0E+00	9.0E+00	\$2,249,141	\$4,268,994	\$4,268,994
Alternative TTZ-1D-4: Biosparging with Alternative 2	3.3E+03	4.9E+04	1.0E+05	1.1E+01	6.9E+00	3.1E-01	9.4E-03	2.0E+00	1.5E+01	1.4E+02	9.0E+00	9.0E+00	\$1,934,116	\$3,953,969	\$3,953,969
Target Treatment Zone 2L															
Alternative TTZ-2L-3: Excavation with Alternative 2	3.4E+03	5.0E+04	1.0E+05	1.0E+01	6.7E+00	2.2E+00	8.3E-03	2.0E+00	1.8E+01	8.8E+03	2.8E+03	3.3E+03	\$2,589,724	\$4,609,577	\$4,609,577
Alternative TTZ-2L-4: Dual-Phase Extraction with Alternative 2	3.3E+03	4.8E+04	9.8E+04	9.8E+00	6.3E+00	2.7E-01	8.6E-03	2.0E+00	1.6E+01	9.4E+01	9.0E+00	9.0E+00	\$1,920,532	\$3,640,385	\$3,640,385
Alternative TTZ-2L-5: Automated N/APL Recovery with Alternative 2	3.9E+03	4.9E+04	9.9E+04	9.9E+00	6.4E+00	2.9E-01	8.1E-03	1.9E+00	1.5E+01	1.4E+02	9.0E+00	9.0E+00	\$1,858,892	\$3,877,845	\$3,877,845
Target Treatment Zone 2S															
Alternative TTZ-2S-3: In-Situ Chemical Oxidation with Alternative 2	3.2E+03	4.8E+04	9.8E+04	9.7E+00	6.3E+00	3.3E-01	7.9E-03	1.8E+00	1.5E+01	3.8E+02	9.0E+00	9.0E+00	\$2,155,515	\$4,175,388	\$4,175,388
Alternative TTZ-2S-4: ESB / AS-BVE sequentially with Alternative 2	3.9E+03	5.0E+04	1.0E+05	1.2E+01	7.4E+00	4.1E-01	1.2E-02	2.4E+00	1.9E+01	4.2E+02	9.0E+00	9.0E+00	\$5,898,874	\$7,829,527	\$7,829,527
Target Treatment Zone 2SP															
Alternative TTZ-2SP-3: ESB / AS-BVE sequentially with Alternative 2	3.7E+03	5.4E+04	1.0E+05	1.1E+01	7.3E+00	3.4E-01	1.1E-02	2.2E+00	1.8E+01	1.4E+02	9.0E+00	9.0E+00	\$2,888,412	\$4,908,265	\$4,912,265

Several of the alternatives have a greater environmental impact than others in the various footprint categories, as noted by the color-coding of this table.
 The environmental impact for this sustainability metric (environmental footprint criteria) is lower (more favorable) for this alternative than the average for the other alternatives.
 The environmental impact for this sustainability metric (environmental footprint criteria) is about average for this alternative relative to the other alternatives.
 The environmental impact for this sustainability metric (environmental footprint criteria) is higher (less favorable) for this alternative than the average for the other alternatives.

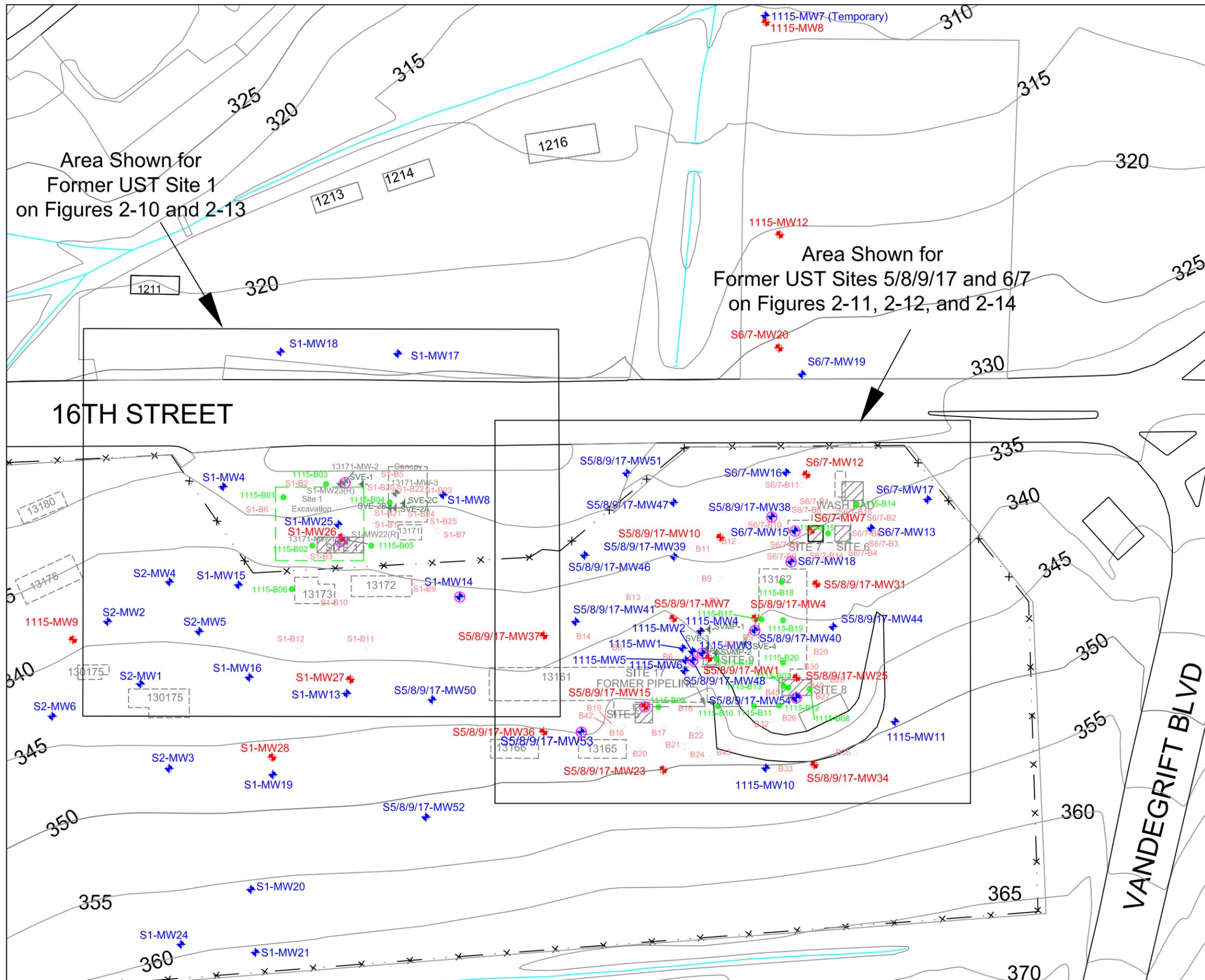


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SITE 1115 FEASIBILITY STUDY

SiteWise™ Results

- ❖ The excavation alternatives (1S-3 and 2L-3) are the only ones that have the negative effect of filling up landfill space, but otherwise the excavation alternatives are generally no more detrimental than the other alternatives in the other footprint categories, such as GHGs, total energy, air emissions, and fatalities and injuries. The excavation alternatives do use some more water than the other alternatives, but water usage is not particularly high for any one of the alternatives.
- ❖ The alternatives involving the biosparge barrier (1SP-3) and EISB/AS-SVE (2S-4 and 2SP-3) are generally more detrimental than the other alternatives in several of the environmental footprint metrics, including GHGs, total energy, air emissions and fatalities and injuries. Generally, these two alternatives are about 20% higher (i.e., worse) than the other alternatives in these environmental criteria.
- ❖ Land Use Controls, Long-Term Monitoring, with Monitored Natural Attenuation is the alternative, as would be expected, that has generally the lowest impacts in the various environmental footprint criteria.



- Legend**
- Shallow Groundwater Monitoring Well
 - Deep Groundwater Monitoring Well
 - Former Building Location
 - Former UST Site
 - Site 1 Soil Excavation (Foster-Wheeler 2002)
 - Groundwater Monitoring Well Where LNAPL Has Historically Been Present
 - Approximate Soil Boring Location Sampled in 1994
 - Approximate Soil Boring Location Sampled in 2000
 - Soil Boring Location Sampled in 2009

