

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION**

**TECHNICAL REPORT FOR
ADDENDUM NO. 2 TO
CLEANUP AND ABATEMENT ORDER NO. 88-89**

**SINGER COMPANY ELECTRONIC SYSTEMS DIVISION
BAE SYSTEMS INFORMATION AND ELECTRONIC SYSTEMS INTEGRATION, INC.**

FORMER BAE SYSTEMS AEROSPACE SAN MARCOS FACILITY

**1370 SAN MARCOS BOULEVARD, SAN MARCOS, CALIFORNIA
SAN DIEGO COUNTY**

1. **SUPPORTING DOCUMENTS.** The findings in Addendum No. 2 are supported by the following documents:
 - a. Semi-Annual 2012 Groundwater Monitoring and Remedial Progress Report. Arcadis U.S. Inc., January 31, 2013.
 - b. BAE San Marcos – soil gas data. Email from Robert Ruscitto of Arcadis U.S., Inc. to Vicente Rodriguez of the San Diego Water Board. Arcadis U.S. Inc., July 31, 2012.
 - c. Annual 2012 Groundwater Monitoring and Remedial Progress Report. Arcadis U.S. Inc., July 31, 2012.
 - d. Request to Update Corrective Action Order Soil Cleanup Levels for Metals 1370 San Marcos Boulevard, San Marcos, California. SMC: 50-0556.05. Letter from Robert Ruscitto of Arcadis U.S., Inc. to Vicente Rodriguez of the San Diego Water Board. Arcadis U.S., Inc. May 7, 2012.
 - e. Economic Feasibility of the Proposed Vinyl Chloride Risk Based Cleanup Level (RBCL). Former BAE SYSTEMS Information and Electronic Systems Integration, Inc., Site, San Marcos, California, RWQCB SMC: 50-0556.05. Arcadis U.S. Inc., November 10, 2011.
 - f. Report on Vinyl Chloride Behavior Characterization and Proposed Revision to Risk Based Cleanup Levels (Vinyl Chloride Report). Former BAE SYSTEMS Information and Electronic Systems Integration, Inc., Site, San Marcos, California, RWQCB SMC: 50-0556.05. Arcadis U.S. Inc., September 29, 2009.

SITE REMEDIATION HISTORY

2. **ON-SITE SOIL REMEDIAL ACTIVITIES**

Soil remedial activities have included multiple on-site excavations to remove soil impacted with constituents of concern (COCs). These COCs include metals (primarily chromium, hexavalent chromium and lead) and volatile organic compounds (VOCs: 1,1,1-trichloroethane [1,1,1-TCA] and trichloroethene [TCE] and their daughter products, and 1,4-dioxane). Finding 3 of Addendum 1 states that the soil cleanup levels required in the CAO were achieved on-site. The cleanup of the offsite soil is addressed in items 7-9 in this Technical Report.

3. **GROUNDWATER TREATMENT**

Groundwater treatment has consisted of installation and operation of a groundwater extraction system to remove metals and VOCs; installation of pilot scale and full-scale carbon injection programs utilizing enhanced reductive dechlorination (ERD) via an in-situ Reactive Zone (IRZ) to treat chlorinated VOCs (CVOCs); and, ambient monitored natural attenuation processes. These remedial activities have reduced CVOC concentrations in groundwater.

4. **IN-SITU REACTIVE ZONE**

The discharger conducted an IRZ pilot test from September 2002 to June 2006. IRZ technology was proposed to promote ERD of chlorinated compounds at the site. During the IRZ pilot test, a total of approximately 20,200 gallons of carbon amendment solution, consisting of molasses, corn syrup, or emulsified vegetable oil (EVO), was injected into the subsurface, and bioaugmentation was performed in two monitoring wells in July 2005. Based on the successful results of the pilot test, a full-scale IRZ program was implemented at the site in October 2006. A summary of all injection activities associated with the full-scale IRZ is presented in Table 1 below.

