Reconnaissance Study Report
Simi Valley Perchlorate Study
Ventura County, California

Prepared for
United States Army Corps of Engineers
Los Angeles District

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Prepared by
CH2M HILL
3 Hutton Centre Drive, Suite 200
Santa Ana, California 92707
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### Appendix

A Perchlorate Sampling Results (CD ROM)

### Table

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## Acronyms and Abbreviations

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<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>µg/L</td>
<td>micrograms per liter</td>
</tr>
<tr>
<td>ac-ft</td>
<td>acre-foot/feet</td>
</tr>
<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
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<tr>
<td>DOE</td>
<td>Department of Energy</td>
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<tr>
<td>DTSC</td>
<td>Department of Toxic Substances Control</td>
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<tr>
<td>DWR</td>
<td>Department of Water Resources</td>
</tr>
<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
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<tr>
<td>FSDF</td>
<td>Former Sodium Disposal Facility</td>
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<tr>
<td>GSWC</td>
<td>Golden State Water Company</td>
</tr>
<tr>
<td>LARWQCB</td>
<td>Los Angeles Regional Water Quality Control Board</td>
</tr>
<tr>
<td>MCL</td>
<td>Maximum Contaminant Level</td>
</tr>
<tr>
<td>mg/kg</td>
<td>milligrams per kilogram</td>
</tr>
<tr>
<td>mg/L</td>
<td>milligrams per liter</td>
</tr>
<tr>
<td>mgd</td>
<td>million gallons per day</td>
</tr>
<tr>
<td>msl</td>
<td>mean sea level</td>
</tr>
<tr>
<td>MWH</td>
<td>Montgomery Watson Harza</td>
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<tr>
<td>NL</td>
<td>Notification Level</td>
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<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>PA</td>
<td>Preliminary Assessment</td>
</tr>
<tr>
<td>RFI</td>
<td>Resource Conservation and Recovery Act (RCRA) Facility Investigation</td>
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<tr>
<td>ROM</td>
<td>rough order-of-magnitude</td>
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<td>SSFL</td>
<td>Rocketdyne Santa Susana Field Laboratory</td>
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<tr>
<td>SWRB</td>
<td>State Water Resources Board</td>
</tr>
<tr>
<td>TDS</td>
<td>total dissolved solids</td>
</tr>
<tr>
<td>USACE</td>
<td>United States Army Corps of Engineers</td>
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1.0 Introduction

This report summarizes the reconnaissance study findings of the United States Army Corps of Engineers (USACE) Simi Valley Perchlorate Study. The purpose of the reconnaissance study is to determine if there is federal interest in further investigations of the perchlorate detected in groundwater in the City of Simi Valley. This work is performed under contract to USACE and is funded by the Department of Energy (DOE). Simi Valley is located in the southeastern portion of Ventura County, California, approximately 35 miles northwest of Los Angeles (Figure 1-1).

1.1 Background

Perchlorate has been detected in shallow monitoring wells in the City of Simi Valley during previous investigations that were conducted under the auspices of the Los Angeles Regional Water Quality Control Board (LARWQCB) and the Department of Toxic Substances Control (DTSC) (LARWQCB, 2003). The concentrations of perchlorate reported are less than 20 micrograms per liter (μg/L). The California Department of Health Services Drinking Water Notification Level (NL) for perchlorate is 6 μg/L; the proposed California Maximum Contaminant Level (MCL) for perchlorate is also 6 μg/L.

1.2 Approach and Scope of Work

The reconnaissance study was conducted generally in accordance with the United States Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Preliminary Assessment (PA) guidance (EPA, 1991). A CERCLA PA is designed to determine whether a site poses a threat to human health or the environment, and if it does pose a threat, whether further investigation is required. In the context of this study, the Simi Valley Groundwater Basin, as defined in California’s Groundwater, Bulletin 118 (Department of Water Resources [DWR], 2003), is the project site. Figure 1-2 shows the location of the basin.