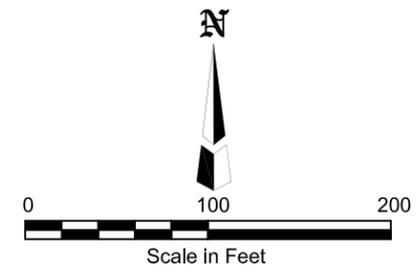
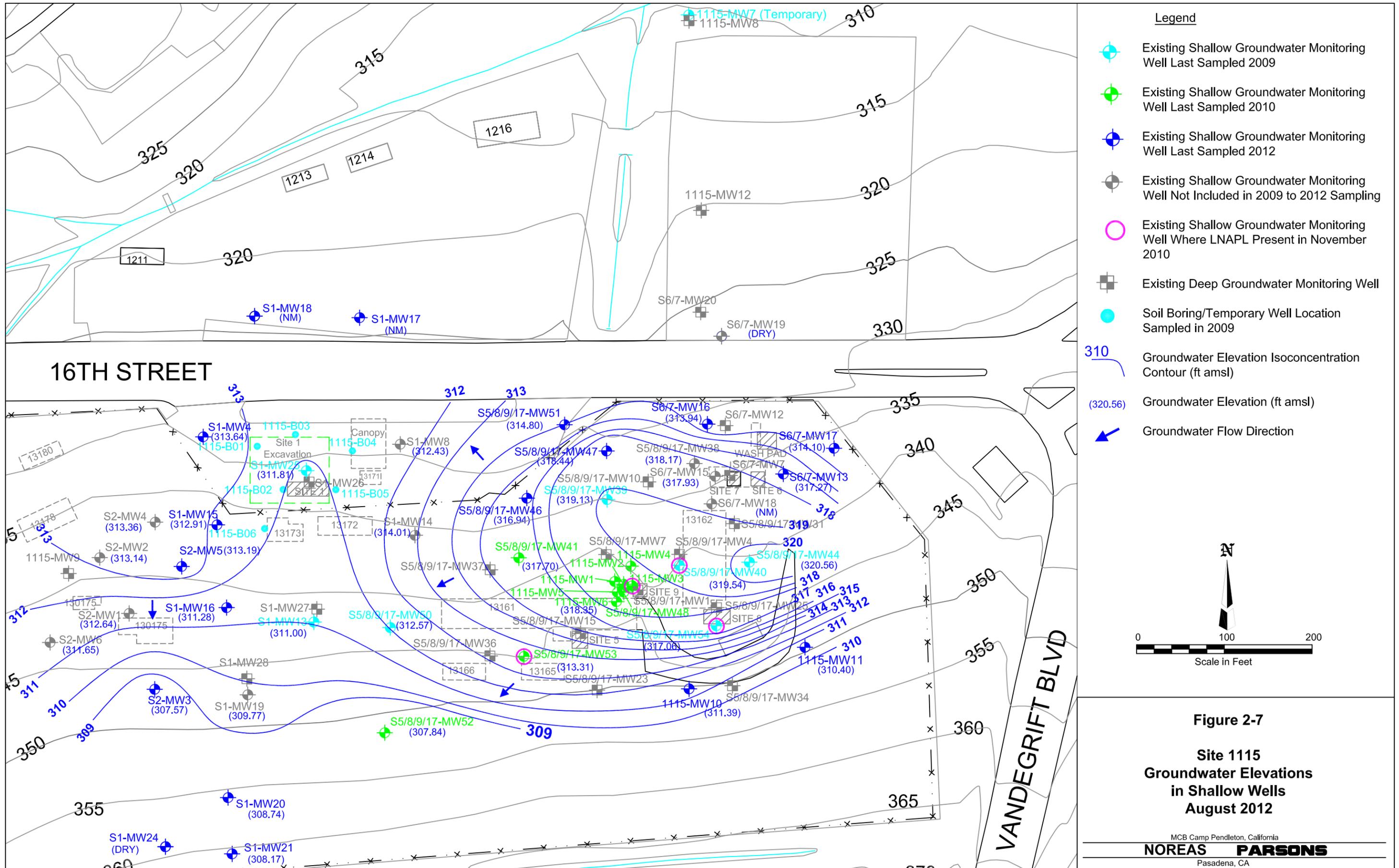
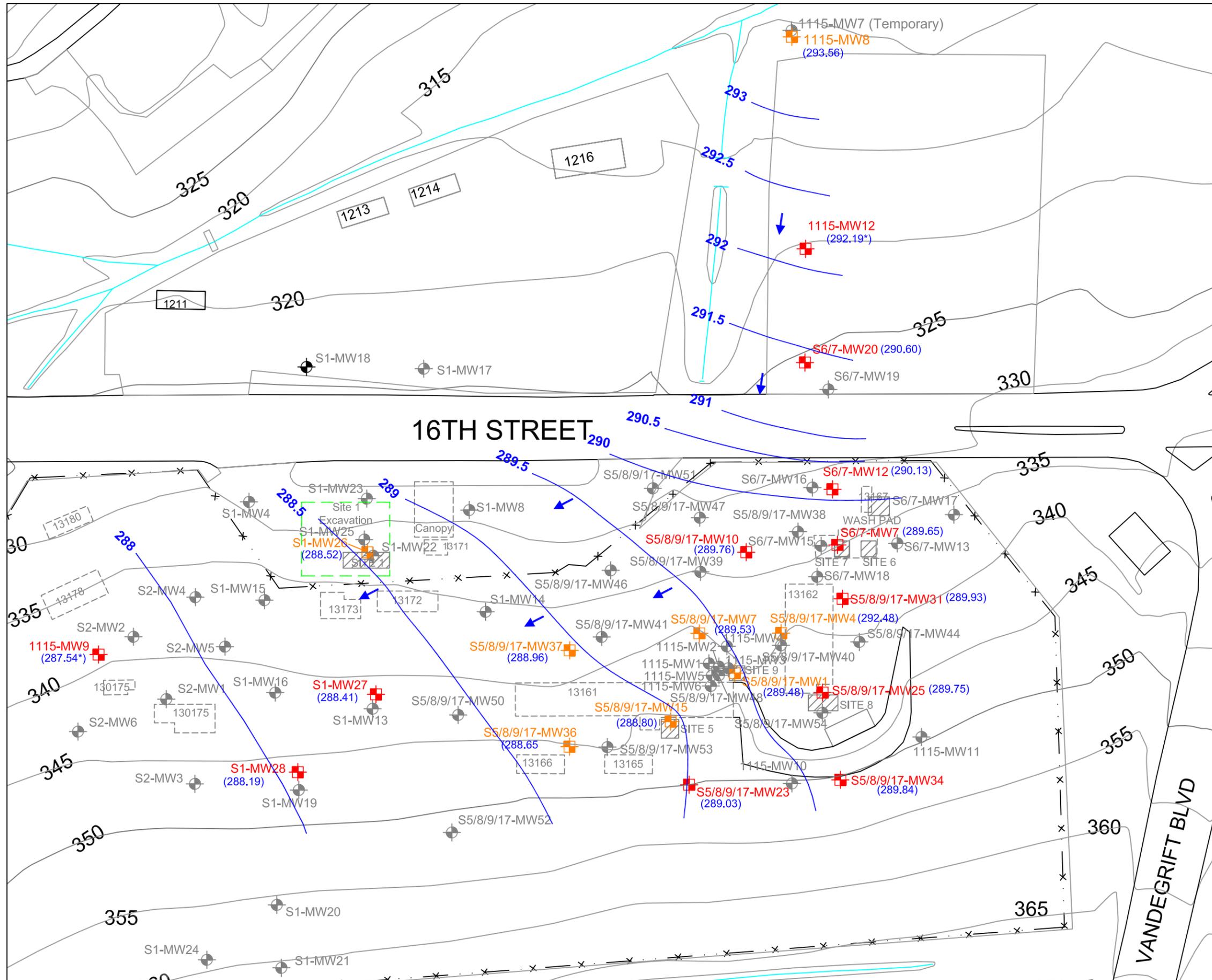


Figure 2-9
Site 1115
Soil Sample Locations
and Inset Map Locations

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Legend

- Existing Shallow Groundwater Monitoring Well
- Existing Deep Groundwater Monitoring Well Last Sampled 2009
- Existing Deep Groundwater Monitoring Well Last Sampled 2012
- 292 Groundwater Elevation Isoconcentration Contour (ft amsl)
- (290.13) Groundwater Elevation (ft amsl)
- (292.19*) Groundwater Elevation Measured October 2012 at wells 1115-MW9 and 1115-MW12
- Groundwater Flow Direction

Note: Elevation data for well S5/8/9/17-MW4 is anomalous and is not used in the contour plot

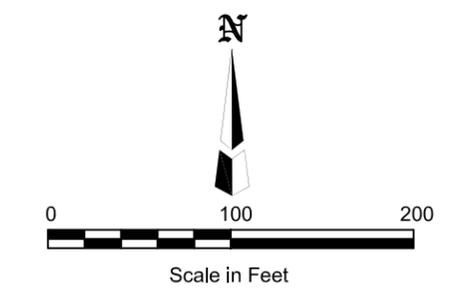
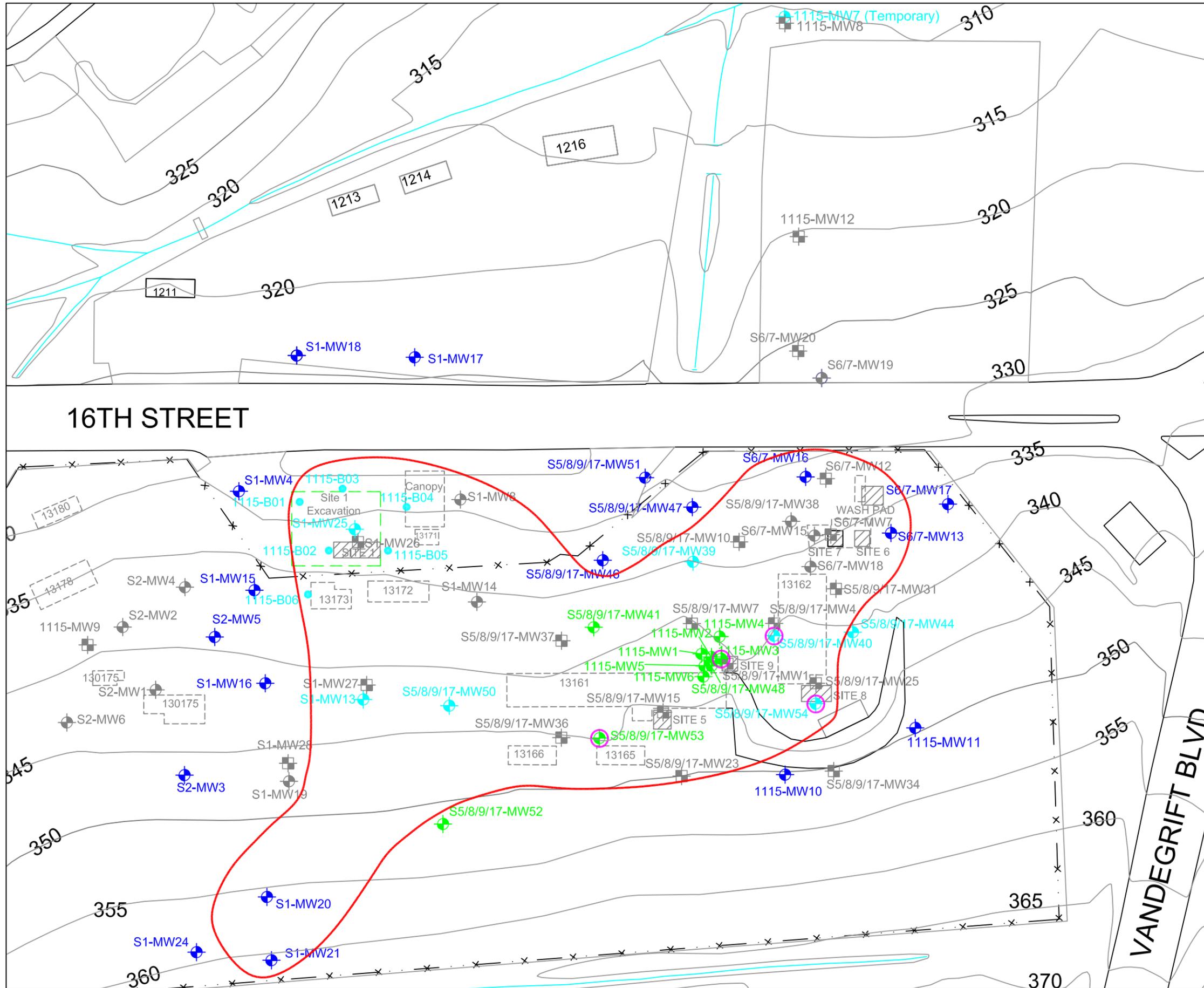


Figure 2-8
Site 1115
Groundwater Elevations
in Deep Wells
August 2012

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Legend

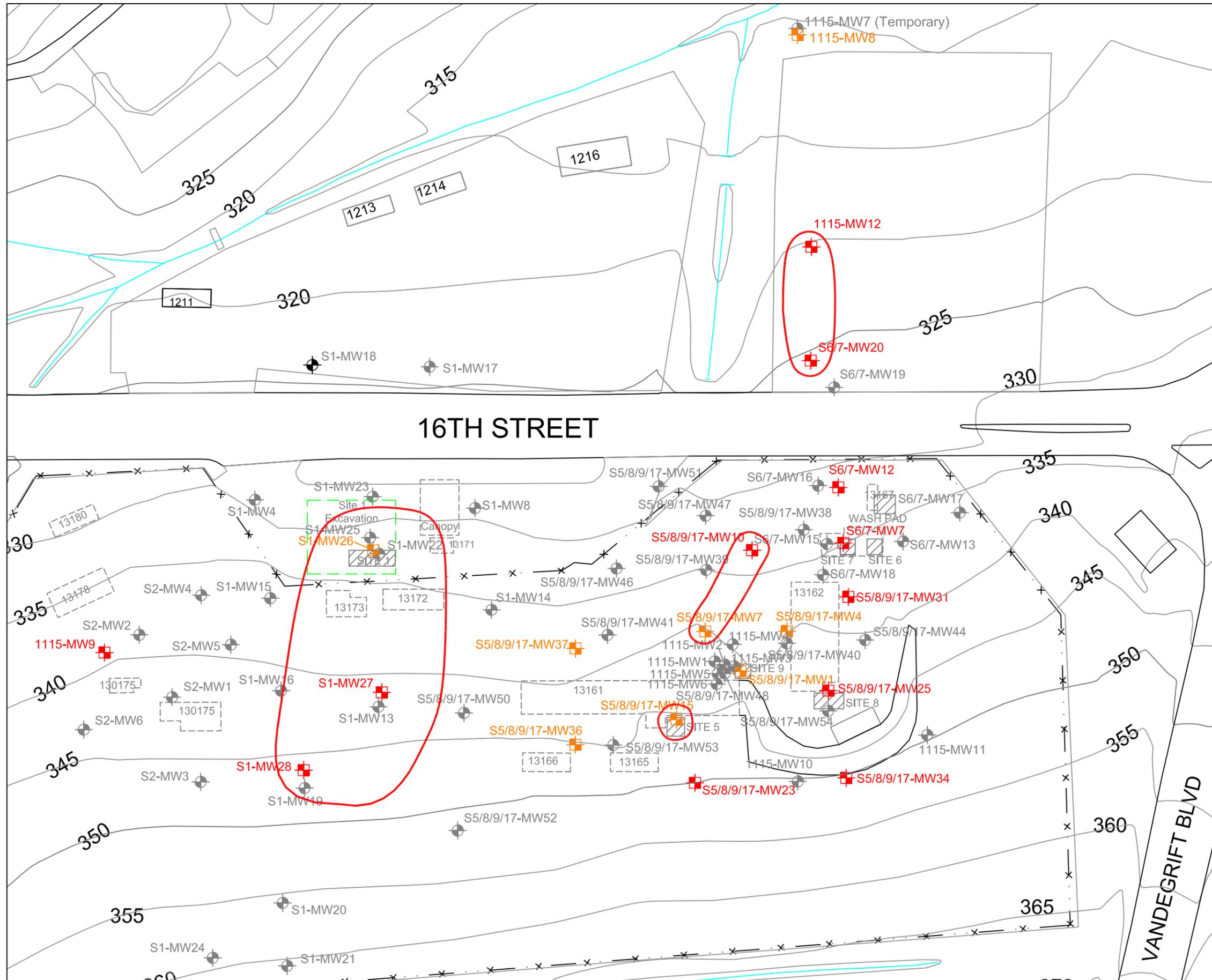
- Existing Shallow Groundwater Monitoring Well Last Sampled 2009
- Existing Shallow Groundwater Monitoring Well Last Sampled 2010
- Existing Shallow Groundwater Monitoring Well Last Sampled 2012
- Existing Shallow Groundwater Monitoring Well Not Included in 2009 to 2012 Sampling
- Existing Shallow Groundwater Monitoring Well Where LNAPL Present in November 2010
- Existing Deep Groundwater Monitoring Well
- Soil Boring/Temporary Well Location Sampled in 2009
- Extent of COPCs Detected Above MCLs or RLs

