



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST

5090
Ser OPAE.RP/049
February 29, 2016

Ms. Sophie DiCampalto
California Environmental Protection Agency
California Regional Water Quality Control Board
Mitigation & Cleanup Unit
2375 Northside Drive, Suite 100
San Diego, CA 92108

Ms. Beatrice Griffey
California Environmental Protection Agency
California Regional Water Quality Control Board
Mitigation & Cleanup Unit
2375 Northside Drive, Suite 100
San Diego, CA 92108

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-8-3
75 Hawthorne Street
San Francisco, CA 94105-3901

SUBJECT: MEETING MINUTES FOR THE 117th FEDERAL FACILITIES
AGREEMENT (FFA) MEETING DATED JANUARY 19, 2016,
MARINE CORPS BASE CAMP PENDLETON

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

Enclosed are the minutes to the Marine Corps Base, Camp Pendleton Federal Facilities Agreement (FFA) Meeting Number 117, held on January 19th, 2016.

5090
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Should you have questions, please call Mr. Ralph Pearce at
(619) 532-3768.

Sincerely,



THERESA MORLEY
By direction

- Enclosures:
- (1) 117th FFA Meeting Minutes
 - (2) 117th FFA Meeting Agenda
 - (3) Sign in Sheet
 - (4) FFA Schedule
 - (5) Deliverables/Fieldwork Spreadsheets
 - (6) Site 1118 Subsite 21565 Update and Path Forward Presentation
 - (7) Site 1116 Status and Planned Actions Presentation
 - (8) Site 22/23 Area Groundwater TCE Plume Progress and Planned Actions

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

PARSONS

Contract No. WSI-IO JV N62473-15-C-3604
Document Control No. WSIO-3604-0000-0014
Parsons Project No. 100076.0000.110032

PROJECT NOTE NO. 67

SUBJECT: Marine Corps Base (MCB) Camp Pendleton Federal Facilities Agreement (FFA) Meeting (No. 117)

DATE HELD: January 19, 2016

Attendees:

Theresa Morley (Naval Facilities Engineering Command Southwest [NAVFAC SW]), Adam Hill (NAVFAC SW), Jennifer Sullivan (MCB Camp Pendleton), Tracy Sahagun (MCB Camp Pendleton), Susan Hulbert (NAVFAC SW), Martin Hausladen (US Environmental Protection Agency [USEPA]), John Chesnutt (USEPA), Letitia Moore (USEPA), Tayseer Mahmoud (California [Cal] EPA/Department of Toxic Substances Control [DTSC]), Kelly Dorsey (San Diego Regional Water Quality Control Board [RWQCB or Water Board]), Mike Bilodeau (WSI-IO), Steve Griswold (Parsons), and Josh Sacker (Parsons).

Attendees via Conference Call:

Julia Gillespie (NAVFAC SW), Luis Ledesma (MCB Camp Pendleton), Kimberly Gettmann (DTSC), Sophie di Campalto (RWQCB), and Dan Griffiths (Parsons).

Introduction

A meeting was held in San Francisco to update the FFA Team (Team) on program status. The agenda, Deliverables Spreadsheet (including status on fieldwork and responses to agency comments), and updated FFA Schedule are attached.

Following introductions of each attendee, Mr. Hill noted that he will be moving from the MCB Camp Pendleton program to the NAVFAC SW Base Realignment and Closure (BRAC) program. In addition, Mr. Hausladen will be retiring from the USEPA by April 2016. As such, this is likely to be their last MCB Camp Pendleton FFA meeting.

Deliverables Schedule Discussion

Ms. Morley discussed each item on the Deliverables Spreadsheet (attached), and noted that the items that are marked as final will be removed from the next version of the spreadsheet. There was some additional team discussion on certain items as follows:

- Item 1: The Land Use Control (LUC) Remedial Design/Remedial Action Work Plan (LUC RD/RAWP) for 22/23 Area Groundwater has been finalized, and Ms.

Morley asked the Team if future sites can be added to this LUC document, or if multiple documents would be needed going forward. Several team members said having one document containing all sites with LUCs would be preferable, and there were no objections.

- Items 2 and 3: Signatures are currently being obtained for both the Site 21 Record of Decision (ROD) and the Site 1119 ROD.
- Item 4: The 22/23 Area Groundwater Zero-Valent Zinc (ZVZ) Pilot Study Report is final. Ms. Morley noted that the contractor had some turnover and that four sampling events had to be done in four months, so there wasn't enough time to prove the technology, but the LTM conducted for 22/23 Area Groundwater will monitor the area. The path forward for this portion of 22/23 Area is still being determined.
- Item 5: Regarding the Site 1121 Remedial Investigation (RI) Report, this will be delayed because a contract needs to be found to complete the risk assessment.
- Item 6: For the Enhanced In Situ Bioremediation (EISB) Pilot Study Report for 22/23 Area Groundwater, the responses to agency comments were sent on January 11, so the document will be finalized if the agencies are satisfied with the responses.
- Item 8: The agencies have commented on the RI Report for Site 1117 (15/16 Area Groundwater). Ms. Morley noted that the underground storage tank (UST) low-threat closure criteria were used in the document because the site has petroleum-related contaminants (primarily benzene and naphthalene). There was only one well with TCE, at a concentration of 5.1 µg/L, so need to get agreement from the Team on the path forward to close the site out under Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and move it to the UST program. Dr. Gettmann said that the approach is acceptable, but that it needs to be made clear in the document why the CERCLA and fuel-related compounds are being handled separately. Mr. Mahmoud suggested that the text in the introduction, conclusions, and recommendations be clarified to better state explain the rationale for the approach.
- Item 10: For the Post-SVE Site Closure Report for 12 Area Site 13, the DTSC requested that the risk assessment be updated. Dr. Lynn Nakayama Wong of DTSC offered to do the re-calculations herself if it would be helpful, and the Navy expressed their gratitude.
- Item 11: Agency comments have been received from DTSC and USEPA for the Additional Investigation Report for Site 1116 (14 Area Groundwater). Ms. Morley said that the trichloroethene (TCE) plume is not from the USTs, but appears to follow the swale. Ms. Di Campalito said that the RWQCB comments were sent last Friday, January 15.
- Item 12: Ms. Morley noted that agency comments are due February 12 for the Performance Monitoring Report for Site 1116 (14 Area Groundwater). The

RWQCB and USEPA will require a couple of extra weeks beyond that date to provide their comments.

- Item 13: For the Site 33 ROD, there was some discussion about how best to incorporate the USEPA checklist into the document. The USEPA reviewer was not satisfied regarding how the checklist was incorporated into the document, so there will likely be USEPA comments on this issue.

Field Work Schedule Discussion

- Items 2 and 4: These tasks (22/23 Area Long-Term Monitoring [LTM] Quarterly Sampling and Site 1114 Performance Monitoring) will be performed semi-annually after the first year of sampling.
- Items 5 and 6: Excavation is complete at Target Treatment Zone (TTZ)-1S, and injection is still in progress at TTZ-1L. At TTZ-2, the groundwater has still not recharged following the thermal remediation.
- Item 9: The Best Management Practices (BMPs) at Site 1122 are planned to be installed this coming week. The San Diego RWQCB storm water specialist recently visited the site to discuss BMP implementation.

FFA Schedule Discussion

A short discussion focused on whether sites that are closed should remain on the FFA schedule for future reference, and the consensus was to keep closed sites on the schedule but move them to the end. Also, the FFA wanted to keep the completed items under each site for historical reasons.

Mr. Hausladen and Mr. Chesnutt briefly noted that there is some focus within the USEPA on the use of Explanation of Significant Differences (ESDs) versus ROD Amendments, and that they are getting more conservative in requiring the use of ROD amendments. Mr. Chesnutt cited the example of a dispute in progress at Edwards Air Force Base (AFB) over the issue. In general, if a remedy is going to become less protective, then a ROD Amendment would likely be needed, whereas if the remedy is going to be more protective, then an ESD would likely be sufficient.

Site 1118 Update

Mr. Hill provided an overview of historical activities, site conditions, and path forward for Subsite 21565 (refer to attached slides). A soil removal action was planned for soils in the area outlined in Figures 4 and 5 (attached). The planned approach would involve placing contaminated soils directly into trucks instead of stockpiling soils at the site, which would have been very disruptive to the current site operations. Pre-removal action optimization sampling was conducted to better define the extent of contamination, and included direct-push sampling in a 160-foot x 160-foot area on a 20-foot grid (approximately 64 sample locations) at three depths each. In addition, groundwater and soil gas sampling was conducted at selected locations.

The results indicate that a relatively small area of soil is impacted above remedial goals for TCE (Volatile Organic Compounds [VOCs] in Vadose Zone), and saturated zone

results indicate a relatively larger area impacted above remedial goals for vinyl chloride (VOCs in Saturated Zone).

Mr. Hill then discussed the recent indoor air sampling conducted at Building 210568. The final work plan for this activity will go out shortly, but there was not time for the normal 60-day review because of the need to collect the indoor air data as quickly as possible. The sampling effort included an initial HAPSITE® gas chromatography/mass spectrometer (GC/MS) screening survey, which then was used to guide the placement of Summa canisters (six indoor canister locations and one outdoor location to measure ambient conditions).

Mr. Hausladen asked if the survey took into account the piping corridors/chases in the building floor as possible vapor pathways. Mr. Hill said that was part of the survey, and that the procedures incorporated lessons-learned from the Space and Naval Warfare Command (SPAWAR) indoor air sampling project, which discovered that a source was a floor drain.

Regarding path forward, the pre-removal action sampling at Subsite 21565 does not support a soil removal action because the affected area is too small. However, soil gas and groundwater concentrations are above project screening levels (PSLs) and therefore options will be evaluated to address these media. A pilot study is likely to be the next step at the site and may include an in situ technology such as bioremediation. Ms. Dorsey asked if pore water sampling may be used at the site, and Mr. Hill said that an evaluation of the technical approach is still underway.

At Building 210568, the indoor air assessment showed that vapor intrusion does not pose a significant risk at the building (refer to slide 17). Another round of indoor air sampling will be conducted at the building in May 2016 to confirm the indoor air results.

Site 1116 Update

Mr. Griswold presented the status and planned path forward for Site 1116 (slides attached). Site 1116 currently consists of three subsites (14112, 1408, and 140008), but two of the subsites (1408 and 140008) can now be referred to as Site 1116 since they are connected by a single TCE plume. Subsite 14112 is still referred to separately because it is geographically separated (1,600 feet northwest) from site 1116. Site hydrogeology and history of removal actions was discussed, followed by the plans going forward.

At Site 1116 (former Subsites 1491 and 140008), additional sampling is planned in order to refine the extent of plume, including addressing data gaps near upgradient source areas and the downgradient edge. In addition, collecting soil gas data and performing a human health risk assessment appears to be warranted at the site. With the new data, remediation locations and configuration can be optimized for a larger-scale injection system based on site geology and an updated conceptual site model (CSM).

At Subsite 14112, additional sampling is planned to further define extent of the plume extending off site, including VOCs (TCE) and total petroleum hydrocarbons (TPH) in groundwater. In addition, product removal is planned by using absorbent socks. An

optimized remedial strategy will be developed based on the additional data gathered via new wells, borings, free product recovery data, and groundwater monitoring data.

22/23 Area Groundwater Update on In Situ Groundwater Remediation

Mr. Griffiths provided an update for the TCE plume in the 22/23 Area and the planned path forward (slides attached). The remedy that was outlined in the 2014 ROD for this site includes enhanced in situ bioremediation to be applied in the source area of the aquifer (i.e., portions of the aquifer having TCE concentrations greater than 20 µg/L). Mr. Griffiths noted that the recent pilot study conducted by Battelle in a portion of the plume was successful in reducing TCE concentrations via reductive dechlorination.

The pilot study included the installation of 12 hydropunch borings during the pre-design characterization, 5 substrate injection locations, and 17 performance monitoring wells. The data collected during the pre-design stage of the pilot study was used to create a more accurate contour map of contaminant concentrations, as shown on Slide 14. The substrate injection for the pilot study was applied on the southern portion of the source area, as shown on Slide 16. There is still a significant portion of the source area that was not treated during the pilot study, primarily to the north, west, and east of the pilot study area.

Going forward, the EISB system will be expanded to treat the source area as outlined in the ROD. Prior to installing the additional injection wells for the expanded system, pre-characterization wells will be installed to better define the lateral and vertical extent of the plume as needed for system design. As part of that design, an updated groundwater contour map will be produced to document flow conditions as accurately as possible. During implementation of the expanded system, aquifer parameters, including pH, will be monitored and managed in the treatment areas.

There was discussion about the need to keep groundwater pH at an optimal level (pH above 6.5). Ms. Dorsey asked if the general Waste Discharge Requirements (WDR) for in situ bioremediation is being followed as an Applicable or Relevant and Appropriate Requirement (ARAR), and Ms. Morley said that it was. In addition, there was some discussion of the contaminant contour maps and the need to collect sufficient data for remedy implementation. Additional pre-characterization data will likely be required in upgradient and downgradient directions, as well as better delineation of plume depth in the planned treatment areas.

Schedule for Next FFA Meeting

The next FFA Meeting is scheduled to be held at MCB Camp Pendleton on May 19, 2016. The meeting was adjourned.

**MCB Camp Pendleton
117th FFA Meeting Agenda**

**Orchard Hotel
665 Bush Street
San Francisco, CA 94108**

January 19th, 2016

- | | |
|--------------------|---|
| 1030 – 1045 | Welcome and Introductions (Navy) |
| 1045 – 1130 | Project Deliverables, FFA Schedule Update and
Planned/In Progress Field Work Status (Navy) |
| 1130 – 1200 | Site 1118 Update and Path Forward (Navy) |
| 1200 – 1300 | Lunch |
| 1300 – 1400 | Site 1116 - Review of Site Conditions and Planned Actions
(Parsons) |
| 1400 – 1415 | Break |
| 1415 – 1500 | 22/23 Area Groundwater TCE Plume – Progress to Date and
Summary of Planned Actions (Parsons) |
| 1500 – 1515 | Meeting Conclusion and Action Items (Navy) |

CLIENT _____ JOB NO. _____ SHEET _____ OF _____
 SUBJECT 117th Comp Pendleton FFA BY _____ DATE 1/19/16
 CKD. _____ REVISION _____

Attendee's Name	Organization	Phone No / e-mail
Josh Sacker	Parsons	(626) 440-6191 josh.sacker@parsons.com
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Kelly Dorsey	RWQCB	kelly.dorsey@waterboard.ca.gov 619-521-3357
Susan Hulbert	NAVFAC SW	Susan.hulbert@navy.mil 619-532-4517
Martin Hausladen	USEPA	(415) 972-3007 hausladen.martin@epa.gov
Tracy Sahagun	USMC	760-725-9771 tracy.sahagun@usmc.mil
Jen Sullivan	USMC	760-725-9752 jennifer.a.sullivan@usmc.mil
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LETITIA MOORE	USEPA	415-972-3928 moore.letitia@epa.gov

Attendees by Conference Call:

- Julia Gillespie NAVFAC SW
- Luis Ledesma MCB Camp Pendleton
- Kimberly Gettman DTSC
- Sophie di Campalto RWQCB
- Dan Griffiths Parsons

MCB Camp Pendleton Deliverables Spreadsheet

Date: 1/19/16

Item	Document	Contractor	Status	Date Due	Agency Comments	Response Received From:		
				to Agencies	Due By	EPA	DTSC	RWQCB
1	Land Use Control Implementation Plan - 22/23 Area Groundwater	Parsons	FINAL	5/16/14	7/15/14	9-Jun	14-Jul	21-Jul
2	Record of Decision for Site 21 (14 Area Surface Impoundment)	SDVJV	ROD out for signature	3/9/15	5/8/15	5-May	29-Apr	4-May
3	Record of Decision for Site 1119 (26 Area Groundwater)	Tidewater	ROD out for signature	3/9/15	5/8/15	17-Apr	28-Apr	11-May
4	ZVZ Pilot Study Report - 22/23 Area Groundwater	Brady	FINAL	3/24/15	5/22/15	31-Mar	14-May	10-Jun
5	Remedial Investigation Report - Site 1121 (Site 1D Groundwater)	SDVJV	Responding to agency comments	5/13/15	7/30/15	30-Jun	9-Jul	21-Jul
6	EISB Pilot Study Report - 22/23 Area Groundwater	Battelle	Responding to agency comments	6/29/15	8/28/15	31-Aug	26-Aug	30-Sep
7	Annual Groundwater Monitoring Report - Site 7 (Box Canyon)	Trevet	FINAL	7/3/15	9/1/15	NC	17-Aug	12-Aug
8	Remedial Investigation Report - Site 1117 (15/16 Area Groundwater)	Trevet	Responding to agency comments	7/24/15	9/22/15	8-Sep	14-Sep	6-Oct
9	Pilot Study Work Plan - Site 1119 (26 Area Groundwater)	Tidewater	Finalizing	8/3/15	10/2/15	15-Sep	28-Sep	9-Nov
10	Post-SVE Site Closure Report for 12 Area Site 13 (Bldg 1280)	SDVJV	Responding to agency comments	10/20/15	12/21/15	NC	7-Dec	13-Nov
11	Additional Investigation Report for Site 1116 (14 Area Groundwater)	TetraTech	Responding to agency comments	11/20/15	1/19/16	7-Jan	11-Jan	15-Jan
12	Groundwater Monitoring and Soil Gas Report for Site 33 (52 Area Armory)	Trevet	With agencies	12/7/15	2/5/16			
13	Performance Monitoring Report for Site 1116 (14 Area Groundwater)	ECM	With agencies	12/14/15	2/12/16			
14	ROD for Site 33 (52 Area Armory)	ECM	With agencies	12/14/15	2/12/16			
15	Annual Post-Closure Maintenance Report for Site 7 (Box Canyon Landfill)	Trevet	Pre-draft in progress	2/22/16				
16	Treatability Study Work Plan for Ag Fields	WSI-IO	Navy review	2/29/16				
17	Remedial Investigation report for IR Site 150 (SEERMA Site)	Trevet	Pre-draft in progress	3/11/16				
18	Annual Groundwater LTM Report for 22/23 Area	Tidewater	Pre-draft in progress	3/16/16				
19	Permeable Reactive Barrier Work Plan Site 1119 (26 Area Groundwater)	CB&I	Pre-draft in progress	3/21/16				
20	RI/FS Report for Site 1120 (Stuart Mesa Pesticide Maintenance Areas)	Tidewater	Pre-draft in progress	3/31/16				
21	Performance Monitoring Report for Site 1114 (41 Area Arroyo)	TetraTech	Pre-draft in progress	4/4/16				

MCB Camp Pendleton Deliverables Spreadsheet

Date: 1/19/16

Item	Document	Contractor	Status	Date Due	Agency Comments	Response Received From:		
				to Agencies	Due By	EPA	DTSC	RWQCB
22	Work Plan for Site 1118 (Subsites 520400)	WSI-IO	Pre-draft in progress	4/22/16				
23	Remedial Design for Site 21 (14 Area Surface Impoundment)	CB&I	Pre-draft in progress	5/4/16				
24	Remedial Design for EISB at TCE Plume (22/23 Area Groundwater)	WSI-IO	Pre-draft in progress	5/19/16				
25	Optimization Tech Memo Site 1116 (14 Area Groundwater)	WSI-IO	Pre-draft in progress	6/10/16				

Agencies have commented

MCB Camp Pendleton Fieldwork Spreadsheet

Date: 1/19/16

Item	Field Work	Planned Start Date	Planned Completion Date
1	Install Production Well - 22/23 Area GW	18-Jan-16	29-Jul-16
2	22/23 Area LTM Quarterly Sampling	Baseline complete	Jan (1st); Apr (2nd); Jul (3rd); Oct (4th)
4	Site 1114 Performance Monitoring	Quarterly event in Nov 2015	2 years performance monitoring 2015/2016 (Feb/May/Aug/Nov)
5	Pilot Study Site 1115 TTZ-1S and 1L	injections (4/6) and (9/1) 1st quarter groundwater monitoring (Dec 2015)	3 more quarters in 2016
6	Pilot Study Site 1115 TTZ-2S and 2L	post-treatment sampling in Feb and Mar 2016	Mar 2016
7	Removal Action Site 1118-Bldg 21565	Sep	Nov
9	BMPs at Site 1122	January 2016	Feb 2016

SIOH Bearing

Date: 1/19/16

Item	Document	Contractor	RTCs to agencies	RTC Approved		
				EPA	DTSC	RWQCB
1	Remedial Investigation Report - Site 1121 (Site 1D Groundwater)	SDVJV	9/30/2015			
2	EISB Pilot Study Report - 22/23 Area Groundwater	Battelle	1/11/2016			
3	Remedial Investigation Report - Site 1117 (15/16 Area Groundwater)	Trevet				
4	Post-SVE Site Closure Report for 12 Area Site 13	SDVJV				
5	Additional Investigation Report for Site 1116 (14 Area Groundwater)	TetraTech				

FFA Schedule for Draft Documents – January 19, 2016

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. Dates in green have changed since the May 14, 2015 FFA schedule.

