Section 7

References, Related Experience & Examples of Work

The following project descriptions describe the CDM Team's experience negotiating agreements between multiple stakeholders to achieve a cooperative solution. A list of references follows the project descriptions and work examples are included at the end of this section.

Site Remediation Feasibility Study, *Sherwin-Williams Company*

Emeryville, Calif.

Team Members/Roles:

Pawan Sharma/Project Manager
Randy Smith/Project Advisor
Roger Olsen/Technical Advisor

Involved Firms:

Mara Feeney and Associates
WEST, Inc.

CDM is providing technical, regulatory, and programmatic support to a private industrial client that is under an enforceable regulatory order to remediate soil and groundwater impacted with arsenic, lead, and volatile organic compounds. The primary chemical of concern is arsenic. Residential lofts, a large commercial and retail center, and a biotechnology corporate campus now surround the active manufacturing site, operational since the early 1900s. The client is under pressure from the city to clean up the contamination, move out of town, and make room for new development.

Stakeholder Negotiation

Throughout each phase of this project, the CDM team worked extensively with the client, property owners, the DTSC, the City of Emeryville, surrounding community members, and other key stakeholders to ensure that the project was progressing appropriately and adhering to all regulatory requirements. The stakeholders participation was formalized through a Consultative Working Group (CWG) process. CDM led several CWG meetings over three years, from remedial investigation through the finalization remedial action plan. At each phase, CDM enabled the project stakeholders to align individual needs and interests into visions, goals, and actions collectively shared by the entire team. Each session provided invaluable in developing an efficient path to project success.

In addition, at each phase of the work, CDM with DTSC held community workshops to understand and subsequently respond to their concerns. CDM educated the community on the technical aspects of the project without use of

excessive technical jargon, and when needed provided clear and concise definitions. CDM also help several meeting without DTSC, as requested by individual community members and approved by the client. These meetings were critical in developing, not a trust, but a respect and understanding for the work being conducted. As appropriate and expected, the community's trust on the project was never something sought. Mr. Sharma was commended on multiple occasions for his presentation skills and willingness to engage the community.

Feasibility Study

As part of the feasibility study process for selecting a remedial action, CDM identified several data caps in the conceptual site model that had been developed for the site and in the remedial technology evaluation for arsenic. CDM developed work plans to address these data gaps, including a soil characterization study and treatability studies. The findings from these studies, particularly those related to determining arsenic speciation in source material, were used to develop and evaluate the effectiveness of a range of remedial action alternatives. The most cost-effective remedy involved focused removal of the arsenic source material followed with monitored natural attenuation for the remaining arsenic in saturated soil and groundwater.

Soil Characterization Study

The purpose of the investigation was to evaluate the fate and transport of arsenic and to develop a site conceptual model to support remedial alternative evaluations for the arsenic within the soils and groundwater at the site. As part of the study, subsurface soil samples were collected from borings located in different parts of the site: areas upgradient of the release area, within the release area, and at various distances downgradient of the release area.

The borings were continuously cored using direct push technology. Soil cores were retrieved from the borings in acetate sleeves that fit inside the drilling rods. Soil samples were collected by cutting a portion of the acetate sleeve and capping both ends. The samples were then flash-frozen through immersion into a liquid nitrogen bath and placed in a cooler with dry ice. This was done in order to minimize the amount of void space present in the sample and possible changes in the arsenic phases from exposure to oxygen.

The samples were sent to the CDM Geophysical Laboratory (CDM-Denver, CO) for sample analysis. The analyses included X-ray fluorescence, electron microprobe, sequential leaching, and X-ray diffraction. Based on these results, the conceptual site model was refined to include processes which had been observed within the site -- natural attenuation of arsenic – and supported the evaluation of remedial options to enhance natural attenuation.