Scale in Feet

Figure 2-24

Site 1115
Extent of COPCs Detected Above
MCLs or RLs
Shallow Groundwater Zone

MCB Camp Pendleton, California
NOREAS **PARSONS**
Pasadena, CA



- Legend**
- Existing Shallow Groundwater Monitoring Well
 - Existing Deep Groundwater Monitoring Well Sampled 2009
 - Existing Deep Groundwater Monitoring Well Sampled 2012
 - Extent of COPCs Detected Above MCLs or RLs

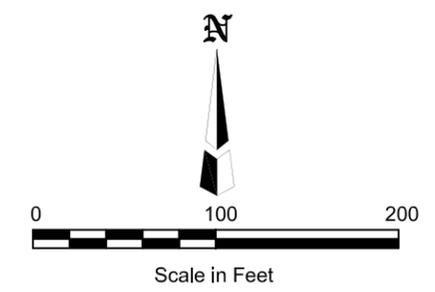
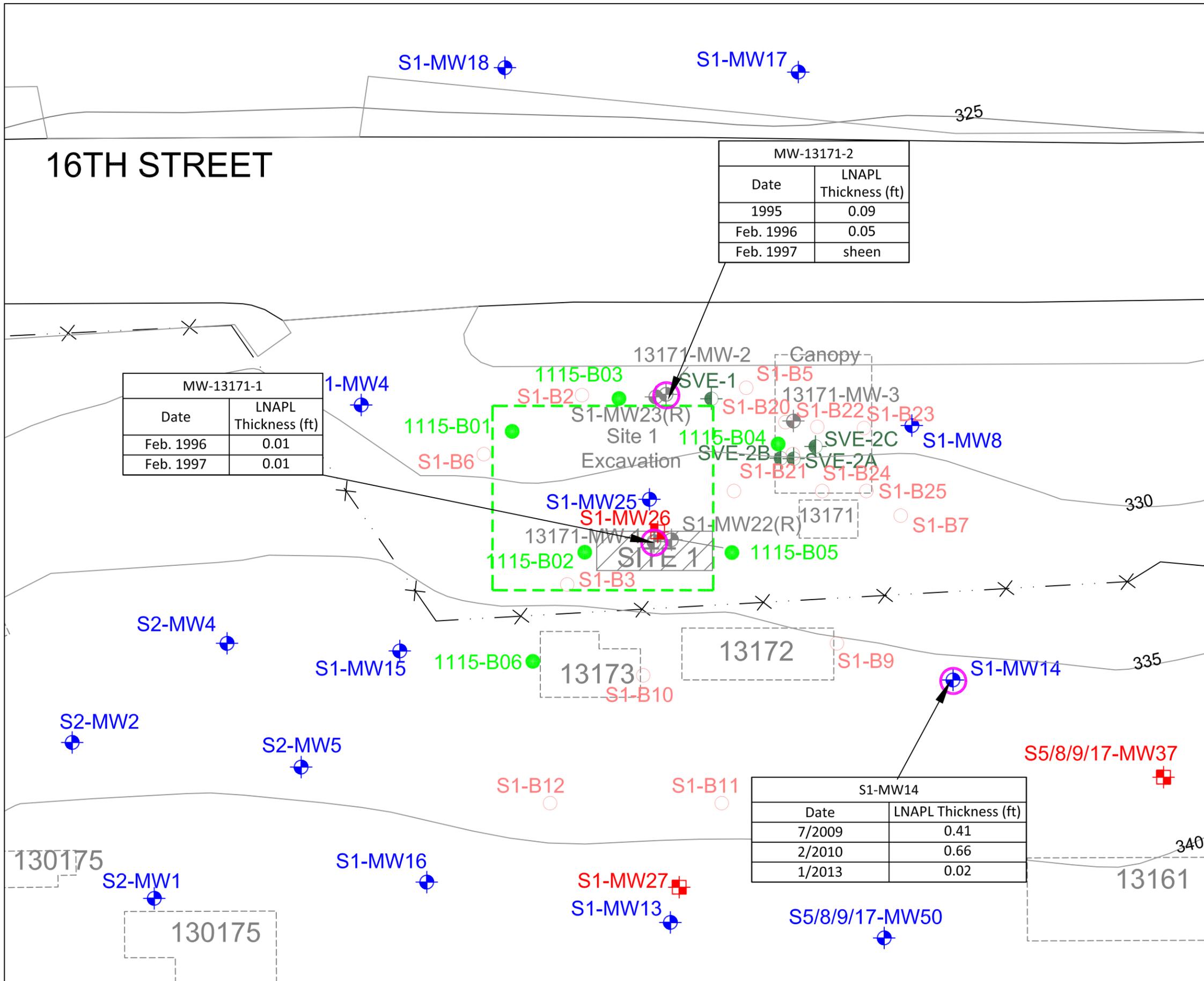


Figure 2-25
Site 1115
Extent of COPCs Detected Above
MCLs or RLs
Deep Groundwater Zone



MW-13171-2	
Date	LNAPL Thickness (ft)
1995	0.09
Feb. 1996	0.05
Feb. 1997	sheen

MW-13171-1	
Date	LNAPL Thickness (ft)
Feb. 1996	0.01
Feb. 1997	0.01

S1-MW14	
Date	LNAPL Thickness (ft)
7/2009	0.41
2/2010	0.66
1/2013	0.02

- Legend**
- Shallow Groundwater Monitoring Well
 - Deep Groundwater Monitoring Well
 - Former Building Location
 - Former UST Site
 - Site 1 Soil Excavation (Foster-Wheeler 2002)
 - Groundwater Monitoring Well Where LNAPL Has Historically Been Present
 - Approximate Soil Boring Location Sampled in 1994
 - Approximate Soil Boring Location Sampled in 2000
 - Soil Boring Location Sampled in 2009

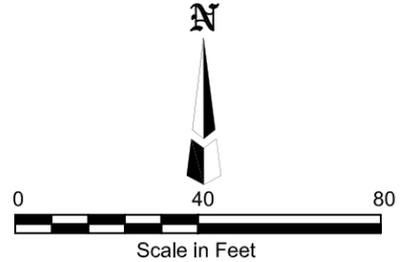


Figure 2-10
Site 1115
Former UST Site 1
LNAPL Observations

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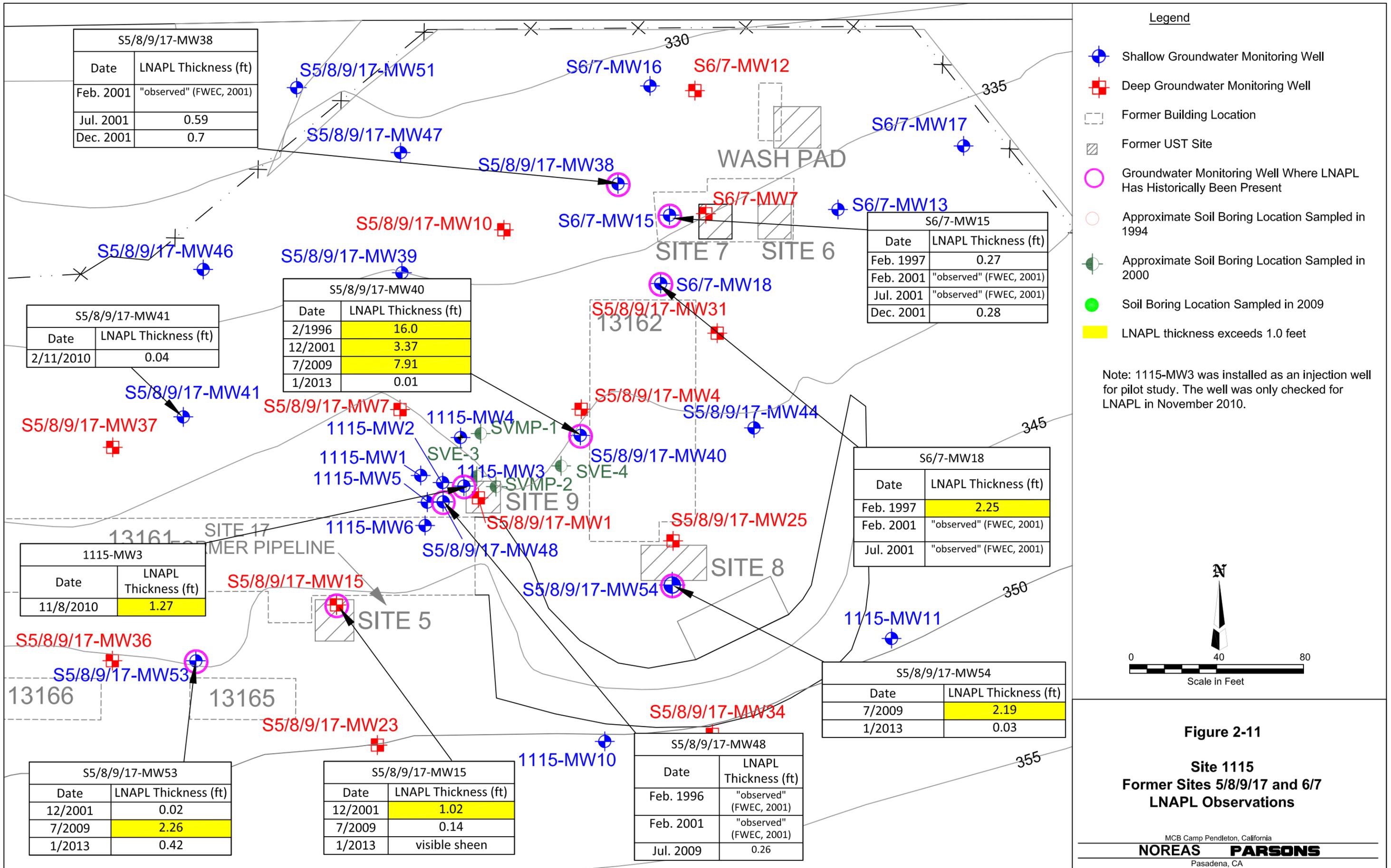
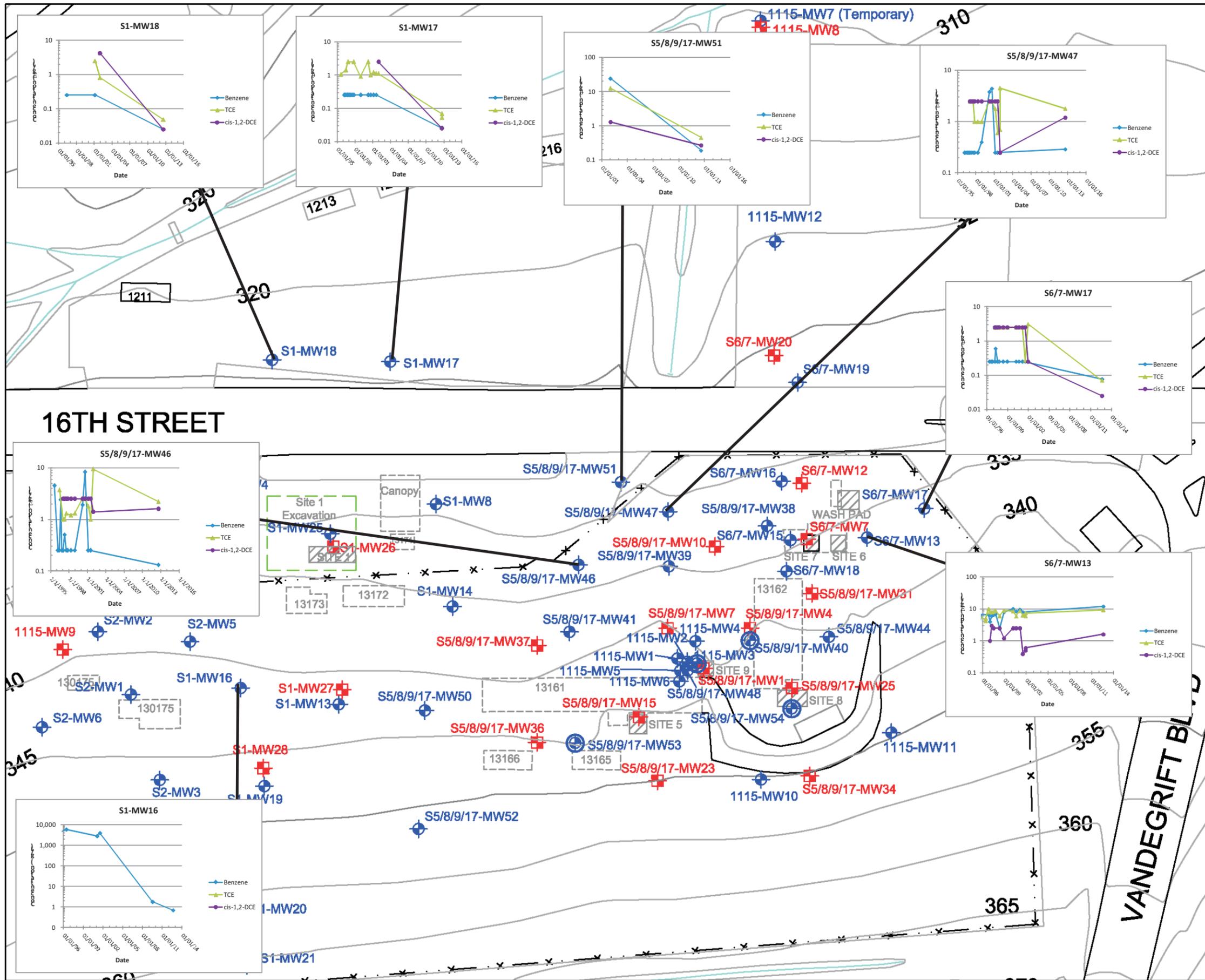