Consistent with CERCLA PA guidance, the scope of work for the reconnaissance study consists of a review of existing information pertinent to the detection of perchlorate in Simi Valley. The types of information reviewed included the results of previous investigations of perchlorate in Simi Valley and other supporting information. Section 3.1 lists the documents reviewed for this work. The threshold for federal interest for this project is the need for additional characterization to better define the nature and extent of perchlorate in groundwater in the City of Simi Valley and to provide insight as to the migration pathways of the perchlorate detections.
1.3 Report Organization

This report includes the following sections:

Section 1 – Introduction: Provides a summary of the purpose of the report and the scope of the project.

Section 2 – Site Background: Provides a summary of background information.

Section 3 – Previous Investigations: Summarizes the findings of previous perchlorate investigations in the City of Simi Valley.

Section 4 – Summarizes federal interest in the project.

Section 5 – Additional Project Tasks: Provides a summary of the scope of additional project tasks.

Section 6 – References.
2.0 Site Background

This section presents a summary of background information on the Simi Valley Groundwater Basin. Figure 1-2 shows the location of the basin.

2.1 Land Use

Current land use in Simi Valley consists of a mixture of residential and commercial development, with limited light industrial facilities in the western end of the valley (Tabidian, 2006). In addition, a major rocket testing and nuclear-energy-related research facility, the Rocketdyne Santa Susana Field Laboratory (SSFL), is located in the Simi Hills on the south side of valley. Agricultural activities were the dominant land use in the valley until the 1960s (Tabidian, 2006).

2.2 Physiography and Climate

The Simi Valley Groundwater Basin consists of alluvial deposits on the floor of Simi Valley. The basin is bound on the north and northeast by the Santa Susana Mountains, and on the south and southwest by the Simi Hills. Surface elevations in the basin range from less than 700 feet above mean sea level (msl) at its western end to over 1,100 feet msl at its southern end (DWR, 2003).

The Simi Valley has cool, humid winters and warm, dry summers. The average yearly precipitation ranges from approximately 16 to 20 inches (DWR, 2003). Most precipitation occurs between November and March. Little or no precipitation occurs in the summer months.

2.3 Hydrology

The Arroyo Simi is the primary surface water feature in Simi Valley (Figure 1-2). The surface water in the Arroyo Simi flows from east to west along the valley, discharging into Arroyo Los Posas in the adjacent Los Posas Valley Groundwater Basin. The Arroyo Simi and its major tributaries are perennial effluent streams, whereas smaller tributaries and canyons that drain from the Santa Susana Mountains and Simi Hills are intermittent and ephemeral (Tabidian, 2006). In addition to local runoff, the Arroyo Simi receives approximately 10 million gallons per day (mgd) of discharge from a local wastewater treatment plant and an additional 3 mgd of discharge from a dewatering system, both of which are located in the western portion of the valley (Figure 1-2) (Tabidian, 2006).

2.4 Geologic Setting

The valley floor is composed of Quaternary alluvium eroded from the adjoining hills. The alluvial sediments are relatively thin in the eastern portion of the basin and thicken toward
the west end of the valley, where they achieve a maximum thickness of approximately 730 feet (DWR, 2003). The alluvial deposits are underlain by older, consolidated sedimentary rocks, which are exposed in the hills adjacent to the valley. Pleistocene through Miocene sedimentary rocks of the Saugus, Pico, Sisquoc, and Sespe Formation occur in the Santa Susana Mountains to the north. Sandstone, siltstone, and conglomerate of the Santa Susana and Chatsworth Formations are exposed in the Simi Hills to the south (Dibblee, 1992b).

2.5 Hydrogeology

The Quaternary alluvium is the primary aquifer unit in the Simi Valley Groundwater Basin. In the western portion of the valley, the alluvium can be separated into a shallow unconfined aquifer system and a deeper confined aquifer system (Tabidian, 2006). The alluvium is underlain and bounded by older consolidated sediments. Groundwater flow in the consolidated sediments is minor compared to that in the alluvial deposits and is thought to be limited to flow in fractured zones and in permeable lenses of sand and gravel (State Water Resources Board [SWRB], 1953). The depth to groundwater in the valley floor varies from approximately 5 to 25 feet (DWR, 2003). The storage capacity of the basin is estimated at 180,000 acre-feet (ac-ft) (DWR, 2003).

