FINAL FEASIBILITY STUDY FOR THE BOUNDARY AREA OPERABLE UNIT (OU-6)

Aerojet Superfund Site
Sacramento, County, California

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Volume III: Final Feasibility Study for the Boundary Area Operable Unit (OU-6)

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Acronyms and Abbreviations

µg/L	Micrograms per liter
1,2-DCA	1,2-Dichloroethane
Admin	Administration
Admin East	Administration Area East
Admin West	Administration Area West
Aerojet	Aerojet-General Corporation
Agencies	Refers collectively to the U.S. Environmental Protection Agency, California Environmental Protection Agency, Regional Water Quality Control Board, and the Department of Toxic Substances Control
ARAR	Applicable or relevant and appropriate requirements
ARGET	American River Groundwater Extraction and Treatment
BERA	Baseline Ecological Risk Assessment
bgs	Below ground surface
BOU	Boundary Operable Unit
Cal/EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chemical of concern
COPEC	Chemical of potential ecological concern
CVEI	Central Valley Environmental, Inc.
DLM	Designated Level Methodology
DNAPL	Dense Nonaqueous Phase Liquid
DTSC	Department of Toxic Substances Control
ERM	Environmental Resources Management
ESL	Ecological Screening Levels
EPA	United States Environmental Protection Agency
FS	Feasibility study
FSP	Field Sampling Plan
FSTP	Former Sewage Treatment Plant
FWBZ	First water-bearing zone
GET	Groundwater extraction and treatment
GIS	Geographic information system
GRA	General response action
GRS	Graphical risk summary
HERO	Health and Ecological Risk Office
HH	Human health
HHERA	Human Health and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
HI	Hazard index
HQ	Hazard quotient
HVAC	Heating, ventilation, and air conditioning
IC	Institutional Control

ILCR	Incremental lifetime cancer risk
IOU	Island Operable Unit
IRIS	Integrated Risk Management System
LOAEL	Lowest Observed Adverse Effect Level
MA	Management Area
MVC	Modified VOC concentration
NCP	National Contingency Plan
NDMA	N-nitrosodimethylamine
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollution Discharge Elimination System
O&M	Operation and maintenance
OM&M	Operations, maintenance and monitoring
OMB	Office of Management and Budget
OS	Open Space
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PCB	Polychlorinated biphenyl
PCD	Partial Consent Decree
PCE	Tetrachloroethene
PGOU	Perimeter Groundwater Operable Unit
PGW	Protection of Groundwater
RAO	Remedial action objective
RCRA	Resource, Conservation, and Recovery Act
RI	Remedial investigation
ROD	Record of Decision
RTG	Risk to groundwater
RWQCB	California Regional Water Quality Control Board
Shaw	Shaw Environmental, Inc.
SMDP	Scientific/Management Decision Points
SLERA	Screening level ecological risk assessment
SMUD	Sacramento Municipal Utility District
SPA	Special Planning Area
SSL	Soil screening level
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
SVRA	State Vehicle Recreation Area
SVSL	Soil vapor screening levels
TBC	To be considered
TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
TPH	Total petroleum hydrocarbons
TPH-D	Total petroleum hydrocarbons as diesel
TPH-MO	Total petroleum hydrocarbons as motor oil

TSCA	Toxic Substances Control Act
VOC	Volatile organic compound
VPGAC	Vapor phase granular activated carbon
WGOU	Western Groundwater Operable Unit
WLLO	An area that includes Westlakes, Line 2, Line 5 North, Buffalo Creek, and OS 5, 6, and 7

Executive Summary

This Feasibility Study (FS) was prepared for the Boundary Operable Unit (BOU) located at the Aerojet Superfund Site in Sacramento County, California. This FS is the mechanism for the development, screening, and detailed evaluation of the alternative remedial actions for remedial areas identified and presented in the *Remedial Investigation Report* (Volume I of the BOU RI/FS Report [ERM-West Inc. 2010]) and the *Human Health and Ecological Risk Assessment* (HHERA) (Volume II of the BOU RI/FS Report [ERM-West Inc., 2011]). This FS is Volume III of the BOU RI/FS Report.

The BOU RI/FS consists of eight Management Areas (MAs) and five Open Space (OS) Areas:

- Administration (Admin) Area
- Line 2 Region
- Line 5 North
- Westlakes Area/OS Area 6
- Buffalo Creek
- Magazine Area/OS Area 3
- Chemical Plant 2 Area
- Dredge Pit and Eastern Basin
- OS Areas 1, 2, 4, 5, and 7

Note Area 39 was moved into the Island Operable Unit.

This FS begins by presenting the human health (HH), ecological risks for areas where habitat currently exists and risks to groundwater (RTG) identified in the HHERA that were provided on graphical risk summary maps (GRSs), which was included in Section 9.0 of Volume II of the BOU RI/FS Report. These GRSs defined the areas of ecological risk in areas where habitat currently exists, and high and low HH risk and risk to groundwater. Based on the summarized risk data compiled from the HHERA, each area was evaluated to assess whether to recommend the retention of the areas for further evaluation in the FS.

Based on discussion with the Agencies, the FS includes additional analysis of ecological data to assess whether additional ecological areas were of concern and should be retained for further remedial consideration. The FS evaluated chemicals of potential ecological concern (COPECs) in samples collected from BOU facility areas. These areas were not included in the HHERA as the structures are not expected to be removed in the near future. Additionally, some facility areas were review with concerns that the area may revert back to habitat.

The FS also included an evaluation for habitat area samples, which had COPEC concentrations greater than 10 times the ESL. Those sample locations found within a retained remedial area were not further evaluated. The remaining samples were assessed as to whether additional consideration in the FS was warranted.

Seventy-three areas were retained for additional evaluation in this FS. Table 1-3 lists the remedial areas that were retained for additional evaluation and presents the chemicals of concern for HH and PGW and the COPECs for ecological receptors for each retained remedial area.

To evaluate the potential remedies for the retained remedial areas, the FS followed EPA guidance process. The final FS also addressed Agencies concerns and incorporated recommended improvements in the process.

The FS identifies and screens appropriate technologies. As part of the technology screening process, Remedial Action Objectives (RAOs) are formulated; potential Applicable or Relevant and Appropriate Requirements (ARARs) were identified; and media specific General Response actions were developed to satisfy the RAOs for each exposure area. For soils these included, No-Action, Institutional Controls, Operational Controls, Physical Containment, In Situ Treatment, and Contaminant Mass Reduction. These GRAs are the same for groundwater except Contaminant Mass Reduction. However, groundwater had Monitoring, Domestic Wellhead Treatment, Monitored Natural Attenuation, Technical Impracticability and Groundwater Extraction and Treatment as additional GRAs.

The FS developed and screened remedial alternatives. The four general alternatives identified for the BOU included:

1. No Action;
2. Institutional Controls (ICs);
3. Containment/Operational Controls; and
4. Source Removal/Reduction.

A detailed analysis was conducted of the four alternatives using the National Contingency Plan (NCP) nine evaluation criteria which broadly are categorized as Threshold Criteria, Primary Balancing Criteria, and Modifying Criteria:

The results of the detailed analysis revealed that, because Alternative 1 (No Action) does not restrict, reduce, or eliminate potential exposures of chemical concentrations to humans or ecological receptors; prevent chemical migration; or reduce potential source area concentrations, Alternative 1 would not apply. Alternatives 2 through 4 were grouped into four potential

Remedial Options (1 through 4) that could potentially be implemented at BOU. The Remedial Options are:

- Remedial Option 1 – A combination of the following:
  - Alternative 2 - Institutional Controls
  - Alternative 3 (Containment/Operational Controls) - Capping of areas posing risk to Human Health and groundwater
  - Alternative 4 (Source Reduction/Removal) - Excavation of areas posing risk to ecological receptors.
- Remedial Option 2 – A combination of the following:
  - Alternative 2 - Institutional Controls
  - Alternative 3 (Containment/Operational Controls) - Capping of areas posing risk to Human Health and groundwater
  - Alternative 4 (Source Reduction/Removal)
    - Excavation of areas posing risk to ecological receptors
    - Groundwater remediation for specific areas in the Administration Area and Line 2
    - Soil flushing for specific areas in Line 2
- Remedial Option 3 – A combination of the following:
  - Alternative 2 - Institutional Controls
  - Alternative 3 (Containment/Operational Controls) - Capping of areas posing risk to Human Health
  - Alternative 4 (Source Reduction/Removal)
    - Soil vapor extraction for areas posing risk to groundwater
    - Excavation of areas posing risk to ecological receptors
    - Groundwater remediation for specific areas in the Administration Area and Line 2
- Remedial Option 4 –
  - Alternative 2 - Institutional Controls
  - Alternative 4 (Source Reduction/Removal)
    - Soil excavation for areas posing risk to human health and groundwater followed by soil vapor extraction for areas posing risk to groundwater
    - Excavation of areas posing risk to ecological receptors
    - Groundwater remediation for specific areas in the Administration Area and Line 2

Section 6 and Appendix B of this FS includes detailed net present value cost estimates and cost summary tables for remedial Options 1 through 4.

1.0 Introduction, Background, and Summarized Risk Assessments, Evaluation of Media-Specific Risk for Further Remedial Action

On behalf of Aerojet-General Corporation (Aerojet), Shaw Environmental Inc. (Shaw), Engineering Management Support, Inc., and Central Valley Environmental, Inc. (CVEI) cooperatively present this Feasibility Study (FS) for the Boundary Operable Unit (BOU), Operable Unit (OU) 6 at the Aerojet Superfund Site in Sacramento County, California. This FS has been prepared as part of a remedial investigation (RI), in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 and Exhibit II of the Partial Consent Decree (PCD).

This FS is Volume III of the BOU RI/FS Report. Volume I of the BOU RI/FS presents the *Remedial Investigation Report* (RI Report [ERM-West Inc. 2010]) and Volume II presents the *Human Health and Ecological Risk Assessment* (HHERA [ERM-West Inc., 2011]).

The CERCLA Information System Identification Number for the Aerojet Superfund Site is CAD 980358832. Government oversight for the Aerojet Superfund Site is shared by the United States Environmental Protection Agency – Region 9 (EPA); and the California Environmental Protection Agency (Cal/EPA), through the California Regional Water Quality Control Board (RWQCB), and the Department of Toxic Substances Control (DTSC), hereinafter referred to as the "Agencies."

The BOU RI provided the investigations results and the HHERA evaluated the human health, ecological screening level and protection of groundwater risks for the nine Management Areas (MAs) and seven Open Space Areas (OSs). Figure 1-1 shows the MAs and OSs locations included in Volumes I and II of the BOU RI/FS Report, however two MAs, Magazine Area and Westlakes, are colocated with OS Areas 3 and 6, respectively. These two MAs along with Buffalo Creek did not have designated source areas and are coded as OS Area on Figure 1-1. The FS does not include one of the MAs. Area 39 was not evaluated for remedial action as the HHERA recommended a Baseline Ecological Risk Assessment (BERA) for the area. Based on this recommendation the Agencies agreed that the Area 39 BERA and resulting FS would be deferred to the Island Operable Unit (IOU). The MAs and OSs are described in the bullets below.

This FS serves as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions. The alternative remedial actions presented in this report were developed based on the BOU RI results; the BOU HHERA results for soil, soil vapor, sediment, surface water, and groundwater; and an evaluation of the potential for chemical migration from

soil and/or soil vapor into groundwater and from groundwater and/or soil into surface water within the BOU.

Figures 1-2 through 1-11 show the site-specific features and source areas within MAs and OS Areas. Table 1-1 summarizes the individual source areas within each MA, where applicable. The following presents a summary of each MA and OS Area:

- Administration (Admin) Area: The Admin Area is the historical liquid rocket manufacturing area and historical and current administration area at the Aerojet propulsion facility. Potential source areas within the Admin Area are associated with liquid rocket manufacturing and the drainage system extending from the manufacturing buildings within the Admin Area to the Westlakes Area. Locations where piping discharged to ditches were identified as potential source areas. The primary chemicals associated with liquid rocket manufacturing were chlorinated solvents and metals. The following sub-areas have been defined for the Admin Area.
  - Administration Area East (Admin East): Source Areas 3D, 4D, 11D, 50D, and 51D; Building 20034 and Resource, Conservation, and Recovery Act (RCRA) Units B, C and X; and associated septic systems;
  - Administration Area West (Admin West): Source Areas 5D, 6D, 9D, 12D, 52D, D(b), and D(d), RCRA Units W and Y, and associated septic systems; and
  - Former Sewage Treatment Plant: Source Areas 8D and D(c).
- Line 2 Region: The Line 2 Region (Source Areas, 28E, 29E, 59E, E(d), E(e), E(m), E(n), Drum Storage Area, associated septic systems, and RCRA Units T and Z) includes various features such as collection systems, floor drains, sumps, storage areas, drainage ditches; tanks; and septic tanks and leach fields.
- Line 5 North: The Line 5 North Area encompasses three source areas [Source Areas 51E, 52E, and E(l)] and various other features including sumps, a possible missile test stand, test cells and associated blast areas, a material storage area, and drains associated with former activities conducted at Building 05087. Building 05087 is identified as a former engineering test laboratory where solid propellants, liner materials, 1,1,1-trichloroethane (TCA), and trichloroethene (TCE) were handled.
- Westlakes Area/OS6: The Westlakes Area receives storm water runoff from various areas of the Aerojet facility via the Main Admin Area Ditch and Buffalo Creek. No source areas have been identified within the Westlakes. The BOU Field Sampling Plan (FSP) identified the Westlakes Area as a feature to investigate because the potential exists for chemicals from various parts of the Aerojet site to have been carried into and deposited within the Westlakes Area via surface water and sediment transport through the Main Admin Area Ditch and Buffalo Creek. Therefore, the Westlakes Area was included in the BOU RI.
- Buffalo Creek: Buffalo Creek was not identified as having source areas. However, due to the potential for storm water from many source areas in Area 00, Line 1,

Line 2, Line 6, and Zone 3 to discharge into Buffalo Creek, the BOU FSP identified it as an investigation area. Within the BOU, Buffalo Creek is comprised of three principal drainages referred to in this report as Upper, Lower, and Cutoff. Upper Buffalo Creek includes its current channel beginning just east of the BOU to the point of discharge into Westlakes. Lower Buffalo Creek includes the current channel that receives surface water discharges from the Westlakes and from the American River Groundwater Extraction and Treatment (ARGET) facility. Buffalo Creek Cutoff refers to a section of drainage adjacent to Line 2 that formerly connected Buffalo Creek and the Main Admin Area Ditch. This section of the channel was abandoned following construction of the portion of Buffalo Creek that runs adjacent to Line 2.

- Magazine Area (Area 48)/OS3: The Magazine Area/OS3 consists of storage bunkers, shipping and transfer facilities, and safety shelters. In the Magazine Area/OS3, two septic systems and a former RCRA Unit (RCRA-C) were identified as features to investigate in the BOU FSP (Aerojet 2005).

- Chemical Plant 2 Area: Chemical Plant 2 was originally operated as a nitroplasticizer manufacturing facility by Aerojet. The plant was shut down in 1968 and later reactivated in 1975 by Cordova Chemical Company for other chemical manufacturing activities. Chemical Plant 2 encompasses Source Areas 59F, 60F, 61F, 62F, CP-207, CP-208[F(c)N], and F(c), associated septic systems, and RCRA Units E and I. Additionally, deep injection wells associated with historical waste operations are present within the Chemical Plant 2 area; however, these injection wells are currently being monitored under a RCRA post closure plan and were; therefore, not included in this evaluation. Various features at Chemical Plant 2 include former offices, control rooms, laboratories (Building 15001) associated with the chemical plant, chemical manufacturing facilities, collection systems, waste lines, floor drains, sumps, former hazardous waste and material storage areas, holding basins, aboveground storage tanks, underground storage tanks, septic tanks and leach fields, drainage ditches, and low-lying areas. Chemicals used at Chemical Plant 2 included chemicals used in the nitroplasticizer process, solvents, diesel, and oil containing polychlorinated biphenyls (PCBs).

- Dredge Pit and Eastern Basin: Two historical dredge pits are located approximately 2,400 feet (one-half mile) northeast of Chemical Plant 2. The western-most dredge pit (Source Area 25F) is referred to as the Dredge Pit and the eastern-most pit is referred to as the Eastern Basin. Although the Eastern Basin was not identified as a Source Area, the BOU FSP identified it as an investigation area.

- OS Areas 1, 2, 4, 5, and 7 (OS1, OS2, OS4, OS5, and OS7): Large areas of contiguous land (buffer land between the MAs) within the BOU, not encompassed by Aerojet-defined MAs or source areas, were identified as OS Areas to manage the CERCLA process for these lands. During the development of the BOU FSP, Aerojet conducted site walks, reviews of current and historical aerial photographs, employee interviews, and document research in an attempt to identify features within these OS Areas that had a potential for chemicals to be released to the environment. In addition, these areas were investigated to evaluate the risk from chemicals present in groundwater beneath the OS Area land from upgradient sources.

- OS1 consists of buffer lands between Chemical Plant 2 and areas west of the Aerojet Superfund Site. No source areas have been identified within OS1, but a railroad line transects the southern portion of OS1 from east to west. Reconnaissance of this section of rail line as part of the carve-out work performed in 1999 and 2000 identified no potential areas of environmental concern (ERM, 2000 and 2001). However, during the development of the FSPs, a reported plasticizer spill in the railroad ballast west of the Chemical Plant 2 fence line and a pond receiving discharge from the SPCC sump and Chemical Plant 2 Source Area 59F were identified as features to investigate. RI samples were collected to evaluate these features.

- OS2 consists of buffer lands between Chemical Plant 2, the Magazine Area, and Line 3. No source areas have been identified within OS2 and no indications of historical industrial activities were observed during site reconnaissance performed as part of the BOU RI. However, during the development of the FSP, a debris pile, drums, and a pond located east of the Chemical Plant 2 fence were identified as features to investigate. RI samples were collected to investigate these features.

- OS4 consists of buffer lands between the Magazine Area and Chemical Plant 1. No source areas have been identified within OS4 and no indications of historical industrial activities were observed during site reconnaissance performed as part of the BOU RI. No RI samples were collected at OS4.

- OS5 consists of buffer lands between Line 2 and Line 5 North. No source areas have been identified within OS5, but a storage yard and two former tanks are present in the southeast corner of the site near the dirt road west of Buffalo Creek. RI samples were collected to evaluate these features.

- OS7 consists of buffer lands west of Line 5 North. No source areas have been identified within OS7 and no indications of historical industrial activities were observed during site reconnaissance performed as part of the BOU RI. No RI samples were collected at OS7.

1.1 Purpose of the Feasibility Study

The purpose of the FS is to develop and evaluate potential remedies to eliminate/reduce the potential for human or ecological receptors to be exposed to those chemicals in soil, soil vapor, surface water, and groundwater at concentrations that were identified in the HHERA as posing an unacceptable risk under residential, commercial, and/or construction worker scenarios. Additionally, the FS also develops and evaluates remedies that would protect the beneficial uses of surface water and groundwater. Specifically, the FS utilizes the information developed during the RI, human health risk assessment (HHRA), screening level ecological risk assessment (SLERA) and risk to surface and groundwater evaluation to:

- Develop specific remedial action objectives (RAOs) and remedial goals;
- Identify and screen applicable remedial technologies;

- Develop and screen remedial alternatives; and
- Conduct a detailed evaluation and comparative analysis of remedial alternatives.

1.2 Document Organization

The report is organized in general conformance with the suggested format contained in the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988).

This BOU FS is composed of seven sections, as outlined below:

- Section 1 describes the purpose of the FS, document organization, BOU background and setting, and BOU identified risk areas. This section also describes the approach used to select vadose zone, surface water or groundwater risk areas for further remedial evaluation in the FS. This section also summarizes additional ecological evaluations. The ecological evaluation of samples collected from BOU facility (non-habitat) areas was completed. Facility areas were defined in the Biological Resource Assessment (ECORP 2005) as areas void of ecological habitat. These areas were not evaluated in the SLERA; however, to ensure risk would not exist if these areas reverted back to habitat in the future, an ecological evaluation was prepared and included in this FS. Additionally, a more detailed assessment (beyond that presented in the SLERA) was performed to evaluate samples collected from areas of ecological habitat where HQs were estimated to be greater than 10 [i.e., 10 times the Ecological Screening Level (ESL)] and were not included in an area recommended for remedial action.

- Section 2 describes the development of RAOs, potential applicable or relevant and appropriate requirements (ARARs), and preliminary remediation goals. Section 2 also includes a discussion of EPA's Presumptive Remedies for various chemicals of concern (COCs) in soil and groundwater, a presentation of general response actions (GRAs), and the identification and screening of remedial technologies/process options.

- Section 3 describes the development of remedial alternatives using those technologies/process options that met the screening criteria.

- Section 4 presents the detailed analysis of alternatives.

- Section 5 presents the comparative analysis of alternatives.

- Section 6 summarizes the application of the components of the alternatives to each of the various MAs within the BOU.

- Section 7 provides a list of references.

Figures and tables follow the report text for each section. Appendices contain the following information:

- Appendix A—ARARs for soil and groundwater,
- Appendix B—Detailed estimates of costs associated with various remedial alternative components,
- Appendix C-Responses to Agency Comments on *Final FS for the BOU (OU-6)*, September 2011,
- Appendix D – Ecological evaluation of samples collected from facility (non-habitat) areas and habitat areas samples greater than 10 times the ESL,
- Appendix E – Description of the construction of the summary soil and soil vapor risk tables and their relation to the GRS figures; and,
- Appendix F – Results of confirmation samples collected for 2010 excavation activities.

The appendices are included on a compact disk along with an electronic copy of this FS Report.

1.3 Boundary Operable Unit Background and Setting

This section summarizes the Aerojet site history and land use as presented in the RI Report. The Aerojet site is located near Rancho Cordova in Sacramento County, California. The Aerojet site is situated at the western end of the Sierra Nevada foothills between the Central Sierra Nevada and the Central Valley geomorphic provinces and is characterized as having a Mediterranean climate.

1.3.1 Site History

The main Aerojet facility consists of approximately 8,500 acres located in eastern Sacramento County, California, about 15 miles east of Sacramento, California. Approximately 5,800 of the 8,500 acres within the main facility are included in the Aerojet Superfund Site, which has been used to develop rocket propulsion systems in support of national defense, space exploration, and satellite deployment since the 1950s. Industrial activities that supported, and continue to support, this work include solid rocket motor manufacturing, testing, and refurbishing; liquid rocket engine manufacturing and testing; and chemical manufacturing. During the development of rocket propulsion systems, a variety of chemicals were manufactured and/or used at the Aerojet site, including solvents, propellants, fuels, oxidizers, plasticizers, lubricants, and metals (ICF Technology, Inc., 1989). Other chemicals manufactured at the two chemical plants on the site included various herbicides, pesticides, and pharmaceutical-related compounds.

Although numerous chemicals were used on the Aerojet site, TCE, tetrachloroethene (PCE), perchlorate, and N-nitrosodimethylamine (NDMA) are the most prevalent chemicals encountered. Other volatile organic compounds (VOCs) commonly detected in soil vapor and groundwater within the BOU include TCA; 1,1-dichloroethane; 1,2-dichloroethane (1,2-DCA); 1,1-dichloroethene; 1,2-dichloroethene; and Freon 113.

1.3.2 Physical Setting

The physical setting of the Aerojet site, including topography, geology, and hydrogeology, are summarized below. Details concerning the physical setting of each of the MAs are presented in the RI Report.

1.3.2.1 Topography

The Aerojet site is characterized by a relatively flat topographic surface gently sloping to the west. Most of the on-site topography is dominated by rows of dredge tailings left from gold mining operations that began in the early 1900s. Roughly 80 percent of the Aerojet site has been dredged for gold.

The dredge tailings consist of alternating rows of cobble piles separated by low areas filled with silt and clay ("slickens"). The depth of dredging ranged from approximately 10 to 90 feet below ground surface (bgs). The difference in surface elevation between the top of the cobble piles to the bottom of the "slickens" areas varies from a few feet to over 40 feet, depending on the depth of dredging. The cobble piles may be as much as 20 to 30 feet above ground surface.

1.3.2.2 Geology and Soils

With the exception of some portions of the Admin Area, Line 2, and Chemical Plant 2, the majority of the lands within the BOU have been dredged to depths below 12 feet bgs, which is the maximum depth considered in the HHRA (6 feet bgs for the SLERA). The dredge tailings consist of furrows of cobble piles separated by low lying "slicken valleys." The cobble piles consist primarily of cobbles in a matrix of sand, silts, and clays. The "slickens valleys" are comprised primarily of silts, fine sands, and clays with some cobbles. Typically, the slickens are underlain by cobbles or native undredged materials.

Soils within the BOU are generally classified as either Xerorthents or Redding-Corning-Red Bluff. Xerorthents are excessively drained and somewhat excessively drained soils found in areas of dredge tailings. Xerorthents formed in material that has a high content of gravels and cobbles derived from mixed rock sources. Xerorthents underlie the majority of the BOU investigation area, which includes Chemical Plant 2, Magazine Area, Line 5, Westlakes Area, and the OS Areas. Redding-Corning-Red Bluff is moderately well-drained soils over a cemented hard pan. This soil unit forms in alluvium derived from mixed rock sources and is found on intermediate and high terraces, terrace remnants, and the side slopes of terraces in the eastern

part of Sacramento County. The soils form in alluvium that is derived from mixed rock sources. The Redding-Corning-Red Bluff soil unit underlies a small portion of the eastern Admin Area (Area 20) and Chemical Plant 2, and large portions of Line 2.

1.3.2.3 Hydrogeology

The conceptual hydrologic model for the Aerojet site and regional groundwater flow characteristics are described below.

Conceptual Regional Hydrologic Model

As a consequence of the historical dredge mining activities, the Aerojet site has become a groundwater recharge zone for the underlying groundwater bearing zones. The Laguna and Mehrten Formations contain the most productive aquifers underlying the Aerojet site and serve as the principal source of water for private and public water supply wells in the area.

Discontinuous lenses of shallow perched groundwater are commonly found across the Aerojet site. Perched groundwater is most often encountered within dredge tailings at depths ranging from 10 to 30 feet bgs. Perched groundwater is affected by seasonal recharge and periods of drought and commonly disappears during long drought periods and rebounds quickly when normal rainfall patterns return.

With the exception of perched groundwater, six individual aquifer layers (Layers A through F) have been defined beneath the Aerojet site, with Layer A being the shallowest (unconfined) and Layer F being the deepest. Unconfined Aquifer A is present at a depth of about 50 feet at the eastern portion of the Aerojet facility and is found at a depth of 120 feet at Aerojet's western boundary, a distance of 6 miles.

Each layer is comprised of relatively continuous lenses of permeable sediments separated by relatively lower permeability sediments. Layer A is defined as the first encountered groundwater that is often, but not always, encountered in the Quaternary sediments. Layer A is not present or is unsaturated in many areas of the site. Layer B is relatively thin and is also dry or absent in some areas of the site. Layers C, D, E, and F are located within the deeper geologic formations and are generally continuous across the western and southern portions of the site, but are not present in the northern and eastern portions of the site due to the eastward thinning of the sedimentary wedge.

For the purposes of conducting the HHERA, facilitating the evaluation of the potential migration of VOCs into ambient and indoor air, and evaluating the potential for exposure to groundwater by construction workers, groundwater data were grouped in the RI/FS as either perched groundwater or as the first water-bearing zone (FWBZ). Correlation of these two hydrologic

units with Layers A through F of the site-wide conceptual hydrologic model is presented in the groundwater discussions for each MA in the RI Report.

Regional Groundwater Flow Characteristics

Groundwater flow is radial from the interior of the Aerojet site towards the various Aerojet property boundaries. Groundwater flows from the Aerojet site in essentially all directions except east, and flow towards the western property boundaries is addressed under the Western Groundwater Operable Unit (WGOU). Groundwater at and beyond the northern and southern Aerojet property boundaries is addressed by the Perimeter Groundwater Operable Unit (PGOU). As a result of the variable groundwater flow directions, multiple interim remedial action groundwater extraction and treatment (GET) facilities were constructed to provide hydraulic containment of the chemical plumes. Generally, the regional groundwater flow direction beyond the Aerojet property boundaries is to the southwest. Local variations in groundwater flow directions are present near the various GET extraction wells. Groundwater flow directions and gradients may also vary between layers across the site.

Potentiometric surface maps for perched groundwater and the FWBZ are presented in the RI Report. In general, the groundwater flow directions vary in each MA, reflecting the radial groundwater flow pattern from the interior of the Aerojet site. Groundwater beneath the BOU MAs flows towards the Aerojet property boundaries and existing GET systems administered under either the WGOU or PGOU. In each of the BOU MAs, there are downward vertical head potentials from perched groundwater to the FWBZ. In addition, the lateral extents of the various perched groundwater zones are limited.

1.3.2.4 Surface Water Hydrology

The BOU regional and local surface water hydrology is described below.

Regional Surface Water

Regional surface water bodies in the vicinity of the BOU include Folsom Lake, Lake Natoma, the American River, and the Folsom South Canal. The American River drains a substantial portion of the western Sierra Nevada, east of Sacramento County. Flows on the American River are controlled by the United States Bureau of Reclamation through Folsom Dam, and to a lesser extent, Nimbus Dam. Folsom Dam is located approximately 3.5-miles northeast (upstream) of Lake Natoma. Lake Natoma is formed by Nimbus Dam, and is located approximately one-quarter to one-half mile north of Aerojet's northern property boundary.

The Folsom South Canal originates at the southwest end of Lake Natoma, and trends along portions of the northern and western Aerojet property boundaries. The Folsom South Canal is a concrete-lined canal and was intended to provide cooling water for the Sacramento Municipal Utility District's (SMUD) Rancho Seco Nuclear Power Plant and municipal water for the East

Bay Municipal Utility District. Current use of the canal is limited to relatively small amounts of water by SMUD, Arden Cordova Water Service, and various other water purveyors and agricultural water users.

Local Surface Water

Local surface water features in or near the BOU include the Admin Area Ditches, the Westlakes storm water retention cells, Buffalo Creek, the headwaters for Coyote Creek, and various man-made ditches and ponds (Figures 1-2 through 1-11). Buffalo Creek, the Admin Area Ditches, and the Westlake storm water retention cells are used to divert and control storm water runoff from the Aerojet property.

Remnants of a former irrigation ditch, the Valley Ditch, are generally present near Folsom Boulevard south of the Westlakes (Figure 1-1). The Valley Ditch was used for irrigation beginning in approximately 1870. Segments of the Valley Ditch traversed the Aerojet property where the Westlake Storm Water Retention Basins are now located, although the Ditch was apparently not used to convey storm water or discharges from the Aerojet site. Most of the Valley Ditch was destroyed by development, probably in the 1970s, and the ditch has not conveyed irrigation water since.

Most storm water runoff originating in the northern (Admin Area) portions of Aerojet is diverted to the Westlake storm water retention cells via the Admin Area Ditches and Buffalo Creek. Storm water runoff from the northeastern portions of the site flows through Buffalo Creek to the Westlake storm water retention cells. Analytical sampling of the storm water runoff is conducted prior to discharging the water to Buffalo Creek and ultimately the American River. Storm water discharges to Buffalo Creek/American River are regulated through the National Pollution Discharge Elimination System (NPDES). Aerojet also discharges treated groundwater from the ARGET system and GET E/F to Buffalo Creek under a separate NPDES permit. Most storm water runoff generated in the southwestern portions of the Aerojet site infiltrates locally and does not leave the Aerojet property.

1.3.3 Biological Setting

The general ecology (habitat and biota) of the Aerojet site and vicinity has been described in several previous reports. Surveys have been conducted to identify important biological resources that may occur on the site or in surrounding areas. These surveys were described and summarized in the *Biological Resource Assessment for Aerojet Boundary Operable Unit, Sacramento County, California* (ECORP Consulting, Inc., 2005) and other reports related to the assessment of biological resources at the Aerojet site. Information from these surveys indicates that the majority of the operational areas within the BOU are covered by pavement, buildings/structures, landscaped ornamental vegetation, or ruderal vegetation.

1.3.4 Current and Future Land Use

The Aerojet site is zoned for industrial use. The facilities that support industrial operations are grouped into manufacturing areas comprising multiple buildings. Large areas of undeveloped land lie within the manufacturing areas, as well as between most manufacturing areas and the property boundaries. The majority of land along the Aerojet site perimeter serves as "buffer space" between operations and neighboring properties. Large areas of the buffer space along the western and northern property boundary were removed from the Aerojet Superfund Site and may be subject to future development.

The Aerojet property is designated as a "Special Planning Area" by Sacramento County Ordinance, Title V, Chapter 8, Article 3, of the Zoning Code of Sacramento County (Sacramento County, 1993). This ordinance identifies existing permitted uses and "provides a regulatory mechanism for making land use decisions that maintain a safe environment in which the subject property can be used given the special requirements of the property owner."

Land use surrounding the Aerojet site includes residential, commercial, industrial, agricultural, and recreational, as well as undeveloped areas. The greatest amount of development exists north and northwest of the site in the communities of Rancho Cordova and Gold River. These communities have a combined population of approximately 60,000. The southern and eastern areas around the site boundaries are primarily undeveloped. Aggregate mining is conducted northeast of the state vehicle recreation area (SVRA), south of the former Ehnisz property and on privately owned property, and on the Inactive Rancho Cordova Test Site owned by Aerojet and located to the south of the Aerojet property. Portions of the lands south of White Rock Road are used for cattle grazing and small farming operations and there are a few ranchettes and houses, including the Clark Cattle Company.

Anticipated redevelopment of the property includes a mixture of residential and commercial land use with final determination dependent on the results of risk assessment using the data obtained during the OU RI process. Proposed development plans including BOU lands are summarized in the PGOU Record of Decision (ROD) (EPA 2011) and can be accessed through the following websites maintained by the County of Sacramento, City of Rancho Cordova, and City of Folsom:

- http://www.msa2.saccounty.net/planning/Pages/TheEastonProject.aspx
- http://www.cityofranchocordova.org/: Departments; Planning; Environmental Review; Environmental Documents; Rio Del Oro and Westborough at Easton
- www.folsom.ca.us/about/whats_new/sphere.asp

1.3.5 Current and Future Groundwater Use

Groundwater within the BOU is considered a Federal Classification IIA drinking water aquifer and is designated for municipal use as a potential drinking water source in the *Basin Plan* (RWQCB, 1998). Groundwater on the Aerojet site is not currently used for any purposes, and future untreated groundwater use is encumbered by environmental restrictions. Currently, Aerojet anticipates that a portion of the treated groundwater from on-site GETs will be utilized at the plant for industrial use. Future groundwater use within the BOU is regulated under Sacramento County Ordinance. The Sacramento County Environmental Management Department manages a "Consultation Zone" that requires all parties to consult with the RWQCB prior to drilling a well within a 2,000 feet distance from chemicals in groundwater around the Aerojet site.

Groundwater is used for domestic and industrial purposes beyond the Aerojet property boundaries. Water supply wells located within a 1-mile radius of the Aerojet site and the status of those wells were identified and described in the RI/FS for the PGOU (Aerojet, 2009). Where appropriate, based on the well locations relative to chemicals in groundwater, active wells are monitored under the WGOU and site-wide groundwater monitoring plans. None of the wells are located within the BOU. Water supply well 1059, the closest well to the BOU, is located on the west side of the Prairie City State Vehicular Recreation Area, and is addressed under the PGOU.

1.3.6 Current Groundwater Remedial Actions

Aerojet is currently operating five interim remedial action perimeter GET systems (GETs A, B, D, E, and F [GETs E and F were subsequently combined and are now referred to as GET E/F]) on the Aerojet Superfund Site designed to remove VOCs; NDMA (GETs A, B, and E/F); and perchlorate (GETs B, D, and E/F) from groundwater beneath the site. These GET systems are targeted at containing chemicals in groundwater at the Aerojet property boundaries. Treated groundwater from the systems is either discharged to Buffalo Creek or recharged to the groundwater system via surface discharge and infiltration (Rebel Hill Ditch), or by recharge wells. A sixth GET system, the ARGET, began operations in July 1998 in the American River Study Area to remove VOCs beyond Aerojet's northern property boundary. The treatment systems at each GET system vary, but generally include combinations of air-stripping for VOC removal; ultraviolet light/chemical oxidation for removal of NDMA, most VOCs, and 1,4-dioxane; and ion-exchange or biological reduction for perchlorate removal.

Three of these GET facilities, GETs D, E/F, and ARGET, are located within or downgradient of the BOU MAs and are included for evaluation as a final remedy in this FS (Figure 1-12). The GET D and ARGET systems are included in the PGOU ROD. GET E/F comprises the on-site portion of the final remedy selected for the WGOU. The hydraulic containment of the GET D/ARGET and GET E/F are shown in Figures 1-13 and 1-14, respectively. Figures 1-15 through

1-23 plot the iso-concentration contours of targeted COCs in groundwater for the perched and the FWBZ for the various MAs and OS. The extent of groundwater impacts is based on data from October 2005 through June 2008.

GET D and ARGET

The GET D and ARGET systems are included in the Zone 1 remedy for the PGOU and plans are currently being developed to implement the remedy stated in EPA's Administrative Order for PGOU (EPA, 2011). Both systems are downgradient of potential source areas located in the Admin Area of the BOU, and they are also downgradient of potential source areas in other operable units (e.g., Central OU). GET D is located on site and was originally constructed in 1981 to hydraulically contain groundwater along portions of the northern Aerojet property boundary using 24 groundwater extraction wells and 6 treated groundwater recharge wells. The ARGET extraction system is located off site and includes extraction wells on the north and south sides of the American River.

Once the PGOU remedy is implemented, the ARGET system will provide hydraulic containment at the downgradient extent of chemicals in groundwater that are beyond the Aerojet site boundaries and hydraulically downgradient of potential BOU sources located in the Admin Area. GET D extraction wells are located on site and remove additional chemical mass closer to the BOU sources areas located in the Admin Area.

The ARGET and GET D hydraulic containment system design was most-recently evaluated in the *Proposed Hydraulic Containment System Design Remedial Alternative Z1-B Zone 1 – Perimeter Operable Unit (OU-5)* (Aerojet and CVEI, November 2006). Although the final remedial system design may vary, groundwater flow simulations indicate that the areas of hydraulic containment will envelop the extent of chemicals in the FWBZ beneath the Admin Area (Figure 1-13).

GET E/F

The GET E/F system is located in Zone 2 and is the on-site or "Inner-Barrier" (and partially off site) component of the final remedy selected for the WGOU. The GET E/F system is required to provide hydraulic containment of chemicals in all groundwater layers along the southwestern, western, and northwestern portions of the Aerojet property boundary. GET E/F is downgradient of the BOU sources located in the following MAs: Westlakes/OS6; Line 2 Region; Line 5 North; Buffalo Creek, Chemical Plant 2, Magazine Area/OS3, Dredge Pit and Eastern Basin, and OS 1, 2, 4, 5 and 7).

The FWBZ defined for the BOU includes the upper portion of Sitewide Hydrostratigraphic Layer C. Hydraulic containment of GET E/F was most recently evaluated in *Draft Inner-Barrier Effectiveness Evaluation, Western Groundwater Operable Unit (OU-3), Aerojet-General*

Superfund Site (Aerojet and CVEI, 2007). The most recent analysis suggests that GET E/F will provide hydraulic containment of chemicals present in the FWBZ beneath the MAs listed above. Figure 1-14 shows the approximate area of GET E/F hydraulic containment in Sitewide Hydrostratigraphic Layer C relative to the furthest downgradient extent of chemicals in the FWBZ.

1.4 Identified BOU Risks

This section presents the risks identified in the HHERA. The HHERA evaluated the RI results, which included previous (prior to 2005) and recent (2005 to 2007) RI data collected from the MA and OS Areas. The HHERA contains a RI summary. The RI Report determined that the lateral and vertical extent of chemicals in soil, sediment, soil vapor, and surface water at source areas within the BOU have been sufficiently characterized to evaluate potential risks to human and ecological receptors and, if necessary, develop remedial alternatives.

The HHERA completed the evaluation of human health risk, screening level ecological risks and risk to surface water and groundwater, which are presented in:

- Section 5.0 of the HHERA: This section presents an evaluation of the potential exposure of receptors to COCs in soil, sediment, surface water, and soil vapor at the site, as well as the use of untreated groundwater for residential supply and the potential for migration of VOCs from groundwater into indoor and ambient air, under both current and future land-use scenarios.
- Section 6.0 of the HHERA: This section presents a preliminary characterization of potential risks to ecological receptors that may be exposed to chemicals of potential ecological concern (COPECs) in soil, sediment, and surface water under both current and future land-use scenarios.
- Section 8.0 of the HHERA: This section presents an evaluation of the potential for compounds identified in soils to adversely impact surface water or groundwater quality.
- Section 9.0 of the HHERA: This section presents graphical risk summaries (GRSs) for the soil and soil vapor media for human health (HH) and risk to groundwater (RTG) (also included herein as Figures 1-24 through 1-31). These figures include residential and commercial scenarios, both of which include a construction worker scenario. These figures also present the areas of potential ecological concern from the SLERA, which includes sediments and surface water for some MAs.

Risks to human health posed by the domestic use of groundwater (i.e., showering and drinking) were calculated as part of the HHERA. The domestic use of groundwater risks were not included in the GRSs because it is assumed that future domestic use of groundwater will be prohibited. Risks to human health posed by domestic use of surface water (i.e., wading and drinking) were calculated as part of the HHERA. The domestic use of surface water risks were not included in

the GRS as the calculated risks posed no or low risk to residential receptors. The surface water and groundwater evaluations are discussed in Section 1.6.

1.4.1 Graphical Summary of Human Health Risk, Screening Level Ecological Risk, and Risk to Surface Water and Groundwater

This section summarizes the process used in the HHERA to complete the GRS figures.

Figures 1-24 through 1-31 present the GRSs of the human health, ecological, and groundwater risks by MA/OSs. The figures contain colored contours or hatched areas, to indicate risk types present in a location. The risk areas are color coded to identify the type of risk, HH (brown), RTG (blue) and ecological (green).

Table 1-2 defines the data presented in each frame in the GRS. The GRS figures include the combinations of risk associated with the upper 12 feet of soil for HH and the upper 6 feet of soil for ecological. Soil results from all depths were evaluated for the RTG. However, the RTG contours for non-VOC were plotted only for risks identified in the upper 12 feet. Non-VOC RTG detections found only below 12 feet bgs are listed in Section 8 of the HHERA.

The deeper non-VOC RTG detections were evaluated for inclusion in this FS. Four locations were found to pose a high RTG due to chemicals present only below 12 feet bgs that were not co-located with other shallower retained area for RTG, or HH, and/or ecological risk identified on the GRS figures. These locations included 59E-SB02 and DSA-SB01 located in Line 2, 51D-SB05 located in Admin East, and 52D-SB18 located in Admin West. Additional discussion is presented in Section 1.4.1.3.

1.4.1.1 Risk to Human Health

The BOU HHRA included risk-based contours for chemicals in soil, soil vapor, and groundwater. Human health risks posed by chemicals that have the potential to cause cancer are expressed as an estimated upper-bound incremental lifetime cancer risk (ILCR). The calculated theoretical upper-bound ILCRs can then be compared to the *de minimus* cumulative risk level of 1×10^{-6} (one in one million) and the range of cumulative risk (1×10^{-6} to 1×10^{-4} [one in ten thousand]) defined by EPA and Cal/EPA and considered acceptable in accordance with the requirements of the *National Oil and Hazardous Substances Pollution Contingency Plan* (EPA, 1990a). Risks posed by non-carcinogenic chemicals are expressed in terms of their hazard index (HI), which is the sum of the hazard quotients (HQ) for all chemicals. An HI greater than 1 indicates that the chemicals of potential concern have the potential to pose an unacceptable risk to human health.

Soil and Soil Vapor

As part of the BOU HHRA, media specific ILCRs and HIs for soil and soil vapor were calculated on a point-by-point basis and are presented in Section 5 of the HHERA. These media-specific ILCRs and HIs were used in this FS to better understand the relative level of risk posed by chemicals in soil and soil vapor. This approach focused the FS on evaluating technologies and processes capable of remediating chemicals in those media.

Figures 1-24 through 1-31 show the soil and soil vapor media-specific risk to human health identified in each of the MAs The media-specific risks areas are plotted as filled, colored-coded contours where soil and soil vapor having chemicals at concentrations that result in a:

- low risk (light brown) for an ILCR greater than 1×10^{-6} or
- high risk (dark brown) for an ILCR greater than 1×10^{-4} or an HI greater than 1 or lead that results in a blood level above 10 micrograms per deciliter.

The high and low risk contours are presented separately for residential land use and commercial land use scenarios (Table 1-2). The construction worker scenario is included in both land uses.

The high and low risk contours are based on contouring the point-by-point calculated results for cancer and non-cancer risks posed by chemicals in soil and soil vapor. Because the contours depicted on the figures were computer generated by using a kriging program, contours drawn around a single location may encompass a larger or smaller area than is indicated by the data, thereby exaggerating or reducing the risk. For example, if you have a single sample point that has chemicals in soil above the acceptable risk levels, but is surrounded by other sampling locations that do not have chemicals above acceptable risk levels, the computer program would generate a contour between the points based on the detected concentration and no other point of reference.

Groundwater

Risk estimates associated with direct contact with groundwater, and model inputs associated with estimating indirect exposures to groundwater were calculated on a sample-by-sample basis in the HHERA. As identified in the facility-wide Conceptual Site Model, potentially complete and significant groundwater pathways include presumed domestic use by current/future residents or commercial/industrial workers, passive volatilization into indoor and outdoor air and inhalation by residents or workers, and dermal contact during construction work.

The estimated theoretical hazards and risks for outdoor air rarely exceeded *de minimus* risk metrics (HI = 1.0, ILCR = 10^{-6}). In all cases where both indoor and outdoor air pathways were assessed, the relative contributions to risks from theoretical indoor air exposures were greater

than the relative outdoor contributions by more than 1 to 2 orders of magnitude. Therefore, the discussions focus on the more conservation exposure of indoor air.

Domestic use by current/future on-site residents or commercial/industrial workers requires extraction of impacted groundwater. As discussed in Section 1.3.4, groundwater use is restricted at the Aerojet site, which is identified in various planning documents. This FS assumes that the same restrictions on Aerojet lands surrounding the BOU will be placed on the BOU lands. This eliminates domestic use by current/future on-site residents or commercial/industrial workers as a complete pathway.

PGOU and WGOU are designed to address domestic use by current/future off-site residents or commercial/industrial workers. To ensure BOU sources would not impact the PGOU/WGOU systems, the chemicals present in groundwater beneath the BOU were evaluated to determine if they would migrate to the PGOU/WGOU extraction systems and whether these systems would be capable of removing these chemicals.

The modeling efforts confirmed that impacted groundwater beneath the BOU would be captured by existing GET systems. The modeled containment areas for the Admin Area, Chemical Plant 2, and WLLO Area are discussed in Section 1.3.6 and shown on Figures 1-13 and 1-14.

The chemicals present in groundwater beneath the BOU include metals, PCBs, semivolatile organic compounds (SVOCs), VOC, perchlorate, NDMA, and total petroleum hydrocarbons (TPH). The RI concluded that lower mobility chemicals such as PCBs and most metals would not migrate much further than their current extent and would not impact the GET facilities. It was further determined that the existing GET systems would be capable of removing the chemicals that could potentially migrate from BOU sources to PGOU/WGOU extraction wells.

Passive volatilization into indoor air and inhalation by residents or workers assumes VOCs in the groundwater volatilize upward and into the indoor breathing space for inhalation by residents or workers. Risk posed by VOC inhalation resulting from the migration of VOCs from groundwater into indoor air for residential use is presented in the figures by showing the lateral extent of TCE in the FWBZ and perched groundwater. The maximum depth to the FWBZ beneath each MA was assumed to be 30 feet for conservatism. The modeled DTSC default concentrations were used. TCE concentrations greater than 11 micrograms per liter (µg/L) in groundwater at depths less than 30 feet bgs could potentially result in indoor air concentrations above acceptable levels for residential use. The TCE 5 µg/L contour was used with an additional 100-foot buffer zone to show the lateral extent of VOCs that pose a risk due to volatilization of chemicals in groundwater into indoor air. This area is depicted on the GRSs figures using purple shading. An exception occurs in the Admin Area where the shading is truncated by the BOU boundary. For commercial use, the risk posed by VOC inhalation resulting from VOC migration from

groundwater was evaluated based on the soil vapor data. Use of actual soil vapor data eliminates a significant variable, modeling of groundwater to soil vapor, which provides more accurate risk calculations.