Figure 2-11
Site 1115
Former Sites 5/8/9/17 and 6/7
LNAPL Observations

k:\cappendleton\cad\Site1115\2013_RIFS\Figure 2-11-12-13_1115 soil other sites.dwg



Legend

- Shallow Groundwater Monitoring Well
- Deep Groundwater Monitoring Well

Scale in Feet

0 100 200

Figure 2-26

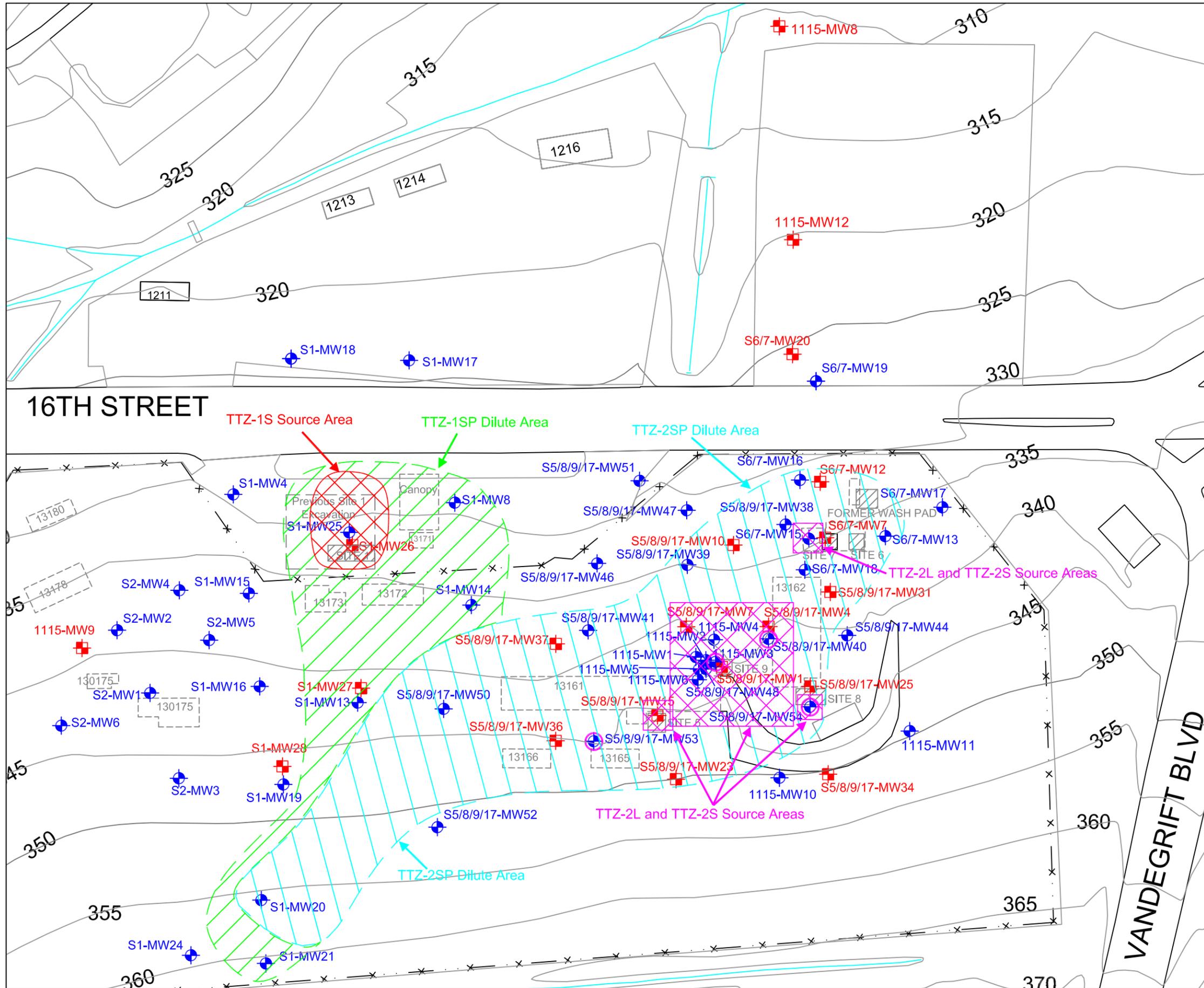
Site 115

Leading Edge Contaminant Concentration Trends in Shallow Groundwater

MCB Camp Pendleton, California

NOREAS PARSONS

Pasadena, CA



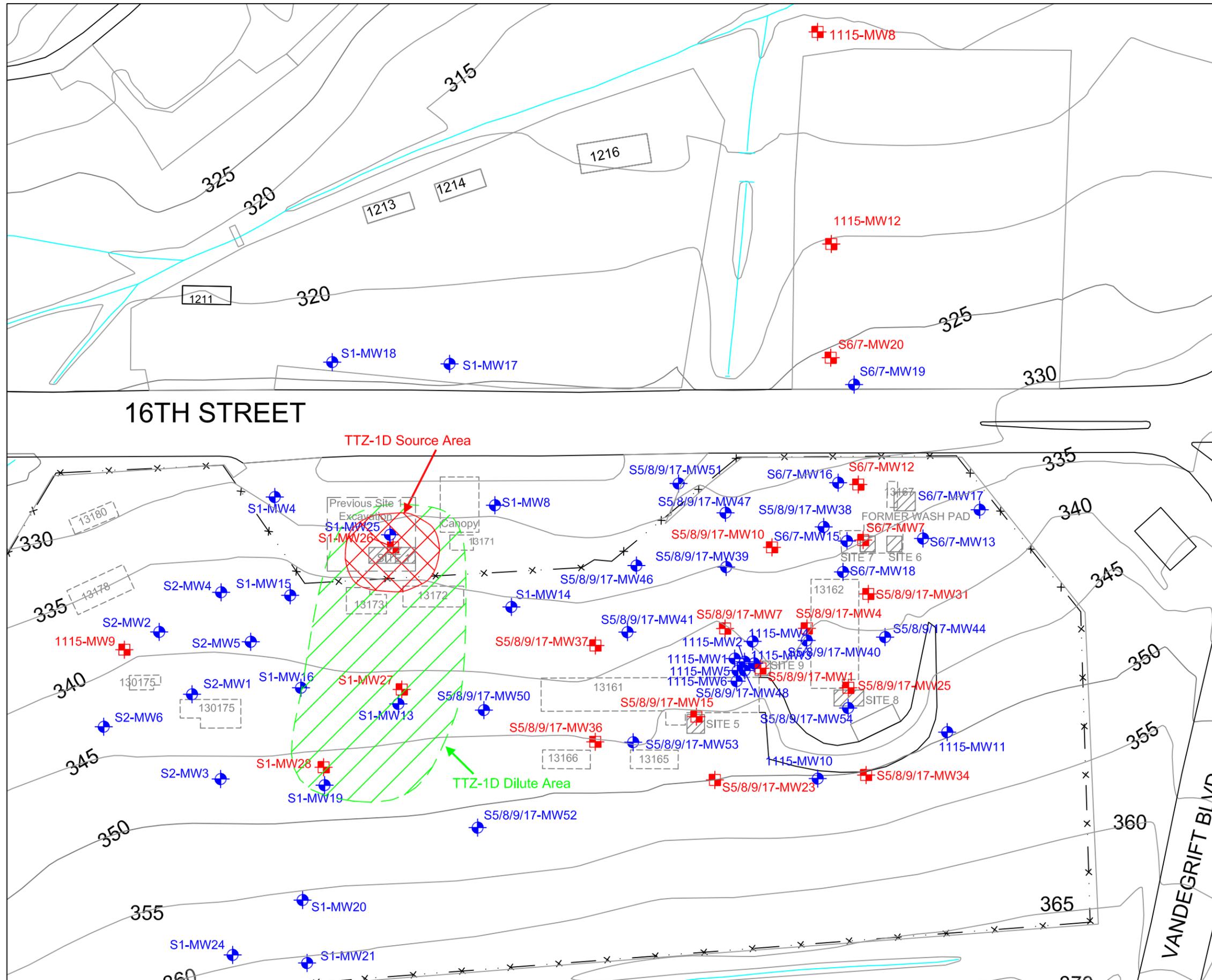
Legend

- Existing Shallow Groundwater Monitoring Well
- Existing Deep Groundwater Monitoring Well
- Former Building Location
- Former UST Site
- Site 1 Soil Excavation (Foster-Wheeler 2002)
- Existing Shallow Groundwater Monitoring Well Where Light Non Aqueous Phase Liquid (LNAPL) is Present in November 2010
- Target Treatment Zone (TTZ) 1S Source Area
- Target Treatment Zone (TTZ) 1SP Dilute Area
- Target Treatment Zone (TTZ) 2L and 2S Source Areas
- Target Treatment Zone (TTZ) 2SP Dilute Area

Scale in Feet
 0 100 200

Figure 3-1
Site 1115
Target Treatment Zones in
Shallow Groundwater

MCB Camp Pendleton, California
NOREAS **PARSONS**
 Pasadena, CA



- Legend**
- Existing Shallow Groundwater Monitoring Well
 - Existing Deep Groundwater Monitoring Well
 - Former Building Location
 - Former UST Site
 - Site 1 Soil Excavation (Foster-Wheeler 2002)
 - Source Area Target Treatment Zone (TTZ)
 - Dilute Target Treatment Zone (TTZ)