Groundwater tends to flow westward through the basin, following the course of the Arroyo Simi (DWR, 2003). Groundwater recharge to the alluvium occurs from direct precipitation, return flows, infiltration of flow in streams, and to a limited extent, by lateral subsurface inflow from flanking consolidated formations (SWRB, 1953; DWR, 2003). Groundwater discharge occurs as groundwater extraction, subsurface underflow, and locally in the western end of the basin, as rising groundwater (i.e., springs and seeps).

Annual groundwater extraction in the basin is estimated to be less than 5,500 ac-ft per year (DWR, 2003). Ventura County operates a dewatering system to lower groundwater levels in the western portion of the basin that includes five dewatering wells (Figure 1-2). The dewatering system extracts approximately 3,200 ac-ft per year of shallow groundwater and discharges to the Arroyo Simi (Tabidian, 2006). In addition, the Golden State Water Company (GSWC) operates two municipal supply wells in the central portion of the basin (i.e., Sycamore Well No. 3 and Niles Well No. 1) (Figure 1-2). In 2004, GSWC extracted approximately 840 ac-ft of groundwater from these wells (CH2M HILL, 2005). Before serving water produced from these wells, GSWC blends groundwater produced with imported water to improve its water quality.

The groundwater in the Simi Valley Groundwater Basin is characterized by elevated concentrations of total dissolved solids (TDS), sulfate, and other inorganic parameters. Most notably, TDS and sulfate have been detected at concentrations as high as 2,000 milligrams per liter (mg/L) and 990 mg/L, respectively, in groundwater produced from the dewatering wells (Tabidian, 2006). These results exceed the California Secondary MCL for TDS (1,000 mg/L) and sulfate (500 mg/L). The concentrations of perchlorate reported in groundwater in the Simi Valley Groundwater Basin are discussed Section 3.
3.0 Previous Investigations

This section provides a summary of the findings of previous perchlorate investigations in Simi Valley.

3.1 Documents Reviewed

CH2M HILL reviewed documents obtained from the LARWQCB perchlorate website (http://www.swrcb.ca.gov/rwqcb4/html/perchlorate.html#FactSheets), the DTSC website for SSFL (http://www.dtsc.ca.gov/SiteCleanup/Projects/Santa_Susana.cfm), and the Valley Public Library, which is a repository for SSFL documents. The following documents were reviewed as part of this reconnaissance study:

- **Supplemental Data Summary for the Water Quality Sampling and Analysis Plan** (Haley and Aldrich, Inc., 2003a)
- **Groundwater Monitoring Quarterly Report, Second Quarter 2003, April through June 2003, Santa Susana Field Laboratory, Ventura County, California** (Haley and Aldrich, Inc., 2003b)
- **Geologic Features and Their Potential Effects on Contaminant Migration, Santa Susana Field Laboratory** (Wilshire, 2006)
- **Land-use Conversion and Its Potential Impact on Stream/Aquifer Hydraulics and Perchlorate Distribution in Simi Valley, California** (Tabidian, 2006)
- **Occurrence of Perchlorate in Simi Valley** (LARWQCB, 2003)
- **Perchlorate Source Evaluation and Technical Report, Santa Susana Field Laboratory, Ventura County, California** (Montgomery Watson Harza [MWH], 2003a)
- **Spring and Seep Sampling and Analysis Report** (MWH, 2003b)
- **Perchlorate Characterization Work Plan, Santa Susana Field Laboratory, Ventura County, California** (MWH, 2003c)
- **Near Surface Groundwater Characterization Report** (MWH, 2003d)
- **Report of Results Phase I of Northeast Investigation Area Groundwater Characterization, Santa Susana Field Laboratory, Ventura County, California** (MWH, 2004)
- **Runkle Ranch Site Investigation, Final Report, Simi Valley, California** (Foster Wheeler Environmental Corporation, 1999)
3.0 PREVIOUS INVESTIGATIONS

- Santa Susana Field Laboratory: RCRA Facility Site Investigation (DTSC, 2002a and 2002b)

3.2 Summary Findings

The following sections summarize the findings of regional sampling activities conducted by DTSC and LARWQCB, as well as investigations conducted at SSFL. Figure 3-1 shows the locations of soil, groundwater, and surface water samples where perchlorate has been detected in Simi Valley. Figures (oversized plates) that provide more detail of the analytical results for each of these media are included in Appendix A on CD ROM.

