

**MCB Camp Pendleton  
104<sup>th</sup> FFA Meeting Agenda**

**Parsons Office  
100 W. Walnut Street, Pasadena**

**May 19<sup>th</sup>, 2011**

- 0900 – 0905**      **Welcome and Introductions (Navy)**
- 0905 – 0920**      **Project Deliverables and Planned/In Progress Field Work Status (Navy)**
- 0920 – 0940**      **Presentation on New and Improved Website (Marine Corps)**
- 0940 – 1010**      **Funding Presentation (Navy)**
- 1010 – 1030**      **Finalize FFA Schedule (Navy and agencies)**
- 1030 – 1045**      **Break**
- 1045 – 1130**      **Site 1118 (21, 26, 52 Area Groundwater) Presentation (Navy) – need agency input on path forward, especially for 26 Area Groundwater, and possible risk issues**
- 1130 – 1200**      **Site 7 (Box Canyon Landfill) ESD and Gas Collection System Presentation (Navy) – need buy-in from agencies on deviations from previous system proposed and discussion of planned ESD**
- 1200 – 1230**      **Lunch (at site due to length of meeting)**
- 1230 – 1330**      **22/23 Area Groundwater ZVZ Pilot Study and Research to Site New Production Well (Navy and Parsons) – discuss concerns with emergent technology**

- 1330 – 1400**      **Site 1114 (41 Area Arroyo) RI Presentation (Trevet) – present risk evaluation and results from the RI, discuss risk**
- 1400 – 1445**      **Site 1D Data Gaps Analysis Presentation (SDV/ZEC) – discuss proposed field work and path forward for site**
- 1445 – 1500**      **Break**
- 1500 – 1545**      **Site 1116 (14 Area Groundwater) Presentation on EE/CA, Action Memo and Planned Remediation Strategies (SDV) – discuss vapour intrusion risk and remediation**
- 1545 – 1645**      **Site 21 (Oxidation Pond)/Site 1115 (FSSG Lot) Presentation (Parsons) – present results from pilot studies and discuss path forward, discuss tech memos, RIs/FSs**
- 1645 - 1700**      **Meeting Conclusion / Action Items**

5-19-11 FFA Meeting

CLIENT \_\_\_\_\_ JOB NO. \_\_\_\_\_ SHEET \_\_\_\_\_ OF \_\_\_\_\_  
 SUBJECT \_\_\_\_\_ BY \_\_\_\_\_ DATE \_\_\_\_\_  
 CKD. \_\_\_\_\_ REVISION \_\_\_\_\_

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MCB Camp Pendleton Deliverables Spreadsheet

Date: 5/19/11

Item	Document	Contractor	Status	Date Due	Agency Comments	Response Received From:		
				to Agencies	Due By	EPA	DTSC	RWQCB
1	Remedial Action Closure Report for OU5 Site 1H - Burn Ash Site	SDV	FINAL	7/6/10	9/6/10	X	X	X
2	Site Inspection Report for Site 1116 - 14 Area Groundwater	Trevet	FINAL	8/12/10	10/12/10	NC	X	X
3	SAP for NMOC Sampling at Site 7 - Box Canyon	Trevet/Parsons	Nars final review	11/8/10	1/17/11	X	X	X
4	RI/FS Work Plan for Site 1119 - 26 Area Groundwater	Parsons	Nars final review	11/11/10	1/10/2011 (24)	NC	X	X
5	SAP Addendum for Site 1117 - 15/16 Area Groundwater	ERRG	FINAL	11/30/10	1/31/11	NC	X	X
6	Site Inspection Report for Site 1118 - 21/26/52 Area Groundwater	SeaAlaska	Responding to agency comments	12/15/10	2/14/11	NC	X	X
7	Remedial Action Closure Report for OU4 Site 1D for Soil - Burn Ash Site	SDV	Responding to agency comments	12/21/10	2/21/11	X	X	X
8	Annual Inspection & Site Maintenance Report	Trevet	FINAL	1/25/11	3/26/11	NC	X	X
9	MTF for Site 7 (Box Canyon) 2nd Photovoltaic Panel Project	CH2MHill	FINAL	3/2/11	5/2/11*	X	X	X
10	Site Inspection Work Plan for Site 150 - SEERMA Site	SDV/TEC	With agencies	3/3/11	5/3/11	X	X	
11	Proposed Plan for 22/23 Area Groundwater*	Parsons	Responding to agency comments	3/23/11	5/23/11	X	X	X
12	Proposed Plan for NFA at Site 1111 and six of the Site 1116 USTs*	SDV	Responding to agency comments	4/11/11	6/10/11	X	X	X
13	Remedial Investigation Report for Site 1114 - 41 Area Arroyo	Trevet	With agencies	4/29/11	6/29/11			
14	EE/CA for Site 1116 (14 Area Groundwater)	SDV	With agencies	5/4/11	7/5/11			
15	Data Gap Analysis Work Plan for Site 1D - Burn Ash Site	SDV	Incorporating Navy comments					

\*Expedited review requested

Agencies have commented

## MCB Camp Pendleton Fieldwork Spreadsheet

Date: 5/19/11

Item	Field Work	Planned Start Date	Planned Completion Date
1	Groundwater at Site 1D - Burn Ash Site	In progress	complete
2	Quarterly Sampling at Site 1115 (FSSG Lot)	4th quarter sampled in Dec	complete
3	Quarterly Sampling at Site 21 (Oxidation Pond)	In progress	Delayed - completed early May
4	Additional Field Work at Site 1117 (15/16 Area GW)	12-May-11	13-May-11
5	Quarterly Sampling at 12 Area Site 13	In progress	Sample 4th quarter in Jun
6	Field Work for Site 1119 (26 Area GW)	1-Jun-11	28-Oct-11

# MCB CAMP PENDLETON IR PROGRAM WEBSITE REDESIGN



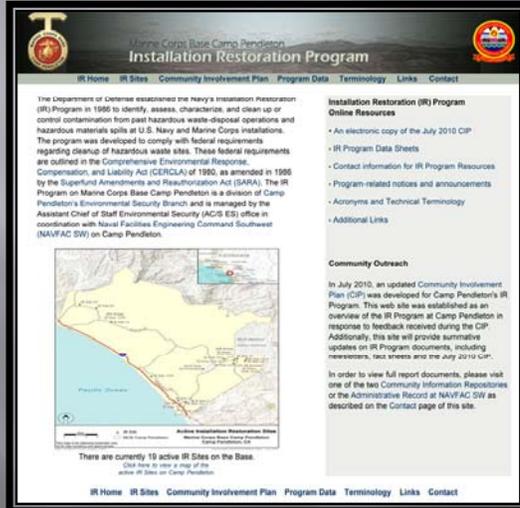
May 19 2011

## Purpose of Redesign

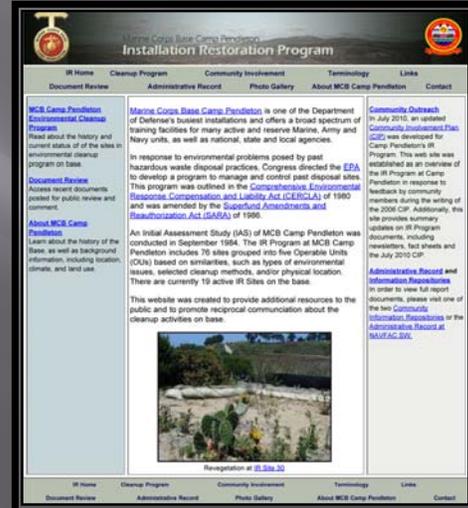
- ❑ Enhanced navigation
- ❑ Quick reference to relevant materials
- ❑ Addition of regulatory references
- ❑ Improved access for public review of documentation
- ❑ Provide additional online resources
- ❑ Show graphical representation of program progress & successes
- ❑ [www.pendleton.usmc.mil/base/environmental/ir/index.html](http://www.pendleton.usmc.mil/base/environmental/ir/index.html)

# Site Design Comparison

## PREVIOUS DESIGN



## NEW LOOK

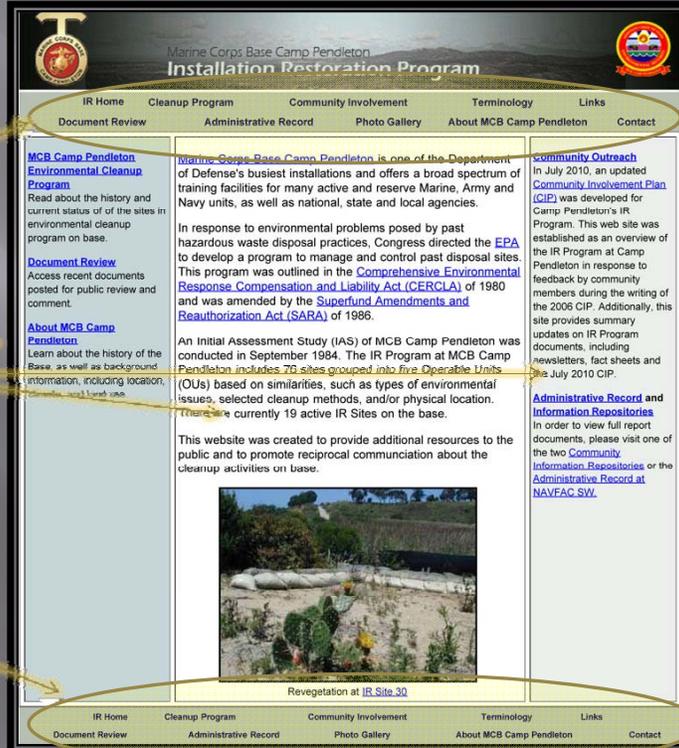


## Enhanced Navigation

- › Sub-pages from original site pulled out to main pages
- › More descriptive page names

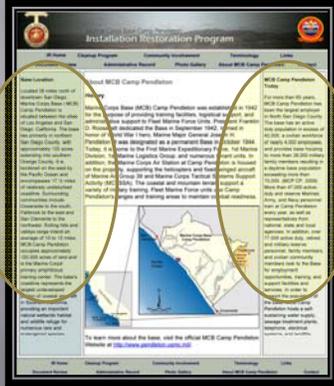
- › Use of 3-column design to provide descriptions of key pages

- › Identical navigation on footer for ease of use

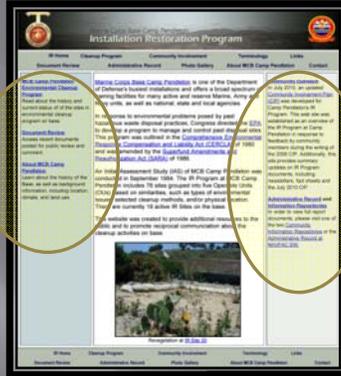


## Quick Reference

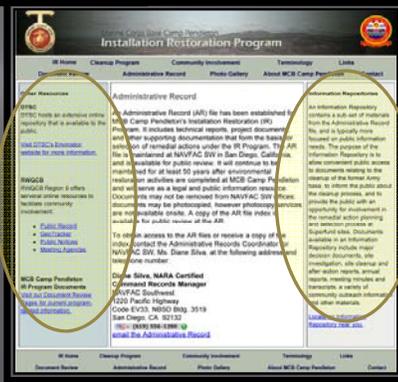
Use of side bars to highlight information of interest for community members



About MCB Camp Pendleton Page



Home Page



Administrative Record Page

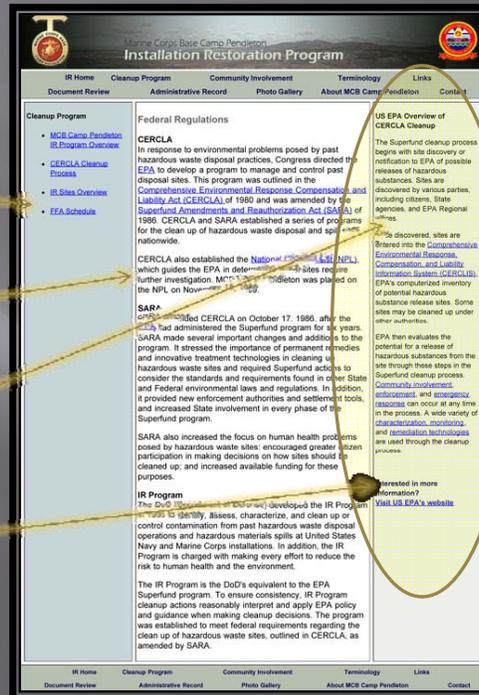
## Addition of Expanded Regulatory References

>Enhanced internal navigation, including link to new FFA page

>Expanded overview of regulatory guidance

>Addition of Superfund cleanup summary

>Quick links to internal web pages and EPA website

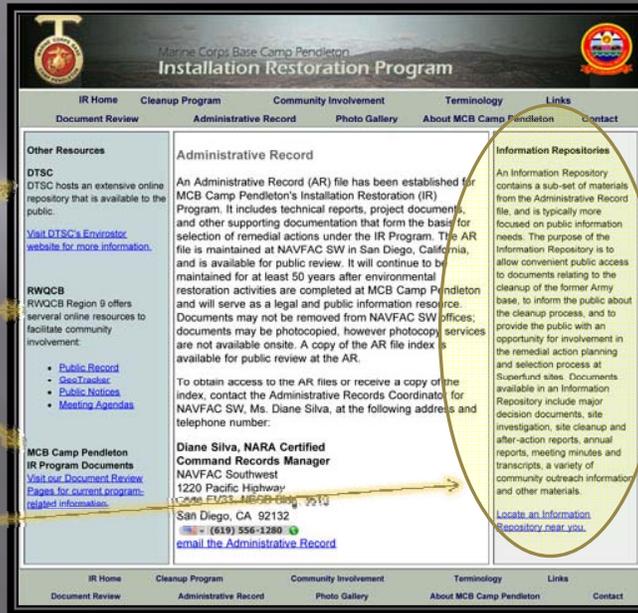


## Administrative Record

>New page added to provide increased access to Administrative Record

>Additional resources provided for online documentation

>Overview of Information Repositories to enhance public access to print resource documents



## Additional Online Resources

To increase public availability to documentation

>Document Review Page

- >Fact Sheets & Newsletters
- >Public Comment Periods
- >Public Meeting Schedule
- >Meeting Minutes

>Administrative Record



## Additional Online Resources

### Addition of FFA page

>Overview of FFA at MCB Camp Pendleton

>Information on future FFA meetings

>Links to recent FFA meeting minutes

>Link to copy of FFA document

The screenshot shows the website's navigation menu with 'Cleanup Program' selected. The main content area is titled 'Federal Facilities Agreement' and contains text about the 1990 agreement between the Navy and various agencies. A sidebar on the right lists 'Upcoming FFA Meeting Information' and 'Past FFA Meeting Minutes'. A yellow arrow points from the text 'View the MCB Camp Pendleton IR Program FFA.' to the 'Link to copy of FFA document' annotation on the left.

## Photos Share Program Successes

### Addition of site photos to showcase progress of cleanup and success stories

The screenshot shows the website's home page with a navigation menu and several text-based sections providing an overview of the program. A yellow arrow points from the 'Home Page' annotation below to the main content area.

Home Page

The screenshot shows the 'Photo Gallery' section of the website. It features a grid of photos with captions for 'Box Canyon Landfill', 'IR Site 1D', 'IR Site 1H', 'IR Site 1111', and 'IR Site 30 Revegetation'. A yellow arrow points from the 'Photo Gallery' annotation below to the gallery content.

Photo Gallery

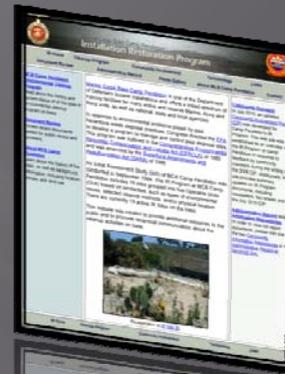
## Next Steps

### Minor Updates to Site as Needed

- Documents for public review/comment
  - ✓ PPs
  - ✓ RI/FS'
  - ✓ RODs
  - ✓ Meeting Minutes
  - ✓ Fact Sheets/Newsletters
- Public Comment Periods
- FFA and/or TRC Meeting Schedules

### Site Evaluation and Major Updates

- In conjunction with Community Involvement Plan (CIP) update (approximately every 3 years)
- In response to major program milestones
- In accordance with community feedback as deemed necessary by program personnel



# 2011 Funding for MCB Camp Pendleton IR Program

May 19, 2011

## FY11 Funding

- Removal Action Work Plan for Site 1116 (14 Area Groundwater) Subsites 140008, 14112 and 1491
- Removal Actions for Site 1116 Subsites 140008 and 14112

## **FY11 Funding (cont.)**

- Site Inspection Addendum for Site 62 (Asphalt Batch Plant) to resolve data gap identified in SI
- Pilot study to evaluate zero-valent zinc for treatment of TCP in 22 Area Groundwater

## **FY11 Funding (cont.)**

- No Further Action Proposed Plan and Record of Decision – will depend on what site has closed
- Removal Action Work Plan and Removal Action for Site 33 (52 Area Armory)

## **FY11 Funding (cont.)**

- Continue free product recovery, well repair and well destruction
- Revegetation maintenance, stormwater BMP maintenance and additional plants at Site 30 (Range Firing Soil) and Site 1111 (26 Area Burn Ash Site)

## **FY11 Funding (cont.)**

- Reinjection of reagent and Technical Memorandum for Site 21 (Oxidation Pond)
- Reinjection of reagent and Technical Memorandum for Site 1115 (FSSG Lot)

## FY11 Funding (cont.)

- Explanation of Significant Difference for Site 7 (Box Canyon Landfill)
- Installation of GCCS for Site 7
- Annual Monitoring and Maintenance for Site 7

## FY11 Funding (cont.)

- Total for FY11 - \$11.8M
- Pre-negotiated Options - \$2M
  - Extended Site Inspection for Site 1118 (21, 26 and 52 Area Groundwater)
  - Removal Action for Site 1116 Subsite 1491
  - Feasibility Study for Site 21 (Oxidation Pond)
  - Remedial Investigation and Feasibility Study for Site 1115 (FSSG Lot)

## FFA Schedule for Draft Documents

\* Dates marked with an asterisk are tentative, based on funding and subject to change

### **Site 6 (Site name is for funding purposes only) – 22/23 Area Groundwater**

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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 outlines the various alternatives from the FS and proposes 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.

- Proposed Plan 3/23/2011
- Geotechnical and Design Information for Pilot Study 10/5/2011
- Record of Decision 3/23/2012\*

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

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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.

- Memo to File for Site 7 (pv panels) 3/28/2011
- Annual Groundwater Monitoring Report 6/19/2011
- Fieldwork for Non Methane Organic Compounds 6/6/2011
- Explanation of Significant Difference 8/11/2011
- Annual Post Closure Maintenance Report (for CY11) 1/27/2012\*
- Report for Non Methane Organic Compounds 6/7/2012\*

### **12 Area Site 13 – Former Building 1280 and 1283**

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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 for the site but the site has not progressed further in the CERCLA process. 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 is underway and is almost complete.

- Groundwater Monitoring Report 10/19/2011
- Technical Report for Soil Removed in Support of the MILCON 6/19/2012\*

- Proposed Plan for No Further Action 6/19/2013\*
- Record of Decision 6/19/2014\*

### **Site 21 – 14 Area Surface Area Impoundment**

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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 in groundwater is underway. A Technical Memorandum reporting on the effectiveness of the first year of the pilot study is in preparation.

- Tech Memo 10/19/2011
- Remedial Investigation/Feasibility Study 6/19/2012\*
- Proposed Plan 2/19/2013\*
- Record of Decision 2/19/2014\*

### **Site 33 – 52 Area Armory**

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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 preferred remedy is excavation of the source material, including groundwater which would then be treated and disposed of in the sanitary sewer system.

- Removal Action Work Plan 8/15/2011
- Removal Action 1/15/2012\*
- Removal Action Completion Report 10/25/2013\*
- Proposed Plan 11/15/2014\*
- Record of Decision 11/15/2015\*

### **Site 150 – 21 Area, Location 1**

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This site became an IR site recently 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. That location is being further investigated under a Site Inspection.

- Fieldwork 7/27/2011
- Site Inspection Report 4/21/2012\*
- Proposed Plan for No Further Action 4/21/2013\*
- Record of Decision for NFA 4/21/2014\*

### **Site 1003 (Site name is for funding purposes only) – Site 1D Groundwater**

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This site is 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 was submitted to close out the soil portion of the site, but the groundwater contamination needs 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.

- Data Gap Analysis for Groundwater 6/4/2011
- Fieldwork 10/11/2011
- Focused Feasibility Study 6/11/2012\*
- Proposed Plan 2/11/2013\*
- Record of Decision 2/11/2014\*

### **Site 1111 – 26 Area Ash and Debris Disposal Area**

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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 3/29/2011
- Record of Decision for NFA 12/22/2011

### **Site 1114 – 41 Area Arroyo**

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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.

- Remedial Investigation Report 3/29/2011
- Proposed Plan 11/29/2011
- Record of Decision 11/29/2012\*

### **Site 1115 – 13 Area FSSG Lot**

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There are two plumes underneath the parking lot at this site, one shallow and one deep, containing chlorinated solvents and benzene. A Remedial Investigation and Feasibility Study are needed for the site. Currently a pilot study to evaluate the effectiveness of in-situ bioremediation of chlorinated solvents in groundwater is underway. A Technical Memorandum reporting on the effectiveness of the first year of the pilot study is in preparation.

- Tech Memo 9/16/2011
- Remedial Investigation/Feasibility Study 4/16/2012\*
- Proposed Plan 12/16/2012\*
- Record of Decision 12/16/2013\*

### **Site 1116 – 14 Area Groundwater**

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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.