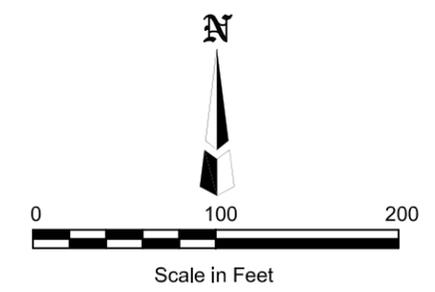
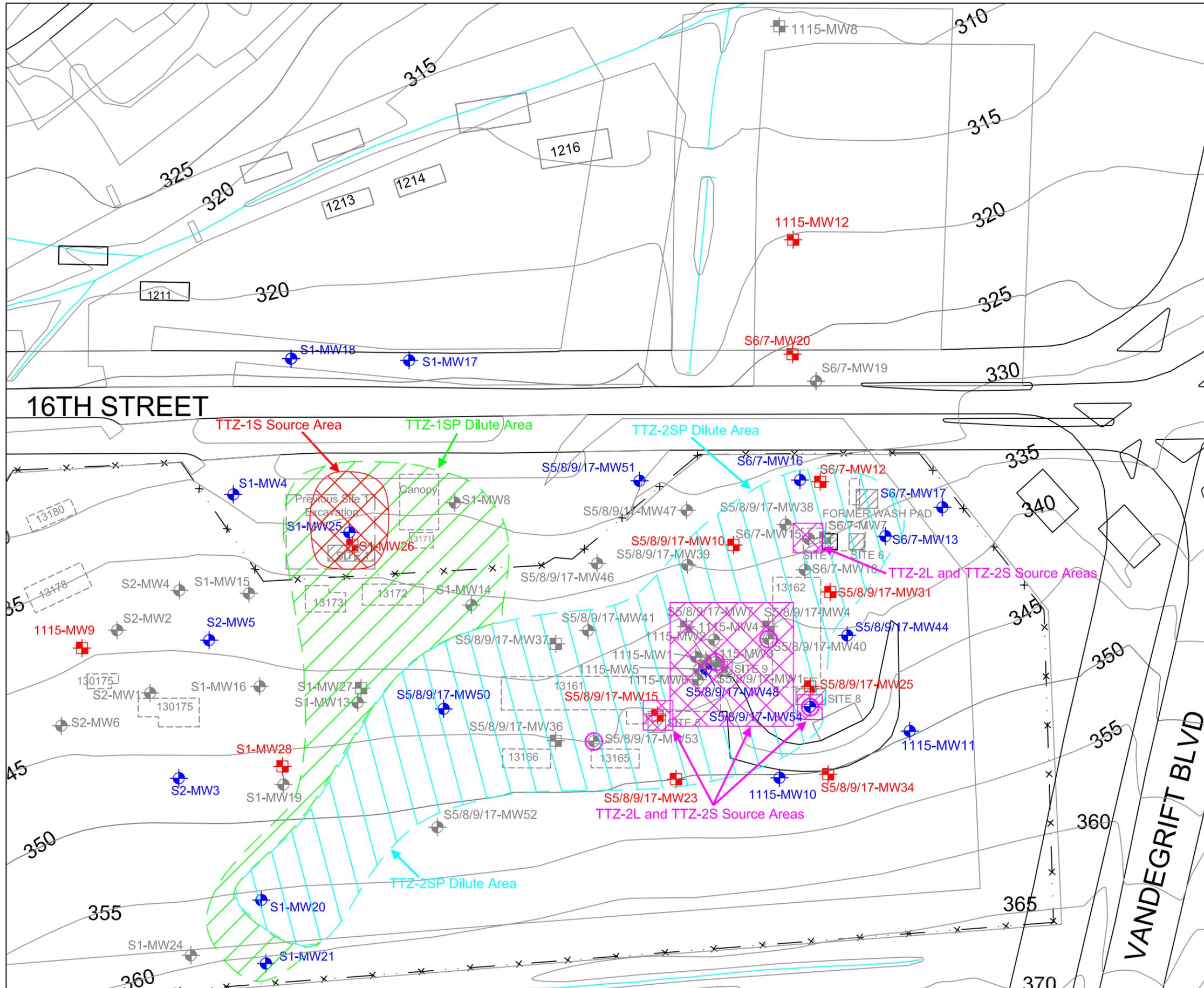


Figure 3-2
Site 1115
Target Treatment Zones in
Deep Groundwater

MCB Camp Pendleton, California
NOREAS **PARSONS**
 Pasadena, CA



Legend

- Existing Shallow Groundwater Monitoring Well Included in Long-term Monitoring Program
- Existing Shallow Groundwater Monitoring Well Not Included in Long-term Monitoring Program
- Existing Deep Groundwater Monitoring Well Included in Long-term Monitoring Program
- Existing Deep Groundwater Monitoring Well Not Included in Long-term Monitoring Program
- Former Building Location
- Former UST Site
- Site 1 Soil Excavation (Foster-Wheeler 2002)
- Existing Shallow Groundwater Monitoring Well Where Light Non Aqueous Phase Liquid (LNAPL) is Present in November 2010
- Target Treatment Zone (TTZ) 1S Source Area
- Target Treatment Zone (TTZ) 1SP Dilute Area
- Target Treatment Zone (TTZ) 2L and 2S Source Areas
- Target Treatment Zone (TTZ) 2SP Dilute Area

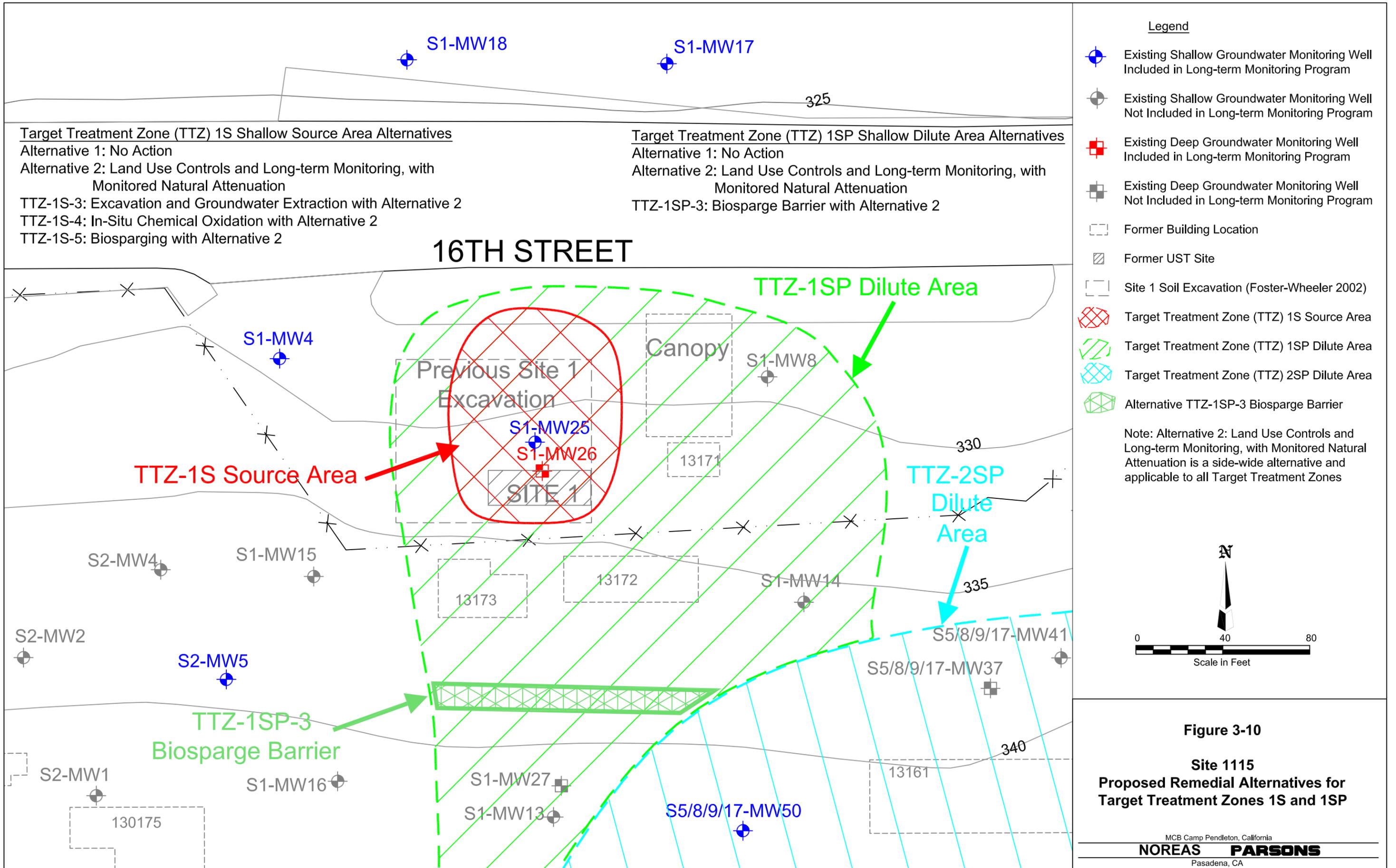
Note: Alternative 2: Land Use Controls and Long-term Monitoring, with Monitored Natural Attenuation is a side-wide alternative and applicable to all Target Treatment Zones

Scale in Feet

Figure 3-9

Site 1115
Proposed Remedial Alternative 2:
Land Use Controls and
Long-term Monitoring, with
Monitored Natural Attenuation

MCB Camp Pendleton, California
NOREAS **PARSONS**
 Pasadena, CA



Target Treatment Zone (TTZ) 1S Shallow Source Area Alternatives

- Alternative 1: No Action
- Alternative 2: Land Use Controls and Long-term Monitoring, with Monitored Natural Attenuation
- TTZ-1S-3: Excavation and Groundwater Extraction with Alternative 2
- TTZ-1S-4: In-Situ Chemical Oxidation with Alternative 2
- TTZ-1S-5: Biosparging with Alternative 2

Target Treatment Zone (TTZ) 1SP Shallow Dilute Area Alternatives

- Alternative 1: No Action
- Alternative 2: Land Use Controls and Long-term Monitoring, with Monitored Natural Attenuation
- TTZ-1SP-3: Biosparge Barrier with Alternative 2

Legend

- Existing Shallow Groundwater Monitoring Well Included in Long-term Monitoring Program
- Existing Shallow Groundwater Monitoring Well Not Included in Long-term Monitoring Program
- Existing Deep Groundwater Monitoring Well Included in Long-term Monitoring Program
- Existing Deep Groundwater Monitoring Well Not Included in Long-term Monitoring Program
- Former Building Location
- Former UST Site
- Site 1 Soil Excavation (Foster-Wheeler 2002)
- Target Treatment Zone (TTZ) 1S Source Area
- Target Treatment Zone (TTZ) 1SP Dilute Area
- Target Treatment Zone (TTZ) 2SP Dilute Area
- Alternative TTZ-1SP-3 Biosparge Barrier

Note: Alternative 2: Land Use Controls and Long-term Monitoring, with Monitored Natural Attenuation is a side-wide alternative and applicable to all Target Treatment Zones