3.2.1 Regional Investigations

DTSC and LARWQCB have conducted groundwater and surface water sampling in Simi Valley and tested the samples for perchlorate. The findings are summarized below:

- In 2002 and 2003, DTSC and LARWQCB collected surface water and groundwater samples from shallow monitoring wells (most are 20 feet deep or less) located on the floor of Simi Valley (DTSC, 2003). Of the 131 samples collected during the sampling events, perchlorate was detected in 18 groundwater samples. The concentrations of perchlorate detected in these samples ranged from 3.35 to 19.28 μg/L. Perchlorate was not detected in any of the surface water samples collected from the Arroyo Simi or its tributaries.

- In May 2003, DTSC collected six samples of surface water seeps in lawns and on sidewalks located in the southwestern portion of Simi Valley (DTSC, 2003). Perchlorate was detected in two of the samples. The reported concentrations ranged from 4.1 to 4.8 μg/L.

- In February 2003, Ventura County sampled the “Bathtub Well-1” (also referred to as the Brandise-Barden Well; Figure 3-1), which is located in the Simi Hills between SSFL and the floor of Simi Valley. The initial sampling results suggested that perchlorate was detected in this well. Later sampling by DTSC, however, produced conflicting results as to the presence of perchlorate in this well (DTSC, 2003).

- Perchlorate has been detected at trace concentrations in the two GSWC public water supply wells at concentrations less than the NL and proposed MCL (CH2M HILL, 2005). Refer to Figure A-1 in Appendix A (CD ROM) for additional details of the perchlorate analytical results for groundwater and surface water samples in Simi Valley.
Figure 3-1
Perchlorate Detections in Simi Valley
Simi Valley Reconnaissance Study

Source: DTSC (2003)

Notes:
1. Perchlorate detected in one sample. Perchlorate was not detected in seven subsequent samples.
2. Perchlorate detected in one sample. Perchlorate was not detected in two subsequent sampling events.
3. Samples collected about 1 mile north of this location.

Perchlorate concentration in micrograms per liter (groundwater and surface water), or micrograms per kilogram (soil)

Perchlorate Detected in Groundwater, Well or Spring

Area of high water and seeps

Brendelis Well
34-150 ppb

Building 359

Santa Susana Field Lab
3.2.2 Investigations at Rocketdyne Santa Susana Field Laboratory

SSFL straddles a topographic divide in the Simi Hills southeast of the valley (Figure 1-2). The facility is underlain by consolidated sedimentary rocks of the San Susana and Chatsworth Formations. Surface water runoff in the northern portion of SSFL flows into Meier Canyon, which leads to Simi Valley. Surface water runoff from the remaining portion of SSFL flows to the south.

Similarly, groundwater on the northern side of SSFL has a northerly flow component toward Simi Valley, and groundwater on the southern side of SSFL has a southerly component toward Adamson Ranch. DTSC is currently providing regulatory oversight of remedial activities at SSFL.

3.2.2.1 Historical Perchlorate Use

The use, storage, or disposal of perchlorate has been documented in the following areas at SSFL (MWH, 2003a):

- Building 359
- Happy Valley
- Former Sodium Disposal Facility (FSDF)
- The Compound A Facility RFI sites (Resource Conservation and Recovery Act Facility Investigation sites)

Figure 3-1 shows the locations of each of these areas. The FSDF is located in the watershed of Meier Canyon.

3.2.2.2 Perchlorate in Groundwater

A summary of perchlorate results for samples of groundwater, springs, and seeps collected at and near SSFL is presented below:

- Perchlorate has been detected in 14 shallow groundwater wells on SSFL. The reported concentrations range from 1.1 μg/L (well ES-12) to 480 μg/L (well ES-11) (MWH, 2003a).