- Engineering Evaluation/Cost Analysis(3 subsites – Moving Forward) 5/31/2011
- Action Memorandum (3 subsites – Moving Forward) 7/15/2011
- Removal Action Work Plan (3 subsites – Moving Forward) 2/30/2012\*
- Interim Removal Action (3 subsites – Moving Forward) 10/30/2012\*
  
- Proposed Plan for No Further Action (7 subsites – NFA) 3/29/2011
- Record of Decision (7 subsites – NFA) 11/22/2011

### **Site 1117 – 15/16 Area Groundwater**

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Six USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. Field work for the Site Inspection is in progress.

- Fieldwork 4/28/2011
- Site Inspection Report 11/11/2011
- Proposed Plan 12/18/2011
- Record of Decision 12/18/2012\*

### **Site 1118 – 21/26/52 Area Groundwater**

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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 a soil gas investigation is needed to verify if no further action is appropriate for these sites.

- Extended Site Inspection (ESI) Work Plan 8/27/2012\*
- Field work 2/27/2013\*
- ESI Report 9/27/2013\*
- Proposed Plan 5/27/2014\*
- Record of Decision 1/27/2015\*

### **Site 1119 – 26 Area Groundwater**

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This site was created to investigate the source or sources of chlorinated solvents in the 26 Area production wells. A Remedial Investigation Work Plan is in agency review.

- Fieldwork 6/1/2011
- RI/FS Report 5/5/2012\*
- Proposed Plan 5/5/2013\*
- Record of Decision 5/5/2014\*

### **Site 62 – Asphalt Batch Plant**

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This site was created when a transformer containing PCBs tipped over and spilled. A Site Inspection was performed, however, a data gap from the SI needs to be investigated.

- Extended Site Inspection Work Plan 9/1/2011
- Fieldwork 2/3/2012\*
- Extended Site Inspection Report 8/16/2012\*
- Proposed Plan 5/1/2013\*
- Record of Decision 5/1/2014\*

# Site Update

## IR SITE 1118 Sub-site 2666 MCB CAMP PENDLETON

104<sup>th</sup> FFA MEETING  
19 MAY 2011



## Agenda/Objectives

- Summarize findings from past actions
  - Significant amount of investigation has occurred previously
  - Helpful to review all work completed to date
  - Need to consolidation historical results to assist in further planning
- Discuss internal Navy efforts to build site conceptual model to date
  - Navy conducted additional GW level measurements
  - Reviewing all historical information
  - Developing communication tools
- Define the path forward

# Overall Site Map



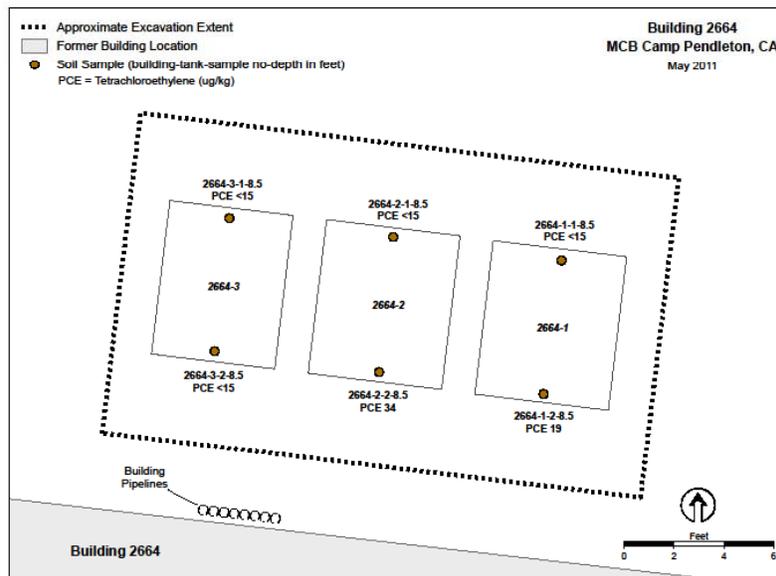
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## Summary of Historical Actions – I UST 2664

- Tank removal
  - Three 500 gallon tanks removed in 1994
  - Reportedly held Stoddard 860 dry cleaning solvents
  - 54.1 CY soil removed
  - 2 of 6 soil samples from bottom of tanks exhibited detection of PCE at 19 and 34  $\mu\text{g}/\text{kg}$
- Interior Building 2664 Pipeline – closure in place
  - Four samples collected below interior pipeline in 1995
  - 1 of 4 samples exhibited detection of PCE 5.6  $\mu\text{g}/\text{kg}$ ; toluene in 3 of 4 samples from 4.8 – 8.2  $\mu\text{g}/\text{kg}$
- Tank and pipeline case closure with NFA granted by County of San Diego DEH 5/30/95.

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# Summary of UST Removal UST 2664



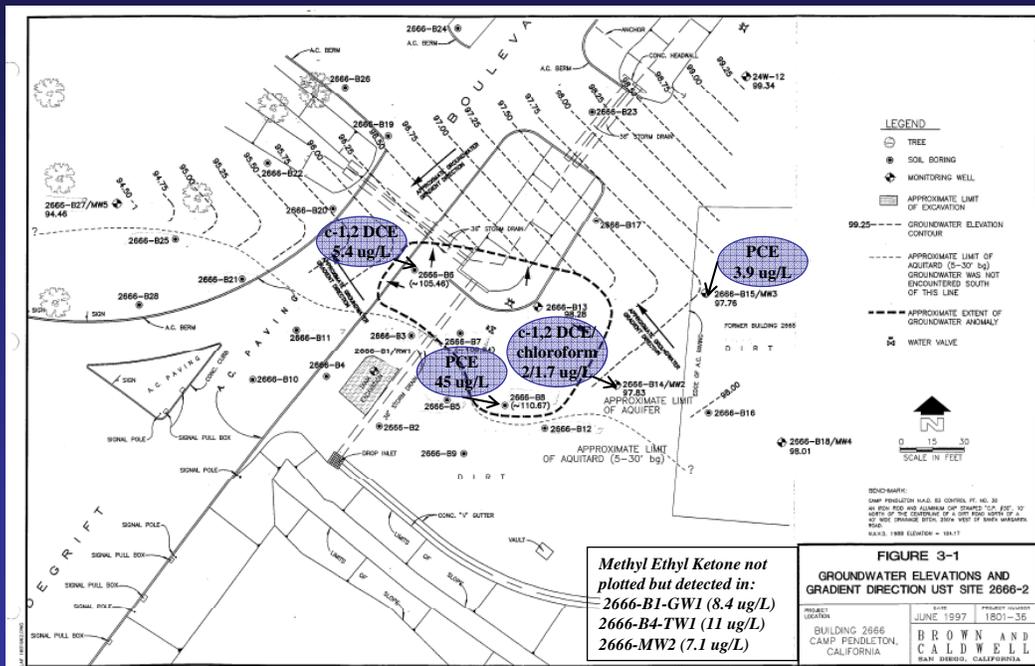
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## Summary of Historical Actions – IIa UST 2666 Site Assessment (1996/1997)

- Separate planning for UST 2666 as part of base UST Program
- Field Work
  - 38 soil borings advanced and sampled – soil samples and GW through Hydropunch/Temp Wells (19 borings)
  - 5 Monitoring wells installed in some borings, one recovery well in historical tank cavity
- Results
  - Geology/Hydrogeology
    - Defined dry conditions on south side of site
    - Defined anomalous groundwater mounding – culvert/hydrant leak?
  - Analytical Results
    - Defined extent of petroleum hydrocarbons and aromatic VOCs in soil/GW
    - Sporadic detection of solvents in GW: PCE, c-1,2-DCE, chloroform, MEK. With exception of PCE at B8, concentrations generally <MCL

6

# Summary of UST 2666 Site Assessment – groundwater and chlorinated solvents



7

## Summary of Historical Actions – IIb UST 2666 – Remedial Actions

- Sparge system pilot test and full scale operation
  - 11 active biosparge points and 2 active biovent points
  - 5 additional MW installed (10 total); all wells monitored quarterly
  - Product recovery efforts quarterly
  - Pilot test in 2003, system operated mid 2003 – end of 2007
- Results
  - No product observed or recovered
  - System effectiveness was inconsistent
    - Lower than expected D.O./ORP
    - Variable concentrations, consistent downward trend not observed in all wells
    - Biodegradation demonstrated but slow progress
  - Site Transferred to IRP in 2008 due to presence of CERCLA constituents (chlorinated VOCs)

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## Map of Biosparge and Biovent system



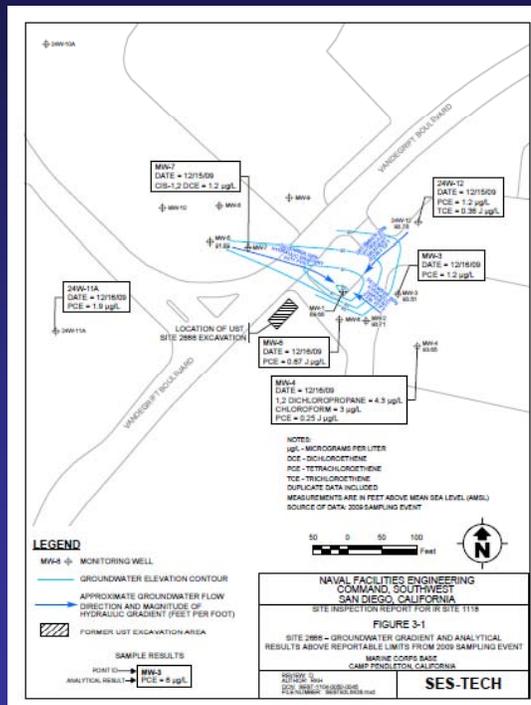
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## Summary of Historical Actions – IIc IR Site 1118, Sub-site 2666

- Work Plan/SAP developed under IRP for further assessment of three sites under IR Site 1118, including Sub-site 2666
- Scope of SI (2009)
  - Review of historical analytical data
  - One time monitoring and sampling of existing GW monitoring wells to define current conditions
- Results
  - Geology/Hydrogeology
    - GW gradient data different than historical observations
  - Analytical Results
    - Concentrations of VOCs generally similar to past sampling events
    - Sporadic detection of solvents in GW: PCE, c-1,2-DCE, chloroform, 1,2-DCP. Concentrations <MCL
  - Conclusion - Further action necessary to fill data gaps

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# SI Groundwater Gradient Map



- Groundwater gradient direction drastically different than historical indications
- Missing groundwater elevations from some wells
- Fails to account for other information collected historically – i.e., dry zones, geology

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# Navy Internal Action April/May 2011

- Navy QA/QC review of IR Site 1118 SI Report and regulatory comments
  - Navy recognizes that SI “missed the mark” at Sub-site 2666
    - QA problems with figures, gradient/water level data seemed erroneous
  - Prompted Navy review of all historical documentation
  - Re-measurement of water levels
- Results
  - Geology/Hydrogeology
    - GW gradient directions revised based on new measurements and now reflect direction similar to historical patterns
    - Review indicated that a detailed CSM imperative for future planning efforts
      - Geologic variability has significant impact on water and contaminant distribution
      - May have leaking water line contributing to GW mounding
    - Have begun detailed development of CSM and will communicate before next FFA meeting

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# Navy Site Visit 2011 – view looking east



Site is located in a basin, surrounded on all sides by low hills

13

## Summary of Water Level Measurements

Table 1-1 Water Level Measurements and Calculations

Location	Top of Well Casing Elevation (ft msl)	Depth to Water (5/2/11 - 5/10/11)	Elevation (5/2/11 - 5/10/11)	Depth to Water (12/15/09 - 12/16/09)	Elevation (12/15/09 - 12/16/09)	Difference between 2011 - 2009
		ft. btoc	amsl, ft.	ft. btoc	amsl, ft.	feet
2666-MW-1	121.48	16.46	105.02	31.80	89.68	15.34
2666-MW-2	123.25	24.56	98.69	29.74	93.51	5.18
2666-MW-3	125.03	26.42	98.61	31.52	93.51	5.10
2666-MW-4	128.12	29.32	98.80	34.47	93.65	5.15
2666-MW-5	118.00	22.44	95.56	26.11	91.89	3.67
2666-MW-6	121.90	19.21	102.69	26.81	95.09	7.60
2666-MW-7	120.11	22.84	97.27	27.21	92.9	4.37
2666-MW-8	117.62	20.69	96.93	25.21	92.41	4.52
2666-MW-9	118.30	20.26	98.04	25.04	93.26	4.78
2666-MW-10	117.10	21.89	95.21	NM	NC	NC
24-W-9A	104.19	14.60	89.59	NM	NC	NC
24-W-10A	104.94	15.73	89.21	NM	NC	NC
24-W-10B	104.82	15.93	88.89	NM	NC	NC
24-W-11A	110.04	20.80	89.24	23.23	86.81	2.43
24-W-11B	110.15	21.12	89.03	NM	NC	NC
24-W-12	122.08	25.48	96.60	NM	NC	NC

Notes:

\* - values adjusted due to change in measuring point elevation

amsl - above mean sea level

btoc - below top of casing

ft - feet

MW- Monitoring Well

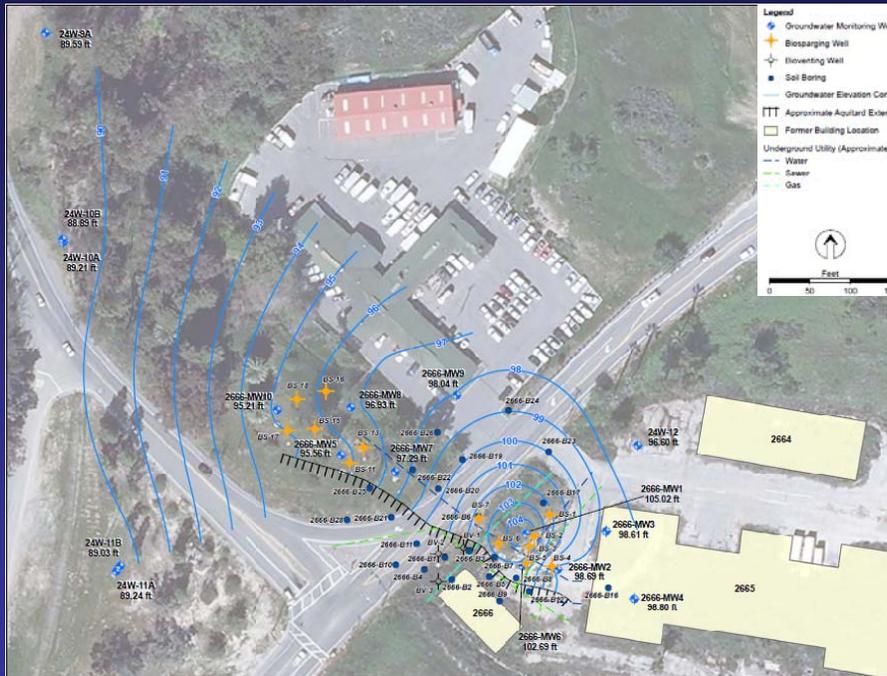
W - Well

NM - Not measured

NC - Not calculated.

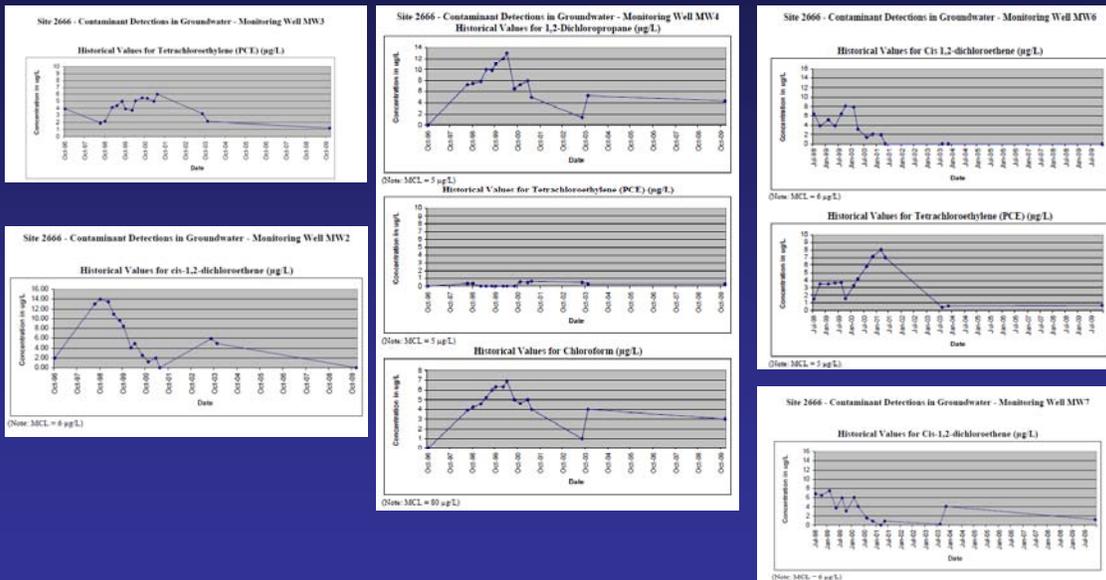
14

# Revised Groundwater Gradient Contours (based on May 2011 measurements)



15

# Navy Internal Actions - Summary of Analytical Data to Date



*Concentrations lower than historical results and below MCLs*

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## Path Forward

- Keep as separate site, and not include in IR Site 1119
  - Low concentrations in GW – not a likely source for regional issues
  - May be able to obtain site closure independently
- Finalize SI Report IR Site 1118 recommending further action for Sub-site 2666
- Before next FFA meeting:
  - Define data gaps in Conceptual Site Model
  - Focus additional investigation on filling data gaps
  - Document decisions
- Complete SAP for Extended SI. Likely focus:
  - Soil gas and groundwater measurements in gap areas
  - Focus on entire site – all buildings in area
- Implement Extended SI field work based on SAP

17

## Summary and Conclusions

- Historical Site Evaluation
  - Significant data exists which needs to be consolidated into a Conceptual Site Model
  - Requires additional information prior to decision making
  - Site VOC concentrations are generally low and hence requires an approach focused on this geographic location
  - Navy recent evaluation of water levels is consistent with historical gradient directions
- Future Actions
  - Incorporate historical information into a Conceptual Site Model
  - Identify data gaps and memorialize approach in a SAP
  - Future actions to include soil gas and further groundwater evaluation

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**MARINES**  
THE FEW. THE PROUD.

# MARINE CORPS BASE CAMP PENDLETON



# Site 7 Update (Box Canyon Landfill)



## Explanation of Significant Difference And Landfill Gas Collection and Control System

### Agenda



- **Explanation of Significant Difference**
  - **Groundwater Monitoring**
  - **Site Surveys**
  - **Land Use Control Process**
  - **GCCS install**
- **Gas Collection and Control System**
- **Schedule**

## Explanation of Significant Difference



### •Groundwater Monitoring

–ROD: “Long-term groundwater monitoring will also be conducted. Selected groundwater monitoring wells will be analyzed biannually for 5 years. The collected groundwater monitoring wells will be analyzed for volatile and semivolatile organics, metals, and general chemistry.”

- 2003 – 2005: quarterly

- 2006: annual

- 2007 – present:

  - VOCs, methane, and general chemistry annually

  - SVOCs, organochlorinated pesticides, priority metals every 3 years or as indicated. ('08 & '11)

–ESD: Incorporate revised sampling schedule

## Explanation of Significant Difference



### •Site Surveys

–As noted in the ROD, aerial surveys should be conducted every five years after completing closure of the landfill, and an iso-settlement map should be done showing change in elevation of cover.

–The ESD will state that future settlement monitoring will be conducted using only settlement monuments due to the PV panel installation. The monuments have been monitored biannually for the past ten years and demonstrate that only minor settlement has occurred. This monitoring will continue unchanged.

## Explanation of Significant Difference



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*Title/Group/Section, etc.*

## Explanation of Significant Difference



### • Land Use Control Process

–ROD: “The MCB Camp Pendleton Base Master Plan will be amended to incorporate the abovementioned use limitations and notice requirements for Site 7. The Master Plan amendments will also include language that describes the risk to human health and the environment that exists at Site 7; will reference the MCB Camp Pendleton Group C and Group D RI reports, the Site 7 EE/CA, the OU3 FS report, and the OU3 ROD; and will provide a legal description (metes and bounds) of the boundaries of Site 7.”

–ESD: Site Approval process is used to manage land use controls (LUCs) and open IR sites instead of the Base Master Plan

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*Title/Group/Section, etc.*

## Explanation of Significant Difference



- **Gas Control and Collection System Installation**

- **ROD:** “To ensure that human health and the environment are protected in the future, no breaching of the soil cap at Site 7, through trenching, excavation, or any other similar activity may occur unless prior approval of the FFA signatories is obtained.”

- **ESD: Install 5 landfill gas extraction wells**

- Final Technical Memorandum Landfill Gas Collection and Control System with a Microturbine (SDV, 2010).