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. A Remedial Investigation/Feasibility Study (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 has been completed. To evaluate the effectiveness of the remedies proposed for Alternative 4, two pilot studies were completed: a Zero Valent Zinc (ZVZ) Permeable Reactive Barrier for the TCP plume; and, Enhanced In Situ Bioremediation (EISB) for the TCE plume. The production well is scheduled to be installed soon. A pilot study to remediate the 1,4-dioxane plume, which is an issue now that the screening level criteria for dioxane was reduced, is planned.

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|---|--------------------|
| – Proposed Plan | complete |
| – Geotechnical and Design Information for ZVZ PRB Pilot Study | complete |
| – <i>Implementation of ZVZ PRB Pilot Study</i> | complete |
| – Record of Decision | complete |
| – Well Siting Study Sampling and Analysis Plan | complete |
| – <i>Field Work for Well Siting Study</i> | <i>complete</i> |
| – Work Plan for Enhanced In Situ Bioremediation (EISB) | complete |
| – <i>Field Work for EISB Pilot Study</i> | <i>complete</i> |
| – Work Plan to Install Wells and Conduct Groundwater Monitoring | complete |
| – <i>Installation of Alternative Water Supply Well</i> | <i>in progress</i> |
| – Land Use Control Implementation Plan | complete |
| – Tech Memo to Implement Alternate Water Supply | complete |
| – Baseline LTM Groundwater Monitoring Tech Memo | complete |
| – ZVZ Pilot Study for TCP Report | complete |
| – EISB Pilot Study for TCE Report | 6/29/2015 |
| – Annual LTM Groundwater Monitoring Report | 3/16/2016 |
| – Work Plan for EISB Expanded System | 5/19/2016 |

****POST ROD Site 7 – Box Canyon Landfill**

This site is a Corrective Action Management Unit (CAMU) situated above an old municipal landfill. This site is post-Record of Decision (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 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 CY15) 2/22/2016
- Annual Groundwater Monitoring Report 7/3/2016
- Five Year Review complete

12 Area Site 13 – Former Building 1280 and 1283

This site is the site of a former Underground Storage Tank (UST) and has some low level concentrations of Volatile Organic Compounds (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. A Soil Vapour Extraction system has reduced concentrations in groundwater; only one well has levels barely above the Maximum Contaminant Level (MCL). A site closure report is in review.

- Groundwater Monitoring Report complete
- Project Completion Report for Soil and Groundwater complete
- *AS/SVE Pilot Study* complete
- Post SVE Closure Report 10/20/2015
- NFA Proposed Plan Jun 2016
- NFA Record of Decision 2016

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. A pilot study to evaluate the effectiveness of in-situ bioremediation of chlorinated solvents at low concentrations in groundwater is complete. Technical Memorandums reporting on the effectiveness of both phases of the pilot study were finalized and the Feasibility Study is in agency review. A Proposed Plan is final and a Record of Decision is

being finalized with the following preferred alternatives: land use controls and long-term monitoring; biosparging/venting for the shallow plume; and, enhanced in situ bioremediation for the deep plume.

- | | |
|---|-----------------|
| – Pilot Study Tech Memo | complete |
| – Site 21 Pilot Study Work Plan Addendum | complete |
| – <i>Second Phase of Pilot Study Field Work</i> | <i>complete</i> |
| – Feasibility Study | complete |
| – Proposed Plan | complete |
| – Record of Decision | 3/9/2015 |
| – Remedial Design | 5/4/2016 |
| – <i>Remedial Action</i> | <i>Aug 2016</i> |
| – Land Use Control Implementation Plan (LUCIP) | 2017* |

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 a Non-Time Critical Action Memorandum have also been completed. The selected remedy was excavation of the source material, and treatment of groundwater from the site. Two interim Removal Actions were completed, concentrating on the worst part of the plume and the source area. Groundwater monitoring, Enhanced InSitu Bioremediation (EISB) injections and soil gas sampling are currently in progress. A Proposed Plan is complete and a Record of Decision is in agency review. The recommended alternatives are: land-use controls, long-term monitoring and monitored natural attenuation.

- | | |
|--|-----------------|
| – 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 | complete |
| – Removal Action Work Plan for source | complete |
| – <i>Source Removal Action/EISB Injection</i> | <i>complete</i> |
| – SAP Addendum for Soil Gas Monitoring | complete |
| – Source Removal Action Completion Report | complete |
| – Proposed Plan | complete |
| – Groundwater Monitoring & Soil Gas Report | 12/7/2015 |
| – Record of Decision | 12/14/2015 |

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.

- *Site Inspection Field Work* complete
- Site Inspection Report complete
- Remedial Investigation Work Plan complete
- *Field Work for Remedial Investigation* in progress
- **Remedial Investigation Report/Feasibility Study** **3/11/2016**
- NFA Proposed Plan 2016
- NFA Record of Decision 2017

Dates changed to collect additional data

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

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 CLOSED 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. A No Further Action Record of Decision (ROD) was signed on April 19, 2013.

- Proposed Plan for No Further Action complete
- Record of Decision for NFA complete

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 (SI) 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 No Further Action

(NFA) recommendation, so an interim Removal Action was completed to address elevated concentrations in groundwater. Performance monitoring to examine the effectiveness of the substrate injected during the removal action is underway.

- Remedial Investigation Report complete
- Engineering Evaluation/Cost Analysis & Action Memorandum complete
- Removal Action Work Plan complete
- *Removal Action* complete
- Work Plan for Performance Monitoring complete
- Removal Action Completion Report complete
- *Performance Monitoring* in progress
- Performance Monitoring Report 4/4/2016
- Proposed Plan Jun 2016
- Record of Decision 2017

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. The Feasibility Study identified remedial alternatives for various Target Treatment Zones (TTZs) throughout the site. TTZ-1S was excavated and an EISB pilot study is in progress at TTZ-1D. A pilot study to evaluate the effectiveness of insitu thermal conductive heating was recently completed at TTZ-2S. Once groundwater recharges, samples will be collected and the results will be presented in a report.

- Tech Memo complete
- Work Plan to collect additional data for site complete
- *Field Work to collect additional data* complete
- Remedial Investigation/Feasibility Study Report complete
- Pilot Study Work Plan for TTZ-2L and TTZ-2S complete
- Pilot Study Work Plan for TTZ-1S complete
- *Field Work for TTZ-2L and TTZ-2S Pilot Study* complete
- *Field Work for TTZ-1S Pilot Study* in progress
- Pilot Study Report for TTZ-2L and TTZ-2S 2016
- Pilot Study Report for TTZ-1L and TTZ-1S 2017
- Proposed Plan 2017*
- Record of Decision 2018*

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 subsites do not warrant further action under the IR Program. The three other subsites will be remediated. An Engineering Evaluation/Cost Analysis (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 complete. The removal action addressed the mainly petroleum sources at the old USTs, along with Dual-Phase Extraction (DPE) at one subsite and an Enhanced In Situ Bioremediation (EISB) pilot study at another subsite. A Removal Action Completion Report (RACR) for the excavations and pilot studies is complete; however, a performance monitoring report for the pilot studies is in agency review. The limited investigation that was conducted in 2012 indicated that the TCE plumes at the site are not likely associated with the USTs. Therefore, an additional investigation was completed to delineate the TCE plumes and to find a source, if possible. The investigation report is in agency review.

– EE/CA and Action Memorandum	(3 subsites – Moving Forward)	complete
– Expanded Site Inspection WP	(3 subsites – Moving Forward)	complete
– <i>Field Work for Site Inspection</i>	<i>(3 subsites – Moving Forward)</i>	<i>complete</i>
– Expanded Site Inspection Report	(3 subsites – Moving Forward)	appendix to RAWP
– Removal Action Work Plan (RAWP)	(3 subsites – Moving Forward)	complete
– <i>Interim Removal Action</i>	<i>(3 subsites – Moving Forward)</i>	<i>in progress</i>
– Additional Investigation Work Plan		complete
– Performance Monitoring SAP		complete
– <i>Additional Investigation Field work</i>		<i>complete</i>
– <i>Performance Monitoring Field Work</i>		<i>complete</i>
– Removal Action Completion Report	(3 subsites – Moving Forward)	complete
– Additional Investigation Report		11/20/2015
– Performance Monitoring Report		12/14/2015
– Optimization/Characterization Tech Memo for Site Groundwater		6/10/2016
– Proposed Plan		2016*
– Record of Decision		2017*

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 concurred with the Site Inspection Report recommending the site move into the Remedial Investigation phase. A Remedial Investigation Report justifying No Further Action at all subsites is currently under agency review.

– <i>Field Work for Site Inspection</i>		<i>complete</i>
– Site Inspection Report		complete
– Remedial Investigation Work Plan		complete
– <i>Remedial Investigation Field Work</i>		<i>complete</i>
– Remedial Investigation Report		7/24/2015

- NFA Proposed Plan 2016
- NFA Record of Decision 2016

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. A Site Inspection and Extended Site Inspection have been completed for this site, resulting in No Further Action for one subsite, 2664. Additional investigation is needed at Subsite 520400 and an interim removal action will begin at Subsite 21565 soon.

- Extended Site Inspection (ESI) Work Plan complete
- *Field Work for Site Inspection* complete
- Extended Site Inspection Report complete
- EE/CA and Action Memo Subsite 21565 complete
- Removal Action Work Plan Subsite 21565 complete
- *Field Work for Subsite 21565 Removal Action* in progress
- Removal Action Completion Report Subsite 21565 2016
- Letter Work Plan for Subsite 520400 4/22/2016
- *Field Work for Subsite 520400* 2016
- Tech Memo for Subsite 520400 2017
- Proposed Plan 2017*
- Record of Decision 2018*

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 was needed to delineate the extent of contamination and to locate the source. The results of the additional investigation and proposed remedial alternatives were included in the Remedial Investigation/Feasibility Study Report. The preferred alternative has been documented in a Proposed Plan, and the Record of Decision is currently in agency review. There are three preferred alternatives: land use controls and long-term monitoring; enhanced in-situ bioremediation at the source area; and, a permeable reactive barrier downgradient of the plume and upgradient of the production wells.

- *Field Work for Remedial Investigation* complete
- Work Plan Addendum to Delineate Source complete
- *Additional RI Field Work* complete
- RI/FS Report complete
- Proposed Plan complete
- Record of Decision 3/9/2015
- EISB Pilot Study Work Plan 8/3/2015
- *EISB Pilot Study Field Work* Feb 2016

- EISB Pilot Study Report 2018
- Permeable Reactive Barrier (PRB) Work Plan 3/21/2016
- *PRB Field Work* 2016
- PRB Completion Report 2017

SITE CLOSED 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, including trenching, has been completed. The ESI Report recommended No Further Action (NFA) at the site and a Proposed Plan has been completed. The NFA Record of Decision is final and signed.

- Extended Site Inspection Work Plan complete
- *Field Work for Extended Site Inspection* complete
- Extended Site Inspection Report complete
- Proposed Plan complete
- Record of Decision complete

Site 1120 – Stuart Mesa Pesticide Maintenance Areas

This site was created in 2012 to address pesticide contamination due to releases from 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 entered the Installation Restoration Program at the Remedial Investigation stage. The field work for the Remedial Investigation is complete and the Remedial Investigation/Feasibility Study Report is in progress. A Treatability Study to treat pesticide contaminated soils is planned for soil located near Site 1120.

- Remedial Investigation Work Plan complete
- *Remedial Investigation Field Work* complete
- Treatability Study Work Plan 2/29/2016
- Remedial Investigation/Feasibility Study Report 3/31/2016
- *Treatability Study Field Work* 2016
- Treatability Study Completion 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

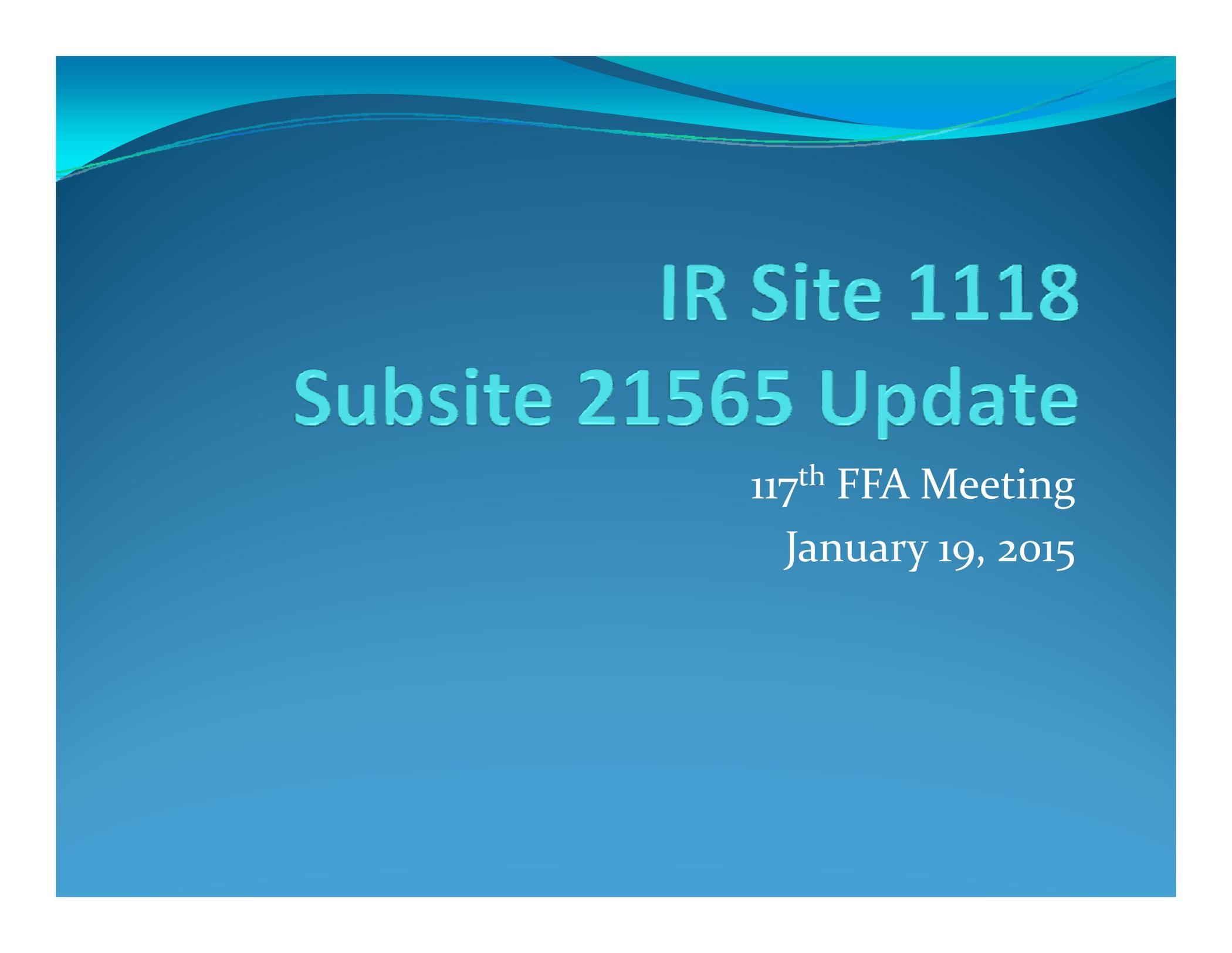
VOCs, metals, and pesticides. A Remedial Investigation is almost complete and a Feasibility Study is currently in progress.

- Remedial Investigation Work Plan complete
- *Remedial Investigation Field Work* complete
- Remedial Investigation Report 5/13/2015
- Feasibility Study 2016
- Proposed Plan 2017*
- Record of Decision 2018*

Site 1122 – Shot Fall Zone

This site was created in 2013 to address lead and Polycyclic Aromatic Hydrocarbon contamination due to overshoot from skeet range activities off base. Limited soil samples were collected that indicated elevated levels of lead, so the site came into the Installation Restoration Program at the Site Inspection stage. The Site Inspection is complete; however, headquarters has determined that the DON must go after the responsible parties before they will fund anymore work under this IR site.

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



IR Site 1118

Subsite 21565 Update

117th FFA Meeting
January 19, 2015

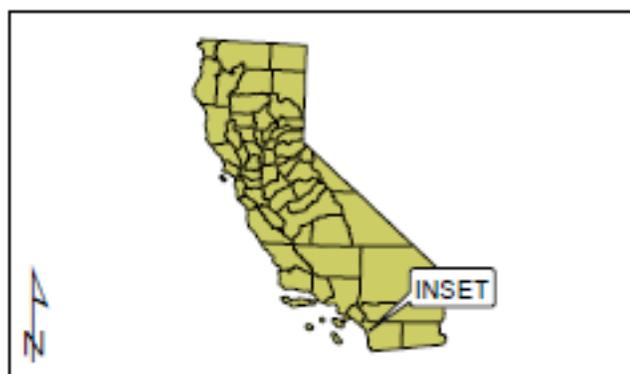
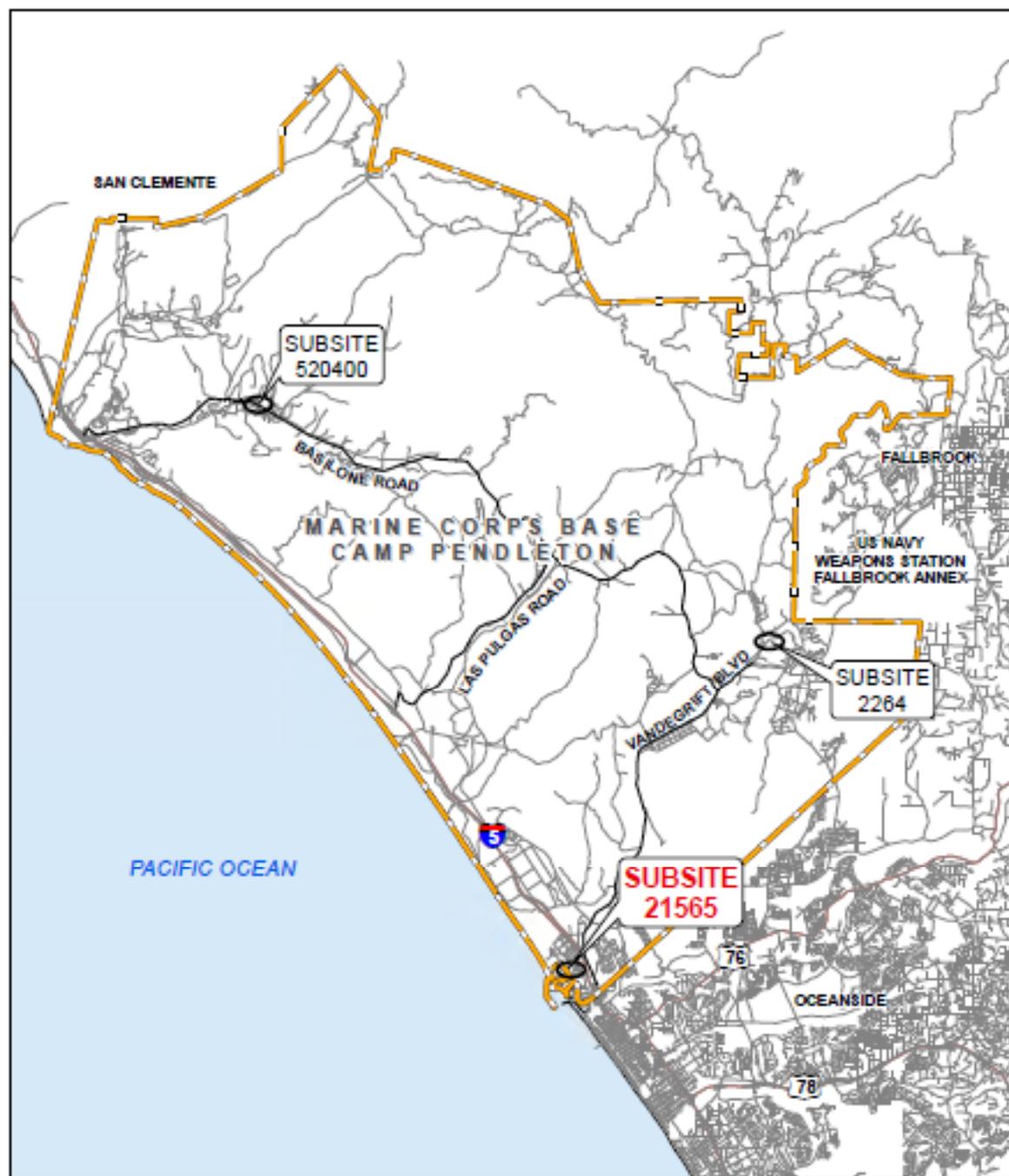


Site 1118

Subsite 21565

- 1,500 gallon diesel fuel UST
 - 1997 – tank removed
 - 1998 – SA conducted
 - 2004 & 2005 – excavations of contaminated soil
- IR Site
 - 2007 – added to IRP due to chlorinated VOCs and PAHs
 - 2011 – SI conducted
 - 2013 – ESI conducted
 - 2015 – AM and EE/CA
 - 2015 – NTCRA work plan