In Situ Soil Treatment Treatability Study

As part of the Treatability Studies, CDM conducted an in situ soil treatment study at the CDM Geotechnical Laboratory (CDM-Cambridge, MA) using bench-scale testing. The objectives of the tests were to determine:

- Whether soil mixing or grouting could decrease the overall permeability of a saturated 20-foot thick soil zone contaminated with arsenic and lead
- Whether there were potential for incompatibilities between the treatment additives and site soils and groundwater
- Whether a change in geochemical conditions in the treated soils could result in an increase in mobility of the contaminants from saturated soil to groundwater.

CDM used a tiered approach to the bench scale study. The first step was to prepare and testing grout mixes (different combinations and dosages of ultra-fine cement and bentonite additives). These were mixed with either site groundwater or potable water to monitor for potential incompatibilities. These mixes that were determined to be ineffective were screened out. The selected grouts were then blended with representative composites of site soils and site waters and tested using various water:cement ratios and volume of grout:volume of soil ratios. After being allowed to set up, the mixes were tested for permeability using both potable water and site groundwater to check for

potential incompatibilities. Successful mixes were then tested on a field pilot scale and evaluated, through soil mixing and grout injection.

CDM designed the field pilot testing to include a permeation grouting of a small test section of the footprint that required remediation. The field program required a grouting contractor to grout a 25-hole grid with 3-foot spacing using various ratios of water:ultrafine cement, depending on the grout take. CDM oversaw the field pilot activities and worked with the grouting contractor to adjust the activities based on early field testing results.

CDM summarized the study in technical memoranda to the client and recommended a soil mix remedy based on the results of the field permeation grouting. In order to include soil mixing as a remedy to be evaluated during the feasibility study, CDM prepared a paper to the regulators on behalf of the client summarizing the history and effectiveness of soil mixing on various projects in the United States and world wide.

In Situ Groundwater Treatment Treatability Study

As part of the Treatability Studies, CDM conducted an in situ groundwater treatment study at the CDM Treatability Laboratory (CDM-Bellevue, WA) on a bench-scale level to determine the effectiveness of several materials or processes for the adsorption/precipitation of arsenic. The materials included iron-rich taconite sand, zero-valent iron, steel furnace slag, and two propriety arsenic adsorption media.

CDM performed three phases of treatability testing: laboratory, bench, and field pilot. Under laboratory testing each of the materials was expected to remove arsenic via a different combination of passive removal methods: physical adsorption, chemical precipitation using iron-containing materials, and biologically-induced precipitation as arsenic sulfide using electron donor and sulfate. Data from the initial bench-scale testing was used to implement a four-month column study at the site, using two different column sizes, groundwater from two wells, and six different mixtures of reactive material. These mixtures included zero-valent iron and other iron-containing material, mulch as an electron donor material, sulfate sources, and sand.

Passive removal methods were compared against pilot-scale treatment of the same groundwater sources, using active chemical precipitation. In this process, ferric chloride was added to provide the iron required for formation of ferric iron oxyhydroxides, which were expected to promote co-precipitation with or adsorption of the arsenic present in groundwater. Other chemicals, such as polymer (settling aid), sodium hydroxide (pH adjustment), and chemical oxidant (organo-arsenic complex disruption) were used to optimize arsenic removal.

Analysis of operational data demonstrated that the most significant arsenic removal was accomplished in the passive columns containing zero-valent iron. The presence of mulch as an electron donor yielded very positive but inconsistent results with respect to the number of pore volumes successfully treated. The active process effectively precipitated arsenic from groundwater. Other parameters critical to full-scale implementation, such as aquifer plugging and hydrogen sulfide generation, were also monitored and evaluated as part of this study.

Environmental Consulting Services for Site Remediation, *Confidential Client*

Sunnyvale, Calif.