Dermal contact during construction work requires encountering groundwater during excavation or other intrusive construction activities. In the HHRA, direct contact was assumed for all layers, including the deeper groundwater zones, however no discharge of untreated groundwater to surface water bodies was identified in the BOU (Figure 5.1-1b in the HHERA, Volume II). The depth to perched groundwater beneath the BOU is variable, ranging from as shallow as about 7 feet bgs in Admin Area to as deep as 43 to 45 feet bgs in Line 2. For the FS, potential excavation activities will be conducted to depth up to 12 feet bgs and, therefore, perched groundwater could be encountered. Additionally, excavation activities for repair of installation of current or future underground utilities could potentially encounter perched groundwater. This FS does not specifically address methods to prevent direct contact with groundwater by construction workers. If groundwater is encountered in an excavation, institutional controls should be in place to limit or preclude direct contact by workers, or engineering controls, such as dewatering.

Surface Water

Surface water is limited on the site and in most areas ephemeral. Surface water was evaluated in the Admin Area, WLLO, and Chemical Plant 2. Two locations were identified with surface water risks.

In the WLLO Area, one sample exceeded the *de minimus* risk of 1×10^{-6} out of 11 samples. B(2-EH)P is the principal contributor to the ILCR above the *de minimus* level. The value was characterized as a low risk and isolated; therefore, the area was not retained.

In the Chemical Plant 2, the estimated residential ILCR maximum was 2×10^{-6}. These estimated ILCRs are above the *de minimus* risk of 1×10^{-6} for one sample out of four. Arsenic is the most significant contributor to the ILCR above the *de minimus* level. The value was characterized as a low risk and isolated; therefore, the area was not retained for further evaluation.

1.4.1.2 Risk to Ecological Receptors

The SLERA identified COPECs, which were further evaluated. A sample location-by-location spatial analysis of identified COPECs was completed to understand the relationship of the identified COPEC to ecological habitat areas, or potential migration to these areas. For soil, a sample location-by-location comparison of the identified COPEC concentrations to guild-specific Ecological Screening Levels (ESL) was performed to characterize potential risks to terrestrial ecological receptors of concern within each habitat. The HQ was calculated, which is the maximum concentration divided by the ESL or guild-specific ESL to characterize the magnitude of the detected concentration relative to this benchmark. The COPECs were further

evaluated with respect to frequency of exceedance, magnitude of exceedance, and their spatial distribution.

The SLERA for the MAs within the BOU integrated the results of the calculated risk posed by COPECs in soil vapor, soil, sediment, and surface water with other critical factors including present and future land use; location, size, and quality of habitat; presence or absence of special status species (e.g., threatened or endangered species); magnitude and spatial distribution of COPEC concentrations; and potential for ecological recovery. A risk management review of the findings of the SLERA led to one of the following conclusions:

- Ecological risks are negligible and there is no need for remediation;
- The information is inadequate and further work is required to address data gaps; or
- The information indicates a potential risk and a more thorough evaluation is warranted, requiring a Scientific/Management Decision Point (SMDP).

Seven of the MAs were identified as requiring an SMDP in the SLERA based on multiple lines of evidence. Each of these seven areas was examined in more detail to provide risk management input for remedial planning. Areas subject to consideration for active remediation were identified based on the following criteria:

- Critical factors that were evaluated to determine if remedial action was necessary for areas where the chemical concentration exceeded an HQ>10; included present and future land use; location, size, and quality of habitat; presence or absence of special status species (e.g., threatened or endangered species); magnitude and spatial distribution of COPEC concentrations; and potential for ecological recovery.

- The presence of COPECs exceeding ESLs by a factor of 10 times or more. The factor of 10 times was chosen as a driver for remediation because, while the ESLs are based on No Observed Adverse Effect Levels (NOAELs), remediation goals for ecological risk are often based on the Lowest Observed Adverse Effect Level (LOAEL) rather than the NOAEL, and the LOAEL is typically a factor of 10 times greater than the NOAEL.

- Areas where COPECs have a significant potential for migration into adjacent or downgradient habitats.

- Inorganic constituents exceeding ESLs by a factor of 10 times or more were also compared to site-specific background levels, to avoid recommending remediation for COPECs only marginally elevated (i.e., less than 2x background [or even below]) background. For example, this situation commonly arises with mercury.

- Areas with exceedances of 10 times that could benefit from further investigation in a BERA (such as Area 39) were also identified, considering the tradeoffs between the

ecological disruption and cost of wide-scale remediation versus the cost and effort required to provide a more realistic evaluation of ecological risk.

Each location outside facility areas, where a sample contained a chemical that exceeded the ESL by >10 times, was evaluated. This detailed evaluation is presented in Appendix D, Tables D-5 and D-6.

The GRS identifies areas of ecological concerns that were recommended for SMDPs and are plotted as green-hatched areas. The green-hatched areas are plotted on the non-VOC figures for residential and commercial scenarios. The SLERA did not evaluate the ecological risk for facility samples. The facility samples were reviewed as part of the FS for ecological impacts and are presented in Section 1.6.

1.4.1.3 Risk to Groundwater and Surface Water

Protection of Groundwater (PGW) screening levels were developed as part of the BOU RI to identify chemical concentrations in soil (including soil vapor) that could potentially migrate into and degrade surface water and groundwater. PGW soil vapor screening levels (SVSLs) for a select number of VOCs in soil vapor were developed using VLEACH modeling and PGW soil screening levels (SSLs) for chemicals in soil were developed using either the Designated Level Methodology (DLM) (inorganic compounds), VLEACH (organic compounds), or attenuation factors defined by the agencies (perchlorate and NDMA). Details regarding the development of the PGW SVSLs for soil vapor and PGW SSLs for soil are presented in Section 3.0 of the RI Report.

The PGW SVSLs for VOCs in soil vapor and PGW SSLs for chemicals in soil were developed using site-specific and/or conservative parameters, which would likely result in an overestimation of the potential risk for those chemicals to impact surface water and groundwater.

For metals, the PGW SSL was the higher of either the statistical background threshold value for that metal based on soil type or the concentration protective of groundwater calculated using the DLM. The comparison of the RI results to the PGW SVSLs and SSLs provided a means to evaluate whether a chemical was adequately characterized in the RI.

Section 8 of the HHERA further evaluated the chemical exceedances of the PGW SVSLs and SSLs. The details are provided in the HHERA and are briefly summarized in the following sections for non-VOCs and VOCs for groundwater and the non-VOCs for surface water.

VOC Risk to Groundwater Contours

VOCs in soil vapor could be present due to either:

- Source of VOCs in the soil
- Volatilization of VOCs in groundwater into the soil column

To determine if a VOC source in the soil is impacting groundwater, the VOC contribution from soil needs to be corrected to exclude VOCs in groundwater that volatilize into the soil column. The correction factor required modeling to determine the soil vapor concentration based solely upon volatilization of VOCs in groundwater into the soil column. This correction factor was subtracted from the measured soil vapor concentration to determine the VOC concentration in soil vapor was due solely to a source of VOCs in the soil, which is referred to as the modified VOC concentration in soil vapor (MVC).

The results of the comparison were divided into low, moderate and high risk as follows:

Low Risk

- If the MVC < PGW SVSL then the area was assigned low RTG as no additional impact to groundwater would be occurring.
- If the MVC > PGW SVSL, but VOCs were not detected within 250 feet in groundwater from the sample point as no impacts have occurred to the groundwater. Given that the VOCs have had sufficient time to migrate to groundwater and have not had an impact it is reasonable to assume that a low RTG exists.

Moderate Risk

- If the MVC > PGW SVSL, but the VOC distribution did not indicate a potential presence of a local VOC source to groundwater. This evaluation looked at the groundwater concentrations in the area to define a local source of VOCs to groundwater.

High Risk

- If the MVC > PGW SVSL and the VOC distribution in the groundwater indicated a local source.

The high risk areas for VOCs were contoured as high risk on the GRS figures. Moderate and low risk areas for VOCs were combined and mapped as the low risk contours on the GRS figures. The contours were based on the evaluation completed in Section 8 of the HHERA.

The moderate and low risks were combined as these areas do not indicate a local chemical source in the vadose zone that would migrate to groundwater, based on the criteria listed above. The high risk areas indicate there is a potential source that might migrate to groundwater.

Non-VOC Risk to Groundwater Contours

For the non-VOC exceedances of the PGW SSL in soils, a separate non-VOC ranking system was developed to evaluate the potential for non-VOC concentrations such as metals, SVOCs, TPH, PCBs, NDMA, and/or perchlorate to adversely impact groundwater. A ranking of the

vertical definition of the compound in the vadose zone was combined with a ranking of the presence, or absence, of the compound in groundwater. Two factors were evaluated and summed to determine the RTG:

- A ranking (from 0-5) of the vertical definition of the compound in the vadose zone.
  - The rankings of 0 to 2 indicate chemicals detected in soil are not impacting groundwater at that location. In all cases, there was a sample at a deeper depth from the same borehole that did not contain chemical concentrations above PGW SSLs or, for metals, were not detected above background concentrations. Therefore, the chemical impact was bounded above the water table.
  - A rank of 3 was applied to either:
    - Locations where chemicals were detected at concentrations above the PGW SSL at depths greater than half the distance from the surface to groundwater, but the chemical was not detected in at least one sample collected below the deepest sample with a detected concentration.
    - For the low mobility chemicals, where the lowest detection was less than half the distance to groundwater.
- A ranking (0,1,3,4,6) of the presence, or absence, of the compound in groundwater.
  - The ranking of 0 or 1 indicated that groundwater was not impacted or impacts were below the appropriate ARARs, within 100 to 250 feet of the soil sample exceeding a PGW SSL or where the groundwater impact was attributable to an upgradient source.
  - The ranking of 3 indicated that a compound was detected above the PGW SSL, but either no wells were available to confirm if groundwater was impacted or the detections could not be distinguished from an upgradient source.
  - The ranking of 4 indicated that a compound was detected above the PGW SSL, and was detected in the nearest groundwater sample between 100 or 250 feet downgradient of the area, but could not be definitively associated with the investigated feature.
  - The ranking of 6 indicated that a compound was detected above the PGW SSL and was detected in a groundwater sample within 100 feet downgradient of the area at a concentration greater than groundwater concentration upgradient of the investigated feature.

For both rankings, a higher ranking indicates that the concentration of a compound detected at concentrations above its PGW SSL potentially poses a higher RTG.

The final cumulative ranking ranged from 0 to 11, which were classified into negligible, low, moderate, and high risk for non-VOCs. Generally, rankings of 0 to 2 were classified as negligible

and are not included in the GRS figures. The low and moderate classifications (3 through 6 rankings) were combined into the low RTG contours. The high classification (>6 ranking) were contoured as high RTG contours.

Similar to the VOCs, the final ranking scheme combined the low or moderate risk for non-VOCs because there is not a local chemical source in the vadose zone that would migrate to groundwater, based on the criteria listed above. The high risk areas indicate there is a potential source that might migrate to groundwater. However, as there was more variability in this scheme, each ranking was reviewed and an exception was found for both the low/moderate and high classification.

Non-VOC Risk to Surface Water

The potential for non-VOCs to impact surface water was evaluated by direct comparison of the concentrations detected in soil samples collected between surface and 1 foot bgs to their respective PGW SSLs. This direct comparison to PGW SSLs was made because (1) no site specific leachability and erodability data was available; and (2) the RI used the PGW SSLs to evaluate whether a chemical was defined sufficiently to assess potential risks to surface water. Due to the shallow sampling depth and proximity to the atmosphere, soil vapor samples were not collected for shallow soils as VOCs were not considered a risk to surface water.

The surface water risks were not uniquely identified on the GRS, but the shallow soils were included in the risk evaluation for HH and RTG. Only Westlakes and Chemical Plant 2 contained samples that identified a risk to surface water. In Westlakes, only 1 sample out of 11 samples had an ILCR (2×10^{-6}) slightly above the *de minimus* risk of 1×10^{-6}. Because of this, Westlakes was not further evaluated for surface water in this FS. In Chemical Plant 2, the maximum estimated residential ILCR was 2×10^{-6} which is only slightly above the *de minimus* risk of 1×10^{-6}. Because of this, Chemical Plant 2 was not further evaluated for surface water in this FS.

Risk to Groundwater from Deeper Impacts

Section 1.4.1 states that for sampling locations with a high RTG ranking where the impacted samples were only located below 12 feet, RTG contours were not plotted on the GRS figures. To assess these deeper impacts, the rankings presented in Section 8 of the HHERA were reviewed. Four sampling locations (59E-SB02, DSA-SP01, 51D-SB05, and 52D-SB18) were found to pose a high RTG due to chemicals present only below 12 feet bgs, that were not colocated or adjacent an area being retained for shallower impacts. Based on the review of the data from the four sampling locations, no further evaluation in the FS was recommended. The rationale is presented below:

- 59E-SB02, Line 2 –.Perchlorate was detected at 85 µg/kg in one sample at 35 feet bgs. The shallower samples (2, 5, 10.5, and 23) were all below the PGW SSL. Although,

groundwater impacts are not confirmed in the vicinity, perchlorate is impacting portions of Line 2, (see DSA-SB01, Line 2). Due to the single detection and the result only slightly above the PGW SSL, this area was not recommended for further evaluation.

- DSA-SB01, Line 2 – Perchlorate was detected in samples from 20, 33, and 43 feet bgs at 800, 620 and 650 µg/kg, respectively. However, shallower (1, 5, 11 feet bgs) and deeper (53 and 63 feet bgs) samples did not contain perchlorate above the PGW SSL. The groundwater in the area is impacted with perchlorate (1,400 µ/L). Based on the groundwater impacts and the bounding of the perchlorate above and below the impacted area, this area was not recommended for further evaluation.

- 51D-SB05, Admin East - TPH-D was detected at 17 feet at 440,000 µg/kg. The area groundwater is impacted by diesel detected at 29,000 µg/L at well 262. Three shallower samples were below the PGW SSL. The TPH in this area is helping to dechlorinate PCE and TCE and, since it is part of a remedy for PCE and TCE, this area was not recommended for remedial evaluation.

- 52D-SB18, Admin West – PCBs were detected at 40 feet bgs at 140,000, however the over lying soil samples at 31 and 37 feet bgs were 800 and 180 µg/kg, respectively. The samples were collected to assess the PCBs left in place following the excavation completed for Air Force Plant 70. The US Air Force has completed the investigation of this area and has been ordered to install and maintain a 6-inch asphalt cap, therefore the area was not recommended for further evaluation.

1.5 Vadose Zone Remedial Area Evaluation Approach

For the FS process, the risk areas presented in the GRS were evaluated to determine, which areas should be retained for further evaluation. This section describes the evaluation approach for the non-VOCs risk in soils and the VOC risk in groundwater and soil vapor. The potential ecological concerns may include sediment and/or surface water depending on the area. The specific information is available in the HHERA.

The GRS figures are accompanied by risk tables (Tables 1-4 through 1-20). Tables 1-4 through 1-11, and 1-14 through 1-20 contained data regarding VOC and non-VOC risks, respectively, for the potential remedial areas identified on the GRS figures. The tables provide summary data to support the remedial area evaluations, which are discussed in the following sections. Appendix A1 provides additional details on the table construction and how the tables relate to the GRS figures. Table 1-3 lists the recommended retained areas.

Table 1-12 is an acronym list for these tables. Table 1-13 provides references to the data sources (i.e., figures and tables) in the RI and HHERA. These references are provided for additional site-specific information.

1.5.1 Soil Vapor Remedial Areas - VOC Risks

The GRS for VOCs are shown on the lower half of Figures 1-24 through 1-31. The VOC HH risk and RTG contours were evaluated to assess whether an area should be retained for further evaluation in the FS.

The VOC evaluation approach used to identify areas for further evaluation in the FS is summarized below:

- The SLERA did not recommend further analysis for areas posing risk from chemicals in soil vapor; therefore, no areas are retained for ecological risk.
- Based on modeled VOC migration from groundwater, areas with impacted groundwater concentrations that could pose a potential indoor or outdoor air risk to residential use were retained along with the low and high HH and low RTG contained within those areas (purple areas) as one remedial area.
- Anywhere soil vapor VOC concentrations pose a HH risk and were outside the purple area with risk due to the modeled VOC migration from groundwater, the areas are retained.
- Anywhere soil vapor VOC concentrations pose a high RTG the areas are retained.

The moderate and low risks for VOCs were combined to form the low RTG areas contoured on the GRS figures. These low risk areas do not indicate a local chemical source in the vadose zone that would migrate to groundwater, based on the criteria listed in Section 1.4.1.3. Therefore the low RTG areas are not retained for evaluation of remedial alternatives because VOCs in soil vapor were either in equilibrium with groundwater or do not appear to be local sources. The high risk areas indicate there is a potential source that might migrate to groundwater.

For the ecological risk, only a few locations in Line 2 contained sufficient concentrations of VOC to pose a risk to ecological receptors. No other areas posed a risk from VOCs to ecological receptors. The locations where VOCs posed greater than ten times the ESL are also identified as high risk to HH. The SLERA for Line 2 soil vapor stated "VOCs in soil vapor do not represent widespread contamination, and as such, are not considered to pose ecological risks at the population level." The SLERA for Line 2 also recommended no further action for soil vapor.

The low RTG areas shown on GRS are not retained for evaluation of remedial alternatives because VOCs in soil vapor were either in equilibrium with groundwater or do not appear to be local sources.

For HH, if the HH risk was at the low end of the risk range (i.e., $<1\times10^{-5}$) and the data point was isolated, the area was not recommended for retention.

Each of the VOC HH or high RTG contours is assigned a unique identification number (Figures 1-24 through 1-31). The identification numbers indicate MA, soil vapor identifier "SV", and "R" for retained or "N" for not-retained and sequential numbering of either retained or not-retained areas (e.g. CP2-SV-R-1 for Chemical Plant 2 first retained remedial area).

To assist in the review, Tables 1-14 through 1-20 were compiled with data associated with each of the identified remedial area on Figures 1-24 through 1-31. Tables 1-14 through 1-20 provide a summary of risk data for the VOC compounds and other tabulated information, which include the following:

- Remedial area number
- Colocated remedial areas
- Risk addressed
- Sample locations
- COCs posing high HH risk or high RTG
- Maximum ILCR
- Maximum HI
- Maximum RTG Ranking
- Maximum concentrations
- Depth of maximum concentration
- Depths of samples with high HH or high RTG
- Depth to groundwater
- Degree of isolation
- Anticipated future use
- Site access issues
- Rationale for recommending site to be retained/not retained for remedial action
- Retained or not retained

The table's rationale column also presents additional information on the COCs, local groundwater impacts and potential alternatives to be evaluated. Figure 1-32 indicates the areas that are retained for further evaluation.

1.5.2 Soils Remedial Areas - Non-VOC Risks

For soils, the GRS for non-VOCs are shown on the upper half of Figures 1-24 through 1-31. The non-VOC HH and RTG contours or ecological green-hatched areas were evaluated to assess whether the area should be retained for further evaluation in the FS.

Each non-VOC HH, RTG or ecological risk area was assigned a unique identification number (Figures 1-24 through 1-31). The identification numbers indicate the MAs, R for retained or N for not retained, and sequential numbering of either retained or not retained areas. For example L2-R-3 would be Line 2, retained, third area. For areas where recent excavation work addressed

the identified risk, a C (remediation completed) was used to denote the area as opposed to an R (retained).

To assist in the review, Tables 1-4 to 1-11 were compiled with data associated with each of the identified soil remedial area on Figures 1-24 through 1-31. Tables 1-4 through 1-11 provide a summary of risk data for the non-VOC compounds and other tabulated information, which include the following:

- Remedial area number
- Colocated remedial area number(s)
- Risk addressed
- Sample locations
- COCs exceeding HH risk levels
- Maximum ILCR
- Maximum HI
- COPECs exceeding SLERA risk levels
- Maximum HQ
- COCs w/potential RTG
- Maximum RTG Score
- Depth to groundwater
- Degree of isolation
- Anticipated future use
- Site access issues
- Rationale for recommending site to be retained/not retained for remedial action
- Retained, not retained or remediation completed.

The table column "rationale for recommending site to be retained/not retained for remedial action" provides additional information for further evaluation. The following criteria were used in selecting whether to recommend that the area be retained:

- If the HH risk was at the low end of the risk range (i.e., less than 1×10^{-5}), HI<1 and had a low RTG, the area was not recommended for retention.

- If ecological risk exceeds screening levels, was identified as a SMDP in the SLERA (Section 1.4.1.2) and identified by green hatching on the GRS, the area was recommended for retention.

- If the RTG risk scoring was negligible or low (0 to 4), the area was not recommended for retention, if the scoring was moderate (5-6) the site might be retained depending on compound mobility and solubility, depth of the impacts and whether bounded, if the scoring was high (greater than 6) the area was recommended for retention.

- For RTG only areas where the COCs were low mobility/solubility compounds (e.g., metals, polynuclear aromatic hydrocarbons, SVOCs), if the RTG was low or moderate and impacts were only in shallow soil samples (<5 feet bgs) then the area was not recommended for retention.
- If the RTG area was only based on the concentrations of TPH as diesel and/or TPH as motor oil, the area was not recommended for retention unless the concentrations were increasing with depth, or TPH was encountered at depth and had impacted the groundwater.
- If the RTG area was bounded at depth and the target non-VOC was not in groundwater the area was not recommended for retention.

The retained areas for non-VOCs are carried forward through the FS for remedial alternatives evaluation and are identified in the last column of Tables 1-4 through 1-11. Figure 1-32 indicates the areas that are retained for further evaluation.

1.5.3 Groundwater Remedial Areas – VOC Risks

Since it is assumed the future domestic use of groundwater will be prohibited, the only risk posed by groundwater is from VOC volatilization into indoor air and subsequent VOC inhalation. All groundwater areas that were defined by the TCE iso-concentration contour of 5 µg/L were retained to assess alternatives for potential mitigation of risk to residential indoor air. Other VOCs with low modeled groundwater risk concentrations that may potentially pose a risk to indoor air were evaluated as well. The distributions of these compounds were compared to retained areas due to TCE concentrations to assess whether additional areas pose a risk to indoor air. Two MAs were identified where other VOCs existed in groundwater at levels that may pose an indoor risk, Admin East and Chemical Plant 2.

In Admin East, PCE and vinyl chloride were detected above the concentrations that pose an indoor air risk at a groundwater depth of 30 feet, 2.1 and 0.11 µg/L, respectively. Generally, the vinyl chloride and PCE distribution in groundwater were encompassed by the TCE 5 µg/L plus buffer. The exception was vinyl chloride concentration yielded from Well 3093; however, this area lies within the PGOU. Currently, the PGOU remedies are being evaluated by the Agencies.

In Chemical Plant 2, 1,2-DCA is a primary compound in the perched groundwater. The highest concentrations (7,500 and 24, 000 µg/L) of 1,2-DCA were detected in a grab samples collected from upper and lower perched groundwater from sampling location 59F-SP35 and CP2-07-SB05, respectively. The higher grab groundwater sample concentration was not confirmed with the subsequently installed Well 3728, which yielded 2.5 µg/L of 1,2-DCA. The depth to FWBZ groundwater ranges from about 75 feet bgs in the northern portion to over 108 feet bgs in the southern portion of Chemical Plant 2. No 1,2-DCA concentrations above the 60-foot DTSC modeled groundwater risk value of 18 µg/L was reported in FWBZ groundwater.

Although, this area does not lie within the retained area for indoor risk from the modeled TCE concentration from groundwater, it is retained as it lies within a high HH risk contour for VOCs.

1.5.4 TCE Uncertainty

On September 28, 2011, EPA released a new toxicological assessment for TCE. The new Integrated Risk Information System (IRIS) Reference Concentration (RfC) is 0.002 mg/m^3, the new Inhalation Unit Risk (IUR) is 4×10^{-6} $(\mu g/m^3)^{-1}$. The IRIS RfC and IUR values are more conservative than those used in the RI and risk assessment to select remedial areas. DTSC's Health and Ecological Risk Office (HERO) conducted an evaluation to determine if the soil vapor screening level of 961 $\mu g/m^3$ and the groundwater screening level of 5 µg/L were conservative enough to ensure the revised toxicity data would not result in additional areas requiring remedy, which were not originally identified in the RI.

HERO's evaluation concluded the following

- Soil vapor - The RISL for soil vapor used in the RI for TCE (961 $\mu g/m^3$) was based off of the previous EPA Indoor Air Screening Level of 0.96 $\mu g/m^3$ with an attenuation factor of 0.001 applied. HERO used default Johnson and Ettinger (J&E) residential parameters (with the new TCE toxicity criteria) to estimate the risk and hazard associated with TCE in soil vapor at 961 $\mu g/m^3$. The results of this evaluation indicate that even with the new TCE toxicity criteria, the incremental cancer risk is not above 1×10^{-6} and the HQ is 0.4.

- Groundwater – The RI assumed a conservative depth to groundwater of 30 feet and retained any location where TCE was present in groundwater at a concentration $\geq$ 5 µg/L for further evaluation in the FS. HERO used the updated J&E spreadsheet and determined that using default settings, 30-foot depth to groundwater, and a TCE concentration equal to 5 µg/L, the incremental cancer risk is 5×10^{-7} and the HQ is 0.15.

Therefore, the TCE evaluation conducted in the BOU RI and risk assessment were sufficiently conservative to be in line with the recently released IRIS TCE toxicity data.

1.6 Evaluation of COPECs in Samples Collected from BOU Facility Areas

Appendix D, Tables D-1 through D-4 provide an evaluation of soil and soil vapor COPEC concentrations in samples collected from Facility Areas (as defined in ECORP 2005) for potential future ecological exposure should these areas, which contain buildings, pavement, or other engineered barriers, revert to habitat. These "facility" COPEC samples were not quantitatively evaluated in the BOU SLERA Risk Characterization Summary Tables or Figures; however, these data were included in the initial SLERA COPEC Selection tables that used a combination of habitat and facility samples. Therefore, COPECs identified during the SLERA

for habitat area samples are applicable for Facility Area samples. The results of this evaluation are summarized by MA below.

Admin Areas

Admin East and West Facility Areas contained samples with COPEC concentrations greater than 10 times the ESL (green-hatched areas shown on Figure 1-33) that could pose an unacceptable hazard to sensitive ecological receptors if these areas revert to habitat in the future. However, since only 6 samples exceed 10 times the ESL in the southern area of Admin West (the former sewage treatment plant [FSTP]), special land use controls for the FSTP area does not appear warranted. As shown in Table D-1, these six samples are either very isolated or moderately isolated; the ESLs used for the HQ estimations were overly conservative for mercury; and/or the home range of some of the modeled receptors (e.g., two acres for the American robin) would be expected to significantly reduce exposure to COPECs.

Land use controls, however, are recommended for Admin East and the northern area of Admin West to ensure these areas do not revert back to habitat in the future, absent further risk evaluation and Agency approval.

Line 2

Line 2 Facility Areas contained samples with COPEC concentrations greater than 10 times the ESL (green-hatched areas shown on Figure 1-33) that could pose an unacceptable hazard to sensitive ecological receptors if these areas revert to habitat in the future. However, due to the limited number of samples exceeding 10 times the ESL (i.e., 5 out of approximately 66 samples), the fact that fewer exceedences are in surface soil compared with subsurface soil, and the overall large size of the MA (36 acres) compared with the 13 acres of Facility Area, special land use controls for these structures does not appear warranted. In addition, as shown in Table D-2, these five samples are either very isolated or moderately isolated; the ESLs used for the HQ estimations were overly conservative for mercury; and/or the home range of some of the modeled receptors (e.g., two acres for the American robin) would be expected to significantly reduce exposure to COPECs.

Line 5 North

Line 5 North Facility Areas contained samples with COPEC concentrations greater than 10 times the ESL (green-hatched areas shown on Figure 1-33) that could pose an unacceptable hazard to sensitive ecological receptors if these areas revert to habitat in the future. However, due to the limited number of samples (i.e., 2 out of approximately 46 samples) exceeding 10 times the ESL, and the overall relatively large size of the MA (15.5 acres) compared with the 4.5 acres of Facility Area, special land use controls for these structures does not appear warranted. In addition, as shown in Table D-3, these two samples are very isolated; and/or the home range of some of the modeled receptors (e.g., two acres for the American robin) would be expected to

significantly reduce exposure to COPECs. Finally, one of the samples (52E-SNS01) is already within a remedial area (L5-R-1) and is being retained for HH risk.

Chemical Plant 2

Chemical Plant 2 Facility Areas contained samples with COPEC concentrations greater than 10 times the ESL (green-hatched areas shown on Figure 1-33) that could pose an unacceptable hazard to sensitive ecological receptors if these areas revert to habitat in the future. However, due to the limited number of samples (i.e., 15 samples) exceeding 10 times the ESL in Chemical Plant 2, special land use controls for Chemical Plant 2 does not appear warranted. As shown in Table D-4, these 15 samples are either very isolated or moderately isolated; the ESLs used for the HQ estimations were overly conservative for mercury; thallium was determined in the SLERA not to be site related; boron was less than 2x background, Prowl concentrations would be expected to be much lower than historical levels due to a half-life of 34 days; use of alternative toluene and vinyl chloride soil vapor ESLs from Santa Susana Field Laboratory (recommended by DTSC, 2011) and/or the home range of some of the modeled receptors (e.g., two acres for the American robin and one, 0.5, and 25 acres for burrowing wildlife such as the short-tailed shrew, California ground squirrel, and weasel, respectively, potentially exposed to soil vapor) would be expected to significantly reduce exposure to COPECs. Finally, four samples (59F-SB19, CP2-08-SNS02, 61F-SNS01, and CP2-08-SB12) are within a remedial area (CP2-R-1, CP2-R-7, and CP2-R-9) being retained for HH risk.

Magazine Area

All the samples collected in the Magazine Area were evaluated in the BOU SLERA, as they were collected from areas with viable habitat or were from areas of vegetated bunkers that were considered in the SLERA to be associated with some habitat (HHERA Figures 6.9-1 and 6.9-2). Therefore, additional evaluation is not required herein.

Conclusions and Recommendations

A detailed evaluation of soil and soil vapor COPEC concentrations in samples collected from Facility Areas, was completed for potential future ecological exposure if these areas, which contain buildings, pavement, or other engineered barriers, were to revert to habitat. The evaluation resulted in the following recommendations for BOU:

- Sufficient risk is present within the Facility Areas at Admin East, and the northern areas of Admin West to warrant remedial action or land use controls. Because of this, those areas with samples greater than 10 times the ESL (Figure 1-33) will either be remediated as part of remedial actions for HH or RTG or special land use controls will be put in place to prevent the area from reverting to habitat over time.
- Facility Areas within Line 2 and Line 5 North have few, isolated samples with elevated ESL exceedences (Figure 1-33) and, therefore, special land use controls do

not appear warranted. The FSTP in the southern area of Admin West has only a few isolated samples with elevated ESL exceedences (Figure 1-33) and as a result of a detailed evaluation, special land use controls and five-year reviews do not appear warranted. Facility Areas within Chemical Plant 2 have 11 samples with elevated ESL exceedences (Figure 1-33) not within an area already retained for HH risk; however, as a result of a detailed evaluation (Table D-4) that looked at isolation as well as many other factors, special land use controls and five-year reviews do not appear warranted.

Given the conservative screening-level approach used in the ecological evaluation in Appendix D, excursions of COPEC concentrations above ESLs may not actually be associated with adverse ecological impacts. Therefore, additional refined ecological evaluation may also be performed for Facility Areas within Admin East and the northern areas of Admin West, should conditions occur such that buildings, pavement, or other engineered barriers actually revert to habitat. This additional ecological evaluation could include, but not be limited to, the following:

- Additional examination of the technical basis of the COPEC-specific ESLs that show exceedences,
- The spatial extent of the sample exceedences and/or estimation of COPEC exposure point concentrations over relevant wildlife home ranges,
- Utilization of more realistic ecological risk assessment exposure scenarios and/or toxicity data to refine the original SLERA findings in Appendix D.

The costs associated with land use controls are detailed in Appendix B and are summarized in Tables 4-1 and 6-1, and the cost of additional refined ecological evaluation (discussed above) may be compared with these land use control costs, in a cost benefit analysis.

Table 1-1
Source Area/Area of Interest
Aerojet- Boundary Operable Unit Feasibility Study

Source Area/ Area of Interest	Description
ADMINISTRATION AREA	
3D and 51D	Liquid Rocket Engine Manufacturing - *Sumps in Building 20002 and 20004, Former 3,000-gallon waste tank north of Building 20002, Former 5,000-gallon fuel oil tank southwest of Building 20002*
5D	Area 20 Surface Water Drainage System - *Ditch system & waste treatment ponds near Building 20009*
6D	Building 20009 Drainage - *Abandoned pond*
8D	Sewage Treatment - *Sewage treatment ponds*
9D	Area 20 Surface Water Drainage System - *Ditch system south of Building 20009*
11D	Area 20 Surface Water Drainage System - *Ditch system and former 5,000-gallon acid holding tank associated with Building 20022*
12D	Area 20 Surface Water Drainage System - *Ditch system west of Sites 8D & D(c)*
D(b)	Building 20009 Surface Water Drainage System - *Ditch System west of Building 20009*
D(c)	Sewage Treatment Plant - *Treatment plant sludge drying area*
D(d)	Storm Drain Sump - *Sump west of Building 20025*
50D	Boiler Fuel Oil Storage - *Former 4,000-gallon underground fuel oil tank west of Building 20001*
52D	Waste Oil Storage - *Former underground waste oil tank west of Building 20009*
52D FWOT and 52D TB	Waste Oil Storage - Former waste oil tank near Building 20009
Building 20034	X-Ray Facility
A20-ST01-1	Septic Tank - *northeast corner of Building 20001, 10,000-gallon capacity, abandoned*
A20-ST01-2	Septic Tank - *at the south west side of Building 20001, 10,000-gallon capacity, abandoned*
A20-ST01-3	Septic Tank - *at the north west side of Building 20001, 10,000-gallon capacity, abandoned*
A20-ST05-1	Septic Tank - *serviced a restroom inside Building 20005, abandoned*
A20-ST05-2	Septic Tank - *1,000 gallon capacity, replaced A20-ST05-1*
A20-ST14	Septic Tank - *east of Building 20014, 1,000-gallon capacity*
A20-ST22	Septic Tank - *serviced a restroom in the northeast corner of the Building 20022*
RCRA-B	RCRA Unit - *consists of Building 20037, a chemical storage building located northwest of Building 20034, a former X-ray facility; closed*
RCRA-C	RCRA Unit - *consists of Building 20029, a former decontamination area located northwest of Building 20002; closed*
RCRA-W	RCRA Unit – *consists of Building 20018, Storage and Treatment Tank; closed*

Table 1-1 (continued)
Source Area/Area of Interest
Aerojet- Boundary Operable Unit Feasibility Study

ADMINISTRATION AREA (continued)	
RCRA-X	RCRA Unit - *consists of Building 20B73, a former oil shed located west of Building 20022; closed*
RCRA-Y	RCRA Unit - *consists of 20025 Storage; closed*
LINE 2	
28E	Drum Cleaning Facility - *Wash slab and 2 gunite lined ponds 600 feet northwest of Building 02028*
29E	Crawford Bomb Station - *Pond north of Building 02024*
59E	Drum Cleaning Facility - *Low area approximately 500 feet west of Building 02028*
E(d)	Grind Station - *Drainage area north of Building 02020*
E(e)	Grind Station - *Dry well at Building 02020*
E(m)	Unknown Operation - *Pond north of Buildings 02025, 02026, and 02027*
E(n)	Office Building - *Waste line east of Building 02025*
Drum Storage Area	Drum Storage - *Flat uncovered ground area 300 feet west of Building 02028*
L2-ST24	Septic Tank - *located south of former Building 02026, connected at one time to both Buildings 02024 and 02026*
L2-ST26	Septic Tank - *located south of former Building 02026, 1,000 gallon capacity*
L2-ST28/90	Septic Tank - *located adjacent to the Drum Storage Area, associated with Building 02028*
RCRA-T	RCRA Unit - *consists of* 02030 Tank Storage; closed
RCRA-Z	RCRA Unit - *consists of* Line 02 Storage Tanks; closed
LINE 5 North	
51E, 52E, and E(l)	Laboratory - *Concrete wash sump, low areas, septic tank (Building 05087)*
WEST LAKES	
Detention Ponds	Storm Water Detention System - *consisting of two storm water detention ponds (an Eastern and Western Pond), three associated overflow cells (Cells 1 through 3), a pump station, diversion structures, outlet structures, and lower Buffalo Creek*
BUFFALO CREEK	
Drainage Ditch	Storm Water Management System – *consists of upper Buffalo Creek, a channel beginning just east of the BO to the point of discharge into Westlakes and Buffalo Creek Cutoff, an abandoned channel located adjacent to tLine 2 that formerly connected Buffalo Creek to the Main Admin Area Ditch.*

Table 1-1 (continued)
Source Area/Area of Interest
Aerojet- Boundary Operable Unit Feasibility Study

MAGAZINE AREA	
Magazine Area Septic Tanks	Septic Tanks - *at Building 48013 (A48-ST13) and at Building 48019 (A48-ST19)*
RCRA-C	RCRA Unit - *consists of Building 48008, a hazardous waste/material storage building; closed*
CHEMICAL PLANT 2	
59F	Chemical Manufacturing - *Lined holding basin, sumps, steel tank, low area (unlined pond) and septic tank*
60F	Wastewater form Bldg 15001 & Bldg 15003 - *Septic tank(CP2-ST01/03)*
61F	Drum Storage Area - *Concrete sump associated with Building 15001N*
62F	Chemical Storage - *Stainless steel paraldehyde tank*
F(c)	Sump - *Boiler blowdown sump*
CP-207	Suspect Area near Building 15007 - *Area of soil discoloration discovered during Stage 1 RI*
CP-208 [F(c)N]	Chemical Storage - *Drum storage (potentially pump oil containing PCBs)*
RCRA-UIC	RCRA Unit - *consists of Underground Injection Wells IW-1 and IW-2 at Chemical Plant 2 (deep well injection headworks and associated areas)*; closed
RCRA-E	RCRA Unit - *consists of Buildings 15000N and 15005, hazardous waste container storage area; closed*
RCRA-I	RCRA Unit - *consists of 700 Area Storage and Treatment Tanks; closed*
DREDGE PIT AND EASTERN BASIN	
25F	Chemical Waste Disposal Pit - *Unlined dredge pit & eastern drainage basin*

Notes:

RCRA Resource Conservation and Recovery Act

Table 1-2
Descriptions of Graphical Risk Summary Figures

RISKS FROM CHEMICALS IN SOIL	Soil Sampling Locations Shows all soil sampling locations, including sample identifications, in the featured MA.	Residential Land Use Non-VOC[1] This figure presents the following: • Soil sampling locations (no labels). High Risk Contour • 10^{-4} Cancer risk contour. • HI >1 Non-cancer risk and lead above 10 µg/dL contour. • High risk to groundwater contour for non-VOCs in shallow[2] soil. Low Risk Contour • 10^{-6} Cancer risk contour. • Low risk to groundwater contour for non-VOCs in shallow[2] soil. Ecological Risk Contour Areas of potential ecological risk.	Commercial Land Use Non-VOC[3] This figure presents the following: • Soil sampling locations (no labels). High Risk Contour • 10^{-4} Cancer risk contour. • HI >1 Non-cancer risk and blood lead above 10 µg/dL contour. • High risk to groundwater contour for non-VOCs in shallow[2] soil. Low Risk Contour • 10^{-6} Cancer risk contour. • Low risk to groundwater contour for non-VOCs in shallow[2] soil. Ecological Risk Contour Areas of potential ecological risk.
RISKS FROM CHEMICALS IN SOIL VAPOR	Soil Vapor Sampling Locations Shows all soil vapor sampling locations, including sample identifications, in the featured MA.	Residential Land Use VOC[1] This figure presents the following: • Soil vapor sampling locations (no labels). High Risk Contour • 10^{-4} Cancer risk contour. • HI >1 Non-cancer risk. • High risk to groundwater contour for VOCs in soil vapor. Low Risk Contour • 10-6 Cancer risk contour. Low risk to groundwater contour for VOCs in soil vapor.	Commercial Land Use VOC[3] This figure presents the following: • Soil vapor sampling locations (no labels). High Risk Contour • 10^{-4} Cancer risk contour. • HI >1 Non-cancer risk. • High risk to groundwater contour for VOCs in soil vapor. Low Risk Contour • 10^{-6} Cancer risk contour. Low risk to groundwater contour for VOCs in soil vapor.

Notes:
µg/dL = Micrograms per deciliter
1 = The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.
2 = Shallow soil is between surface and 12 feet below ground surface (bgs).
3 = The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

Table 1-3
Recommended Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs [a]	Ecological COPECs [a,b]	Protection of Groundwater COCs [a]
Administration Area East			
AE-R-1	-	-	B(a)A, TPH-D, TPH-Mo
AE-R-2	1,1,2,2-PCA, A-1254, Fe	-	-
AE-R-3	B(a)A, B(a)P, B(b)F, B(k)F, Chrysene, D(a,h)A, I(1,2,3-cd)P, 1,1,2,2-PCA	-	-
AE-R-4	A-1254	-	-
AE-R-5	A-1254	-	-
AE-R-6	A-1254, B(a)A, B(a)P, B(b)F, B(k)F, Chrysene, I(1,2,3-cd)P	-	-
AE-R-7	-	-	Naph, A-1254, TPH-D, TPH-Mo
AE-R-8	A-1254, Pb	-	-
AE-R-9	A-1254, A-1260, Cr+6	Zn, DmP, A-1254, A-1260 [b]	-
AE-SV-R-1	VC	-	-
AE-SV-R-2	PCE, VC, TCE, Benzene	-	-
AE-SV-R-3	VOCs	-	-
AE-SV-R-4	-	-	PCE
AE-SV-R-5	-	-	PCE
AE-SV-R-6	-	-	TCE
AE-SV-R-7	-	-	PCE
AE-SV-R-8	-	-	TCE, PCE
Administration Area West			
AW-R-1	A-1260	Cr, A-1260 [b]	-
AW-R-2	A-1254	Cd, Cr, Hg, A-1254 [b]	-
AW-R-3	A-1260	Hg [b]	-
AW-R-4	A-1260	-	-
AW-R-5	-	Cd, Zn, A-1260 [b]	TPH-D, TPH-Mo
AW-R-6	Ni	-	-
AW-R-7	B(a)P, B(b&k)F	-	-
AW-R-8	Cr+6 , Sb, Ni	Hg, Cd, Sb, B, Cr, Cu, Mn, Ni, Zn [b]	-

Table 1-3
Recommended Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs [a]	Ecological COPECs [a,b]	Protection of Groundwater COCs [a]
Administration Area West (continued)			
AW-R-9	-	-	TPH-D, TPH-Mo, B(a)P, B(b&k)F, B(b)F, ClO4, Sb, Cd, Cr, Cr+6, Pb
AW-R-10	-	Sb, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Ag, Zn	-
AW-R-11	A-1254	A-1254 [b]	-
AW-R-12	B(a)P, Ni, Cr+6	-	-
AW-R-13	Cr+6, Ni, Pb	-	-
AW-R-14	CR+6	-	-
AW-SV-R-1	VOCs	-	-
Line 02			
L2-R-1	-	-	ClO4
L2-R-2	B(a)P B(b&k)F	TCE, PCE, toluene (soil vapor) [b]	-
L2-R-3	-	-	ClO4, TPH-D
L2-R-4	-	-	ClO4, Mn, Ni, Tl
L2-R-5	-	-	ClO4
L2-R-6	-	-	ClO4
L2-R-7	-	-	ClO4
L2-R-8	-	-	ClO4
L2-R-9	-	-	ClO4, Al, Mn, NDMA, Tl
L2-SV-R-1	VOCs	-	-
L2-SV-R-2	-	-	TCE
L2-SV-R-3	-	-	TCE
Line 05 North			
L5-R-1	B(a)P	-	-
L5-R-2	-	-	ClO4
L5-R-3	-	Cd DnOP	-
L5-SV-R-1	-	-	TCE, PCE
L5-SV-R-2	-	-	TCE
L5-SV-R-3	VOCs	-	-
Buffalo Creek and West Lakes			
Buffalo Creek			
BC-R-1	-	A-1254, Pb, Hg, Ag, Zn	-
BC-R-2	-	A-1254, Cr, Pb, Hg, Ni, Ag, Zn	-
West Lakes			

Table 1-3
Recommended Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs [a]	Ecological COPECs [a,b]	Protection of Groundwater COCs [a]
WL-R-1	-	-	ClO4
Magazine Area			
MA-SV-R-1	VOCs	-	-
Chemical Plant 2			
CP2-R-1	-	Sb, Ni, Se, 4,4-DDD, 4,4-DDE, 4,4-DDT, A-1248, A-1254, d-BHC, Endrin, Prowl, phenol, Ba, B, Cd, Pb, Zn	-
CP2-R-2	A-1254	-	-
CP2-R-3	-	4,4'-DDE, 4,4'-DDT, endrin, phenanthreneBEHP, dieldrin, EA, A-1254, Cr, Cu, Ni	-
CP2-R-4	A-1248, A-1254	-	-
CP2-R-5	A-1254	-	-
CP2-R-6	A-1254	-	-
CP2-R-7	-	A-1254	-
CP2-R-8	A-1248	-	-
CP2-R-9	A-1248 A-1254	-	-
CP2-R-10	A-1248	-	-
CP2-R-11	Ba	-	-
CP2-SV-R-1	1,2-DCA VC	-	-
CP2-SV-R-2	1,2-DCA	-	-
CP2-SV-R-3	1,2-DCA	-	-
CP2-SV-R-4	1,2-DCA	-	-
CP2-SV-R-5	1,2-DCA	-	-
CP2-SV-R-6	VOCs	-	-
Dredge Pit and Eastern Basin			
DPEB-R-1	-	B, Cd, Hg, Mo, Ni, Tl, Zn, DnBP, Prowl	-
DPEB-SV-R-1	VOCs	-	-

Notes:

For list of acronyms, see Table 1-12.

[a] Information from Tables 1-4 through 1-11.

[b] Additional COPECs from Table D-5.