DNV 11/2014 P:\M\NODL\Engineering\Publications\1100001\Figure_1114190

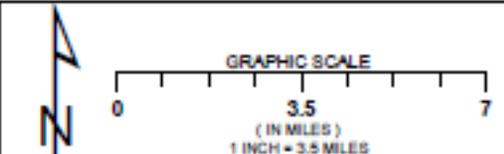


LEGEND

 MCB CAMP PENDLETON BASE BOUNDARY

NOTES:
 IR - INSTALLATION RESTORATION
 MCB - MARINE CORPS BASE

SOURCE:
 ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE
 (ESRI) USA SPATIAL FEATURE CLASSES



GRAPHIC SCALE
 0 3.5 7
 (IN MILES)
 1 INCH = 3.5 MILES

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

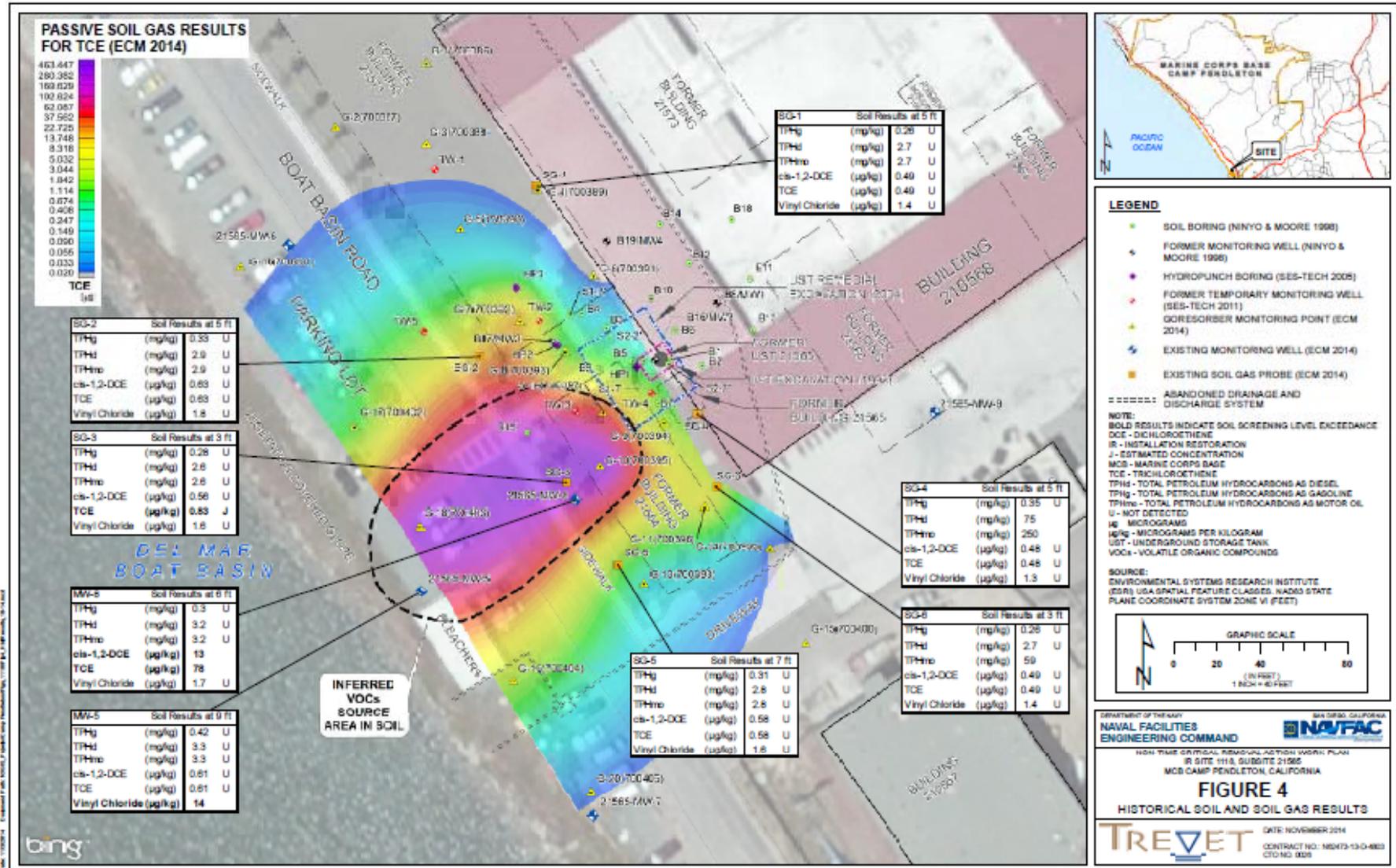
Naval Facilities Engineering Command

NON-TIME CRITICAL REMOVAL ACTION WORK PLAN
 IR SITE 1118, SUBSITE 21565
 MCB CAMP PENDLETON, CALIFORNIA

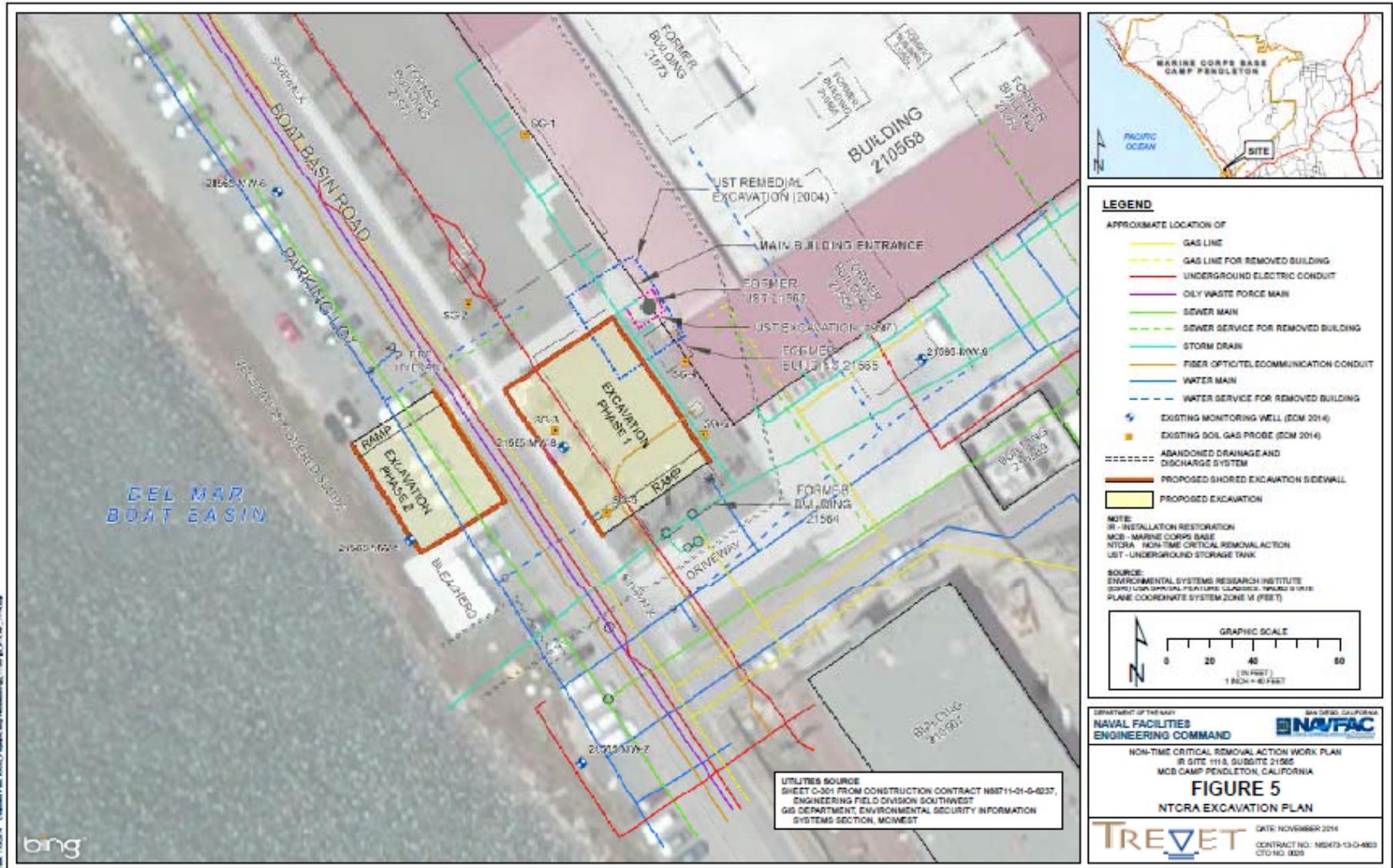
FIGURE 1
 MCB CAMP PENDLETON FACILITY MAP
 SHOWING IR SITE 1118 SUBSITES

 DATE: NOVEMBER 2014
 CONTRACT NO.: N62473-13-D-4803
 CTO NO. 0026

Subsite 21565 ESI



Subsite 21565 NTCRA



Subsite 21565 NTCRA

Pre-NTCRA Optimization Sampling

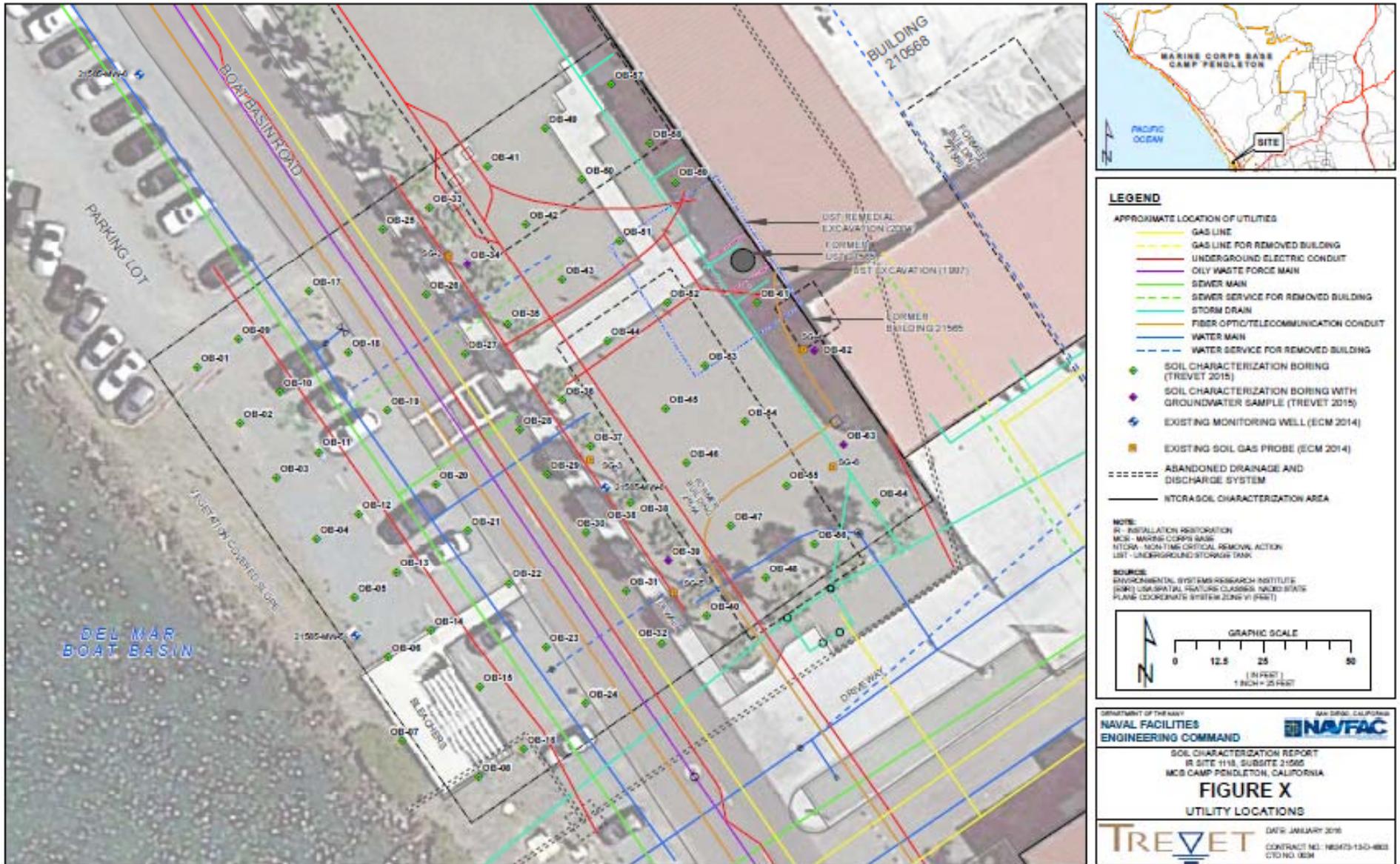
- 1) collect representative samples of the area to be excavated for waste disposal purposes,
- 2) optimize the extent of the excavation area so that the source zone soil can be better delineated and removed during the following NTCRA, and
- 3) evaluate the impact of contaminants in soil and groundwater adjacent to existing soil gas wells SG-2 through SG-6

Subsite 21565 NTCRA

Pre-NTCRA Optimization Sampling

- Direct push soil sampling
 - 160' x 160' area on 20' grid
 - 4 depths: 2', 5', at water table, and 15'
 - All samples analyzed for TPH-d, TPH-mo, VOCs
 - Waste profiling: ~29 samples TPH-g, metals, SVOCs, and pH
- Groundwater samples
 - 4 locations near SG-2, SG-4, SG-5, & SG-6
 - VOCs only
- Soil gas from existing probes SG-1, SG-4, & SG-6

Pre-NTCRA Optimization Sampling



Pre-NTCRA Optimization Sampling Vadose Zone

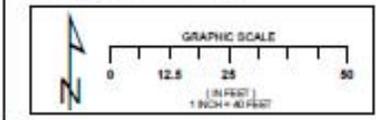


LEGEND

- SOIL CHARACTERIZATION BORING (TREVET 2015)
- SOIL CHARACTERIZATION BORING WITH GROUNDWATER SAMPLE (TREVET 2014)
- ⊕ EXISTING MONITORING WELL (ECM 2014)
- EXISTING SOIL GAS PROBE (ECM 2014)
- ABANDONED DRAINAGE AND DISCHARGE SYSTEM
- NTCRA SOIL CHARACTERIZATION AREA
- VOCs >= REMEDIATION GOAL IN SOIL

NOTE:
 RI - INSTALLATION RESTORATION
 MCB - MARINE CORPS BASE
 µg/kg - MICROGRAMS PER KILOGRAM
 HTRM - HIGH TIME CRITICAL REMOVAL ACTION
 TCE - TRICHLOROETHYLENE
 UST - UNDERGROUND STORAGE TANK
 VOC - VOLATILE ORGANIC COMPOUNDS

SOURCE:
 ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE
 (BORING LOG SPATIAL FEATURES CLASSIFIED BY STATE PLANE COORDINATE SYSTEM ZONE VI (FEET))



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
 SAN DIEGO, CALIFORNIA

SOIL CHARACTERIZATION REPORT
 IN SITE 1118, SUBSITE 21565
 MCB CAMP PENDLETON, CALIFORNIA
FIGURE X
 VOCs IN VADOSE ZONE (0-8 FEET)

DATE: JANUARY 2015
 CONTRACT NO.: N6475-13-D-8803
 CTO NO. 00M

Pre-NTCRA Optimization Sampling Saturated Zone



Pre-NTCRA Optimization Sampling Preliminary GW and SG Results

Boring ID	Sample Depth (ft)	Date Sampled	2-Butanone (ug/l)	Acetone (ug/l)	Benzene (ug/l)	Carbon Disulfide (ug/l)	cis-1,2-Dichloro ethene (ug/l)	Methylene Chloride (ug/l)	Methyl tert-butyl ether (ug/l)	Toluene (ug/l)	trans-1,2-Dichloro ethene (ug/l)	Trichloro ethene (ug/l)	Vinyl Chloride (ug/l)
Project Screening Level			8,400	1,500	0.37		44	510	180	40	260	1.1	0.027
Project Screening Level Reference			ESL	AHG	DTSC		DTSC	NRWQG	ESL	ESL	ESL	RSL	DTSC
21565-OB34	10 - 15	09/21/2015	10 U	3.0 J	0.12 J	1.0 U	2.4	2.0 U	1.0 U	0.21 J	0.24 J	0.25 J	3.7
21565-OB39	10 - 15	09/21/2015	10 U	3.2 J	0.23 J	1.0 U	260	2.0 U	1.0 U	1.0 U	24	0.20 J	180
21565-OB39	DUP	09/21/2015	10 U	4.1 J	0.27 J	1.0 U	180	2.0 U	1.0 U	0.15 J	24	0.26 J	200
21565-OB62	10 - 15	09/21/2015	3.0 J	13	1.0 U	1.0 U	46	2.0 U	0.20 J	0.11 J	0.65 J	0.30 J	1.3
21565-OB63	10 - 15	09/21/2015	10 U	4.1 J	1.0 U	0.46 J	0.23 J	2.0 U	1.0 U	1.0 U	1.0 U	1.7	1.0 U
trip blank	--	09/21/2015	10 U	10 U	1.0 U	1.0 U	1.0 U	0.57 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

TCE (ug/m3)		
PSL = 215 ug/m3		
	May 2013	Sept 2015
SG-1-5'	13	16
SG-4-5'	510	230
SG-6-5'	19000	4800



Subsite 21565

Building 210568 Indoor Air Assessment

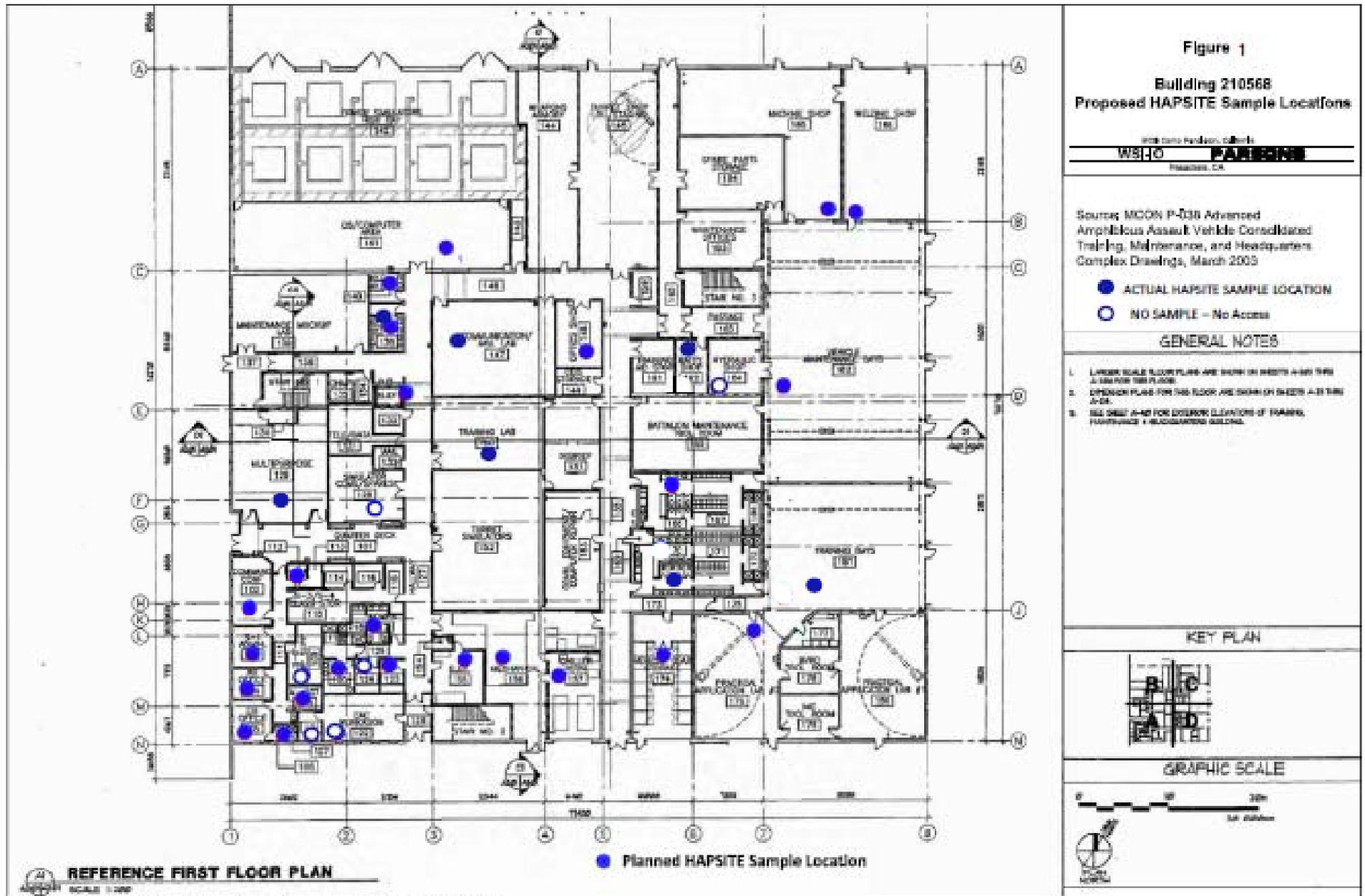
- Primary goal – to determine whether or not TCE and/or target VOCs are present in indoor air inside Building 210568.
 - benzene, cis-1,2-DCE, trans-1,2- DCE, PCE, TCE, and vinyl chloride
- Secondary goal – review the spatial distribution of TCE and/or target VOCs, if present in indoor air, to determine whether their presence appears to be related to vapor intrusion (VI) due to a prior release at former underground storage tank (UST) 21565 or from a current/ongoing source at Building 210568.