Team Members/Roles:

Pawan Sharma/Project Manager
Vibhav Mankad/Project Engineer
Peggy Bloisa/Project Geologist
Kassandra Tzou/Risk Assessment

Involved Firms:

N/A

Over the last seven years, CDM has been implementing in situ bioremediation at this superfund site to reduce VOC concentrations in groundwater. The groundwater is impacted by both upgradient and onsite releases. Through initial efforts in the onsite source area, we have successfully demonstrated that in situ bioremediation is a technology capable of reducing VOC concentrations to background levels. We are now expanding the in situ bioremediation area to include additional downgradient portions of the site. This approach is on target to provide a faster and lower cost solution than the pump-and-treat system that was in place when CDM inherited the project. Given the success of in situ bioremediation, the pump and treat system has been completely shut down for the last five years. We are currently in negotiation with EPA to amend the ROD and officially change the selected groundwater remedy from pump and treat to in situ bioremediation.

CDM began remediation operations in 1997 with the objective of shutting down the existing pump and treat system and installing an in-situ remediation program for both impacted aquifers (Zone A and Zone B1). In October 1999, CDM evaluated natural attenuation and chemical oxidation. The natural attenuation evaluation considered whether reductive dechlorination was contributing to the attenuation of TCE across the site, and if so, whether the rate and completeness of dechlorination could be enhanced.

The objective of the chemical oxidation study was to evaluate the effectiveness of an in situ oxidation-catalyst process to remediate TCE in groundwater and soil samples collected from Zone A. Results of the groundwater and slurry tests indicated over 98% removal of TCE without production of lasting degradation products. Based on the control samples, only a small portion of the removal was due to test dilution and volatilization.

In October 2000, CDM initiated an enhanced anaerobic biodegradation (EAB) application in Zone B1 within and immediately downgradient of the former source area by injecting two types of Hydrogen Release Compound® (HRC). Approximately 1,200 pounds of the slow-releasing HRC and 1,200 pounds of the fast-releasing HRC were injected into 29 temporary boreholes constructed with direct push technology. The purpose of injecting both types of HRC products was to provide an immediate and long-term sustained transformation of the aquifer geochemistry to methanogenic conditions.

The primary intent of the EAB application was to inject HRC only into Zone B1; however, a small portion of HRC was also injected into Zone A. In January 2001, CDM investigated the effects of the HRC within Zone A and concluded that the limited amount of HRC had significantly changed conditions within the aquifer to support EAB. Based on these data, CDM expanded the EAB application to include Zone A in lieu of in situ chemical oxidation, and injected approximately 3,300 pounds of slow-releasing HRC at 30 additional locations targeting Zone A.

Since the injection of HRC, TCE concentrations have been reduced by 99% in the treatment area in both Zones A and B1, and are three orders of magnitude less than upgradient offsite groundwater concentrations. The decrease in TCE is supported by the temporary increase in its degradation compounds and the observed endpoint (i.e., ethene). Four years after HRC injection, methanogenic conditions and elevated levels of ethene continue to be observed in the source area in both Zones A and B1, indicating that complete dechlorination of TCE continues to occur.

In August 2007, the EAB treatment area was expanded to include an area further downgradient of the source area that continues to demonstrate elevated TCE concentrations. Instead of continued HRC injection in temporary holes, fresh cheese whey was selected as the electron donor and injected over four quarterly events into nine temporary injection wells, spaced on 10-foot centers. The wells were of 1.5-inch design and constructed using direct push

technology. Cheese whey was determined to be a more, cost effective electron donor in this downgradient area with lower TCE concentrations than the former source area.

Between the first and second cheese whey injection events, a one-time bioaugmentation injection event was conducted at these nine wells. Approximately 120 gallons of well water from the treated former source area was injected into each well to introduce indigenous dechlorinating microorganisms. At these wells, the water was injected under minimal pressure (less than 20 psi) and pushed into the formation within a couple of hours after being extracted. To minimize negative effects to the microbes from mechanical stress or oxygen exposure, the groundwater was extracted using a peristaltic pump and injected using compressed argon gas.