Table 1-4
Summary of Soil Risks and Rationale for Remedial Action - Administration Area East
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained, or Remediation Completed
AE-R-1	—	RTG	03D-SB12	—	—	—	—	—	B(a)A, TPH-D, TPH-Mo	11	37	NI	Commercial	Adjacent to building, excavation may impact structure	B(a)A was ranked as a negligible RTG and TPH-D and TPH-Mo were ranked as high RTGs. B(a)A (45 µg/kg) exceeded its PGW SSL (29 µg/kg) only in the 11-foot bgs sample. TPH-D (180 mg/kg, 350 mg/kg, and 970 mg/kg) exceeded its PGW SSL (100 mg/kg) in the 5-, 11-, and 35-foot bgs samples, respectively. TPH-Mo (1,100 mg/kg, 2,100 mg/kg, and 750 mg/kg) exceeded its PGW SSL (500 mg/kg) at 5-, 11-, and 35-foot bgs, respectively. Groundwater in the vicinity of this location is impacted by TPH-D and TPH-Mo. A containment/remedial alternative other than excavation (eg air sparging and soil vapor extraction) will be used (See Section 6.0).	R
AE-R-2	AE-R-4 AE-N-4 AE-N-5 AE-N-21	HH	03D-SB05 03D-SB06 03D-SB07 03D-SB20 03D-SB33	1,1,2,2-PCA, A-1254, Fe	5E-4	4.2E+1 (RC)	—	—	—	—	34-37	NI	Commercial	Adjacent to building, excavation may impact structure	**At sample location 03D-SB05**, A-1254 exceeded the resident ILCR in the 1- and 5-foot bgs samples (2.6E-5 and 1.4E-6, respectively) and commercial worker receptors (7.8E-6) at 5 feet bgs, but A-1254 did not exceed HH risk in the 4- or 10-foot bgs samples. **At sample location 03D-SB06**, A-1254 (5E-6) exceeded the ILCR for resident child in the 10-foot bgs sample, but does not exceed HH risk in the 1-or 5-foot bgs samples. Iron (3.8E+0) exceeded resident child HI at 10 feet bgs. **At sample location 03D-SB07**, 1,1,2,2-PCA exceeded the ILCR for resident child (5E-6) and commercial worker (2E-6) receptors at 1 foot bgs, but 1,1,2,2-PCA did not exceed HH risk in the 5-, 7-, or 10-foot bgs samples. **At sample location 03D-SB20**, A-1254 (5E-6) exceeded the resident child ILCR in the 11-foot bgs sample, but did not exceed HH risk in the 5-foot bgs sample. **At sample location 03D-SB33**, A-1254 exceeded the ILCR for resident child (5E-4), construction worker (2E-5) and commercial worker (2E-4), and the HI for resident child (4.2E+1), resident adult (5.0E+0), construction worker (1.1E+1) and commercial worker (4.4E+0) in the 5-foot bgs sample. No compounds exceeded HH risk in the 11-foot bgs sample. At a minimum, the area will be capped or excavated to a depth of 6 feet bgs (to protect future commercial/industrial reuse and construction worker) and the extent of impacts will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 and 1,1,2,2-PCA impacts (outside the buildings) will be determined prior to capping. Additional land use controls will be necessary to prevent residential reuse unless soil is remediated to residential standards.	R
AE-R-3	AE-N-17	HH	03D-AH01	B(a)A, B(a)P, B(b)F, B(k)F, Chrysene, D(a,h)A, I(1,2,3-cd)P, 1,1,2,2-PCA	2E-3	4.6E-1 (RC)	—	—	—	—	33	NI	Commercial	Adjacent to building, excavation may impact structure	B(a)A, B(a)P,B(b) F, B(k)F, D(a,h,)A, chrysene, and I(1,2,3-cd)P risk exceeded the ILCR for resident (total risk 2E-3), and commercial worker (total risk 7E-4) and B(a)A, B(a)P,B(b) F, B(k)F, D(a,h,)A, and I(1,2,3-cd)P exceeded the construction worker (total risk 7E-5) ILCR in the 3-foot bgs sample, but not in the 0.01-foot bgs sample, and no deeper samples were collected. At a minimum, the area will be excavated to 4 feet bgs and the lateral and vertical extent of PAH impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of PAH impact (outside the building) will be determined prior to capping.	R
AE-R-4	AE-R-2 AE-N-5	HH	03D-SB33	A-1254	5E-4	4.2E+1 (RC)	—	—	—	—	35	NI	Commercial	No	A-1254 exceeded the ILCR for resident child (5E-4), construction worker (2E-5) and commercial worker (2E-4). A-1254 exceeded the HI for resident child (4.2E+1), resident adult (5.0E+0), construction worker (1.1E+1), and commercial worker (4.4E+0) receptors at 5 feet bgs. No compounds exceeded HH risk at 11 feet bgs. At a minimum, the area will be excavated to a depth of 6 feet bgs (to protect future commercial/industrial reuse and construction worker), and the lateral and vertical extent of A-1254 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping. Additional land use controls will be necessary to prevent residential reuse unless soil is remediated to residential standards.	R
AE-R-5	AE-R-6 AE-R-7 AE-N-6	HH	03D-SB02 03D-SB67 03D-SB69	A-1254	3E-5	3.0E+0 (RC)	—	—	—	—	34	NI	Commercial	A portion of the excavation area is adjacent to a building, excavation may impact structure	**At sample location 03D-SB02**, A-1254 exceeded the resident (3E-5) and commercial worker (9E-6) ILCR and resident child HI (3E+0) in the 1-foot bgs sample but not in the 0.01- 3-, 6-, 7-, 10-, and 11-foot bgs samples. **At sample location 03D-SB67**, A-1254 exceeded resident and commercial worker ILCR (1E-6) in the 1-foot bgs sample (6E-6 and 2E-6, respectively), and residential ILCR in the 10-foot bgs sample (2E-6), but not in the 5-foot bgs sample. **At sample location 03D-SB69,** A-1254 exceeded resident ILCR (1E-6) in the 1-foot bgs sample (4E-6), but not in the 5-foot bgs sample. At a minimum, the area will be capped or excavated to a depth of 2 feet bgs (to protect future commercial/industrial reuse and construction worker), and the lateral and vertical extent of A-1254 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact (outside the buildings) will be determined prior to capping. Additional land use controls will be necessary to prevent residential reuse unless soil is remediated to residential standards.	R

Table 1-4
Summary of Soil Risks and Rationale for Remedial Action - Administration Area East
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained, or Remediation Completed
AE-R-6	AE-R-5 AE-R-7 AE-N-6	HH	03D-AH02 03D-SB02 03D-SB46 03D-SB68	A-1254, B(a)A, B(a)P, B(b)F, B(k)F, Chrysene, I(1,2,3-cd)P	2E-3	9.8E+0 (RC)	—	—	—	—	34	NI	Commercial	A portion of the excavation area is adjacent to a building, excavation may impact structure	**At sample location 03D-AH02**, the total risk from B(a)A, B(a)P,B(b) F, B(k)F, chrysene and/or I(1,2,3-cd)P exceeded the resident (2E-3), construction worker (7E-5) and commercial worker (7E-4) ILCR (1E-6) in the 3-foot bgs sample, but not in the 0.01-foot bgs sample. No deeper samples were collected at this location. **At sample location 03D-SB02**, A-1254 exceeded the ILCR for resident (3E-5) and commercial worker (9E-6) and resident child HI (3E+0) in the 1-foot bgs sample. No compounds exceeded HH risk in the 0.01-, 3-, 6-, 7-, 10-, and 11-foot bgs samples. **At sample location 03D-SB46,** A-1254 exceeded the ILCR for resident (1E-4), construction worker (4E-6), and commercial worker (4E-5) and the HI for resident child (9.8E+0), adult (1.2E+0), and construction worker (2.6E+0) in the 11-foot bgs sample. No compounds exceeded HH risk in the 5-foot bgs sample at this location. **At sample location 03D-SB68,** A-1254 exceeded the ILCR for resident (2E-5) and commercial worker (6E-6) and HI for resident child (1.5E+0) in the 1 foot bgs sample, and the ILCR for resident (4E-6) in the 10-foot bgs sample. No compounds exceeded the HH risk in the 5 foot bgs sample at this location. At a minimum, the area will be capped or excavated to 4 feet bgs to address the shallow HH risk to commercial/industrial reuse and construction workers and the lateral and vertical extent of the A-1254 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent (outside the buildings) of A-1254 impact will be determined prior to capping. Additional land use controls will be necessary to prevent residential reuse unless soil is remediated to residential standards. Additional land use controls will be necessary to prevent residential reuse unless soil is remediated to residential standards.	R
AE-R-7	AE-R-5 AE-R-6 AE-N-6	RTG	03D-SB46 03D-SB67	—	—	—	—	—	Naph, A-1254, TPH-D, TPH-Mo	9	34	NI	Commercial	A portion of the excavation area is adjacent to a building, excavation may impact structure	**At sample location 03D-SB46**, A-1254, TPH-D, and TPH-Mo were ranked as high RTGs and Naph was ranked as a low RTG. Naph (1,900 µg/kg) exceeded its PGW SSL (140 µg/kg) in only the 5-foot bgs sample. A-1254 (11,000 µg/kg), TPH-D (9,100 mg/kg), and TPH-Mo (12,000 mg/kg) exceeded their PGW SSLs (34 µg/kg, 100 mg/kg and 500 mg/kg, respectively) only in the 11-foot bgs sample. No compounds exceeded PGW SSLs in the 15-foot bgs sample. Groundwater was impacted by A-1254, TPH-D, and TPH-Mo in nearby well 881. **At sample location 03D-SB67**, A-1254 was ranked as a high RTG. A-1254 (510 µg/kg, 140 µg/kg, and 8,700 µg/kg) exceeded its PGW SSL (34 µg/kg) at depths of 1, 10 and 15 feet bgs, respectively. At a minimum, the area will be capped or excavated to 12 feet bgs (1 foot below the deepest exceedence at sample location 03D-SB46) and a containment/remedial alternative other than excavation will be used for the deeper A-1254 exceedence at this location (See Section 6.0). If capping is selected as the final remedy, the lateral extent of A-1254 and TPH impacts (outside the buildings) will be determined prior to capping.	R
AE-R-8	AE-N-14 AE-N-15	HH	A20-RB37-SB01 A20-RB37-SB02	A-1254 Pb	4E-5	3.0E+0 (RC)	—	—	—	—	27	NI	Commercial	Adjacent to building, excavation may impact structure	**At sample location A20-RB37-SB01**, A-1254 exceeded the HI for resident child (2.8E+0) in the 1-foot bgs sample. Resident child blood lead (14 µg/dL) exceeded the blood lead risk level (10 µg/dL) in the 1-foot bgs sample. No compounds exceeded HH risk in the 5-foot and 11-foot bgs samples. **At sample location A20-RB37-SB02**, A-1254 exceeded the HI for a resident child (1.8E+0) in the 1-foot bgs sample, HH risk was not exceeded in the 5- and 11-foot bgs samples. The high human health risk contour is based upon a residential scenario. The risk to human health (residential) extends to a depth of 1 foot below ground surface. Although this area is intended to remain commercial/industrial; since the impact is so limited, the area will be excavated to 2 feet bgs and the lateral and vertical extent of A-1254 and lead impact will be assessed during excavation. If excavation is not selected, then deed restrictions will need to be developed to prevent residential redevelopment and/or specify the requirements for residential redevelopment (excavation to 2 feet bgs or capping).	R
AE-R-9	AE-N-12 AE-N-13	HH	03D-SNS34	A-1254, A-1260, Cr+6	2E-5	1.8E+0 (RC)	—	—	—	—	22	NI	Commercial	Adjacent to building, excavation may impact structure	This sample was collected from a drainage inlet. A-1254 (4.7E-6 and 1.4E-6) and A-1260 (1.7E-5 and 5.0E-6) exceeded residential and commercial worker ILCR, respectively, and A-1260 (1.3E+0) exceeded resident child HI in the 0.25 foot bgs sample. Cr+6 (2.9E-6) exceeded the construction worker ILCR at 0.5 feet. The high human health risk contour is based upon a residential scenario. The risk to human health (residential) extends to a depth of 0.5 foot below ground surface. Although this area is intended to remain commercial/industrial; since the impact is so limited, the sediment will be removed and the culvert will be cleaned. Alternatively, deed restrictions will need to be developed to prevent residential redevelopment and/or specify the requirements for residential redevelopment (culvert cleaning or capping).	R
AE-C-1	AE-C-2 AE-C-5 AE-C-10	HH	11D-SNS22	A-1260	2E-5	1.2E+0 (RC)	—	—	—	—	27	NA HH Risk Only	Commercial	No	A-1260 exceeded the resident (2E-5) and commercial worker (4E-6) ILCR and resident child HI (1.2E+0) in the 0.5-foot bgs sample but not in the 2.5-foot bgs sample. Sample 11D-SNS22 is within the ditch and the high HH risk at this RA was addressed in 2010 by excavation at AE-C-5.	C

Table 1-4
Summary of Soil Risks and Rationale for Remedial Action - Administration Area East
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Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained, or Remediation Completed
AE-C-2	AE-C-1 AE-C-5 AE-C-10	RTG	11D-SNS16 11D-SNS17 11D-SNS22	—	—	—	—	—	A-1260, B(a)P, B(b&k)F, Cd	6	27-28	NI	Commercial	No	The RTG contaminants were low mobility/solubility compounds (A-1260, SVOCs, and metals), ranked as negligible to moderate RTGs, and the contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. The RTG at this RA was addressed by the excavation conducted during 2010 at AE-C-5. **At sample location 11D-SNS16**, A-1260 (1,100 µg/kg) exceeded its PGW SSL (34 µg/kg) at 0.5 feet and was ranked as a moderate RTG. Cd (2 mg/kg) exceeded its PGW SSL (1.2 mg/kg) in the 0.5-foot bgs sample and was ranked as a low RTG. No compounds exceeded their PGW SSLs in the 2.5-foot bgs sample. **At sample location 11D-SNS17**, A-1260 (150 µg/kg) exceeded its PGW SSL (34 µg/kg) at 0.5 feet and was ranked as a moderate RTG. B(a)P (41 µg/kg) and B(b&k)F (64 µg/kg and 29 µg/kg) exceeded their PGW SSLs (2.9 µg/kg and 29 µg/kg, respectively) in the 0.5-foot bgs sample and were ranked as low RTGs. **At sample location 11D-SNS22**, A-1260 (1,300 µg/kg) and B(a)P (9 µg/kg) exceeded their PGW SSLs (34 µg/kg and 2.9 µg/kg, respectively) in the 0.5-foot bgs sample and were ranked as low RTGs. Cd (3.7 mg/kg) and Pb (23 mg/kg) exceeded their PGW SSLs (1.2 mg/kg and 23 mg/kg, respectively) in the 0.5-foot bgs sample and were ranked as negligible RTGs.	C
AE-C-3	AE-C-5 AE-C-6 AE-C-11	HH	11D-SNS15	A-1254, Pb	1E-4	9E+0 (RC)	NA	NA	NA	NA	28	NI	Commercial	No	A-1254 exceeded the ILCR for the resident (1.1E-4) and exceeded the HI for resident child (8.9E+0), resident adult (1.1E+0) and construction worker (2.3E+0) in the 0.5-foot bgs sample. Resident child blood lead (11 µg/dL) exceeded the blood lead risk level (10 µg/dL) in the 0.5-foot bgs sample. HH risks were not exceeded at 2.5 feet bgs. The risk drivers for this remedial area are the residential child HI and blood lead exceedences. The HH risk at this RA was addressed in 2010 by excavation at AEE-C-5.	C
AE-C-4	AE-C-3 AE-C-5 AE-C-6	HH	A20-RB37-SB01 A20-RB37-SB02	A-1254, A-1260, Pb	1E-4	—	—	—	—	—	28	—	Commercial	A portion of the excavation area is adjacent to a building, excavation may impact structure	**At sample location A20-RB37-SB01**, A-1254 exceeded the ILCR for resident (3.5E-5) and commercial worker (1.0E-5) ILCRs and the resident child HI (2.8E+0) in the 1-foot bgs sample. Resident child blood lead (14 µg/dL) in the 1-foot bgs sample exceeded the blood lead risk level (10 µg/dL). No compounds exceeded HH risk in the 5- and 11-foot bgs samples. **At sample location A20-RB37-SB02**, A-1254 exceeded the ILCR for resident (2.3E-5) and commercial worker (6.7E-6) receptors and the HI for resident child (1.8E+0) at 1 foot bgs, respectively. No compounds exceeded HH risk in the 5- and 11-foot bgs samples. The HH risk at this RA was addressed in 2010 by excavation at AE-C-5.	C
AE-C-5	AE-C-1 AE-C-2 AE-C-3 AE-C-4 AE-C-5 AE-C-6 AE-C-10 AE-C-11	Ecological	11D-SNS01 11D-SNS02 11D-SNS03 11D-SNS10 11D-SNS12 11D-SNS14 11D-SNS13 11D-SNS15 11D-SNS16 11D-SNS17 11D-SNS22 A20-RC29-SB01	—	—	—	A-1016, A-1248, A-1254, A-1260, Hg, Mo, Zn	6941 (A)	—	—	28	NI	Commercial	No	COPECS exceeding their respective screening levels were detected in the 0.01- to 2.5-foot bgs interval. The southern east-west portion of the drainage system is a concrete culvert covered with asphalt. No habitat exists; however, the area is retained for HH risk (AE-R-8). The ecological risk at this RA was addressed in 2010 by excavation to depths between 2 and 10 feet bgs and the culverted portions of this area were rinsed to remove sediment. A removal action report (Aerojet, 2010) was submitted and accepted by the Agencies as documentation to support completion of terms in the Unilateral Administrative Order dataed November 2, 2009 for a Time Critical Removal Action (USEPA 2010).	C
AE-C-6	AE-C-3 AE-C-4 AE-C-5 AE-C-11	RTG	11D-SNS12 11D-SNS14 11D-SNS15 A20-RC29-SB01	—	—	—	—	—	A1254, A-1260, B(a)P, B(b&k)F, TPH-Mo, Cd, Pb	6	27-28	NI	Commercial	No	The RTG contaminants were low mobility/solubility compounds (PCBs, SVOCs and metals), ranked as negligible to moderate RTGs, and the contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. The RTG at this RA was addressed by the excavation conducted during 2010 at AE-C-5. **At sample location 11D-SNS12**, A-1254, A-1260, and Pb were ranked as low RTGs. A-1254 (160 µg/kg), A-1260 (330 µg/kg), and Pb (36 mg/kg) exceeded their PGW SSLs (34 µg/kg, 34 µg/kg, and 23 mg/kg, respectively) only at 0.5 foot bgs. **At sample location 11D-SNS13**, A-1254 and A-1260, were ranked as negligible RTGs. A-1254 (120 µg/kg) and A-1260 (310 µg/kg) exceeded their PGW SSLs (34 µg/kg) in only the 0.5-foot bgs sample. **At sample location 11D-SNS14**, A-1254, B(a)P and Cd were ranked as low RTGs. A-1254 (150 µg/kg), B(a)P (7 µg/kg), and Cd (1.4 mg/kg) exceeded their PGW SSLs (34 µg/kg, 2.9 µg/kg, and 1.2 mg/kg, respectively) only in only the 0.5-foot bgs sample. **At sample location 11D-SNS15**, A-1254 was ranked as a moderate RTG, B(a)P, B(b&k)F, Cd, and Pb were ranked as low RTGs. A-1254 (10,000 µg/kg), B(a)P (41 µg/kg), B(b&k)F (30 µg/kg), Cd (2.7mg/kg), and Pb (150 mg/kg) exceeded their PGW SSLs (34 µg/kg, 2.9 µg/kg, 29 µg/kg, 1.2 mg/kg, and 23 mg/kg, respectively) in only the 0.5-foot bgs sample. **At sample location A20-RC29-SB01**, A-1254 was ranked as a negligible RTG and TPH-Mo was ranked as a moderate RTG. A-1254 (59 µg/kg) exceeded its PGW SSL (34 µg/kg) in only the 1-foot bgs sample. TPH-Mo (620 mg/kg) exceeded its PGW SSL (500 mg/kg) in only the 5-foot bgs sample. No compounds exceeded their PGW SSLs in the 11-foot bgs sample.	C
AE-C-7	AE-C-8 AE-C-9	HH	11D-SB06	A-1260	2E-5	1.4E+0 (RC)	—	—	—	—	27	NI	Commercial	No	A-1260 exceeded the HI for resident child HI (1.4E+0) risk level in the 1 foot bgs sample. No compounds exceeded HH risk in the 5- and 11-foot bgs samples. The high HH risk at this RA was addressed in 2010 by excavation to a depth of 8 feet over a 25-foot by 30 foot area in the vicinity of sample location 11D-SB06 and an additional 90-foot by 30-foot strip was excavated to the south of this location to a depth of 2 feet bgs.	C

Table 1-4
Summary of Soil Risks and Rationale for Remedial Action - Administration Area East
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained, or Remediation Completed
AE-C-8	AE-C-7 AE-C-9	HH	11D-SB06	A-1260	2E-5	1.4E+0 (RC)	—	—	—	—	27	NI	Commercial	No	A-1260 exceeded the ILCR risk levels for resident (2E-5) and commercial worker (5E-6) in the 1 foot bgs sample. No compounds exceeded HH risk in the 5- and 11-foot bgs samples. The low HH risk at this RA was addressed in 2010 by excavation to a depth of 8 feet over a 25-foot by 30 foot area in the vicinity of sample location 11D-SB06 and an additional 90-foot by 30-foot strip was excavated to the south of this location to a depth of 2 feet bgs.	C
AE-C-9	AE-C-7 AE-C-8	RTG	11D-SB06	—	—	—	—	—	A-1260	3	27	NI	Commercial	No	A-1260 (1,600 µg/kg) exceeded its PGW SSL (34 µg/kg) at 1-foot bgs and was ranked as a low RTG. No compounds exceeded their PGW SSLs at 5 feet or 11 feet bgs. The RTG risk at this RA was addressed in 2010 by excavation to a depth of 8 feet over a 25-foot by 30 foot area in the vicinity of sample location 11D-SB06 and an additional 90-foot by 30-foot strip was excavated to the south of this location to a depth of 2 feet bgs.	C
AE-C-10	AE-C-1 AE-C-2 AE-C-5	HH	11D-SNS16 11D-SNS17 11D-SNS22	A-1260	2E-5	1.2E+0 (RC)	—	—	—	—	28	NI	Commercial	No	**At sample location 11D-SNS16**, A-1260 (1E-5 and 4E-6) in the 0.5-foot bgs sample exceeded resident and commercial worker ILCR, respectively. No compounds exceeded HH risk in the 2.5-foot bgs sample. **At sample location 11D-SNS17**, A-1260 (3E-6) exceeded resident ILCR in the 0.5 foot bgs sample. No compounds exceeded HH risk in the 2.5-foot bgs sample. **At sample location 11D-SNS22**, A-1260 exceeded the ILCR for resident (2E-5) and commercial worker (4E-6) and the HI for resident child (1.2E+0) in the 0.5-foot sample. No compounds exceeded HH risk in the 2.5-foot bgs sample. The risk at this area was based on samples collected from a ditch. The low HH risk at this RA was addressed in 2010 by excavation at AE-C-5.	C
AE-C-11	AE-C-3 AE-C-4 AE-C-5 AE-C-6	HH	11D-SNS15	A-1254	3E-5	9.5E-1 (CW)	—	—	—	—	28	NI	Commercial	No	A-1254 exceeded the ILCR for construction worker (3.3E-6), and commercial worker (3.4E-5) receptors. HH risks were not exceeded at 2.5 feet bgs. The low HH risk at this RA was addressed in 2010 by excavation at AE-C-5.	C
AE-N-1	—	RTG	51D-SB06	—	—	—	—	—	Cd	1	36	NI	Commercial	No	The RTG was ranked as negligible; therefore, this RA was not recommended for retention. Cd (2.2 mg/kg) exceeded its PGW SSL (1.2 mg/kg).	N
AE-N-2	AE-N-3	RTG	03D-SB17	—	—	—	—	—	B(a)A, TPH-D, TPH-Mo	6	37	NI	Commercial	No	The RTG contaminants were a low mobility/solubility compound (B(a)A) ranked as a negligible RTG, and TPH ranked as a moderate RTG. The concentrations were decreasing with depth and were bounded below the PGW SSL at 5 feet; therefore, this RA was not recommended for retention. B(a)A (130 µg/kg) exceeded its PGW SSL (29 µg/kg) in the 1-foot bgs sample. TPH-D (850J mg/kg) and TPH-Mo (4,300 mg/kg) exceeded their PGW SSLs (100 mg/kg and 500 mg/kg, respectively) at 1- foot bgs sample. B(a)A was not detected and TPH-D and TPH-Mo were below their PGW SSLs in the 5- and 11-foot samples.	N
AE-N-3	AE-N-2	HH	03D-SB04	1,1,2,2-PCA	6E-6	4.7E-1 (RC)	—	—	—	—	35	NI	Commercial	Adjacent to building, excavation may impact structure	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. 1,1,2,2-PCA exceeded the ILCR for resident child (6E-6) and commercial worker (2E-6) in the 1-foot bgs sample and resident child (3E-6) at 10 feet bgs. No compounds exceeded HH risk at 3-, 5-, and 6 feet bgs.	N
AE-N-4	AE-R-2 AE-N-5 AE-N-21	RTG	03D-SB43	—	—	—	—	—	A-1254	6	34	NI	Commercial	No	The RTG contaminant (A-1254) was a low mobility/solubility compound and ranked as moderate. The concentrations decrease with depth and were bounded below the PGW SSL at 11 feet, which is deeper than the retention criteria (<5 feet); however, no compounds exceeded their PGW SSLs in the 23- or 35-feet bgs samples. Therefore, this RA was not recommended for retention. **At sample location 03D-SB43,** A-1254 (110 µg/kg and 37 µg/kg) exceeded the PGW SSL (34 µg/kg) at 5 feet and 11 feet bgs, respectively, and was ranked as a moderate RTG.	N
AE-N-5	AE-R-2 AE-R-4 AE-N-4 AE-N-21	RTG	03D-SB20 03D-SB33 03D-SB43 03D-SB63 03D-SB64 03D-SB65 03D-SB66	—	—	—	—	—	A-1254, TPH-D, TPH-Mo	6	34-37	NI	Commercial	No	The RTG contaminants were A-1254 (a low mobility/solubility compound) and TPH, ranked as negligible to moderate RTGs. The A-1254 concentrations decreased with depth and were bounded below 15 feet. TPH was not bounded at 03D-SB20 below PGW SSLs by samples collected deeper than 11 feet bgs; however, TPH concentrations were below PGW SSLs in samples collected at 23 feet bgs at location 03D-SB33 located about 30 feet away. Although the screening levels were still exceeded deeper than the retention criteria, based on thickness of unimpacted soils at depth and the contaminants' low mobility, the area was not recommended for retention. **At sample location 03D-SB20**, A-1254 and TPH-Mo were ranked as low RTGs, and TPH-D was ranked as a moderate RTG. A-1254 (430 µg/kg), TPH-D (6,000 mg/kg), and TPH-Mo (1,000 mg/kg) exceeded their PGW SSLs (34 µg/kg, 100 mg/kg, and 500 mg/kg, respectively) at 11 feet bgs. **At sample location 03D-SB33**, A-1254 (47,000 µg/kg and 98 µg/kg) exceeded the PGW SSL (34 µg/kg) in the 5- and 11-foot bgs samples, respectively, and was ranked as a moderate RTG. **At sample location 03D-SB43**, A-1254 (110 µg/kg and 37 µg/kg) exceeded the PGW SSL (34 µg/kg) in the 5- and 11-foot bgs samples, respectively, and was ranked as a moderate RTG. **At sample location 03D-SB63**, A-1254 (46 µg/kg and 63 µg/kg) exceeded the PGW SSL (34 µg/kg) in the 10- and 15-foot bgs samples, respectively, and was ranked as a moderate RTG. **At sample location 03D-SB64**, A-1254 (50 µg/kg and 47µg/kg) exceeded the PGW SSL (34 µg/kg) in the 1- and 5-foot bgs samples, respectively, and was ranked as a negligible RTG. **At sample location 03D-SB65**, A-1254 (55 µg/kg) exceeded the PGW SSL (34 µg/kg) at 12 feet bgs and was ranked as a moderate RTG. **At sample location 03D-SB66**, A-1254 (51 µg/kg and 100 µg/kg) exceeded the PGW SSL (34 µg/kg) in the 10- and 15-foot bgs samples, respectively, and was ranked as a low RTG.	N

Table 1-4
Summary of Soil Risks and Rationale for Remedial Action - Administration Area East
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained, or Remediation Completed
AE-N-6	AE-R-5 AE-R-6 AE-R-7	RTG	03D-SB45 03D-SB68 03D-SB69	—	—	—	—	—	Naph, A-1254	6	34	NI	Commercial	A portion of the area is adjacent to a building, excavation may impact structure	The RTG contaminants were low mobility/solubility compounds (Naph and A-1254) and were ranked as a low to moderate RTG, respectively; therefore, this RA was not recommended for retention. **At sample location 03D-SB45**, Naph (280 µg/kg) exceeded its PGW SSL (140 µg/kg) at 5 feet bgs. No other samples were collected. **At sample location 03D-SB68**, A-1254 (1,700 µg/kg, 86 µg/kg, 320 µg/kg, and 78 µg/kg) exceeded the PGW SSL (34 µg/kg) in the 1-, 5-,10-, and 15-foot bgs samples. **At sample location 03D-SB69**, A-1254 (370 µg/kg and 16,000 µg/kg) exceeded the PGW SSL (34 µg/kg) in the 1- and 15-foot bgs samples.	N
AE-N-7	—	RTG	03D-SB52	—	—	—	—	—	A-1254, TPH-D, TPH-Mo, Pb	4	33	NI	Commercial	No	RTG contaminants were ranked as low or negligible RTGs; therefore, this RA was not recommended for retention. A-1254 (48 µg/kg) and Pb (23 mg/kg) exceeded their PGW SSLs (34 µg/kg and 23 mg/kg, respectively) in the 1-foot bgs sample and were ranked as negligible RTGs. TPH-D (110 mg/kg) and TPH-Mo (660 mg/kg) exceeded their PGW SSLs (100 mg/kg and 500 mg/kg, respectively) in the 5-foot bgs sample and were ranked as low RTGs. No compounds exceeded PGW SSLs in the 11-foot bgs sample at this location. PCBs, TPH, and metals generally have low solubility and mobility.	N
AE-N-8	—	RTG	03D-SB27	—	—	—	—	—	B(a)P, TPH-D, TPH-Mo	6	32	NI	Commercial	Adjacent to building, excavation may impact structure	The RTG contaminants were a low mobility/solubility compound (B(a)P) ranked as a low RTG, and TPH ranked as a moderate RTG. The contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. TPH-D (170 mg/kg) and TPH-Mo (660 mg/kg) exceeded their PGW SSLs (100 mg/kg and 500 mg/kg, respectively) in the 1-foot bgs sample. B(a)P (6.1 µg/kg) exceeded the PGW SSL (2.9 µg/kg) in the 1-foot bgs sample.	N
AE-N-9	—	RTG	03D-SB36	—	—	—	—	—	B(a)A, TPH-D	6	31	NI	Commercial	Adjacent to building, excavation may impact structure	The RTG contaminants were a low mobility/solubility compound (B(a)A) ranked as a low RTG, and TPH ranked as a moderate RTG. Both compounds were found in groundwater, but are likely from upgradient sources (see PGW Evaluation in HHRA Volume II); therefore, this RA was not recommended for retention. TPH-D (120 mg/kg) exceeded the PGW SSL (100 mg/kg) only in the 11-foot bgs sample. No deeper samples were collected. B(a)A (42 µg/kg) exceeded the PGW SSL (29 µg/kg) only in the 1-foot bgs sample.	N
AE-N-10	AE-N-20	RTG	03D-SB22	—	—	—	—	—	A-1248	4	30	NI	Commercial	Collected inside building, excavation delayed until building demolition	The RTG ranking was low; therefore, this RA was not recommended for retention. A-1248 (260 µg/kg) exceeded the PGW SSL (34 µg/kg) only in the 7.75-foot bgs sample, but was not detected in the 11-foot bgs sample.	N
AE-N-11	—	RTG	A20-RX73-SB03	—	—	—	—	—	B(a)P, TPH-D, TPH-Mo	6	29	NI	Commercial	Adjacent to building, excavation may impact structure	The RTG contaminants were a low mobility/solubility compound (B(a)P) ranked as a low RTG, and TPH ranked as a low or moderate RTG. The contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(a)P (7.4 µg/kg), TPH-D (250 mg/kg), and TPH-Mo (940 mg/kg) exceeded PGW SSLs (2.9 µg/kg, 100 mg/kg, 500 mg/kg, respectively) in the 1-foot bgs sample. No compounds exceeded PGW SSLs in the 5- or 11-foot bgs samples.	N
AE-N-12	AE-R-9 AE-N-13	RTG	03D-SNS34	—	—	—	—	—	A-1254, A-1260, B(a)A, B(a)P, B(b&k)F, Cd, Pb	6	22	NI	Commercial	Adjacent to building, excavation may impact structure	The RTG contaminants were a low mobility/solubility compound (B(a)P) ranked as a low RTG, and TPH ranked as a low or moderate RTG. The contamination was only in shallow[5] soil samples collected from a lined culvert; therefore, this RA was not recommended for retention. A-1254, A-1260, B(a)A, B(a)P, B(b&k)F, Cd, and Pb RTG were ranked as a negligible RTG because the sample was collected from a lined culvert. A-1254 (420 mg/kg), A-1260 (1,500 mg/kg), B(a)A (42 µg/kg), B(a)P (38 µg/kg), B(b&k)F (88 µg/kg), Cd (3.5 mg/kg), and Pb (110 mg/kg) exceeded PGW SSLs (34 µg/kg, 34 µg/kg, 29 µg/kg, 2.9 µg/kg, 29 µg/kg, 1.2 mg/kg, and 23 mg/kg, respectively) in the 0.25-foot bgs sample; no deeper samples were collected. The high HH risk associated with this boring location is addressed in RA AE-R-9 above.	N
AE-N-13	AE-R-9 AE-N-12	HH	03D-SNS34	A-1254, A-1260, Cr+6	2E-5	1.8E+0 (RC)	—	—	-	-	-	NI	Commercial	Adjacent to building, excavation may impact structure	The HH risk was just above 1E-6, HI<1; therefore, this RA was not recommended for retention. A-1254 (4.7E-6 and 1.4E-6) and A-1260 (1.7E-5 and 5.0E-6) exceeded residential and commercial worker ILCR, respectively, in the 0.25 foot bgs sample. No deeper samples were collected at this location. Cr+6 (2.9E-6) exceeded the construction worker ILCR at 0.5 feet. The high HH risk associated with this boring location is addressed in RA AE-R-9 above.	N
AE-N-14	AE-R-8 AE-N-15	RTG	A20-RB37-SB01	—	—	—	—	—	A1254, B(a)P, TPH-D, Cd, Pb	4	29	NI	Commercial	Adjacent to building, excavation may impact structure	The RTG contaminants were low mobility/solubility compounds (A-1254, B(a)P, and metals) and TPH, ranked as low or negligible RTGs, and the contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. TPH-D was ranked a low RTG and A-1254, B(a)P, Cd, and Pb were ranked as negligible RTGs. A-1254 (3,100 µg/kg), B(a)P (16 µg/kg), TPH-D (270 mg/kg), Cd (1.6 mg/kg), and Pb (210 mg/kg) exceeded their PGW SSLs (34 µg/kg, 2.9 µg/kg, 100 mg/kg, 1.2 mg/kg, and 23 mg/kg, respectively) in the 1-foot bgs sample, but were below their respective PGW SSLs in the 5- and 11-foot bgs samples. The high HH risk associated with this boring location is addressed in RA AE-R-8 above.	N
AE-N-15	AE-R-8 AE-N-14	HH	A20-RB37-SB01 A20-RB37-SB02 A20-RB37-SB03	A-1254	4E-5	3.0E+0 (RC)	—	—	—	—	—	NI	Commercial	Adjacent to building, excavation may impact structure	The risk driver for this remedial area is low risk for residential and commercial receptors. The area is covered with asphalt. The RA was not recommended for retention because the anticipated future use for this remedial area is commercial. The high HH risks associated locations A20-RB37-SB01 and A20-RB37-SB02 are discussed in RA AE-R-8 above. **At sample location A20-RB37-SB01**, A-1254 exceeded the ICLR for resident (3.5E-5) and commercial worker (1.0E-5) in the 1-foot bgs sample. No compounds exceeded HH risk in the 5-foot and 11-foot bgs samples. **At sample location A20-RB37-SB02**, A-1254 exceeded the ILCR for the resident (2.3E-5) and commercial worker (6.7E-6) receptors in the 1-foot bgs sample, HH risk was not exceeded in the 5- and 11-foot bgs samples. **At sample location A20-RB37-SB03,** A-1254 exceeded the ILCR for the resident (2.4E-6) in the 1-foot bgs sample, HH risk was not exceeded in the 5- and 11-foot bgs samples.	N

Table 1-4
Summary of Soil Risks and Rationale for Remedial Action - Administration Area East
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Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained, or Remediation Completed
AE-N-16	—	HH	03D-SB37	A-1254	2E-6	1.4E-4 (RC)	—	—	—	—	30	NI	Commercial	Adjacent to building, excavation may impact structure	HH risk was just above 1E-6, HI<1; therefore, this RA was not recommended for retention. A-1254 (1.6E-6) exceeded the resident ILCR in the 5- foot bgs sample, but did not exceed in the 11-foot bgs sample.	N
AE-N-17	AE-R-3	HH	03D-SB01 03D-AH01	1,1,2,2-PCA	3E-6	7.9E-1 (RC)	—	—	—	—	33	NI	Commercial	No	The HH risk was just above 1E-6, HI<1; therefore, this RA was not recommended for retention. 1,1,2,2-PCA (3E-6) exceeded the resident ILCR at 1-foot bgs sample, but not in the 5- or 10-foot bgs samples.	N
AE-N-18	—	HH	51D-SB02 51D-SB04	1,1,2,2-PCA	8E-6	3.1E-3 (RC)	—	—	—	—	34	NI	Commercial	No	HH risk was just above 1E-6, HI<1; therefore, this RA was not recommended for retention. **At sample location 51D-SB02**, 1,1,2,2-PCA (5E-6 and 2E-6) exceeded ILCR for resident and commercial worker, respectively in the 1-foot bgs sample. No compounds exceeded HH risk levels in the 5- and 11-foot bgs samples. **At sample location 51D-SB04**, 1,1,2,2-PCA exceeded ILCR for resident (8E-6) and commercial worker (3E-6) in the 1 foot bgs sample. No compounds exceeded HH risk levels in the 1.5-, 5-, and 11-foot bgs samples.	N
AE-N-19	—	RTG	03D-SB50	—	—	—	—	—	A-1260	3	34	NI	Commercial	No	The RTG contaminant was a low mobility/solubility compound (A-1260) and ranked as a low RTG, and the contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1260 (65 µg/kg) exceeded its PGW SSL (34 µg/kg) in the 1-foot bgs sample and was not detected in the 5- or 11-foot bgs samples.	N
AE-N-20	AE-N-10	HH	03D-SB22	A-1248	3E-6	2.4E-1 (RC)	—	—	—	—	30	NI	Commercial	Collected inside building, excavation delayed until building demolition	The HH risk was just above 1E-6, HI<1; therefore, this RA was not recommended for retention. A-1248 (3E-6) exceeded resident ILCR in the 7.75-foot bgs sample. No compounds exceeded HH risk in the 11 foot bgs sample.	N
AE-N-21	AE-R-2 AE-N-4 AE-N-5	HH	03D-SB05 03D-SB06	A-1254, A-1260Fe	3E-5	3.8E+0 (RC)	—	—	—	—	35	NI	Commercial	Adjacent to building, excavation may impact structure	The HH risk was below 1E-5; Commercial or CW HI<1 for any individual chemical; therefore, this RA was not recommended for retention. The likelihood for residential re-use of the Admin Area is low. **At sample location 03D-SB05**, A-1254 (2.4E+0) exceeded the HI for resident child and ILCR for resident (3E-5) and commercial worker (8E-6) at 5 feet bgs only. **At sample location 03D-SB06**, iron (3.8E+0) exceeded resident child HI and A-1260 exceeded the ILCR for resident (5E-6) at 10 feet bgs. Additional land use controls will be necessary to prevent residential reuse unless soil is remediated to residential standards.	R

Notes:

1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-33 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - Shallow soil samples are defined as samples collected at depths less than 5 feet bgs
6 - "—" means "not applicable"

Table 1-5
Summary of Soil Risks and Rationale for Remedial Action - Administration Area West
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AW-R-1	AW-N-23	HH	05D-SB07	A-1260	9E-6	8.1E-1 (RC)	—	—	—	—	44	MI	Mixed Use	No	A-1260 exceeded the ILCR for the resident (9E-6) and commercial (3E-6) receptors in the 1 foot bgs sample and no deeper samples were collected. At a minimum, the area will be capped or excavated to a depth of 2 feet bgs and the lateral and vertical extent of A-1260 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1260 impact will be determined prior to capping.	R
AW-R-2	AW-N-20 AW-N-24	HH	O5D-SB06	A-1254	3E-5	2.5E+0 (RC)	—	—	—	—	40	MI	Mixed Use	No	A-1254 exceeded the HI for the resident child (2.5E+0) and commercial worker (1.0E+0) receptors in the 1-foot bgs sample and no deeper samples were collected. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent of A-1254 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping.	R
AW-R-3	AW-N-11	HH	05D-SNS18	A-1260	2E-6	3.7E-1 (CW)	—	—	—	—	37	NI	Mixed Use	No	A-1260 exceeded the ILCR for resident (2E-6) in the 0.5 foot sample, but not in the 2.5-foot bgs sample at sample location 05D-SNS18. At a minimum, the area will be capped or excavated to 1.5 feet bgs beneath the deepest sample where risk was exceeded and the lateral and vertical extent of will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1260 impact will be determined prior to capping.	R
AW-R-4	AW-R-5 AW-N-17	HH	D(b)-SD01	A-1260	3E-6	5.2E-1 (RC)	—	—	—	—	40	NI	Mixed Use	No	A-1260 exceeded the ILCR for resident (2E-6) in the surface (0 foot) sample at sample location D(b)-SD01, and no deeper samples were collected because the sample was collected from a lined culvert. At a minimum, the area will be capped or excavated to 0.5 foot or to depth of the lining of the culvert. If capping is selected as the final remedy, the lateral extent of A-1260 impact will be determined prior to capping.	R
AW-R-5	AW-R-4 AW-N-17	RTG	D(b)-SB03	—	—	—	—	—	TPH-D, TPH-Mo	9	40	NI	Mixed Use	No	TPH-D and TPH-Mo were ranked as high RTGs in D(b)-SB03. TPH-D (240 mg/kg) and TPH-Mo (730 mg/kg) exceeded their PGW SSLs (100 mg/kg and 500 mg/kg, respectively) in the 1-foot bgs sample, but no deeper samples were collected. Groundwater was impacted by TPH-D and TPG-MO in nearby boring 52D-SB18. At a minimum, the area will be capped or excavated to 2 feet and the lateral and vertical extent of TPH impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of TPH impact will be determined prior to capping.	R
AW-R-6	AW-N-12 AW-N-18	HH	52D-SB01 52D-SB02	Ni	3E-7	2.6E+0 (RC)	—	—	—	—	47	NI	Mixed Use	No	Ni exceeded resident child HI (1.4E+0) and construction worker (1.5E+1) HI in the 1-foot bgs sample, but not in the 5- or 10-foot bgs samples. At a minimum, the area will be capped or excavated to 2 feet and the lateral and vertical extent of Ni impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of Ni impact will be determined prior to capping.	R
AW-R-7	AW-N-25	HH	52D-SB07	B(a)P, B(b&k)F	1E-5	2.1E-1 (CW)	—	—	—	—	45	NI	Mixed Use	No	B(a)P and B(b&k)F exceeded resident ILCR (1E-5) and commercial worker HH risk (3E-6) in the 5-foot sample, but not in the 11-foot bgs sample at sample location 52D-SB07. At a minimum, the area will be capped or excavated to 6 feet and the lateral and vertical extent of PAH impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of PAH impact will be determined prior to capping.	R
AW-R-8	AW-R-9 AW-R-10 AW-N-21	HH	05D-SB03 06D-SB01 06D-SB02 06D-SB05 06D-SNS01 06D-SNS02 06D-SNS03 06D-SNS04 06D-SNS06 06D-SNS07 06D-SNS08 06D-SNS09 06D-SNS10	Cr+6, SB, Ni	4E-4	2.9E+1 (CW)	—	—	—	—	45	NI	Mixed Use	No	Cr+6 exceeded the noncancer HI for the resident child (3.2E+0) and CW (1.1E+1) receptors at 0.01 foot at sample location 06D-SNS01, at 0.5 foot at sample locations 06D-SNS06 (2.1E+0 and 1.1E+1, respectively) , 06D-SNS07 (4.3E+0 and 1.2E+1, respectively), and 06D-SNS08 (1.9E+0 and 9.4E+0, respectively), and the CW receptor only at 2.5 feet bgs at sample locations 06D-SNS06 (1.3E+0) and 06D-SNS07 (2.2E+0); no deeper samples were collected at these locations. At sample location 06D-SB02, Cr+6 exceeded the noncancer HH risk level for resident child (2.1E+0 and 2.9E+0) and CW (2.0E+1 and 2.9E+1), and the ILCR level for the resident (2E-5 and 4E-5), CW (3E-4 and 4E-4), and commercial worker (1E-5 and 2E-5) receptors at 5 and 11 feet bgs, respectively. At 05D-SB03, Cd exceeded the HI for the resident child (2.7E+0) at 1 foot bgs . At 06D-SNS07, Ni exceeded the HI for the resident child (1.1E+0) at 0.5 feet bgs and CW (1.1E+1 and 2.1E+0) at 0.5 and 2.5 feet bgs, respectively. NI also exceeded the HI for the CW receptor at 06D-SNS06 (1.1E+1 and 1.2E+0) at 0.5 and 2.5 feet bgs and at 06D-SNS08 (0.1E+0) at 0.5 feet bgs. The area will be capped or excavated to a depth of 12 feet bgs to address the HH risk and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of Cr+6 impact will be determined prior to capping.	R

Table 1-5
Summary of Soil Risks and Rationale for Remedial Action - Administration Area West
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AW-R-9	AW-R-8 AW-R-10 AW-R-12 AW-R-13 AW-N-14 AW-N-21 AW-N-26	RTG	05D-SB02 05D-SB03 05D-SB04 05D-SNS03 05D-SNS04 05D-SNS10 05D-SNS11 05D-SNS12 05D-SNS13 05D-SNS14 05D-SNS15 06D-SB01 06D-SB02 06D-SB05 06D-SB06 06D-SNS02 06D-SNS03 06D-SNS04 06D-SNS06 06D-SNS07 06D-SNS08 06D-SNS09 06D-SNS10 06D-SNS11 52D-SB11 52D-SB12 52D-SNS01 52D-SNS02	—	—	—	—	—	TPH-D, TPH-Mo, B(a)P, B(b&k)F, B(b)F, ClO4, Sb, Cd, Cr, Cr+6, Pb	6	43-47	NI	Mixed Use	No	The remedy proposed for RA AW-R-10 addresses the RTG for the majority of the listed sample locations. Sample locations that exceed HH or ecological risks are shown in separate RAs and included in other remedial areas. Of these borings, only sample location 06D-SNS09, 06D-SNS10 and 06D-SNS11 were ranked as moderate RTG for ClO4. ClO4 was detected above its PGW SSL (60 µg/kg) and at 2.5-foot bgs samples from locations 06D-SNS09 (1,300 µg/kg), 06D-SNS10 (530 µg/kg), and 06D-SNS11 (1,900 µg/kg). The remainder of the borings and the compounds—B(a)P, B(b&k)F, B(b)F, Sb, Cd, Cr, Cr+6, and Pb—were ranked as low or negligible RTGs in Table 8.3-1 of the HHERA (Volume II). The area surrounding sample locations 06D-SNS09, 06D-SNS10, and 06D-SNS11 will be capped or excavated to a minimum depth of 3.5 feet bgs and the lateral and vertical extent of ClO4 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of CLO4 impact will be determined prior to capping.	R
AW-R-10	AW-R-6 AW-R-8 AW-R-9 AW-R-12 AW-R-13 AW-N-6 AW-N-7 AW-N-10 AW-N-12 AW-N-18 AW-N-21	Ecological	05D-AH01 05D-SNS02 05D-SNS03 05D-SNS04 05D-SNS05 05D-SNS06 05D-SNS11 05D-SNS13 05D-SNS14 05D-SNS15 05D-SNS16 05D-SNS17 05D-SNS20 09D-SNS05 12D-SNS01 12D-SNS02 12D-SNS03 12D-SNS04 12D-SNS05 12D-SNS09	—	—	—	Sb, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Ag, Zn	609,804 (A)	—	—	—	NI	Mixed Use	No	COPECs exceeding their respective screening levels were detected in the 0.25- to 1-foot bgs interval. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent of the COPEC's impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from COPECs will be determined prior to capping. The human health risk from B(a)P, Ni, Cr+6 and Pb (AW-R-12 and AW-R-13) will be tracked as part of the ecological remedy at this RA.	R
AW-R-11	AW-N-22	HH	05D-SB09	A-1254	7E-6	5.9E-1 (RC)	—	—	—	—	46	VI	Mixed Use	No	A-1254 was the only compound detected above HH risk levels. A-1254 exceeded the 1E-6 ILCR level for the commercial worker (2E-6) and resident (7E-6) receptors at 1 foot bgs and no deeper samples were collected. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent of A-1254 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping.	R
AW-R-12	AW-R-9 AW-R-10 AW-N-21	HH	05D-SNS15	B(a)P, Ni, Cr+6	2E-6	2.0E+0 (CW)	—	—	—	—	43	NI	Mixed Use	No	Cr+6 (3E-6, 2E-6 and 2E-6) exceeded the ILCR(1E-6) risk for the construction worker receptor in the 0.5-,5- and 10-foot bgs samples, respectively, but not in the 2.5-foot bgs sample. Nickel (1.8E+0)exceeded the HI (1.0E+0) in the 0.5-foot bgs sample only. No deeper samples were collected. B(a)P (2E-6) exceeded the ILCR for the resident child receptor in the 0.5-foot bgs sample only. This area will be capped or excavated to 2 feet bgs in Remedial Area AW-R-10 for ecological risk. The HH risk will be tracked as part of the AW-R-10 remedy.	R
AW-R-13	AW-R-9 AW-R-10 AW-N-21	HH	05D-SNS04 05D-SNS13	Cr+6, Ni, Pb	3E-6	1.7E+0 (CW)	—	—	—	—	43	NI	Mixed Use	No	Cr+6 exceeded resident child ILCR and CW noncancer HI risk levels and resident child blood Pb >10 µg/dL at sample location 05D-SNS04 in the 0.01-foot bgs sample and at sample location 05D-SNS13 in the 0.5-foot bgs sample. Cr+6 exceeded CW ILCR levels in the 0.5- (3E-6), 5- (2E-6) and 10-foot bgs (2E-6) samples, but not in the 2.5-foot bgs samples. No deeper samples were collected. This area will be capped or excavated to 2 feet in Remedial Area AW-R-10 for ecological risk. The HH risk will be tracked as part of the AW-R-10 remedy.	R