Subsite 21565

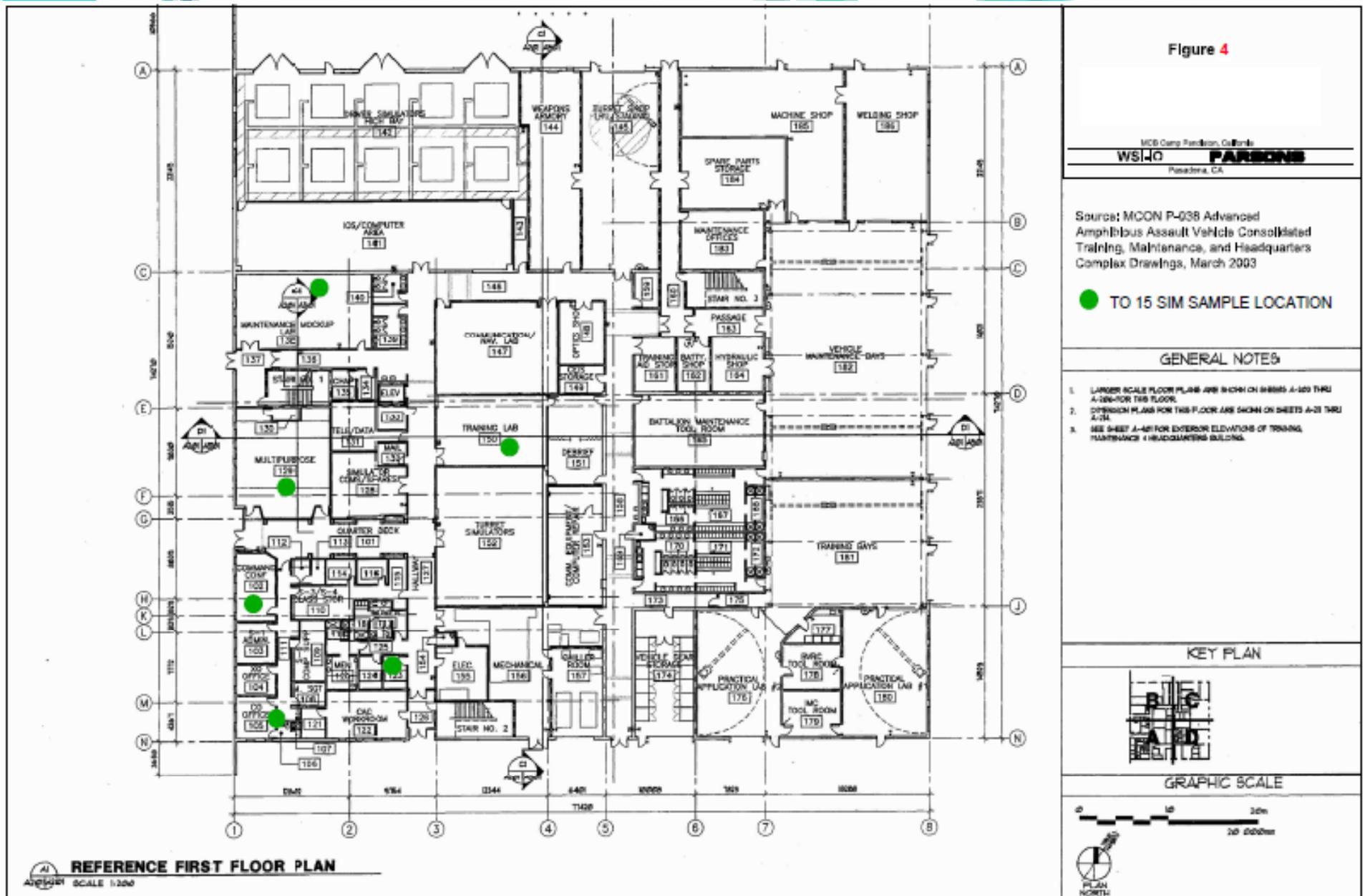
Building 210568 Indoor Air Assessment

- Building plan review and site survey
 - Visual inspection and interviews
- HAPSITE GC/MS screening survey
 - 39 locations planned
- Summa canisters
 - TO₁₅ SIM
 - 24-hour samples
 - Unoccupied and HVAC turned off

Building 210568 HAPSITE



Building 210568 Summa Locations



Building 210568 Summa Results

Sample ID	IA-105-01	IA-105-DUP	IA-123-01	IA-129-01	IA-138-01	IA-150-01	IA-CONF-01	OA-BLEACH-01 ^b	
Sample Location	Room 105	Room 105	Room 123	Room 129	Room 138	Room 150	Conference Rm 102	Outside (Ambient) Air	
ANALYTE	Action Level	Indoor Air ($\mu\text{g}/\text{m}^3$)							
Benzene	0.42	0.56 J	0.36 J	0.38	0.51	0.64	0.43	0.4	0.52
<i>cis</i> -1,2-DCE	35	0.025 U	0.025 U	0.025 J	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
<i>trans</i> -1,2-DCE	350	0.01 J	0.01 J	0.013 J	0.025 U	0.013 J	0.025 U	0.013 J	0.025 U
Trichloroethene	3	0.045 J	0.034 J	0.043 J	0.052 J	0.025 J	0.59	0.038 J	0.069 J
Tetrachloroethene	2.1	0.37	0.52	0.56	0.26	0.52	1.5	0.51	0.083 J
Vinyl chloride	0.16	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U	0.016 U

Notes:

a = Indoor and outdoor air screening levels are based on industrial air screening levels provided in DTSC HERO Note 3 for all chemicals except TCE (DTSC, 2015b). DTSC (2015b) screening levels are more conservative than USEPA (2015b) industrial air RSLs for these chemicals. The action level referenced for TCE is the most conservative value between DTSC HERO Note 5 (DTSC, 2014), the USEPA RSL for industrial air (USEPA, 2015b), and the RAL (USEPA, 2014; DTSC, 2014). DTSC (2014) and USEPA (2014) provide accelerated and urgent response action levels to address short-term exposure to TCE in indoor air. The level of $3 \mu\text{g}/\text{m}^3$ is not a response action level, but a concentration to trigger consultation and review. DTSC (2014) and USEPA (2014) have identified $8 \mu\text{g}/\text{m}^3$ as an interim TCE indoor air response action level for commercial/industrial use (8-hour workday) that may prompt accelerated and urgent response actions.

b = Outdoor air sample collected at bleachers near lagoon, west of Building 210568

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

U = compound analyzed, not detected above laboratory reporting limit

J = analyte detected, but estimated value due to concentration below LOD but above DL

BOLD = compound detected concentration



Site 1118

Subsite 21565 Path Forward

- Pre-NTCRA optimization sampling does not support AM and EE/CA removal action
 - Dry soil exceed RGs in limited area
 - Soil gas and groundwater remain above PSLs
 - Evaluate options to treat groundwater
 - Substrate injections and barrier?
- Indoor air assessment shows VI is not a risk
 - May 2016 – seasonal confirmation sampling



Site 1118

Subsite 21565 Path Forward

- Questions?

MCB CAMP PENDLETON SITE 1116 STATUS

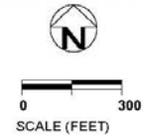
19 January 2016

117th FFA Meeting

SITE 1116



- NOTES
 1. Original CADD basemap created by: Landmark Surveying, La Mesa CA.
 2. Aerial Image Source: Google Earth © 8/23/2010.



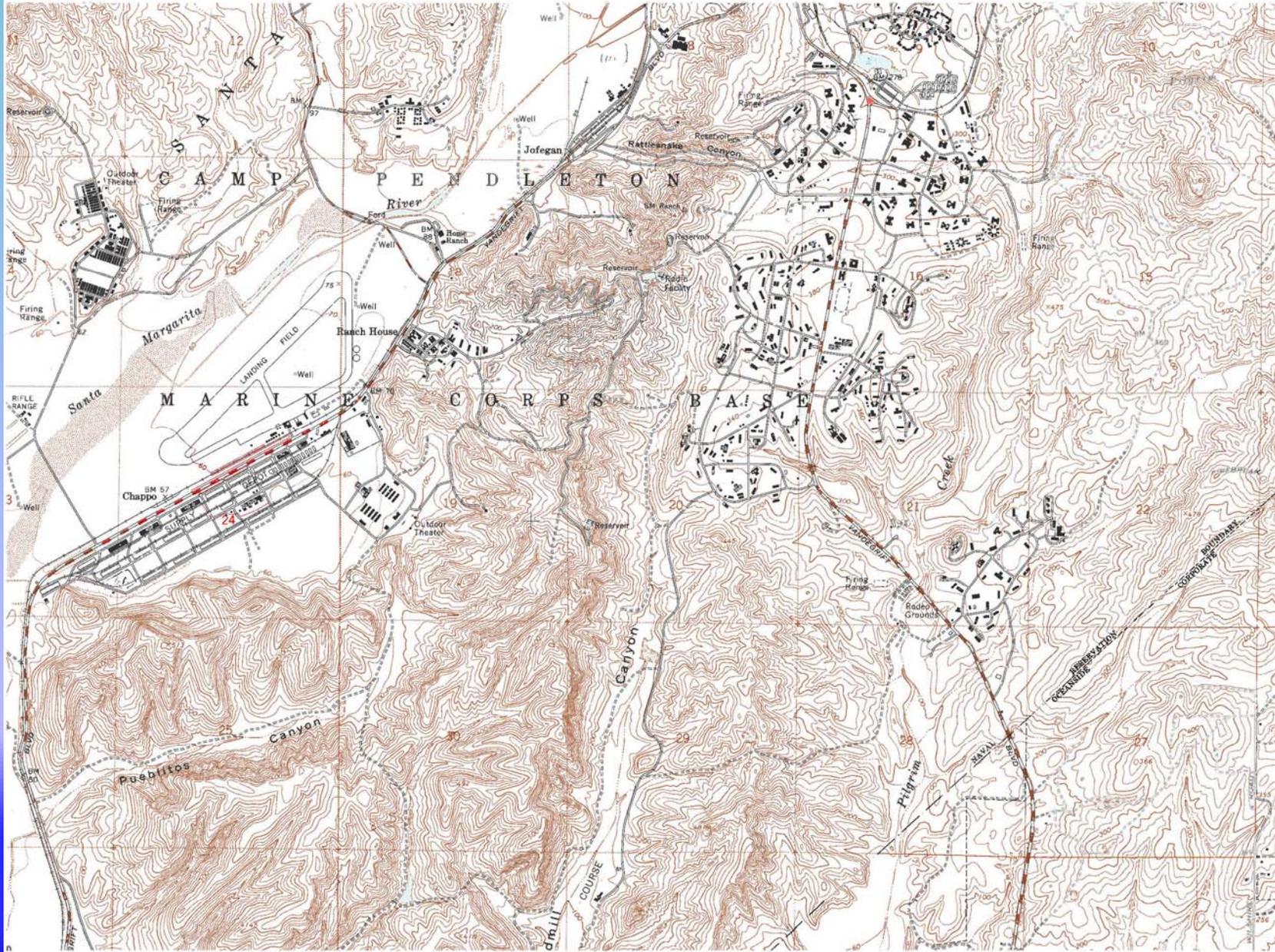
IR Site 1116
 Marine Corps Base
 Camp Pendleton, California

ENVIRONMENTAL COST MANAGEMENT, INC.
Managing Cost and Liability
 3525 Hyland Avenue, Suite 200 • Costa Mesa, CA 92626
 Tel: (714) 662-2759 • Fax: (714) 662-2758

Site Location Map
 Subsites 1491, 14112, 140008

Figure
 1-2





SITE 1116

Three Recent Documents

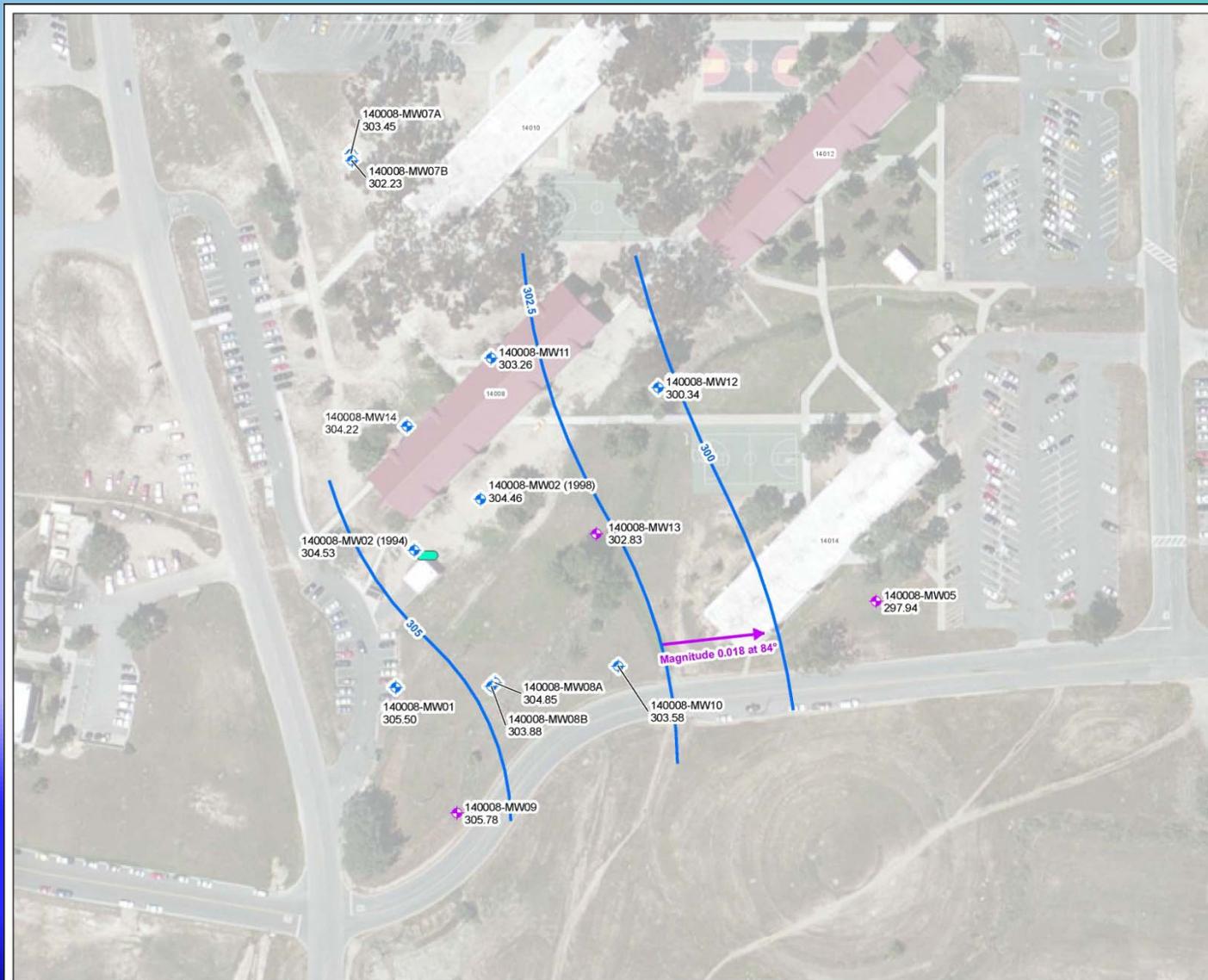
- ❖ **Final Site 1116 Non-Time Critical Removal Action Completion Report (ECM, March 2015) . Objective of Removal Action was to address VOCs and fuel compounds in soil and groundwater to reduce potential risks to human health and the environment. The NTCRA included soil excavations, DPE system, and an EISB pilot test.**
- ❖ **Draft Site 1116 Investigation Summary Report (TetraTech, November 2015). Objective of investigation was to delineate extent of VOCs in groundwater and trends in TCE concentrations.**
- ❖ **Draft Post NTCRA Performance Groundwater Monitoring Report (ECM, December 2015). Includes groundwater monitoring between January 2014 (Baseline) and March 2015 (5 events total).**

SITE 1116

Site Setting/Hydrogeology

- ❖ Mission Hydrologic Subarea of the Lower San Luis Hydrologic Area, within the San Luis Rey Hydrologic Unit.
- ❖ Groundwater has designated beneficial uses including domestic supply, but nearest supply wells are approximately 1 mile from the site.
- ❖ Groundwater is generally within alluvium, Santiago Formation or weathered granodiorite.
- ❖ Groundwater depth is 5 to 15 ft bgs.
- ❖ Groundwater flow at the site is generally northeast/east.
- ❖ Up to 7.5 ft of fill or alluvium is overlying sedimentary Santiago Formation or granodiorite bedrock.

SITE 1116



LEGEND

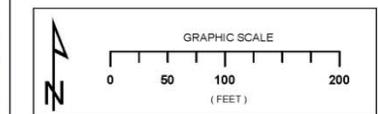
- GROUNDWATER MONITORING WELL LOCATION
- MONITORING WELL USED IN 3-POINT ANALYSIS
- GROUNDWATER ELEVATION CONTOUR
- HORIZONTAL HYDRAULIC GRADIENT
- FORMER UST LOCATION, APPROXIMATE

IR INSTALLATION RESTORATION
 NAD NORTH AMERICAN DATUM
 NAVD NORTH AMERICAN VERTICAL DATUM

NOTES:

1. Groundwater flow direction and gradient estimated from a 3-point problem using groundwater elevations at wells 140008-MW05, 140008-MW09, and 140008-MW13.
2. Groundwater elevations measured April 15 through May 5, 2015.
3. New monitoring wells (2014) surveyed to NAD 83, California State Plane Zone 6 (horizontal) and NAVD83 (vertical).

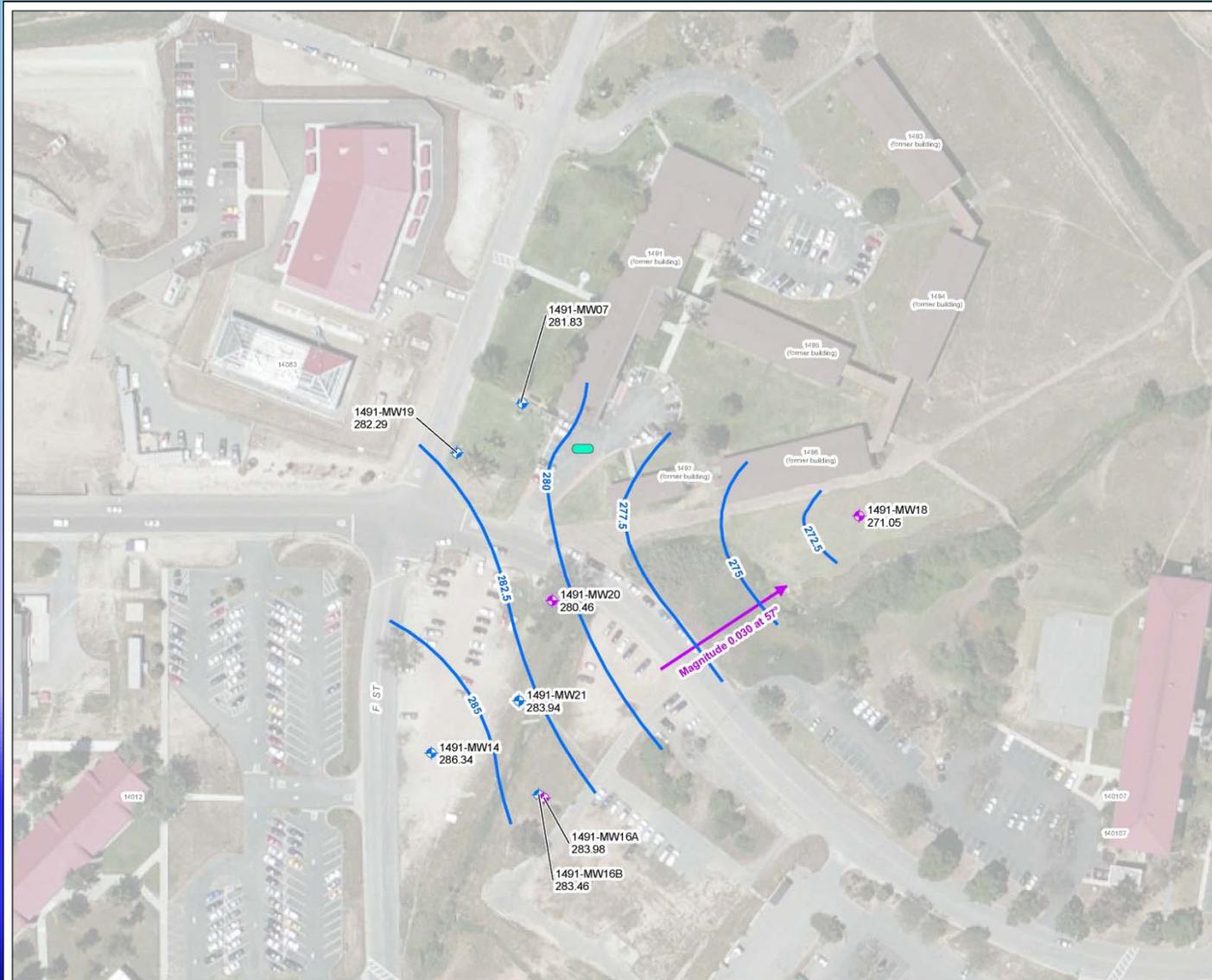
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



DEPARTMENT OF THE NAVY
NAVFAC SOUTHWEST SAN DIEGO, CALIFORNIA
 MARINE CORPS BASE CAMP PENDLETON
 CAMP PENDLETON, CALIFORNIA

FIGURE 6-2
GROUNDWATER ELEVATION, SPRING 2015
IR SITE 1116 SUBSITE 140008

SITE 1116



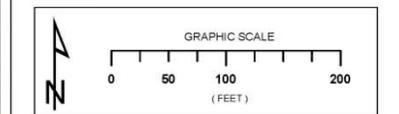
- LEGEND**
- GROUNDWATER MONITORING WELL LOCATION
 - MONITORING WELL USED IN 3-POINT ANALYSIS
 - GROUNDWATER ELEVATION CONTOUR
 - HORIZONTAL HYDRAULIC GRADIENT
 - FORMER UST LOCATION, APPROXIMATE

IR INSTALLATION RESTORATION
 NAD NORTH AMERICAN DATUM
 NAVD NORTH AMERICAN VERTICAL DATUM

NOTES:

1. Groundwater flow direction and gradient estimated from a 3-point problem using groundwater elevations at wells 1491-MW16A, 1491-MW18 1491-MW20.
2. Groundwater elevations measured April 24 through 28, 2015.
3. New monitoring wells (2014) surveyed to NAD 83, California State Plane Zone 6 (horizontal) and NAVD88 (vertical).