Table 1. Summary of Full-Scale Injections

Injection Event	Start Date	End Date	Volume Injected (gallons)	Injection Solution	Area Treated*	Number of Wells
1st	10/26/2006	11/9/2006	27,791	1% Corn Syrup	S	25
2nd	12/6/2006	12/14/2006	8,116	1-3% Corn Syrup	DG	25
3rd	6/5/2007	6/19/2007	28,551	2% Corn Syrup	S	25
4th	7/3/2007	7/11/2007	12,560	5% Emulsified Oil	DG	25
5th	11/28/2007	12/13/2007	24,374	2% Corn Syrup	S	24
6th	5/8/2008	5/20/2008	19,412	1% Corn Syrup	S	21
7th	10/7/2008	10/16/2008	20,798	1% Corn Syrup	S	23
8th	5/19/2009	6/1/2009	16,560	1% Corn Syrup	S	18
9th	10/20/2009	11/5/2009	33,746	1.5% Corn Syrup	S/DG	35
10th	3/9/2010	3/12/2010	7,350	1.5% Corn Syrup	DG	9
11th	5/24/2010	6/10/2010	31,058	1.5% Corn Syrup	S/DG	33
12th	8/23/2010	8/27/2010	8,564	1.5% Corn Syrup	DG	8
13th	11/1/2010	11/17/2010	28,744	1.5% Corn Syrup	S/DG	29
14th	2/28/2011	3/3/2011	5,206	1.5% Corn Syrup	DG	4
15th	5/31/2011	6/8/2011	13,253	1.5% Corn Syrup	S/DG	12
Total Volume Injected to Date			286,083			

*S = Source
 DG = Down-Gradient

5. VINYL CHLORIDE

In September 2009, the Vinyl Chloride Report was submitted to the San Diego Water Board with the purpose of documenting the observed behavior of vinyl chloride. Specifically, this report evaluated vinyl chloride production and occurrence in soil-gas as a result of its occurrence in groundwater. The Vinyl Chloride Report proposed a revised Risk Based Cleanup Level (RBCL) for vinyl chloride in groundwater.

Comparisons of vinyl chloride soil gas concentrations with groundwater concentration indicate that a vinyl chloride Risk Based Cleanup Level (RBCL) of 1,000 µg/L is protective of site receptors. The most recent sampling results are listed in Table 2 below.

Table 2. Soil Gas and Ground Water Most Recent Sampling Results for Vinyl Chloride

Location		Date & Results (µg/L)						
		2/2011	5/2011	8/2011	10/2011	6/2012	9/2012	12/2012
Soil Gas	VP4 ¹						0.1330	RL 0.0039
Soil Gas	VP4 ¹ (DUP)						0.1380	0.0177
Ground Water	IRZ-26 ²	2500	4400		2700	15000		17000
Soil Gas	VP5 ¹						5.0400	1.6000
Ground Water	MW-9 ³	170	200	250	110	7.5		< 5.0 ^L
Soil Gas	VP6 ¹						RL 0.00416	RL 0.00417
Ground Water	MW-5 ⁴	660	950		650	600		420
Soil Gas	VP7 ¹						0.1310	0.1330
Ground Water	IRZ-36 ⁵	330 ^J	320 ^J	< 2500	< 5000	<2500		<2000

1 - Semi-Annual 2012 Groundwater Monitoring and Remedial Progress Report. Arcadis U.S. Inc., January 31, 2013. Appendix E, September 28, 2012 Table E-1 and December 7, 2012 Table E-1

2 - Appendix D, page 6.

3 - Appendix D, Page 18.

4 - Appendix D, Page 15.

5 - Appendix D, Page 9.

J = Estimated value. Analyte detected at a level less than the reporting limit (RL) and greater than or equal to the method detection limit (MDL).

L = Laboratory control sample and/or laboratory control sample duplicate recovery was above the acceptance limits.

Analyte not detected.

RL = reporting limit

ALTERNATIVE CLEANUP LEVELS

6. ECONOMIC FEASIBILITY REPORT

The Economic Feasibility Report was prepared to evaluate the technological and economic feasibility with respect to modifying the current vinyl chloride RBCL of 9.07 µg/L to a proposed RBCL of 1,000 µg/L. The Economic Feasibility Report evaluated three scenarios:

Scenario 1 – ERD¹ with cleanup to current RBCLs: Assumes that active ERD will continue until cleanup below the current RBCLs² are achieved (estimated 8 years) at a cost of \$2.4 million.

¹ ERD - enhanced reductive dechlorination

² The current RBCL for vinyl chloride is 9.07 µg/L and was established in Addendum No.1 to CAO 88-89.