Table 1-5
Summary of Soil Risks and Rationale for Remedial Action - Administration Area West
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Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AW-R-14	AW-R-7 AW-N-26	HH	52D-SB10	Cr+6	5E-4	3.3E+1 (CW)	—	—	—	—	46	NI	Mixed Use	No	Cr+6 (720 mg/kg) exceeded the ILCR for resident (4E-5), CW (5E-4), and commercial worker (2E-5) and the HI for RC (3.3E+0) and CW (3.3E+1) risk levels in the 11-foot bgs sample at sample location 52D-SB10. However, the 1-, 5-,23-, 35-, and 39-foot bgs samples and none of the samples from nearby boring 52D-SB09 exceeded the risk levels. Cr+6 also did not exceed the HH risk levels in soil samples collected from the 10.5- or 11-foot depth at nearby borings 52D-SB08 or 52D-SB12. Further sampling will be conducted at, and in the vicinity of, sampling location 52E-SB-10 to determine the lateral and vertical extent of Cr+6 in soil. The results of this soil sampling activity will be used to aid in the selection of an appropriate remedy. Costs to cap the area shown on Figure 1-25 are included in the costing tables for reference.	R
AW-N-1	—	RTG	05D-SNS01 05D-SNS08	—	—	—	—	—	Cd, Pb	6	48	VI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (metals), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Cd was detected above its PGW SSL (1.2 mg/kg) in the 0.5- (1.4 and 1.5 mg/kg, respectively) and 2.5-foot (26 and 1.5 mg/kg, respectively) samples, and no deeper samples were collected. The Cd detections were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). Pb also was detected above its PGW SSL (23 mg/kg) in the 0.5- (106 and 70 mg/kg, respectively) and in the 2.5-foot bgs (67 mg/kg) samples at 05D-SNS08 only; no deeper samples were collected. The depth to groundwater at this sample location is 48 feet.	N
AW-N-2	—	RTG	05D-SB10	—	—	—	—	—	A-1254	6	48	VI	Mixed Use	No	The RTG contaminant was a low mobility/solubility compound (A-1254), ranked as a moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1254 (46 µg/kg) was detected above its PGW SSL (34 µg/kg) in the 1-foot bgs sample at sample location 05D-SB10; however, no deeper samples were collected. The depth to groundwater at this location is 48 feet.	N
AW-N-3	—	RTG	12D-SNS08	—	—	—	—	—	Cd	6	34	VI	Mixed Use	No	The RTG contaminant was a low mobility/solubility compound (Cd), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Cd was ranked as a low RTG in the PGW evaluation in the HHRA, Volume II, despite the RTG score of 6. Cd (1.7 mg/kg) was detected above its PGW SSL (1.2 mg/kg) in the 2.5-foot bgs sample at sample location 12D-SNS08, but was below the PGW SSL at 1 foot bgs (0.52 mg/kg). Cd tends to have low solubility and mobility and the depth to groundwater is 34 feet at this location. The Cd detection at 2.5 feet bgs was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHRA Volume II).	N
AW-N-4	—	RTG	08D-SB06	—	—	—	—	—	ClO4	3	34	MI	Mixed Use	No	The RTG was ranked as low, concentrations were bounded at depth, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. ClO4 (78 µg/kg) was detected above its PGW SSL (60 µg/kg) in the 1-foot sample at sample location 08D-SB06, but was below the PGW SSL in the 5- (18 µg/kg) and 11-foot bgs (27 µg/kg) samples. At this location, the depth to groundwater is 34 feet.	N
AW-N-5	—	RTG	08D-SB03	—	—	—	—	—	ClO4	3	35	MI	Mixed Use	No	The RTG was ranked as low, concentrations were bounded at depth, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. ClO4 (99 µg/kg) was detected above its PGW SSL (60 µg/kg) in the 1- foot bgs sample at sample location 08D-SB03, but was not detected in the 5- and 11-foot bgs samples. The depth to groundwater at this location is 35 feet.	N
AW-N-6	AW-R-10	RTG	09D-SNS05	—	—	—	—	—	Cd, Pb	6	37	NI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (metals), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Cd was detected above its PGW SSL (1.2 mg/kg) in the 0.5 foot (2.5 mg/kg) and 2.5-foot (1.7 mg/kg) samples, but no deeper samples were collected. Pb also was detected above its PGW SSL (23 mg/kg) in the 0.5 foot (24 mg/kg), but not in the 2.5-foot bgs (12 mg/kg) sample. The PGW SSLs for Cd and Pb are the BTV. The depth to groundwater is 37 feet at this location. The Cd and Pb detections were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHRA Volume II).	N
AW-N-7	AW-R-10	RTG	05D-SNS17	—	—	—	—	—	Cd, Pb	6	38	NI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention for RTGs. Cd was ranked as a moderate RTG in the 0.5-foot bgs sample, and Cd (2.5 feet) and Pb (0.5 and 2.5 feet) were ranked as low RTGs. Cd was detected above its PGW SSL (1.2 mg/kg) in the 0.5- (5.6 mg/kg) and 2.5-foot bgs (2.3 mg/kg) samples, and no deeper samples were collected. Pb was also detected above the PGW SSL (23 mg/kg) in the 0.5-foot bgs sample (130 mg/kg), but not in the 2.5-foot (10 mg/kg) sample. The PGW SSLs for Cd and Pb are the BTV. The depth to groundwater is 38 feet at this location. The Cd (2.5 feet bgs) and Pb detections were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
AW-N-8	—	RTG	05D-SNS19	—	—	—	—	—	Pb	4	36	VI	Mixed Use	No	The RTG contaminant was a low mobility/solubility compound (Pb), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Pb was detected above its PGW SSL (23 mg/kg) in the 0.5-foot bgs (41 mg/kg) sample, but not in the 2.5-foot (9.9 mg/kg) sample. The PGW SSL for Pb is the BTV. The depth to groundwater at this location is 36 feet. The Pb detection was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHRA Volume II).	N
AW-N-9	—	RTG	A20-ST01-SB03	—	—	—	—	—	A-1254	4	38	MI	Mixed Use	No	The RTG contaminant was a low mobility/solubility compound (A-1254), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, the RA was not recommended for retention. A-1254 (130 µg/kg) was detected above its PGW SSL (60 µg/kg) in the 1-foot bgs sample at sample location A20-ST01-SB03, but was not detected in the 5-foot bgs sample. At this location, the depth to groundwater is 38 feet and the A-1254 concentration is bounded.	N
AW-N-10	AW-R-10	RTG	05D-SNS16	—	—	—	—	—	B(a)A, B(a)P, B(b&k)F, TPH-D, TPH-Mo, Cd, Pb	6	41	NI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (SVOCs and metals) and TPH, ranked as a low or moderate RTG, contamination was only in shallow[5] soil samples, and it was bounded; therefore, this RA was not recommended for retention. B(a)A, B(a)P, B(b&k)F, TPH-D (250 mg/kg) and TPH-Mo (850 mg/kg) exceeded their PGW SSLs (100 and 500 mg/kg, respectively) in the 0.5-foot bgs sample and were ranked as moderate RTGs, but were below PGW SSLs in the 2.5-foot bgs sample. Cd and Pb were each ranked as low RTGs. At sample location 05D-SNS16, B(a)A (47 µg/kg), B(a)P (7 µg/kg), and B(b&k)F (260 µg/kg) exceeded their PGW SSLs (29 µg/kg, 2.9 µg/kg, and 29 µg/kg, respectively) in the 0.5-foot bgs sample and B(b&k)F (30 µg/kg) exceeded its PGW SSL in the 2.5-foot bgs sample. Cd was detected above its PGW SSL (1.2 mg/kg) in the 0.5- (4.6 mg/kg), 2.5- (3.9 mg/kg) and 5-foot bgs (2 mg/kg) samples, but was below the PGW SSL in the 10-foot bgs sample. Pb also was detected above its PGW SSL (23 mg/kg) in the 0.5- (65 mg/kg) and 2.5-foot bgs (76 mg/kg) samples, but was below the PGW SSL in the 5- and 10-foot bgs samples. The depth to groundwater is 41 feet at this location. Although this area is not retained, remedy under AW-R-10 for ecological will remove shallow soils.	N

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Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AW-N-11	AW-R-3	RTG	05D-SNS18	—	—	—	—	—	A-1260, B(a)P, B(b&k)F, Cd, Pb	6	37	NI	Mixed Use	No	A-1260 and Pb were ranked as moderate RTGs, and B(a)P, B(b&k)F, and Cd were ranked as low RTGs. A-1260 (100 µg/kg and 65 µg/kg) and Pb (48 mg/kg and 62 mg/kg) exceeded their PGW SSLs (34 µg/kg and 23 mg/kg, respectively) in the 0.5- and 2.5-foot samples, and no deeper samples were collected. B(a)P (14 µg/kg), B(b&k)F (38 µg/kg), and Cd (1.7 mg/kg) exceeded their PGW SSLs (2.9 µg/kg, 29 µg/kg and 1.2 mg/kg, respectively) in the 0.5-foot sample. No data was available to assess if these compounds were present in groundwater. Although this area is not retained, remedy under AW-R-3 for HH will address shallow RTG.	N
AW-N-12	AW-R-6 AW-N-18	RTG	05D-SB01 05D-SNS09 05D-SNS20	—	—	—	—	—	A-1254, Cd, Pb	3	47	NI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (A-1254 and metals), ranked as a low or negligible RTG, and the contamination was only in shallow[5] soil samples; therefore this RA was not recommended for retention. A-1254, Cd, and Pb were ranked as low RTGs. At sample location 05D-SB01, A-1254 (76 µg/kg) was detected above its PGW SSL (60 µg/kg) in the 1-foot bgs sample, but was not detected in the 5-, 11-, 23-, 35, and 39-foot bgs samples. At 05D-SNS20, Cd (1.8 mg/kg) and Pb (150 mg/kg) were detected above their PGW SSLs (1.2 mg/kg and 23 mg/kg, respectively) in the 0.5-foot bgs sample, but were below the PGW SSLs in the 2.5-, 5- and 10-foot bgs samples. The depth to groundwater at this location is 47 feet.	N
AW-N-13	AW-N-16	RTG	08D-SB02	—	—	—	—	—	A-1254, B(a)P, B(b&k)F	4	35	NI	Mixed Use	No	RTG was ranked as low; therefore this RA was not recommended for retention. A-1254, B(a)P, and B(b&k)F were ranked as low RTGs. A-1254 (270 µg/kg), B(a)P (20 µg/kg), and B(b&k)F (31 µg/kg) exceeded their PGW SSLs (34 µg/kg, 2.9 µg/kg, and 29 µg/kg, respectively) in the 0.5-foot bgs sample this sample location, but only B(a)P (8.5 µg/kg) exceeded in the 5-foot bgs sample. None of these compounds exceeded their respective PGW SSLs in samples collected at 11-, 23-, and 35-feet bgs at this location. A-1254 is limited to near-surface soil and this location is surrounded by samples that do not exceed risk, so this is an isolated detection.	N
AW-N-14	AW-N-9	HH	A20-ST01-SB03	—	—	—	—	—	—	—	38	NI	Mixed Use	No	This area is below the HH risk of $1x10^{-6}$ and an HI of 1 and poses no risk. It was inadvertently mapped and, therefore, is not recommended for retention.	N
AW-N-15	AW-N-19	HH	D(c)-SB05	B(a)P	4E-6	4.0E-1 (CW)	—	—	—	—	33	VI	Mixed Use	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. B(a)P was the only compound above the residential HH risk levels (2.6E-6 ILCR). The cumulative risk for B(a)A, B(b&k)F, D(a,h)A, and I(1,2,3-cd)P was 4E-6, which did not exceed HH risk levels at 5 feet.	N
AW-N-16	AW-N-28	HH	08D-SB02	A-1254	4E-6	5.3E-1 (CW)	—	—	—	—	35	NI	Mixed Use	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. A-1254 was the only compound detected above HH risk levels. A-1254 (3E-6) exceeded the residential ILCR level at 0.5 foot bgs, but was below 1E-6 at 5 feet bgs, and was not detected in the 11-, 23- or 35-foot samples collected at sample location 08D-SB02.	N
AW-N-17	AW-R-4 AW-R-5	HH	D(b)-SB04	B(a)P	2E-6	7.1E-5 (RC)	—	—	—	—	40	NI	Mixed Use	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. B(a)P (1.6E-6) exceeded HH risk levels in the 1 foot bgs sample, but did not exceed in the 5- and 11-foot bgs samples at D(b)-SB04. B(a)P is limited to near-surface soil, so this is an isolated detection.	N
AW-N-18	AW-R-6 AW-N-12	HH	05D-SNS09	B(a)P	3E-6	3.00E-01	—	—	—	—	47	NI	Mixed Use	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. B(a)P (2.4E-6) exceeded residential ILCR (1E-6) in the 0.5-foot sample at sample location 05D-SNS09, but not in the 2.5-foot bgs sample. B(a)P is limited to near-surface soil, so this is an isolated detection. Additionally, this area will be capped or excavated as part of AW-R-10 and the risk will be addressed by that excavation.	N
AW-N-19	AW-N-15	RTG	D(c)-SB05	—	—	—	—	—	B(a)A, B(a)P, B(b&k)F, D(a,h)A, I(1,2,3-cd)P	4	33	VI	Mixed Use	No	RTG was ranked as low; therefore this RA was not recommended for retention. B(a)A, B(a)P, B(b&k)F, D(a,h)A, I(1,2,3-cd)P were ranked as low RTGs. B(a)A (77 µg/kg), B(a)P (100 µg/kg), B(b&k)F (200 µg/kg), D(a,h)A (18 µg/kg), and I(1,2,3-cd)P (59 µg/kg) exceeded their PGW SSLs (29 µg/kg, 2.9 µg/kg, 29 µg/kg, 2.9 µg/kg, and 29 µg/kg, respectively)in the 1-foot bgs sample at sample location D(c)-SB05, but were not detected in the 5-foot bgs sample collected at this location.	N
AW-N-20	AW-R-2 AW-N-24	HH	05D-SB06	A-1254	3E-5	2.5E+0 (RC)	—	—	—	—	—	MI	Mixed Use	No	A-1254 exceeded the ILCR for resident (3E-5) and commercial worker (8E-6) receptors in the 1-foot bgs sample and no deeper samples were collected. The high HH risks associated with location 05D-SB06 are discussed in RA AW-R-2 above.	N

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Summary of Soil Risks and Rationale for Remedial Action - Administration Area West
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Remedial Area Number	Colocated Remedial Area	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AW-N-21	AW-R-7 AW-R-8 AW-R-9 AW-R-10 AW-N-13 AW-N-14	HH	05D-SB02 05D-SB03 05D-SB04 05D-SNS03 05D-SNS04 05D-SNS10 05D-SNS11 05D-SNS12 05D-SNS13 05D-SNS14 05D-SNS15 06D-SB01 06D-SB02 06D-SB05 06D-SNS03 06D-SNS04 06D-SNS06 06D-SNS07 06D-SNS08 06D-SNS09 06D-SNS10 06D-SNS11 52D-SB06 52D-SB08 52D-SB09 52D-SB10 52D-SB11 52D-SB12 52D-SB13 52D-SNS01 52D-SNS02 52D-SNS03 52D-SNS04 52D-SNS12	Cr+6, Ni, Pb	3E-6	2.9E+1 (CW)	—	—	—	—	—	NI	Mixed Use	No	This large RA is based on low HH risks, which will be addressed by retained RAs AW-R-7 and AW-R-8 (high risk HH), AW-R-9 (RTG) and AW-R-10 (ecological risk). Based on this, this area is not recommended for retention.	N
AW-N-22	AW-R-11	RTG	05D-SB09	—	—	—	—	—	A-1254	6	46	VI	Mixed Use	No	A-1254 was ranked as a moderate RTG. A-1254 (610 µg/kg) was detected above its PGW SSL (34 µg/kg) in the 1-foot bgs sample at sample location 05D-SB09; however, no deeper samples were collected. A-1254 tends to have low solubility and mobility and the depth to groundwater at this sample location is 46 feet.	N
AW-N-23	AW-R-1	RTG	05D-SB07	—	—	—	—	—	A-1260, Cd	6	44	MI	Mixed Use	No	A-1260 was ranked as a moderate RTG and Cd was ranked as a low RTG. A-1248 (800 µg/kg) and Cd (2.6 mg/kg) exceeded their PGW SSLs (34 µg/kg and 1.2 mg/kg, respectively) in the 1-foot sample and no deeper samples were collected. No data were available to assess if A-1260 or Pb were present in groundwater. A-1260 and metals tend to have low solubility and mobility and the depth to groundwater is 44 feet at this location.	N
AW-N-24	AW-R-2 AW-N-20	RTG	05D-SB06	—	—	—	—	—	A-1254, Cd, Cr, Pb	6	40	MI	Mixed Use	No	A-1254, Cd, and Cr were ranked as moderate RTGs and Pb was ranked as a low RTG. A-1248 (2,500 µg/kg), Cd (9.6 mg/kg), Cr (670 mg/kg), and Pb (30.1 mg/kg) exceeded their PGW SSLs (34 µg/kg, 1.2 mg/kg, 500 mg/kg, and 23 mg/kg, respectively) in the 1-foot bgs sample and no deeper samples were collected. A-1254 and metals tend to have low solubility and mobility and the depth to groundwater is 48 feet at this location.	N
AW-N-25	AW-R-7	RTG	52D-SB07	—	—	—	—	—	B(a)A, B(a)P, B(b&k)F, I(1,2,3-cd)P, TPH-D, TPH-Mo	8	45	NI	Mixed Use	No	B(a)A, B(a)P, B(b&k)F, I(1,2,3-cd)P, and TPH-D were ranked as low RTGs and TPH-Mo was ranked as a moderate RTG. B(a)A (330 µg/kg), B(a)P (340 µg/kg), B(b&k)F (450 µg/kg), I(1,2,3-cd)P (59 µg/kg), TPH-D (220 mg/kg), and TPH-Mo (530 mg/kg) were detected above their PGW SSLs (29 µg/kg, 2.9 µg/kg, 29 µg/kg, 29 µg/kg, 100 mg/kg, and 500 mg/kg, respectively) in the 5-foot bgs sample at sample location 52B-SB07, but did not exceed their respective PGW SSLs in the 1-or 10-foot bgs samples. The depth to groundwater is 38 feet at this location. PAHs and TPH generally have low solubility and mobility.	N
AW-N-26	AW-R-7 AW-R-14	RTG	52D-SB10	—	—	—	—	—	Cr, Cr+6	1	45	NI	Mixed Use	No	RTG was ranked negligible. At sample location 52D-SB10, Cr (550 mg/kg) and Cr+6 (720 mg/kg) exceeded their PGW SSLs (500 mg/kg and 21 mg/kg, respectively) in the 11-foot bgs sample, but not in the 1-,5-, 23-, 35-, and 39- foot bgs samples. Cr (5.4 µg/L) was detected in groundwater at well 3684 at a concentration an order of magnitude below the MCL (50 µg/L) an Cr+6 was not detected in groundwater.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-30 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - Shallow soil samples are defined as samples collected at depths less than 5 feet bgs
6 - "—" means "not applicable"

Table 1-6
Summary of Soil Risks and Rationale for Remedial Action - Line 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
L2-R-1	—	RTG	E(n)-SNS03	—	—	—	—	—	ClO4	6	41	VI	Mixed Use	Adjacent building, excavation may impact structure.	ClO4 was ranked as a high RTG. The maximum ClO4 concentration (550 µg/kg) above the PGW SSL (60 µg/kg) was detected at 0.5 foot bgs and remained a high RTG for the sample collected at 2.5 feet bgs (250 µg/kg) and no deeper samples were collected. At a minimum, the area will be capped or excavated to 1 foot below the deepest sample where risk was exceeded and the lateral and vertical extent of ClO4 will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of ClO4 impact will be determined prior to capping.	R
L2-R-2	—	HH	L2-ST26-SB01 L2-ST24-SB01	B(a)P B(b&k)F	1.E-05	8.4E-01 (CW)	—	—	—	—	45	NI	Mixed Use	Adjacent building, excavation may impact structure.	B(a)P and B(b&k)F exceeded the ILCR risk level for the resident (1E-5) and commercial worker (4E-6) receptors at 2 feet bgs. The maximum PAH concentrations were both detected in the 2-foot bgs sample, but were not detected in the 5-foot bgs sample. At a minimum, the area will be capped or excavated to 1 foot below the deepest sample where risk was exceeded and lateral and the vertical extent of PAHs will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of PAH impact will be determined prior to capping.	R
L2-R-3	—	RTG	E(e)-SNS01	—	—	—	—	—	ClO4, TPH-D	10	43	NI	Mixed Use	No	ClO4 was ranked as a high RTG and TPH-D was ranked as a moderate RTG. ClO4 concentrations (140 and 74 µg/kg) exceeded the PGW SSL (60 µg/kg) in the 0.5- and 2.5-foot bgs samples, respectively, in sampling location E(e)-SNS01. TPH-D (110 mg/kg) exceeded the PGW SSL (100 mg/kg) at 0.5 foot bgs, but not at 2.5 feet bgs. No deeper samples were collected. At a minimum, the area will be capped or excavated to 1 foot below the deepest sample where risk was exceeded and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of CLO4 impact will be determined prior to capping.	R
L2-R-4	—	RTG	28E-SB01 28E-SB05	—	—	—	—	—	ClO4, Mn, Ni, Tl	8	50	NI	Mixed Use	No	Mn, Ni, and Tl concentrations exceeded their respective PGW SSLs at 11.5 feet bgs and below at sampling location 28E-SB01, but were ranked as low RTGs because they were "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). ClO4 was ranked a high RTG. ClO4 concentrations exceeded the PGW SSL (60 µg/kg) at depths of 1 foot bgs (670 µg/kg) and 10 feet bgs (67 µg/kg) in sampling location 28E-SB05 only. In sampling locations 28E-SB01 and 28E-SB05, ClO4 concentrations (up to 1,700 µg/kg at 28E-SB01 at 35 feet bgs) exceeded the PGW SSL below 10 feet bgs and continued to exceed the PGW SSL to a depth of 50 feet bgs (the depth to groundwater). ClO4 was detected in groundwater. At a minimum, the area will be capped or excavated to a depth of 12 feet and the lateral and vertical extent of ClO4 will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of ClO4 impact will be determined prior to capping. Deeper ClO4 impacts will be addressed by L2-R-9.	R
L2-R-5	—	RTG	28E-SB03 28E-SB06	—	—	—	—	—	ClO4	8	50	NI	Mixed Use	Adjacent building, excavation may impact structure.	ClO4 was ranked as a high RTG. ClO4 concentrations exceeded the PGW SSL (60 µg/kg) in only the 11-foot bgs sample (69 µg/kg) from sampling location 28B-SB03. For sampling location 28E-SB06, ClO4 concentrations exceeded the PGW SSL at depths of 1- (110 µg/kg), 5- (5,100 µg/kg), and 10-feet bgs (4,300 µg/kg) and at each 10-foot interval to 50 feet bgs (depth of groundwater). ClO4 was detected in groundwater. At a minimum, the area will be capped or excavated to a depth of 12 feet and the lateral and vertical extent of ClO4 will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of ClO4 impact will be determined prior to capping. Deeper ClO4 impacts will be addressed by L2-R-9.	R
L2-R-6	—	RTG	L2-ST28-90-SB01	—	—	—	—	—	ClO4	7	45	NI	Mixed Use	No	ClO4 was ranked as a high RTG. ClO4 concentrations (75 µg/kg and 140 µg/kg) exceeded the PGW SSL (60 µg/kg) in the 2.5- and 4.5-foot bgs samples, respectively, and was not bounded vertically. At a minimum, the area will be capped or excavated to 1 foot below the deepest sample where risk was exceeded and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of ClO4 impact will be determined prior to capping.	R
L2-R-7	—	RTG	E(e)-SB03	—	—	—	—	—	ClO4	11	45	NI	Mixed Use	Adjacent building, excavation may impact structure.	ClO4 was ranked as a high RTG. ClO4 concentrations exceeded the PGW SSL (60 µg/kg) in the 1-, 5-, 20-, 30-, 40- and 50-foot bgs samples and was not bounded vertically. The ClO4 concentration in the 10-foot bgs sample (57 µg/kg) was slightly below the PGW SSL (60 µg/kg). The highest concentration (1,400 µg/kg) of ClO4 was detected in the 20-foot bgs sample. At a minimum, the area will be capped or excavated to a depth of 12 feet and the vertical extent of ClO4 will be assessed during excavation.	R
L2-R-8	L2-N-10	RTG	E(d)-SNS03 E(e)-SB02	—	—	—	—	—	ClO4	11	45	NI	Mixed Use	Adjacent building, excavation may impact structure.	ClO4 is a high RTG. ClO4 concentrations exceeded the PGW SSL at depths of 0.5-, 2.5-, 10-, 20-, 30-, and 40-feet bgs in sampling location E(d)-SNS03 and at 11-, 22-, and 42-feet bgs, but not at 1- and 5-feet bgs in sampling location E(e)-SB02. ClO4 was detected in groundwater. At a minimum, this area will be capped or excavated to a depth of 12 feet and the lateral and vertical extent of ClO4 will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of ClO4 impact will be determined prior to capping.	R
L2-R-9	—	RTG	28E-SB02 28E-SB07 28E-SPB02	—	—	—	—	—	ClO4, Al, Mn, NDMA, Tl	8	50	NI	Mixed Use	No	Al (53,000 mg/kg), Mn (1,300 and 1,500 mg/kg), and Tl (2.8 and 3.2 mg/kg) concentrations exceeded their respective PGW SSL between 11.5 and 47 feet bgs, but were ranked as a low RTG as these metals were "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). ClO4 and NDMA are a high RTG. ClO4 concentrations exceeded the PGW SSL at depths of 11 feet bgs and continued to 50 feet bgs (depth of groundwater). NDMA was only detected above the PGW SSL in one sample from sampling location 28E-SBO2 at a depth of 35 feet. ClO4 was detected in groundwater. A containment/remedial alternative other than excavation will be used (See Section 6.0).	R
L2-N-1	—	RTG	29E-SB10 29E-SNS07	—	—	—	—	—	Cd	6	46	NI	Open Space	No	The RTG was ranked as low and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Cd (1.2 mg/kg) exceeded its PGW SSL (0.72 mg/kg) in the 1-foot bgs sample at sampling location 29E-SB10. No deeper samples were collected for Cd. Cd at this location was "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L2-N-2	—	RTG	L2-ST26-SNS02	—	—	—	—	—	B(a)P	4	46	MI	Residential	No	The RTG was ranked as low and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(a)P (55 µg/kg) exceeded the PGW SSL (2.9 µg/kg) only in the 0.5-foot bgs sample; B(a)P was not detected in the 2.5-foot bgs sample. The depth to groundwater is 45 feet at this location.	N

Table 1-6
Summary of Soil Risks and Rationale for Remedial Action - Line 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
L2-N-3	—	RTG	L2-ST26-SB04	—	—	—	—	—	Tl	3	45	MI	Residential	No	The RTG was ranked as low and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Tl (2.8 mg/kg) exceeded the PGW SSL (2.5 mg/kg) only in the 1-foot bgs sample and did not exceed the PGW SSL in the 5- and 11-foot bgs samples. The PGW SSL concentrations are also equivalent to the BTV. Tl was "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L2-N-4	—	RTG	E(n)-SB01 E(n)-SD01	—	—	—	—	—	Cd, Mn, Tl	4	43	MI	Residential	No	The RTGs were ranked as low and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Cd and Mn were ranked as a low RTG in sample E(n)-SD01. Cd concentrations only exceeded the PGW SSL (0.72 mg/kg) in the 0.25- and 1.5-foot bgs samples (0.74 and 0.79 mg/kg, respectively), but did not exceed in the 5-foot bgs sample. Mn concentrations only exceeded the PGW SSL (1,100 mg/kg) in the 1.5-foot bgs sample (1,700 mg/kg), but did not exceed in the 5-foot sample. Tl exceeded the PGW SSL (2.5 mg/kg) in the 1-foot bgs sample (2.9 mg/kg), but did not exceed in the 5- or 9.5-foot bgs samples. The PGW SSL concentrations are equivalent to the BTV. Mn and Tl were "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L2-N-5	—	RTG	29E-SB05 29E-SB09	—	—	—	—	—	B(b&k)F, Cd, I(1,2,3-cd)P, Al	6	48	NI	Mixed Use	Adjacent building, excavation may impact structure.	The RTG contaminants were low mobility/solubility compounds (SVOCs and metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(b&k)F and I(1,2,3-cd)P are ranked as moderate RTG and Cd and Al are ranked as low RTG. B(b,k)F (31 µg/kg) and I(1,2,3-cd)P (33 µg/kg) concentrations only slightly exceed the PGW SSL (29 µg/kg for both compounds) in the 2-foot bgs sample at sampling location 29E-SB09; however, no deeper samples were collected. Both compounds exhibit extremely low solubility and high affinity for organic carbon and, therefore, low mobility. Cd concentrations (both 1.2 mg/kg) exceeded the PGW SSL (0.72 mg/kg) only in the 2- and 6-foot bgs samples at sampling location 29E-SB05. Cd did not exceed the PGW SSL in the 11.5-foot bgs sample. Al (47,000 and 45,000 µg/kg) concentrations only exceeded the PGW SSL (43,000 mg/kg) in the 1- and 5-foot bgs samples, respectively, at sampling location 29E-SB09, but did not exceed the PGW SSL in the 11-foot bgs sample. The Al and Cd PGW SSL concentrations are equivalent to their respective BTVs. These metal detections were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L2-N-6	—	RTG	E(n)-SNS01	—	—	—	—	—	Cd	2	45	MI	Mixed Use	No	The RTG was ranked as negligible and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Cd (3.3 mg/kg) exceeded the PGW SSL (0.72 mg/kg) only in the 0.5-foot bgs sample, but did not exceed in the 2.5-foot bgs sample at sampling location E(n)-SNS01. Metals tend to have low solubility and mobility and the depth to groundwater is 45 feet bgs at this location.	N
L2-N-7	—	HH	59E-SB01 59E-SB03 59E-SB04	Al, Ni	NA	3.0E+00 (CW)	—	—	—	—	48.5	NI	Mixed Use	No	The contaminants are suspected to be naturally occurring (see PGW Evaluation in HHERA Volume II); therefore, this RA was not recommended for retention. The cumulative risk (1.1E+0) for Al and Sb exceeded the HI for a child receptor in the 11-foot bgs sample from sampling location 59E-SB03; however, neither compound exceeded the HI of 1.0. Aluminum exceeded construction worker HI at 11 feet bgs (2.0E+0) in sampling location 59E-SB03 and at 2.5 feet bgs (1.2E+0) in sampling location 59E-SB04 and nickel exceeded the construction worker HI at 11 feet bgs (1.5E+0) in sampling location 59E-SB04.	N
L2-N-8	—	HH	59E-SB02	Al	NA	1.6E+00 (CW)	—	—	—	—	44	MI	Mixed Use	No	Al concentrations were suspected to be naturally occurring (see PGW Evaluation in HHERA Volume II); therefore, this RA was not recommended for retention. Al (1.2E+0) was the only compound to exceed HH risk levels, but only for the construction worker scenario in the sample collected from a depth of 10.5 feet bgs at sampling location 59E-SB02. The cumulative risk (1.2E+0) from Al, Sb, and Ni concentrations exceeded the HI of 1.0E+0 for a construction worker in the 5-foot bgs sample; however, none of these metals exceeded risk levels.	N
L2-N-9	—	RTG	DSA-SB04	—	—	—	—	—	Tl	6	45	NI	Mixed Use	Adjacent building excavation may impact structure.	The RTG contaminant was a low mobility/solubility compound (Tl) ranked as moderate and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Tl was ranked as a moderate RTG. Tl (3.0 mg/kg) exceeded the PGW SSL (2.5 mg/kg) only in the 5-foot bgs sample. Tl did not exceed the PGW SSL at 11 feet bgs. The Tl detections were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L2-N-10	L2-R-8	RTG	E(d)-SNS01 E(d)-SNS02 E(d)-SNS03 E(e)-SB01 E(e)-SB02	—	—	—	—	—	B(a)P, B(b&k)F, I(1,2,3-cd)P, TPH-D, TPH-Mo, Al, Mn, Tl	11	45	NI	Mixed Use	Adjacent building, excavation may impact structure.	The RTG contaminants were low mobility/solubility compounds (metals), and ranked as a low RTG; therefore, this RA was not recommended for retention. PAH concentrations were a negligible RTG in sample E(d)-SNS01 at 0.5 feet bgs. Al (51,000 mg/kg), Mn (1,300 and 4,900 mg/kg), and Tl (4.2, 4.6, and 5.1 mg/kg) were detected above their respective PGW SSLs at depths between 11 feet and 42 feet bgs at sampling location E(e)-SB02, but each metal is a low RTG, as these metals were "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L2-N-11	—	RTG	59E-SB04	—	—	—	—	—	Al, Mn, Ni, Tl	6	48.5	NI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (metals) and ranked as a low RTG; therefore, this RA was not recommended for retention. Al exceeded the PGW (43,000 mg/kg) only at 2.5 feet bgs in sampling location 59E-SB04 (48,000 mg/kg). Mn (1,500 mg/kg) exceeded the PGW SSL (1,100 mg/kg) only at 2.5 feet bgs in 59E-SB04. Ni was detected above the PGW SSL (120 mg/kg) in samples collected at 11 feet bgs in sampling location 59E-SB04 (210 mg/kg). Tl was detected above the PGW SSL (2.5 mg/kg) in samples collected at 11 feet bgs in sampling location 59E-SB04 (2.8 mg/kg). The metal concentration above the PGW SSLs were "outside the range of statistical background, but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). Metals tend to have low solubility and mobility and the depth to groundwater averages 48.5 feet bgs.	N

Table 1-6
Summary of Soil Risks and Rationale for Remedial Action - Line 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
L2-N-12	—	RTG	59E-SB03	—	—	—	—	—	Al, Ni, Tl	6	48.5	NI	Mixed Use	No	The RTG contaminants were low mobility/solubility compounds (metals) and ranked as a low RTG; therefore, this RA was not recommended for retention. Al exceeded the PGW (43,000 mg/kg) only at 11 feet bgs in sampling location 59E-SB03 (79,000 mg/kg). Ni was detected above the PGW SSL (120 mg/kg) only at 11 feet bgs in sampling location 59E-SB03 (130 mg/kg). Tl was detected above the PGW SSL (2.5 mg/kg) only at 11 feet bgs in sampling location 59E-SB03 (3.4 mg/kg). The metal concentrations above the PGW SSLs were "outside the range of statistical background, but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). Metals tend to have low solubility and mobility and the depth to groundwater averages 48.5 feet bgs.	N
L2-N-13	—	RTG	59E-SB02	—	—	—	—	—	Al, Mn, NDMA, ClO4	8	44	MI	Mixed Use	No	Al and Mn were ranked as low RTGs, NDMA a moderate RTG, and ClO4 a high RTG. AL and Mn were suspected to be naturally occurring, NDMA was a single isolated occurrence and bounded above the water table, and CLO4 was also a single isolated occurrence at depth. Based on these data, this RA was not recommended for retention. Al and Mn were considered to be "outside range of statistical background, but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). NDMA (0.21 µg/kg) was detected above its PGW SSL (0.03 µg/kg) only at 23 feet bgs. The NDMA was an isolated detection and the underlying sample did not contain NDMA. ClO4 (85 µg/kg) was detected above its PGW SSL (60 µg/kg) only at 35 feet bgs. The depth to groundwater is 44 feet bgs.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-31 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - Shallow soil samples are defined as samples collected at depths less than 5 feet bgs
6 - "—" means "not applicable"

Table 1-7
Summary of Soil Risks and Rationale for Remedial Action - Line 5 North
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
L5-R-1	L5-R-3 L5-N-4	HH	52E-SNS01	B(a)P	5.E-06	6.8E-02 (RC)	—	—	—	—	65	NI	Residential	No	B(a)P (5E-6 and 1E-6) exceeded the ILCR for resident and commercial worker receptors, respectively in the 0.5-foot bgs sample, but not in the 5- or 11-foot bgs samples. At a minimum, the area will be capped or excavated to 1.5 feet bgs and the lateral and vertical extent of PAH impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of PAH impact will be determined prior to capping.	R
L5-R-2	—	RTG	52E-SB14	—	—	—	—	—	ClO4	7	68	NI	Residential	No	ClO4 was ranked as a high RTG. The maximum ClO4 concentration (520 µg/kg) above the PGW SSL (60 µg/kg) was detected in the 5-foot bgs sample, and ClO4 remained a high RTG for the deepest sample at 11 feet bgs (240 µg/kg). At a minimum, the area will be capped or excavated to a depth of 12 feet and the lateral and vertical extent of ClO4 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of CLO4 impacts will be determined prior to capping.	R
L5-R-3	L5-R-1 L5-N-4	Ecological	52E-SNS01	—	—	—	Cd DnOP	Cd 13.3 (M) DnOP 96 (A)	—	—	65	NI	Residential	No	This area was selected for retention in the facility ecological evaluation (Appendix D). There are elevated Cd and Di-n-octalphthalate (DnOP) ecological hazards. This area will be capped or excavated to 1.5 feet bgs in Remedial Area L5-R-1. The ecological risk will be tracked as part of the L5-R-1 remedy.	R
L5-N-1	—	RTG	E(L)-SB01	—	—	—	—	—	ClO4, TPH-D	8	68	NI	Residential	No	The high RTG ranking was based on concentrations of TPH as diesel; however, the concentrations were decreasing with depth and were bounded below the PGW SSL at 5 feet and, therefore, this RA was not recommended for retention. TPH-D was ranked as a high RTG and ClO4 was ranked as a low RTG in the 0.25- foot bgs sample. TPH-D and ClO4 were not detected in underlying samples collected at 5 feet bgs and greater depths. TPH-D (150 mg/kg) and ClO4 (86 µg/kg) were detected above their PGW SSLs (100 mg/kg and 60 µg/kg, respectively) in the 0.25-foot bgs sample. TPH-D has limited mobility and the depth to groundwater is 68 feet bgs.	N
L5-N-2	—	RTG	52E-SB04 52E-SB05	—	—	—	—	—	B(b&k)F, TPH-D, TPH-Mo, ClO4, Cd, Pb	7	70	NI	Residential	No	The RTG was ranked as low or negligible and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(b&k)F, TPH-D, TPH-Mo, ClO4, and Cd were ranked as low RTGs and Pb was ranked as a negligible RTG; B(b&k)F (180 µg/kg) was detected above the PGW SSL (29 µg/kg) in the 1-foot bgs sample at sampling location 52E-SB04. No deeper samples were collected. TPH-D (2,200 mg/kg), TPH-Mo (5,700 mg/kg), ClO4 (260 µg/kg), Cd (1.8 mg/kg) and Pb (52 mg/kg) were detected above their PGW SSLs (100 mg/kg, 500 mg/kg, 60 µg/kg, 1.2 mg/kg and 23 mg/kg, respectively) in the 1.5-foot bgs sample at sampling location 52E-SB05. None of these compounds exceeded their PGW SSLs in the 5- or 11-foot bgs samples. The Cd and Pb detections in the 1.5-foot bgs sample at sampling location 52E-SB05 were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).PAHs, TPH and metals tend to have limited mobility and solubility and TPH will degrade over time. The depth to groundwater is 70 feet. Cd and Pb were detected in groundwater from boring 51E-SB04.	N
L5-N-3	—	RTG	52E-SB07 52E-SB12	—	—	—	—	—	ClO4 Cd, Pb	6	70	NI	Residential	No	The RTG was ranked low for ClO4 at 52E-SB07. The RTG was ranked low for metals and moderate for ClO4 at 52E-SB12; however, the CLO4 concentration was bounded below the PGW SSL at 5 feet and, therefore, this RA was not recommended for retention. ClO4 was detected at 1 foot bgs at sampling locations 52E-SB07 (77 µg/kg) and 52E-SB12 (65 µg/kg) at concentrations slightly above the PGW SSL (60 µg/kg). ClO4 was not detected at sampling location 52E-SB07 at 5- and 11 feet bgs and was below the PGW SSL at sampling location 52E-SB12 at 5 feet bgs. ClO4 was detected in groundwater beneath this area; however, concentrations are higher in areas that are upgradient of these locations. Cd and Pb were ranked as low and negligible RTGs, respectively, at sampling location 52E-SB12. Cd (4 mg/kg) and Pb (39 mg/kg) exceeded their PGW SSLs (1.3 mg/kg and 23 mg/kg, respectively) in the 1-foot bgs sample, but did not exceed the PGW SSLs in the 5-foot bgs samples. The Cd and Pb detections in the 1-foot bgs sample at sampling location 52E-SB12 were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). The depth to groundwater is 70 feet. Cd and Pb were detected in groundwater from boring 51E-SB04.	N
L5-N-4	—	RTG	52E-SB18	—	—	—	—	—	B(a)A, B(a)P, B(b,k)F, D(a,h)A, I(1,2,3-cd)P, TPH-D, TPH-Mo, Cd, Pb	6	65	NI	Residential	No	The RTG was ranked as low or moderate and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(a)A, B(a)P, B(b,k)F, D(a,h)A, I(1,2,3-cd)P and TPH-Mo were ranked as moderate RTGs and Cd, Pb, and TPH-D were ranked as low RTGs. B(a)A (88 µg/kg), B(a)P (130 µg/kg), B(b,k)F (350 µg/kg), D(a,h)A (14 µg/kg), I(1,2,3-cd)P (57 µg/kg) exceeded their PGW SSLs (29 µg/kg, 2.9 µg/kg, 29 µg/kg, 2.9 µg/kg, and 29 µg/kg, respectively) only in the 0.5-foot bgs sample. TPH-D (180 mg/kg) and TPH-Mo (550 mg/kg) exceeded their PGW SSLs (100 mg/kg and 500 mg/kg, respectively) only in the 0.5-foot bgs sample and were below their PGW SSLs in the 5- and 11-foot bgs samples. TPH has limited mobility and solubility and will naturally degrade. Cd (4.8 mg/kg) and Pb (170 mg/kg) exceeded their PGW SSLs (1.2 mg/kg and 23 mg/kg, respectively) only in 0.5-foot bgs sample and were below their PGW SSLs in the 5- and 11-foot bgs samples. The Cd detection at 0.5-foot bgs was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II).	N
L5-N-5	—	Ecological	51E-SB02	—	—	—	Cd	15.6 (M)	—	—	70	NI	Residential	No	Cd was the only COPEC collected from Facility areas, with maximum concentration of 5.61 mg/kg, that was > 10x ESL, in the 1-foot bgs sample at sampling location 51E-SB02, with an HQ of 15.6, for potenital mammalian wildlife risk. Cd exceedance was very isolated, with no other Cd sample results at Line 5 North being > 10x the ESL, except for 52E-SNS01 at a depth of 0.5 ft bgs (4.8 mg/kg). Background Xero BTV for Cd was 1.2 mg/kg.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-32 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - Shallow soil samples are defined as samples collected at depths less than 5 feet bgs
6 - "—" means "not applicable"

Table 1-8
Summary of Soil Risks and Rationale for Remedial Action - Buffalo Creek and West Lakes
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2,3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained or Remediation Completed
Buffalo Creek																
BC-R-1	BC-N-1 BC-N-2 BC-N-3 BC-N-4 BC-N-5	Ecological	59E-SD02 BC-SD01 BC-SD02 BC-SD03 WL-SD11 WL-SD14	—	—	—	A-1254, Pb, Hg, Ag, Zn	6078 (A)	—	—	49-63	VI	Open Space Drainage	No	This Remediation Area was selected for further action in the SLERA. **At sample location WL-SD11**, Ag (10 mg/kg) was the highest ecological risk (>10 times the benthic macroinvertebrate receptor ESL) in the 0.25 foot sample, and was still elevated (10 mg/kg) in the 1.5-foot sample; deeper samples for metals were not analyzed. **At sample WL-SD14**, Ag (22.3J mg/kg) was the highest ecological risk (>10 times benthic macroinvertebrate receptor ESL) in the 0.25-foot sample; deeper samples for metals were not analyzed. **At sample location 59E-SD02**, A-1254 was retained as a COPEC at 0.25 and 1 foot bgs. Hg (0.31 mg/kg) was the highest ecological risk in the 0.25-foot sample, but was not detected above the BTV (0.13 mg/kg) in the 1 -foot sample. **At sample location BC-SD01**, A-1254, Cd, Cr, Pb, Ni, Ag, and Zn were retained as COPECs at 0.25 foot bgs; however, Ni (34.9 mg/kg) was below the BTV (140 mg/kg). Ag was the highest ecological risk in the 0.25-foot sample; however, deeper samples for metals were not analyzed. **At sample location BC-SD02**, A-1254, Pb, and Ag were retained as COPECs at 0.25 foot bgs. A-1254 was the highest ecological risk (>10 times avian receptor ESL) in the 0.25-foot sample; however, deeper samples were not analyzed. **At sample location BC-SD03**, Ni, Ag, and Zn were retained as COPECs; however, the Ni concentration (33.3 mg/kg) was below the BTV (140 mg/kg). Of these compounds, Ag is the highest ecological risk (>10 times benthic macroinvertebrate receptor ESL) at 0.25 foot. The area will be excavated to a depth of 2.5 feet bgs, 1 foot below the deepest sample exceeding ecological risk levels. The lateral and vertical extent of COPECs will be assessed during excavation.	R
BC-R-2	BC-N-8 BC-N-9	Ecological	28E-SNS01 59E-SD03 59E-SD04 WL-SD09	—	—	—	A-1254, Cr, Pb, Hg, Ni, Ag, Zn	3529 (A)	—	—	46-50	MI	Open Space Drainage	No	This Remediation Area was selected for further action in the SLERA. **At sample location WL-SD09,** Ag (35 mg/kg) was retained as a COPEC in the 0.25-foot sample. **At sample location 59E-SD03**, A-1254 (21J µg/kg), Cr 90.5J mg/kg), Pb (45.5 mg/kg), Ni (50.5 mg/kg), Ag (6.1J mg/kg), and Zn (196 mg/kg) were retained as COPECs at 0.25 foot bgs; however, Cr and Ni concentrations were below their BTVs (118 mg/kg and 140 mg/kg, respectively). No deeper samples were collected at this location; however a 1-foot bgs sample was collected at nearby sample 59E-SB05. **At sample location 28E-SNS01**, Hg (0.18 mg/kg) and Ag (17 mg/kg) were retained as COPECs in the 0.25 foot bgs sample. **At sample location 59E-SD04**, A-1254 (2J µg/kg), Ni (51.1 mg/kg), Ag 13.8J mg/kg), and Zn (187 mg/kg) were retained as COPECs; however, the Ni concentration was below the BTV (140 mg/kg). The area will be excavated to a depth of 2 feet bgs, 1 foot below the deepest sample exceeding ecological risk levels. The lateral and vertical extent of COPECs will be assessed during excavation.	R
BC-C-1	—	Ecological	WL-SD02 WL-SD16 WL-SD13 WL-SD12	—	—	—	A-1254, Cr, Cu, Hg, Mn, Ni, Ag, Zn	>10 (B)	—	—	63-78	VI	Open Space Drainage	No	This Remediation Area was selected for further action in the SLERA. **At sample location WL-SD16**, Ag, Cr, Ni, and Zn were retained as COPECs; however, the Cr (106J mg/kg) and Ni (36.9 mg/kg) concentrations were below their BTVs (118 mg/kg and 140 mg/kg, respectively). Ag was the highest ecological risk (>10 times benthic macroinvertebrate receptor ESL) in the 0.25-foot sample; deeper samples for metals were not analyzed. **At sample location WL-SD02**, A-1254, Cr, Cu, Hg, Ni, Ag and Zn were retained as COPECs; however, the Cu (75 mg/kg) and Ni (43 mg/kg) concentrations were below their BTVs (76 mg/kg and 140 mg/kg, respectively). Ag was the highest ecological risk (>10 times benthic macroinvertebrate receptor ESL) in the 0.25-foot bgs sample and was still elevated (24 mg/kg) in the 1.5-foot sample; deeper samples for metals were not analyzed. **At sample location WL-SD13**, Cr, Cu, Ni, and Ag were retained as COPECs; however, the Ni concentration (55 mg/kg) was below the BTV (140 mg/kg). Cr (1,200 mg/kg) was the highest ecological risk (>10 times benthic macroinvertebrate receptor ESL) in the 0.25-foot bgs sample, but was much lower (40 mg/kg) in the 1.5-foot bgs sample; deeper samples for metals were not analyzed. **At sample location WL-SD12**, Cr, Cu, Mn, Ni, and Ag were retained as COPECs. Ag was the highest ecological risk (>10 times benthic macroinvertebrate receptor ESL) in the 1.5-foot bgs sample and was also elevated (17 mg/kg) in the 0.25-foot bgs sample; deeper samples for metals were not analyzed. This area was excavated during 2010 as part of the "Removal Action Proposal – Buffalo Creek Vegetation and Sediment Near the ARGET Discharge, Aerojet Superfund Site, Sacramento County, California" dated August 16, 2010. USEPA approved this proposal in a letter dated September 29, 2010.	C
BC-N-1	BC-R-1 BC-N-10	RTG	59E-SD01	—	—	—	—	—	A-1254	3	45	MI	Mixed Use	No	The RTG contaminant was a low mobility/solubility compound (A-1254), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1254 (73 µg/kg) exceeded the PGW SSL (34 µg/kg) at 0.2 foot bgs and was not detected in the 1.5- or 5-foot bgs samples.	N
BC-N-2	BC-R-1 BC-N-3	RTG	BC-SD01	—	—	—	—	—	A-1254 Cd, Pb	6	49	VI	Open Space Drainage	No	The RTG contaminants were low mobility/solubility compounds (PCBs and metals) and ranked as a moderate RTG; therefore, this RA was not recommended for retention. A-1254 (740 µg/kg), Cd (27.9 mg/kg), and Pb (72.1 mg/kg) exceeded their PGW SSLs (34 µg/kg, 102 mg/kg, and 23 mg/kg, respectively) at 0.25 foot bgs and no deeper samples were collected.	N
BC-N-3	BC-R-1 BC-N-2	HH	BC-SD01	A-1254	8E-6	8.6E-1 (RC)	—	—	—	—	—	VI	Open Space Drainage	No	The HH risk was just above 1E-6 and HI>1; therefore, this RA was not recommended for retention. A-1254 exceeded the resident ILCR for the resident child (8E-6) and commercial worker receptors (2.5E-6) at 0.25 foot bgs. No deeper samples were collected.	N
BC-N-4	BC-R-1 BC-N-5	RTG	BC-SD02	—	—	—	—	—	A-1254 Pb	3	45	VI	Open Space Drainage	No	The RTG contaminants were low mobility/solubility compounds (A-1254 and Pb) and ranked as a low RTG; therefore, this RA was not recommended for retention. A-1254 (1,100 µg/kg) and Pb (29.9 mg/kg) exceeded their PGW SSLs (34 µg/kg, and 23 mg/kg, respectively) at 0.25 foot bgs and no deeper samples were collected.	N
BC-N-5	BC-R-1 BC-N-4	HH	BC-SD02	A-1254	1E-5	1.0E+0 (RC)	—	—	—	—	—	VI	Open Space Drainage	No	The HH risk was just above 1E-6 and HI=1; therefore, this RA was not recommended for retention. A-1254 exceeded the resident ILCR for the resident child (1.2E-5) and commercial worker receptors (3.7E-6) at 0.25 foot bgs. No single compound exceeded the HI; however, the additive risk for A-1254 and Ag was 1.0E+0. No deeper samples were collected. This area will be excavated to 2.5 feet bgs in BC-R-1	N
BC-N-6	BC-R-1 BC-N-7	RTG	59E--SD02	—	—	—	—	—	A-1254 Pb	4	50	VI	Open Space Drainage	No	The RTG contaminants were low mobility/solubility compounds (A-1254 and Pb), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1254 (91 µg/kg) and Pb (25 mg/kg) exceeded their PGW SSLs (34 µg/kg, and 23 mg/kg, respectively) at 0.25 foot bgs, but did not exceed at 1.5 feet bgs.	N