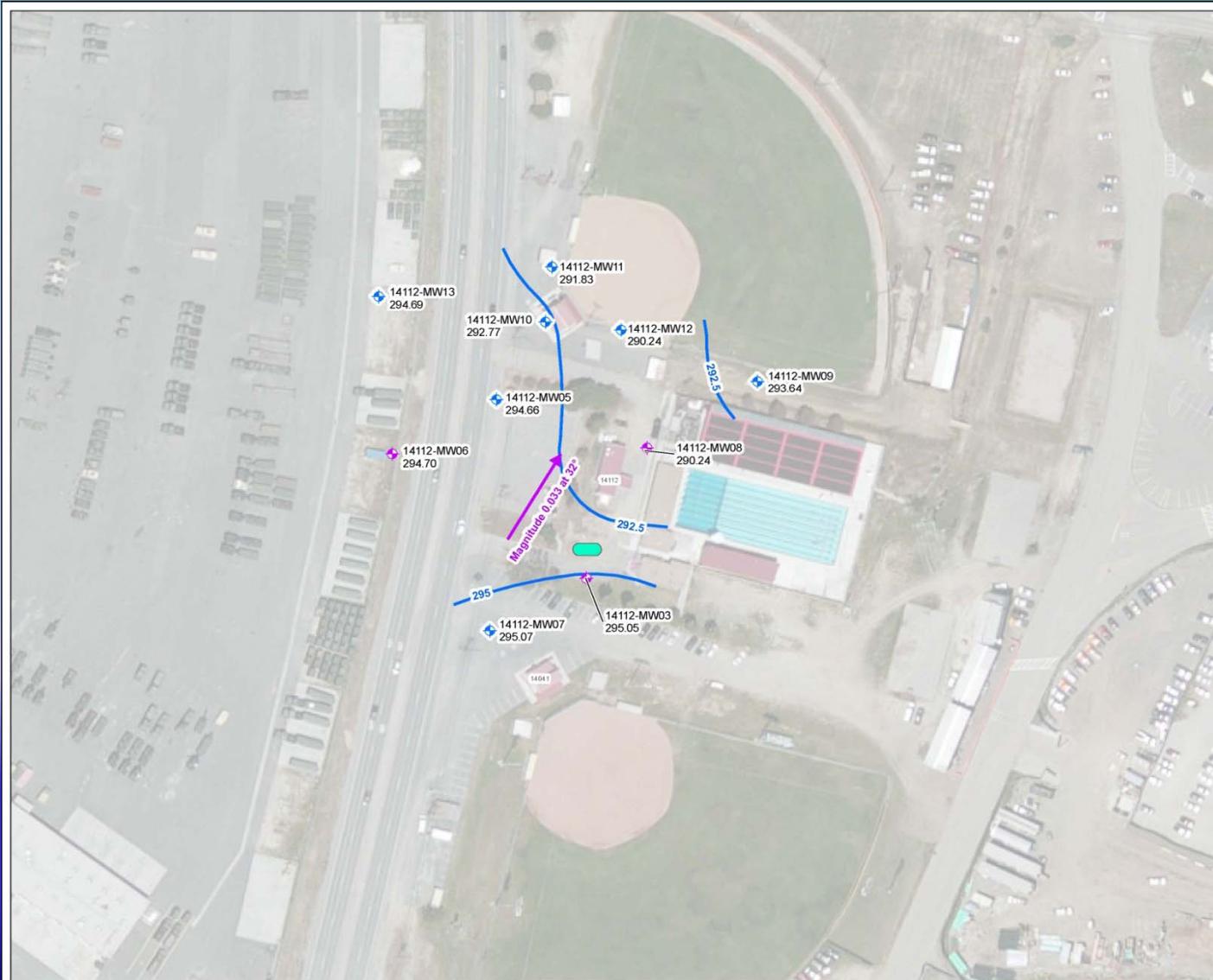
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

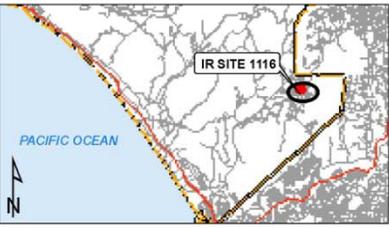


DEPARTMENT OF THE NAVY
NAVFAC SOUTHWEST
 MARINE CORPS BASE CAMP PENDLETON
 CAMP PENDLETON, CALIFORNIA

FIGURE 4-2
GROUNDWATER ELEVATION, SPRING 2015
IR SITE 1116 SUBSITE 1491

SITE 1116





LEGEND

- ◆ GROUNDWATER MONITORING WELL LOCATION
- ◆ MONITORING WELL USED IN 3-POINT ANALYSIS
- GROUNDWATER ELEVATION CONTOUR
- HORIZONTAL HYDRAULIC GRADIENT
- FORMER UST LOCATION, APPROXIMATE

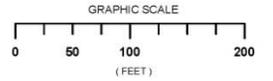
IR INSTALLATION RESTORATION
 NAD NORTH AMERICAN DATUM
 NAVD NORTH AMERICAN VERTICAL DATUM

NOTES:

1. Groundwater flow direction and gradient estimated from a 3-point problem using groundwater elevations at wells 14112-MW03, 14112-MW05, and 14112-MW08.
2. Groundwater elevations measured April 30 through May 5, 2015.
3. New monitoring wells (2014) surveyed to NAD 83, California State Plane Zone 6 (horizontal) and NAVD88 (vertical).

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GRAPHIC SCALE



(FEET)



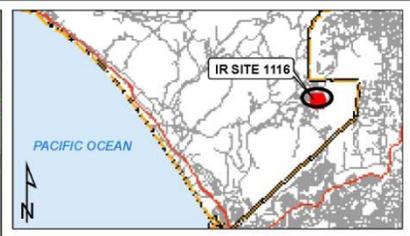
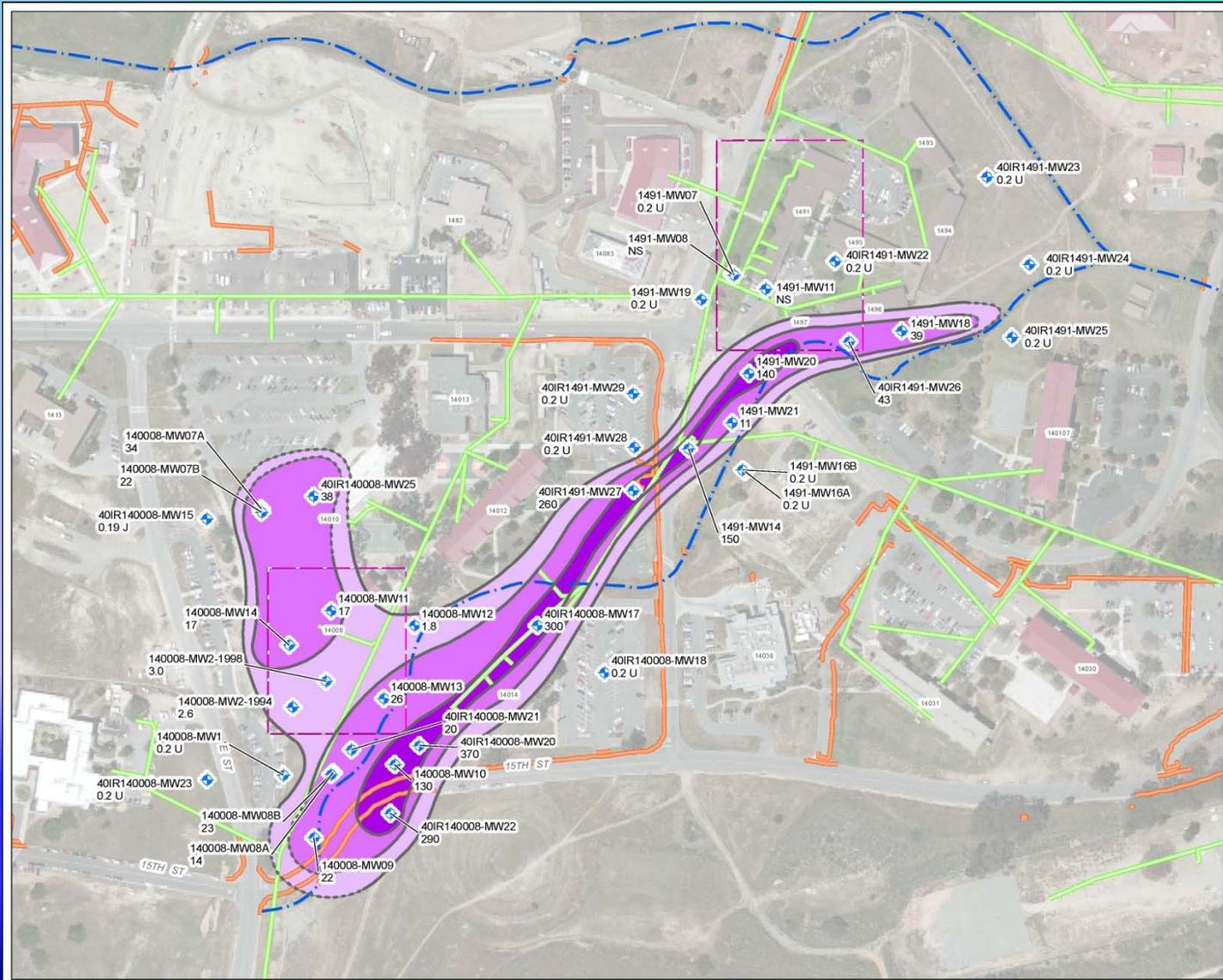
DEPARTMENT OF THE NAVY

NAVFAC SOUTHWEST 

MARINE CORPS BASE CAMP PENDLETON
 CAMP PENDLETON, CALIFORNIA

FIGURE 5-2
GROUNDWATER ELEVATION, SPRING 2015
IR SITE 1116 SUBSITE 14112

SITE 1116



LEGEND

- SAMPLED MONITORING WELL LOCATION
- DRAINAGE
- STORM SEWER LINE
- WASTEWATER LINE
- APPROXIMATE IR SITE BOUNDARY

TRICHLOROETHENE PLUME

- > 100 µg/L
- > 10 µg/L and < 100 µg/L
- > 1 µg/L and < 10 µg/L

Contours dashed where inferred.

NOTES:

1. All results are in micrograms per liter (µg/L).
2. Project screening level for trichloroethene is 0.49 µg/L.

IR INSTALLATION RESTORATION
NS NOT SAMPLED
J ESTIMATED RESULT
U NOT DETECTED

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GRAPHIC SCALE

0 100 200 400 (FEET)

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NAVFAC SOUTHWEST SAN DIEGO, CALIFORNIA
 MARINE CORPS BASE CAMP PENDLETON
 CAMP PENDLETON, CALIFORNIA

FIGURE 7-1
IR SITE 1116
TRICHLOROETHENE PLUME MAP
FOR SUBSITES 1491 AND 140008
APRIL 2015

SITE 1116

Status

- ❖ Site 1116 encompasses both former Subsites 1491 and 140008.
- ❖ The 1491 and 140008 subsite designations are no longer needed.
- ❖ Subsite 14112 is still referred to separately since it is geographically separated (1,600 feet northwest).
- ❖ Site 1116 originally consisted of nine former UST sites.
- ❖ Further action recommended at 14112, 1491, and 140008 in 2011; No further action determined for remaining sites in 2013.

SITE 1116

Status (continued)

- ❖ Site 1116 COCs are VOCs and fuel-related compounds, specifically:
 - Benzene, *cis*-1,2-DCE, TCE, and TPH-d (1491)
 - 1,1,2-TCA, TCE, and TPH-d (140008)
 - 1,2-DCA, benzene, naphthalene, TCE, and TPH-d (14112)

- ❖ Cleanup goals are equal to MCLs; for TPH-d the cleanup goal is 100 µg/L (SF Board ESL).

SITE 1116

Removal Actions and Performance Groundwater Monitoring

- ❖ At Site 1116, removal actions were conducted in 2013 and 2014, which consisted of the following:
 - Subsite 1491 – Soil removal/dewatering and EISB Pilot Study
 - Subsite 140008 – Soil removal/dewatering
 - Subsite 14112 – Soil removal and DPE system

- ❖ Performance groundwater monitoring for the removal actions was conducted in Jan 2014 to March 2015, and will be reported in the Post-NTCRA Performance Groundwater Monitoring Report.

SITE 1116

Former Subsite 1491

- ❖ Former administrative offices and parking
- ❖ Two 1,000 gallon USTs removed in 1996
- ❖ 700 cubic yards removed in 2006
- ❖ Building 1491 demolished in 2012
- ❖ Two phases of investigation completed in 2012 (17 CPTs, 9 hydropunches, and sampling 8 new wells in addition to 9 existing wells)
- ❖ Two phases of NTCRA

SITE 1116

Former Subsite 1491 (continued)

- ❖ 665 cubic yards removed (45'x25'x18') in 2013, dewatering of excavation
- ❖ EISB pilot study injection in July to August 2014

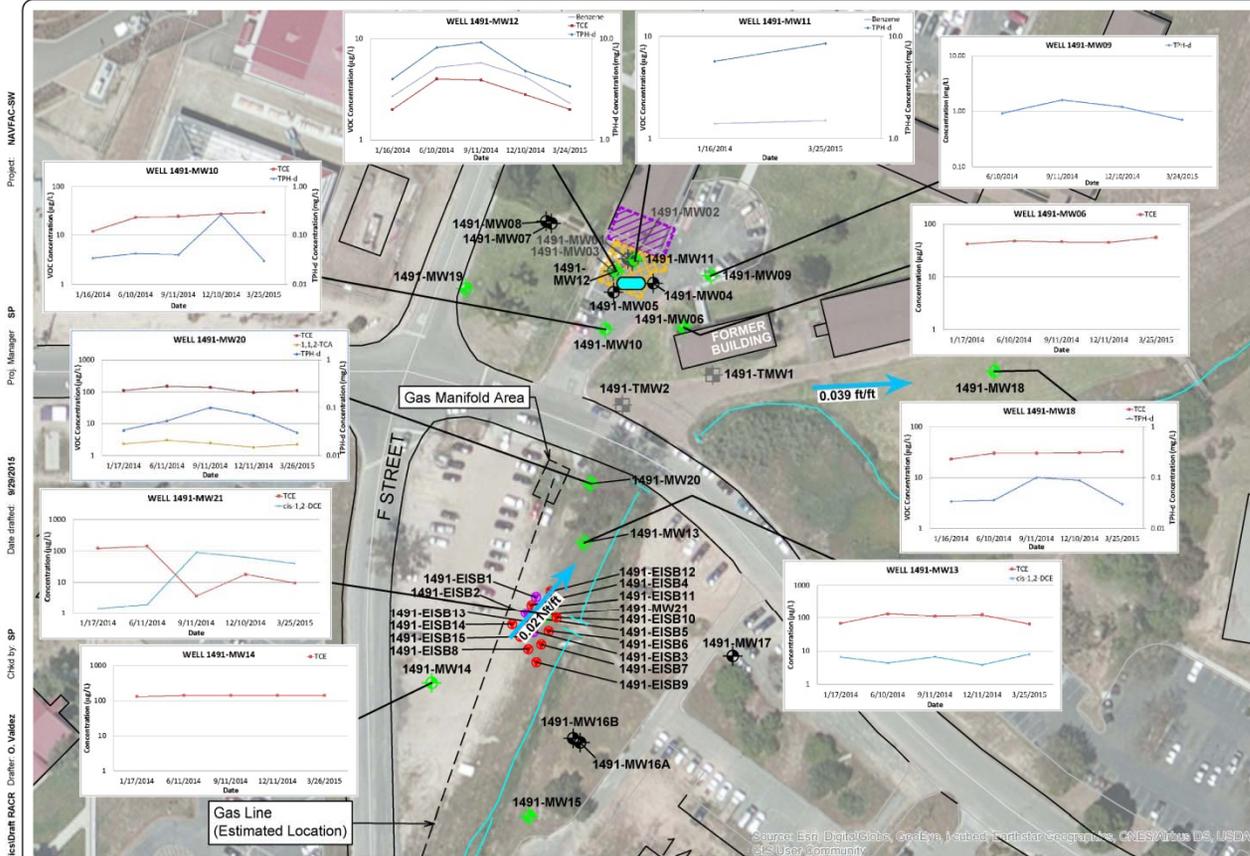


Photo 6 – South side of excavation (10/08/13)



Photo 14 – EISB injection well head (8/07/14)

SITE 1116



LEGEND

- 1491-TMW2 Former Temporary Monitoring Well (January / February 2010) (Shaw 2011)
- 1491-MW01 Monitoring Well (abandoned 1/2006)
- 1491-MW09 Monitoring Well
- 1491-MW19 Performance Monitoring Well
- EISB Pilot Test Injection Well
- EISB Full-Scale Injection Well (Phase I and II)
- Former UST Location
- 0.039 ft/ft Inferred Groundwater Flow Direction and Hydraulic Gradient
- Excavation Extent (September / October 2013)
- Excavation Extent (January 2006)

CLEANUP GOALS	
TPH-d	100 µg/L
1,1,2-Trichloroethane	3 µg/L
Benzene	1 µg/L
cis-1,2-DCE	6 µg/L
TCE	5 µg/L

NOTES:
ORIGINAL CADD BASEMAP. CREATED BY LANDMARK SURVEYING, LA MESA CALIFORNIA.