Scenario 2 – Focused Hot Spot ERD/Monitored Natural Attenuation (MNA): Assumes that localized ERD applications (two years), then post-remedial MNA to confirm declining trends (another 2 years), and then remedial natural attenuation with no active monitoring (RNA)³ will continue until cleanup below the proposed vinyl chloride RBCL of 1,000 µg/L is achieved at an estimated total cost of \$0.8 million.

Scenario 3 – MNA for 2 Years to conditional No Further Action (NFA): Assumes IRZ injections are halted, MNA to confirm declining trends (two years), then RNA will continue until cleanup below the proposed vinyl chloride RBCL of 1,000 µg/L is achieved at an estimated total cost of \$0.3 million.

The Economic Feasibility Report identifies and selects Scenario 3 as the most appropriate remedial alternative. Based on the analysis, the estimated quantity of VOC mass remaining within the groundwater footprint through the first half of 2011 was approximately one pound.

Vallecitos Water District

7. **OFFSITE IMPACTS**

Offsite impacts to shallow soil from copper, total chromium, and lead were previously identified at the adjacent property owned by the Vallecitos Water District (VWD). In the CAO soil cleanup levels were set for copper, chromium (as trivalent chromium), hexavalent chromium, and lead.

8. **BACKGROUND**

Metals in the soil were initially identified at the VWD property in the upper approximate one foot portion of soil. Subsequently, in 1995 soil excavation was performed at three locations on the VWD property, and approximately 330 cubic yards of metal impacted soil was removed. The site COCs detected at the VWD were copper, total chromium and lead. Volatile organic compounds were analyzed but not detected in soil. A portion of the soil contaminated with copper, chromium and lead with concentrations exceeding the 1988 CAO levels were not removed due to the presence of clean overburden soil that had been placed over some of the impacted area. This clean overburden creates a barrier between contaminated soil and receptors at the site. Based on confirmatory soil sampling following the initial excavation, the discharger estimated that approximately 480 cubic yards of metal impacted soil above 1988 CAO cleanup levels may remain on the VWD property.

³ (RNA) Remedial Natural Attenuation assumes ongoing natural attenuation with no further monitoring.

9. RATIONALE FOR UPDATED CLEANUP LEVELS FOR SOIL BASED ON CALIFORNIA SCREENING LEVELS

The cleanup levels in the CAO for copper, trivalent chromium and hexavalent chromium were 100, 98 and 5 milligrams per kilogram (mg/kg) respectively. A site specific, scientific or regulatory basis for the establishment of the soil cleanup levels was not provided in the findings of the CAO. Since the time that the CAO was adopted, relevant screening levels developed by regulatory agencies in California have been established based on more current conservative risk assessment and toxicological studies. Specific to metals, the California Human Health Screening Levels (CHHSLs) are widely accepted as appropriate screening levels for soil. In addition, since the VWD property is not owned by BAE Systems, the remaining COC concentrations should also be compared against Total Threshold Limit Concentrations (TTLCs; used in determining hazardous waste levels once soil has been removed from the site and ensures that remaining soil impacted with metals does not exceed a hazardous waste threshold). The 1988 CAO levels, CHHSLs and TTLCs are summarized in the following Table 3:

Table 3. Soil Cleanup Levels and Proposed Levels for Metals

Metal	1988 CAO Cleanup Level (mg/kg)	California Human Health Screening Levels		Total Threshold Limit Concentration (TTLC) (mg/kg)	Maximum Concentration in Remaining Soil (mg/kg)	Final Proposed Soil Cleanup Level (mg/kg)
		Residential (mg/kg)	Industrial (mg/kg)			
Copper	100	3,000	38,000	2,500	14,000	2,500
Lead	NA	80	320	1,000	500	80
Trivalent (total) Chromium	98	100,000	100,000	2,500	390	2,500
Hexavalent Chromium	5	17	37	500	<0.1	17

NA=Not Applicable; in the case of lead, no CAO cleanup level was set.

Even though the area is zoned for industrial uses, a more conservative revised soil cleanup levels will be based on the more stringent of residential CHHSLs or the TTLC: copper of 2,500 mg/kg based on TTLCs; lead of 80 mg/kg based on residential CHHSLs, chromium of 2,500 mg/kg based on TTLCs; and hexavalent chromium of 17 mg/kg based on residential CHHSLs.