Table 1-8
Summary of Soil Risks and Rationale for Remedial Action - Buffalo Creek and West Lakes
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2,3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained, Not Retained or Remediation Completed
BC-N-7	BC-R-1 BC-N-6	HH	59E--SD02	Mn	1E-6	4.0E+0 (CW)	—	—	—	—	—	—	Open Space Drainage	No	The HH risk was below 1E-6; however, the HI>1. The sample was collected in a drainage ditch that will remain in use for this purpose; therefore, this RA was not recommended for retention. Mn exceeded the HI (4.0E+0 and 3.7E+0) for the construction worker receptor at 0.25 and 1.5 feet bgs. No deeper samples were collected.	N
BC-N-8	BC-R-2 BC-N-9	RTG	59E-SD03	—	—	—	—	—	A-1254 Pb	6	47	VI	Open Space Drainage	No	The RTG contaminants were low mobility/solubility compounds (A-1254 and Pb) and ranked as a low to moderate RTG; therefore, this RA was not recommended for retention. A-1254 (210 µg/kg) and Pb (45.5 mg/kg) exceeded their PGW SSLs (34 µg/kg, and 23 mg/kg, respectively) at 0.25 foot bgs and no deeper samples were collected.	N
BC-N-9	BC-R-2 BC-N-8	HH	59E-SD03	A-1254	2E-6	2.0E-1 (RC)	—	—	—	—	—	—	Open Space Drainage	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. A-1254 exceeded the resident ILCR for the resident child (2.4E-6) a at 0.25 foot bgs. No deeper samples were collected. The HH risk for this RA will be addressed while addressing the ecological risk in BC-R-2.	N
BC-N-10	BC-R-1 BC-N-1	HH	59E-SD01	Mn	0.0000009	1.1E+1 (CW)	—	—	—	—	45	VI	Mixed Use	No	Mn (200 mg/kg, and 1,200 mg/kg) exceeded the construction worker HHSL in the 1.5- and 5-foot bgs samples, respectively. The BTV for Mn is 1,500 mg/kg. The area will be excavated to a depth of 1 foot bgs to address the ecological risk as part of BC-R-3.	R
West Lakes																
WL-R-1	—	RTG	WL-SB01	—	—	—	—	—	ClO4	4	73	MI	Open Space	No	ClO4 (9,000 µg/kg) exceeded the PGW SSL (60 µg/kg) in the 5-foot bgs sample and was ranked as a low RTG. At a minimum, the area will be excavated to a depth of 6 feet bgs, 1 foot below the deepest risk exceedence. The lateral and vertical extent of ClO4 will be assessed during	R
WL-N-1	—	RTG	WL-SD07	—	—	—	—	—	A-1260	4	63	VI	Open Space	No	The RTG contaminant was a low mobility/solubility compound (A-1260), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1260 was a low RTG in the 0.5-foot bgs sample, but was not detected in the 1.5-foot bgs sample. A-1260 has low solubility and mobility.	N
WL-N-2	—	RTG	WL-SD08	—	—	—	—	—	B(a)P, B(b&k)F	4	63	VI	Open Space	No	The RTG contaminants were low mobility/solubility compounds (B(a)P and B(b&k)F), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(a)P and B(b&k)F were low RTG in the 0.5-foot bgs sample, but were not detected in the 1.5-foot bgs sample. PAHs have low solubility and mobility.	N
WL-N-3	—	RTG	WL-SD04	—	—	—	—	—	A-1260	4	63	VI	Open Space	No	The RTG contaminant was a low mobility/solubility compound (A-1260), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1260 (37J µg/kg) exceeded the PGW SSL (34 µg/kg) in the 0.5-foot sample, but not in the 1.5-foot sample) and has low solubility and mobility.	N
WL-N-4	—	RTG	WL-SD06	—	—	—	—	—	A-1260	6	63	VI	Open Space	No	The RTG contaminant was a low mobility/solubility compound (A-1260), ranked as a moderate RTG, and only detected in one sample at an estimated concentration (38Jug/Kg) just above teh PGW SSL (34ug/Kg); therefore, this RA was not recommended for retention.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-33 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - Shallow soil samples are defined as samples collected at depths less than 5 feet bgs
6 - "—" means "not applicable"

Table 1-9
Summary of Soil Risks and Rationale for Remedial Action - Magazine Area, Open Space 3 and Open Space 4 Areas
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
MA-N-1	—	RTG	A48-RCO8-SB01	—	—	—	—	—	Tl	6	75	VI	Not Currently Planned	Adjacent to building, excavation may impact structure	The RTG contaminant was a low mobility/solubility compound (Tl), ranked as moderate, and suspected to be naturally occurring; therefore, this RA was not recommended for retention. The maximum concentration (4.5 mg/kg) was detected at 11 feet bgs, but Tl concentrations in the 2- and 5.5-foot bgs samples did not exceed the PGW SSL (2.5 mg/kg). Detected Tl concentrations were " outside the range of statistical background, but suspected to be naturally occurring." No data were available to assess if the Tl was present in groundwater.	N
MA-N-2	—	RTG	A48-ST13-SB01	—	—	—	—	—	ClO4	6	80	VI	Not Currently Planned	No	The RTG was ranked as a moderate and the ClO4 was only detected at significant concentration (330 ug/Kg) in the 6 foot bgs sample. The 11 foot bgs sample contained perchlorate (64 ug/Kg) at the PGW SSL (60 ug/Kg). Therefore, since RTG was moderate and ClO4 was very isolated, this RA was not recommended for retention.	N

Notes:

1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-34 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - "—" means "not applicable"

Table 1-10
Summary of Soil Risks and Rationale for Remedial Action - Chemical Plant 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
CP2-R-1	CP2-R-10 CP2-R11 CP2-N-18 CP2-N-21 CP2-N-22 CP2-N-23	Ecological	59F-SD01 59F-SD05 59F-SB22 59F-SPB02 CP2-08-SNS02 CP2-08-SNS04	—	—	—	Sb, Ni, Se, 4,4-DDD, 4,4-DDE, 4,4-DDT, A-1248, A-1254, d-BHC, Endrin, Prowl, phenol, Ba, B, Cd, Pb, Zn	1581 (A)	—	—	82-85	NI	Not Currently Planned	No	COPECS exceeding their respective screening levels were detected in the 0.25 to 1-foot depth interval. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from COPECs will be determined prior to capping. The human health risk from A-1248 (CP2-R-10) and Ba (CP2-R-11) will be tracked as part of the ecological remedy at this RA.	R
CP2-R-2	CP2-R-3 CP2-N-2 CP2-N-24	HH	59F-SB28	A-1254	3E-5	2.5E+0 (RC)	—	—	—	—	80	MI	Not Currently Planned	No	A-1254 exceeded the residential child (2.5E+0) HI in the 1-foot sample at sampling location 59F-SB28. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping. Confirmation of remedy for HH will be tracked under CP-R-3.	R
CP2-R-3	CP2-R-2 CP2-R-6 CP2-N-2 CP2-N-3 CP2-N-24	Ecological	59F-SB26 59F-SB27 59F-SB28 59F-SD02	—	—	—	4,4'-DDE, 4,4'-DDT, Endrin, phenanthrene, BEHP, Dieldrin, EA, A-1254, Cr, Cu, Ni	280 (A)	—	—	80-85	NI	Not Currently Planned	No	BEHP, Dieldrin, Endrin, A-1254, Cr, Cu, Ni, and Zn were retained as COPECs in the 1-foot bgs sample at 59F-SB28. COPECS that exceeded their respective screening levels were detected in the 1-foot depth interval at both locations. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from COPECs will be determined prior to capping.	R
CP2-R-4	CP2-R-5 CP2-N-25	HH	59F-SD02	A-1248, A-1254	6E-6	5.2E-1 (RC)	—	—	—	—	85	MI	Not Currently Planned	No	A-1248 exceeded HH risk levels at sampling location 59F-SD02. A-1248 exceeded the resident (6E-6) and commercial worker (2E-6) ILCR in the 0.25-foot sample. A-1254 also exceeded HH risk levels at sampling location 59F-SD02. A-1254 exceeded the resident (4E-6 and 5E-6) ILCR in the 1.5- and 5-foot samples. At a minimum, the area will be capped or excavated to 6 feet and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1248 impact will be determined prior to capping.	R
CP2-R-5	CP2-R-4 CP2-N-25	HH	59F-SB27	A-1254	4E-6	3.2E-1 (RC)	—	—	—	—	82	MI	Not Currently Planned	No	A-1254 exceeded the resident (4E-6) ILCR in the 1-foot bgs sample at sampling location 59F-SB27. No deeper samples were collected at this location. At a minimum, the area will be capped or excavated to 2 feet and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping. Confirmation of remedy for HH will be tracked under CP2-R-3.	R
CP2-R-6	CP2-R-3 CP2-N-3	HH	59F-SB26	A-1254	2.5E-5	9.9E-1 (RC)	—	—	—	—	85	MI	Not Currently Planned	No	A-1254 exceeded the resident (2E-5) and commercial worker (5E-6) ILCR in the 1-foot bgs sample at sampling location 59F-SB26. No deeper samples were collected at this location. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping. Confirmation of remedy for HH will be tracked under CP2-R-3.	R
CP2-R-7	CP2-N-1 CP2-N-30	Ecological	OS1-F3-SD01	—	—	—	A-1254	16 (A)	—	—	75	VI	Not Currently Planned	No	A-1254 was retained as a COPEC at this location. A-1254 (160 µg/kg) exceeded 10x the ESL (10.1 µg/kg) for the avian receptor in the 0.25 foot sample. No deeper samples were collected. This area will be capped or excavated to 1.25 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from Ba will be determined prior to capping. .	R
CP2-R-8	CP2-N-27 CP2-N-28	HH	F(c)-SB04	A-1248	1E-3	1.1E+2 (RC)	—	—	—	—	100	NI	Not Currently Planned	No	A-1248 exceeded the ILCR for resident (1E-3) and commercial worker (4E-4), and the HI for resident child (1.1E+2), adult (1.3 E+1), construction worker (2.8E+1), and commercial worker (1.1E+1) in the 1-foot bgs sample at sampling location F(c)-SB04, but not in the 5-foot bgs sample. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from A-1248 will be determined prior to capping.	R
CP2-R-9	CP2-N-18 CP2-N-29	HH	C208-SB02 C208-SB05 C208-SPB01 CP2-08-SB12	A-1248 A-1254	2E-5	1.7E+0 (RC)	—	—	—	—	95-98	NI	Not Currently Planned	No	**At sampling location C208-SB02**, A-1254 exceeded the HI (1.1E+0) and ICLR (1E-5) in the 1-foot bgs sample and exceeds the ICLR (5E-6) in the 3-foot bgs sample, but did not exceed HH risk levels in the 5- and 10-foot bgs samples. **At sampling location C208-SB05**, A-1248 exceeded the HI (1.2E+0) and ICLR (2E-5) in the 1-foot bgs sample and exceeded the ICLR in the 3-foot bgs (7E-6) and 5-foot bgs (3E-6) samples, but did not exceed HH risk levels in the 10-foot bgs sample. **At sampling location C208-SPB01**, A-1254 exceeded the HI (1.6E+0) in the 1-foot bgs sample and exceeded ILCR in the 1-foot bgs (2E-5) and 6-foot bgs (2E-6) samples, but did not exceed the ILCR in the 3- and 10-foot bgs samples. **At sampling location CP2-08-SB12**, A-1248 exceeded the HI (1.7E+0) and ICLR (2E-5) in the 1-foot bgs sample, but did not exceed HH risk levels in the 5-foot bgs sample. The high human health risk contour is based upon a residential scenario. The risk to human health (residential) extends to a depth of 1 foot below ground surface. This area is intended to remain commercial/industrial; therefore, deed restrictions will need to be developed to prevent residential redevelopment and/or specify the requirements for residential redevelopment (excavation to 2 feet bgs or capping).	R
CP2-R-10	CP2-R-1 CP2-N-21 CP2-N-22	HH	59F-SD01	A-1248	2E-4	1.4E+1 (RC)	—	—	—	—	82	MI	Not Currently Planned	No	A-1248 exceeded the HI for RC (1.4E+1) and the ILCR for resident (2.3E-4) risk level in the 0.25-foot bgs sample, but not in the 1.5- or 5-foot bgs samples. This area will be capped or excavated to 2 feet bgs in remedial area CP2-R-1 for ecological risk. The HH risk will be capped or excavated to 1.25 feet bgs and implemented as part of the CP2-R-1 remedy. If excavation is selected as the remedial option, the lateral and vertical extent of contamination will be assessed during excavation for CP2-R-1. Because the sample was collected within a drainage feature, the kriged extent shown on Figure 6-3 will not necessarily be excavated. The additional kriged area was not included in the excavation volume estimate.	R
CP2-R-11	CP2-R-1 CP2-N-18	HH	59F-SPB02	Ba	2E-9	3.4E+0 (CW)	—	—	—	—	85	NI	Not Currently Planned	No	Ba (3.4E+0) exceeds the construction worker HI in the 1-foot sample at sample location 59F-SPB02, but does not exceed in 5- or 10-foot samples. This area will be capped or excavated to 2 feet bgs and implemented as part of the CP2-R-1 remedy and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from BA will be determined prior to capping. If excavation is selected as the remedial option, the lateral and vertical extent of contamination will be assessed during excavation for CP2-R-1. Because the sample was collected within a drainage feature, the kriged extent shown on Figure 6-3 will not necessarily be excavated. The additional kriged area was not included in the excavation volume estimate.	R

Table 1-10
Summary of Soil Risks and Rationale for Remedial Action - Chemical Plant 2
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Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
CP2-N-1	CP2-R-7 CP2-N-30	HH	OS1-F3-SD01	Prowl	2E-6	1.5E-1 (RC)	—	—	—	—	75	VI	Not Currently Planned	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Prowl (2E-6) only slightly exceeded the ILCR risk level (1E-6) at 0.25 foot bgs and has an HI<1.	N
CP2-N-2	CP2-R-2 CP2-R-3 CP2-N-24	RTG	59F-SNS02 59F-SB28	—	—	—	—	—	A-1254, Dieldrin, Cd, Tl	6	81	MI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (A-1254, Dieldrin, and metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1254 (2,800 µg/kg) and Dieldrin (5.4 µg/kg) were detected above their PGW SSLs (34 µg/kg and 4.2 µg/kg, respectively) in the 1-foot bgs sample at sampling location 59F-SB28 and were ranked as moderate RTGs. Cd (0.96 mg/kg and 0.8mg/kg) was detected at 0.5 foot and 2.5 feet bgs, respectively, in sampling location 59F-SNS02 at concentrations above the PGW SSL (0.72 mg/kg), and Tl (2.8 mg/kg) was detected above the PGW SSL (2.5 mg/kg) in the 2.5-foot bgs sample at this location. A-1254 and metals generally have low solubility and low mobility, and coupled with the 81-foot depth to water, are not likely to impact groundwater beneath this area.	N
CP2-N-3	CP2-R-3 CP2-R-6	RTG	59F-SB13 59F-SB26 59F-SNS03 59F-SNS04	—	—	—	—	—	A-1254, B(a)A, B(a)P, B(b)F, I(1,2,3-cd)P, Cd, Tl	6	83	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (A-1254, SVOCs and metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. The compounds A-1254 (1,100 µg/kg), B(a)A (170 µg/kg), B(a)P (150J µg/kg), B(b)F (230J µg/kg), and I(1,2,3-cd)P (100 µg/kg) were detected at 1-foot bgs in sampling location 59F-SB26 above their PGW SSLs (34 µg/kg, 29 µg/kg, 2.9 µg/kg, 29 µg/kg, and 29 µg/kg, respectively) and were ranked as moderate RTGs. Cd (0.84 mg/kg) exceeded its PGW SSL (0.72 mg/kg) at 5 feet bgs in sampling location 59F-SB13. B(a)P (6.8 µg/kg) at 0.5 foot bgs, Cd (0.83 mg/kg), and Tl (3.2 mg/kg) at 2.5 feet bgs exceeded their PGW SSLs (2.9 µg/kg, 0.72 mg/kg and 2.5 mg/kg, respectively) at sampling location 59F-SNS03; Tl (3.2 mg/kg) also exceeded the PGW SSL at 0.5 foot bgs at sampling location 59F-SNS04. B(a)P, Cd, and Tl at sampling locations 59F-SNS03 and 59F-SNS04 were all ranked as low RTGs. Cd and Tl metals were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). B(a)P and the metals generally have low solubility and mobility.	N
CP2-N-4	—	RTG	59F-SB11 59F-SB12 59F-SB15	—	—	—	—	—	B(a)P, B(b&k)F, CL04, Tl	3	87	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (A-1254, ClO4 and metals), ranked as a low to moderate RTG, and contamination was only in shallow5 soil samples; therefore, this RA was not recommended for retention. B(a)P, B(b&k)F, Cl04, and Tl were low RTGs. The maximum ClO4 concentration (95 µg/kg) above the PGW SSL (60 µg/kg) was detected at 5 feet bgs in sampling location 59F-SB11, but ClO4 was not detected at 11- and 15-feet bgs. ClO4 (11 µg/kg) also was below the PGW SSL in the 1-foot bgs sample at this location. B(a)P and B(b&k)F were only detected above their respective PGW SSLs in the 1-foot bgs sample at sampling location 59F-SB-12 and the 5-foot bgs sample at sampling location 59F-SB15, but were not detected in the 11- and 15-foot bgs samples at these locations. Tl was detected above its PGW SSL in the 1- and 5-foot samples at 59F-SB12 and in the 1-foot sample at sampling location 59F-SB11, but was below the PGW SSL in the 11- and 15-foot samples at these locations. Tl was considered to	N
CP2-N-5	—	RTG	CP2-07-SB03 CP2-07-SB11	—	—	—	—	—	Tl	6	104	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (metals), ranked as a low to moderate RTG, and contamination was only in shallow5 soil samples; therefore, this RA was not recommended for retention. Tl was a low RTG. Tl was detected above its PGW SSL only in the 55-foot bgs sample at sampling location CP2-07-SB03 and in the 1- and 5-foot samples at sampling location CP2-07-SB11, but was below the PGW SSL in the 11-foot sample at both of these locations. Tl was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW	N
CP2-N-6	—	RTG	OS1-F2-SNS02 OS1-F2-SNS03	—	—	—	—	—	Dieldrin, HE, B(a)P	6	92	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (B(a)P, pesticides and metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. Heptachlor epoxide was ranked as a moderate RTG, while Dieldrin and B(a)P were ranked as low RTGs. HE (28 µg/kg) was detected above its PGW SSL (6 µg/kg) in the 0.5-foot bgs sample at sampling location OS1-F2-SNS02. Dieldrin (8.3 µg/kg and 5.1 µg/kg) was detected above the PGW SSL (4.2 µg/kg) in the 0.5-foot samples collected from sampling locations OS1-F2-SNS02 and OS1-F2-SNS03, respectively. B(a)P (12 µg/kg) was detected above the PGW SSL (2.9 µg/kg) in the 0.5-foot bgs sample at sampling location OS1-F2-SNS03. None of these compounds were detected above their respective PGW SSL in samples collected at 2.5 feet bgs. These compounds tend to have low solubility and mobility and the depth to groundwater is 92 feet bgs at this location.	N
CP2-N-7	—	RTG	OS1-F2-SB03	—	—	—	—	—	A-1254	6	93	MI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (A-1254) and ranked as moderate; therefore, this RA was not recommended for retention. A-1254 (61 µg/kg) was detected above its PGW SSL (34 µg/kg) in the 1-foot bgs sample at sampling location OS1-F2-SB03; however, no deeper samples were collected. A-1254 tends to have low solubility and mobility and the depth to groundwater is 93 feet bgs at this location.	N
CP2-N-8	—	RTG	OS1-F2-SB04	—	—	—	—	—	A-1254	6	90	MI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (A-1254) and ranked as a moderate RTG; therefore, this RA was not recommended for retention. A-1254 (93 µg/kg) was detected above its PGW SSL (34 µg/kg) in the 1-foot bgs sample at sampling location OS1-F2-SB04; however, no deeper samples were collected. A-1254 tends to have low solubility and mobility and the depth to groundwater is 90 feet bgs at this location.	N
CP2-N-9	—	RTG	CP2-08-SB15	—	—	—	—	—	Tl	3	98	MI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (Tl) and ranked as a low RTG; therefore, this RA was not recommended for retention. Tl was ranked as a low RTG. Tl (2.8 mg/kg) was detected above its PGW SSL (2.5 mg/kg) in the 11-foot bgs sample at sampling location CP2-08-SB15; however, no deeper samples were collected. Tl was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II) and the depth to groundwater is 90 feet bgs at this location.	N
CP2-N-10	—	RTG	62F-SB07 62F-SNS01	—	—	—	—	—	B(a)P, B(b&k)F	4	100	MI	Not Currently Planned	Exterior fence bisects the two sample locations	The RTG contaminants were low mobility/solubility compounds (B(a)P and B(b&k)F), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(a)P (7 µg/kg and 8.1 µg/kg) was detected above its PGW SSL (2.9 µg/kg) in the 0.5-foot bgs sample at sampling location 62F-SNS01 and the 5-foot bgs sample at sampling location 62F-SB07, respectively. No deeper samples were collected at sampling location 62F-SNS01, but these PAHs were not detected in samples collected from sampling location 62F-SB07 at 10-, 20-, 30- and 40-feet bgs. PAHs tend to have low solubility and mobility and the depth to groundwater is 100 feet bgs at this location.	N
CP2-N-11	—	RTG	62F-SNS02	—	—	—	—	—	B(b&k)F	6	100	NI	Not Currently Planned	Adjacent to railroad tracks	The RTG contaminant was a low mobility/solubility compound (B(b&k)F) and ranked as a moderate RTG; therefore, this RA was not recommended for retention. B(b&k)F (39 µg/kg) was detected above its PGW SSL (29 µg/kg) in the 0.5-foot bgs sample at sampling location 62F-SNS02; however, no deeper samples were collected. PAHs tend to have low solubility and mobility and the depth to groundwater is 100 feet bgs at this location.	N
CP2-N-12	—	RTG	61F-SNS02	—	—	—	—	—	Cd	6	105	VI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (Cd) and ranked as a low RTG; therefore, this RA was not recommended for retention. Cd (1 mg/kg) was detected above its PGW SSL (0.72 mg/kg) in the 1-foot bgs sample at sampling location 61F-SNS02; however, no deeper samples were collected. Cd was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II) and the depth to groundwater is 105 feet bgs at this location.	N

Table 1-10
Summary of Soil Risks and Rationale for Remedial Action - Chemical Plant 2
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Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
CP2-N-13	—	RTG	62F-SB06 62F-SB10	—	—	—	—	—	B(a)P, HE, As	3	100	NI	Not Currently Planned	Adjacent to railroad tracks	The RTG contaminants were low mobility/solubility compounds (B(a)P, HE, and As), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. B(a)P (7.5 µg/kg) and HE (33 µg/kg) were detected above their PGW SSLs (2.9 µg/kg and 6 µg/kg, respectively) in the 2-foot bgs sample at sampling location 62F-SB06, but were not detected in the 5.5- or 11-foot samples. As (35 mg/kg) was detected above its PGW SSL (11 mg/kg) in the 1-foot bgs sample at sampling location 62F-SB10, but not in the 5- or 11-foot bgs samples. PAHs, pesticides, and metals tend to have low solubility and mobility and the depth to groundwater is 100 feet bgs at this location.	N
CP2-N-14	—	RTG	61F-SB04	—	—	—	—	—	HE	6	108	VI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (HE) and ranked as a moderate RTG; therefore, this RA was not recommended for retention. HE (41 µg/kg) was detected above its PGW SSL (6 µg/kg) in the 1-foot bgs sample at sampling location 61F-SB04; however, no deeper samples were collected. Pesticides tend to have low solubility and mobility and the depth to groundwater is 108 feet bgs at this location.	N
CP2-N-15	CP2-N-3/7	RTG	60F-SNS01	—	—	—	—	—	B(a)P, B(b&k)F	4	108	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (B(a)P and B(b&k)F) and ranked as a low RTG; therefore, this RA was not recommended for retention. B(a)P (14 µg/kg) and B(b&k)F (58 µg/kg) were detected above their PGW SSLs (2.9 µg/kg and 29 µg/kg, respectively) in the 0.5-foot bgs sample at sampling location 60F-SNS01; however, no deeper samples were collected. PAHs tend to have low solubility and mobility, and the depth to groundwater is 108 feet bgs at this location.	N
CP2-N-16	—	RTG	CP2-RE05-SB04	—	—	—	—	—	Cd	7	110	NI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (Cd), ranked as a moderate RTG, and suspected to be naturally occurring; therefore, this RA was not recommended for retention. Cd (1 mg/kg) was detected above its PGW SSL (0.72 mg/kg) in the 11-foot sample at sampling location CP2-RE05-SB04, but not in the 1- or 5-foot bgs samples. No deeper samples were collected. Cd was detected in a nearby grab groundwater sample at a concentration above the PHG. Cd was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II) and the depth to groundwater is 110 feet at this location.	N
CP2-N-17	—	RTG	F(c)-SB02	—	—	—	—	—	A-1254	6	100	NI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (A-1254) and ranked as a moderate RTG; therefore, this RA was not recommended for retention. A-1254 (77 µg/kg) was detected above its PGW SSL (34 µg/kg) in the 1-foot bgs sample at sampling location F(c)-SB02; however, no deeper samples were collected. PCBs tend to have low solubility and mobility and the depth to groundwater is 100 feet bgs at this location.	N
CP2-N-18	CP2-R-1 CP2-R-9 CP2-R-11 CP2-N-19 CP2-N-23 CP2-N-29	RTG	F(c)-SNS01 CP2-08-SB10 CP2-08-SB13 F(c)-SNS02 CP2-08-SB12 F(c)-SNS03 CP2-08-SNS01 CP2-08-SNS02 CP2-08-SNS03 CP2-08-SNS04 59F-SB22	—	—	—	—	—	4,4-DDD, 4,4-DDT, A-1248, A-1254, Aldrin B(a)A, B(a)P, B(b&k)F, D(a,h)A, Al, Cd, Tl	6	85-98	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (PCBs, pesticides, SVOCs and metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. RTGs for all contaminants were ranked as low with the following exceptions: sampling location F(c)-SNS02 where A-1254 (200J µg/kg) was a moderate RTG at 0.5 feet, sampling location F(c)-SNS03 where A-1254 (230 µg/kg), B(a)P (12 µg/kg), and B(b&k)F (30 µg/kg) were moderate RTGs at 0.5 feet, sampling location CP2-08-SNS03 where A-1254 (75 µg/kg and 45 µg/kg) was a moderate RTG at 0.5 and 2.5 feet bgs, respectively. Pesticides, PAHs, PCBs, and metals generally have low solubility and mobility and the depth to groundwater is 85 to 98 feet bgs at this location.	N
CP2-N-19	CP2-N-18	HH	CP2-08-SNS02	—	2E-6	1.30E-01	—	—	—	—	90	NI	Not Currently Planned	No	The cumulative ILCR (2E-6) was just above 1E-6 and had an HI<1; therefore, this RA was not recommended for retention. A-1254 met the ILCR level (1E-6), but did not exceed it. The total resident ICLR was 2E-6 at 0.5 feet bgs, but did not exceed at 2.5 feet at sampling location CP2-08-SNS02.	N
CP2-N-20	—	RTG	59F-SNS01	—	—	—	—	—	B(a)P, B(b&k)F, As, Cd	6	87	NI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (SVOCs and metals), ranked as a low to moderate RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. The maximum As concentration (17 mg/kg) above the PGW SSL (11 mg/kg) was detected at 2.5-feet bgs, but did not exceed the PGW SSL at 1 foot bgs. B(a)P, B(b&k)F, and Cd exceeded their respective PGW SSLs at 0.5 feet bgs, but did not exceed at 2.5 feet bgs.	N
CP2-N-21	CP2-R-1 CP2-R-10 CP2-N-22	RTG	59F-SD01	—	—	—	—	—	A-1248, Al, Pb	4	82	MI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (A-1248 and metals), ranked as a low RTG, and contamination was only in shallow[5] soil samples; therefore, this RA was not recommended for retention. A-1248, Al, and Pb were low RTGs. A-1248 (16,000J µg/kg) and Pb (140 mg/kg) exceeded their PGW SSLs (34 µg/kg and 23 mg/kg, respectively) only in the 0.25-foot sample. Al (52,000 mg/kg) exceeded its PGW SSL (43,000 mg/kg) in the 1.5-foot bgs sample, but not in the 0.25- or 5-foot bgs samples, and was considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). No data was available to assess if A-1248, Pb, or Al were present in groundwater.	N
CP2-N-22	CP2-R-1 CP2-R-10 CP2-N-21	HH	59F-SD01	A-1248	5E-5	—	—	—	—	—	82	MI	Not Currently Planned	No	The HH risk for the low risk contour was based on A-1248 exceeding ILCR for the construction worker (5E-6) and commercial worker (5E-5) receptors at 0.25 feet bgs, but not at 1.5 feet bgs. The high HH risk will be addressed in RA CP2-R-1; therefore, the low risk RA was not recommended for retention. HI for resident child (1.4E+1) and the ILCR for resident (2.3E-4) is discussed in RA CP2-R-10.	
CP2-N-23	CP2-R-1 CP2-N-18	HH	CP2-08-SNS04	A-1254	9E-6	4.6E-1 (RC)	—	—	—	—	85	NI	Not Currently Planned	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. A-1254 exceeded the resident (9E-6) and commercial worker (3E-6) ILCR levels in the 0.5 foot bgs sample, but not in the 2.5-foot bgs sample at sample location CP2-08-SNS04. This area was identified for further action in the SLERA and the ecological risks will be addressed in CP2-R-1.	N
CP2-N-24	CP2-R-2 CP2-R-3 CP2-N-2	HH	59F-SB28	A-1254	3E-5	—	—	—	—	—	80	MI	Not Currently Planned	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. A-1254 exceeded the ILCR for residential (3E-5) and commercial worker (9E-6) at 1 foot bgs, no deeper samples were collected. As CP2-R-2 will address the source, this area is not recommended for retention.	N

Table 1-10
Summary of Soil Risks and Rationale for Remedial Action - Chemical Plant 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
CP2-N-25	CP2-R-4 CP2-R-5	RTG	59F-SD02	—	—	—	—	—	A-1248, A-1254, Al, As	6	85	MI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (A-1248, A-1254, Al, and As) and ranked as a low RTG; therefore, this RA was not recommended for retention. At 59F-SD02, A-1248 (540J µg/kg [0.25 foot]), A-1254 (320J µg/kg [1.5 feet] and 440 µg/kg [5 feet]), Al (51,000 mg/kg [0.25 foot] and 64,000 mg/kg (1.5 feet]) and As (15 mg/kg [1.5 feet]) exceeded their respective PGW SLs (34 µg/kg, 34 µg/kg, 43,000 mg/kg and 11 mg/kg, respectively). At 59F-SB27, A-1254 (350 µg/kg) exceeded its PGW SL (34 µg/kg) in the 1-foot sample and no deeper samples were collected at this location.	N
CP2-N-26	CP2-N-31	RTG	61F-SNS01	—	—	—	—	—	B(a)P, B(b&k)F, PCP, Cd	6	110	VI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (SVOCs and metals) and ranked as a low to moderate RTG; therefore, this RA was not recommended for retention. B(a)P, B(b&k)F, and PCP were each ranked as a moderate RTG, while Cd was ranked as a low RTG. B(a)P (33J µg/kg) B(b&k)F (130J µg/kg), PCP (2,800 µg/kg), and Cd (1.6 mg/kg) were detected above their PGW SSLs (2.9 µg/kg, 29 µg/kg, 400 µg/kg, and 0.72 mg/kg, respectively) in the 0.5-foot bgs sample at sampling location 61F-SNS01, but no deeper samples were collected.	N
CP2-N-27	CP2-R-8 CP2-N-28	RTG	F(c)-SB04	—	—	—	—	—	A-1248	4	100	NI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (A-1254), ranked as a low RTG, and contamination was only in shallow[5] soil samples. This RA was not recommended for retention. A-1248 (120,000 µg/kg) was detected above the PGW SSL (34 µg/kg) in the 1-foot bgs sample at sampling location F(c)-SB04, but did not exceed the PGW SSL in the 5-foot bgs sample (13 µg/kg) and was not detected in the 11-foot sample at this location.	N
CP2-N-28	CP2-R-8 CP2-N-27	HH	F(c)-SB04	A-1248	4E-5	—	—	—	—	—	100	NI	Not Currently Planned	No	Because this area will be capped or excavated to 2 feet in Remedial Area CP2-R-8 for HH risk, this RA was not recommended for retention for HH to avoid duplication of retained areas. For the low risk contour, A-1248 (4E-5) exceeded the ILCR (1E-6) for a construction worker at a depth of 1 foot bgs, but not at 5 feet bgs.	N
CP2-N-29	CP2-R-9 CP2-N-18	HH	C208-SB02 C208-SB05 C208-SPB01 C208-SPB06 CP2-08-SB12 F(c)-SNS02 F(c)-SNS03	A-1248 A-1254	5E-6	4.20E-01	—	—	—	—	95-98	NI	Not Currently Planned	No	HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. At sampling location C208-SPB06, A-1248 (4E-6 and 5E-6) exceeded the ILCR for the resident receptor at 1 foot and 3 feet bgs, and for the commercial worker receptor (2E-6) at 3 feet bgs, but did not exceed the HI. The high HH risk at locations C208-SB02, C208-SB5, C208-SPB01, and CP2-08-SB12 will be addressed in RA CP2-R-9.	N
CP2-N-30	CP2-R-7 CP2-N-1	RTG	OS1-F3-SD01	—	—	—	—	—	A-1254	6	75	VI	Not Currently Planned	No	The RTG contaminant was a low mobility/solubility compound (A-1254) and ranked as a moderate RTG; therefore, this RA was not recommended for retention. A-1254 (160 µg/kg) exceeded its PGW SSL (34 µg/kg) in the 0.25-foot sample. No deeper samples were collected at this location. A-1254 generally has low solubility and low mobility, and coupled with the 75-foot depth to water, is not likely to impact groundwater beneath this area.	N
CP2-N-31	CP2-N-26	HH	61F-SNS01	B(a)P, B(b&k)F, PCP	2E-6	1.7E-1 (CW)	—	—	—	—	110	VI	Not Currently Planned	No	HH risk was just above 1E-6 and HI<1; thereofre, this RA was not recommended for retention. B(a)P, B(b&k)F, and PCP were the main compounds that together caused an ILCR exceedence (2E-6) at sample location 61F-SNS01; however, no single compound's risk exceeds 1E-6. The human health risk contour is based upon a residential scenario. The risk to human health (residential) extends to a depth of 0.5 foot below ground surface. This area is intended to remain commercial/industrial; therefore, deed restrictions will need to be developed to prevent residential redevelopment and/or specify the requirements for residential redevelopment (excavation to 1.5 feet bgs or capping).	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-35 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - Shallow soil samples are defined as samples collected at depths less than 5 feet bgs
6 - "—" means "not applicable"

Table 1-11
Summary of Soil Risks and Rationale for Remedial Action - Dredge Pit and Eastern Basin
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Exceeding HH Risk Levels[2]	Maximum ILCR[2]	Maximum HI[2]	COPECs Exceeding SLERA Risk Levels[2, 3]	Maximum HQ[2]	COCs w/ Potential RTG[2]	Maximum RTG Score[2,4]	Depth to Groundwater[2] (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
DPEB-R-1	DPEB-N-1 DPEB-N-2 DPEB-N-3 DPEB-N-4	Ecological	25F-AH01 25F-SB04 25F-SB05 25F-SB06 25F-SB07 25F-SB14 25F-SD01 25F-SPB01 25F-SPB02 25F-SPB03	—	—	—	B, Cd, Hg, Mo, Ni, Tl, Zn, DnBP, Prowl	823529 (A)	—	—	60	VI	Not Currently Planned	No	Hg, Prowl, DnBP, B, Cd, Mo, and Ni were retained as COPECs. Hg was widespread. The Hg screening levels are below the xerothent BTV (0.127 mg/kg); however, concentrations of Hg above the xerothent BTV were detected as deep as 41 feet at location 25F-SB06. Prowl (17,000 mg/kg) exceeded avian (0.865 mg/kg) and mammalian (0.624 mg/kg) ecological screening levels at 1 foot bgs at 25F-SPB03. This remedial area is an excavated depression and will be backfilled to at least 6 feet above grade, the depth of ecological exposure.	R
DPEB-N-1	DPEB-R-1 DPEB-N-2 DPEB-N-3 DPEB-N-4	HH	25F-AH01 25F-SB06 25F-SB07	Hg	7.E-07	1.5E+0 (RC)	—	—	—	—	60	VI	Not Currently Planned	No	The HH risk at this RA will be addressed by the action for ecological risk in DPEB-R-1 above. Hg (1.5E+0) exceeded the HI for resident child in the 1-foot sample at sample location 25F-SB07, but HH risk levels were not exceeded in sample locations 25F-HA01 and 25F-SB06. The likelihood for residential reuse of this area is extremely low. If reused, the area of this sample location will be backfilled, which will remove the exposure pathway.	N
DPEB-N-2	DPEB-R-1 DPEB-N-1 DPEB-N-3 DPEB-N-4	HH	25F-SB07 25F-SPB03	Prowl	2.E-08	7.3E+0 (RC)	—	—	—	—	60	VI	Not Currently Planned	No	The HH risk at this RA will be addressed by the action for ecological risk in DPEB-R-1 above; therefore, this RA is not recommended for retention. Prowl exceeded the HI for resident child (7.3E+0) and construction worker (2.0E+0) in the 1 foot sample only. The likelihood for residential reuse of this area is extremely low. If reused, the area of this sample location will be backfilled, which will remove the exposure pathway.	N
DPEB-N-3	DPEB-R-1 DPEB-N-1 DPEB-N-2 DPEB-N-4	HH	25F-SPB02	Hg	—	2.2E+0 (RC)	—	—	—	—	60	VI	Not Currently Planned	No	The HH risk at this RA will be addressed by the action for ecological risk in DPEB-R-1 above; therefore, this RA is not recommended for retention. Hg (1.5E+0 and 2.2E+0) exceeded the HI for a resident child in the 1- and 5-foot samples, respectively. The likelihood for residential reuse of this area is extremely low. If reused, the area of this sample location will be backfilled, which will remove the exposure pathway.	N
DPEB-N-4	DPEB-R-1 DPEB-N-1 DPEB-N-2 DPEB-N-3	RTG	25F-AH01 25F-SB06 25F-SB07	—	—	—	—	—	B(a)P B(b&k)F Hg, Tl	6	60	VI	Not Currently Planned	No	The RTG contaminants were low mobility/solubility compounds (SVOCs and metals), and were all ranked as low RTG; therefore, this RA is not recommended for retention. Hg, Tl, B(a)P, and B(b&k)F are low RTGs. Hg and Tl were detected above their respective PGW SSLs only in sample location 25F-SB07. Hg was detected at 1 foot and 11 feet bgs and Tl was detected at 5 and 41 feet bgs. Hg was bounded at depth and Tl was suspected to be "naturally occurring based on its distribution in the subsurface" (See PGW Evaluation in HHERA, Volume II). B(a)P and/or B(b&k)F were detected at concentrations exceeding the PGW SSL in samples collected from 25F-AH01 and 25F-SB06 to depths of 5 feet bgs, but were not detected in samples collected below 5 feet.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - References for these columns can be found in Table 1-13
3 - Green-hatched areas shown on Figure 1-36 were identified by the risk assessors in Section 9 of the HHERA as the only areas requiring mitigation for ecological risks
4 - RTG Score Ranking: 0-2 Negligible, 3-4 Low, 5-6 Moderate, >6 High
5 - "—" means "not applicable"

Table 1-12
List of Acronyms Used in Risk Summary Tables
Aerojet – Boundary Operable Unit Feasibility Study

µg/dL	micrograms per deciliter
µg/kg	micrograms per kilogram
µg/m^3	micrograms per cubic meter
A-1016	Aroclor-1016
A-1248	Aroclor-1248
A-1254	Aroclor-1254
A-1260	Aroclor-1260
A	avian
Ag	silver
Al	aluminum
B	B is boron; (B) is benthic macroinvertebrate
Ba	barium
B(a)A	benzo(a)anthracene
B(b)F	benzo(b)fluoranthene
B(a)P	benzo(a)pyrene
B(b&k)F	benzo(b&k)fluorine
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BTV	background threshold value
Cd	cadmium
cis-1,2-DCE	cis-1,2-dichloroethene
ClO4	perchlorate
COC	chemical of concern
COPEC	chemical of potential ecological concern
Cr	chromium
Cr+6	chromium (VI)
Cu	copper
CW	construction worker
D(a,h)A	dibenzo(a,h)anthracene
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
4,4-DDD	4,4-dichlorodiphenyldichloroethane
4,4-DDE	4,4-dichlorodiphenyldichloroethene
4,4-DDT	4,4-dichlorodiphenyltrichloroethane
d-BHC	delta-benzene hexachloride
DMP	dimethyl phthalate
DnBP	di-n-butyl phthalate
DnOP	di-n-octyl phthalate
EA	endrin aldehyde

Table 1-12 (continued)
List of Acronyms Used in Risk Summary Tables
Aerojet – Boundary Operable Unit Feasibility Study

ESL	environmental screening level
$feet^2$	square feet
HE	heptachlor epoxide
Hg	mercury
HH	human health
HHERA	human health and ecological risk assessment
HHSL	human health screening limit
HI	hazard index
HQ	hazard quotient
I	invertebrate
I(1,2,3-cd)P	ideno(1,2,3-cd)pyrene
ILCR	incremental lifetime cancer risk
J	estimated value
Li	lithium
M	mammal
mg/kg	milligrams per kilogram
MI	moderately isolated
Mo	molybdenum
Mn	manganese
N	not recommended site be retained
NA	not applicable
Naph	naphthalene
NDMA	n-nitrosodimethylamine
Ni	nickel
NI	not isolated
P	plant
PAH	polycyclic aromatic hydrocarbon
1,1,2,2-PCA	1,1,2,2-tetrachloroethane
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
Pb	lead
PGW SSL	protection of groundwater soil screening level
PHG	California Public Health Goal
R	recommended site be retained
RC	resident child
RI	remedial investigation
RTG	risk to groundwater
Sb	antimony
Se	selenium

Table 1-12 (continued)
List of Acronyms Used in Risk Summary Tables
Aerojet – Boundary Operable Unit Feasibility Study

SLERA	screening level ecological risk assessment
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
TEQ	toxicity equivalent quotient
Ti	titanium
TPH	total petroleum hydrocarbon
TPH-D	total petroleum hydrocarbons as diesel
TPH-Mo	total petroleum hydrocarbons as motor oil
VOC	volatile organic compound
VC	vinyl chloride
VI	very isolated
Ti	titanium
Tl	thalium
V	vanadium
Zn	zinc

Table 1-13
References for Risk Summary Tables
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Administration Area East								
AE-R-1	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	B(a)A, TPH-D, TPH-Mo	Table 8.2-1	TBD	Figures 4.2-12 and 4.2-14
AE-R-2	1,1,2,2-PCA, A-1254, Fe	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	2	Figures 4.2-9 and 4.2-13
AE-R-3	B(a)A, B(a)P, B(b)F, B(k)F, Chrysene, D(a,h)A, I(1,2,3-cd)P, 1,1,2,2-PCA	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-11
AE-R-4	A-1254	Tables 5.2-31, 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	6	Figure 4.2-13
AE-R-5	A-1254	Tables 5.2-31, 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	2	Figure 4.2-13
AE-R-6	A-1254, B(a)A, B(a)P, B(b)F, B(k)F, Chrysene, I(1,2,3-cd)P	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	4	Figures 4.2-11 and 4.2-13
AE-R-7	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	Naph, A-1254, TPH-D, TPH-Mo	Table 8.2-1	12	Figures 4.2-12 and 4.2-14
AE-R-8	A-1254, Pb	Table 5.2-31	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	2	Figure 4.2-13
AE-R-9	A-1254, A-1260, Cr+6	Tables 5.2-31, 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	1	Figures 4.2-9 and 4.2-13
AE-C-1	A-1260	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	NA HH Risk Only	-	Figure 4.2-13
AE-C-2	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1260, B(a)P, B(b&k)F, Cd	Table 8.2-1	-	Figures 4.2-10, 4.2-12 and 4.2-14
AE-C-3	A-1254, Pb	Tables 5.2-31, 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-C-4	A-1254, A-1260, Pb	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13