## Gas Collection and Control System



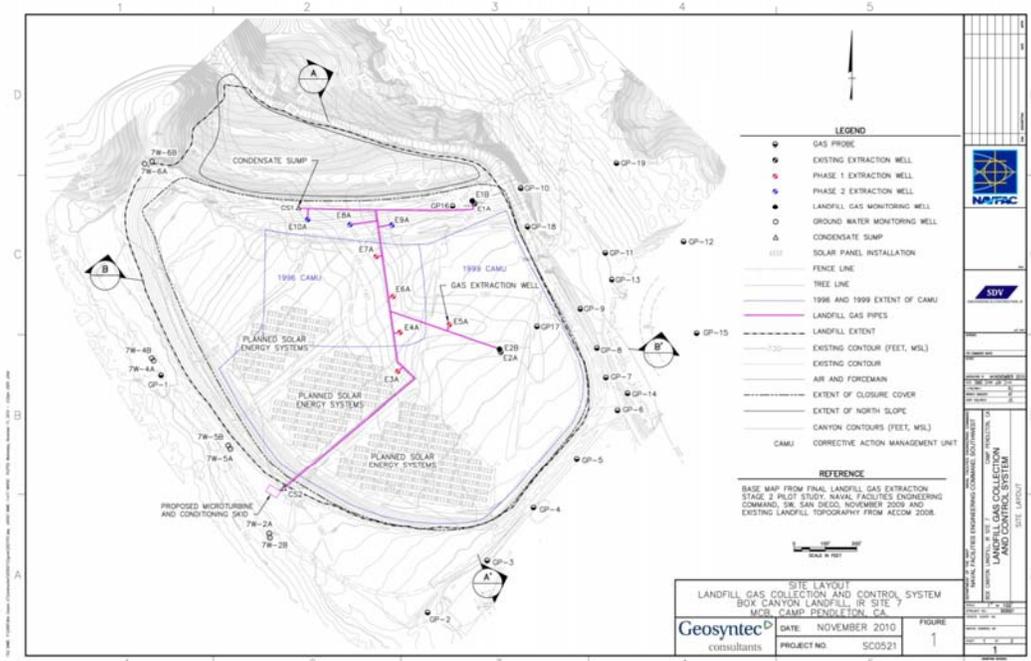
- **Final Technical Memorandum Landfill Gas Collection and Control System with a Microturbine (SDV, 2010)**

- **Phase I ('11)**

- Original estimate: \$600k + O&M

- Proposal: \$1.5M + O&M

# Gas Collection and Control System



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*Title/Group/Section, etc.*

# Gas Collection and Control System



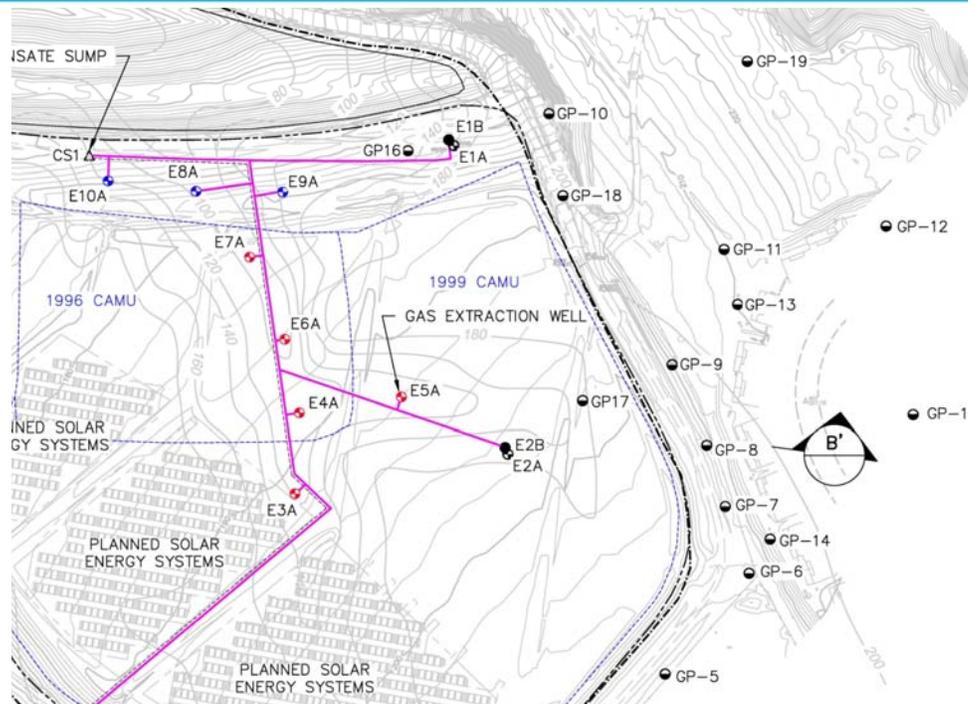
- **New Approach**
  - 7 solar powered flares
    - CF-5 Solar Spark Vent Flares with vacuum and vent shield
  - 2 air injection wells
    - Near GP-9 and GP-10
    - Pulsed 2x per year
  - 2 new gas probes
    - Near air injection wells



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*Title/Group/Section, etc.*

# Gas Collection and Control System



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*Title/Group/Section, etc.*

# Schedule



- **ESD**
  - Draft to agencies: August 11, 2011
  
- **GCCS**
  - Contract awarded: May 16, 2011
  - Field work: agency concurrence

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*Title/Group/Section, etc.*

# Questions?



- **Adam Hill**  
**NAVFAC SW**  
**619-532-4340**  
**adam.j.hill@navy.mil**

# MCB CAMP PENDLETON SITE 21 PILOT STUDY UPDATE

19 May 2011  
104<sup>th</sup> FFA Meeting



## Site 21 Fieldwork Update

### Fieldwork Summary

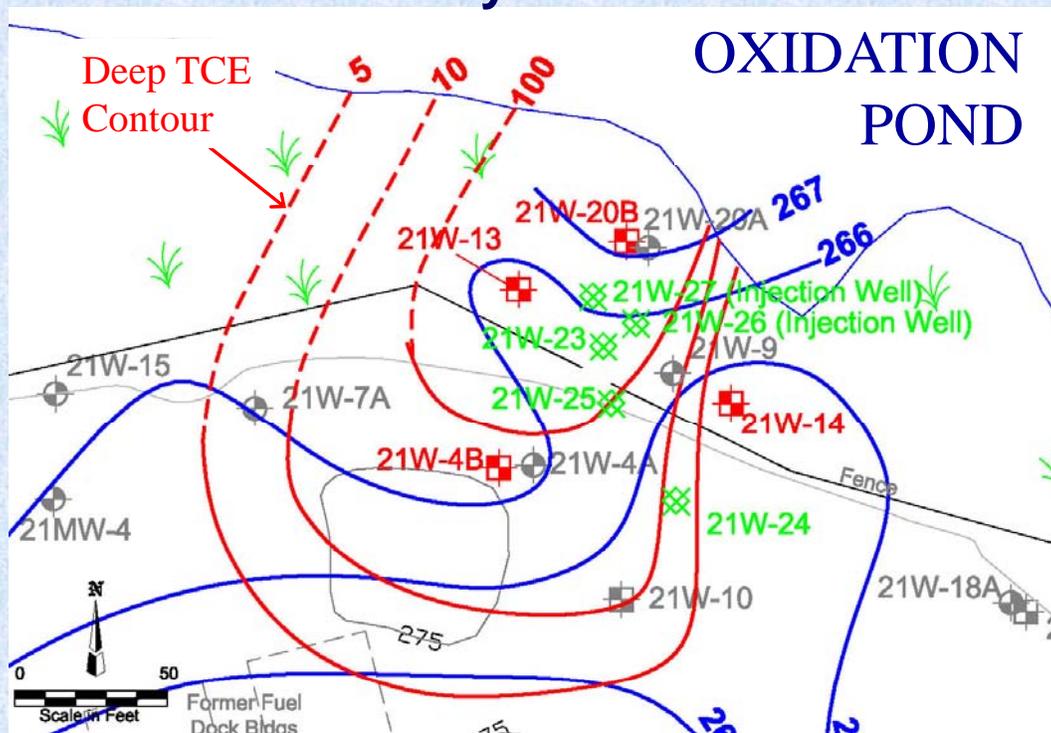
- November 2009: Well installation
- November 2009: Baseline sampling event
- December 2009: Substrate injection
- Performance Monitoring Events:
  - June 2010
  - September 2010
  - December 2010
  - May 2011 (data pending)



# Site 21 Brush Removal Completed



# Site 21 Newly Installed Wells



# Site 21 Pilot Study Injection

Well ID	Injection Points		Substrate Injection Mixture						Total Volume			Injection Interval (feet)	Estimated Effective Porosity (percent)	Radius of Influence (feet)	Injection Time at 2 gpm (hours)
	Interval (feet)	Spacing (feet)	Emulsion Product			Whey Product			Water (gallons)	Substrate (pounds)	Substrate (gallons)				
			Volume (gallons)	Oil Component (gallons)	(pounds)	Buffer Agent (gallons)	(pounds)	80% Lactose by weight (pounds)							
21W-26	40-45	NA	18	10.4	80.9	33.6	362.9	183	700	264	751	4	9%	9.4	6.3
21W-27	31-46	NA	40	23.7	184.9	76.8	829.4	419	1,600	604	1,717	13	9%	8.1	14.3
<b>TOTAL:</b>			<b>58</b>	<b>34</b>	<b>266</b>	<b>110</b>	<b>1,192</b>	<b>603</b>	<b>2,300</b>	<b>868</b>	<b>2,468</b>			<b>Days:</b>	<b>1</b>

SUBSTRATE CONCENTRATIONS						
Final Percent Substrate by Weight:	4.5%	Final Lactose Concentration (injection Fluid):	18.8	grams/liter	Percent Lactose by Volume in Emulsion:	NA
Final Percent Water by Weight:	95.5%	Final Oil Concentration:	12.9	grams/liter	Percent Oil Product by Volume in Emulsion:	2.5%

EFFECTIVE TREATMENT ZONE CONCENTRATIONS						
Total Design Factor	8.0	Final Lactose Concentration (Treatment Fluid):	664	mg/L	Final Vegetable Oil Concentration (mg/L):	456
Design Life (years):	3.0	Lactate Design Factor	5.0		Vegetable Oil Design Factor	3.0
Total Porosity of Treatment Zone + Groundwater Flux			69,934	gallons		

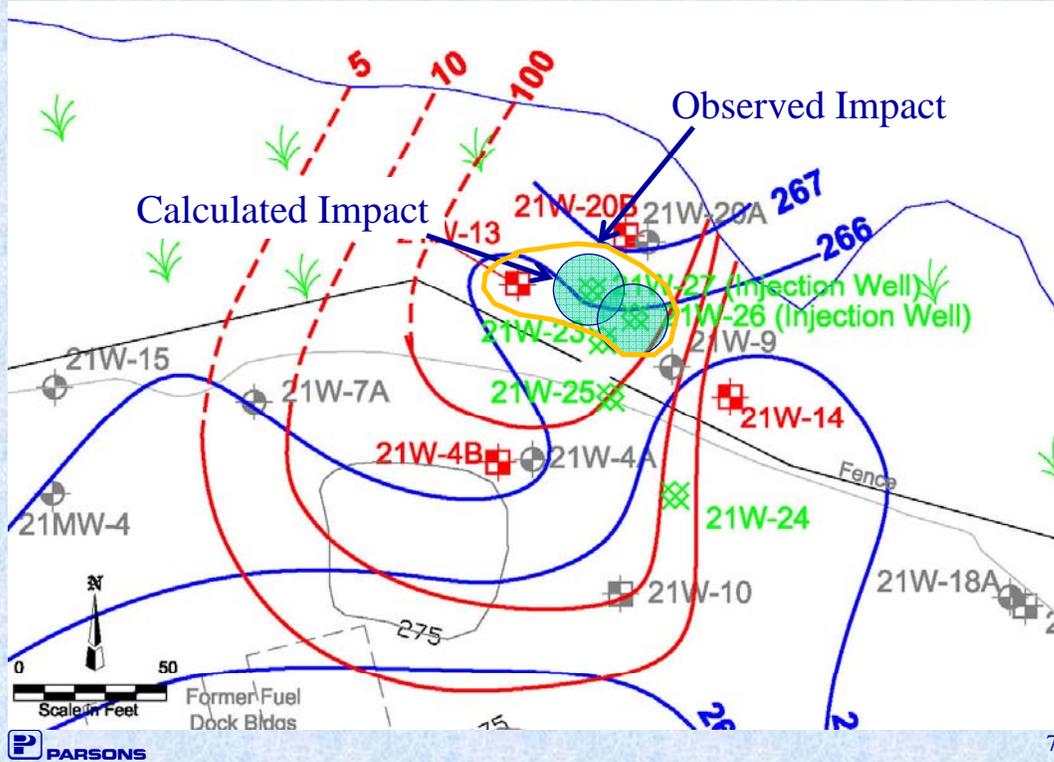


## Site 21 Injection Products

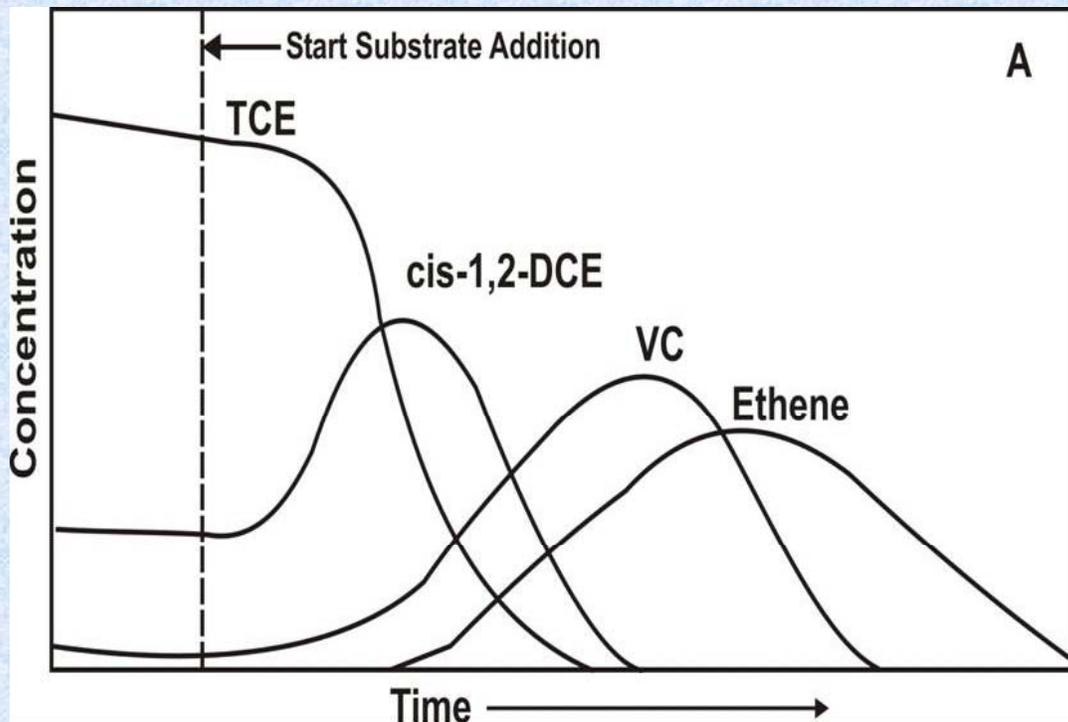
### Injected Materials

- Soybean Oil: Long term non-soluble organic substrate expected to drive dechlorination for about 3 years.
- Sweet Dairy Whey: Short term soluble substrate to deplete geochemical demand over first 6 months.
- pH Buffer: Maintain groundwater pH above 6 for at least 12-18 months.
- Site Groundwater: Match natural geochemistry to avoid shocking the system and avoid the “dilution effect” to reduce performance uncertainty.

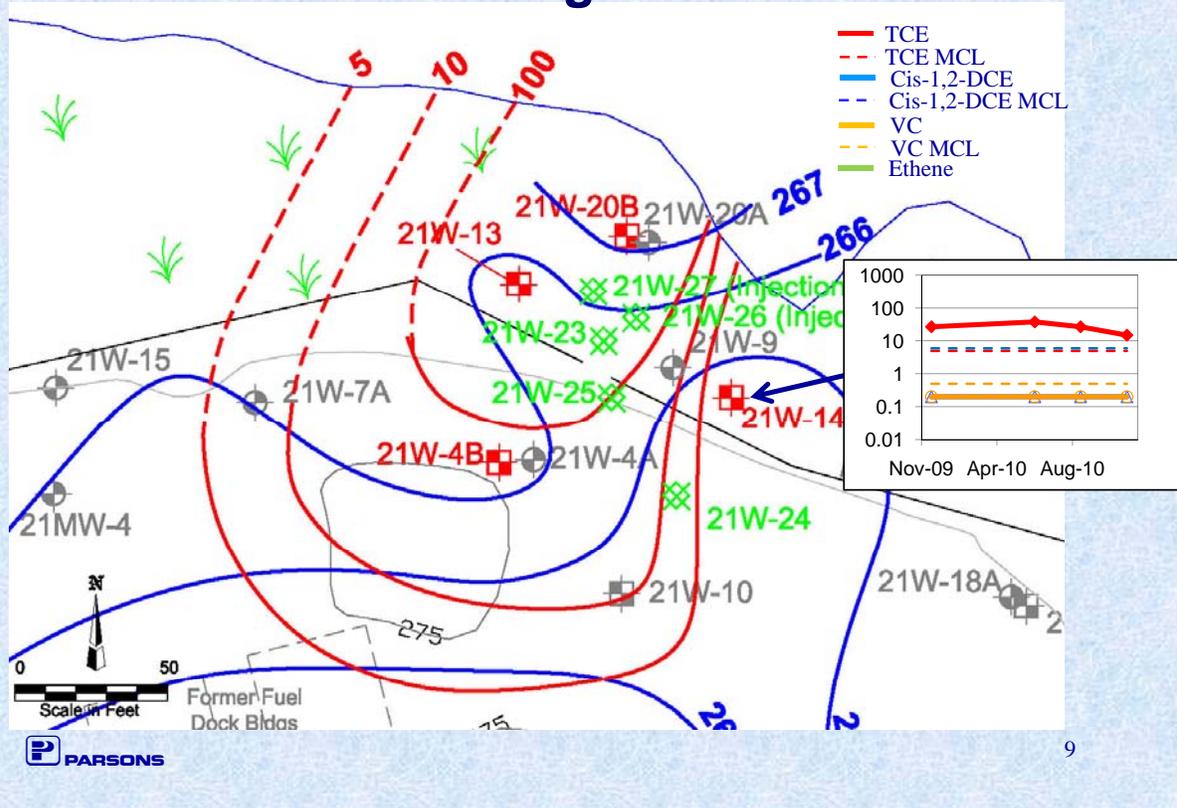
## Site 21 Initial Substrate Distribution