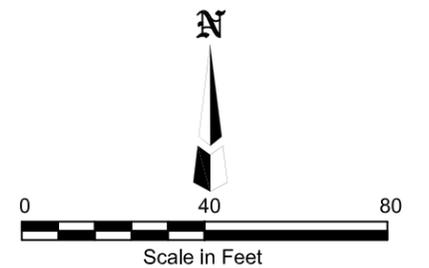
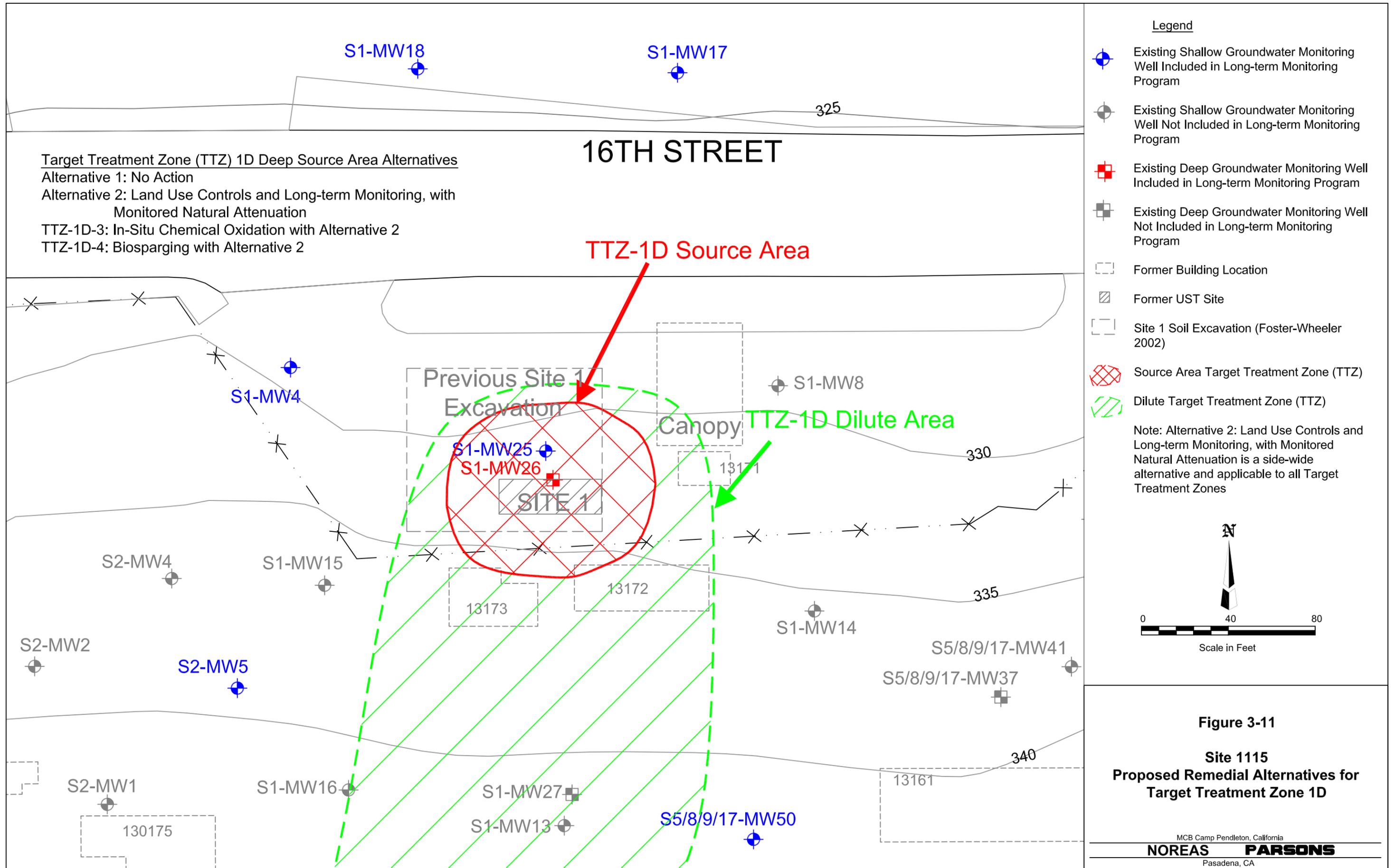


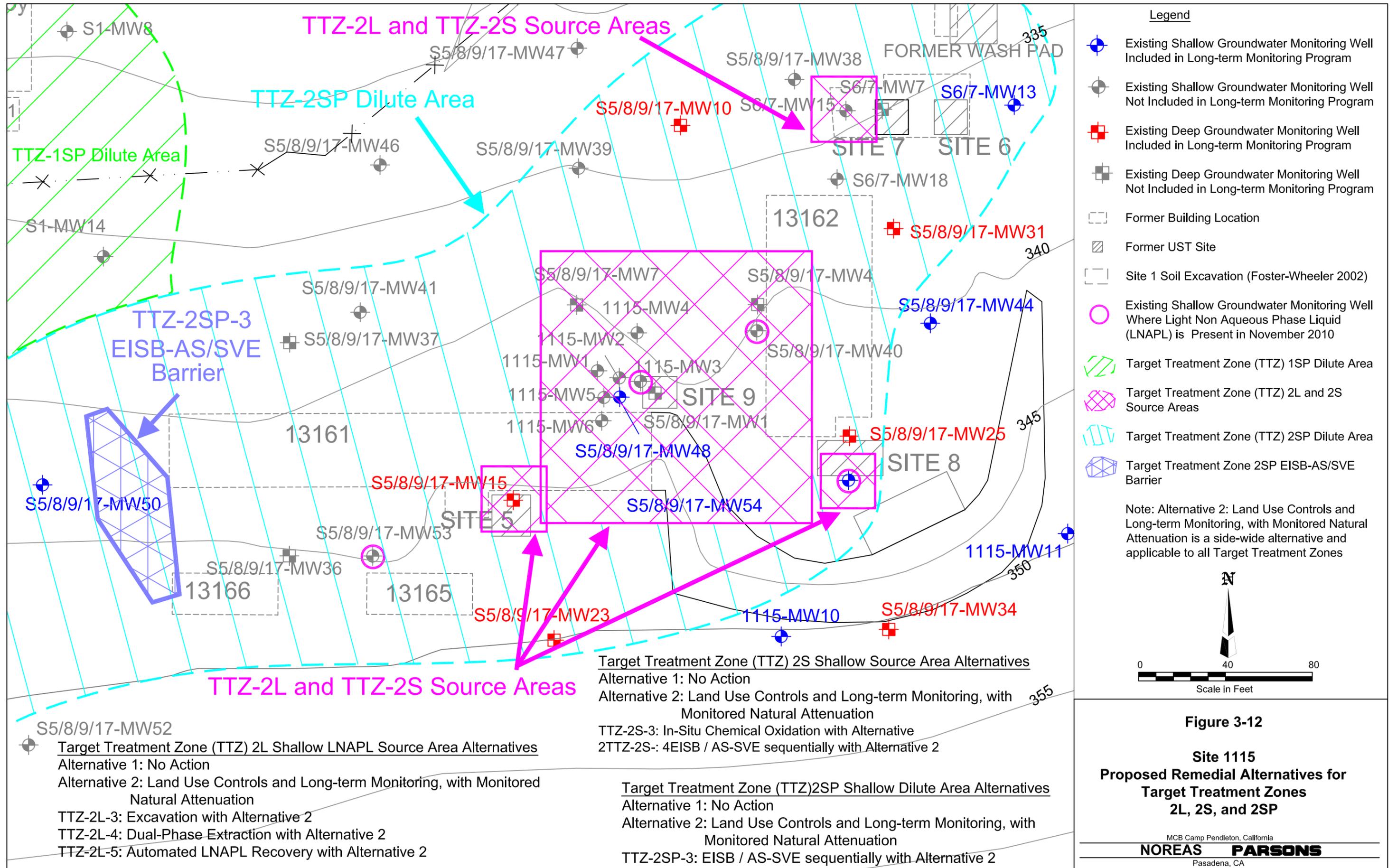
Figure 3-10

**Site 1115
Proposed Remedial Alternatives for
Target Treatment Zones 1S and 1SP**

MCB Camp Pendleton, California

NOREAS **PARSONS**
Pasadena, CA







MCB CAMP PENDLETON 22/23 AREA GROUNDWATER WELL SITING STUDY (CHAPPO SUBBASIN)

16 May 2013

110th FFA Meeting



CHAPPO SUBBASIN INVESTIGATION

Update:

- ❖ December 3, 2012 - Briefed OWR on the IR Program, this IR Site, and the New Well
- ❖ December 5, 2012 – Sent Final Sampling and Analysis Plan to FFA Team
- ❖ December 28, 2012 - Sampled Well CH-5A with HydraSleeves for 1,2,3,-TCP – Preliminary Results ND.
- ❖ January 18, 2013 – Collected Passive Diffusion Bags (PDBs) from CH-5A for all other VOCs – toluene, ethylbenzene, and xylenes detected below MCLs and RSLs





CHAPPO SUBBASIN INVESTIGATION

Update:

- ❖ January 22 to February 28 - Installed monitoring wells at four locations (20 total wells)
- ❖ Alternate location for CSB-MW2 was approved by MCAS (biological, air space clear zones, utilities, rig mast height, and operational constraints).
- ❖ March 4 to 8 - Well development
- ❖ March 12 to 14 – Well sampling

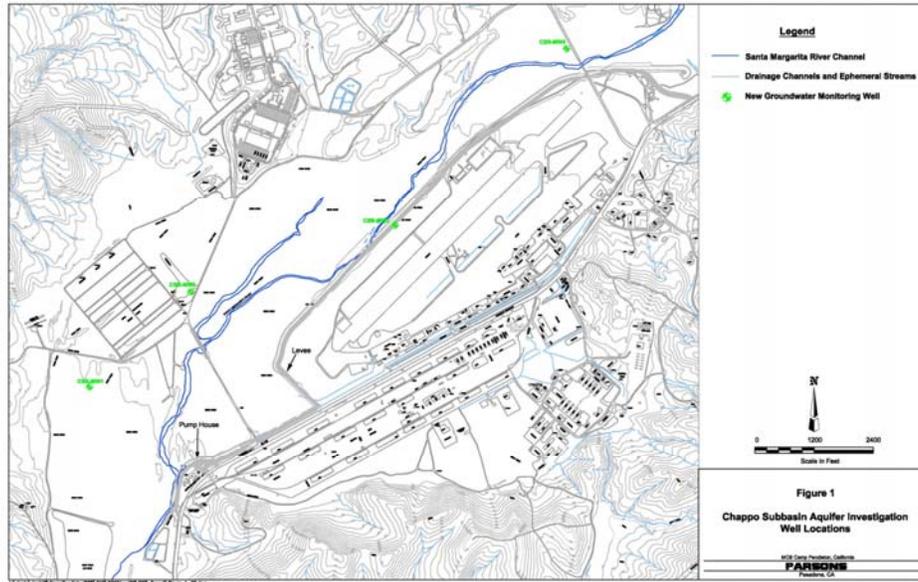


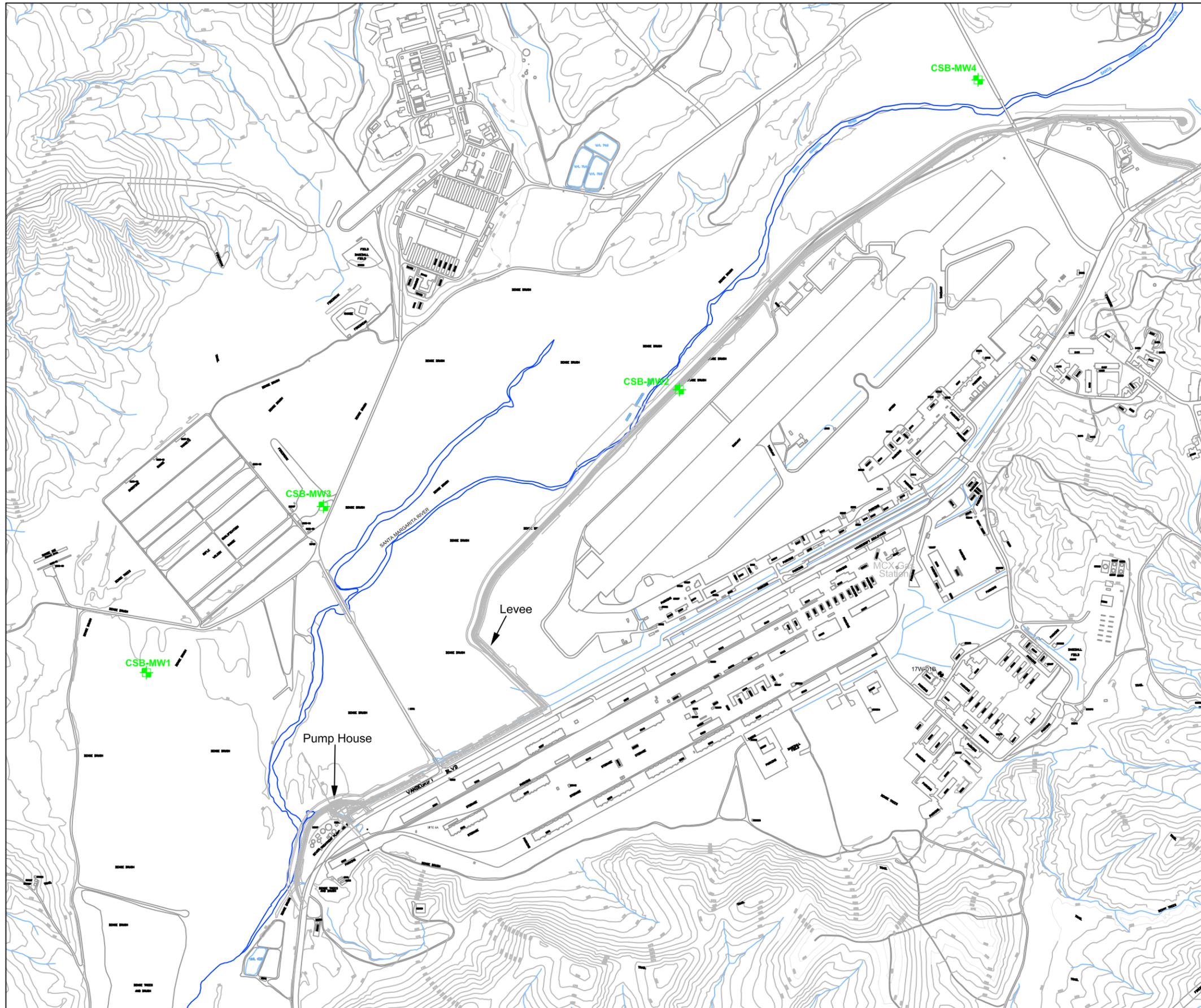
CHAPPO SUBBASIN INVESTIGATION

Update:

- ❖ Finalize data from 20 new wells
- ❖ Work with Base OWR and ES to agree on next test well location
- ❖ Install, develop, and sample new well
- ❖ Conduct pumping Test
- ❖ Finalize all results and include in technical memorandum

CHAPPO SUBBASIN INVESTIGATION





Legend

- Santa Margarita River Channel
- Drainage Channels and Ephemeral Streams
- + New Groundwater Monitoring Well

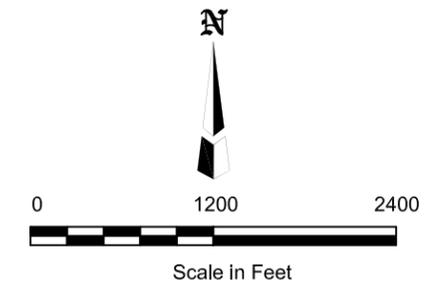


Figure 1
Chappo Subbasin Aquifer Investigation
Well Locations

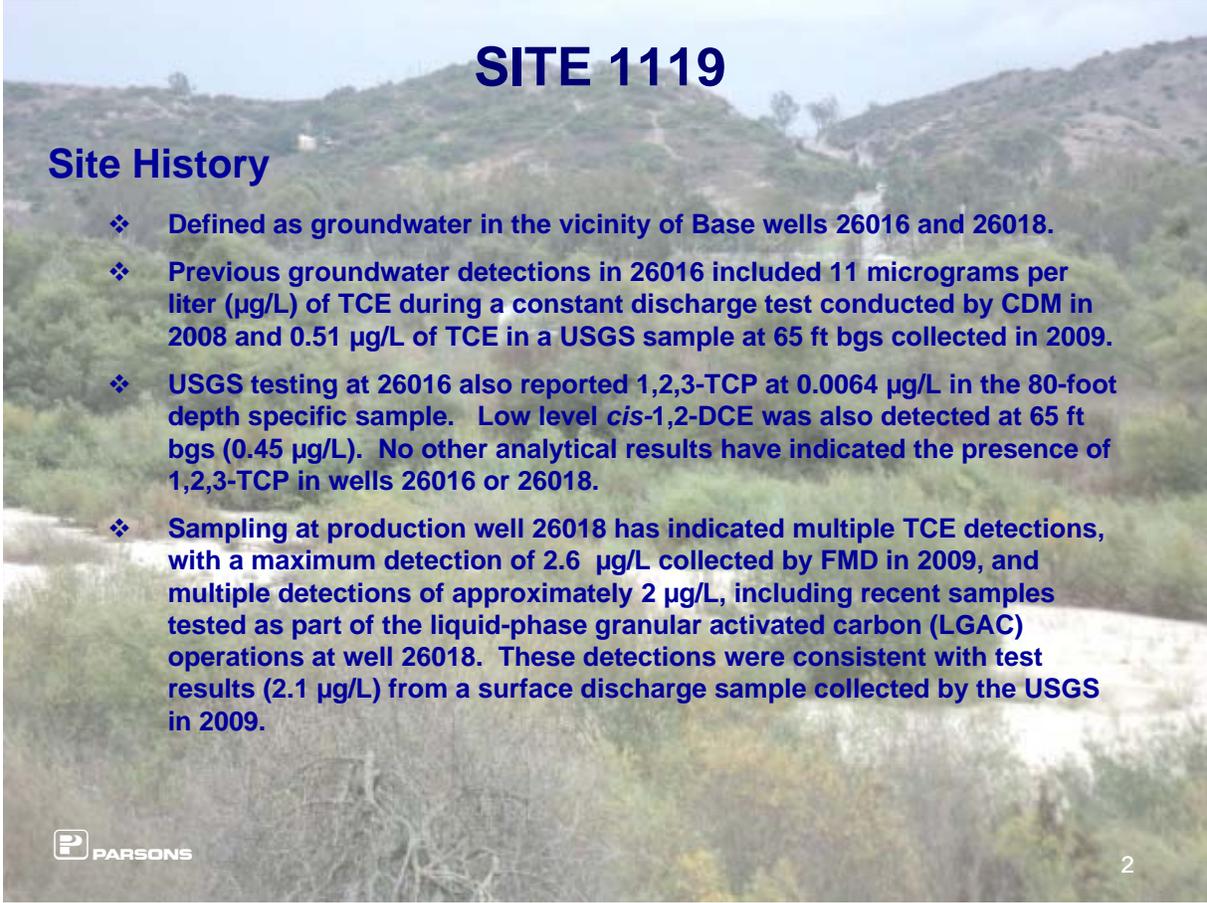
MCB Camp Pendleton, California
PARSONS
 Pasadena, CA



MCB CAMP PENDLETON SITE 1119 PROJECT UPDATE

16 May 2013

110th FFA Meeting

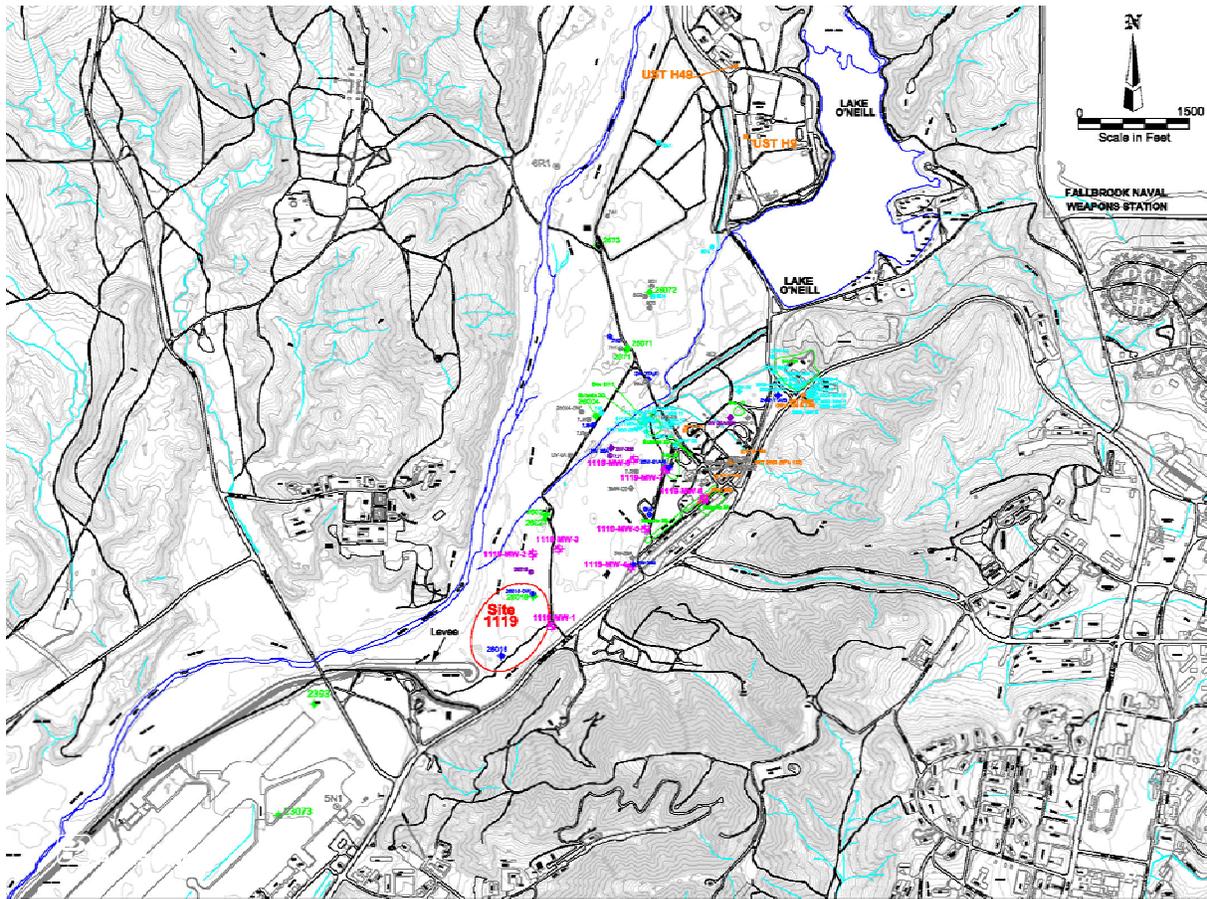


SITE 1119

Site History

- ❖ Defined as groundwater in the vicinity of Base wells 26016 and 26018.
- ❖ Previous groundwater detections in 26016 included 11 micrograms per liter ($\mu\text{g/L}$) of TCE during a constant discharge test conducted by CDM in 2008 and 0.51 $\mu\text{g/L}$ of TCE in a USGS sample at 65 ft bgs collected in 2009.
- ❖ USGS testing at 26016 also reported 1,2,3-TCP at 0.0064 $\mu\text{g/L}$ in the 80-foot depth specific sample. Low level *cis*-1,2-DCE was also detected at 65 ft bgs (0.45 $\mu\text{g/L}$). No other analytical results have indicated the presence of 1,2,3-TCP in wells 26016 or 26018.
- ❖ Sampling at production well 26018 has indicated multiple TCE detections, with a maximum detection of 2.6 $\mu\text{g/L}$ collected by FMD in 2009, and multiple detections of approximately 2 $\mu\text{g/L}$, including recent samples tested as part of the liquid-phase granular activated carbon (LGAC) operations at well 26018. These detections were consistent with test results (2.1 $\mu\text{g/L}$) from a surface discharge sample collected by the USGS in 2009.





SITE 1119

2011 Fieldwork Summary

July 2011 - Measured water levels in 47 existing wells. Pull old pumps to sample. Sampled 12 existing wells.

Collected groundwater samples at 26016 and 26018-OW using passive diffusion bags (PDBs) and hydrasleeves.

August 2011 - New well locations determined based on initial groundwater sampling results and review of data from Stetson Engineers, including depth to bedrock and alluvial thickness maps. Summary email sent to Team.

September 2011 - Based on review of additional well data provided at meeting, two additional existing OWR wells (7J1 and 26019) were sampled using passive diffusion bags (PDBs) and hydrasleeves.