Table 1-13
References for Risk Summary Tables
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Administration Area East (continued)								
AE-C-5	-	Tables 5.2-31 and 5.2-40	A-1016, A-1248, A-1254, A-1260, Hg, Mo, Zn	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figures 4.2-3 and 4.2-4
AE-C-6	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A1254, A-1260, B(a)P, B(b&k)F, TPH-Mo, Cd, Pb	Table 8.2-1	-	Figures 4.2-10, 4.2-12, and 4.2-14
AE-C-7	A-1260	Table 5.2-31	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-C-8	A-1260	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-C-9	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1260	Table 8.2-1	-	Figure 4.2-14
AE-C-10	A-1260	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-C-11	A-1254	Tables 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-N-1	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	Cd	Table 8.2-1	-	Figure 4.2-10
AE-N-2	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	B(a)A, TPH-D, TPH-Mo	Table 8.2-1	-	Figures 4.2-12 and 4.2-14
AE-N-3	1,1,2,2-PCA	Table 5.2-31	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figures 4.2-3 and 4.2-4
AE-N-4	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1254	Table 8.2-1	-	Figure 4.2-14
AE-N-5	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1254, TPH-D, TPH-Mo	Table 8.2-1	-	Figure 4.2-14
AE-N-6	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	Naph, A-1254	Table 8.2-1	-	Figures 4.2-12 and 4.2-14
AE-N-7	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1254, TPH-D, TPH-Mo, Pb	Table 8.2-1	-	Figures 4.2-10 and 4.2-14
AE-N-8	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	B(a)P, TPH-D, TPH-Mo	Table 8.2-1	-	Figures 4.2-12 and 4.2-14
AE-N-9	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	B(a)A, TPH-D	Table 8.2-1	-	Figures 4.2-12 and 4.2-14

Table 1-13
References for Risk Summary Tables
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Administration Area East (continued)								
AE-N-10	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1248	Table 8.2-1	-	Figure 4.2-14
AE-N-11	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	B(a)P, TPH-D, TPH-Mo	Table 8.2-1	-	Figures 4.2-12 and 4.2-14
AE-N-12	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1254, A-1260, B(a)A, B(a)P, B(b&k)F, Cd, Pb	Table 8.2-1	-	Figures 4.2-10, 4.2-12, and 4.2-14
AE-N-13	A-1254, A-1260, Cr+6	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figures 4.2-9 and 4.2-13
AE-N-14	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A1254, B(a)P, TPH-D, Cd, Pb	NA RTG Only	-	Figures 4.2-9 through 4.2-14
AE-N-15	A-1254	Tables 5.2-31 and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-N-16	A-1254	Table 5.2-31	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1254	Table 8.2-1	-	Figure 4.2-13
AE-N-17	1,1,2,2-PCA	Table 5.2-31	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figures 4.2-3 and 4.2-4
AE-N-18	1,1,2,2-PCA	Tables 5.2-31, 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figures 4.2-3 and 4.2-4
AE-N-19	-	Table 5.2-43	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	A-1260	Table 8.2-1	-	Figure 4.2-14
AE-N-20	A-1248	Table 5.2-31	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	-	Figure 4.2-13
AE-N-21	A-1254, A-1260, Fe	Tables 5.2-31, 5.2-36, and 5.2-40	-	Table (p. 6-33) Figs 6.2-1, 6.2-2, 6.2-3	-	Table 8.2-1	6	Figures 4.2-9 and 4.2-13
Administration Area West								
AW-R-1	A-1260	Tables 5.2-47 and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	2	Figure 4.3-11
AW-R-2	A-1254	Tables 5.2-47 and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	2	Figure 4.3-11
AW-R-3	A-1260	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	1	Figure 4.3-11

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Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Administration Area West (continued)								
AW-R-4	A-1260	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4,	-	Table 8.3-1	0.5	Figure 4.3-11
AW-R-5	-	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	TPH-D, TPH-Mo	Table 8.3-1	2	Figure 4.3-12
AW-R-6	Ni	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	2	Figure 4.3-7
AW-R-7	B(a)P, B(b&k)F	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	6	Figure 4.3-9
AW-R-8	Cr+6, Sb, Ni	Tables 5.2-47, 5.2-52 and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	12	Figure 4.3-7
AW-R-9	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	TPH-D, TPH-Mo, B(a)P, B(b&k)F, B(b)F, ClO4, Sb, Cd, Cr, Cr+6, Pb	Table 8.3-1	3.5	Figures 4.3-8, 4.3-10, and 4.3-12
AW-R-10	-	Table 5.2-59	Sb, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Ag, Zn	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	2	Figures 4.3-3 and 4.3-4
AW-R-11	A-1254	Tables 5.2-47 and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	2	Figure 4.3-11
AW-R-12	B(a)P, Ni, Cr+6	Tables 5.2-47 and 5.2-52	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-7
AW-R-13	Cr+6, Ni, Pb	Tables 5.2-47 and 5.2-52	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-7
AW-R-14	Cr+6	Tables 5.2-47, 5.2-52, and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-7
AW-N-1	-	Tables 5.2-47 and 5.2-52	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	Cd, Pb	Table 8.3-1	-	Figure 4.3-7
AW-N-2	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1254	Table 8.3-1	-	Figure 4.3-12
AW-N-3	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	Cd	Table 8.3-1	-	Figure 4.3-8

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Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Administration Area West (continued)								
AW-N-4	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	ClO4	Table 8.3-1	-	Figure 4.3-12
AW-N-5	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	ClO4	Table 8.3-1	-	Figure 4.3-12
AW-N-6	-	Tables 5.2-47 and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	Cd, Pb	Table 8.3-1	-	Figure 4.3-8
AW-N-7	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	Cd, Pb	Table 8.3-1	-	Figure 4.3-8
AW-N-8	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	Pb	Table 8.3-1	-	Figure 4.3-8
AW-N-9	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1254	Table 8.3-1	-	Figure 4.3-12
AW-N-10	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	B(a)A, B(a)P, B(b&k)F, TPH-D, TPH-Mo, Cd, Pb	Table 8.3-1	-	Figures 4.3-8, 4.3-10, and 4.3-12
AW-N-11	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1260, B(a)P, B(b&k)F, Cd, Pb	Table 8.3-1	-	Figures 4.3-8, 4.3-10, and 4.3-12
AW-N-12	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1254, Cd, Pb	Table 8.3-1	-	Figures 4.3-8 and 4.3-12
AW-N-13	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1254, B(a)P, B(b&k)F	Table 8.3-1	-	Figures 4.3-10 and 4.3-12
AW-N-14	-	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-9
AW-N-15	B(a)P	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-9
AW-N-16	A-1254	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-11
AW-N-17	B(a)P	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-9
AW-N-18	B(a)P	Table 5.2-47	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-9

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Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Administration Area West (continued)								
AW-N-19	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	B(a)A, B(a)P, B(b&k)F, D(a,h)A, I(1,2,3-cd)P	Table 8.3-1	-	Figure 4.3-10
AW-N-20	A-1254	Tables 5.2-47 and 5.2-56	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-11
AW-N-21	Cr+6, Ni, Pb	Tables 5.2-47 and 5.2-52	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	-	Table 8.3-1	-	Figure 4.3-7
AW-N-22	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1254	Table 8.3-1	-	Figure 4.3-12
AW-N-23	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1260, Cd	Table 8.3-1	-	Figures 4.3-8 and 4.3-12
AW-N-24	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	A-1254, Cd, Cr, Pb	Table 8.3-1	-	Figures 4.3-8 and 4.3-12
AW-N-25	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	B(a)A, B(a)P, B(b&k)F, I(1,2,3-cd)P, TPH-D, TPH-Mo	Table 8.3-1	-	Figures 4.3-10 and 4.3-12
AW-N-26	-	Table 5.2-59	-	Table (p. 6-40) Figs 6.2-4, 6.2-5, 6.2-6	Cr, Cr+6	Table 8.3-1	-	Figures 4.3-8 and 4.3-12
Line 2								
L2-R-1	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4	Table 8.4-1	3.5	Figure 5.1-14
L2-R-2	B(a)P B(b&k)F	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	-	Table 8.4-1	3	Figure 5.1-11
L2-R-3	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4, TPH-D	Table 8.4-1	3.5	Figure 5.1-14
L2-R-4	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4, Mn, Ni, Tl	Table 8.4-1	12	Figures 5.1-10 and 5.1-14
L2-R-5	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4	Table 8.4-1	12	Figure 5.1-14
L2-R-6	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4	Table 8.4-1	5.5	Figure 5.1-14
L2-R-7	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4	Table 8.4-1	12	Figure 5.1-14

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References for Risk Summary Tables
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Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Line 2 (continued)								
L2-R-8	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4	Table 8.4-1	12	Figures 5.1-10, 5.1-12, and 5.1-14
L2-R-9	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	ClO4, Al, Mn, NDMA, Tl	Table 8.4-1	12	Figures 5.1-10, 5.1-12, and 5.1-14
L2-N-1	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Cd	Table 8.4-1	-	Figure 5.1-10
L2-N-2	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	B(a)P	Table 8.4-1	-	Figure 5.1-12
L2-N-3	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Tl	Table 8.4-1	-	Figure 5.1-10
L2-N-4	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Cd, Mn, Tl	Table 8.4-1	-	Figure 5.1-10
L2-N-5	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	B(b&k)F, Cd, I(1,2,3-cd)P, Al	Table 8.4-1	-	Figures 5.1-10 and 5.1-12
L2-N-6	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Cd	Table 8.4-1	-	Figure 5.1-10
L2-N-7	Al, Ni	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	-	Table 8.4-1	-	Figure 5.1-9
L2-N-8	Al	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	-	Table 8.4-1	-	Figure 5.1-9
L2-N-9	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Tl	Table 8.4-1	-	Figure 5.1-10
L2-N-10	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	B(a)P, B(b&k)F, I(1,2,3-cd)P, TPH-D, TPH-Mo, Al, Mn, Tl	Table 8.4-1	-	Figures 5.1-10, 5.1-2, and 5.1-14
L2-N-11	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Al, Mn, Ni, Tl	Table 8.4-1	-	Figure 5.1-10
L2-N-12	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Al, Ni, Tl	Table 8.4-1	-	Figure 5.1-10
L2-N-13	-	Table 5.3-10	-	Table (p. 6-45) Figs. 6.3-2, 6.3-3	Al, Mn, NDMA, ClO4	Table 8.4-1	-	Figures 5.1-10 and 5.1-14

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Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Line 5 North								
L5-R-1	B(a)P	Table 5.4-10	-	Table (p. 6-48), Fig. 6.4.1	-	Table 8.4-1	1.5	Figure 5.2-11
L5-R-2	-	Table 5.4-10	-	Table (p. 6-48), Fig. 6.4.1	ClO4	Table 8.4-1	12	Figure 5.2-13
L5-R-3	-	Table 5.4-10	Cd DnOP	Table (p. 6-48), Fig. 6.4.1	-	Table 8.4-1	-	Figure 5.2-12 and 5.2-13
L5-N-1	-	Table 5.4-10	-	Table (p. 6-48), Fig. 6.4.1	ClO4, TPH-D	Table 8.4-1	-	Figure 5.2-13
L5-N-2	-	Table 5.4-10	-	Table (p. 6-48), Fig. 6.4.1	B(b&k)F, TPH-D, TPH-Mo, ClO4, Cd, Pb	Table 8.4-1	-	Figures 5.2-11, 5.2-12 and 5.2-13
L5-N-3	-	Table 5.4-10	-	Table (p. 6-48), Fig. 6.4.1	ClO4, Cd, Pb	Table 8.4-1	-	Figure 5.2-13
L5-N-4	-	Table 5.4-10	-	Table (p. 6-48), Fig. 6.4.1	B(a)A, B(a)P, B(b,k)F, D(a,h)A, I(1,2,3-cd)P, TPH-D, TPH-Mo, Cd, Pb	Table 8.4-1	-	Figures 5.2.105.2-12 and 5.2-13
L5-N-5	-	Table 5.4-10	Cd	Table (p. 6-48), Fig. 6.4.1	-	Table 8.4-1	-	Figure 5.2-12
Buffalo Creek and West Lakes								
Buffalo Creek								
BC-R-1	-	Table 5-11-13	A-1254, Pb, Hg, Ag, Zn	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	2.5	Figure 5.4-3
BC-R-2	-	Table 5-11-13	A-1254, Cr, Pb, Hg, Ni, Ag, Zn	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	2	Figure 5.4-3
BC-C-1	-	Table 5-11-13	A-1254, Cr, Cu, Hg, Mn, Ni, Ag, Zn	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	-	Figure 5.4-3
BC-N-1	-	Table 5-11-13	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	A-1254	Table 8.4-1	-	Figure 5.4-3
BC-N-2	-	Table 5-11-13	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	A-1254, Cd, Pb	Table 8.4-1	-	Figure 5.4-3
BC-N-3	A-1254	Tables 5-11-6, and 5.11-10	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	-	Figure 5.4-3
BC-N-4	-	Table 5-11-13	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	A-1254, Pb	Table 8.4-1	-	Figure 5.4-3
BC-N-5	A-1254	Tables 5-11-6, and 5.11-10	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	-	Figure 5.4-3

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BC-N-6	-	Table 5-11-13	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	A-1254, Pb	Table 8.4-1	-	Figure 5.4-3
Buffalo Creek and West Lakes (continued)								
BC-N-7	Mn	Table 5.11-8	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	1	Figure 5.4-3
BC-N-8	-	Table 5-11-13	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	A-1254, Pb	Table 8.4-1	-	Figure 5.4-3
BC-N-9	A-1254	Table 5-11-6	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	-	Figure 5.4-3
BC-N-10	Mn	Table 5.11-8	-	Table (p. 6-66) Figs. 6.6-1, 6.6-2	-	Table 8.4-1	1	Figure 5.4-3
West Lakes								
WL-R-1	-	Table 5-5-9	-	Table (p. 6-57) Figs. 6.5-1, 6.5-2	ClO4	Table 8.4-1	6	Figure 5.3-7
WL-N-1	-	Table 5-5-9	-	Table (p. 6-57) Figs. 6.5-1, 6.5-2	A-1260	Table 8.4-1	-	Figure 5.3-7
WL-N-2	-	Table 5-5-9	-	Table (p. 6-57) Figs. 6.5-1, 6.5-2	B(a)P, B(b&k)F	Table 8.4-1	-	Figure 5.3-5
WL-N-3	-	Table 5-5-9	-	Table (p. 6-57) Figs. 6.5-1, 6.5-2	A-1260	Table 8.4-1	-	Figure 5.3-7
WL-N-4	-	Table 5-5-9	-	Table (p. 6-57) Figs. 6.5-1, 6.5-2	A-1260	Table 8.4-1	2.5	Figure 5.3-7
Magazine Area, Open Space 3 and Open Space 4 Areas								
MA-N-1	-	Table 5.7-10	-	Table (p. 6-86) Figs. 6.9-1, 6.9-2	Tl	Table 8.5-1	-	Figure 6.2-3
MA-N-2	-	Table 5.7-10	-	Table (p. 6-86) Figs. 6.9-1, 6.9-2	ClO4	Table 8.5-1	12	Figure 6.2-3

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Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Chemical Plant 2								
CP2-R-1	-	Table 5.6-22	Sb, Ni, Se, 4,4-DDD, 4,4-DDE, 4,4-DDT, A-1248, A-1254, d-BHC, Endrin, Prowl, phenol, Ba, B, Cd, Pb, Zn	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	2	Figures 6.1-3 and 6.1-4
CP2-R-2	A-1254	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	2	Figure 6.1-13
CP2-R-3	-	Table 5.6-22	4,4'-DDE, 4,4'-DDT, Endrin, phenanthrene BEHP, Dieldrin, EA, A-1254, Cr, Cu, Ni	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	2	Figures 6.1-3 and 6.1-4
CP2-R-4	A-1248, A-1254	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	6	Figure 6.1-13
CP2-R-5	A-1254	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	2	Figure 6.1-13
CP2-R-6	A-1254	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	2	Figure 6.1-13
CP2-R-7	-	Table 5.6-10	A-1254	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	1	Figure 6.1-11
CP2-R-8	A-1248	Tables 5.6-10, 5.6-15, and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	2	Figure 6.1-13
CP2-R-9	A-1248 A-1254	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	4 (res) 2 (com)	Figure 6.1-13
CP2-R-10	A-1248	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13

Table 1-13
References for Risk Summary Tables
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Chemical Plant 2 (continued)								
CP2-R-11	Ba	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figures 6.1-9
CP2-N-1	Prowl	Table 5.6-10		Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figures 6.1-3 and 6.1-4
CP2-N-2	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254, Dieldrin, Cd, Tl	Table 8.5-1	-	Figures 6.1-10, 6.1-12, and 6.1-14
CP2-N-3	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254, B(a)A, B(a)P, B(b)F, I(1,2,3-cd)P, Cd, Tl	Table 8.5-1	-	Figures 6.1-10, 6.1-12, and 6.1-14
CP2-N-4	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(a)P, B(b&k)F, CL04, Tl	Table 8.5-1	-	Figures 6.1-10, 6.1-12, and 6.1-14
CP2-N-5	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	Tl	Table 8.5-1	-	Figure 6.1-10
CP2-N-6	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	Dieldrin, HE, B(a)P	Table 8.5-1	-	Figure 6.1-12
CP2-N-7	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254	Table 8.5-1	-	Figure 6.1-14
CP2-N-8	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254	Table 8.5-1	-	Figure 6.1-14
CP2-N-9	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	Tl	Table 8.5-1	-	Figure 6.1-10
CP2-N-10	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(a)P, B(b&k)F	Table 8.5-1	-	Figure 6.1-12
CP2-N-11	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(b&k)F	Table 8.5-1	-	Figure 6.1-12
CP2-N-12	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	Cd	Table 8.5-1	-	Figure 6.1-10
CP2-N-13	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(a)P, HE, As	Table 8.5-1	-	Figures 6.1-10, and 6.1-12

Table 1-13
References for Risk Summary Tables
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Chemical Plant 2 (continued)								
CP2-N-14	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	HE	Table 8.5-1	-	Figures 6.1-3 and 6.1-4
CP2-N-15	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(a)P, B(b&k)F	Table 8.5-1	-	Figure 6.1-12
CP2-N-16	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	Cd	Table 8.5-1	-	Figure 6.1-10
CP2-N-17	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254	Table 8.5-1	-	Figure 6.1-14
CP2-N-18	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	4,4-DDD, 4,4-DDT, A-1248, A-1254, Aldrin B(a)A, B(a)P, B(b&k)F, D(a,H)A, Al, Cd, Tl	Table 8.5-1	-	Figures 6.1-10, 6.1-12 and 6.1-14
CP2-N-19	-	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13
CP2-N-20	-	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(a)P, B(b&k)F, As, Cd	Table 8.5-1	-	Figures 6.1-10 and 6.1-12
CP2-N-21	-	Table 5.6-10	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1248, Al, Pb	Table 8.5-1	-	Figures 6.1-10 and 6.1-14
CP2-N-22	A-1248	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13
CP2-N-23	A-1254	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13
CP2-N-24	A-1254	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13
CP2-N-25	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1248, A-1254, Al, As	Table 8.5-1	-	Figures 6.1-10 and 6.1-14
CP2-N-26	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	B(a)P, B(b&k)F, PCP, Cd	Table 8.5-1	-	Figures 6.1-10 and 6.1-12

Table 1-13
References for Risk Summary Tables
Aerojet - Boundary Operable Unit Feasibility Study

Area	Human Health COCs	HHERA Reference	Ecological COPECs	HHERA Reference	Protection of Groundwater COCs	HHERA Reference	Depth of Proposed Remedial Action (feet bgs)	RI Reference
Chemical Plant 2 (continued)								
CP2-N-27	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1248	Table 8.5-1	-	Figure 6.1-14
CP2-N-28	A-1248	Table 5.6-15	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13
CP2-N-29	A-1248, A-1254	Tables 5.6-10 and 5.6-16	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	-	Table 8.5-1	-	Figure 6.1-13
CP2-N-30	-	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254	Table 8.5-1	-	Figure 6.1-14
CP2-N-31	B(a)P, B(b&k)F, PCP	Table 5.6-22	-	Table (p. 6-77) Figs 6.8-1, 6.8-2	A-1254	Table 8.5-1	-	Figure 6.1-12
Dredge Pit and Eastern Basin								
DPEB-R-1	-	Table 5.6-22	B, Cd, Hg, Mo, Ni, Tl, Zn, DnBP, Prowl	Table (p. 6-83) Figs. 6.8-3, 6.8-4	-	Table 8.5-1	NA To be Backfilled	Figures 6.3-4 and 6.3-5
DPEB-N-1	Hg	Table 5.6-10	-	Table (p. 6-83) Figs. 6.8-3, 6.8-4	-	Table 8.5-1	-	Figures 6.3-4 and 6.3-5
DPEB-N-2	Prowl	Tables 5.6-10 and 5.6-16	-	Table (p. 6-83) Figs. 6.8-3, 6.8-4	-	Table 8.5-1	-	Figures 6.3-4 and 6.3-5
DPEB-N-3	Hg	Table 5.6-10	-	Table (p. 6-83) Figs. 6.8-3, 6.8-4	-	Table 8.5-1	-	Figures 6.3-4 and 6.3-5
DPEB-N-4	-	Table 5.6-22	-	Table (p. 6-83) Figs. 6.8-3, 6.8-4	B(a)P B(b&K)F Hg, Tl	Table 8.5-1	-	Figures 6.3-4 and 6.3-5

Notes:
For list of acronyms, see Table 1-12.

Table 1-14
Summary of Soil Vapor Risks and Rationale for Remedial Action - Administration Area East
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration (µg/m^3)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AE-SV-R-1	AE-SV-N-6	HH	03D SP144	VC	1E-4	1.3E-1 (RC)	—	14,000 (VC)	30	30	30	MI	Commercial	No	The maximum ILCR is for resident receptor; the maximum ILCR for commercial worker is 3E-5. A containment/operational control alternative other than source removal/reduction will be employed (See Section 6.0).	R
AE-SV-R-2	AE-SV-R-3 AE-SV-N-1	HH	03D SP85	PCE, VC, TCE, Benzene	2E-3	3.0E+0 (RC)	—	70,000 (PCE) 170,000 (VC) 8300 (TCE) 2300 (Benzene)	25	25	30	NI	Commercial	No	The maximum ILCR is for resident receptor; maximum ILCR for commercial worker is 5E-4. The maximum HI for commercial worker is 4.7E-1. A containment/operational control alternative other than source removal/reduction will be employed (See Section 6.0).	R
AE-SV-R-3	AE-SV-R-2 AE-SV-R-6 AE-SV-R-7 AE-SV-R-8	HH	Various	VOCs	—	—	—	—	—	—	—	NI	Commercial	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R
AE-SV-R-4	—	RTG	A20 RC29 SP01	PCE	—	—	High	350	20	10, 20	30	VI	Commercial	No	Soil at this RA was excavated to a depth of 4' bgs in 2010 (AE-C-5 in Table 1-3). Groundwater contours indicate a potential source and groundwater impact. Estimated groundwater concentration 0.5 µg/L PCE (Volume II, Part E Table 8.2-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
AE-SV-R-5	AE-SV-N-4 AE-SV-N-10	RTG	A20 RB37 SP01	PCE	—	—	High	73,000	20	10, 20	30	MI	Commercial	No	Groundwater contours indicate a potential source and groundwater impact. Estimated groundwater concentration 56 µg/L PCE and 9.6 µg/L TCE (Volume II, Part E Table 8.2-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
AE-SV-R-6	AE-SV-R-3	RTG	A20 ST05 SP01	TCE	—	—	High	700,000	20	20, 30	30	MI	Commercial	No	Groundwater contours indicate a potential source and groundwater impact. Estimated groundwater concentration 190 µg/L TCE (Volume II, Part E Table 8.2-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
AE-SV-R-7	AE-SV-R-3	RTG	03D SP100 03D SP102	PCE	—	—	High	30,000,000	20	10, 20	30	NI	Commercial	Sample locations in and around buildings excavation may impact structure.	Groundwater contours indicate a potential source and groundwater impact. Estimated groundwater concentration up to 140,000 µg/L PCE (Volume II, Part E Table 8.2-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
AE-SV-R-8	AA-SV-R-3	RTG	03D SP107	TCE, PCE	—	—	High	340,000 (PCE) 260,000 (TCE)	29	10, 20, 29	30	NI	Commercial	Sample locations in and around buildings excavation may impact structure.	Groundwater contours indicate a potential source and groundwater impact. Estimated groundwater concentration is up to 140,000 µg/L PCE (Volume II, Part E Table 8.2-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
AE-SV-N-1	AE-SV-R-2	HH	03D SP84	VC	8E-6	9.7E-3 (RC)	—	420 (VC)	15	—	30	NI	Commercial	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. VC exceeded the ILCR (1E-6) for the resident receptor (7.2E-6) and for the commercial worker receptor (1.7E-6) at 15 feet bgs, but did not exceed at 25 feet bgs.	N
AE-SV-N-2	—	HH	03D SP134	VC	3E-6	2.2E-2 (RC)	—	40 (VC)	20	—	30	NI	Commercial	Sample locations in and around buildings excavation may impact structure.	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. VC exceeded the ILCR (1E-6) for the resident receptor (1.7E-6) at 20 feet bgs, but did not exceed at 10 feet bgs.	N

Table 1-14
Summary of Soil Vapor Risks and Rationale for Remedial Action - Administration Area East
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration ($\mu g/m^3$)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AE-SV-N-3	—	HH	A20 RX73 SP01	Chloroform	3E-6	1.7E-2 (RC)	—	450 (Chloroform)	20	—	30	NI	Commercial	Sample locations in and around buildings excavation may impact structure.	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (3.2E-6 and 1.2E-6) at 10 and 20 feet bgs, respectively.	N
AE-SV-N-4	AE-SV-R-5 AE-SV-N-10	HH	A20 RB37 SP01	PCE	8E-5	1.6E+0 (RC)	—	73,000	20	10, 20	30	MI	Commercial	No	The remedy proposed for RA AE-SV-R-5 will address the high HH risk; therefore, this area is not recommended for retention to avoid duplication of retained areas. PCE exceeded the HI (1.0E+0) for the resident child receptor (1.2E-6) at 10 feet and 20 feet bgs. The HH risk will be tracked as part of the AE-SV-R-5 remedy.	N
AE-SV-N-5	—	HH	03D SP96	Chloroform	9E-6	7.4E-2 (RC)	—	1,600 (Chloroform)	10	—	30	MI	Commercial	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (8.5E-6 and 7.2E-6) and the commercial receptor (2.0E-6 and 1.7E-6) at 10 and 17 feet bgs, respectively.	N
AE-SV-N-6	AE-SV-R-1	HH	03D SP144	VC	—	—	—	14,000 (VC)	30	30	30	MI	Commercial	No	This is the low risk contour surrounding AE-SV-R-1. Although this area is listed separately, it will be remediated under AE-SV-R-1.	N
AE-SV-N-7	—	HH	A20 B34 SP03	PCE	1E-6	2.5E-2 (RC)	—	1000 (PCE)	29	—	30	MI	Commercial	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. PCE exceeded the ILCR (1E-6) for the resident receptor (1.2E-6) at 10 feet bgs, but did not exceed at 20 or 29 feet bgs.	N
AE-SV-N-8	—	HH	A20 ST05 SP03	PCE	1E-6	2.4E-2 (RC)	—	320 (PCE)	10	—	30	MI	Commercial	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. No compound exceeded the ILCR risk level (1E-6). The cumulative ILCR (1.2E-6) slightly exceeded the ILCR risk level (1E-6).	N
AE-SV-N-9	—	HH	03D SP116	Chloroform	3E-6	2.9E-2 (RC)	—	400 (chloroform)	10	—	30	NI	Commercial	Sample location near building excavation may impact structure.	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor(2.8E-6) at 10 feet bgs and no deeper samples were collected.	N
AE-SV-N-10	AE-SV-R-5 AE-SV-N-4	HH	A20 RB37 SP01	PCE	—	—	—	73,000 (PCE)	20	10, 20	30	MI	Commercial	No	This is the low risk contour surrounding AE-SV-R-5. Although this area is listed separately, it will be remediated under AE-SV-R-5.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - The data sources for this table are Tables 5.2-44 and 8.2-2 of the HHERA (Volume II)
3 - "—" means "not applicable"

Table 1-15
Summary of Soil Vapor Risks and Rationale for Remedial Action - Administration Area West
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration (µg/m^3)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
AW-SV-R-1	—	HH	—	VOCs	—	—	—	—	—	—	—	NI	Mixed Use	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R
AW-SV-N-1	—	HH	52D SP42	TCE	2E-6	1.8E-2 (RC)	—	8,300 (TCE)	—	—	—	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. TCE exceeded the ILCR (1E-6) for the resident receptor (1.5E-6) at 30 feet bgs, but did not exceed at 10 or 20 feet bgs.	N
AW-SV-N-2	—	HH	D(c) SP05	Chloroform	2E-6	9.0E-3 (RC)	—	180 (Chloroform)	—	—	—	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (1.9E-6) at 30 feet bgs, but did not exceed at 10 or 20 feet bgs.	N
AW-SV-N-3	—	HH	D(c) SP06	Chloroform	5E-6	1.9E-2 (RC)	—	560 (Chloroform)	—	—	—	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (4.0E-6) at 10 feet bgs, but did not exceed at 20 feet bgs.	N
AW-SV-N-4	—	HH	D(c) SP09	Chloroform	1E-6	5.2E-3 (RC)	—	290 (Chloroform)	—	—	—	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (1.1E-6) at 20 feet bgs, but did not exceed at 10 feet bgs.	N
AW-SV-N-5	—	HH	D(c) SP11	Chloroform	1E-6	5.2E-3 (RC)	—	290 (Chloroform)	—	—	—	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (1.1E-6) at 20 feet bgs, but did not exceed at 10 feet bgs.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - The data sources for this table are Tables 5.2-44 and 8.2-2 of the HHERA (Volume II)
3 - "—" means "not applicable"

Table 1-16
Summary of Soil Vapor Risks and Rationale for Remedial Action - Line 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration (µg/m^3)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
L2-SV-R-1	L2-SV-R-2 L2-SV-R-3	HH	Various	VOCs	—	—	—	—	—	—	—	NI	Mixed Use	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R
L2-SV-R-2	L2-SV-R-1	RTG	28E SP16	TCE	—	—	High	10,000,000	10	10, 20, 30, 40	45	VI	Mixed Use	No	Groundwater contours indicate a potential source and groundwater impact. The groundwater is impacted by TCE (1,100 µg/L) beneath 28E-SP16 (Volume II, Part E Table 8.4-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
L2-SV-R-3	L2-SV-R-1	RTG	DSA SP04	TCE	—	—	High	160,000	30	20, 30, 40	45	NI	Mixed Use	No	The groundwater is impacted by TCE (990 µg/L) beneath DSA-SP04 (Volume II, Part E Table 8.4-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
L2-SV-N-1	L2-SV-N-5	HH	DSA SP16	Chloroform	5E-6	2.6E-6 (RC)	—	1,600 (Chloroform)	40	—	45	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for the resident receptor (1.9E-6 at 10 feet bgs, 3.9E-6 at 20 feet bgs, 3.8E-6 at 30 feet bgs, and 3.3E-6 at 40 feet bgs).	N
L2-SV-N-2	L2-SV-N-5	HH	DSA SP20	TCE	8E-6	3.5E-2 (RC)	—	24,000(TCE)	20	—	45	MI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. TCE exceeded the ILCR (1E-6) for the resident receptor(1.5E-6 at 10 feet bgs and 6.4E-6 at 20 feet bgs) and the commercial receptor (1.5E-6 at 20 feet bgs).	N
L2-SV-N-3	—	HH	DSA SP13	Benzene	1E-6	1.6E-2 (RC)	—	130 (Benzene)	10	—	45	VI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Benzene equaled the ILCR (1E-6) for the resident receptor at 10 feet bgs and the cumulative risk for benzene and other VOCs slightly exceeded the ILCR (1.1E-6), but did not exceed at 20 feet bgs.	N
L2-SV-N-4	—	HH	DSA SP26	Benzene	1E-6	2.6E-2 (RC)	—	280 (Benzene)	20	—	45	VI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Benzene exceeded the ILCR (1.2E-6) for the resident receptor at 20 feet bgs, but did not exceed at 10 feet bgs.	N
L2-SV-N-5	—	HH	DSA SP12	—	1E-6	8.6E-3 (RC)	—	180 (Chloroform)	20	—	45	VI	Mixed Use	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. No single compound exceeded the ILCR. Chloroform (7.1E-7)was the main risk driver and the cumulative risk for chloroform and other VOCs slightlyu exceeded the ILCR (1.3E-6) for the resident receptor at 20 feet bgs, but did not exceed at 10 feet bgs.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - The data sources for this table are Tables 5.2-44 and 8.2-2 of the HHERA (Volume II)
3 - "—" means "not applicable"

Table 1-17
Summary of Soil Vapor Risks and Rationale for Remedial Action - Line 5 North
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration ($\mu g/m^3$)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
L5-SV-R-1	L5-SV-N-1	RTG	52E SP07	TCE, PCE	—	—	High	27,000 (TCE) 2,300 (PCE)	20	20	65	VI	Residential	Adjacent to building excavation may impact structure.	Groundwater contours indicate a potential source and groundwater impact. Perched Groundwater is impacted by TCE (9.8 µg/L) (Volume II, Part E Table 8.4-2). Capping or an appropriate source removal/reduction alternative will be implemented in the area of high RTG to decrease VOC mass in this area (See Section 6.0).	R
L5-SV-R-2	L5-SV-N-2	RTG	51E SP11	TCE	—	—	High	7,800 (TCE)	20	20	65	VI	Residential	No	Groundwater contours indicate a potential source and groundwater impact. Perched Groundwater is impacted by TCE (13 µg/L) (Volume II, Part E Table 8.4-2). Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).	R
L5-SV-R-3	—	HH	Various	VOCs	—	—	—	—	—	—	—	NI	Residential	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R
L5-SV-N-1	L5-SV-R-1	HH	52E SP07	TCE, PCE	9E-6	6.3E-2 (RC)	—	27,000 (TCE) 2,300 (PCE)	20	—	65	VI	Residential	No	The HH risk was just above 1E-6 and HI<1 and was at depth; therefore, this RA was not recommended for retention. TCE (7.6E-6) and PCE (1.7E-6) exceeded the ILCR (1E-6) for the resident receptor and TCE (1.8E-6) exceeded the ILCR for the commercial worker receptor at 20 feet bgs. The maximum cumulative ILCR (8E-9) did not exceeded 1E-6 at 10 feet bgs.	N
L5-SV-N-2	L5-SV-R-2	HH	51E SP11	TCE	3E-6	2.5E-2 (RC)	—	7,800 (TCE)	20	—	65	VI	Residential	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. TCE (2.2E-6) exceeded the ILCR risk level (1E-6) at 20 feet bgs. The maximum cumulative ILCR (6E-8) did not exceeded 1E-6 at 10 feet bgs.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - The data sources for this table are Tables 5.2-44 and 8.2-2 of the HHERA (Volume II)
3 - "—" means "not applicable"

Table 1-18
Summary of Soil Vapor Risks and Rationale for Remedial Action - Magazine Area, Open Space 3 and Open Space 4 Areas
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[1]	Maximum HI[1]	Maximum RTG Ranking	Maximum Concentration ($\mu g/m^3$)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
MA-SV-R-1	—	HH	—	VOCs	—	—	—	—	—	—	—	VI	Not Currently Planned	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R
MA-SV-N-1	—	HH	A48 ST13 SP06	PCE	3E-6	5.3E-2 (RC)	—	1,800 (PCE)	10	—	80	MI	Not Currently Planned	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. PCE exceeded the ILCR (1E-6) for a resident receptor (3E-6) at 10 feet bgs and did not exceed 1E-6 at 20 feet.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - The data sources for this table are Tables 5.2-44 and 8.2-2 of the HHERA (Volume II)
3 - "—" means "not applicable"

Table 1-19
Summary of Soil Vapor Risks and Rationale for Remedial Action - Chemical Plant 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration (µg/m^3)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
CP2-SV-R-1	CP2-SV-N-1	HH	59F SP33 59F SP34 59F SP35	1,2-DCA VC	1E-3	4.7E+1 (RC)	—	310,000 (1,2-DCA) 830 (VC)	20	10, 15, 20	87	NI	Not Currently Planned	No	The maximum ILCR is for the resident receptor. The maximum ILCR for commercial worker is 3E-4. The maximum HI for the commercial worker receptor is 7.3E+0. A containment/operational or institutional control alternative other than source removal/reduction will be employed (See Section 6.0).	R
CP2-SV-R-2	CP2-SV-N-2	HH	CP2 07 SP01	1,2-DCA	4E-2	1.3E+3 (RC)	—	8,600,000 (1,2-DCA)	20	10, 20, 40	87	NI	Not Currently Planned	No	The maximum ILCR is for the resident receptor. The maximum ILCR for the commercial worker receptor is 1E-2. The maximum HI for the commercial worker receptor is 2.0E+2 and for the construction worker receptor is 5.0E+0. A containment/operational control alternative other than source removal/reduction will be employed (See Section 6.0).	R
CP2-SV-R-3	CP2-SV-N-7	HH	CP2 RE05 SP01	1,2-DCA	2E-3	8.2E+1 (RC)	—	300,000 (1,2-DCA)	10	10, 20	100	MI	Not Currently Planned	No	The maximum ILCR is for the resident receptor. The maximum ILCR for commercial worker receptor is 6E-4. The maximum HI for the commercial worker is 1.3E+1. A containment/operational control alternative other than source removal/reduction will be employed (See Section 6.0).	R
CP2-SV-R-4	CP2-SV-R-6 CP2-SV-N-8	HH	CP2 RE05 SP02	1,2-DCA	3E-4	1.0E+1 (RC)	—	38,000 (1,2-DCA)	10	10, 20	110	MI	Not Currently Planned	No	The maximum ILCR is for the resident receptor. The maximum ILCR for tje commercial worker receptor is 1E-5. The maximum HI for the resident receptor is 1.6E+0. A containment/operational control alternative other than source removal/reduction will be employed (See Section 6.0).	R
CP2-SV-R-5	CP2-SV-N-6	HH	CP2 RE05 SP06	1,2-DCA	1E-4	3.3E+0 (RC)	—	12,000 (1,2-DCA)	10	10	104	MI	Not Currently Planned	No	The maximum ILCR is for the resident receptor. The maximum ILCR for the commercial worker receptor is 2E-5. The maximum HI for the resident receptor is 3.3E+0. A containment/operational control alternative other than source removal/reduction will be employed (See Section 6.0).	R
CP2-SV-R-6	CP2-SV-R-4 CP2-SV-N-8	HH	Various	—	—	—	—	—	—	—	—	—	Not Currently Planned	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R
CP2-SV-N-1	CP2-SV-R-1	HH	59F SP33 59F SP34	1,2-DCA VC	1E-3	4.7E+1 (RC)	—	310,000 (1,2-DCA) 830 (VC)	20	10, 15, 20	87	NI	Not Currently Planned	No	The low HH risk contour was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. **At sample location 59F SP33**, 1,2-DCA exceeded the ILCR (1E-6) for the resident receptor (3.1E-5) at 10 feet bgs and exceeded the ILCR for the commercial worker receptor (7.3E-6 and 3.4E-5) at 10 and 20 feet bgs, respectively. **At sample location 59F SP34,** 1,2-DCA exceeded the ILCR (1E-6) for the commercial worker receptor (7.7E-5 and 4.0E-5) at 10 and 15 feet bgs, respectively.	N
CP2-SV-N-2	CP2-SV-R-2	HH	CP2 07 SP01 CP2 07 SP02 CP2 07 SP05 CP2 07 SP06	1,2-DCA	2E-5	4.1E-2 (RC)	—	1,500 (CCl4) 1,300 (Chloroform)	10, 20	—	87	NI	Not Currently Planned	No	The low HH risk contour was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. **At sample location CP2 07 SP01** 1,2-DCA exceeded the ILCR (1E-6) for the resident receptor (9.1E-6) at 20 feet bgs, but did not exceed at 10 or 40 feet bgs. **At sample location CP2 07 SP02**, CCL4 exceeded the ILCR (1E-6) for the resident receptor (1.6E-5) and the commercial worker receptor (3.7E-6) at 10 feet bgs, but did not exceed at 20 feet bgs. **At sample location CP2 07 SP05,** chloroform exceeded the ILCR (1E-6) for the resident receptor (1.3E-6 and 1.3E-6) at 10 and 20 feet bgs, respectively. **At CP2 07 SP06,** chloroform exceeded the ILCR (1E-6) for the residential receptor 9.2E-6 and 1.9E-6) at 10 and 20 feet bgs, respectively, and exceeded the ILCR for the commercial worker receptor (2.2E-6) at 10 feet bgs.	N
CP2-SV-N-3	—	HH	CP2 07 SP04	Chloroform	4E-6	5.6E-2 (RC)	—	310 (Chloroform) 190 (1,2-DCA)	—	—	80-87	MI	Not Currently Planned	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. Chloroform exceeded the ILCR (1E-6) for a resident receptor (1.3E-6 and 2.7E-6) at 10 and 20 feet bgs, respectively, and 1,2-DCA exceeded the ILCR for a resident receptor (1.4E-6) at 10 feet bgs.	N
CP2-SV-N-4	—	HH	CP2 RE05 SP05	1,2-DCA	3E-6	9.3E-2 (RC)	—	340 (DCA)	—	—	80-87	I	Not Currently Planned	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. 1,2-DCA exceeded the ILCR for a resident receptor (2.7E-6) at 10 feet bgs, but did not exceed at 20 or 40 feet bgs.	N
CP2-SV-N-5	—	HH	CP2 08 SP11	1,2-DCA	1E-5	7.0E-2 (RC)	—	2,200 (1,2-DCA)	—	—	80-87	NI	Not Currently Planned	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. 1,2-DCA exceeded the ILCR (1E-6) for the resident receptor (9.8E-6) at 20 feet bgs, but did not exceed at 10 feet bgs.	N

Table 1-19
Summary of Soil Vapor Risks and Rationale for Remedial Action - Chemical Plant 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR[2]	Maximum HI[2]	Maximum RTG Ranking[2]	Maximum Concentration ($\mu g/m^3$)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
CP2-SV-N-6	CP2-SV-R-5	HH	CP2 RE05 SP06	1,2-DCA	--	--	—	12,000 (1,2-DCA)	10	10	104	MI	Not Currently Planned	No	This is the low risk contour surrounding CP2-SV-R-5. Although this area is listed separately, it will be remediated under CP2-SV-R-5	N
CP2-SV-N-7	CP2-SV-R-4 CP2-SV-R-5 CP2-SV-R-6	HH	CP2 RE05 SP01 CP2 RE05 SP02	1,2-DCA	--	--	—	38,000 (1,2-DCA)	10	10, 20	110	MI	Not Currently Planned	No	This is the low risk contour surrounding CP2-SV-R-4. Although this area is listed separately, it will be remediated under CP2-SV-R-4.	N
CP2-SV-N-8	—	HH	61F SP03	1,2-DCA	6E-6	2.1E-1 (RC)	—	760 (1,2-DCA)	—	—	110	MI	Not Currently Planned	No	The HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. 1,2-DCA exceeded the ILCR (1E-6) for the resident receptor (6.1E-6 and 1.5E-6) at 10 and 20 feet bgs, respectively.	N

Notes:
1 - See Table 1-12 for a list of acronyms
2 - The data sources for this table are Tables 5.2-44 and 8.2-2 of the HHERA (Volume II)
3 - "—" means "not applicable"

Table 1-20
Summary of Soil Vapor Risks and Rationale for Remedial Action - Dredge Pits/Eastern Basin
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Colocated Remedial Areas	Risk Addressed	Sample Location	COCs Posing High HH Risk or High RTG	Maximum ILCR	Maximum HI	Maximum RTG Ranking	Maximum Concentration ($\mu g/m^3$)	Depth of Maximum Concentration (feet, bgs)	Depths of Samples with High HH or High RTG (feet, bgs)	Depth to Groundwater (feet, bgs)	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action	Retained or Not Retained
DPEB-SV-R-1	—	HH	—	VOCs	—	—	—	—	—	—	—	VI	Not Currently Planned	No	This RA covers the area where a residential human health risk is identified due to modeled VOC migration from groundwater to indoor air based on VOC concentrations detected in groundwater. The human health risk at this RA will be addressed through the use of institutional controls.	R

Notes:
1 - See Table 1-12 for a list of acronyms
2 - "—" means "not applicable"

Administration Area

(Admin East)

(Admin West)

Buffalo Creek

(Former Sewage Treatment Plant)

Line 2

Westlakes OS-6

OS-5

OS-7

Buffalo Creek

Line 5 North

Magazine Area OS-3

OS-4

Dredge Pits

OS-2

Chemical Plant 2

OS-1

Area 39

EXPLANATION

Management Area (MA) Containing Source Sites

Open Space (OS) Area/MAs Without Source Sites (West Lakes, Magazine Area, and Buffalo Creek)

N

Scale: 1" = 2000'

0 1000 2000

AEROJET
Environmental Remediation

FIGURE 1-1

Management Areas and Open Space Locations
Boundary Operable Unit

10/20/08 pr SR10131248

Materials and Equipment Storage Areas
1900
1940
1960
11D
A20-ST22
Former Vehicle Maintenance Shop
Acid Holding Tank
RCRA X
Former Septic Tank
Former Fuel Oil UST
10D
Former Company Store
A20-ST14
20022
20039
20030
20B73
RCRA C
51D
20031
20029
Approximate Former Location of Waste Oil Tank
Former TCE Degreaser
Sump
Catch Basin
Drain Line
Chemical Lab Sump
3D
Former Mill Sump
Solvent Sump
Former Radiographic Facility
Former Dye Pan
20002
Freon Sump
RCRA B
Compressor Blowdown Area
3D & 51D
50D
20037
20034
Solvent Sump
Former Oil/ Water Sump
3D
20001
Hydro Sump
Sump
TCE/PCE Sump
Sump
Former Etching & Plating Area
Former Kerosene UST
Decon Sump
Sump
Former Electron Beam Welding Sump
A20-ST01-03
Former Tank
20026
20006
50D
Former Blowdown Pit
Former Solvent Storage Area
Former Autoclave Vapor Separation Waste Sump
Septic Leach Pits
A20-ST01-02
Plastics Lab Sump
Administration Area East
3D
Machine Shop Waste Sump
20008
Floor Drain
20007
Floor Drains
20004
Waste Collection Tank
20090
Oil Tank Sump
20005
X-Ray Sump
Former Paint Booth Drain Sump
Former X-ray & Dye Pan Sump
20024
Lindberg Sump
20015
20019
Former PCB Transformer
Storm Drain
Former Solvent Storage Area
Sump
Fuel Tank
4D
20025
Waste Storage Tanks & Degreasers
Former Paint Booth
Floor Drain Sump
Former Chemical Storage Area

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Fence
- Underground Culvert
- Road
- Railroad
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- A20-ST14 Septic Tank and Leach Line
- Surface Water Flow Direction.

N

Scale: 1" = 300'

0 150 300

AEROJET
Environmental Remediation

FIGURE 1-2

Site Features Map
Administration Area East

7\17\08 PR SR10131248

Administration Area West

Akron St
Baltimore St
Arizona Ave
Alabama Ave

20001
20006
20008
20009
20010
20091
20015
20025
20018
20012

A20-ST01-03
A20-ST01-02
Septic Leach Pits
50D
Hazardous Materials Storage
Former Waste Oil Tank
Waste Treatment Basins
6D
Bermed Pond
Paint Spray Booth
Inactive Plating Area
Sump
TCE Degreaser
52D
Clean Room
Hydro Sump
Deep Sump
SMUD Electrical Substation
D(b)
Hazardous Materials Storage
Concrete Pad
Dye Pen Sump
Drop Inlet Basin
D(d)
5D
9D
Sludge Drying Area
Settling Pond
8D
Aerator
Digester
Sludge Drying Area
D(c)
RCRA W
Treatment Works
Digester
Treatment Works
Low Area
RCRA Y
12D
Holding Tank

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Fence
- Underground Culvert
- Road
- Railroad
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- ST26 Septic Tank and Leach Line
- Surface Water Flow Direction.