A long-term benefit from source area bioremediation has been an increased rate of natural attenuation of TCE across the downgradient portion of the plume, outside of the influence of the HRC and whey injections. Over the last six years, the first order attenuation rate constant for TCE at downgradient site property has increased from approximately 0.013 to 0.19 day-1, with concentrations of TCE being sustained at levels less than background (i.e., levels present in wells upgradient and crossgradient that are impacted by upgradient TCE releases not associated with the site.)

The EAB program paid for itself within a year from lowered site operating costs due to the shutdown of the existing pump and treat system. Compared to continued pump and treat, the EAB program is expected to provide project life-cycle cost savings of over $2 million.

The effective cleanup of the source area allowed the property owner to redevelop the property and expand the office building onto areas around the source area. On behalf of the property owner, who was not the client / responsible party, in order to secure redevelopment approval, Mr. Sharma met with the City redevelopment agency and presented at a City council meeting regarding the effectiveness of the cleanup and land use controls being implemented, assure them that long-term protection of future building occupants was critical concern of the client.

The site plume co-mingles with two other plumes in downgradient areas. CDM provided technical expertise to the client and their outside counsel to successfully negotiate a reduction in remediation responsibility from 13 to 7 percent for the off-site contamination. CDM provided extensive assistance to the client in the negotiation toward the implementation of consensus-driven remediation program for the co-mingled portion of the plume.

Fresno Sanitary Landfill Remedial Investigation/ Feasibility Study, Remedial Design, and Remedial Construction, *City of Frenso*

Fresno, Calif.

Team Members/Roles:

Yash Nyznyk/Project Manager
Kassandra Tzou/Risk Assessment

Involved Firms:

N/A

The Fresno Sanitary Landfill (FSL) is a 145-acre landfill that was operated from 1937 to 1989 as a disposal facility for municipal waste. CDM was contracted by the City of Fresno (City) to perform the remedial investigation and feasibility study (RI/FS) for the FSL, in accordance with requirements set forth by USEPA's Superfund program. Since this initial work on the project, CDM has had the opportunity to participate throughout the full lifecycle of this Superfund project, from initial remedial investigation activities through the implementation of remedial actions.

CDM has been responsible for a range of services on this project. Highlights are presented below

- **Negotiations Support** – Of importance to the success of the project, CDM has provided negotiations support to the City in their ongoing interactions with USEPA, including development of the Consent Decree language governing the remedial design/remedial action at the landfill site. Additionally, during development of the

remedial objectives for the Site, CDM successfully negotiated an alternative cleanup goal for the groundwater remedial action.

- **Phased Implementation of Groundwater Remedial Acton** – CDM demonstrated creativity by developing the concept of phased implementation of remedial action. Nationally, this was the first USEPA approval for this concept in a Record of Decision. It is estimated that this approach could result in a cost savings of almost $10M over the 30-year life of the groundwater remedial action.
- **Groundwater Modeling** – CDM developed and is utilizing three-dimensional finite element groundwater model, using CDM's proprietary DYN-system of flow and contaminant transport code, to better understand hydrogeologic flow conditions and to predict the fate of contaminants in groundwater over time. Using the model, CDM has employed recent USEPA guidance in evaluating target capture zones as part of periodic evaluation of the groundwater remediation system performance. This has allowed incremental refinement of the system, leading to cost-effectiveness in operation of the ongoing remedial action.
- **Well Decommissioning Program** – CDM developed a well decommissioning program designed to remove from service agricultural water supply wells, monitoring wells, and residential wells within the plume boundary that were not contributing to the goal of aquifer restoration at the Site.

Remedial Action Implementation Plan, *Potrero Hills Facility*

Fairfield, Calif.

Team Members/Roles:

Yash Nyznyk/Project Manager

Involved Firms:

N/A

Since 1999, CDM has provided a range of environmental management services for the Potrero Hills Site, an explosives testing facility located adjacent to the Travis Air Force base in Fairfield, CA. CDM activities at the Site, including site assessment through remediation of soil contamination through ongoing monitoring and evaluation of groundwater impacts.