Concentration trends for COCs with at least one detection reported above the respective cleanup goal are plotted

ABBREVIATIONS:	
ft/ft	feet per foot
µg/L	micrograms per liter
1,1,2-TCA	1,1,2-Trichloroethane
cis-1,2-DCE	cis-1,2-Dichloroethene
COCs	Chemicals of concern
EISB	Enhanced in-situ bioremediation
IR	Installation Restoration
TCE	Trichloroethene
TPH-d	Total petroleum hydrocarbons as diesel
UST	Underground Storage Tank
VOC	Volatile Organic Compound



Project: MAFAC-SW
 Prog. Manager: SP
 Date drafted: 02/2015
 Chd by: SP
 File Path: \\sharepoint\CPIEN\150\site 1116\graphics\Draw RACR Draw\IR O_Valecz



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Camp Pendleton, California

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Subsite 1491 COC Concentration Trends (January 2014 to March 2015)

Figure
3-3

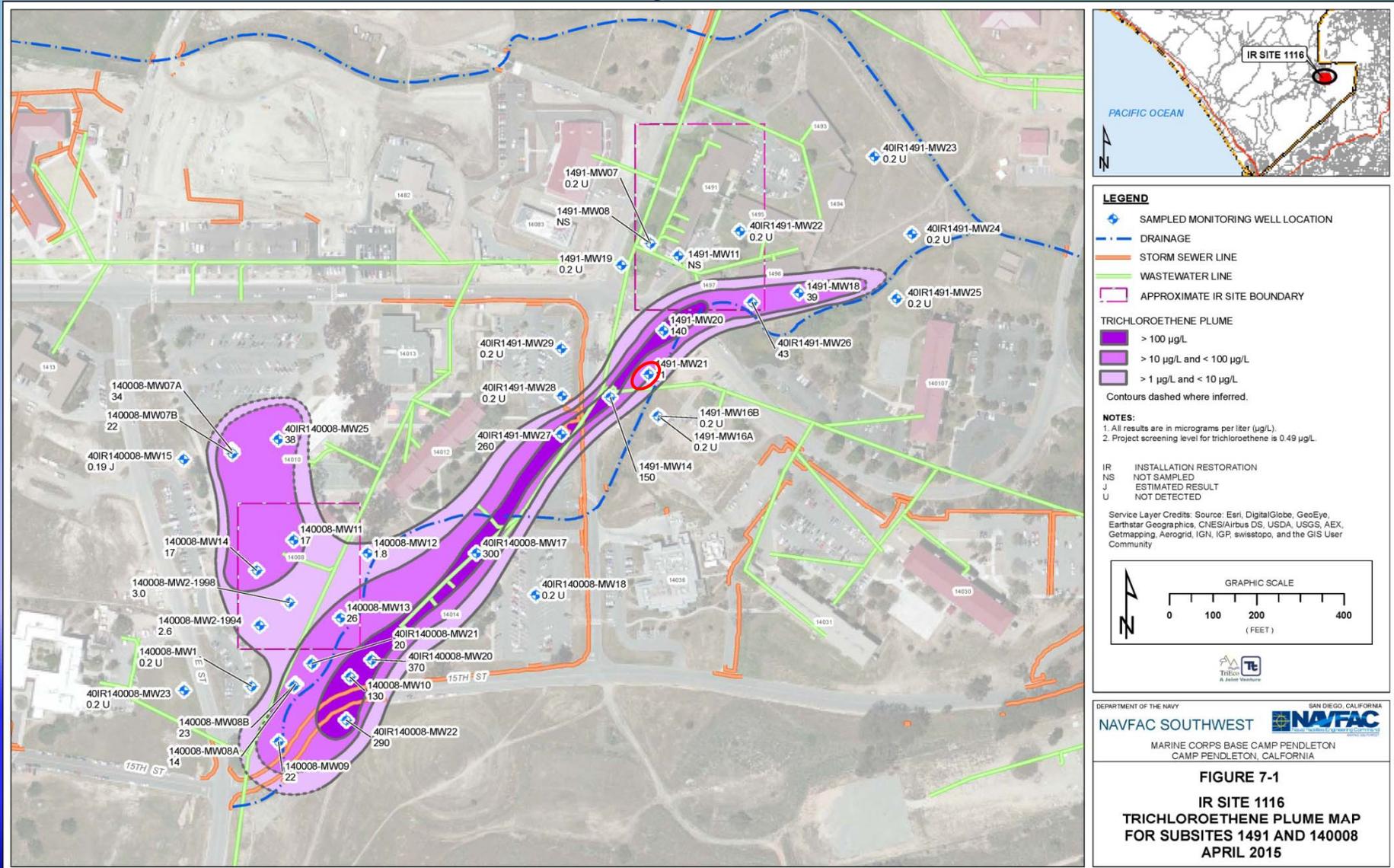


SITE 1116

Former Subsite 1491 (continued)

- ❖ By March 2015 (7 months), EISB reduced TCE concentrations in the performance monitoring well (MW-21) within the injection cluster from 140 µg/L to 10 µg/L, and increased *cis*-1,2 DCE from 1.5 to 90 µg/L (decreased to 40 µg/L in March 2015).
- ❖ There was no significant effect on the performance monitoring well approximately 80 feet downgradient in March 2015.

SITE 1116 Pilot Study



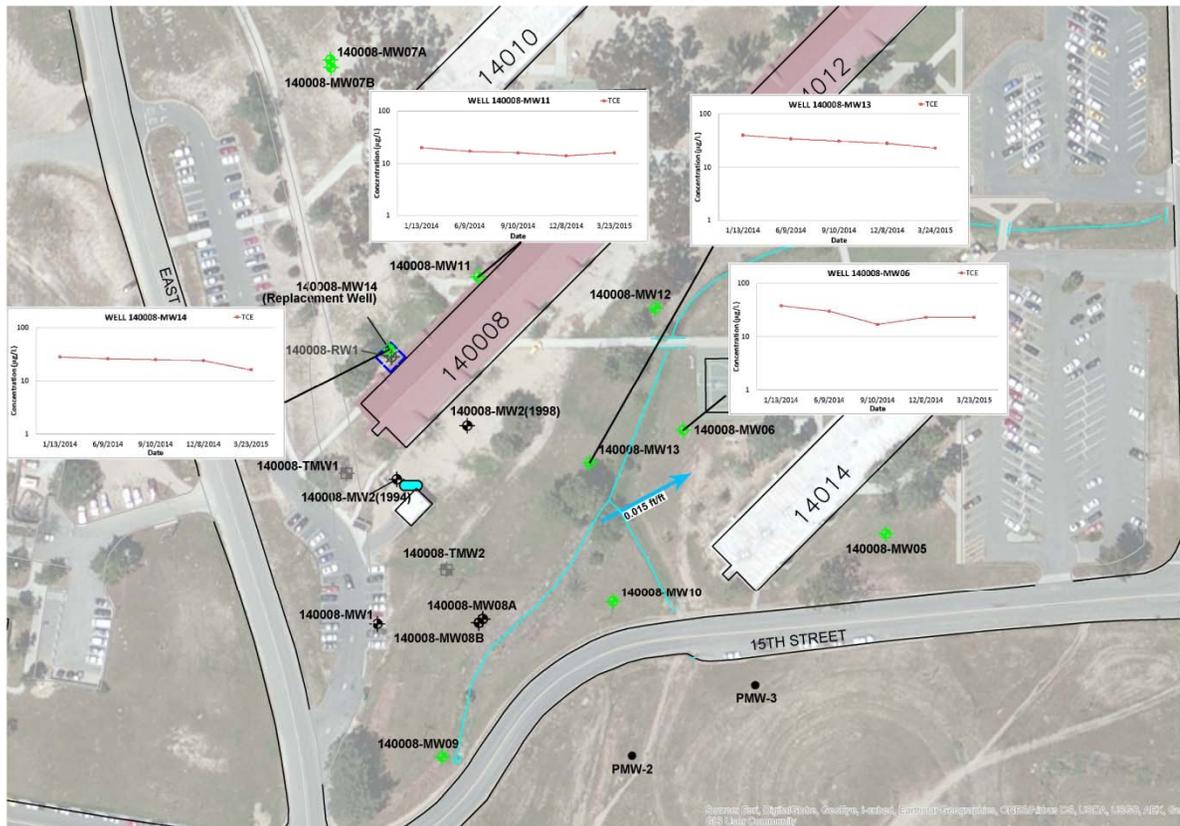
SITE 1116

Former Subsite 140008

- ❖ Former 12,000 gal diesel tank was removed in 1995.
- ❖ Removal action in 2013 – 230 cubic yards were excavated south of building and there was dewatering.
- ❖ Sewer line connection near 140008-MW-9 (15th and E St) may be a contributing factor for the multi-site plume.
- ❖ Potential source near 140008-MW-07A/B (in the vicinity of Bldg 140008) may have contributed to the Building 140008 portion of the plume, which is unbounded to the north and east.
- ❖ Movement of combined plume is likely controlled by geologic factors; i.e., contact between Santiago Formation and granodiorite.

SITE 1116

Project: NAVFAC-SW
 Prog. Manager: SP
 Date drafted: 08/29/2015
 Chd by: SP
 Drafter: DV



LEGEND

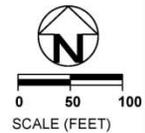
- 140008-MW1 Monitoring Well
- 140008-MW12 Performance Monitoring Well
- 140008-RW1 Abandoned Monitoring Well
- 140008-TMW1 Former Temporary Monitoring Well (January / February 2010) (Shaw 2011)
- PMW-3 Borehole Location (Dry)
- Excavation Extent (October 2013)
- Former UST Location
- Inferred Groundwater Flow Direction and Hydraulic Gradient (March 2015)

CLEANUP GOALS	
TCE	5 µg/L

NOTES:
 ORIGINAL CADD BASEMAP: CREATED BY LANDMARK SURVEYING, LA MESA CALIFORNIA.
 CONCENTRATION TRENDS FOR COCs WITH AT LEAST ONE DETECTION REPORTED ABOVE THE RESPECTIVE CLEANUP GOAL ARE PLOTTED.

ABBREVIATIONS:

ft/ft	feet per foot
µg/L	micrograms per liter
COCs	Chemicals of concern
IR	Installation Restoration
TCE	Trichloroethene
UST	Underground Storage Tank



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Subsite 140008 COC Concentration Trends (January 2014 to March 2015)

Figure
5-3



SITE 1116

Plans Going Forward

Former Subsites 1491 and 140008

- ❖ **Sampling to refine extent of plume, including addressing data gaps near upgradient source areas and downgradient edge.**
- ❖ **Determine best remediation locations and configuration based on geology and updated CSM.**
- ❖ **Collect soil gas data and perform risk assessment.**
- ❖ **Design and implement a larger-scale injection system.**

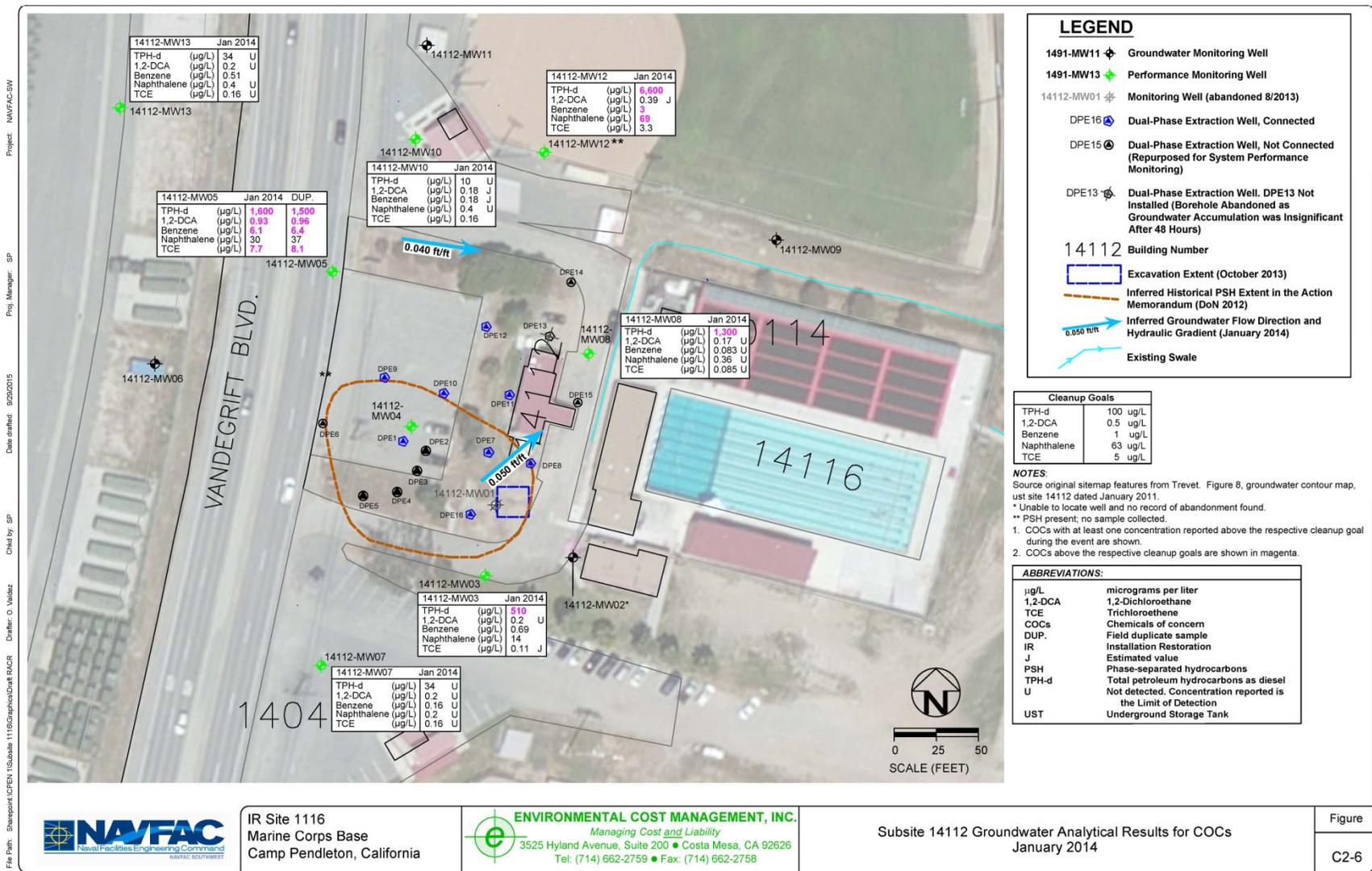
SITE 1116

Subsite 14112

- ❖ Two diesel USTs removed in 1997
- ❖ Several investigations between 1999 and 2012
- ❖ NTCRAs
 - Source area excavation (270 yards) and dewatering in 2013
 - DPE system installed in 2014 to address PSH
 - System operated in Feb 2015 and was discontinued after generating large amounts of water requiring treatment to concentrations below system capabilities



SITE 1116 – Subsite 14112



Project: NAFAC/SW
 Proj. Manager: SP
 Date drafted: 3/20/2015
 Ctd by: SP
 Drafter: C. Valdez
 File Path: Sharepoint:DPEN\1116\Graphics\Draft\RUCR



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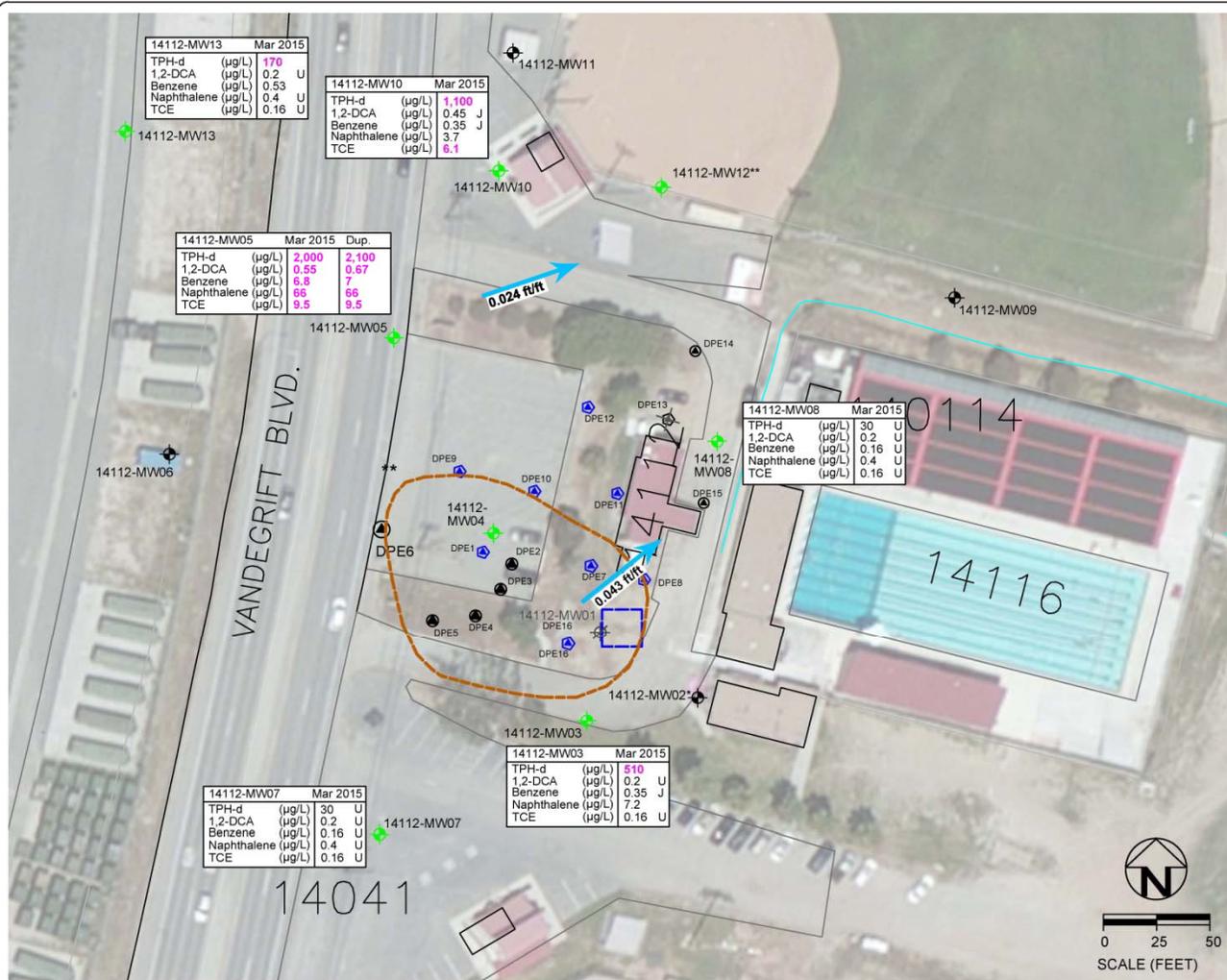
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Subsite 14112 Groundwater Analytical Results for COCs
 January 2014

Figure
 C2-6



SITE 1116 – Subsite 14112



LEGEND

- 1491-MW09 Groundwater Monitoring Well
- 1491-MW19 Performance Monitoring Well
- 14112-MW01 Monitoring Well (abandoned 8/2013)
- DPE16 Dual-Phase Extraction Well, Connected
- DPE15 Dual-Phase Extraction Well, Not Connected (Repurposed for System Performance Monitoring)
- DPE13 Dual-Phase Extraction Well. DPE13 Not Installed (Borehole Abandoned as Groundwater Accumulation was Insignificant After 48 Hours)

14112 Building Number

- Excavation Extent (October 2013)
- Inferred Historical PSH Extent in the Action Memorandum (DoN 2012)
- Inferred Groundwater Flow Direction and Hydraulic Gradient (March 2015)
- Existing Swale

Cleanup Goals

TPH-d	100 ug/L
1,2-DCA	0.5 ug/L
Benzene	1 ug/L
Naphthalene	63 ug/L
TCE	5 ug/L

NOTES:
 Source original sitemap features from Trevet. Figure 8, groundwater contour map, ust site 14112 dated January 2011.
 * Unable to locate well and no record of abandonment found.
 ** PSH present, no sample collected.
 1. COCs with at least one concentration reported above the respective cleanup goal during the event are shown.
 2. COCs above the respective cleanup goals are shown in magenta.

ABBREVIATIONS:

ug/L	micrograms per liter
1,2-DCA	1,2-Dichloroethane
TCE	Trichloroethene
COCs	Chemicals of concern
DUP.	Field duplicate sample
IR	Installation Restoration
J	Estimated value
NS	Not Sampled
PSH	Phase-separated hydrocarbons
TPH-d	Total petroleum hydrocarbons as diesel
U	Not detected. Concentration reported is the Limit of Detection
UST	Underground Storage Tank



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Subsite 14112 Groundwater Analytical Results for COCs
 March 2015

Figure
 C2-10



SITE 1116

Plans Going Forward

Subsite 14112

- ❖ Further define extent of plume extending off site, including VOCs (TCE) and TPH in groundwater.
- ❖ Remove free product via periodic placement of absorbent socks, track thickness and removal rates.
- ❖ Determine optimized remedial strategy based on additional groundwater monitoring data.