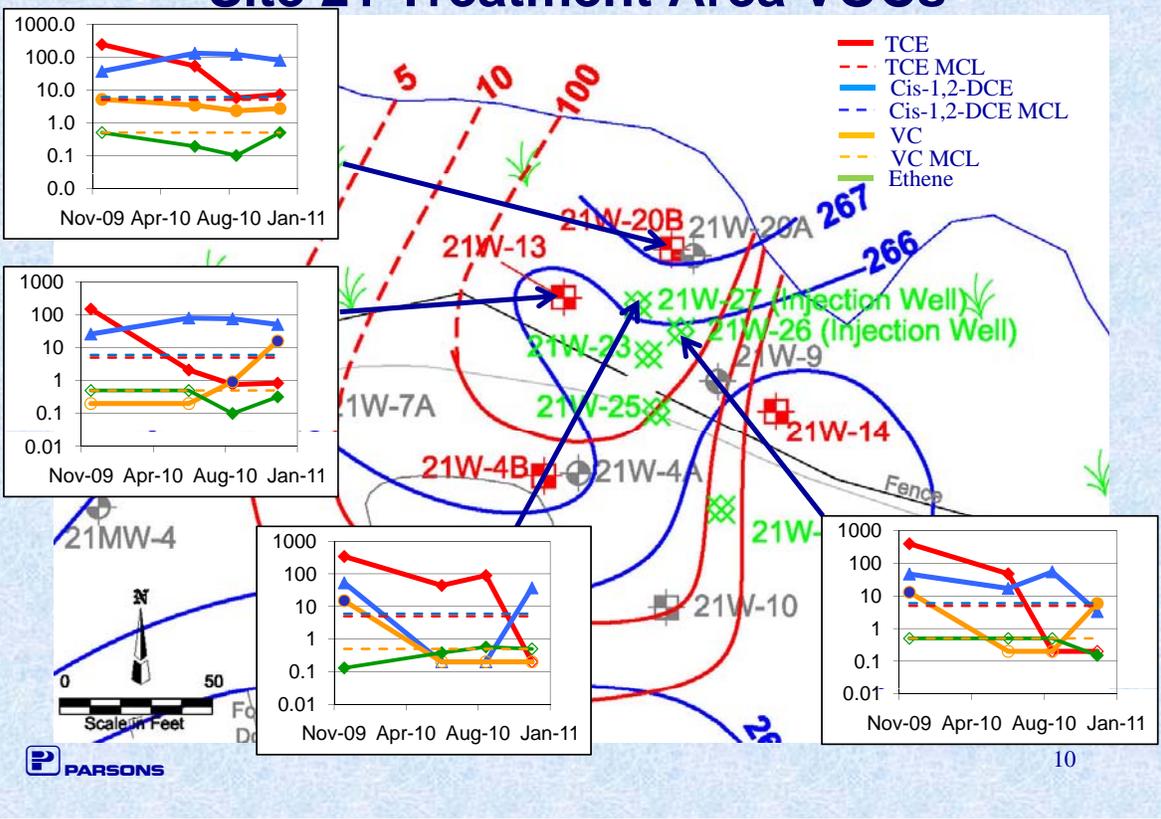
## Textbook Reductive Dechlorination



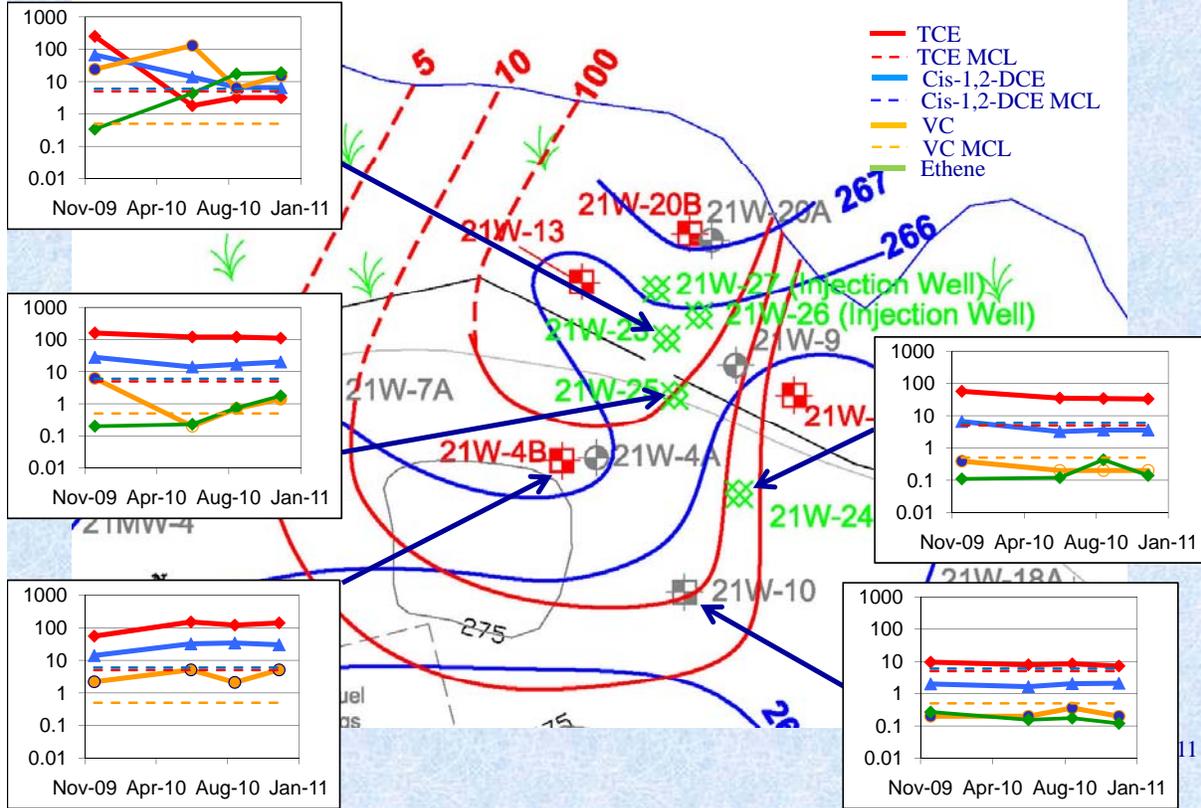
# Site 21 "Background" VOCs



# Site 21 Treatment Area VOCs



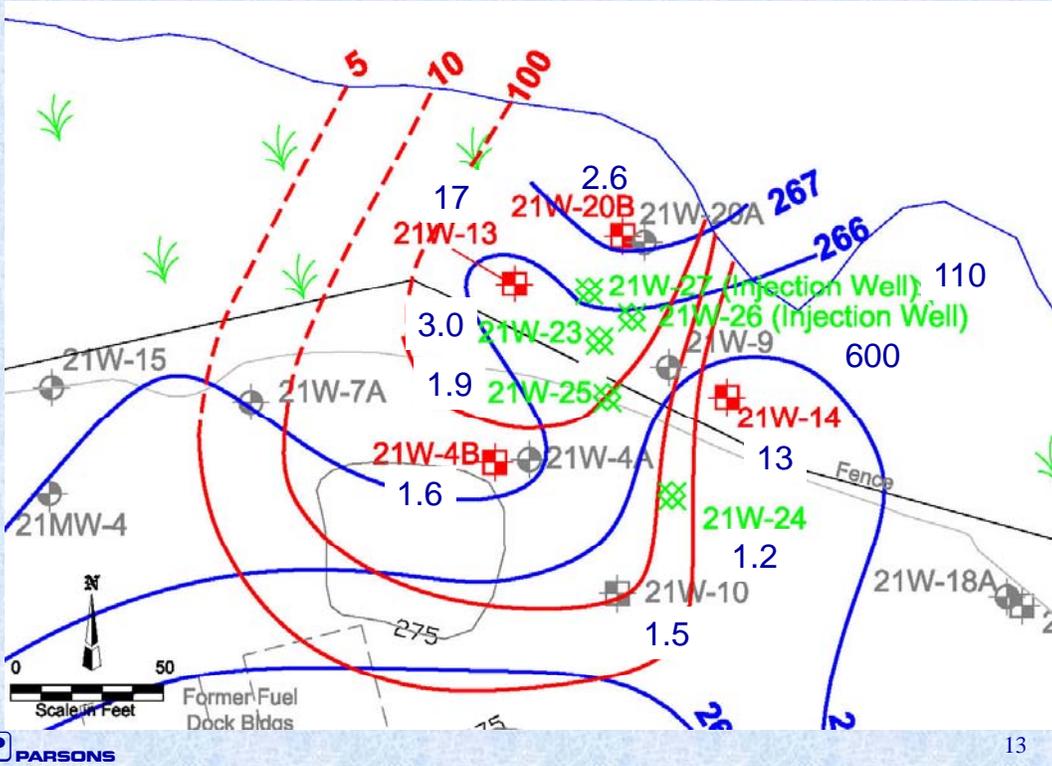
## Site 21 Down Gradient VOCs



## Site 21 VOC Changes

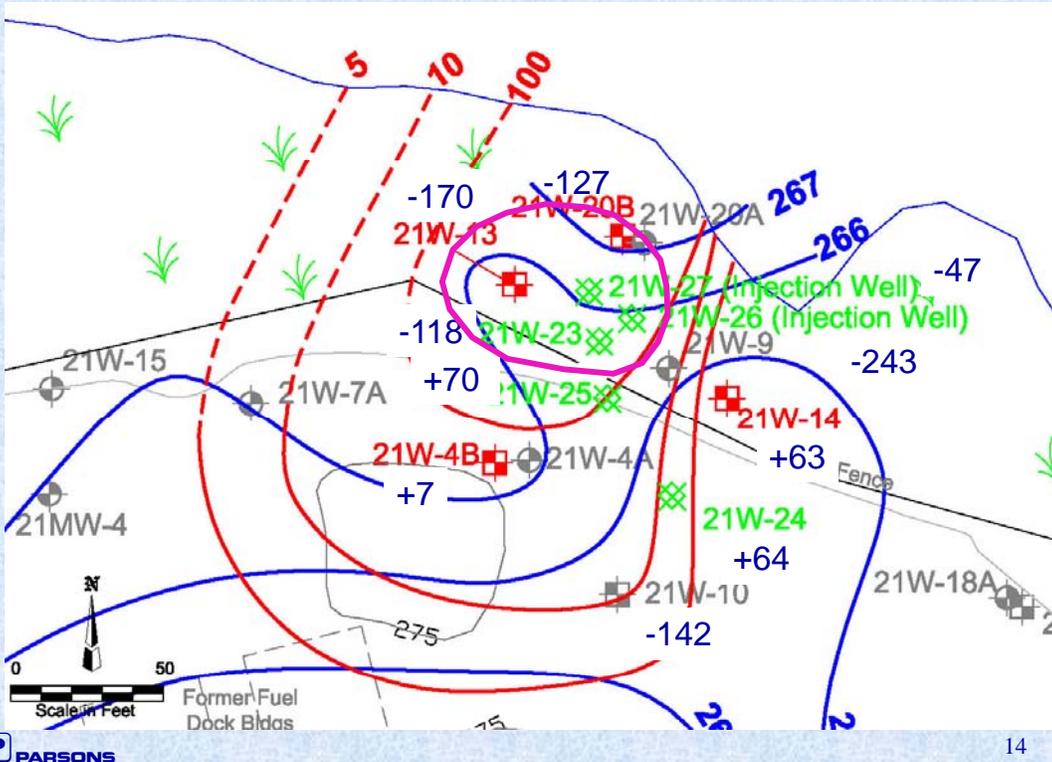
Well ID	TCE (ug/L)		Cis-DCE (ug/L)		VC (ug/L)		Ethene (ug/L)		Molar % Change
	T-0	T-12	T-0	T-12	T-0	T-12	T-0	T-12	
14	27	26	ND	ND	ND	ND	ND	ND	-7%
20B	240	7	36	79	5	3	ND	ND	-60%
13	150	0.8	26	51	ND	16	ND	0.5	-44%
27	340	ND	53	37	15	ND	0.1	0.6	-89%
26	400	ND	47	3	13	6	ND	0.2	-97%
23	250	3	67	7	24	15	0.3	19	-89%
25	160	110	28	20	6	1	0.2	1.8	-34%
24	57	33	7	4	0.4	ND	0.1	0.1	-43%

## Site 21 Current TOC Concentrations



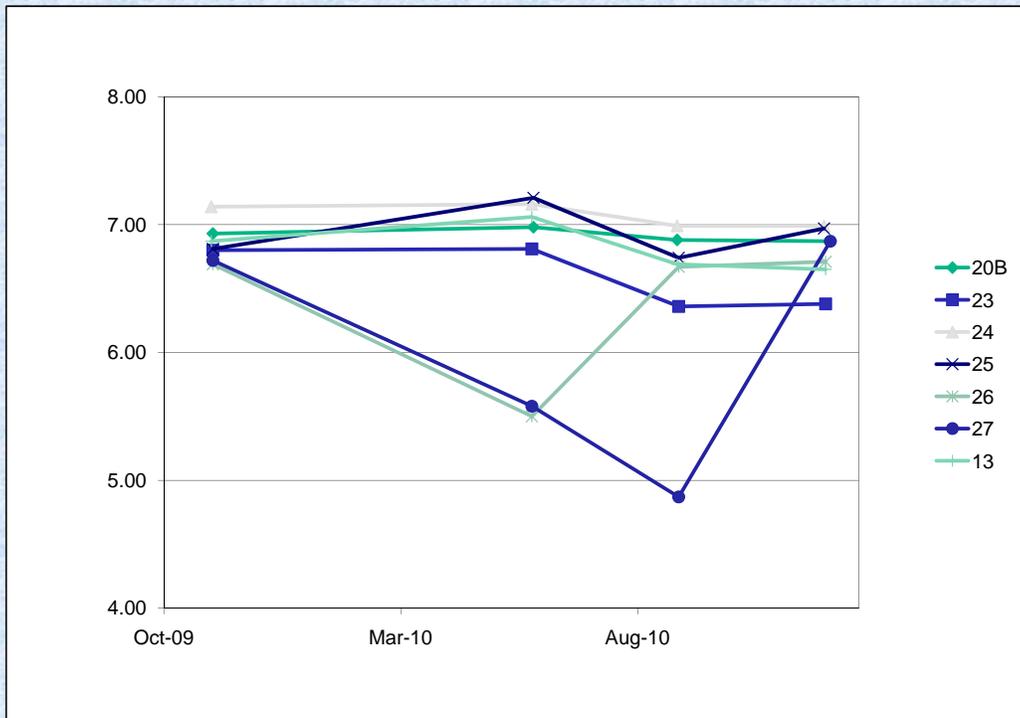
13

## Site 21 Current ORP Conditions



14

## Site 21 pH



## Site 21 Pilot Study Injection

### First Year Conclusions

- Complete reductive dechlorination of TCE to ethene was induced.
- Significant chlorinated solvent total molar mass reductions achieved within and down gradient from the treatment area (90%+ COC molar mass loss in 3 wells and >40% molar mass loss in 3 more wells).
- Near-neutral pH was maintained through month 12.
- Dissolved phase TOC migrated beyond area impacted during injection by month 6 and contracted back to the injection area by month 12.
- Anaerobic conditions were induced over a large area for the first 12 months. Geochemistry outside of the immediate injection area (21W-26 and 21W-27) is expected to revert to aerobic conditions in the coming months.

# Site 21 Pilot Study Injection

## First Year Conclusions

- High concentrations of TOC persist in the injection wells. However, TOC concentrations at 13, 20B, and 23 declined to <20 mg/L by month 12.
- Pilot test is a success.

# Site 21 Recommendations

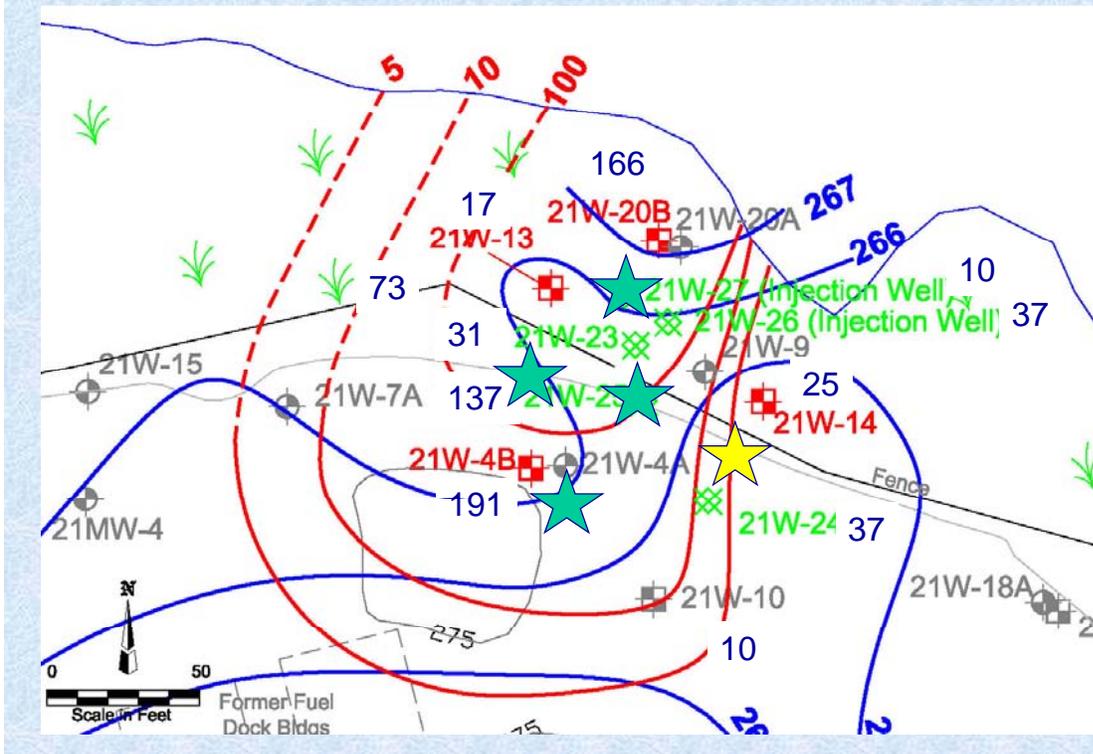
## •Short Term Recommendations

- Continue to monitor performance of pilot injection to document system performance through substrate depletion.

## • Future Action to Consider

- Expand enhanced bioremediation reaction area over the remainder of the deep plume.

# Site 21 Current Total Cl-Ethene and Potential New Injection Areas



# MCB CAMP PENDLETON SITE 1115 PILOT STUDY UPDATE

19 May 2011  
104<sup>th</sup> FFA Meeting



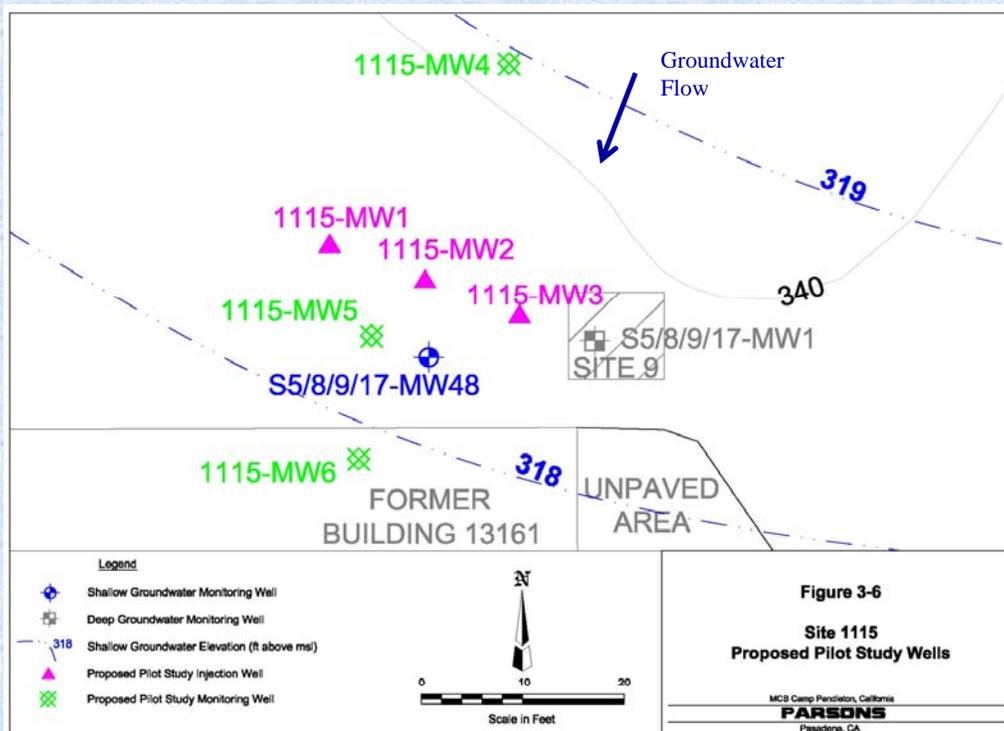
## Site 1115 Fieldwork Update

### Fieldwork Summary

- August 2009 – Well Installation
- September 2009 – Baseline Event and Substrate Injection
- Performance Monitoring Events:
  - January 2010
  - April 2010
  - July 2010
  - November 2010



# Site 1115 Pilot Wells



# Site 1115 Pilot Study Injection

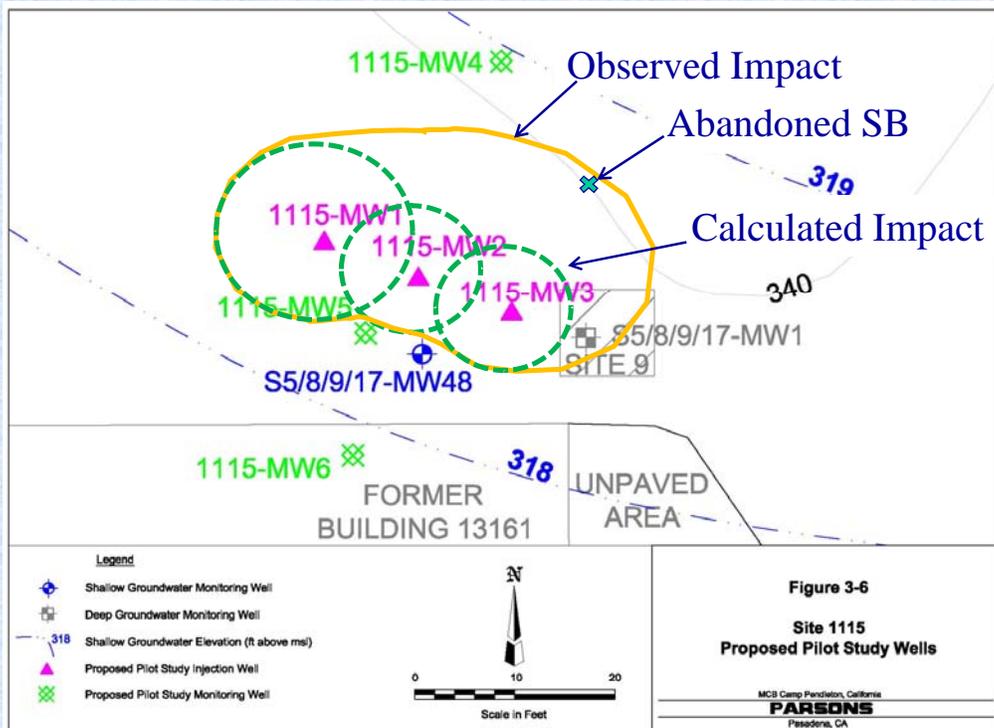
**Summary of Substrate Injection**  
 Site 1115, MCB Camp Pendleton, CA

Injection Location	Oil/Water Emulsion				Total Injection Volume (gallons)	Estimated Radius of Influence (feet)	Substrate Injection Pressure (psi) <sup>a/</sup>	Substrate Flow Rate (gpm) <sup>b/</sup>
	Newman Zone (50% soybean oil) (gallons)	Neutral Zone (50% solids) (gallons)	Water (gallons)	Whey (pounds)				
1115MW-01	30.5	91.6	1,527.0	199.3	1,649.1	19	10 to 15	1.2
1115MW-02	3.7	11.0	182.6	23.8	197.3	8	18 to 21	0.3
1115MW-03	4.1	12.4	206.0	26.9	222.5	9	20 to 23	< 0.1
<b>TOTALS:</b>	<b>38</b>	<b>115</b>	<b>1,915.6</b>	<b>250.0</b>	<b>2,068.9</b>	--	--	--
<b>AVERAGES:</b>	--	--	--	--	--	<b>11.9</b>	--	--