The initial work involved characterization and evaluation of soil and groundwater to assess impacts from explosives testing activities that had been performed on-site. A range of contaminants were identified the at the Site, including metals, chlorinated volatile organic compounds, and perchlorate. In response to a final site cleanup and rescission order adopted by the RWQCB, CDM was tasked with preparing a remedial action implementation plan (RAIP) for remediation of metals-impacted soils. Although there were a number of metals constituents, lead was the metal detected at the highest concentrations and at the greatest lateral and vertical extent. A critical element of CDM's work was successful negotiations with the RWQCB to obtain approval for a risk-based cleanup level for addressing soil impacts. CDM also performed a treatability study to establish the method for lead stabilization in excavated soil.

Following approval by the RWQCB for the RAIP, CDM prepared bid documents to guide the site remediation work. Another important element of the soil excavation activities involved pre-screening and testing of soil areas targeted for remediation for munitions and explosives of concern. CDM served in an oversight role during construction, responsible for monitoring air quality during construction activities, collecting confirmatory soil samples to ensure compliance with the risk-based cleanup standards, regulatory agency interactions throughout the remedial action, and weekly reporting. As part of the response to the Water Board Order, CDM prepared a document addressing Institutional Controls, including preparation of a deed restriction for the Site.

Ongoing work at the facility includes supplemental investigation related to VOC and perchlorate groundwater impacts at two different locations of the Site. Based on recent passive soil gas testing in the area of VOC impacts and data from several years of groundwater monitoring, CDM is in the process of moving forward with proposing closure of the area with VOC-impacted groundwater. We are encouraged by early negotiations with the RWQCB in our efforts to achieve low-risk closure of the VOC-impacted area of the Site.

Project References

We invite the City of Benicia to contact our project references. Below is the contact information for three projects that demonstrate our capabilities to perform the required tasks.

Client Reference

Project	Client	Contact Information
Fresno Sanitary Landfill	City of Fresno	George Slater, Program Manager (559) 960-8049
Remedial Action Implementation Plan	Potrero Hills Facility	Leonard Barton (801) 620-8287
Site Remediation Feasibility Study	Sherwin-Williams Company	Larry Mencin, Project Manager (216) 566-1768

Examples of work

The following pages include examples of our work that demonstrate our experience with these sorts of activities. Included are:

- City of Brisbane, Final Report of Findings Environmental Engineering Peer Review Baylands Remediation Efforts, Nov. 2, 2005
- AMCO Superfund Community Outreach Materials
- Sherwin-Williams Remedial Action Plan, June 11, 2010

CDM

Report for

City of Brisbane

Final Report of Findings Environmental Engineering Peer Review Baylands Remediation Efforts

November 2, 2005

CDM

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November 2, 2005

Mr. Randy Breault, P.E.
Director of Public Works
50 Park Place
Brisbane, California 94005-1310

Subject: Environmental Engineering Peer Review Report
Baylands Remediation Efforts, Brisbane, California

Dear Mr. Breault:

Camp Dresser & McKee Inc. (CDM) is pleased to submit our report presenting the results of CDM's Environmental Engineering Peer Review, Baylands Remediation Efforts, Brisbane, California, dated November 2, 2005. This report serves as an update to CDM's previous report titled "Revised Draft, Environmental Engineering Peer Review, Baylands Remediation Efforts, dated April 20, 2005." As requested by the City, this submittal includes 10 bound reports and one CD report in PDF format.

It has been a pleasure working with you and the City on this important project, please feel free to contact me at (925) 933-2900 with any questions or additional information needs.

Very truly yours,

Michael G. Gray, C.E.G.
Principal
Camp Dresser & McKee Inc.

CERTIFIED ENGINEERING GEOLOGIST
MICHAEL G. GRAY
No. 2002
Exp. 2/28/07
STATE OF CALIFORNIA

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