22/23 Area Groundwater Enhanced In Situ Bioremediation

January 19, 2016

117th FFA Meeting

22/23 AREA GROUNDWATER EISB

Presentation Outline

- Site Background
- 22/23 Area ROD Review
- Battelle Pilot Study Results
- Full Scale EAB Remedy Path Forward
- Questions / Discussion

22/23 AREA GROUNDWATER EISB

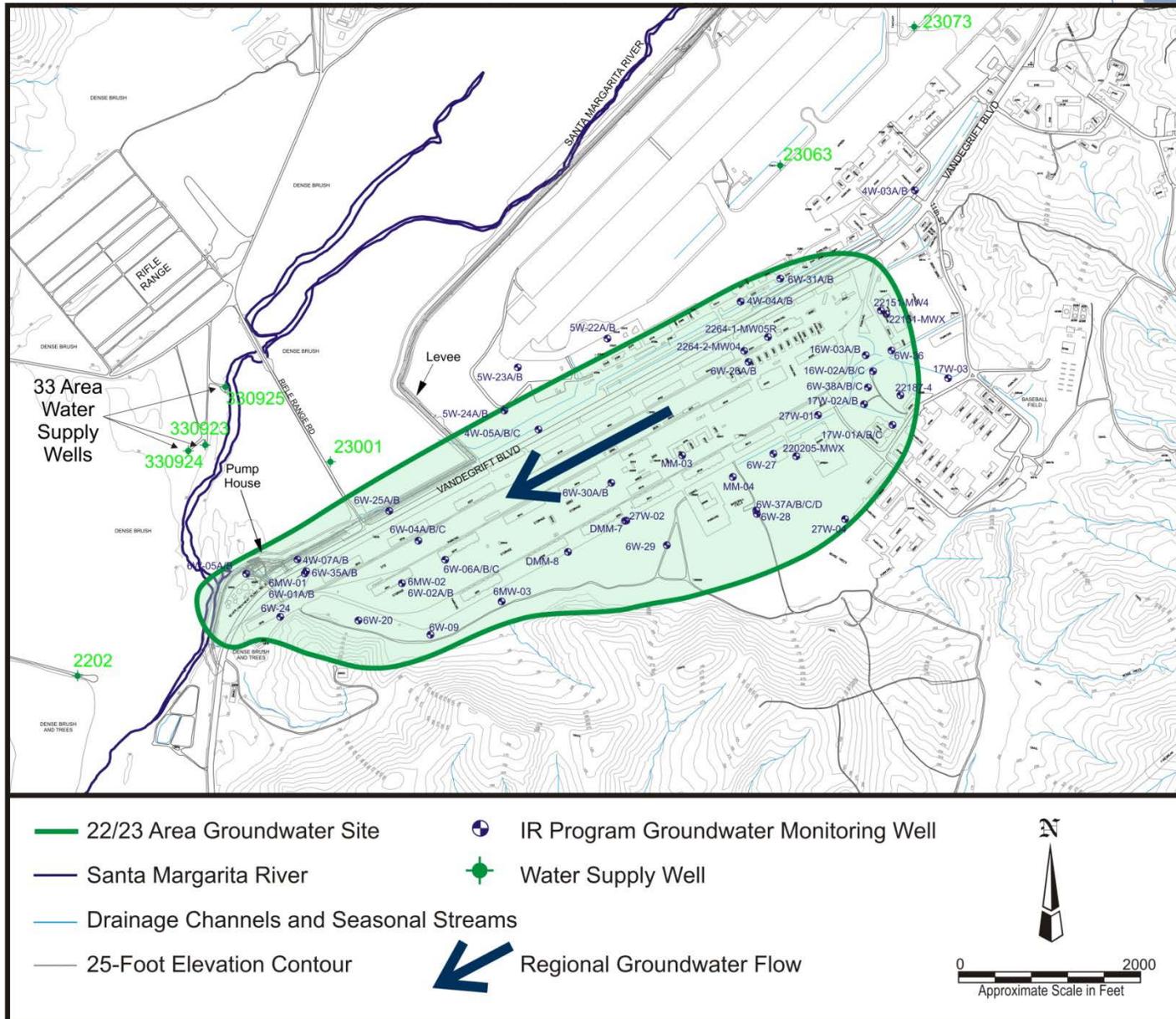
Site Background

- Site on MCAS is within the Chappo Hydrologic Subarea of the Ysidora Hydrologic Area of the Santa Margarita Hydrologic Unit.
- Facilities with the 22/23 Area include industrial operations, warehouses, office buildings, an airfield, and associated air base complex.

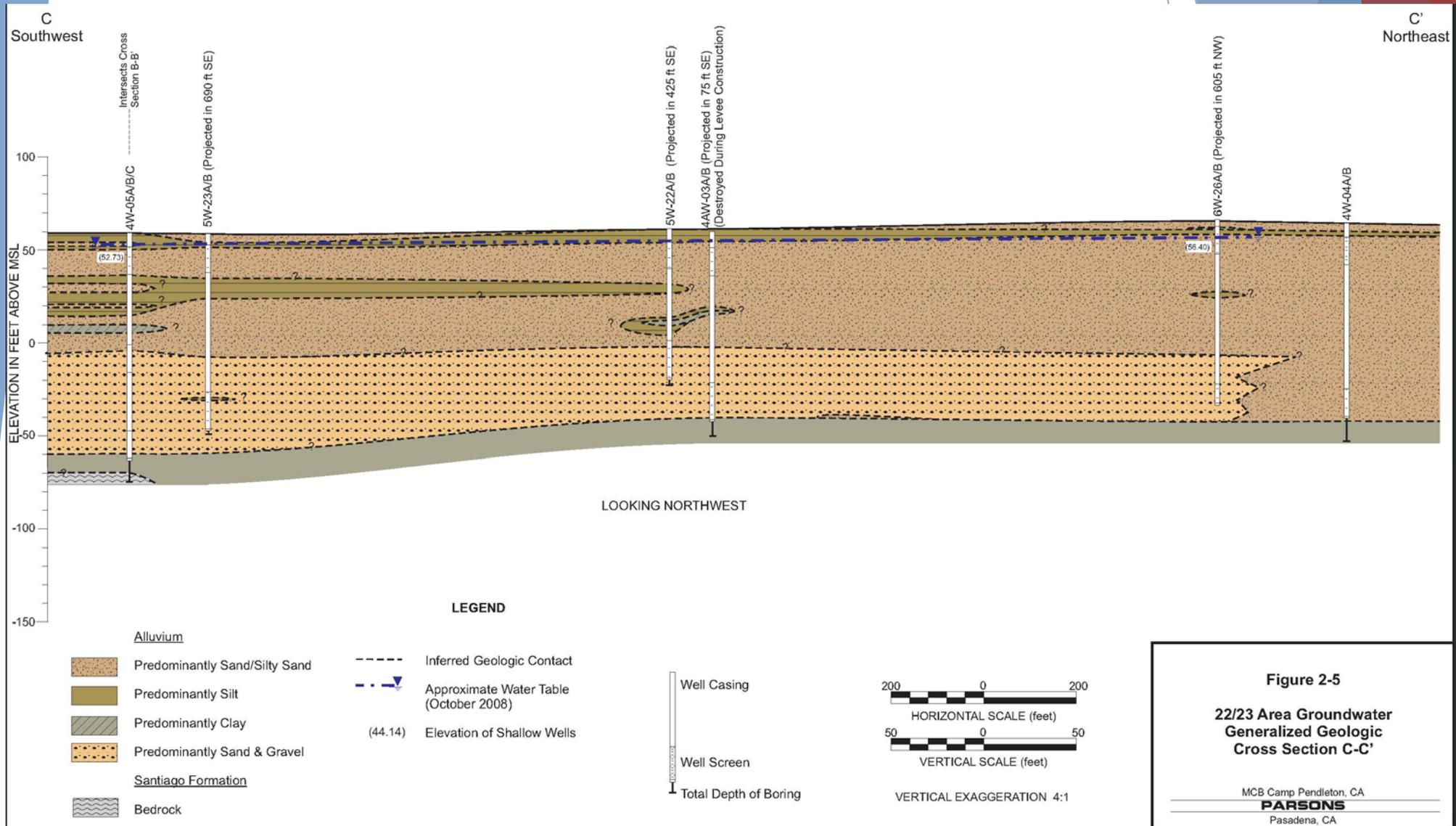


22/23 AREA GROUNDWATER EISB

Site Background (continued)



22/23 AREA GROUNDWATER EISB Site Background (continued)



22/23 AREA GROUNDWATER EISB

Site Background (continued)

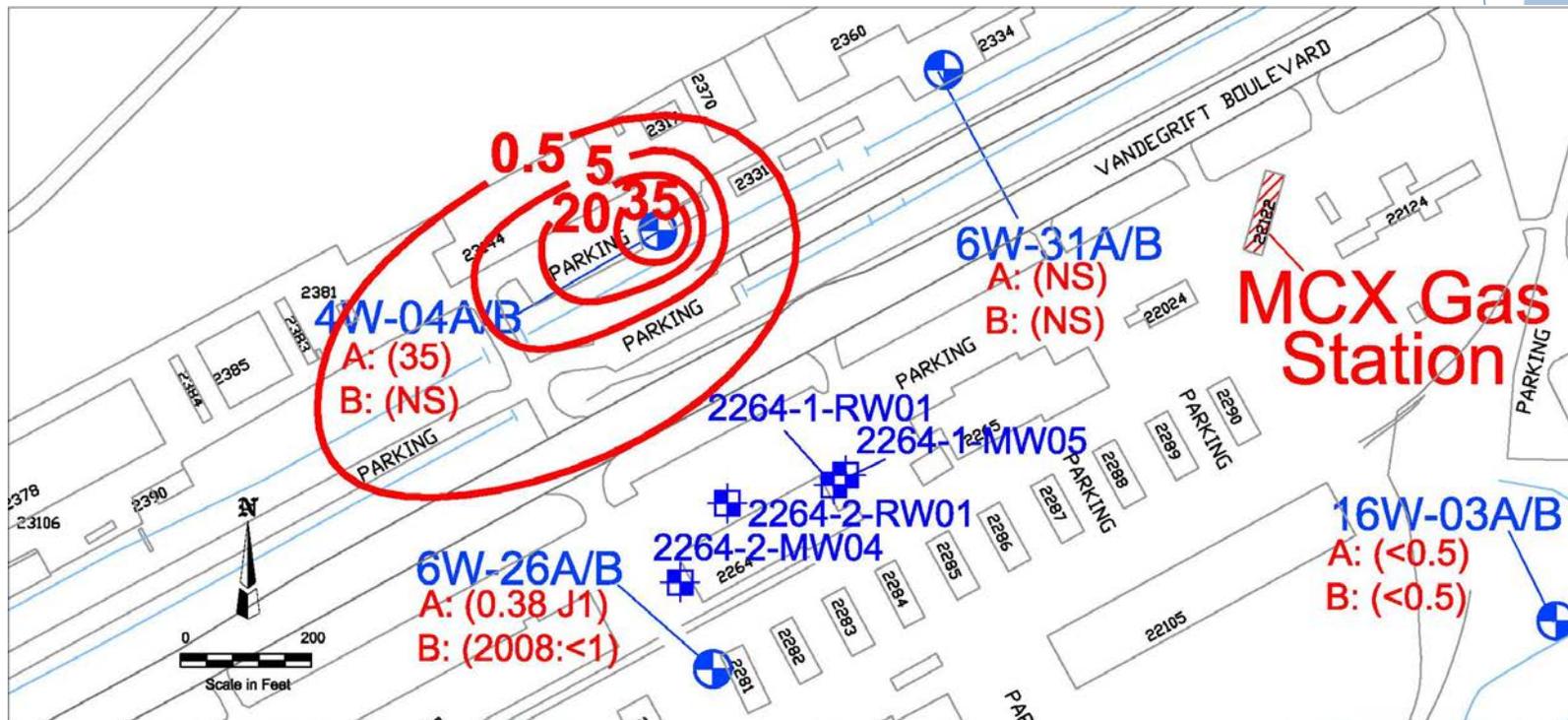
- Groundwater is found in alluvial and flood plain deposits, which occur to a total depth of approximately 110 ft bgs at 4W-04A/B.
- At the site, there are interbedded layers of silty sand, sand, and silt down to 55 ft bgs (very minor clay layers), and between 55 and 110 ft bgs is primarily clean sand.
- Santiago Formation occurs at greater than 110 ft bgs.

22/23 AREA GROUNDWATER EISB

Site Background (continued)

- Detections at well 4W-04A during the RI in 2007 included TCE at 35 $\mu\text{g/L}$, and *cis*-1,2 DCE at 23 $\mu\text{g/L}$ (screened 7.6 to 23.6 ft bgs). In 2012, sampling confirmed results in 4W-04A (31 $\mu\text{g/L}$).

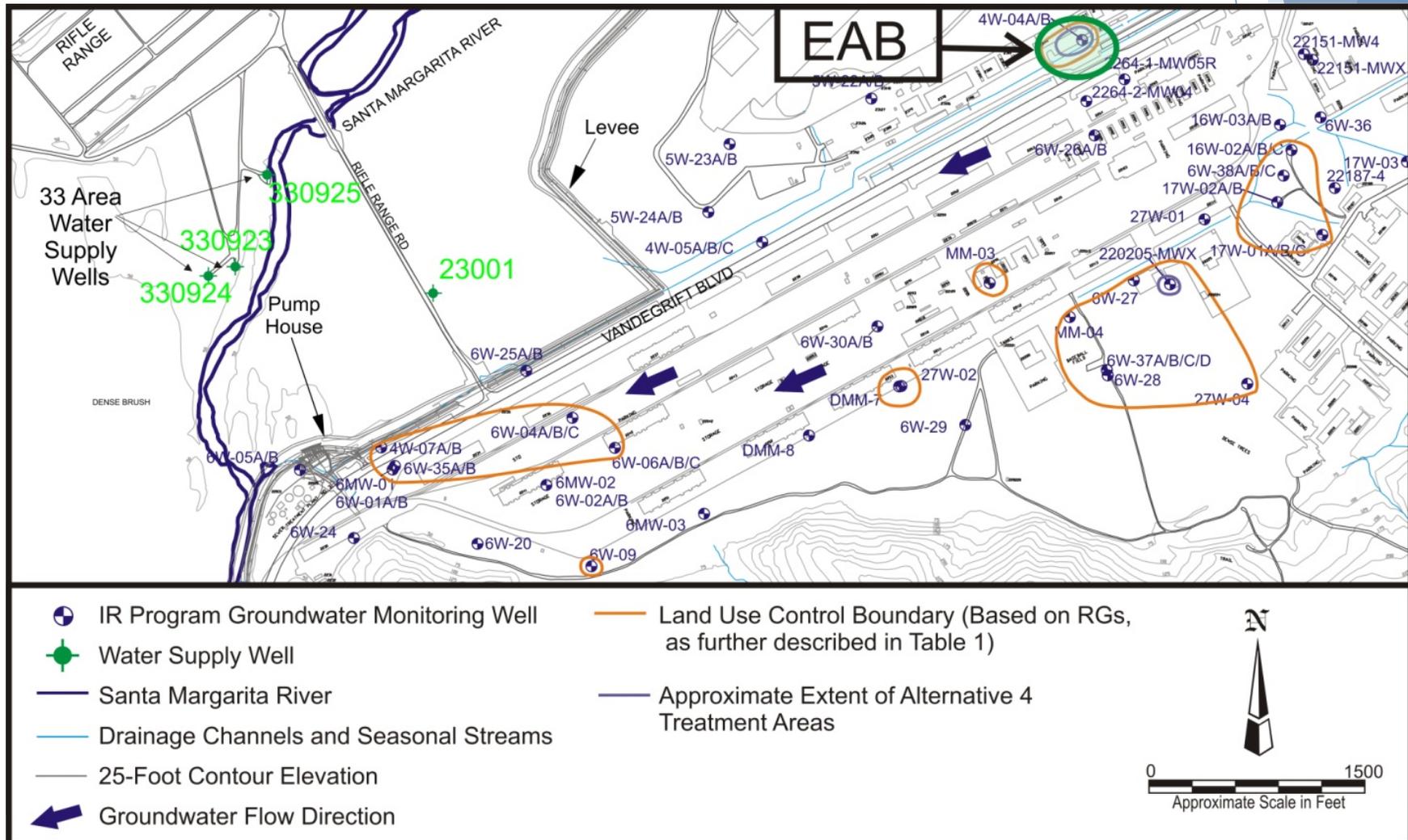
TCE Source Area in RI/FS



22/23 AREA GROUNDWATER EISB

22/23 Area ROD Review

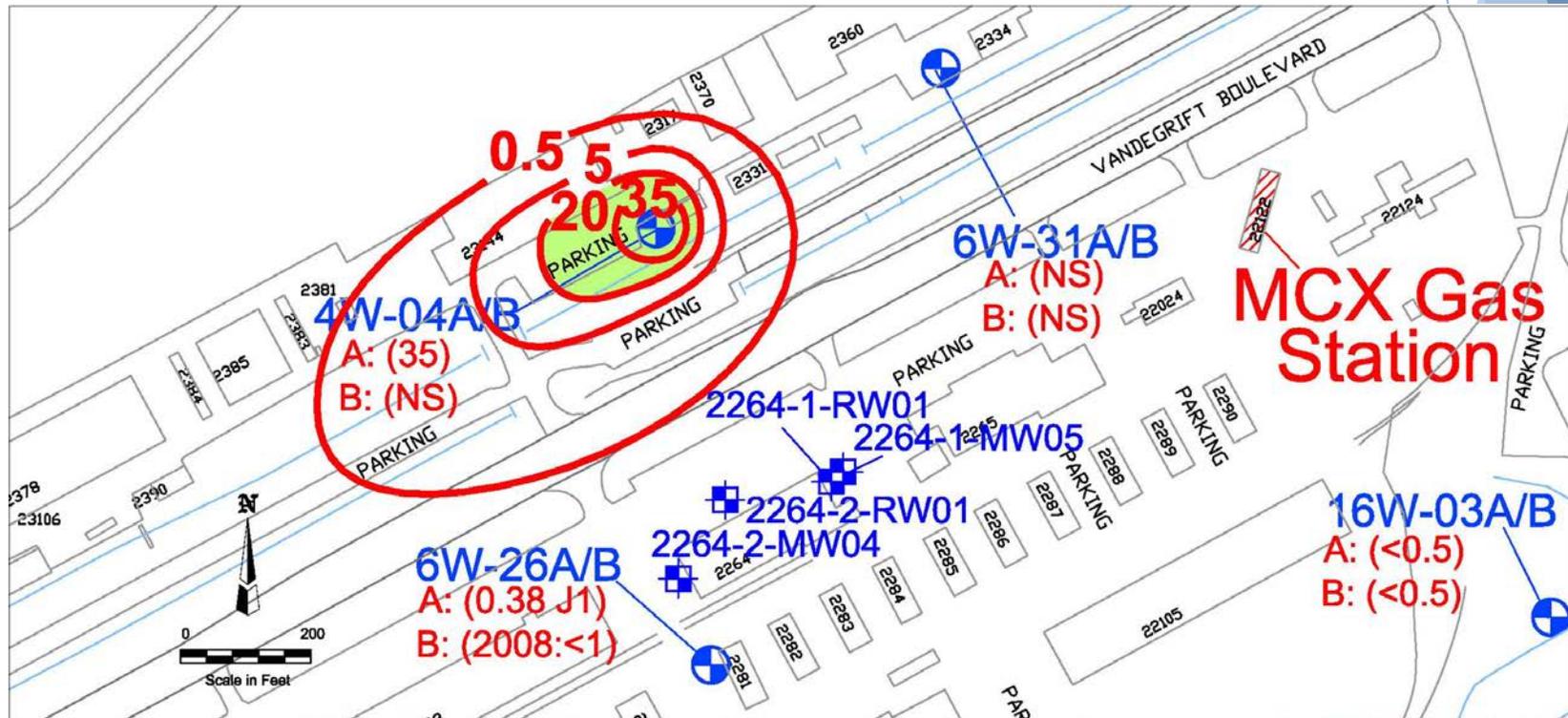
- Selected remedy includes EAB at the TCE source area near 4W-04A



22/23 AREA GROUNDWATER EISB

22/23 Area ROD Review (continued)

- 4W-04A source area treatment plan and objectives:
 - Implement EAB in the 4W-04A source area as defined by the 20 µg/L TCE contour to reduce hotspot mass and to support the greater LTM remedy.
 - Implement a design study evaluate the effectiveness of this technology and to refine the full scale remedy implementation.
 - Design full scale application to actively reduce concentrations in the source area (greater than 20 µg/L TCE).