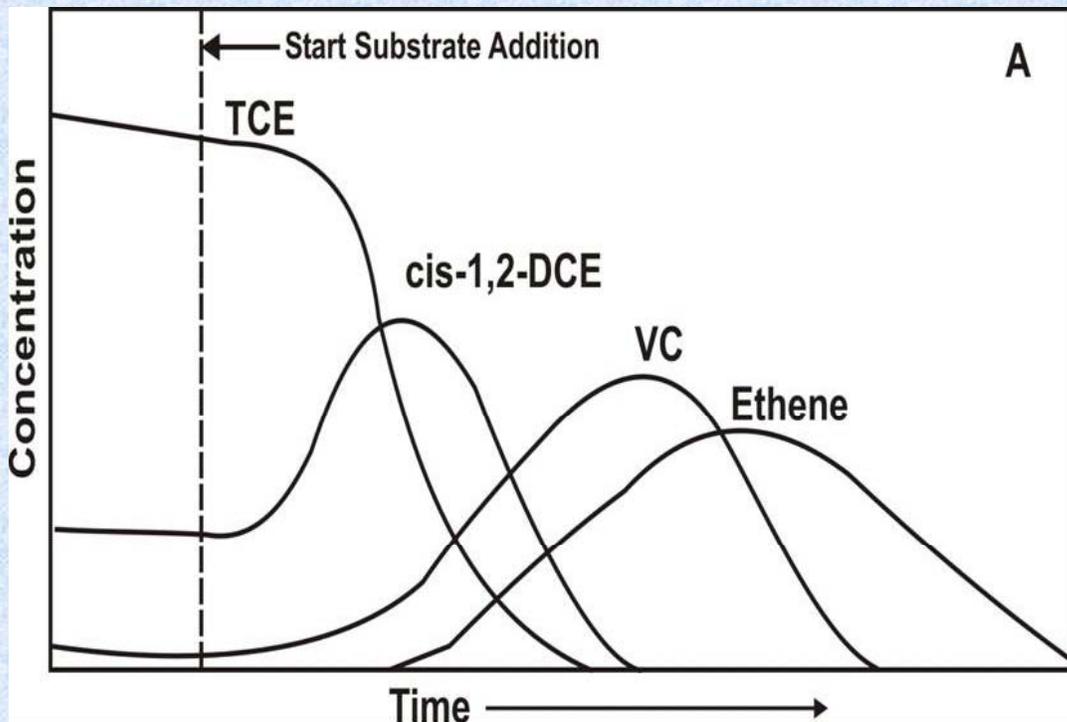
<sup>a/</sup> psi = pounds per square inch  
<sup>b/</sup> gpm = gallons per minute



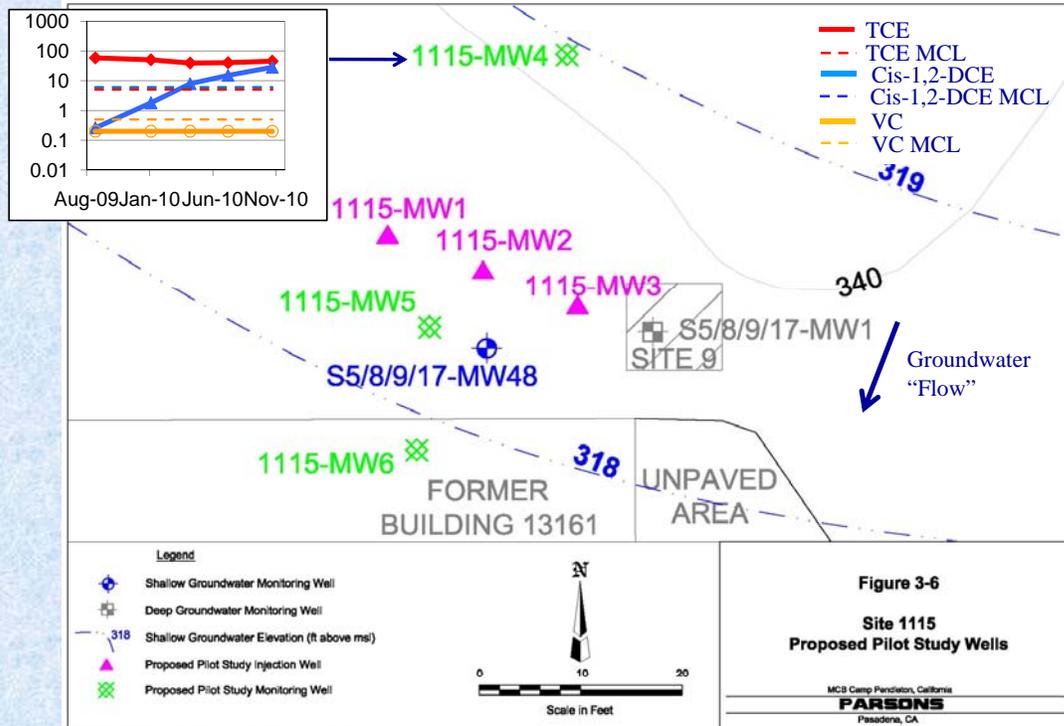
## Site 1115 Area of Influence



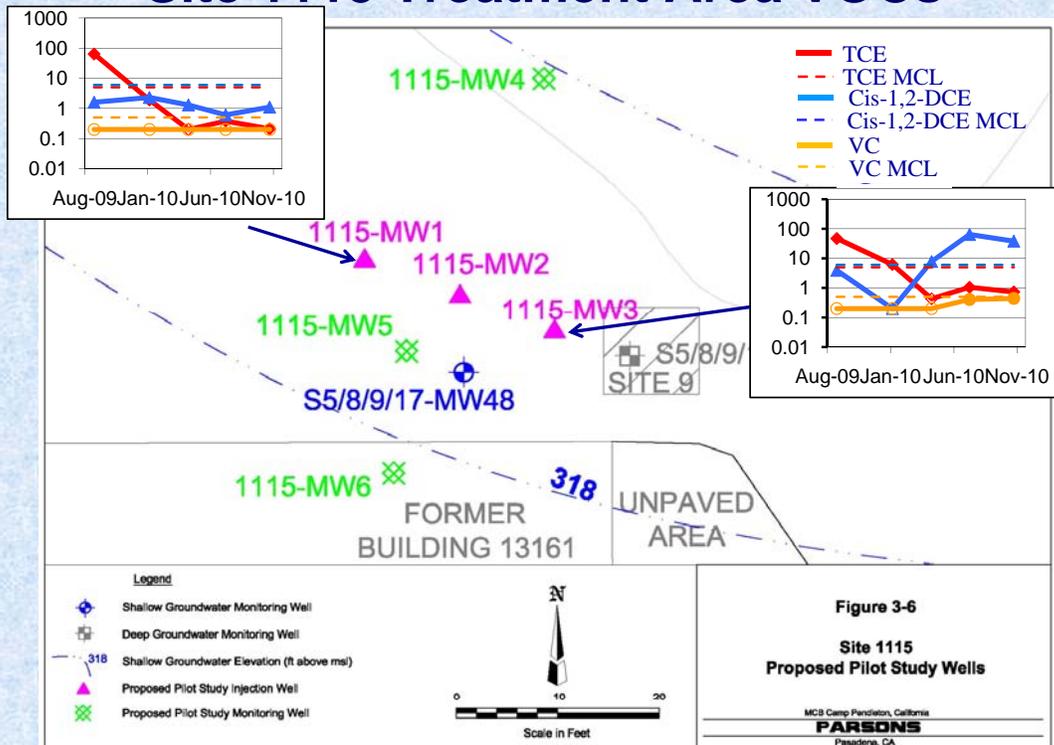
## Textbook Reductive Dechlorination



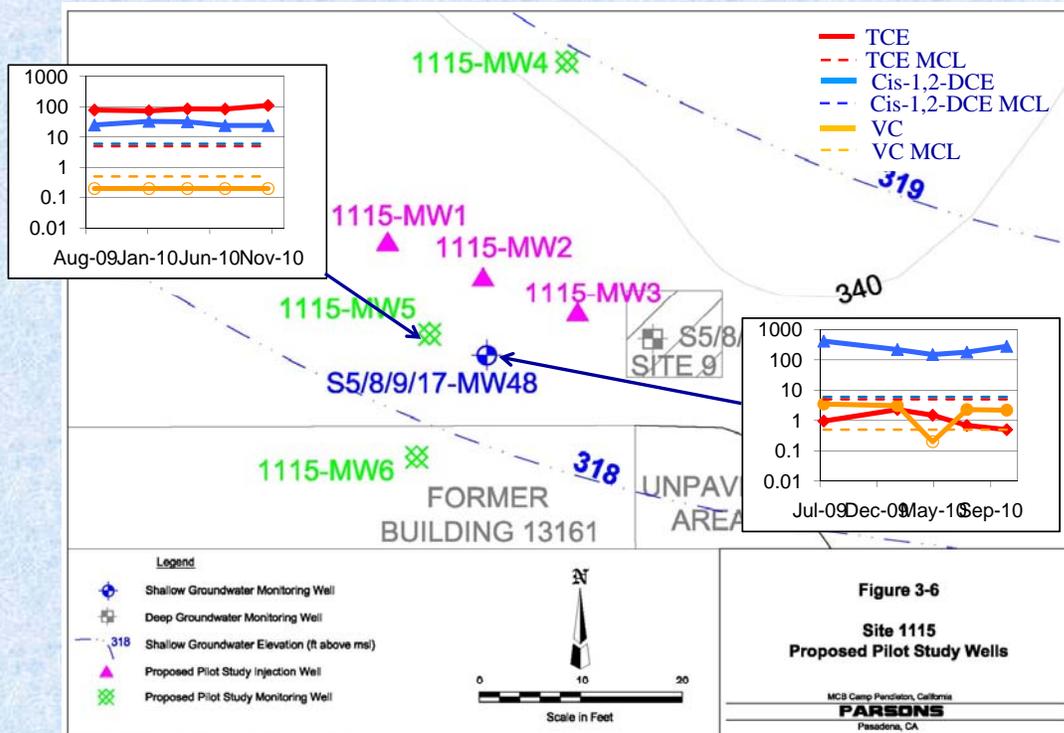
# Site 1115 Background VOCs



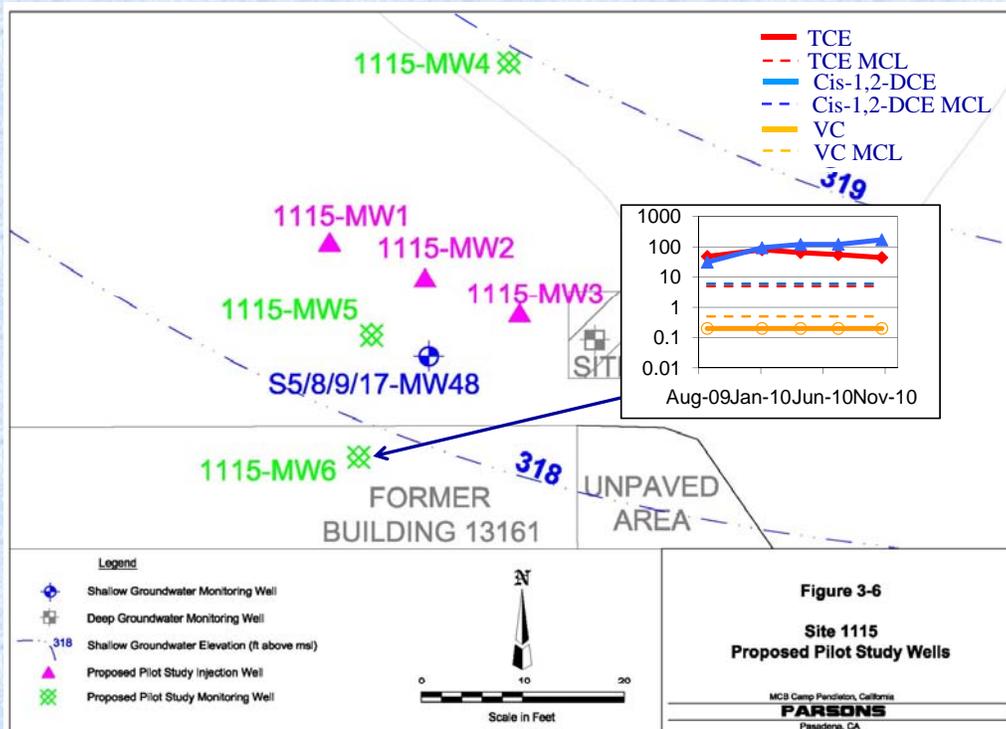
# Site 1115 Treatment Area VOCs



# Site 1115 Downgradient VOCs



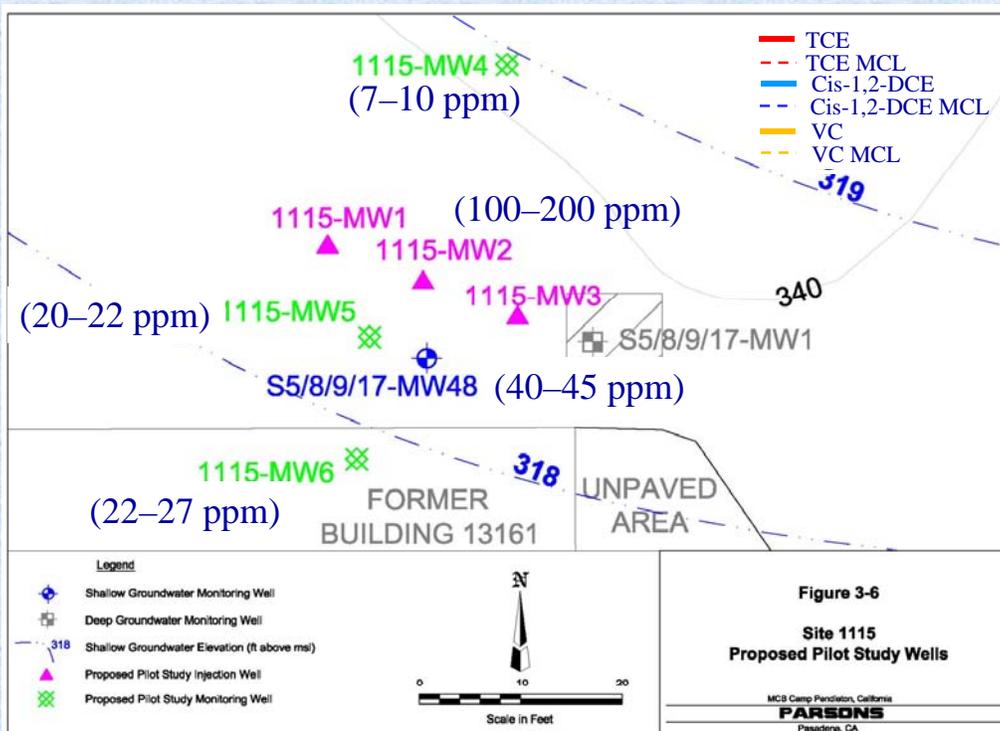
# Site 1115 Down Gradient VOCs



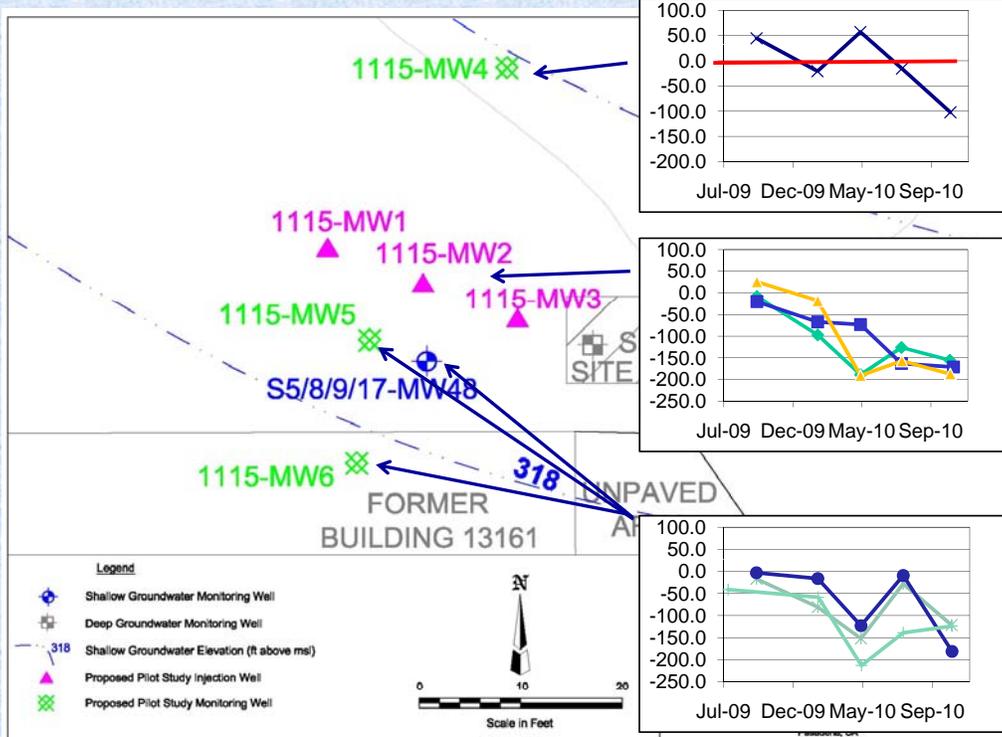
## Site 1115 VOC Changes

Well ID	TCE (ug/L)		Cis-DCE (ug/L)		VC (ug/L)		Ethene (ug/L)		Molar % Change
	T-0	T-14	T-0	T-14	T-0	T-14	T-0	T-14	
MW4	58	45	0.3	28	ND	ND	ND	2.8	+16%
MW1	64	0.2	1.6	1.1	ND	ND	NA	NA	-97%
MW2	57	0.3	57	26	ND	0.5	NA	NA	-73%
MW3	47	0.7	3.9	38	ND	0.4	NA	NA	-2%
MW5	78	110	25	24	ND	ND	ND	2.8	+17%
MW48	1.0	0.5	420	280	ND	2.2	ND	ND	-33%
MW6	48	44	31	170	ND	ND	ND	4.4	+28%

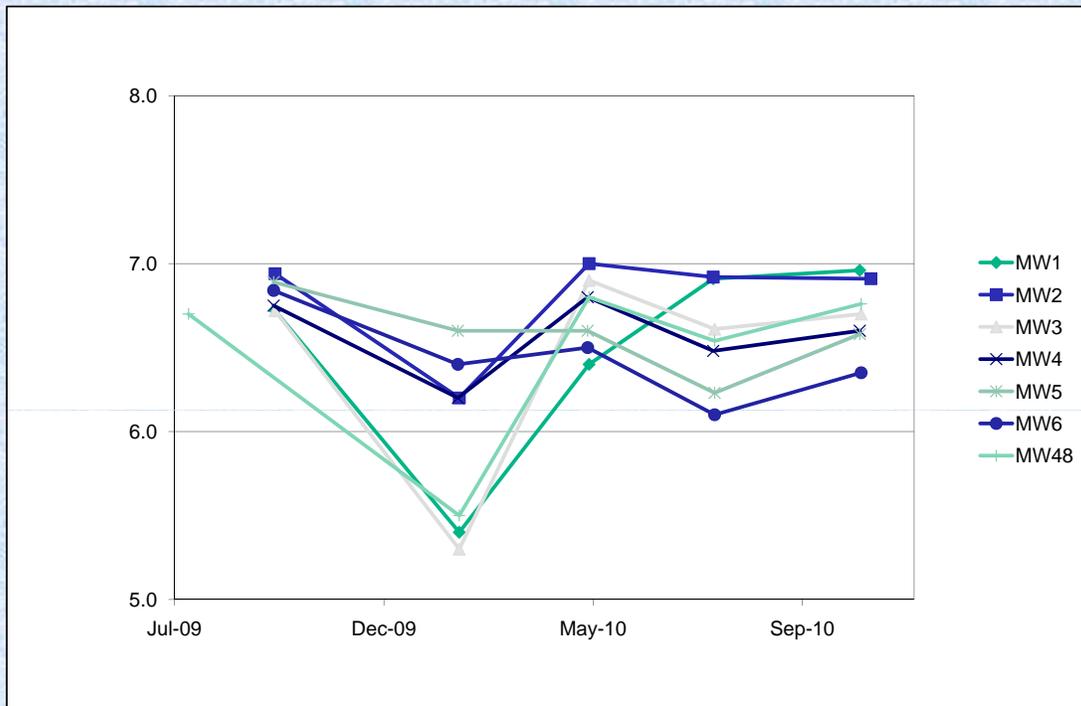
## Site 1115 TOC Distribution



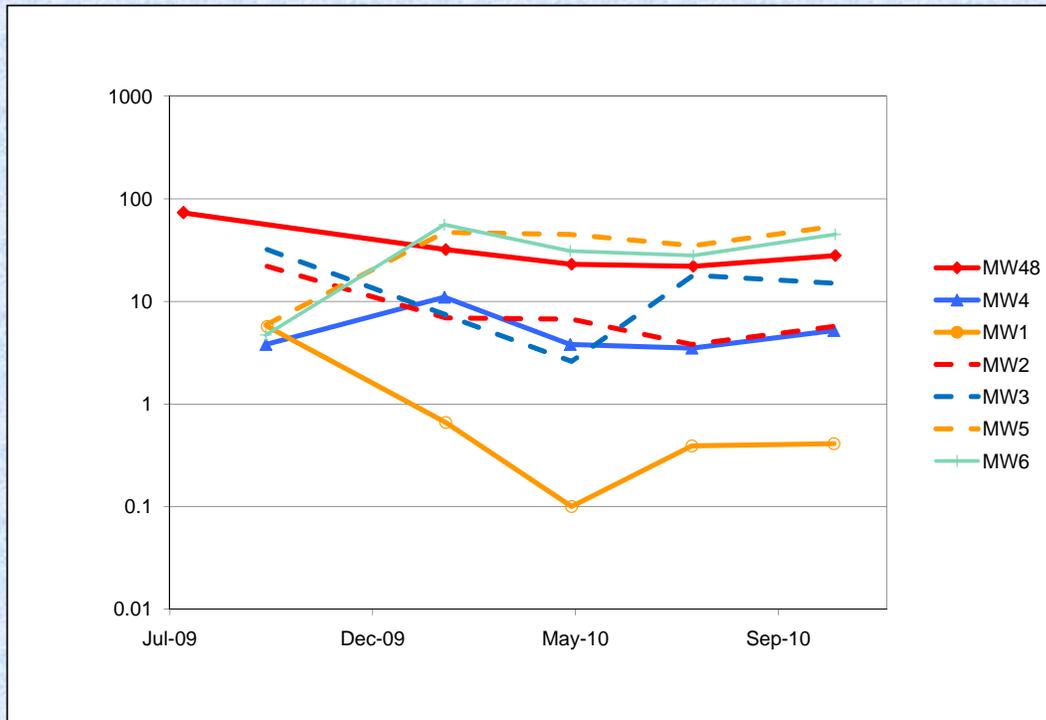
# Site 1115 Oxidation-Reduction Potential



# Site 1115 pH



## Site 1115 Benzene



## Site 1115 Pilot Study Injection

### First Year Conclusions

- Reductive dechlorination was induced where organic substrate was delivered.
- Significant chlorinated solvent total molar mass reductions achieved within the treatment area.
- Minimal solvent reduction in downgradient wells.
- Dissolved phase TOC did not migrate beyond area impacted during injection within the first 14 months.
- Geochemical impacts associated with substrate did migrate slowly to eventually impact MW4, MW5, MW48, and MW6 (diffusion dominated or very slow radial flow??).