- Perchlorate has been detected in 13 wells at SSFL that are completed in the Chatsworth Formation. The reported concentrations range from 1.8 μg/L (well RD-47) to 1,600 μg/L (well HAE-16, port 11) (MWH, 2003a; Haley and Aldrich, Inc., 2006).

- Perchlorate has not been detected in offsite wells near SSFL except for the conflicting results at the Bathtub Well-1 (as discussed above in Section 3.2.1), and one-time detections at RD-59D and OS-15 (MWH, 2003e).

Refer to Figures A-1 and A-2 in Appendix A (CD ROM) for additional details of the perchlorate analytical results for groundwater, seeps, and springs at and near SSFL.
3.2.2.3 Perchlorate in Surface Water

Since 1984, surface water at SSFL has been regulated under a National Pollutant Discharge Elimination System (NPDES) permit issued by the LARWQCB. Figure A-3 in Appendix A (CD ROM) shows the locations the NPDES sampling stations (outfalls) at SSFL. A summary of perchlorate results for NPDES compliance sampling at SSFL is presented below:

- Perchlorate was detected in 1 of the 29 samples collected at Outfall No. 6 between January 1998 and December 2002. The reported perchlorate concentration was 4.26 $\mu$g/L (MWH, 2003a). Outfall No. 6 is located at a tributary of Meier Canyon that drains the FSDF.

- Perchlorate was detected in 17 of the 24 samples collected at the Happy Valley outfall between January 1998 and December 2002. The reported concentrations range from 4.2 to 35.1 $\mu$g/L (MWH, 2003a).

- Perchlorate has not been detected in surface water samples from the remaining outfalls at SSFL.

Refer to Figures A-3 through A-5 in Appendix A (CD ROM) for additional details of the perchlorate analytical results for surface water samples collected at SSFL.

3.2.2.4 Perchlorate in Soil

A summary of perchlorate results for soil and soil leachate samples collected at and near SSFL is presented below:

- Most of the perchlorate detections in soil at SSFL have occurred in the Happy Valley/Building 359 area. The reported perchlorate concentrations range from 20 to 71,290 milligrams per kilogram (mg/kg).

- Perchlorate has not been detected in samples of soil or soil leachate collected offsite of SSFL, except for one sample. Perchlorate was detected at a concentration of 4.6 $\mu$g/L in leachate from one soil sample collected in Meier Canyon; however, perchlorate was not detected in seven additional samples collected at the same location (DTSC, 2003).

Refer to Figures A-2 through A-4 in Appendix A (CD ROM) for additional details of the perchlorate analytical results for soil and soil leachate samples collected at and near SSFL.

3.3 Current Understanding of Perchlorate Detections

The distribution of perchlorate detected in shallow groundwater in Simi Valley is sporadic and poorly defined (Figure 3-1; Figure A-1 in Appendix A [CD ROM]). Furthermore, the existing data are not sufficient to define either the nature or extent of perchlorate in the valley, or the migration pathways of the perchlorate detected in the valley. Potential sources of perchlorate in the valley that have been reported include SSFL (Tabidian, 2006), as well as regional nonpoint source contamination associated with fertilizer use, imported water, and the use of flares, fireworks, and explosives (MWH, 2003a).
4.0 Determination of Federal Interest

Based on the reconnaissance study, USACE has determined that there is federal interest for further characterization of perchlorate-impacted groundwater in the City of Simi Valley. As described previously, perchlorate has been detected in shallow groundwater in Simi Valley at concentrations that exceed its NL and proposed MCL; however, the nature and extent of perchlorate in groundwater are not well-defined. Therefore, there is need for additional characterization to define the nature and extent of perchlorate-impacted groundwater in Simi Valley and to provide further insight into the possible migration pathways of the perchlorate detected in the valley.
5.0 Additional Project Tasks

This section provides a summary of additional project tasks. Table 5-1 presents a summary of potential project tasks through the conceptual remedial design. Table 5-1 also includes rough order-of-magnitude (ROM) costs for the completion of the tasks, and the general assumptions used to estimate the ROM costs. Figure 5-1 shows a conceptual schedule for this work.