N

Scale: 1" = 200'

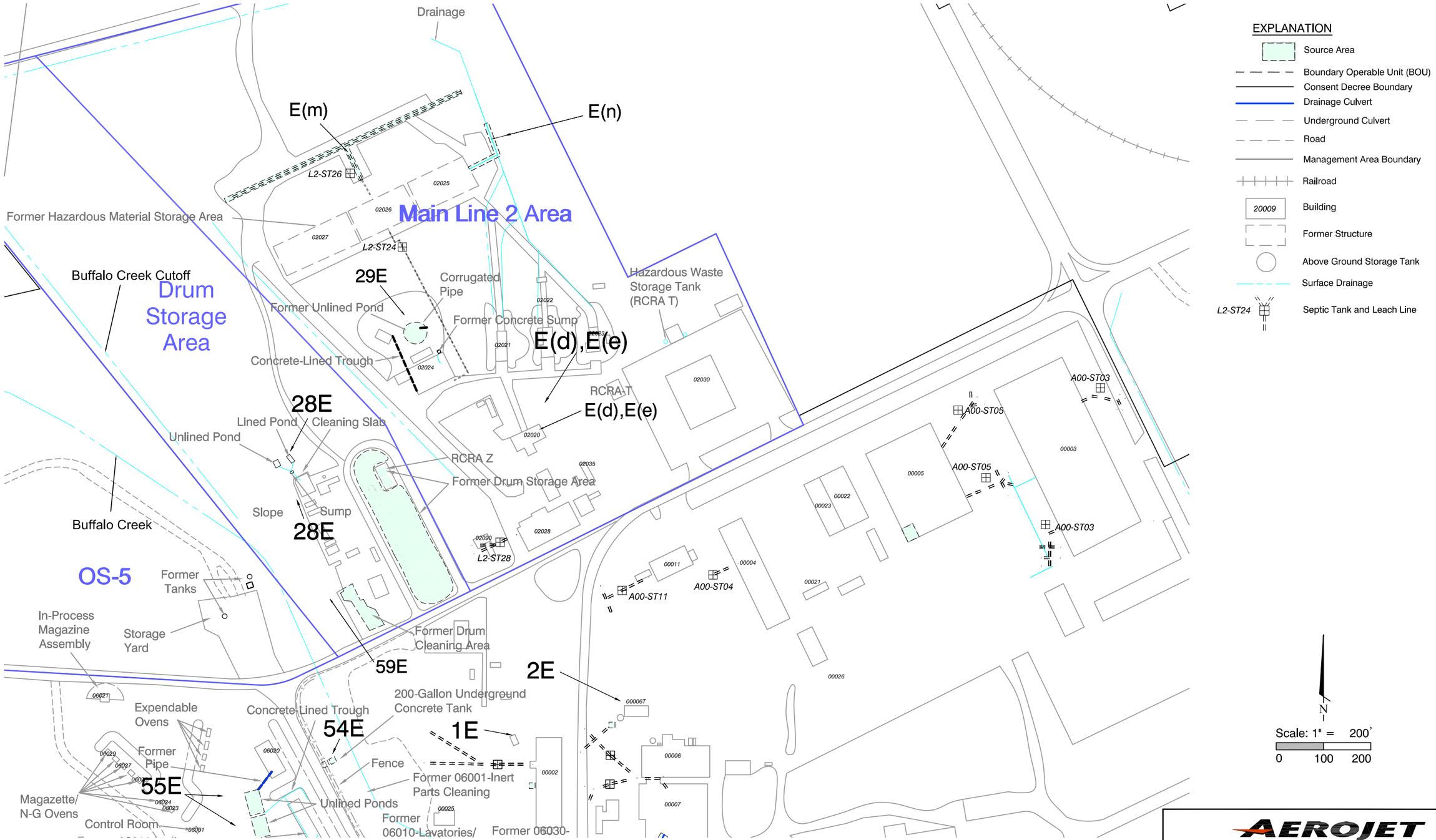
0 100 200

AEROJET
Environmental Remediation

FIGURE 1-3

Site Features Map
Administration Area West

7\17\08 PR SR10131248



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Environmental Remediation

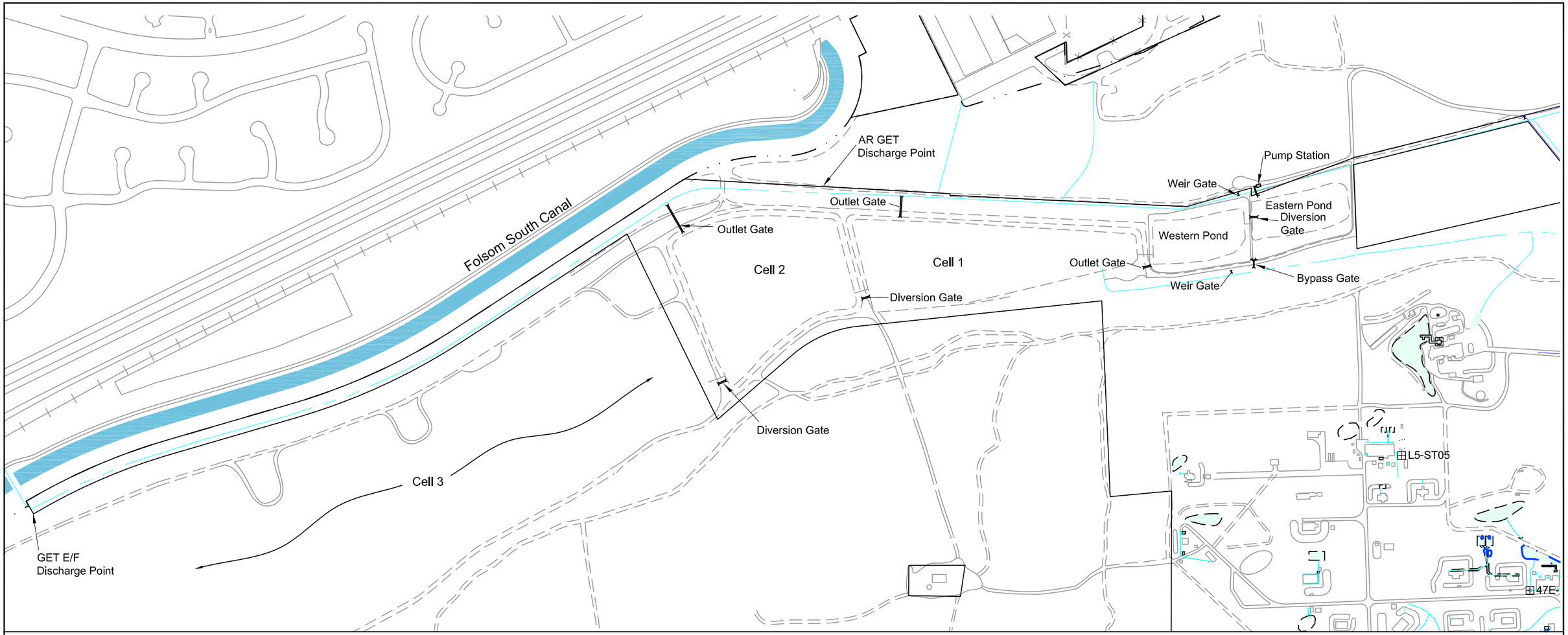
FIGURE 1-4
Site Features Map
LIne 02

09/15/10 PER SR10131248

AEROJET
Environmental Remediation

FIGURE 1-5
Site Features Map
Line 5 North

7/22/08 PER SR10131248



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- Railroad
- 20009 — Building
- Above Ground Storage Tank
- Surface Drainage
- Septic Tank and Leach Line
- AR — American River
- GET — Groundwater Extraction and Treatment

N

Scale: 1" = 500'

0 250 500

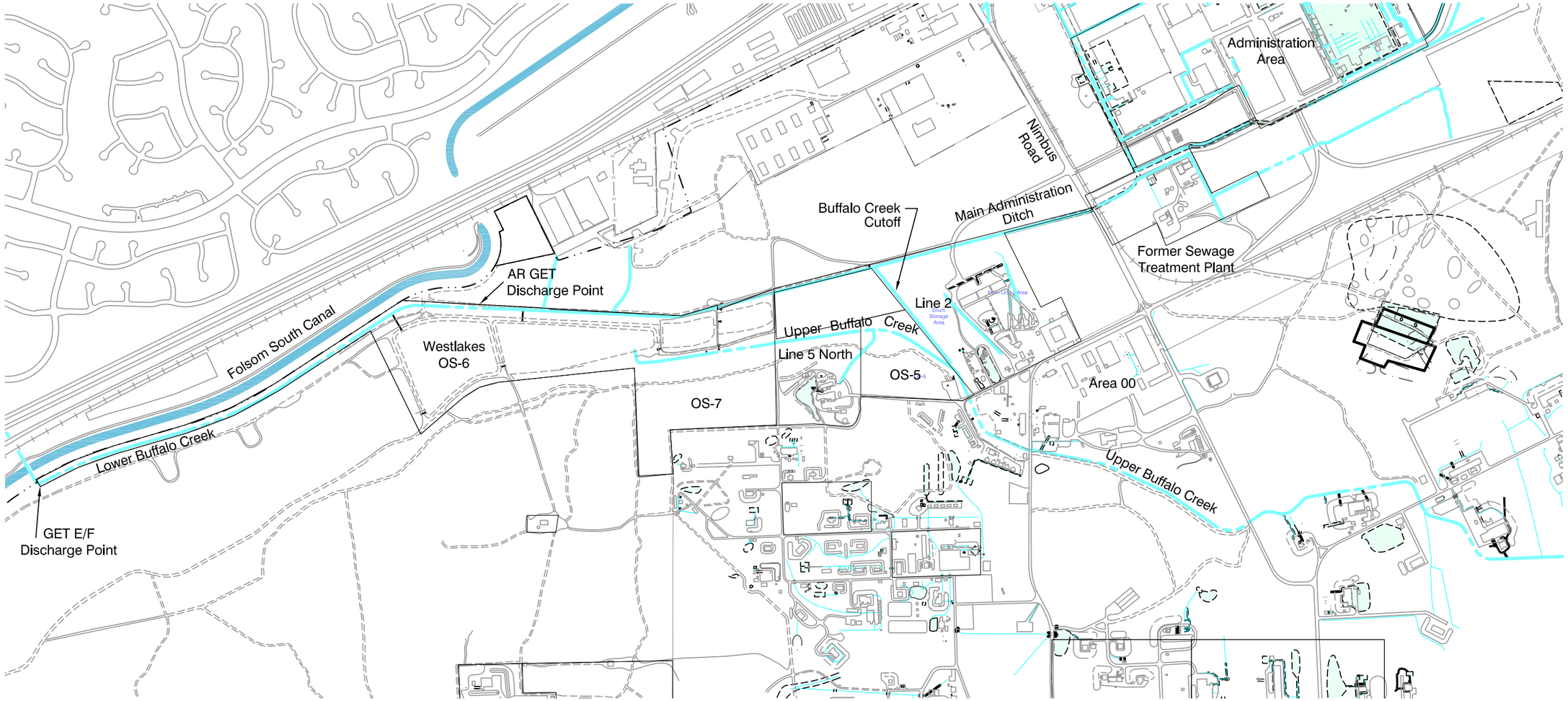
AEROJET
Environmental Remediation

FIGURE 1-6

Site Features Map

Westlakes and Open Space Area 6

9/8/08 PER SR10131248



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Fence
- Road
- Railroad
- AR American River
- GET Groundwater Extraction and Treatment
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- L2-ST24 Septic Tank and Leach Line

N

Scale: 1" = 1000'

0 500 1000

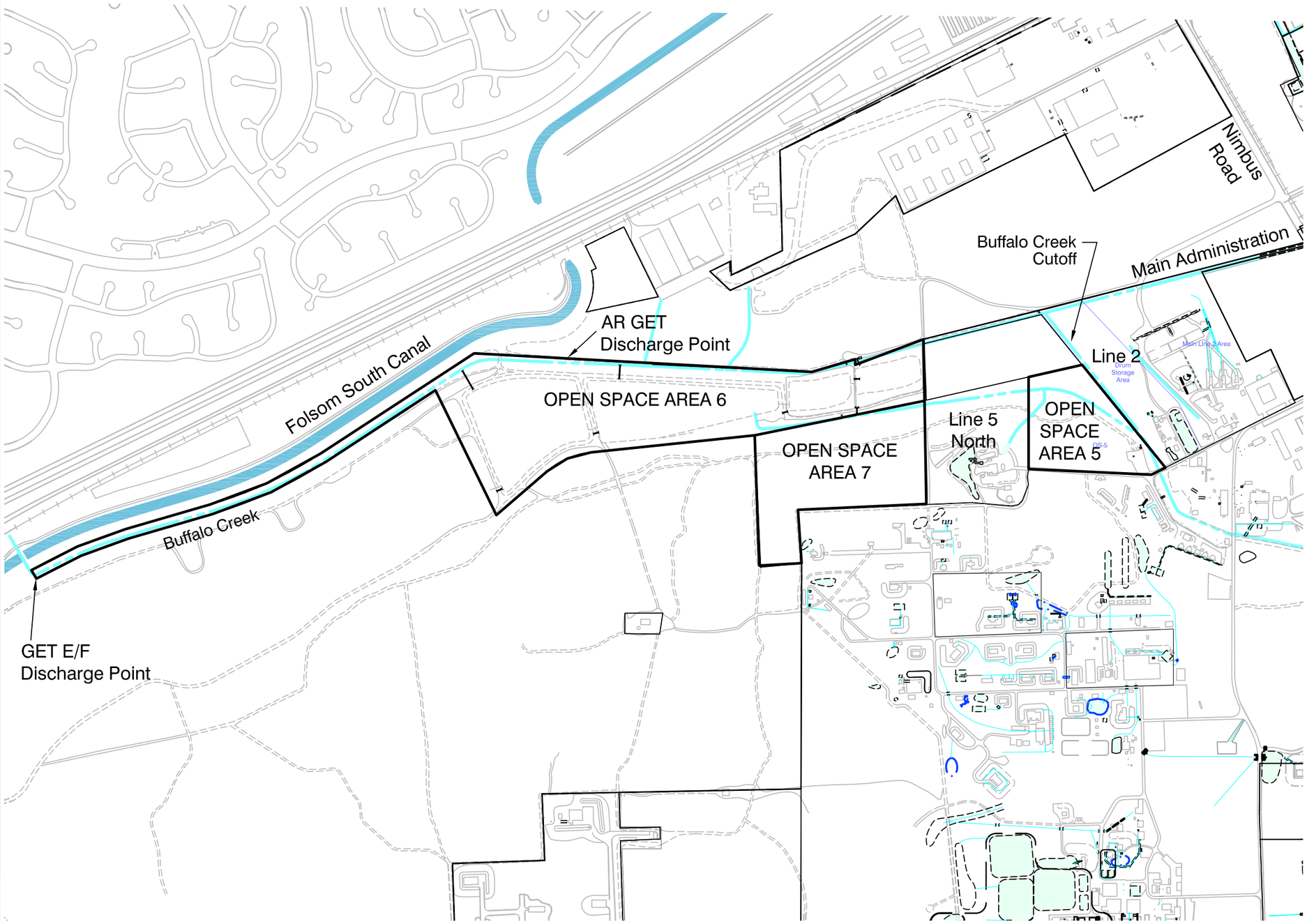
AEROJET
Environmental Remediation

Figure 1-7

Site Features Map

Buffalo Creek

09/10/10 PR SR10131248



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Road
- Management Area Boundary
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- AR American River
- GET Groundwater Extraction and Treatment

N

Scale: 1" = 800'

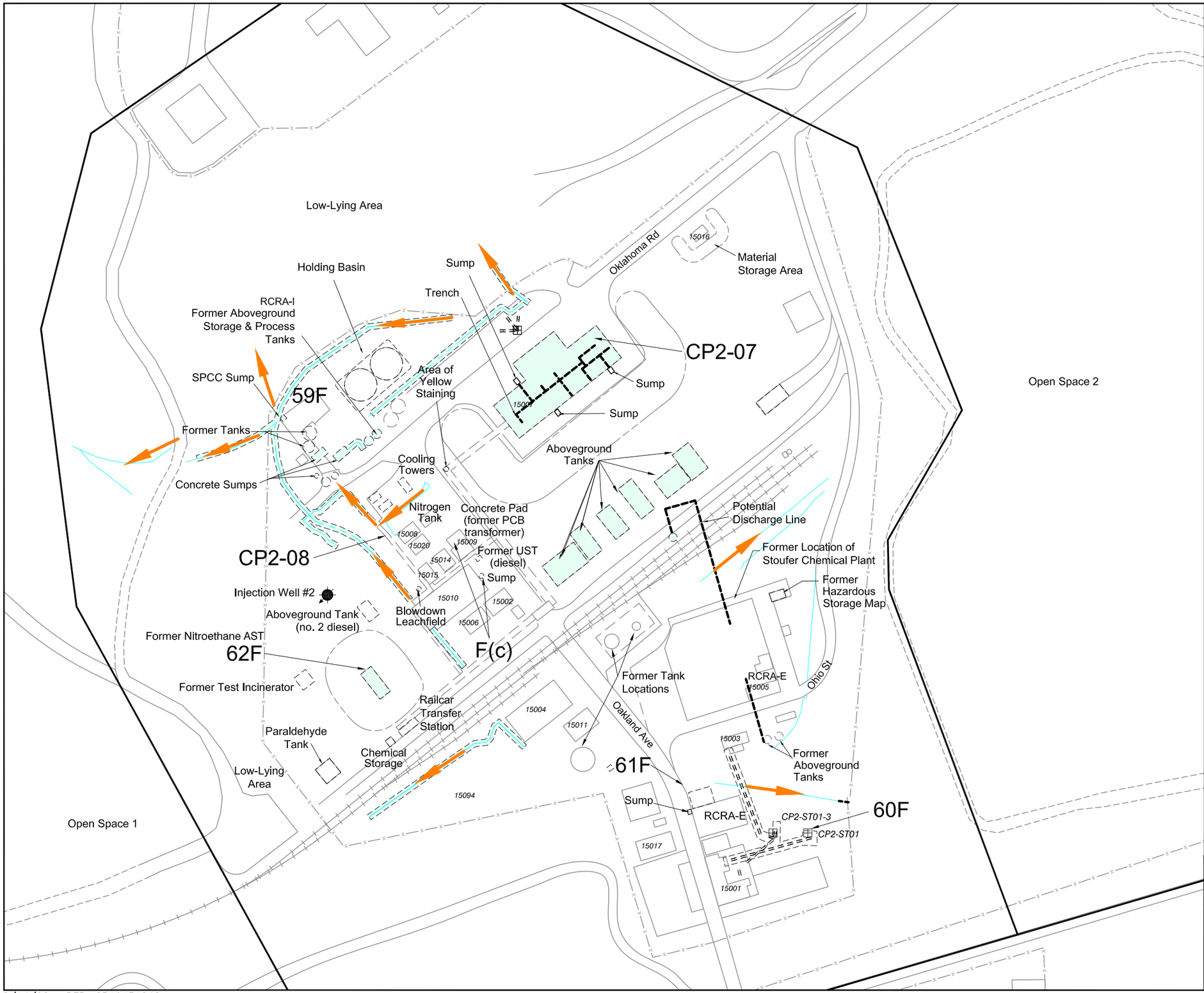
0 400 800

AEROJET
Environmental Remediation

FIGURE 1-8

Site Features
Open Space Areas 5, 6, and 7

8/14/08 pr SR10131248



EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Drainage Culvert
- Underground Culvert
- Road
- Management Area Boundary
- Railroad
- 20009 Building
- Former Structure
- Above Ground Storage Tank
- Surface Drainage
- L2-ST24 Septic Tank and Leach Line
- Injection Well Location
- Surface Water Flow Direction.

N

Scale: 1" = 160'

0 80 160

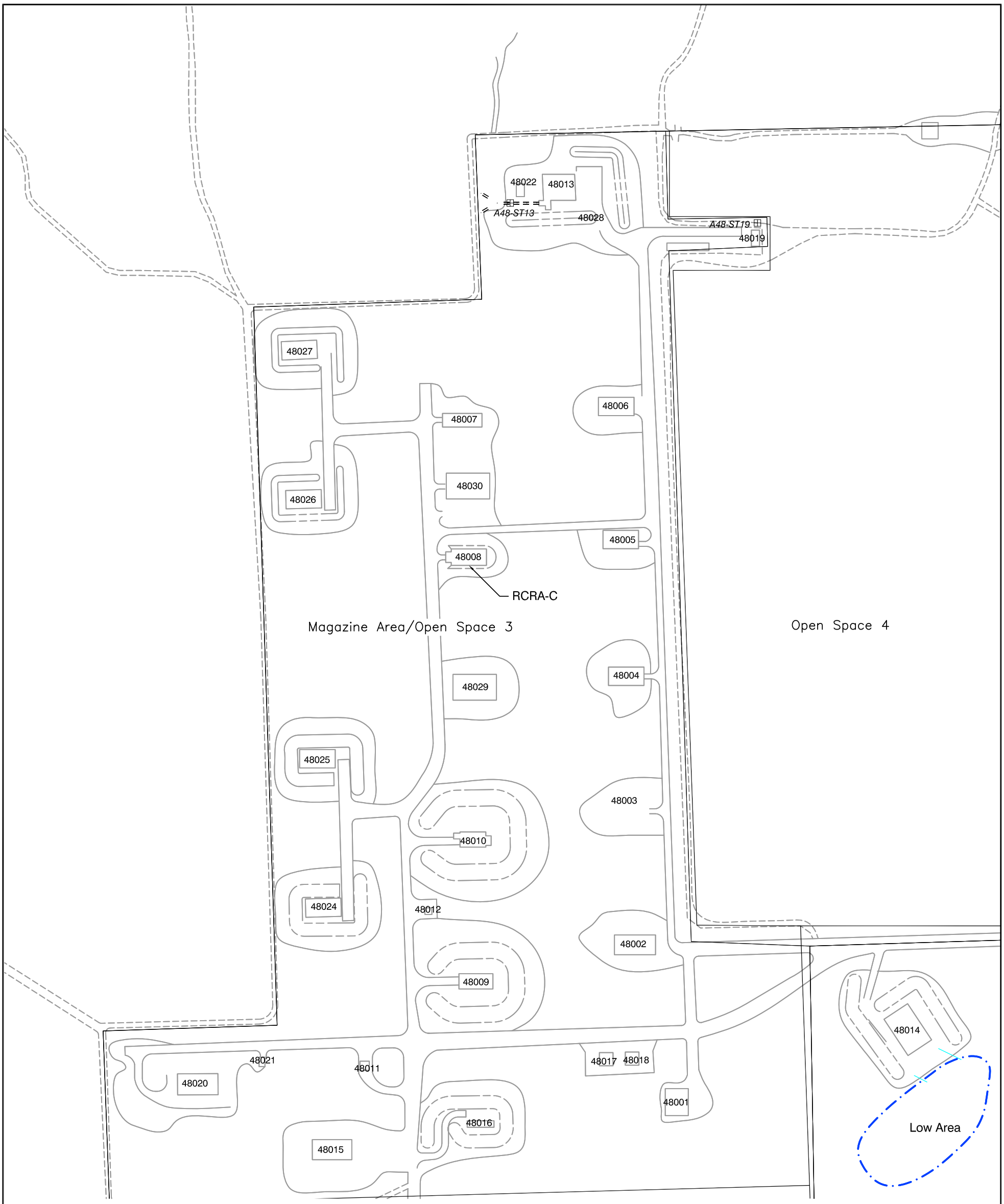
AEROJET
Environmental Remediation

FIGURE 1-9

Site Features

Chemical Plant 2 Area

8/14/08 PER SR10131248



EXPLANATION

- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Management Area Boundary
- Road
- Berm
- 40815 Building
- Surface Drainage
- ST26 Septic Tank and Leach Line

N

Scale: 1" = 300'

0 150 300

AEROJET
Environmental Remediation

FIGURE 1-10
Site Features
Magazine Area and Open Space 3

8/14/08 pr SR10131248

EXPLANATION

- Source Area
- Boundary Operable Unit (BOU)
- Consent Decree Boundary
- Road
- Management Area Boundary

N

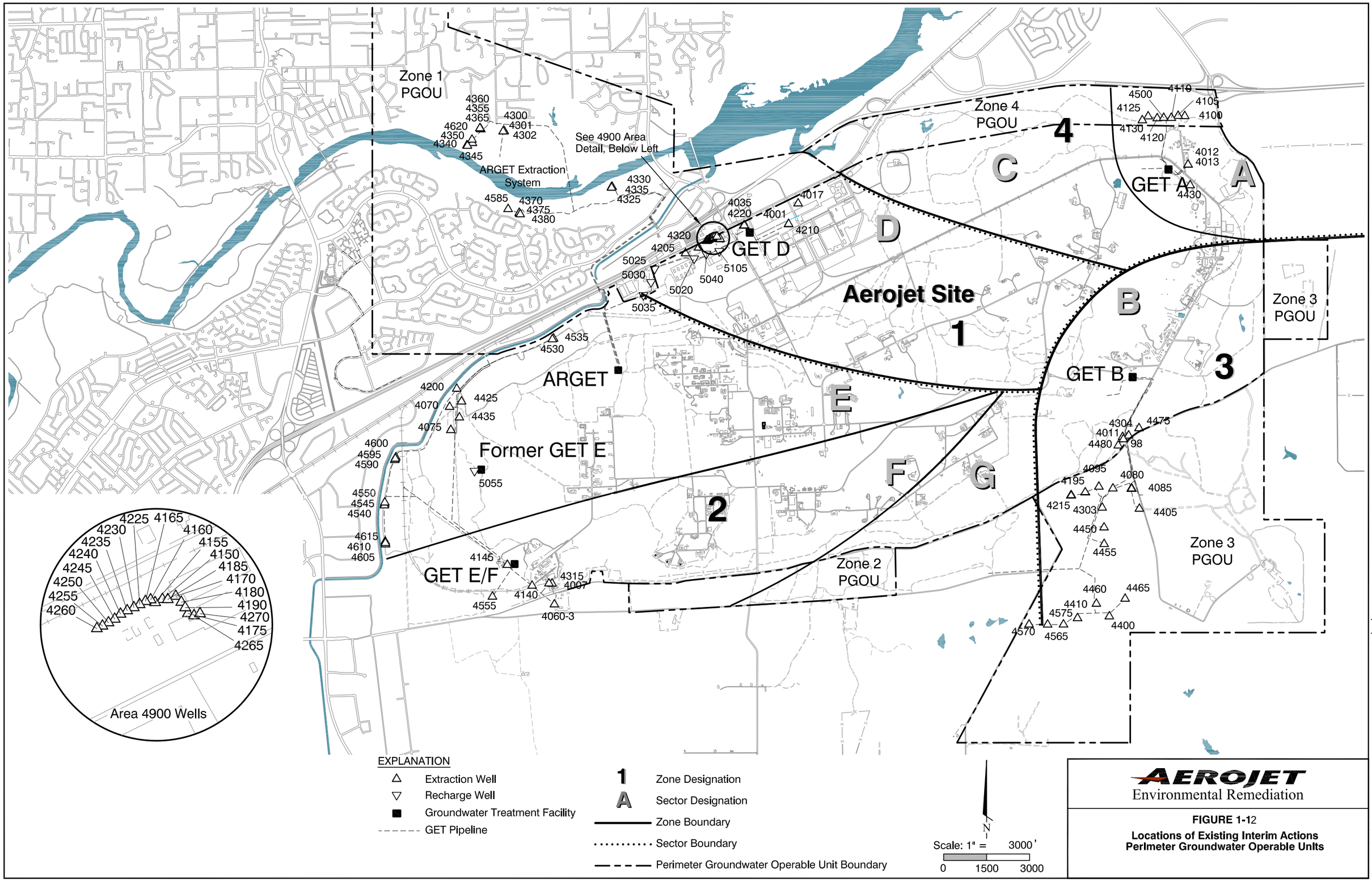
Scale: 1" = 100'

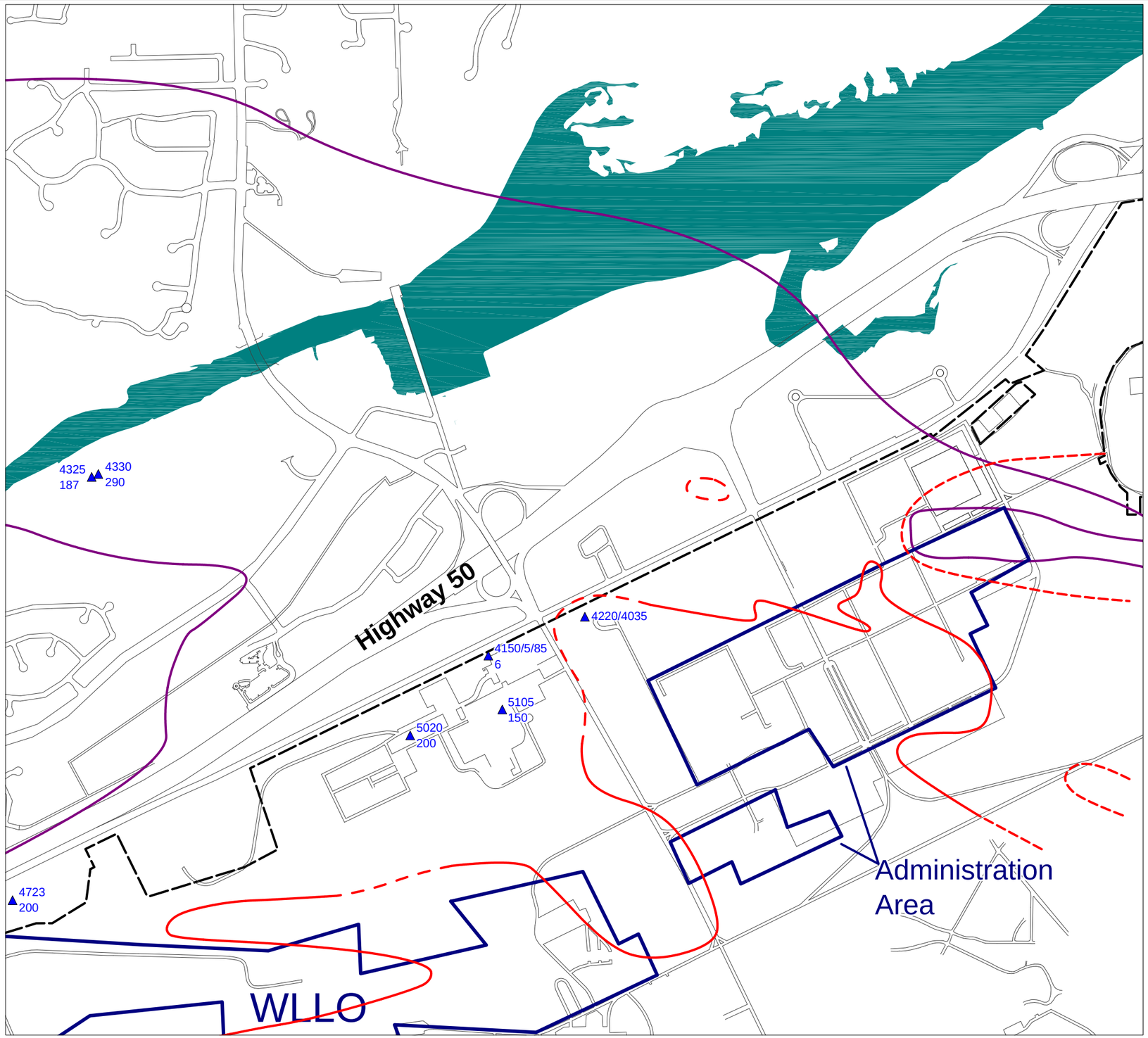
0 50 100

AEROJET
Environmental Remediation

FIGURE 1-11
Site Features
Dredge Pit and Eastern Basin

8/14/08 PER SR10131248


Zone 1
PGOU
Zone 4
PGOU
Zone 3
PGOU
Zone 2
PGOU
Zone 3
PGOU
Aerojet Site
1
2
3
4
A
B
C
D
E
F
G
ARGET Extraction
System
See 4900 Area
Detail, Below Left
GET A
GET B
GET D
ARGET
Former GET E
GET E/F
Area 4900 Wells
EXPLANATION
Extraction Well
Recharge Well
Groundwater Treatment Facility
GET Pipeline
Zone Designation
Sector Designation
Zone Boundary
Sector Boundary
Perimeter Groundwater Operable Unit Boundary
N
Scale: 1" = 3000'
0 1500 3000
AEROJET
Environmental Remediation
FIGURE 1-12
Locations of Existing Interim Actions
Perimeter Groundwater Operable Units
SR10131248_FIG_1-13
12/7/10
Aerojet



Explanation

4530
218
Extraction Well, ID and Rate (gpm)

Maximum Extent of Chemicals of Concern in First Water-Bearing Zone - lines dashed where inferred

Approximate Area of GET D/ARGET Hydraulic Containment (1)

BOU Management Area Boundary

Aerojet Property Boundary

(1) Figure modified from - *"Proposed Hydraulic Containment System Design Remedial Alternative Z1-B Zone 1 - Perimeter Groundwater Operable Unit (OU5)"* , CVEI, 2006

N

0 1,000 2,000
feet

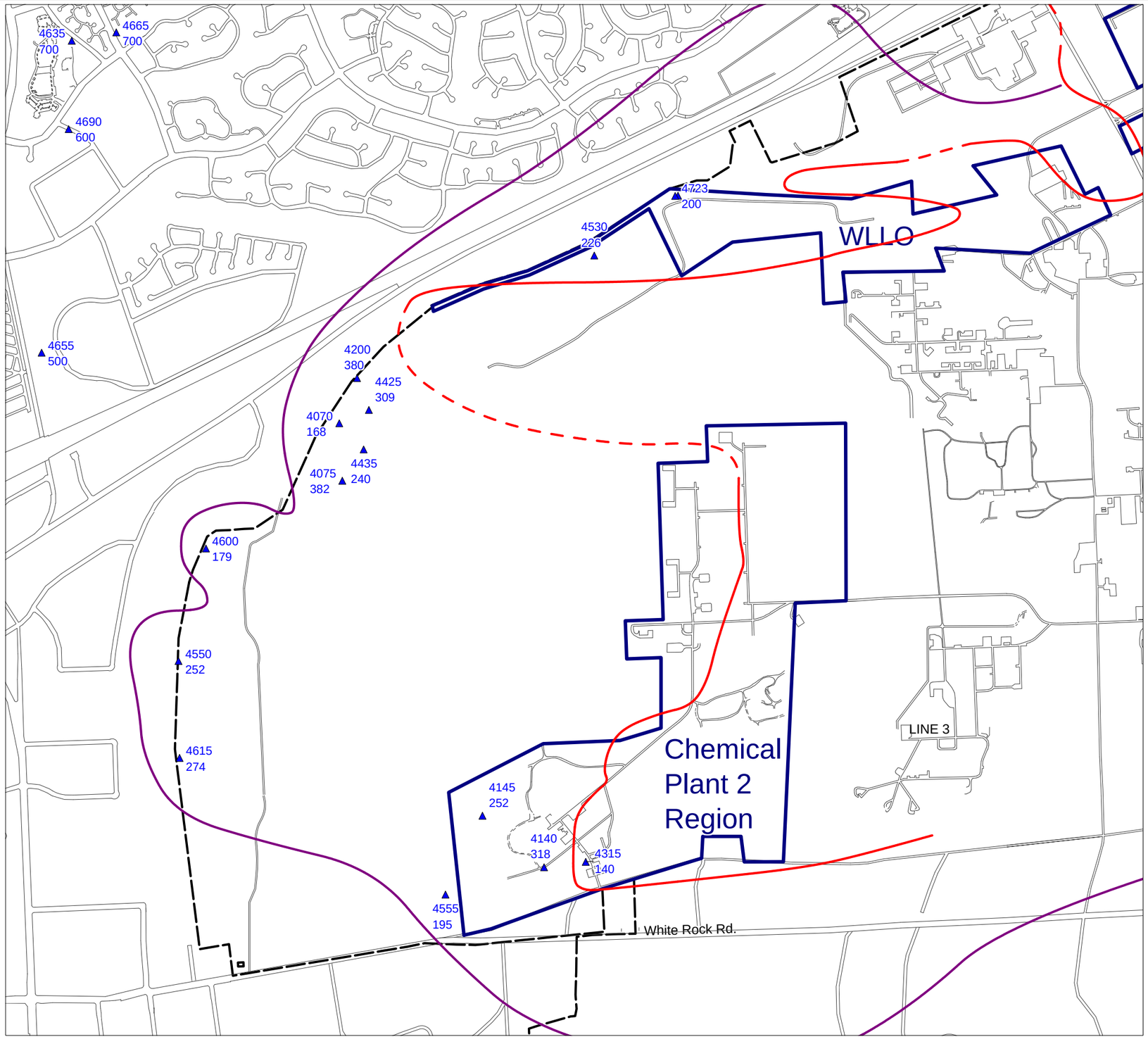
TITLE: GET D/ARGET Hydraulic Containment

LOCATION: Boundary Operable Unit (OU-6)

CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

CHECKED		FIGURE:
DRAFTED		1-13
FILE		
DATE		

SR10131248



Explanation

ACWS17 450 — Water Supply Well, ID and Rate (gpm)

4530 218 — Extraction Well, ID and Rate (gpm)

Maximum Extent of Chemicals of Concern in First Water-Bearing Zone - lines dashed where inferred

Approximate Area of GET E/F Hydraulic Containment (1)

BOU Management Area Boundary

Aerojet Property Boundary

(1) Figure modified from - *"Draft Inner-Barrier Effectiveness Evaluation - Western Groundwater Operable Unit (OU3)"*, CVEI, 2007

N

0 1,500 3,000
feet

TITLE: GET E/F Hydraulic Containment

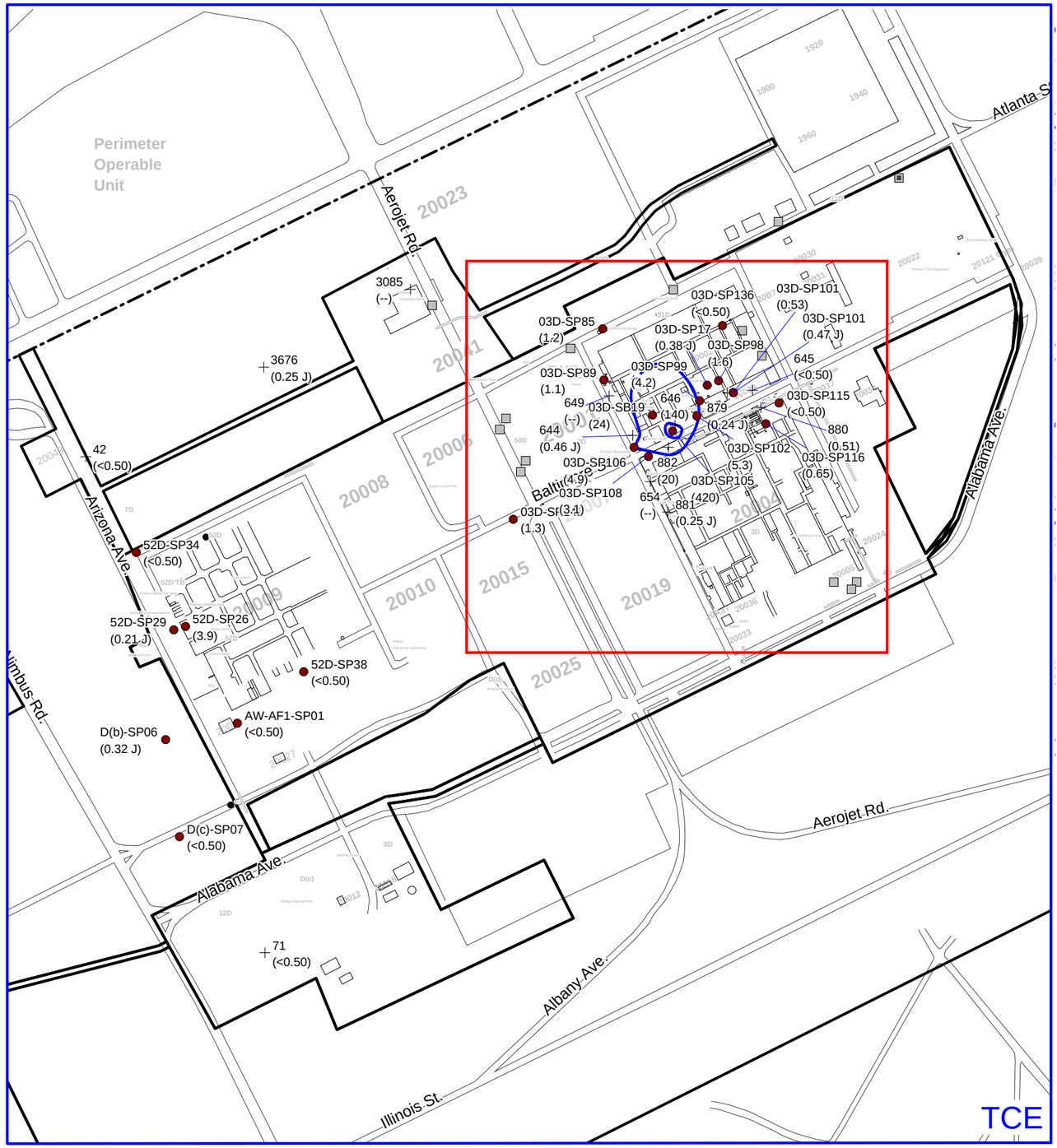
LOCATION: Boundary Operable Unit (OU-6)

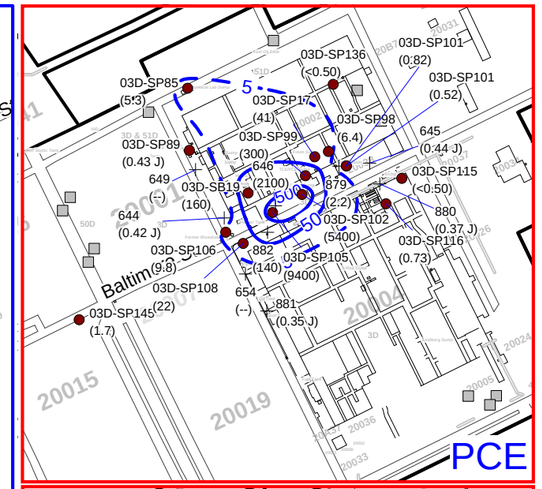
CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

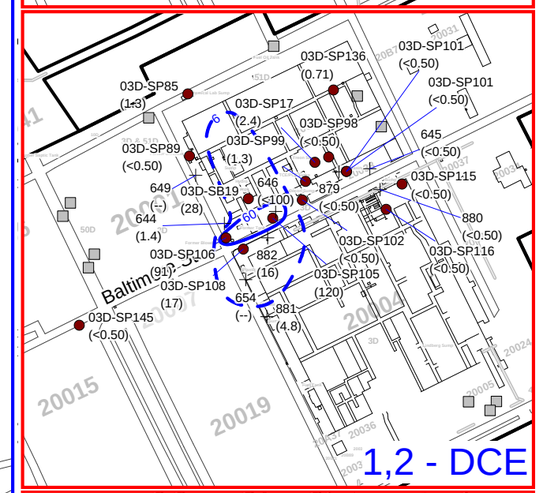
CHECKED	
DRAFTED	
FILE	
DATE	

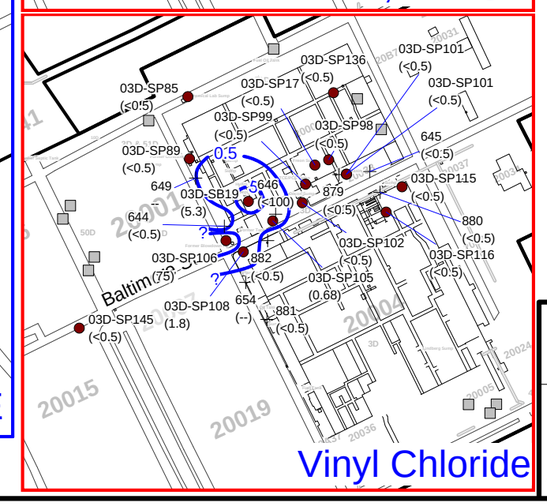
FIGURE: **1-14**

SR10131248







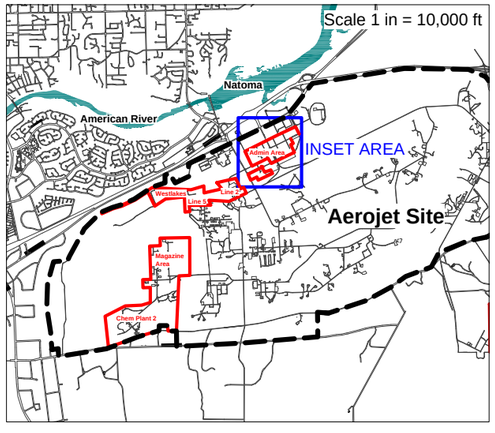


Explanation

- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)

Note: -- = not sampled.
"J" = Estimated Concentration
Sample Period - October 2005 to October 2006

- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 1-15
Perched Groundwater
VOC Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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SR10122520

Explanation

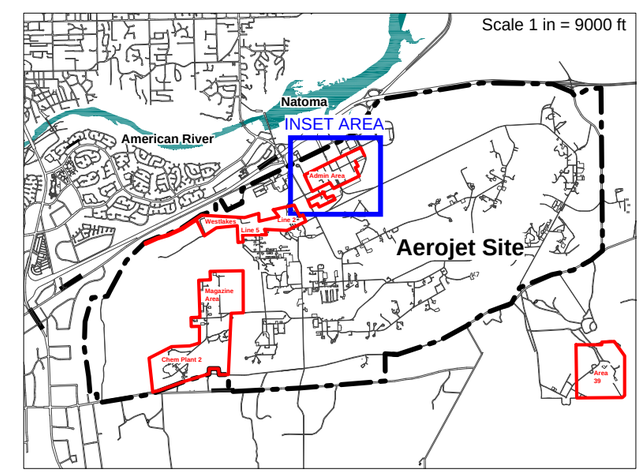
- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)
- 4001 -- — Extraction Well, ID and Concentration (ug/L)

* = Well screen extends below the first water-bearing zone (FWBZ) Concentrations may not be representative of the FWBZ

-- = not sampled. "J" = estimated concentration

Sample Period - October 2005 to October 2006

- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000 feet

AEROJET
Environmental Remediation

Figure 1-16
First Water-Bearing Zone
TCE Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

Figure created on behalf of Aerojet by: CVEI CENTRAL VALLEY ENVIRONMENTAL, INC.

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SR10122521

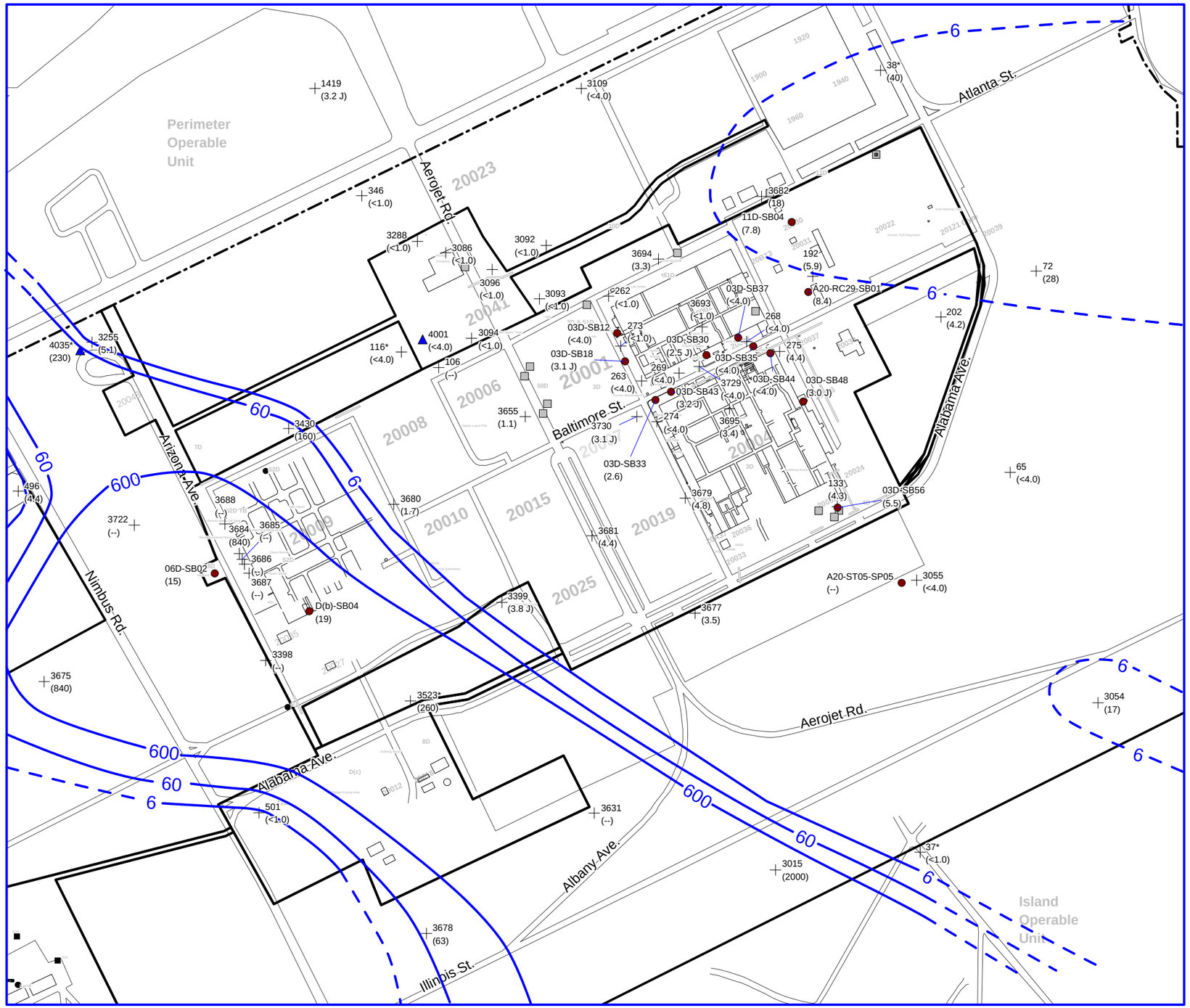


Figure created on behalf of Aerojet by: **CVEI**
CENTRAL VALLEY ENVIRONMENTAL, INC.