# Site 1115 Pilot Study Injection

## First Year Conclusions

- Initial injection treatment area was larger than expected due to larger ROI. However, post injection TOC migration as minimal so no advective expansion due to slow groundwater flow and low permeability soils.
- Future injections of any reagent will have to be designed to emplace treatment zones during injection.
- Neutral conditions were maintained through 14 months of treatment.
- Organic substrate should last for at least an additional 6 to 12 months.
- Benzene concentrations remained relatively unchanged.



# In Situ Treatment of 1,2,3-Trichloropropane (TCP) to Protect Drinking Water Resources NESDI Project # 434

Nancy E. Ruiz, Ph.D.  
NAVFAC ESC  
805-982-1155

[Nancy.ruiz@navy.mil](mailto:Nancy.ruiz@navy.mil)

West Coast In-Progress Review  
17 May 2011



## *Project Team*



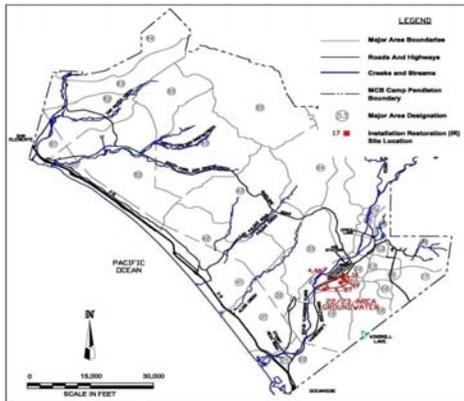
- NAVFAC
  - ESC, Nancy Ruiz – PI
  - SW, Theresa Morley – RPM for Camp Pendleton
  - SW, Derral Van Winkle
  - ESC, Andy Drucker – Technical Integration
- Geosyntec Consultants – Field Deployment, Documentation
  - John Fortuna, Eric Suchomel (Oakland, CA area)
  - Suzanne O'Hara (Northeast Canada)
  - Chris Walker (Seattle, WA area)
- Oregon University of Science and Health – Materials testing and evaluation
  - Paul Tratnyek, Ph.D. and Alexandra Salter-Blanc



# Introduction



- Project Objectives
- Technology Description
- Technical Progress
- Issues
- Technology Integration
- Funding Profile
- Backup slides



# Project Objectives



- Demonstrate that zero valent metals can be used ex situ to treat TCP in drinking water at ambient temperatures.
  - Zero-valent zinc (ZVZ)
  - Zero-valent iron (ZVI), HC-15, a specific formulation produced by Hepure Technologies

**Why is this important?**

**Production well shut down at MCB Camp Pendleton due to TCP**

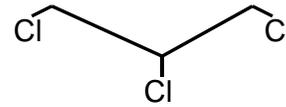
**Anticipate state and federal regulations**



# Technology Description Background - 1,2,3-Trichloropropane (TCP)



- TCP used as a solvent
  - Paint and varnish removal
  - Cleaning and degreasing



- Detected in > 200 samples at 20+ DoD sites as of 2007
- “...reasonably anticipated to be a human carcinogen”  
National Toxicological Program, 2005
- Monitoring has not been required until recently in CA
- Detected in Camp Pendleton production well

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## Regulatory Considerations



- EPA Chronic Oral Reference Dose (RfD):
  - Current: 6 ug/kg/day
  - Proposed: 4 ug/kg-day (Sep 2009)

### State Action Levels (Federal MCL anticipated)

State	Concentration	Units
CA	0.005 <sup>a</sup> 0.0007 <sup>b</sup>	µg/L
CT	0.05	µg/L
TX	0.13	µg/L
OR <sup>c</sup>	N/A	N/A

a – CA DPH notification level  
 b – CA OEHHA Public Health Goal (Draft)  
 c – TCP designated an “Unregulated Organic”

5



## *Chemical-Specific Issues*



- Chemical Characteristics
  - Difficult to air-strip – low volatility, relatively low Henry's Constant
  - Recalcitrant to biological and chemical degradation
- Analytical Method Detection Limits
  - EPA 8250B: PQL of 5 ug/L
  - SRL 524-M TCP (2003): PQL of 0.005ug/L
- Zero-Valent Metals (ZVM) have been shown to reduce TCP to non-chlorinated end-products
- Combination of reaction pathways favor formation of completely dechlorinated products

6



## *Technical Approach*



- Phased approach
  - Initial material evaluation and treatability testing through batch and column experiments
  - Develop scale-up factors and design pilot tests
  - Pilot tests at Camp Pendleton
  - Interim and Final Reporting
- Pilot Test at Camp Pendleton – 6 months of monitoring
  - 3 treatment systems – 2 Zn, 1 Fe
  - Site groundwater held in reservoir tank
  - Spike influent TCP concentration to 5 ug/L
  - Analyze influent and effluent
  - Construct 2 additional treatment systems halfway through field demonstration to apply potential optimization process

7



# Performance Criteria



Performance Objective	Metric	Data Requirements	Success Criteria and Outcome
Quantitative Performance Objectives			
TCP Concentration	SRL 524M-TCP	TCP influent, effluent concentrations	$\geq 95\%$ reduction in TCP Concentration <b>Success</b>
Secondary Water Quality Characteristics	Atomic Absorption Analysis	Zn, Fe dissolved concentrations	Zn $\leq 5$ mg/L Fe $\leq 0.3$ mg/L <b>Success</b>
Qualitative Performance Objectives			
Long-term performance of treatment system	SRL 524M-TCP Influent flow rate	TCP effluent concentrations Visual Inspection of treatment materials	No plugging of treatment materials No loss of flow rate <b>Success</b>

8



# Technical Progress: Tasks



Task/Milestone #	Planned Schedule	Actual
Contract Award	4/30/2009	7/06/2009
1. Evaluate Treatment Materials - SERDP ER-1457	9/30/2009	10/31/2009
2. Perform Column Tests; Design Field System	11/30/2009	12/15/09
3. Construct, Shake Out Field System	1/31/2010	5/14/10
4. Start Field System	3/31/2010	5/14/10
5. Construct, Shake Out, Start Optimized Additional Systems	5/31/2010 9/15/2010	11/23/10
6. Start Final Data Analysis	7/31/2010 11/15/2010	2/16/11
7. Prepare Draft Technical Report	9/30/2010 5/25/11	
8. Prepare Final Technical Report	11/30/2010 7/10/11	

9



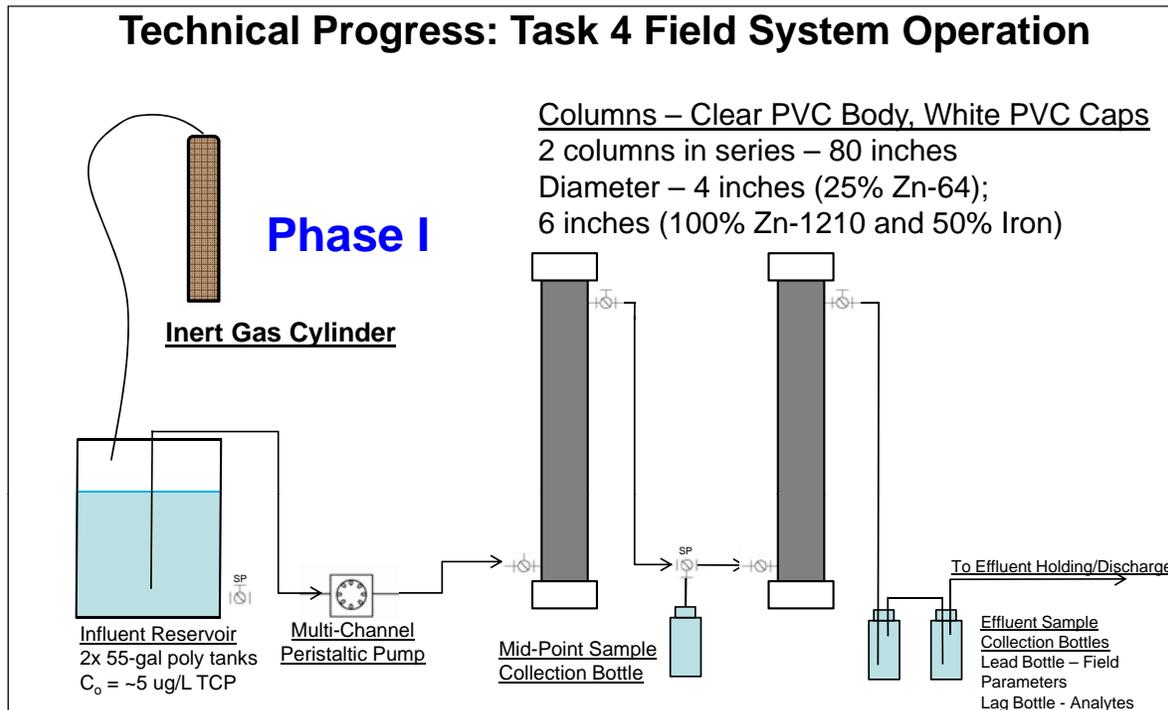
# Technical Progress: Task 3 Construct, Shake Out Field Treatment System



- Columns – Varying Metal %
  - 2 m length
  - 1.6 – 2.4 cm diameter
  - 5 ml/min flow rate
- Cost to treat 0.005 ug/L TCP: \$0.05 - \$0.12/100 CF Water



## Technical Progress: Task 4 Field System Operation



Notes:  
TCP – 1,2,3-Trichloropropane

SP  
Sampling Port

Ball Valve

**Figure XX**  
**Treatment System Schematic**

NESDI Project 434 – Abiotic Treatment of 1,2,3-Trichloropropane  
Marine Base Camp Pendleton, California

Project: WR1256

April 2010

Geosyntec<sup>®</sup>  
consultants



## Technical Progress: Task 4 Field System Operation – Phase I



### Issue 1:

Week 5 of operation - leaks from the zinc columns observed

- Plastic hose barb failure at influent and effluent tubing connections
- Gas generation and pressure buildup

### Fix:

Column design modified:

- Larger diameter stainless-steel fittings at column effluent, valve, filter unit, and hose barb
- Pressure relief valves at top of columns to vent built-up gases

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## Technical Progress: Task 4 Field System Operation – Phase I (cont'd)



### Issue 2:

After restart, iron column flow unsustainable (possible cementation)

### Fix:

Column reconfigured to operate with upward flow through the lead column and downward flow through the lag column.

### Issue 3:

Week 8 of operation - pump tubing for Zn-1210 column burst, draining lead column. Flow rate of 5 mL/min unsustainable.

### Fix:

Lead Zn-1210 column taken offline. Reduced flow observed in lag column in Week 10. Column operation discontinued.

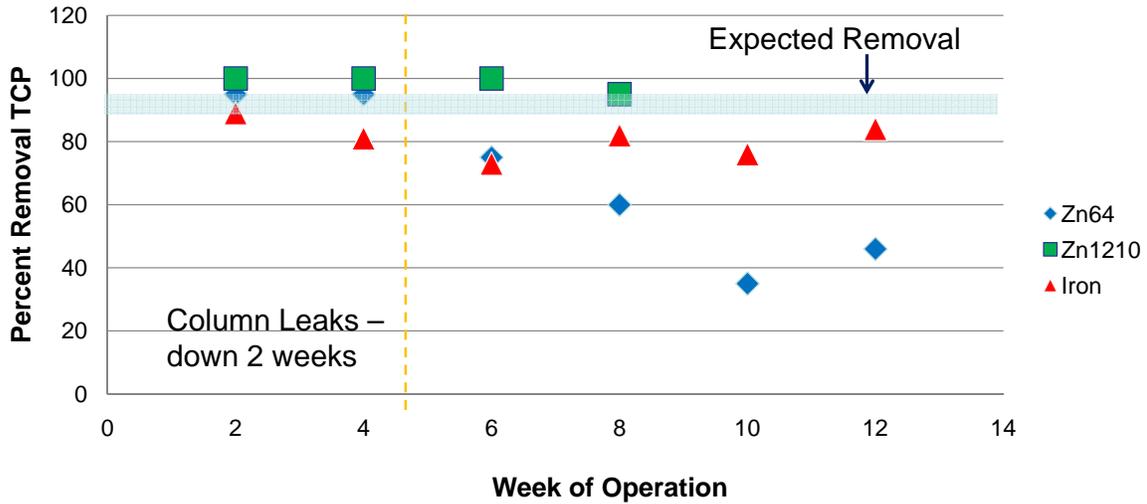
13



# Technical Progress: Task 4 Field System Operation - Phase I



## TCP Removal During Phase I Operations



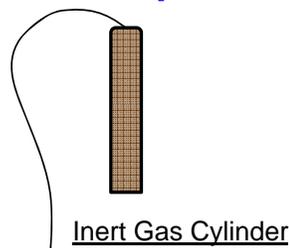
Phase I - Iron did not meet success criteria (25% Zn64, 100% Zn1210 acceptable)

For Phase II: Zn64 - 25%, Balance Sand; Zn1210 - 3 metal concentrations

14

## Technical Progress: Task 5 Field System Operation - Phase II

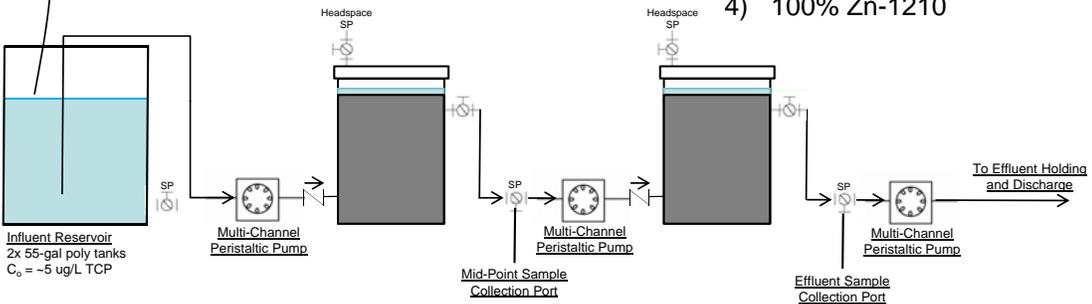
### Phase II Optimized



#### Reactors - 5-Gallon PVC Screw-Top Pails

- 2 reactors in series
- Nominal headspace in reactors for collection/ sampling gases
- To avoid water/gas buildup, peristaltic pumps used

- 1) 25% Zn-64/75% Sand;
- 2) 33% Zn-1210/67% Sand;
- 3) 67% Zn-1210/33% Sand;
- 4) 100% Zn-1210



Notes:  
TCP - 1,2,3-Trichloropropane  
SP - Sampling Port  
CV - Check Valve  
BV - Ball Valve

Figure XX  
Column Schematic - Phase II Columns

NESDI Project 434 - Abiotic Treatment of 1,2,3-Trichloropropane  
Marine Base Camp Pendleton, California

Project: WR1256

November 2010

Geosyntec<sup>D</sup>  
consultants



## Technical Progress: Task 5 Field System Operation – Phase II



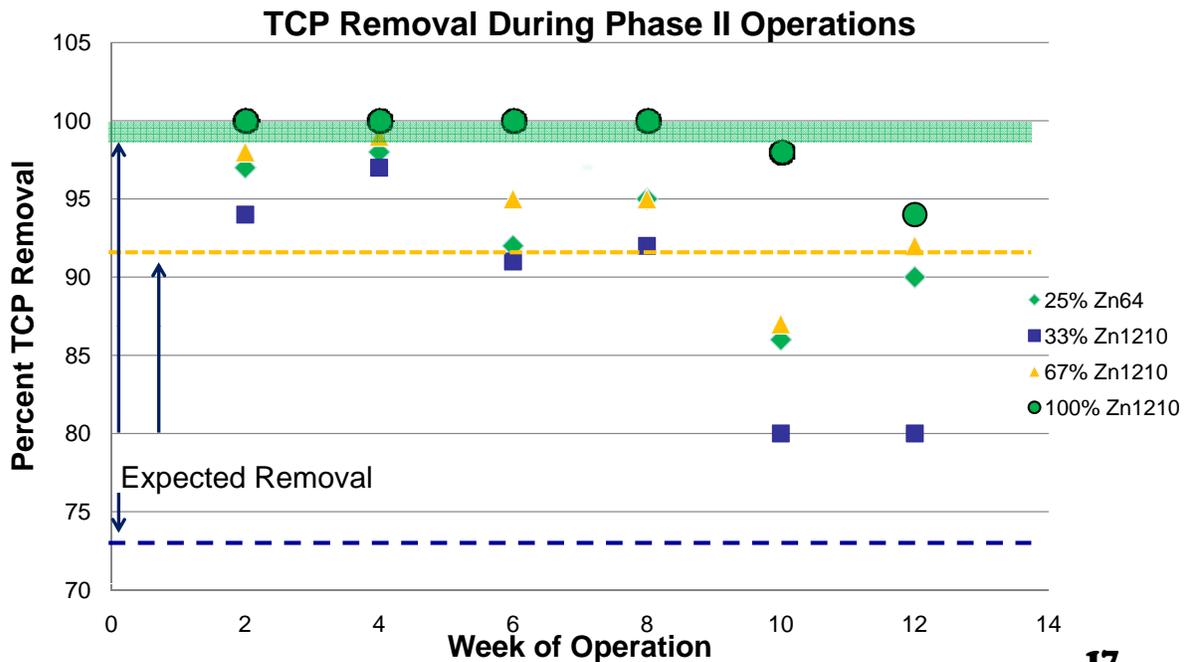
- System Operational November 2010-February 2011

Effluent Concentrations	Zn64, 25%	Zn1210, 33%	Zn1210, 67%	Zn1210, 100%
Average pH increase, units	1.52	0.86	1.31	1.24
Propene, ug/L	0.11	0.36	0.46	0.23
Range of Dissolved Zn, mg/L	0.08 – 0.11	0.08 – 0.16	0.07 – 0.24	0.04 – 0.07

16



## Technical Progress: Task 5 Field System Operation – Phase II



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## Technical Progress: Task 6 Final Data Analysis



- Column material also being evaluated:
  - Visual inspection
  - Sieving
  - XRF Condition of material
  
- Physical Characterization
  - Sieve Data
  - TEM/EDX analysis
    - TEM - at least two phases (fluffy vs dense)
    - EDX - relatively high concentrations of Si on the surface of all particles from all three buckets
  
- TCP Degradation Inhibition Analysis
  - Re-use material to assess continued effectiveness

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## Technical Progress: Tasks 7 and 8 Draft and Final Technical Report



- Draft Technical Report in work – expected delivery 5-25-11
  
- Assume an initial TCP concentration of 0.01 ug/L, treat to 0.005 ug/L
  - Zero-Valent Zinc O&M costs range: \$0.05 to \$0.12/100 CF
  
  - MWD (SoCal) water - \$920/acre-foot
    - \$7400/CFS for delivery
    - \$146M Readiness-To-Serve (RTS) capital costs
  
- Current Assessment of Technology:
  - System works ex-situ
  - Long-term may be more economically viable in-situ
    - Reduces/eliminates gas management issues
    - Economies of scale for materials costs
  - Secondary Water Quality impacts minimal

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# Technology Integration



- Planned Technology Integration Activities
  - Briefing MCB Camp Pendleton FFA Group on 19 May
  - Remediation Innovative Technology Seminar (RITS) topic to be developed
  
- Navy Wide Focus:
  - Target audience - Facilities producing drinking water
  - Technology transfer strategy
    - Guidance will be developed for distribution to the NAVFAC clean water media field team and their stakeholders.
    - NAVFAC SW will coordinate first use with Camp Pendleton POC, RCRA Division Head

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# Technology Integration: TICA Output



Update - April 2011

- Site undertaking a project to install a pilot-scale zero-valent zinc permeable reactive barrier.
- Construction costs are now being developed
- Project team plans to submit a proposal to ESTCP for expanded pre-installation site characterization and system performance monitoring.

b) Intangible Benefits:

Benefit	Description
Regulatory Compliance	No Federal MCL exists as of FY09, but several states have developed notification/action levels.
Increased/New Capability	No technology has been previously demonstrated at field scale which will degrade 1,2,3-TCP in drinking water.

c) Integration Sites, ROI, and Payback:

Site Name	ROI / Payback(yrs)
Camp Pendleton	62.90 / 1.76

21



## *Action Items*



- **An article for Currents Magazine will be developed after the Final Report has been submitted.**
- **The site is undertaking a pilot scale in-situ zinc permeable reactive barrier**
- **The project team plans to submit an ESTCP proposal to supplement the performance monitoring planned for the Zn PRB**

**22**



## *Issues*



- **System works ex-situ; Long-term may be more economically viable in-situ**
  - Reduces/eliminates gas management issues
  - Economies of scale for materials costs
- **Impact to secondary water quality seems minimal at this point; more study at larger scale required.**

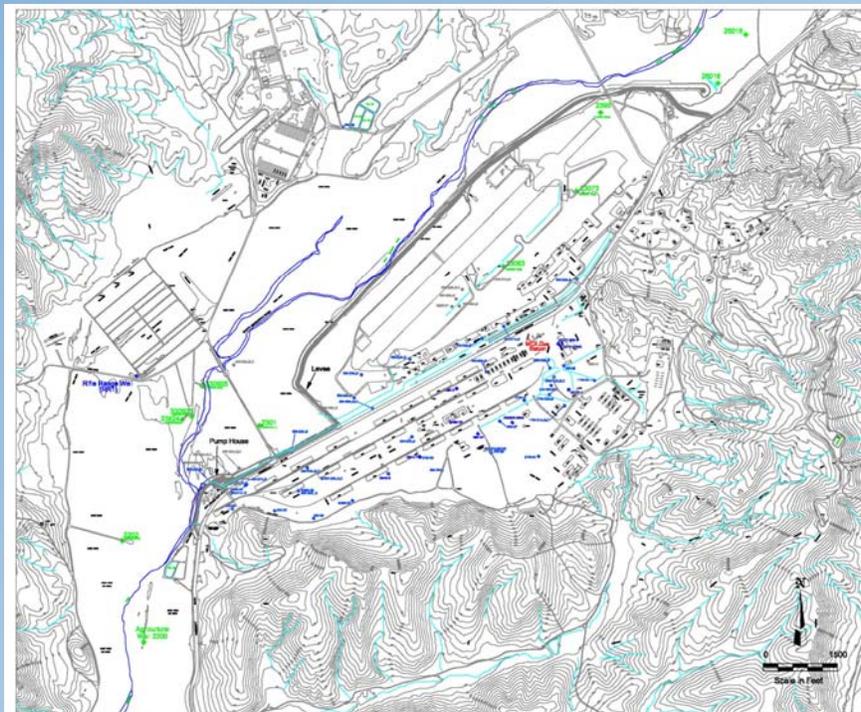
**23**

# MCB CAMP PENDLETON 22/23 AREA AQUIFER INVESTIGATION

19 May 2011  
104<sup>th</sup> FFA Meeting



## 22/23 AREA AQUIFER INVESTIGATION





## 22/23 AREA AQUIFER INVESTIGATION

### **Purpose:**

- ❖ To identify area(s) of the Chappo subbasin that are not impacted by VOCs.
- ❖ Supplement existing data to also determine areas and zones of best yield.
- ❖ Provide recommendations for potential future supply well locations and depth.



## 22/23 AREA AQUIFER INVESTIGATION

### **Scope of Hydrogeologic Investigation:**

- ❖ Review existing data and reports to eliminate areas of known low yield and/or contamination.
- ❖ Interact with contractors and Base personnel.
- ❖ Drill and sample test wells with multiple screened intervals and conduct downhole geophysical logging.



## 22/23 AREA AQUIFER INVESTIGATION

### Scope of Hydrogeologic Investigation (continued):

- ❖ Use data from test wells to determine the horizontal and vertical contaminant distribution and provide hydrogeologic information needed to select suitable locations for the new supply well(s).
- ❖ Based on results of initial sampling, subsequent steps may include: flow logging, aquifer testing, depth-specific sampling, capture zone analysis.

# Site 1D Data Gap Analysis

19 May 2011 FFA Meeting

07/02/2008



## Background

- Source zone in grid cell G9 – approx. 85- 90 buried drums/fragments some with solid & liquid materials.
- Drums/fragments removed and soils excavated to concentrations less than screening levels (RSLs).



## Excavated Material from Grid Cell G9

- Analytical results of drum/over-excavation material:
  - Drum G9-5:
    - 1,500 mg/kg 1,1,2,2-tetrachloroethane,
    - 2,900 mg/kg TCE,
    - 110 mg/kg PCE,
    - 570 mg/kg 4,4-DDD,
    - 909,000 mg/kg oil/grease.
  - Roll-off bins:
    - 255,000 mg/kg arsenic,
    - 86,100 mg/kg lead,
    - 44,200 mg/kg antimony,
    - 19,600 mg/kg chromium,
    - 2,900 mg/kg 1,1,2,2-tetrachloroethane
    - 1,100 mg/kg TCE



## Site 1D Groundwater Impacted

- Grab groundwater samples from excavation indicated impacts of VOCs and pesticides.
- Hydropunch investigation performed in 2008 to determine nature and extent of groundwater impacts.
- Trench excavated and GW extraction system installed.
  - Groundwater pumped from Sept 2009 to January 2011 and a total of 600,000 gallons removed.
  - Eleven sampling events were performed between 9/09 and 1/11. Grab samples collected using a bailer.



## Groundwater Contamination

- Higher concentrations of VOCs and pesticides observed at 1D-4WF (source zone).
- Concentrations decrease along trench axis.
- TCE, PCE, 1,2-DCA, cis-1,2-DCE, and 1, 1, 2, 2-tetrachloroethane, arsenic, and gamma chlordane are the prevalent chemicals.
- Chemical concentrations are still elevated in groundwater at source area after extraction.



## Data Gap Analysis at Site 1D

- Required to assist in evaluating potential remedial technologies. Data gaps include determining:
  - Vertical delineation of subsurface contaminants, particularly, VOCs – possible DNAPL?
  - Lateral extent of contamination – data gap north of HP-8 and HP-2.
  - Site stratigraphy to update CSM.
  - Groundwater geochemistry.
  - Groundwater conditions (gradient, flow, hydraulic conductivity).



## Approach to Site 1D Investigation

- Perform a CPT survey along a predetermined grid to:
  - Collect stratigraphic data through continuous lithologic logging.
  - Update CSM for the site.
  - Stratigraphic correlation will take into account recent fill material from Site 1D soil excavation.
  - Site and install temporary microwells and sample for VOCs, metals, and/or pesticides (24-hr turnaround analyses).
- Perform a MIP survey
  - TCE present at concentrations indicative of possible DNAPL.
  - Use real-time lithologic/stratigraphic information and microwell sampling results.
  - Vertically profile target VOCs in vicinity of grid cell G9.



## Approach (continued)

- Install minimum of five permanent groundwater monitoring wells based on results from microwell sampling.
  - One well sited where drums were removed and reported elevated concentrations of target contaminants.
  - Three down gradient, one up gradient sentry wells
  - Groundwater samples will be collected and analyzed for chemical, geochemical, water quality, and MNA parameters.
  - Groundwater gradient and flow direction will be determined for the site.
  - Soil samples will be collected from one well location for soil physical characteristics (bulk density, TOC, pH, CEC, hydraulic conductivity).
  - Propose abandoning 1DW-01 since it is improperly screened and distance from area of interest.

# Proposed Sampling at Site 1D



## Site 1D Data Gap Analysis Status

- Work plan has been through Navy review and Draft document is being prepared.
- Submittal expected early June.
- In process of prepping site for investigation:
  - Install gravel and bioreactive material (mulch from on-base source) into trench.
  - Backfill and compaction of trench.



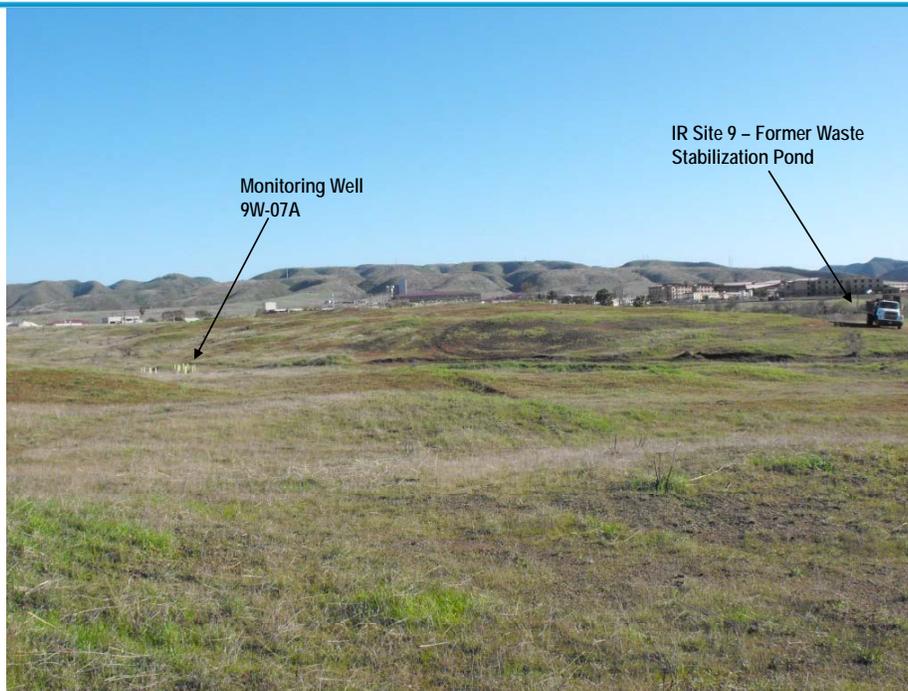
# Results of Human Health Risk Assessment Installation Restoration Program Site 1114, Marine Corps Base Camp Pendleton

19 May 2011

## Overview



- **IR Site 1114 Remedial Investigation (RI) was conducted in July 2010. Consisted of a soil, groundwater, and soil gas investigation.**
- **The Human Health Risk Assessment (HHRA) was conducted using the VOC data from the RI.**



## Objectives of the Risk Assessment



- **The objective of the HHRA was to evaluate the potential risks and health hazards (risks/hazards) for on-site current and potential future VOC exposures at IR Site 1114 for the protection of human health.**

## Human Health Risk Assessment Process



- **Quantitative evaluations based on RAGS Part D.**
- **Quantitative evaluation included CalEPA-modified toxicity values.**
- **Calculated direct exposure pathways including**
  1. **Ingestion of site groundwater**
  2. **Dermal exposure to VOCs during showering/bathing**
  3. **Inhalation of ambient air.**
- **For indirect exposure such as vapor intrusion to indoor air or volatilization from groundwater to a construction trench, EPC were calculated using J-E model for vapor intrusion to indoor air and the Virginia trench model for volatilization from groundwater to a construction trench.**

## Data Set Formation



- **The HHRA is based on data sets compiled from the RI conducted in July 2010.**
- **Groundwater and soil gas samples were collected previously but those data have not been used for this HHRA.**
  - ✓ **Soil gas may move as much as 26 feet/year in the soil matrix, and groundwater concentrations can change with time.**
  - ✓ **Results from the RI and previous investigation compared well but the data from the RI was evaluated separately to maintain the temporal value of the data.**

## Selection of Chemicals of Potential Concern



- All detected analytes in soil, soil gas, and groundwater were selected as COPCs.
- DQOs for detection limits were established using Risk-Based Concentrations, as a Conservative Approach.

### SOIL

- Twelve soil samples were collected from six locations near monitoring well 9W-07A to assess if a surface spill had occurred in the area.
- VOCs were not detected in any of the soil samples.
- Based on this, there were no COPCs chosen for surface soil and no further evaluation of risk/hazard conducted for the soil media.

## Selection of Chemicals of Potential Concern

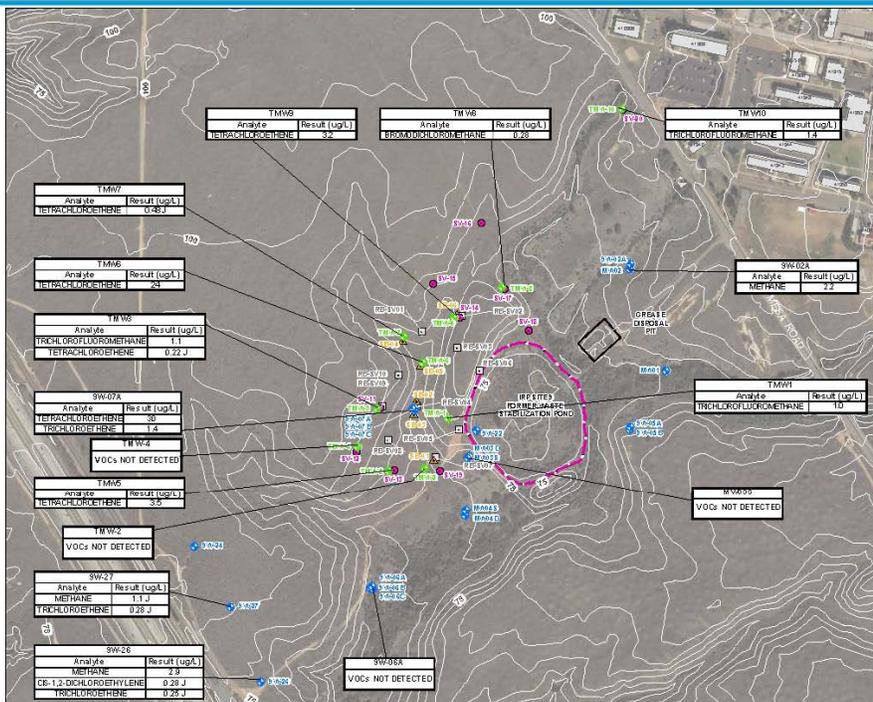


### GROUNDWATER

- 16 groundwater samples collected
  - ✓ 10 temporary monitoring wells
  - ✓ 6 permanent monitoring wells
- Only six VOCs detected in groundwater
- Maximum concentration of each analyte selected for risk/hazard HHRA evaluation for potential exposure via ingestion, dermal contact absorption, and inhalation

Analyte	Frequency	Max. Concentration
PCE	6 of 16	30 µg/L - 9W-07A
TCE	3 of 16	1.4 µg/L - 9W-07A
Trichlorofluoromethane	2 of 16	1.4 µg/L - TMW-10
cis-1,2-dichloroethene	1 of 16	0.28J µg/L - 9W-26
Bromodichloromethane	1 of 16	0.28J µg/L - TMW-8
Methane	3 of 6	2.9 µg/L - 9W-26

# Groundwater Analytical Results



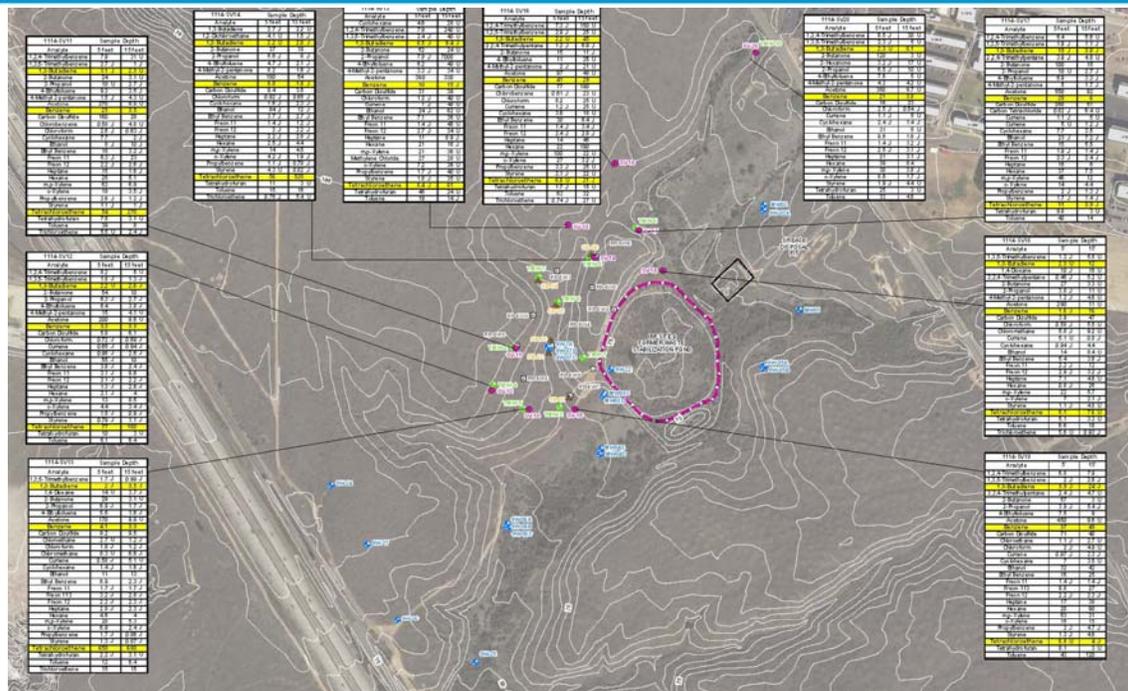
# Selection of Chemicals of Potential Concern



## SOIL GAS

- Collected from 5 feet bgs and 15 feet bgs from 10 locations.
- 35 VOCs detected at 5 foot; 31 VOCs detected at 15 feet.
- Maximum concentration of each analyte selected for risk/hazard evaluation for potential exposure.

# Soil Gas Analytical Results



# Conceptual Site Exposure Model

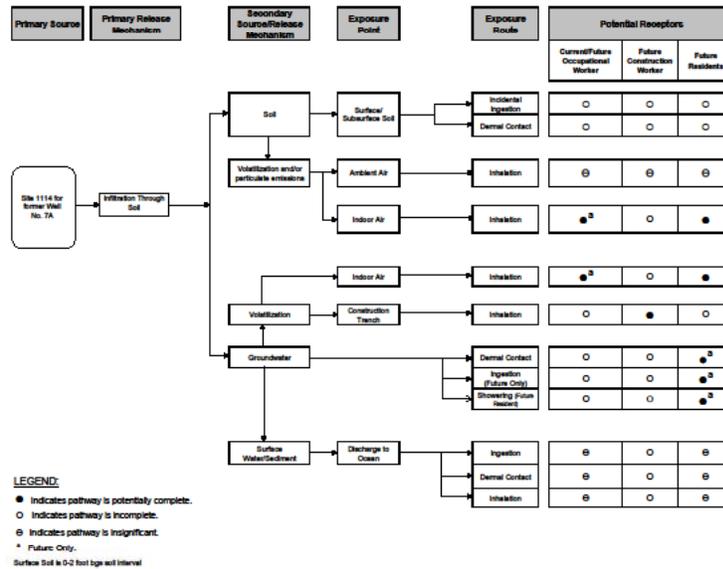


- Groundwater and soil gas are considered potential complete exposure pathways/media.
- Potential future receptors for exposure at the site include workers and future hypothetical residents
  - ✓ Future Site Worker, inhaling indoor air in a hypothetical building
  - ✓ Future Subsurface Construction Worker, inhaling trench air
  - ✓ Future Lifetime Adult Resident, breathing indoor air and shower room air, having dermal exposure to shower water derived from site groundwater, and ingesting site groundwater
  - ✓ Future Child Resident, breathing indoor air and shower room air, having dermal exposure to bath water derived from site groundwater, and ingesting site groundwater

# Conceptual Site Exposure Model



Figure 5  
Conceptual Site Exposure Model



CSM  
B3130409 MCB Camp P (Trevet) Figures/ Figure 5 CSEM.xls

1/26/2011

# Human Health Risk Assessment Results



Table 5-33  
Receptor/Pathway Cumulative Risk/Hazard Summarized From RAGS Part D Tables

Receptors and Exposure Pathways of the CSEM	Cumulative Risk (ILCR)				Cumulative Health Hazard Index (HI)			
	Based on Highest Concentration of Each Detected Analyte							
	Federal	% of Total	CalEPA	% of Total	Federal	% of Total	CalEPA	% of Total
<b>Future Site Worker</b>								
Indoor Air Based on Soil Gas	6E-7	100%	1E-6	100%	0.009	100%	0.01	100%
<b>Future Construction Worker</b>								
Trench Air Based on Groundwater	6E-7	100%	1E-7	100%	0.005	100%	0.04	100%
<b>Future Lifetime Adult Resident</b>								
Groundwater Ingestion	2E-4	65.9%	2E-4	65.0%	0.3	77%	0.3	71%
Dermal (shower) Based on Groundwater	1E-4	32.9%	1E-4	32.5%	0.05	13%	0.05	12%
Inhalation of Indoor Air Based on Soil Gas	3E-6	1.0%	7E-6	2.2%	0.04	10%	0.06	14%
Inhalation of Shower Air Based on Groundwater	7E-7	0.2%	7E-7	0.2%	0.001	0%	0.009	2%
<b>Total</b>	<b>3E-4</b>	<b>100%</b>	<b>3E-4</b>	<b>100%</b>	<b>0.4</b>	<b>100%</b>	<b>0.4</b>	<b>100%</b>
<b>Future Child Resident</b>								
Groundwater Ingestion	9E-5	64%	9E-5	63%	0.7	81%	0.7	78%
Dermal (bath) Based on Groundwater	5E-5	36%	5E-5	36%	0.1	14%	0.1	13%
Inhalation of Indoor Air Based on Soil Gas	6E-7	0%	1E-6	1%	0.04	4%	0.06	7%
Inhalation of Shower Room Air Based on Groundwater	3E-7	0%	3E-7	0%	0.002	0%	0.02	2%
<b>Total</b>	<b>1E-4</b>	<b>100%</b>	<b>1E-4</b>	<b>100%</b>	<b>0.8</b>	<b>100%</b>	<b>0.8</b>	<b>100%</b>

**Notes:**

*bold* denotes total ILCR or HI for receptor designated

RAGS Part D refers to EPA, 2001, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part D).