The initial task would include two rounds of groundwater sampling to confirm the results of previous perchlorate sampling in the valley. Groundwater samples would be analyzed for perchlorate by EPA Method 6850 and general groundwater quality parameters. EPA Method 6850 can be more reliable than EPA Method 314.1, which was used during the previous sampling events, because it has a lower Practical Quantitation Limit (generally 0.5 μg/L vs. 3.0 μg/L). In addition, EPA Method 6850 is known to be less prone to matrix interference at the elevated TDS concentrations that occur in Simi Valley (AMEC Earth and Environmental, 2004).

The decision to continue beyond the initial confirmation groundwater sampling would be made collectively with project stakeholders based in part on the findings of the confirmation sampling program. As summarized in Table 5-1, the additional project tasks would include two phases of remedial investigation, a baseline risk assessment, groundwater modeling, treatability testing, a feasibility study, the preparation of decision documents, and the preparation of the conceptual remedial design.
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<th>Major Task</th>
<th>Estimated Cost</th>
<th>Comments/Assumptions</th>
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<tr>
<td>Confirmation Groundwater Sampling</td>
<td>$150,000</td>
<td>Two sampling events, 23 wells (18 wells with previous perchlorate detections + 5 additional wells)</td>
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<tr>
<td>Remedial Investigation (RI)</td>
<td></td>
<td></td>
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<tr>
<td>RI Scoping and Planning</td>
<td>$900,000</td>
<td>Conceptual site model development and preparation of planning documents</td>
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<tr>
<td>Field Investigation - Phase I</td>
<td>$833,000</td>
<td>15 shallow (&lt;=50 feet) monitoring wells, 5 deep (&lt;=200 feet) monitoring wells; sampling of new and existing wells</td>
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<tr>
<td>Field Investigation - Phase II</td>
<td>$450,000</td>
<td>7 shallow (&lt;=50 feet) monitoring wells, 2 deep (&lt;=200 feet) monitoring wells; sampling of new and existing wells</td>
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<td>Baseline Risk Assessment</td>
<td>$175,000</td>
<td>Baseline human health risk assessment and ecological risk assessment</td>
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<tr>
<td>Groundwater Modeling</td>
<td>$400,000</td>
<td>Construction and calibration of a groundwater flow model</td>
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<td>RI Report</td>
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<td>Feasibility Study</td>
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<tr>
<td>Treatability Testing</td>
<td>$600,000</td>
<td>Bench-scale ($50K) to full-scale (&gt;500K)</td>
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<td>Feasibility Study</td>
<td>$500,000</td>
<td>Includes full applicable or relevant and appropriate requirements (ARARs) and additional groundwater modeling (Preferred Alternatives Selection)</td>
</tr>
<tr>
<td>Decision Documents</td>
<td>$150,000</td>
<td>Includes Proposed Plan (PP) and Record of Decision (ROD)</td>
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<tr>
<td>Remedial Design (RD) (30% complete)</td>
<td>$700,000</td>
<td>Approximately 20% of cost for 100% complete RD (3.5 million)</td>
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<td>Public Involvement</td>
<td>$180,000</td>
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<td>Project Management</td>
<td>$529,000</td>
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<td>USACE Oversight/Review/Management</td>
<td>$1,058,000</td>
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<td>Cost Contingency</td>
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<td>20% of total project cost</td>
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<td><strong>Total Cost through 30% RD =</strong></td>
<td>$10,302,000</td>
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6.0 References


Appendix A
Perchlorate Sampling Results (CD ROM)
Figure A-1
Perchlorate Data in Simi Valley
Simi Valley Reconnaissance Study

Source: MWH (2003a)
Perchlorate in Wells, Springs, and Seeps at and Near SSFP Simi Valley Reconnaissance Study

Source: MWH (2003a)
Figure A-3
Percholate in Surface Water Samples at SSFL
Simi Valley Reconnaissance Study
Source: MWH (2003a)
Santa Susana Field Laboratory

PERCHLORATE SAMPLING RESULTS

Source: MWH (2003a)

Figure A-6
Soil Perchlorate Sampling Results Near SSFL
Simi Valley Reconnaissance Study

Features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information.