SITE 1119

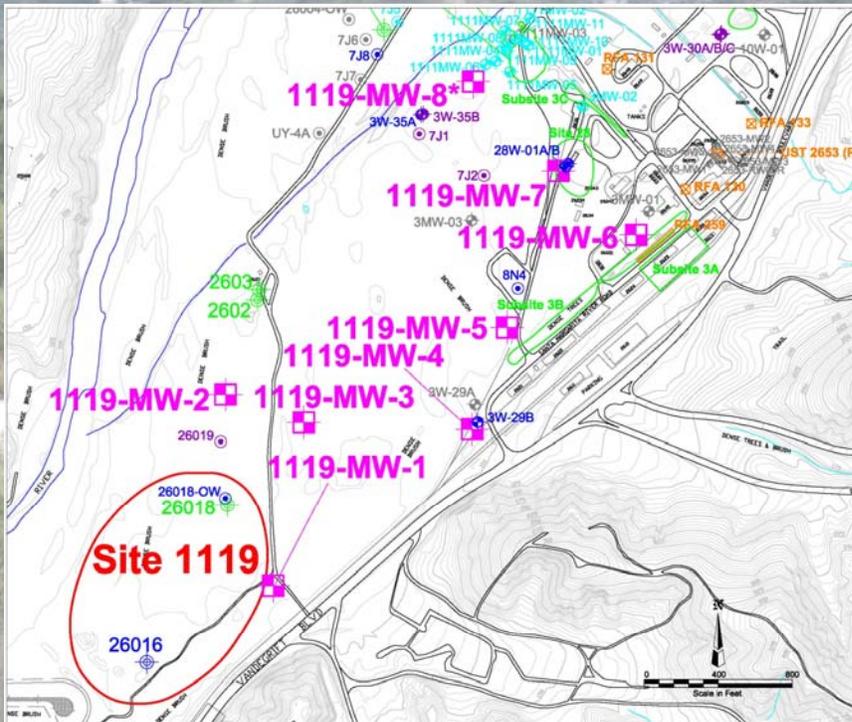
2001 Fieldwork Summary (continued)

- October 2011 - Toad fencing installed at three locations.
- November 2011 - Installed 26 new monitoring wells at 8 locations. Began well development.
- December 2011 - Completed well development. Collected groundwater samples from the 26 new wells and 4 existing wells that could not be sampled during the breeding season (bringing the total to 78 groundwater samples collected from discrete well screens and PDBs and hydrasleeves).



SITE 1119

Well Locations



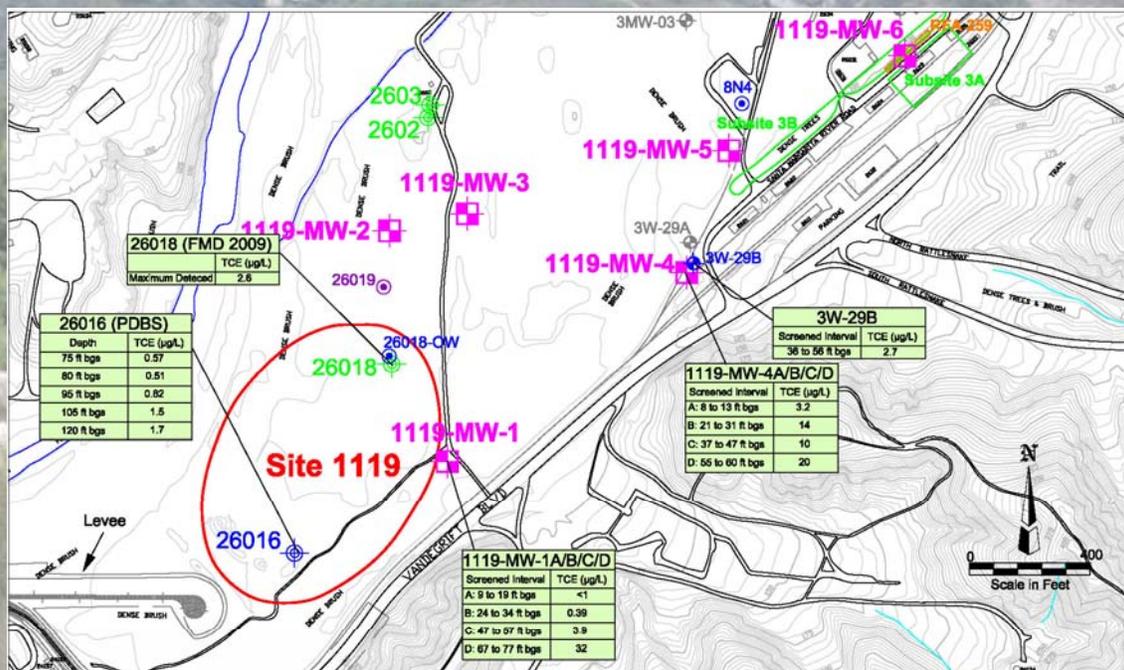
SITE 1119

Results to Date

- ❖ TCE detected in new monitoring wells MW-1 and MW-4 at multiple depths.
- ❖ TCE concentrations increase with depth (closer to bedrock).
- ❖ Highest concentrations along southeast edge of valley (i.e., southeast edge of aquifer), limited to downstream of Rattlesnake Canyon.
- ❖ Possible source area near former train depot.
- ❖ Higher concentrations historically detected in Well 26016 than in 26018; Well 26016 is closer to southeast edge of valley.
- ❖ The various locations where VOCs were not detected helps to isolate the potential source location of TCE at Site 1119 (i.e., former sites in a large upgradient portion of the basin are not contributing sources).

SITE 1119

2011 TCE Detections



SITE 1119

Additional Investigation

- ❖ **Objective: To further define the area of contamination identified in the first mobilization.**

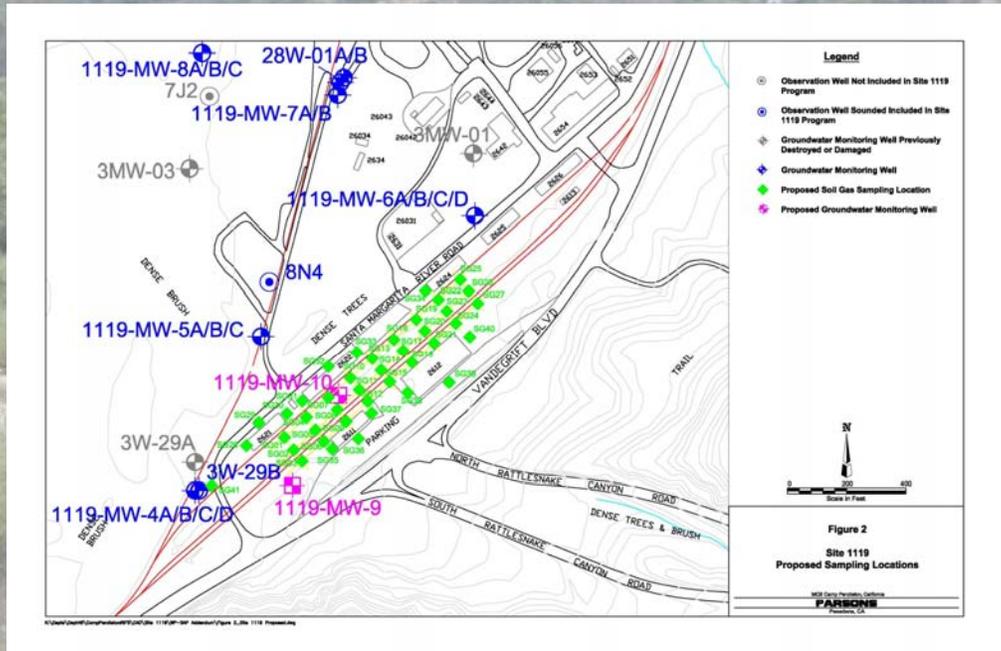
SITE 1119

Additional Investigation

- ❖ **Soil gas survey.**
- ❖ **Two new monitoring well locations.**
- ❖ **Maximum total depth of the deepest new monitoring wells will be 150 feet bgs, based on the data reviewed to date.**
- ❖ **Four or five separate clustered monitoring wells at each location.**

SITE 1119

Planned Sampling Locations



SITE 1119

Sampling Activities

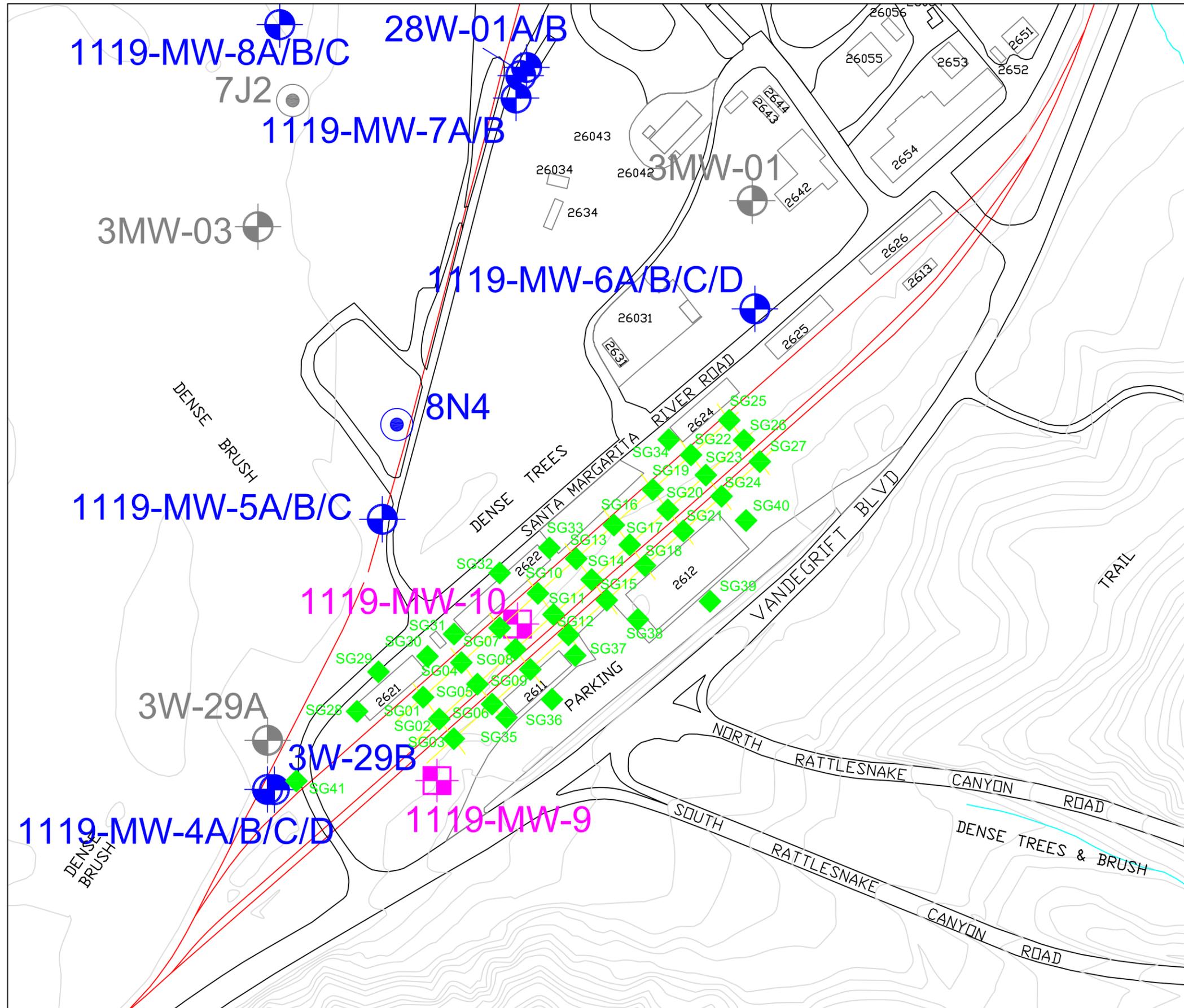
- ❖ Draft Work Plan Addendum with Sampling and Analysis Plan - December 2012
- ❖ Final Work Plan Addendum with Sampling and Analysis Plan - April 2013
- ❖ Survey Soil Gas Sample Grid - April, 2013
- ❖ Soil Gas Probe Installation – April/May 2013

SITE 1119

Sampling Activities

- ❖ Soil Gas Purge Testing - May 10, 2013
- ❖ Soil Gas Sampling - May 20 to 24, 2013
- ❖ Preliminary Results - June 7, 2013
- ❖ Finalize Well Locations





Legend

-  Observation Well Not Included in Site 1119 Program
-  Observation Well Sounded Included in Site 1119 Program
-  Groundwater Monitoring Well Previously Destroyed or Damaged
-  Groundwater Monitoring Well
-  Proposed Soil Gas Sampling Location
-  Proposed Groundwater Monitoring Well



Scale in Feet



Figure 2

Site 1119
Proposed Sampling Locations

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