% denotes percent

CalEPA denotes California-modified toxicity values were used in risk/hazard estimation (<http://www.oehha.ca.gov/risk/chemicals/index.asp>)

CSEM denotes Conceptual Site Exposure Model

CalEPA denotes California Environmental Protection Agency regional toxicity values (<http://www.epa.gov/osm>) were used in risk/hazard estimation by RAGS PART D equations.

<http://www.epa.gov/osm/riskassessment/assess.html>

HI denotes Hazard Index

ILCR denotes Incremental Lifetime Cancer Risk

RAGS denotes Risk Assessment Guidance for Superfund



In summary, HHRA indicates the estimated cancer risk is either within or below the risk management range for the following receptors and exposure scenarios:

- Future Subsurface Construction Worker inhaling trench air ( $6 \times 10^{-7}$  ILCR)
- Future Site Worker inhaling indoor air in a hypothetical building ( $6 \times 10^{-7}$  ILCR)
- Future Lifetime Adult Resident breathing indoor air and shower room air ( $3 \times 10^{-6}$  ILCR and  $7 \times 10^{-7}$  ILCR), and having dermal exposure to shower water derived from site groundwater ( $1 \times 10^{-4}$  ILCR)
- Future Child Resident breathing indoor air and shower room air ( $6 \times 10^{-7}$  ILCR and  $3 \times 10^{-7}$  ILCR), having dermal exposure to shower water derived from site groundwater ( $5 \times 10^{-5}$  ILCR), and ingesting site groundwater ( $9 \times 10^{-5}$  ILCR)
- Cumulative Hazard Index (HI) for each receptor did not exceed 1, indicating no unacceptable non-cancer risk

## Human Health Risk Assessment Results



The results of the HHRA also indicate that the estimated risk from ingestion of site groundwater for potential future lifetime adult resident exceeds the upper bound of the risk management range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  ILCR, as follows:

- Future Lifetime Adult Resident ingesting site groundwater ( $2 \times 10^{-4}$  ILCR)
- The HI is less than 1

## Summary



- The future use of groundwater as a potable water source is extremely unlikely.
- Groundwater has been designated as having potential beneficial uses, including potential future use as drinking water, due to its proximity to the Pacific Ocean and the high TDSs in groundwater underlying the site, groundwater at IR Site 1114 is not considered potable.
- No groundwater production wells located downgradient of the site.
- Future use of groundwater as a source of water for bathing/showering is highly unlikely since the Marine Corps will not likely build structures at the site due to the critical habitat and because they would lose the use of the area as a military training area.

## Summary



### **If the groundwater were to be used by MCB Camp Pendleton**

- The average concentration of PCE in water would be significantly lower than the maximum detected value used in this risk assessment.
- The groundwater would be pumped from the site and blended with other sources of water prior to redistribution through the potable water pipeline.

## Summary



- The estimated risk from the ingestion of site groundwater is based on ingesting 2 liters per day for an adult and 1 liter per day for a child.
- It also assumes that drinking site groundwater represents 100 percent of the daily intake and that the adult and child do not ingest drinking water from any other source.
- Going on the premise that the site groundwater is used for showering purposes in the future it is reasonable to assume that incidental ingestion of the groundwater during showering in much less than 2 liters per day.

## Summary



- If the assumption is made that 1 percent of the 2 liters per day threshold is ingested (20 milliliters), then the estimated risk for a potential future lifetime adult resident from the ingestion of site groundwater is  $2 \times 10^{-6}$  ILCR. This ingestion scenario puts the estimated risk associated with the incidental ingestion of groundwater during showering well within the risk management range.



- The maximum detected concentration of PCE in groundwater was 30 µg/l, and only two of the 16 groundwater samples had reported concentrations of PCE above the MCL of 5 µg/l.
- The remaining concentrations ranged from non-detectable to 3.5 µg/l, indicating that the maximum concentration of PCE at the site is limited to a very small area, approximately 700 square feet (0.02 acres).

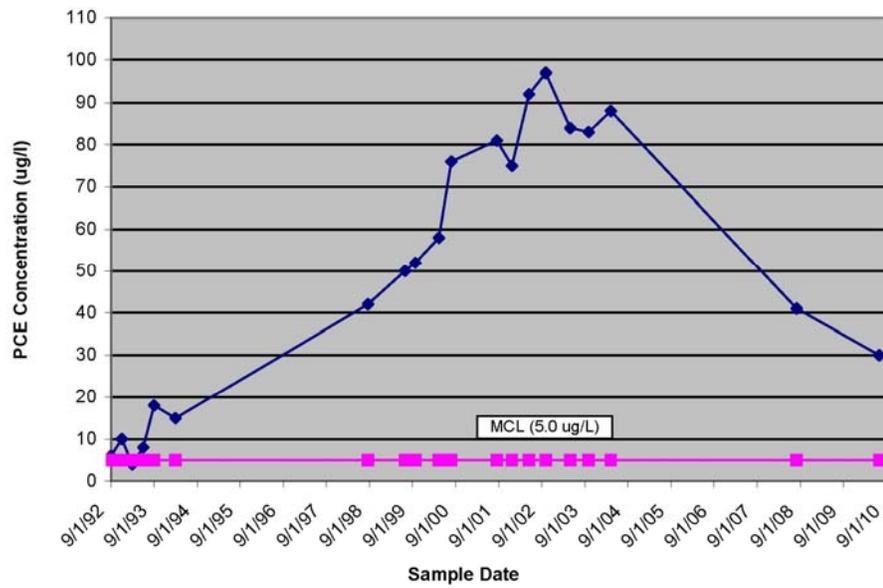


- The future concentration of PCE in groundwater will decrease over time and is expected to meet the Water Quality Objective for PCE (MCL of 5.0 µg/l) within a reasonable timeframe.
- Based on the fact that PCE concentrations in Monitoring Well 9W-07A have decreased to 30 µg/l (2010) from a historical high of 97 µg/l in 1992, attainment of Water Quality Objectives could take between four years (based on a linear regression of PCE concentration trends) to approximately 65 years (using a highly conservative site-specific half-life of PCE in groundwater of 15 years).

# Summary



Water Quality Hydrograph  
PCE Concentrations Reported In Groundwater From  
Monitoring Well 9W-07A



**IR Site 1116**  
**14 Area Groundwater**  
**Engineering Evaluation/Cost Analysis**  
**FFA Meeting - May 19, 2011**

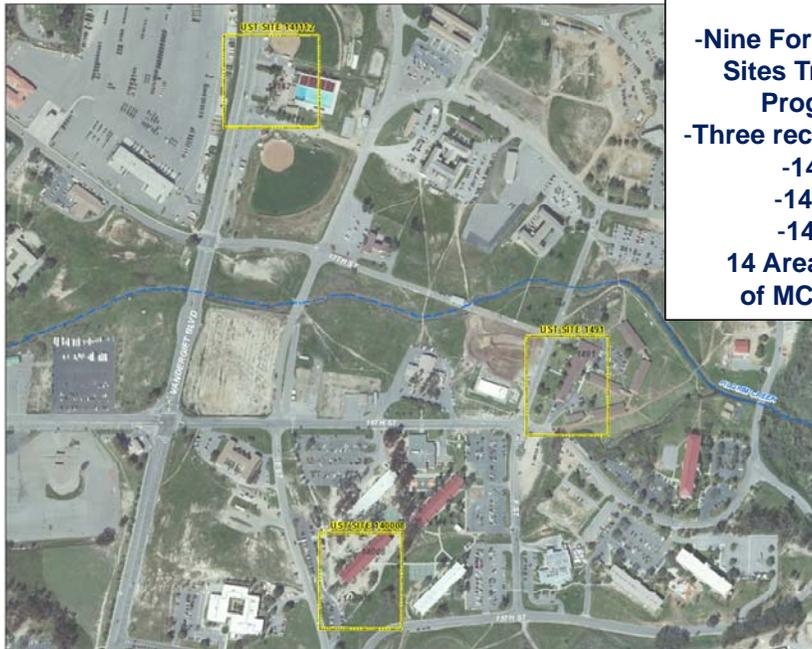
**MCB Camp Pendleton**

**Presentation Overview**



- I. Background Information**
  - A. Former UST Site 1491**
  - B. Former UST Site 14112**
  - C. Former UST Site 140008**
- II. Risk Evaluation**
- III. Technology Screening**
- IV. Analysis and Selection of Removal Action Alternatives**
- V. Next Steps**

# I. Background Information



**IR Site 1116**  
 -Nine Former Heating Fuel UST Sites Transferred from UST Program, March 2007  
 -Three recommended for NTCRA:  
 -14112 (Rec. Pool)  
 -1491 (Admin Bldg)  
 -140008 (Barracks)  
 14 Area, Southeast portion of MCB Camp Pendleton

# I. Background Information



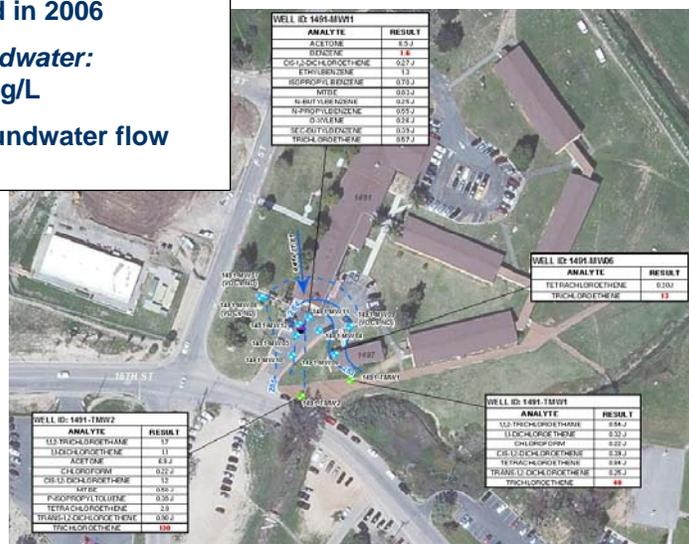
## Former UST Site 1491

- Two 1,000-gal USTs removed in 1991
- 690 cy soil removed in 2006

*Jan/Feb 2010 groundwater:  
 TCE up to 130 ug/L*

- Historically variable groundwater flow direction

**Remaining Contaminants**  
 TPH-d and TCE  
 -Soil and groundwater beneath utilities and building  
 - Downgradient groundwater



# I. Background Information



## Former UST Site 14112

- Two USTs (1943) removed in 1997
- No impacted soil removal to date

Jan/Feb 2010 groundwater:  
 Benzene up to 23 ug/L  
 1,2-DCA up to 0.65 ug/L  
 cis-1,2-DCE up to 6.9 ug/L  
 TCE up to 6.6 ug/L

### Remaining Contaminants

- Former UST cavity,
- Substantial area and thickness of free product TPH, benzene, low concentration CVOCs
- Utilities and slope area complicate access

# I. Background Information



## Former UST Site 140008

- UST removed in 1995;
- No TPH impacts in UST cavity

Jan/Feb 2010 groundwater:  
 TCE up to 16 ug/L

### Remaining Contaminants

- Free product TPH in RW-1
- Unknown source near RW-1
- Presumed CVOC co-contaminant in free product; elevated CVOC detection limits during assessment of RW-1 area limited data quality

## II. Risk Evaluation



### Former UST Site 1491: Carcinogenic total risk estimate of $\sim 1 \times 10^{-4}$

Potable use of groundwater (benzene, PCE, 1,1,2-TCA, and TCE)  $> 1 \times 10^{-6}$

Vapor intrusion (TCE)  $> 1 \times 10^{-6}$

Direct soil exposure  $< 1 \times 10^{-6}$

HI  $< 1.0$

### Former UST Site 14112: Carcinogenic total risk estimate of $\sim 1 \times 10^{-3}$

Potable use of groundwater (benzene, chloroform, 1,2-DCA, ethylbenzene, naphthalene, PCE, and TCE)  $\sim 1 \times 10^{-3}$

Vapor intrusion  $\sim 4 \times 10^{-6}$

HI = 36 (naphthalene = 31)

### Former UST Site 140008: Carcinogenic total risk estimate of $\sim 1 \times 10^{-5}$

Potable use of groundwater (PCE, TCE)  $\sim 1 \times 10^{-5}$

Vapor intrusion  $< 1 \times 10^{-6}$

Direct soil exposure  $< 1 \times 10^{-6}$

HI  $< 1.0$

Site 1116 Ecological Receptors: [VOCs]  $<$  NRAWQC for Freshwater Aquatic Life

## III. Technology Screening



### Technologies Considered Retained/Rejected

- Excavation
- In-Situ Enhanced Anaerobic Bioremediation (EISB)
- Groundwater/Free Product (PSH) Extraction
- Monitored Natural Attenuation\* (MNA)
- In-Situ Thermal Treatment
- Air Sparging/Soil Vapor Extraction
- Zero Valent Iron
- Enhanced Aerobic Bioremediation
- In-Situ Chemical Oxidation

\* Monitored natural attenuation considered for evaluation of full life-cycle costs of removal actions.

## IV. Analyses and Selection of RA



### Considerations (all sites):

- Relatively low permeability of soil
- Shallow groundwater
- Accessibility issues from utilities, structures, and/or topography

## IV. Analyses and Selection of RA



### Former UST Site 1491

Criterion	1491-1 No Action	1491-2 Source Excavation & MNA*	1491-3 Source Excavation & EISB	1491-4 Source Excavation & ISCO
Short-term effectiveness	Low	Low	Moderate	Moderate
Long-term effectiveness and permanence	Low	Low	Moderate to High	Moderate
Reduction of toxicity, mobility and volume through treatment	Low	Low	Moderate to High	Moderate
Implementability	High	Moderate to High	Moderate	Moderate
Overall protection of human health and the environment	Low	Low	Moderate to High	Moderate
Compliance with ARARs	N/A	High	High	High
Cost	\$0	\$719,000	\$761,000	\$748,000
State (Support Agency) Acceptance	TBA	TBA	TBA	TBA
Community Acceptance	TBA	TBA	TBA	TBA

EISB – Enhanced In-Situ Anaerobic Bioremediation

ISCO – In-Situ Chemical Oxidation

N/A – Not Applicable

TBA – To be addressed following agency/public review

\* Monitored natural attenuation considered for evaluation of full life-cycle costs

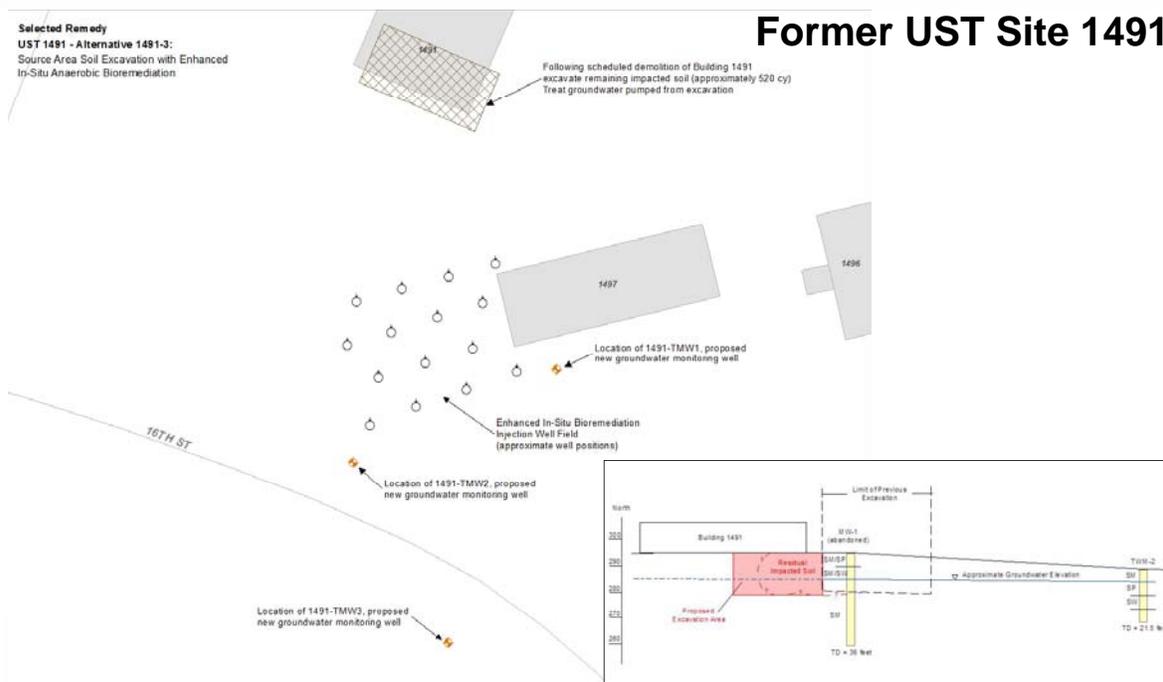


# IV. Analyses and Selection of RA



**Selected Remedy**  
**UST 1491 - Alternative 1491-3:**  
 Source Area Soil Excavation with Enhanced In-Situ Anaerobic Bioremediation

## Former UST Site 1491



# IV. Analyses and Selection of RA



## Former UST Site 14112

Criterion	14112-1 No Action	14112-2 Source Excavation & DPE + MNA*	14112-3 Source Excavation & PSH Extraction + MNA	14112-4 Alternative 2 or 3 with downgradient EISB
Short-term effectiveness	Low	Moderate to High	Moderate	Moderate to High
Long-term effectiveness and permanence	Low	Moderate to High	Low to Moderate	Moderate to High
Reduction of toxicity, mobility and volume through treatment	Low	Moderate to High	Low to Moderate	Moderate to High
Implementability	High	Moderate	Moderate	Low to Moderate
Overall protection of human health and the environment	Low	Moderate to High	Low to Moderate	Moderate to High
Compliance with ARARs	N/A	High	High	High
Cost	\$0	\$1,876,000	\$1,462,000	\$2,256,000
State (Support Agency) Acceptance	TBA	TBA	TBA	TBA
Community Acceptance	TBA	TBA	TBA	TBA

Alt. 14112-3 – Automated Pump PSH Extraction  
 DPE – Dual-Phase Extraction (vapor/vacuum/PSH)  
 EISB – Enhanced In-Situ Anaerobic Bioremediation  
 N/A – Not Applicable  
 TBA – To be addressed following agency/public review

\* Monitored natural attenuation considered for evaluation of full life-cycle costs

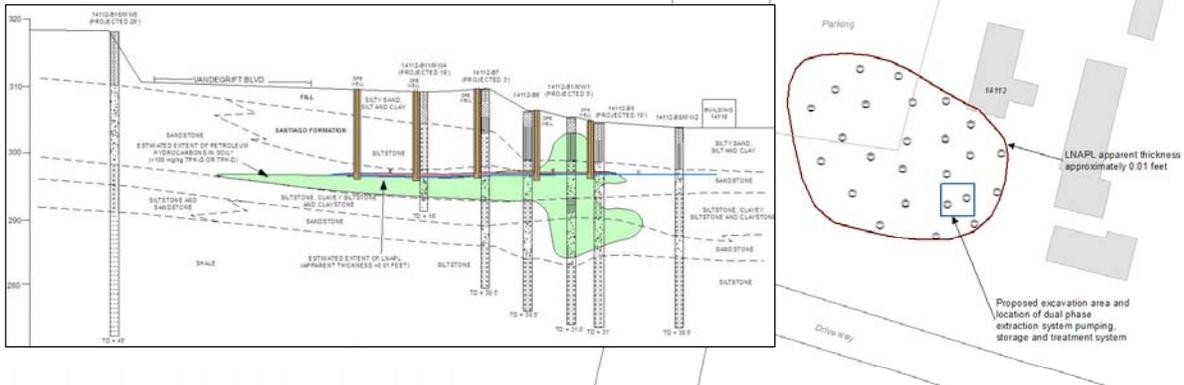


# IV. Analyses and Selection of RA



## Former UST Site 14112

**Selected Remedy**  
**UST 14112 - Alternative 14112-2:**  
 Source Area Excavation with Dual  
 Phase Extraction and MNA



# IV. Analyses and Selection of RA



## Former UST Site 140008

Criterion	140008-1 No Action	140008-2 MNA*	140008-3 Source Excavation & MNA*	140008-4 Source Excavation & EISB
Short-term effectiveness	Low	Low	Moderate	Moderate
Long-term effectiveness and permanence	Low	Low to Moderate	Moderate to High	Moderate to High
Reduction of toxicity, mobility and volume through treatment	Low	Low to Moderate	Moderate	Moderate to High
Implementability	High	High	High	Moderate
Overall protection of human health and the environment	Low	Low to Moderate	Moderate to High	Moderate to High
Compliance with ARARs	N/A(1)	High	High	High
Cost	\$0	\$486,000	\$478,000	\$611,000
State (Support Agency) Acceptance	TBA	TBA	TBA	TBA
Community Acceptance	TBA	TBA	TBA	TBA



EISB – Enhanced In-Situ Anaerobic Bioremediation  
 MNA – Monitored Natural Attenuation  
 N/A – Not Applicable  
 TBA – To be addressed following agency/public review  
 \* Monitored natural attenuation considered for evaluation of full life-cycle costs

# IV. Analyses and Selection of RA



## Former UST Site 140008

Selected Remedy  
UST 140008 - Alternative 140008-3  
Source Area Excavation and MNA