22/23 AREA GROUNDWATER EISB

Implementation of Pilot Scale In Situ Bioremediation

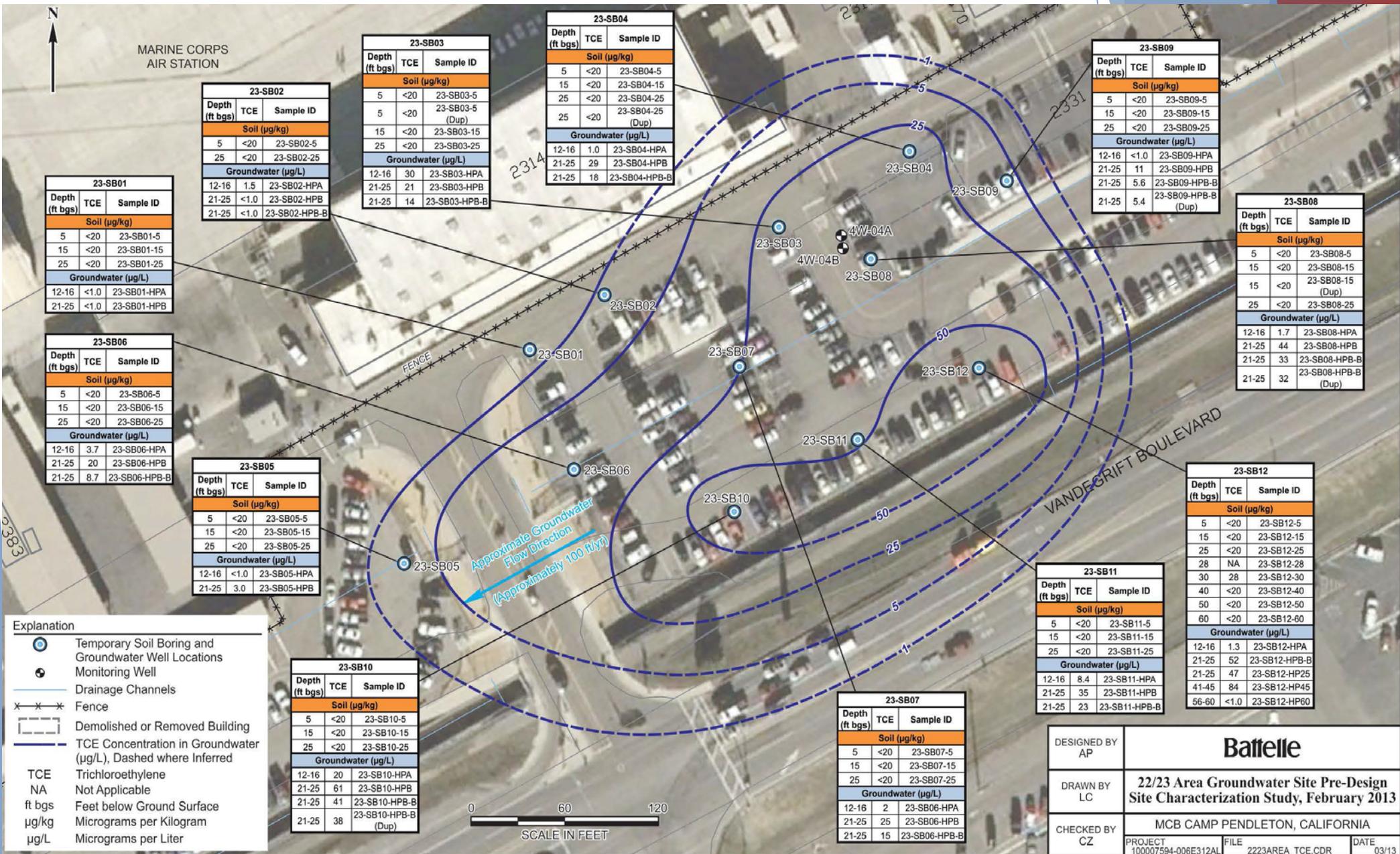
- Pre-design Site Characterization Study (February 2013)
- Design for the EISB Pilot Study
- Well installations and Substrate Injection (October 2013)
- Performance Monitoring (January 2014 to February 2015)
- Draft ESIB Pilot Study Report (June 2015)

22/23 AREA GROUNDWATER EISB

Pre-Design Characterization

- Twelve hydropunch borings:
 - At 11 of the 12 hydropunches, groundwater samples were collected at two shallow intervals to a maximum depth of 26 ft bgs, and
 - At the 12th hydropunch location (23-SB12) samples were collected to maximum depth of 60 ft bgs.
- Elevated TCE concentrations were found to the south of known contamination at 4W-04A/B (Figure 3):
 - Elevated TCE in hydropunch samples mostly in samples between 21 to 25 ft bgs, not between 12 to 16 ft bgs,
 - Highest TCE was 84 µg/l in 23-SB12 at 41 to 45 ft bgs (this is the only hydropunch drilled greater than 26 ft bgs), and
 - Injection wells were proposed to be installed to 50 feet and performance monitoring wells were installed to a total depth of 50 to 70 ft bgs.
- EISB Pilot Study was planned for area south of 4W-4A/B in area of highest concentrations as indicated by hydropunch sampling.

22/23 AREA GROUNDWATER EISB

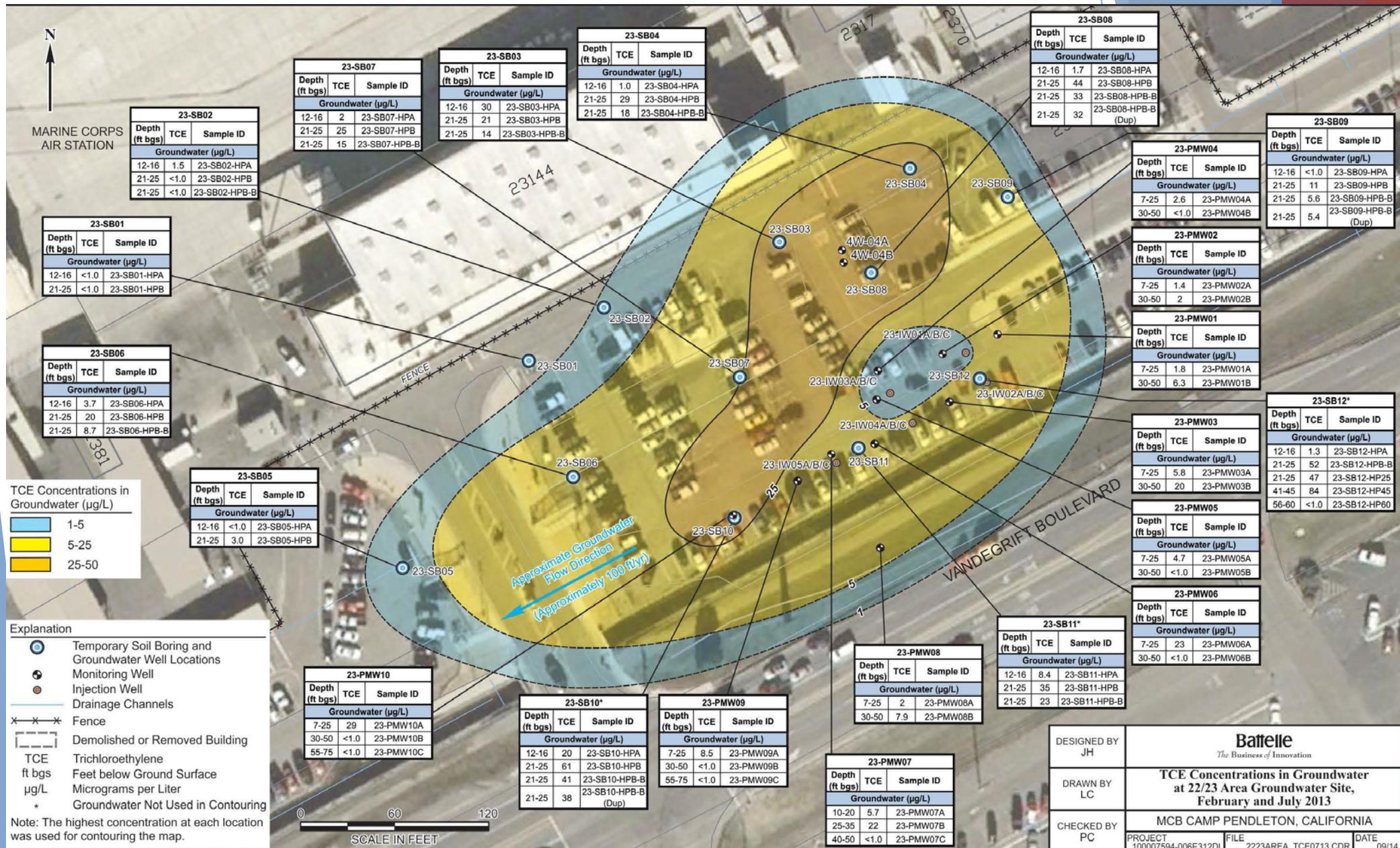


22/23 AREA GROUNDWATER EISB

Pilot Scale In Situ Bioremediation

- System Installation consisted of:
 - Five 2-inch diameter injection wells to 50 ft bgs with three screen intervals per location (15 wells total),
 - Ten performance monitoring wells around treatment area,
 - Seven performance wells with multiple screens to 50 ft bgs and three wells with multiple screens to 75 ft bgs, and
 - Three soil gas monitoring points to monitor hydrogen sulfide and methane in the vadose zone.
- Baseline groundwater sampling in July 2013.
- Figure 6 includes February 2013 pre-design data and July 2013 data for baseline conditions.

22/23 AREA GROUNDWATER EISB



22/23 AREA GROUNDWATER EISB

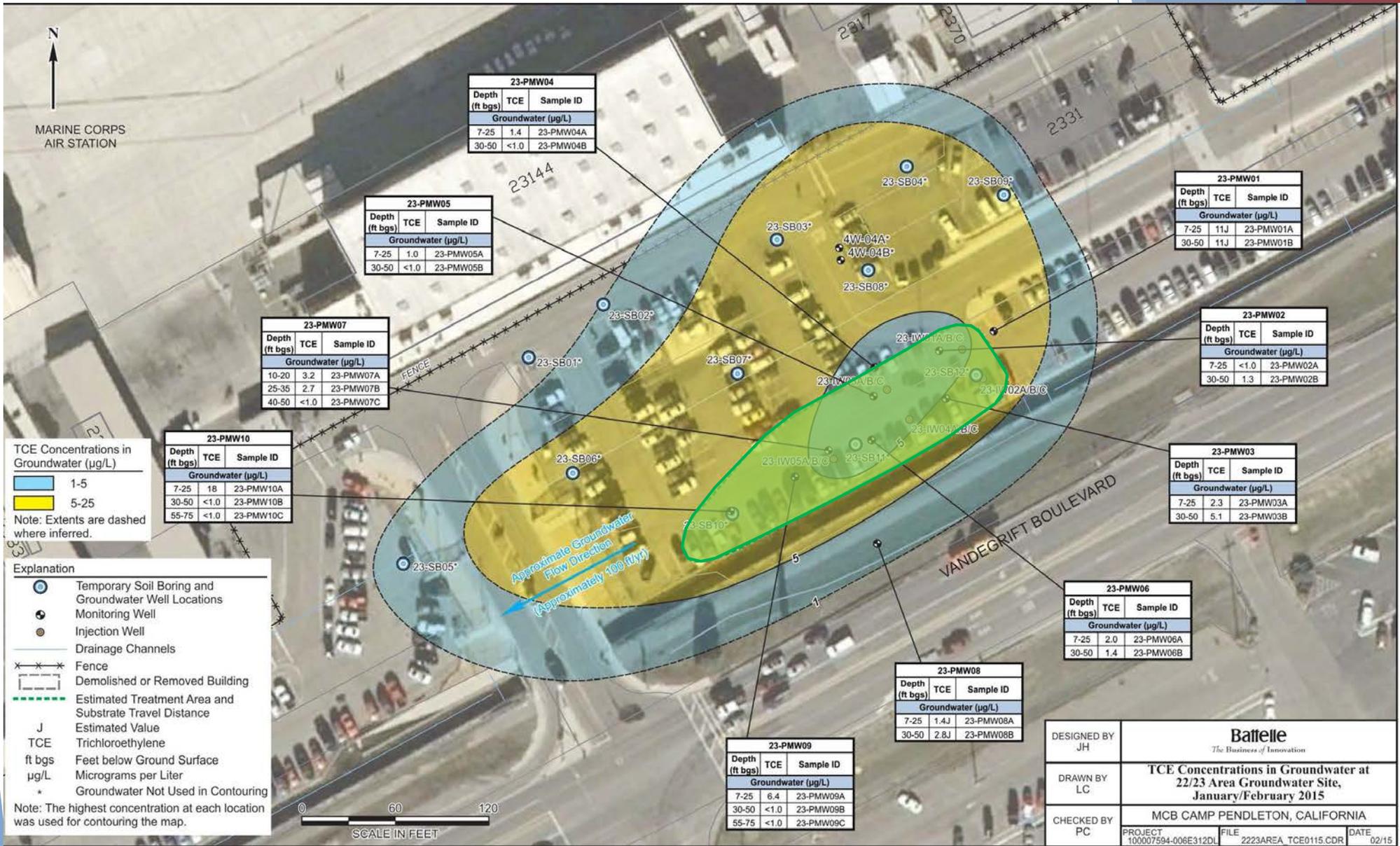
Substrate Injection

- A total of 131,030 gallons of extracted groundwater, EVO and buffer were injected:
 - EVO loading rate of 0.5% (0.25% oil),
 - Buffer loading rate of 0.4%, and
 - Substrate was gravity feed into the subsurface.
- After 3rd quarter of performance monitoring, additional buffer injected to address low pH conditions.

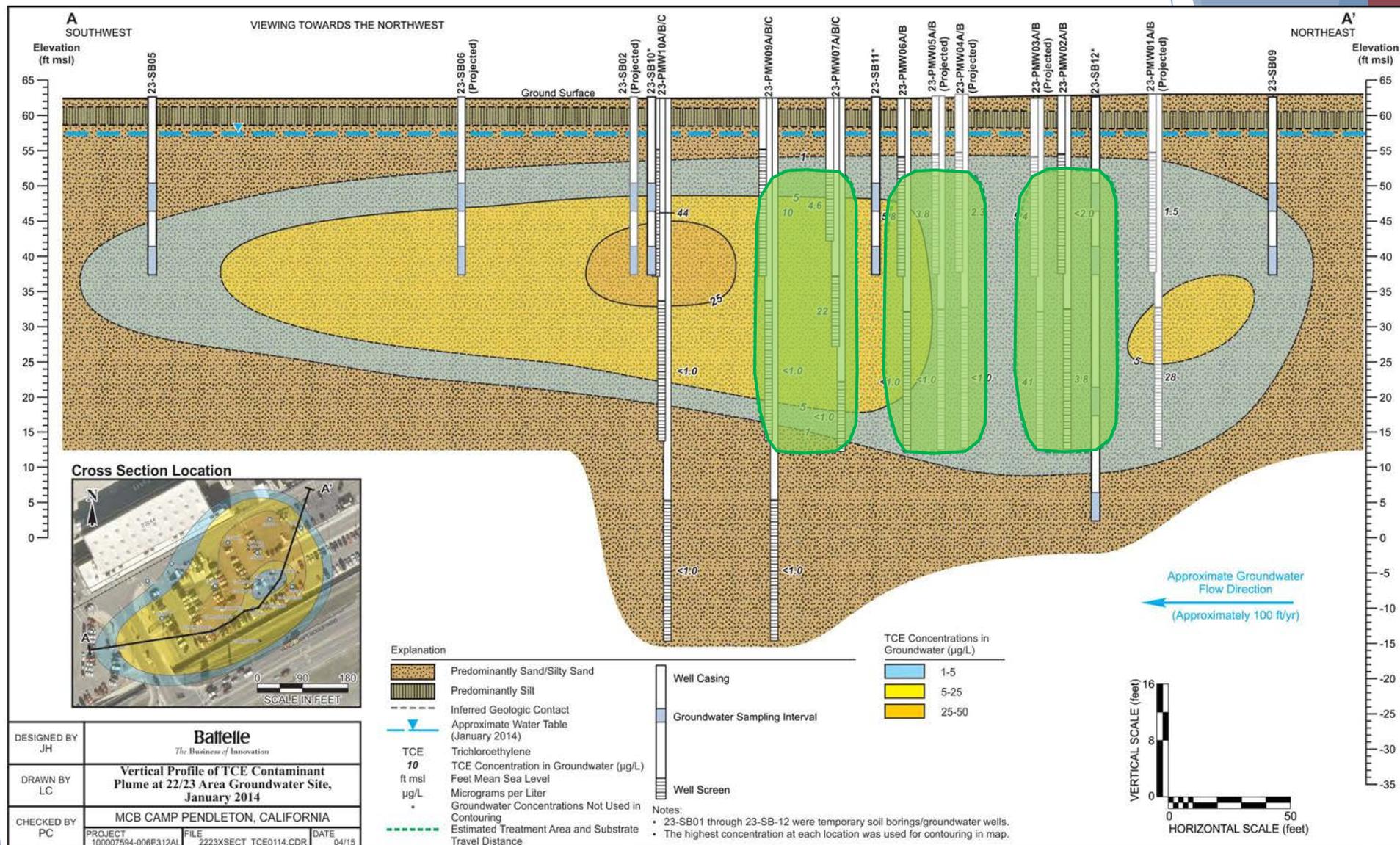
Performance Monitoring

- Four rounds of performance monitoring conducted (January 2014, April 2014, July 2014, and January/February 2015).

22/23 AREA GROUNDWATER EISB



22/23 AREA GROUNDWATER EISB



22/23 AREA GROUNDWATER EISB

Pilot Study Conclusions

- Anaerobic geochemical conditions conducive to dechlorination were induced.
- Reductive dechlorination was occurring by Q2.
- During pre-design in Feb 2013, TCE ranged from 1.0 µg/L to 84 µg/L; during Jan/Feb monitoring event, TCE ranged from 1.0 to 18 µg/L.
- Total number of wells with chlorinated solvent detections decreased.
- DHC functional genes concentrations have increased since baseline monitoring indicating that DCE and VC can be dechlorinated.

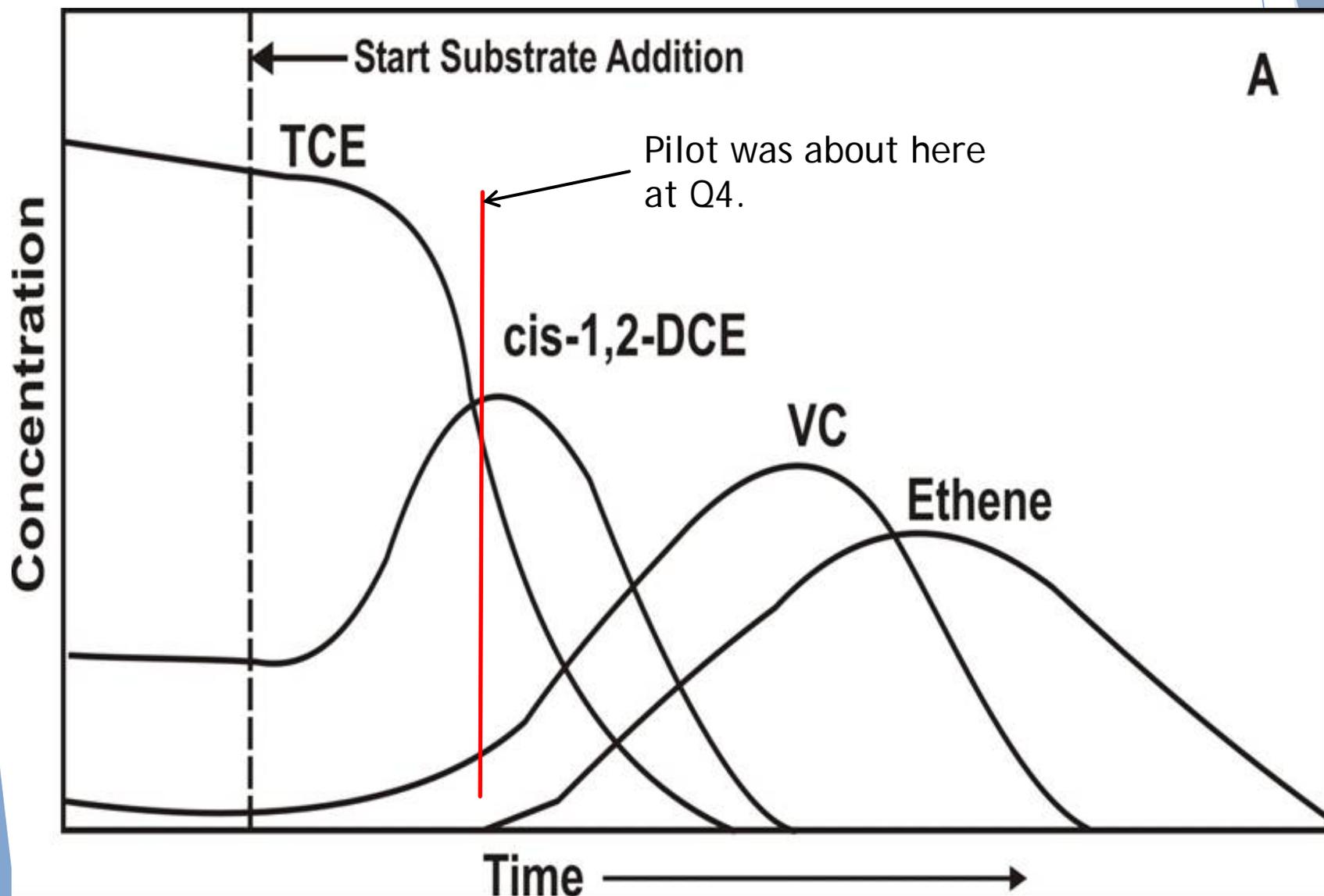
22/23 AREA GROUNDWATER EISB

Pilot Study Conclusions (continued)

- Relatively low levels of DHC cells and volatile fatty acids indicate that reductive dechlorination will be slow.
- Increases in methane concentrations indicate that methanogenesis is occurring.
- TCE concentrations are decreasing; dechlorination is occurring and will continue for some period of time.
- TOC concentrations have declined by Q4 such that continued anaerobic biological activity will soon halt within the pilot study area.

22/23 AREA GROUNDWATER EISB

► So what does all that mean?



*From USEPA, 1998

22/23 AREA GROUNDWATER EISB

Path Forward (continued)

- Expand in situ enhanced bioremediation system in accordance with the ROD.
- Technology to be applied to treat TCE concentrations exceeding 20 µg/L.
- Less effective at concentrations below 20 µg/L due to inability of dechlorinating microbial populations to compete with other non-dechlorinating microbes where TCE is too low.
- Pre-characterization to define lateral and vertical extent to extent necessary for system design (out to ~20 µg/L), using new wells and select existing wells.

22/23 AREA GROUNDWATER EISB

Path Forward (continued)

- Develop new groundwater contour map to ensure accurate flow directions for system design.
- Design locations/depths of injection system will be based on additional data on objectives of the ROD.
- Install performance monitoring wells and injection wells.
- Following injection, proactively monitor and manage aquifer pH in the treatment areas.
- Conduct performance monitoring to track temporal trends.

22/23 AREA GROUNDWATER EISB

Questions?