Explanation

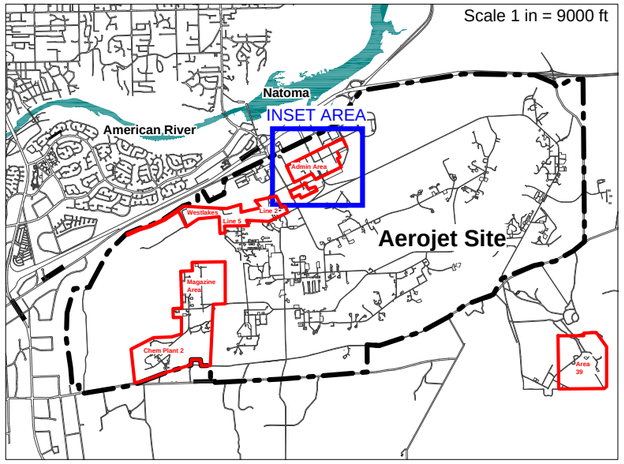
- 03D-SP29 (61.3) — Grab Groundwater Sample Location and Concentration (ug/L) - Data not used for contouring
- 645 (61.3) — Monitoring Well, ID and Concentration (ug/L)
- 4001 -- — Extraction Well, ID and Concentration (ug/L)

* = Well screen extends below the first water-bearing zone (FWBZ) Concentrations may not be representative of the FWBZ

-- = not sampled. "J" = estimated concentration

Sample Period - October 2005 to October 2006

- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Consent Decree Boundary
- 20026 — Building
- Septic Tank
- 5(d) — Source Area ID
- Drainage Culvert



N

0 500 1,000
feet

AEROJET
Environmental Remediation

Figure 1-17
First Water-Bearing Zone
Perchlorate Iso-concentration Contours
Administration Area - Boundary Operable Unit (OU-6)

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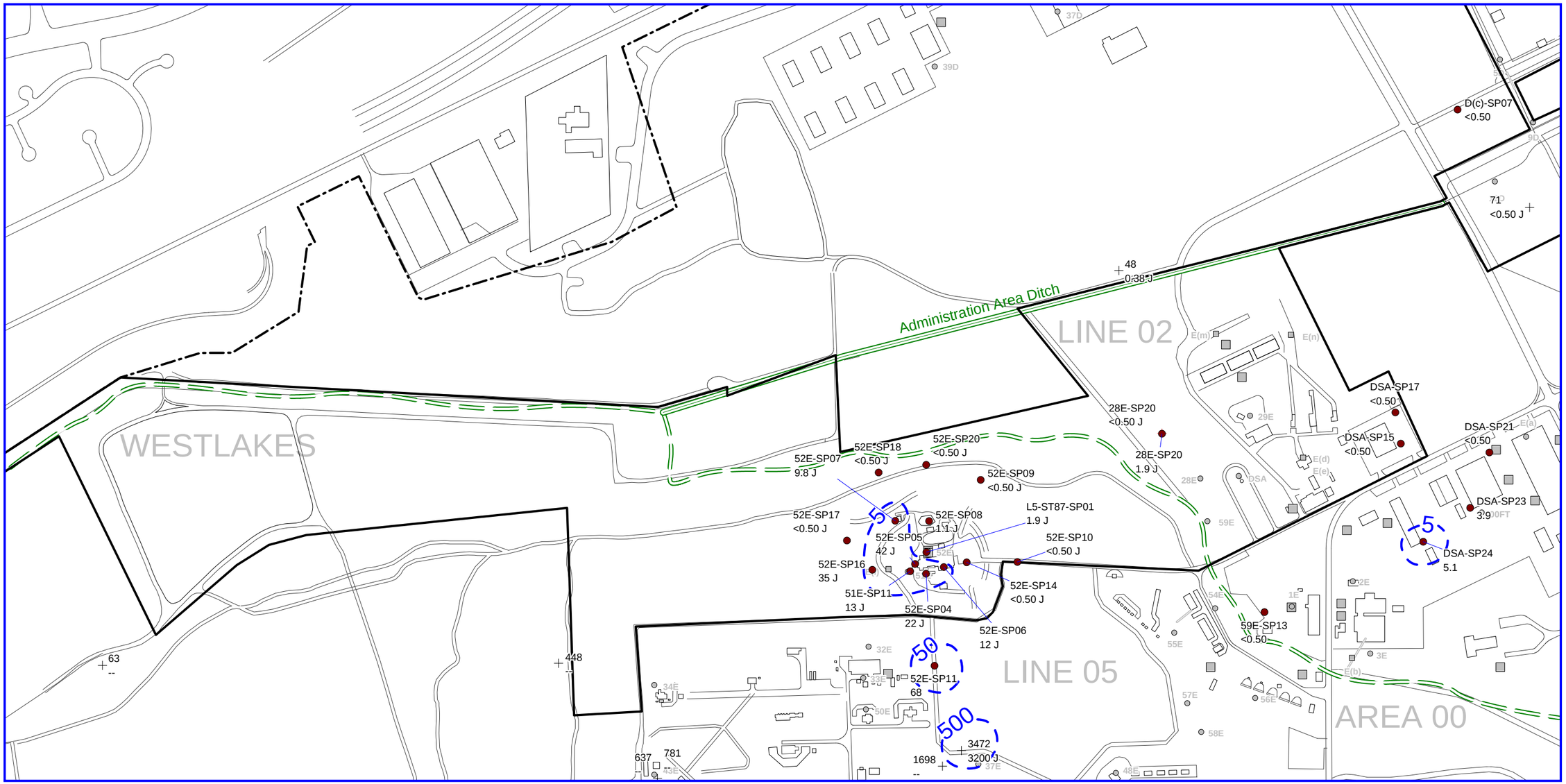
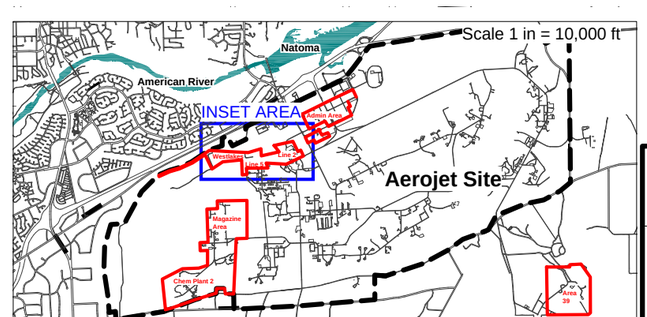
SR10122522



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Drainage Culvert
- Septic Tank
- 39D — Source Site ID

Note: -- = Not Sampled Sample Period - October 2005 to October 2006
* = Asterisk Indicates Data Collected Outside RI Sampling Period. J = Estimated Value PGW SVSL = Protection to Groundwater Soil Vapor Screening Level



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

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Environmental Remediation

Figure 1-18
Perched Groundwater
TCE Iso-concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

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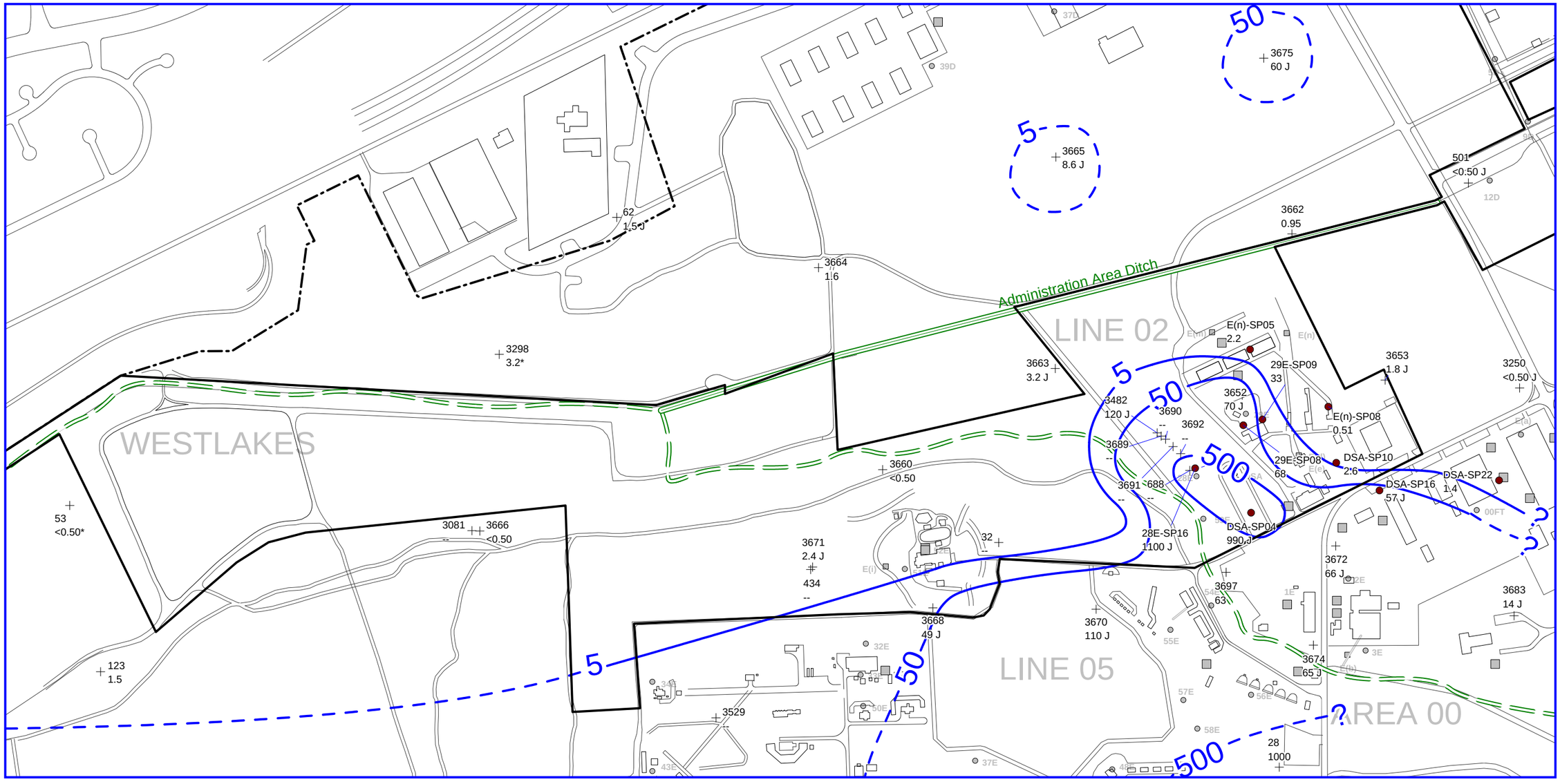
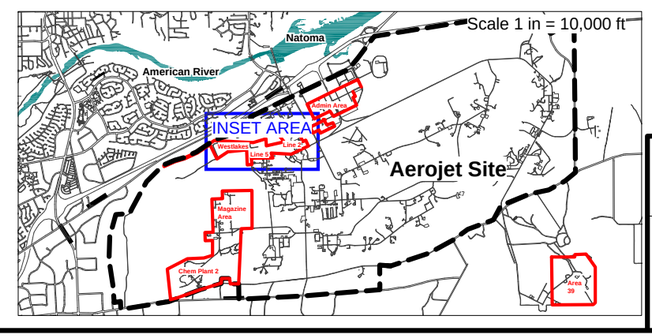
SR10122533



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID

Note: -- = Not Sampled Sample Period - October 2005 to October 2006
* = Asterisk Indicates Data Collected Outside RI Sampling Period. J = Estimated Value PGW SVSL = Protection to Groundwater Soil Vapor Screening Level



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 1-19
First Water-Bearing Zone
TCE Iso-Concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

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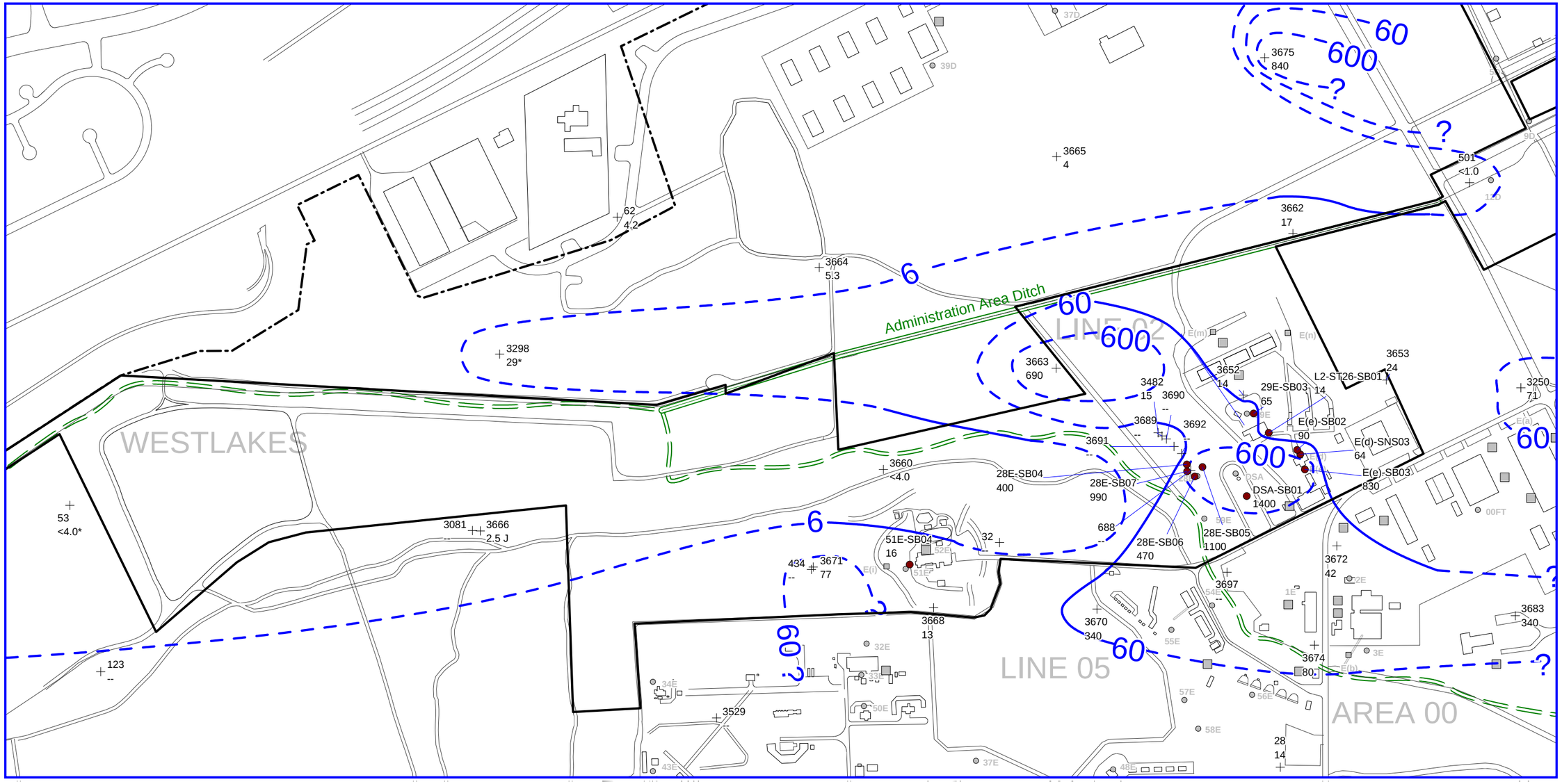
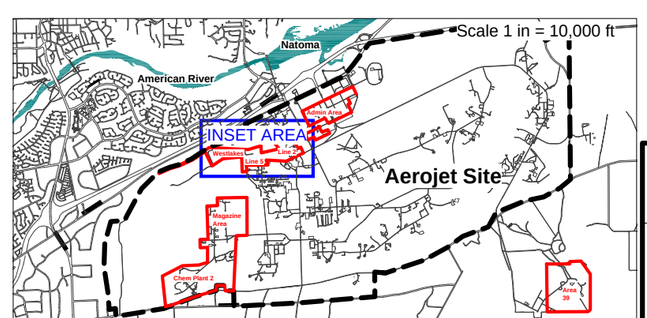
SR10122534



Explanation

- 03D-SP01 61.3 — Grab Groundwater Sample Location and Concentration (ug/L)
- 645 61.3 — Monitoring Well, ID and Concentration (ug/L)
- Iso-Concentration Contour (ug/L) - lines dashed where inferred
- Aerojet Property Boundary
- Buffalo Creek
- Building
- Consent Decree Boundary
- Septic Tank
- Drainage Culvert
- 39D — Source Site ID

Note: -- = Not Sampled J = Estimated Value PGW SSL = Protection to Groundwater Soil Screening Level
* = Asterisk Indicates Data Collected Outside RI Sampling Period Sample Period = October 2005 to October 2006



N

0 500 1,000
feet

Figure created on behalf of Aerojet by: CVEI
CENTRAL VALLEY ENVIRONMENTAL, INC.

AEROJET
Environmental Remediation

Figure 1-20
First Water-Bearing Zone
Perchlorate Iso-Concentration Contours
Westlakes Area, Boundary Operable Unit (OU-6)

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SR10122535

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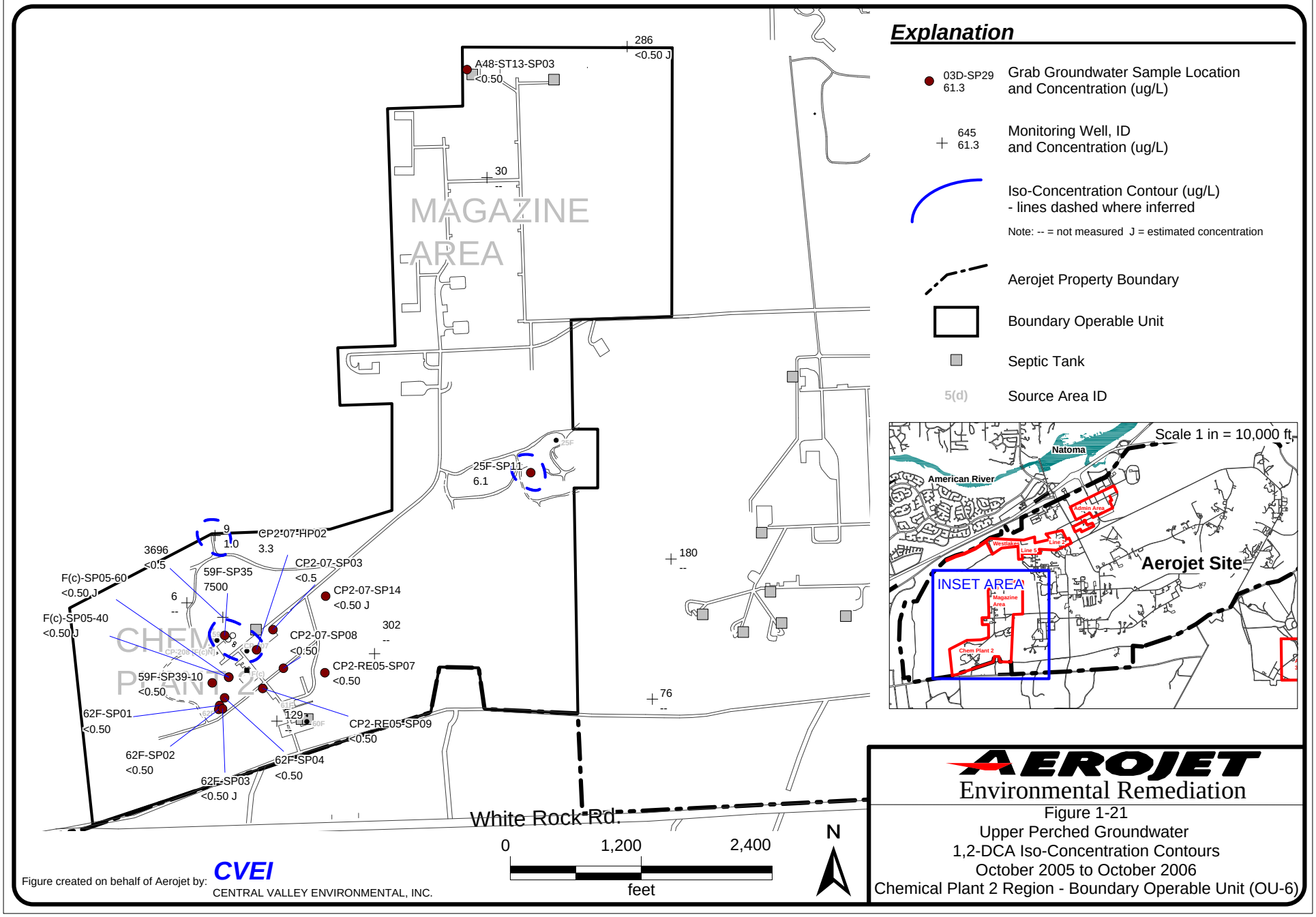

SR10122536

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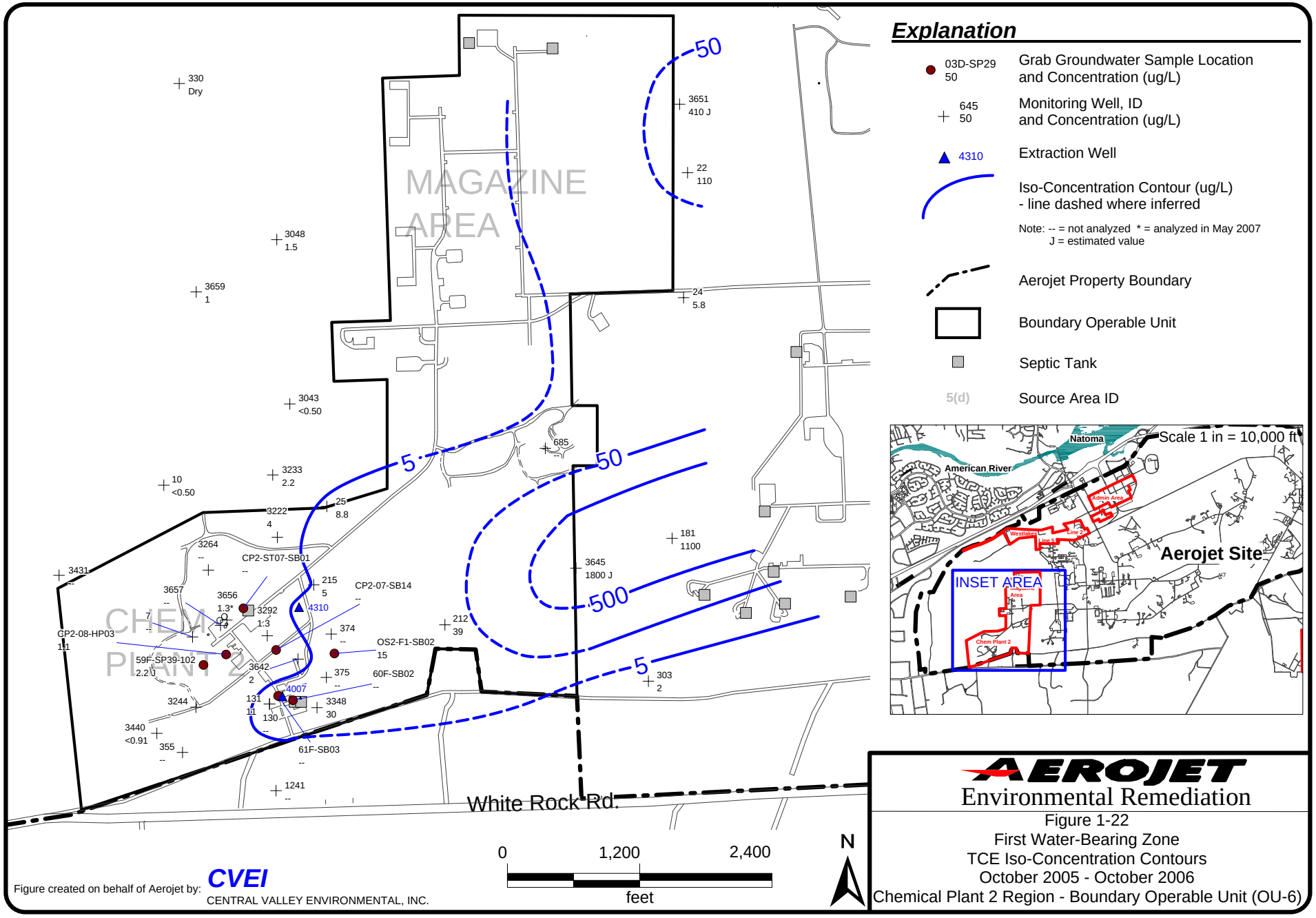

Figure 1-22
First Water-Bearing Zone
TCE Iso-Concentration Contours
October 2005 - October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

SR10122537

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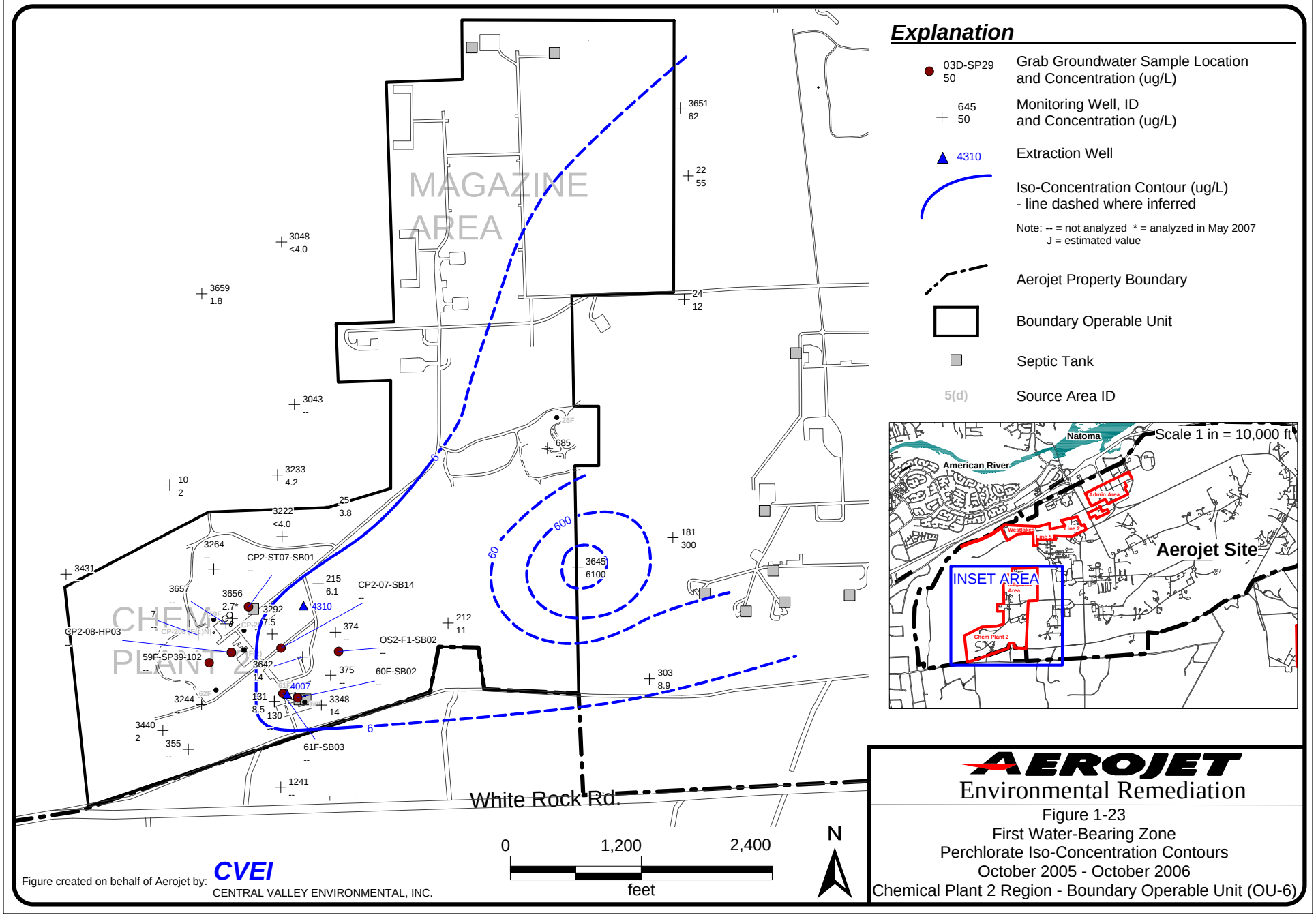
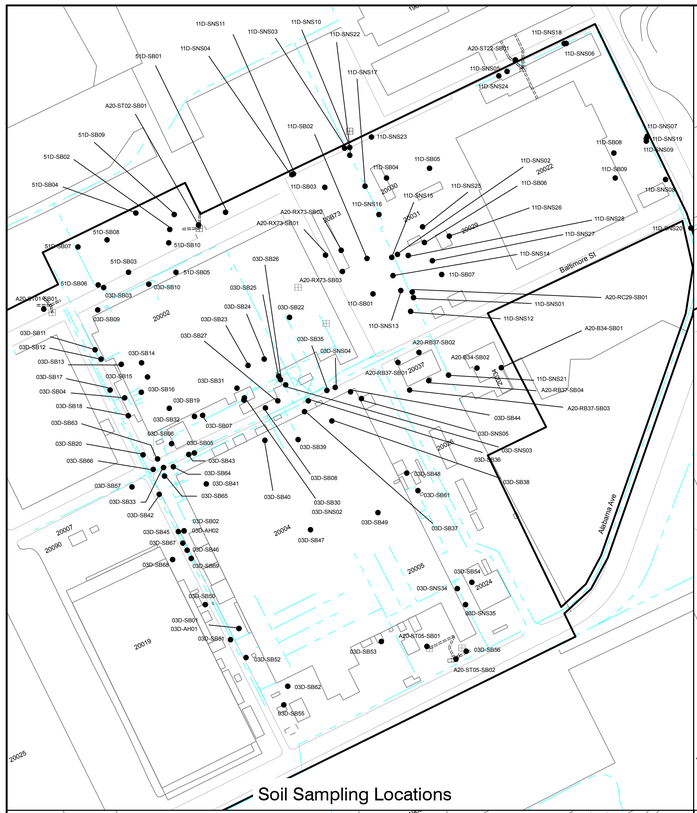
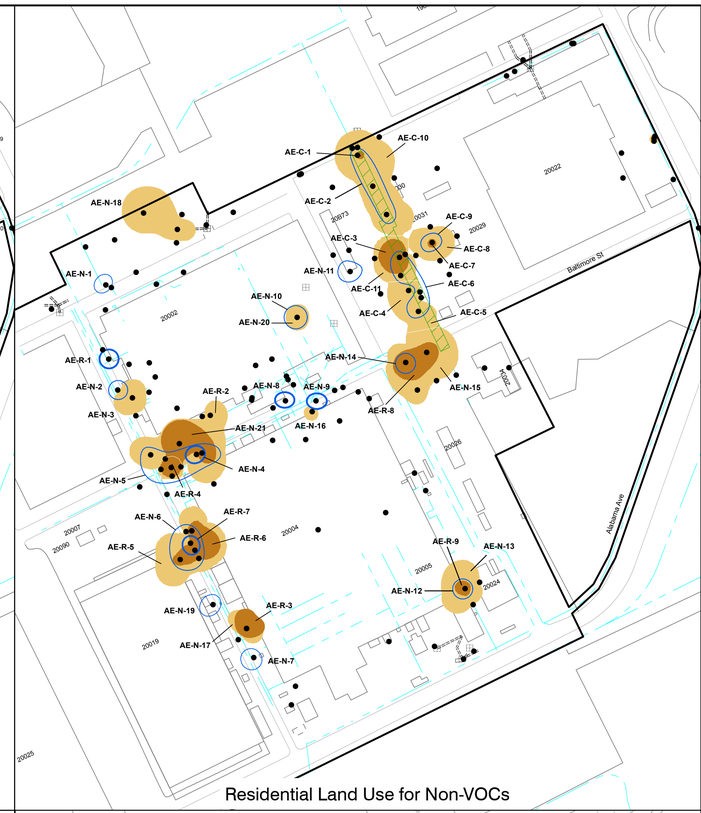


Figure 1-23
First Water-Bearing Zone
Perchlorate Iso-Concentration Contours
October 2005 - October 2006
Chemical Plant 2 Region - Boundary Operable Unit (OU-6)

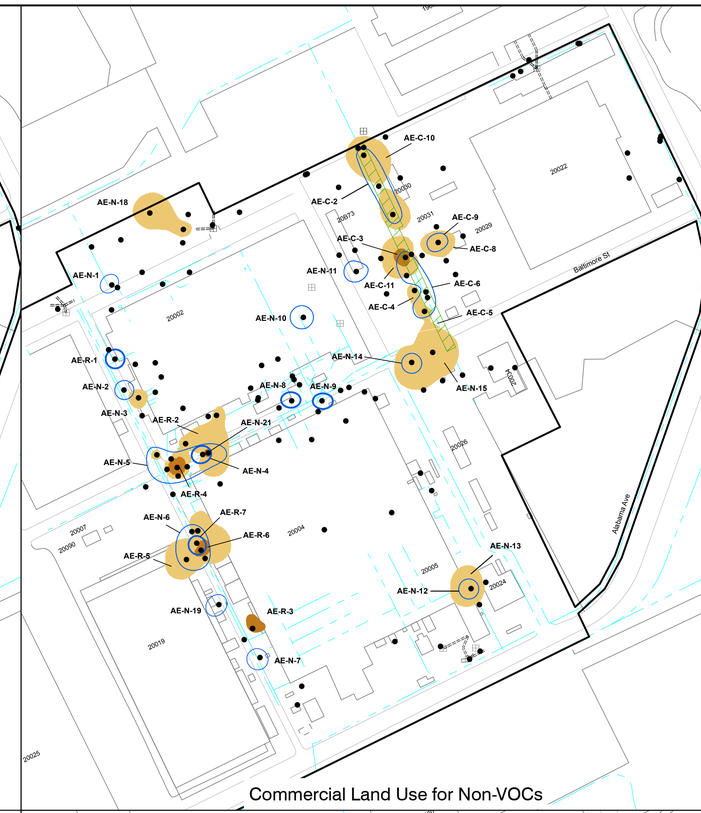
SR10122538



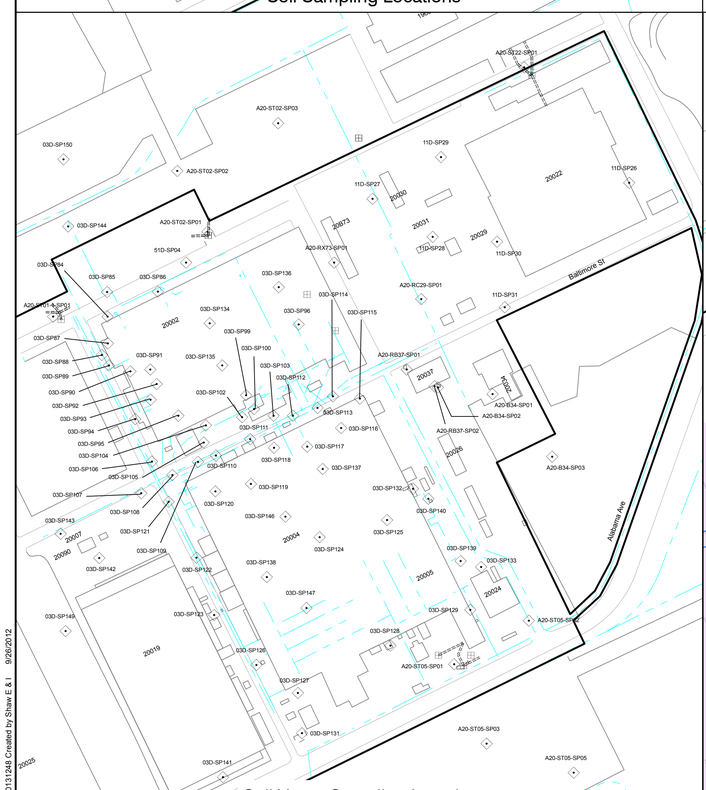
Soil Sampling Locations



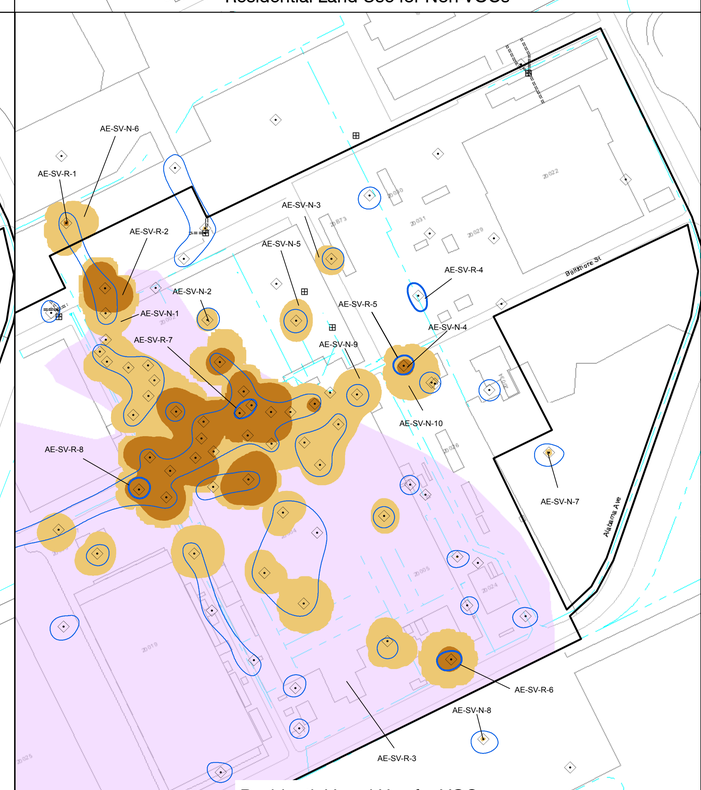
Residential Land Use for Non-VOCs



Commercial Land Use for Non-VOCs



Soil Vapor Sampling Locations



Residential Land Use for VOCs

Commercial Land Use for VOCs

28E-SB01 Soil Boring Location

29E-SP07 Soil Vapor Location

Residential Risk Due to Modeled VOC Migration from Groundwater

High Risk Contour[1]

Low Risk Contour[2]

High Risk to Groundwater

Low Risk to Groundwater

Potential Ecological Concern

Surface Drainage

Fence

Railroad

Road

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) Administration Area East does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

N

0 100 200 400 600 800 Feet

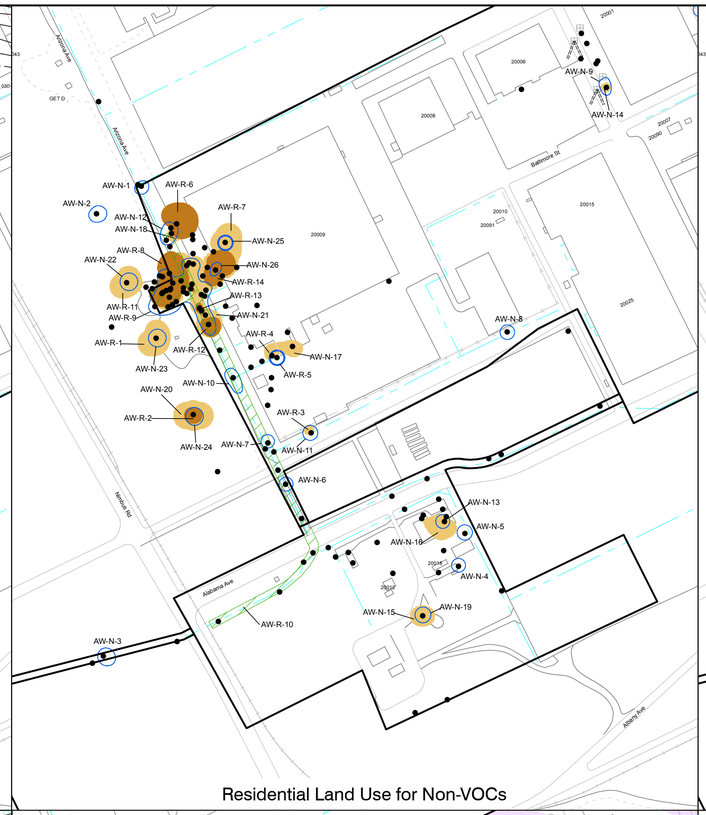
1 inch = 200 feet

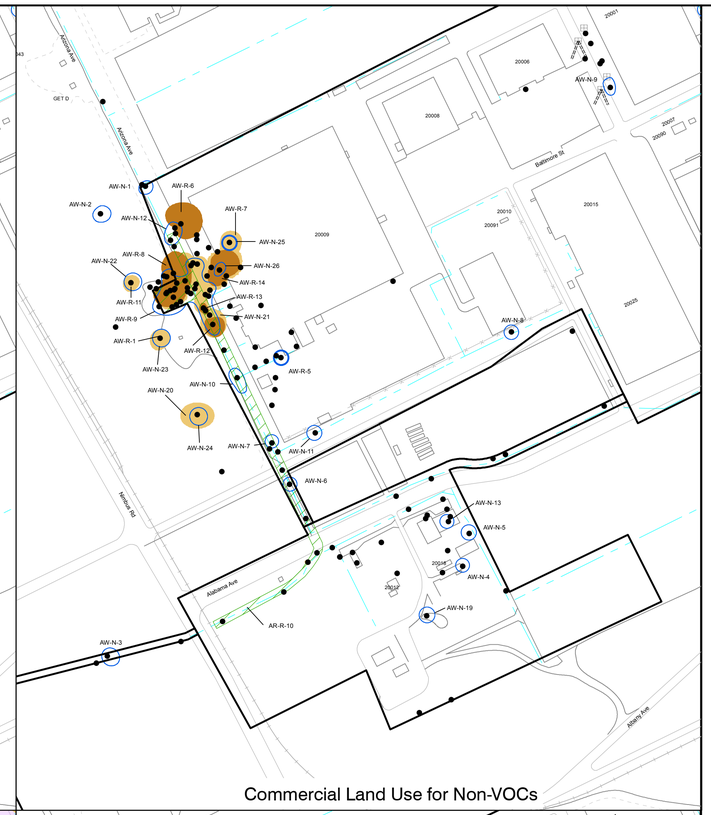
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

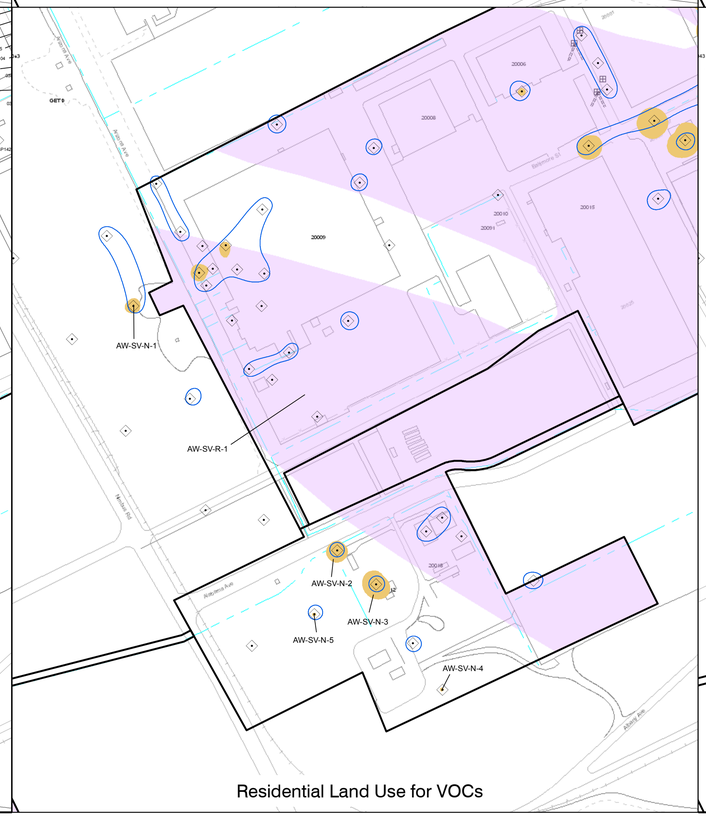
AEROJET
Environmental Remediation

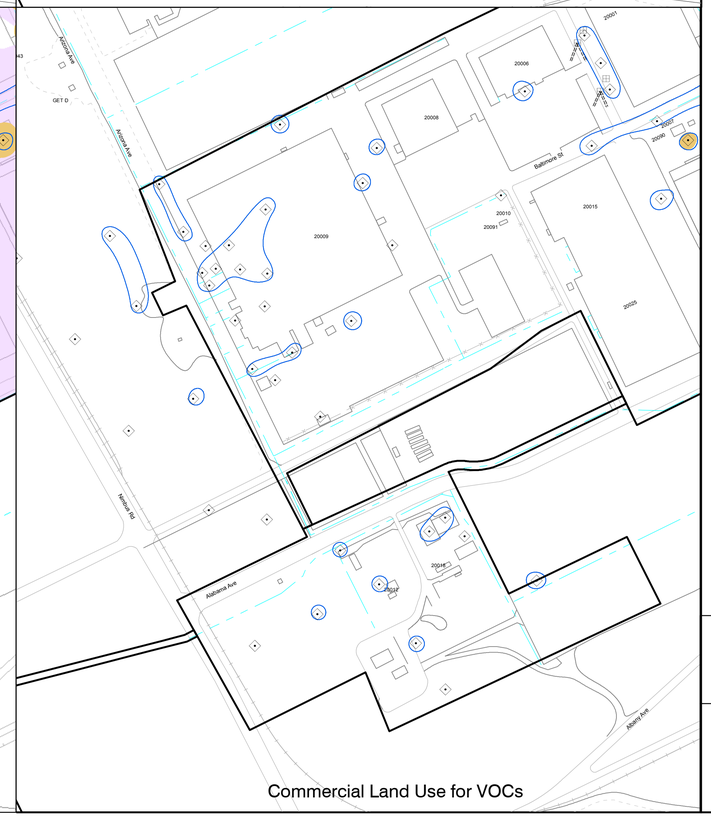
Figure 1-24
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Administration Area East
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012









28E-SB01 • Soil Boring Location

29E-SP07 ◇ Soil Vapor Location

Residential Risk Due to Modeled VOC Migration from Groundwater

High Risk Contour[1]

Low Risk Contour[2]

High Risk to Groundwater

Low Risk to Groundwater

Potential Ecological Concern

Surface Drainage

Road

Railroad

Fence

Structure

Management Area/Open Space Boundary

Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) Administration Area West does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

N

0 125 250 500 750 1,000 Feet

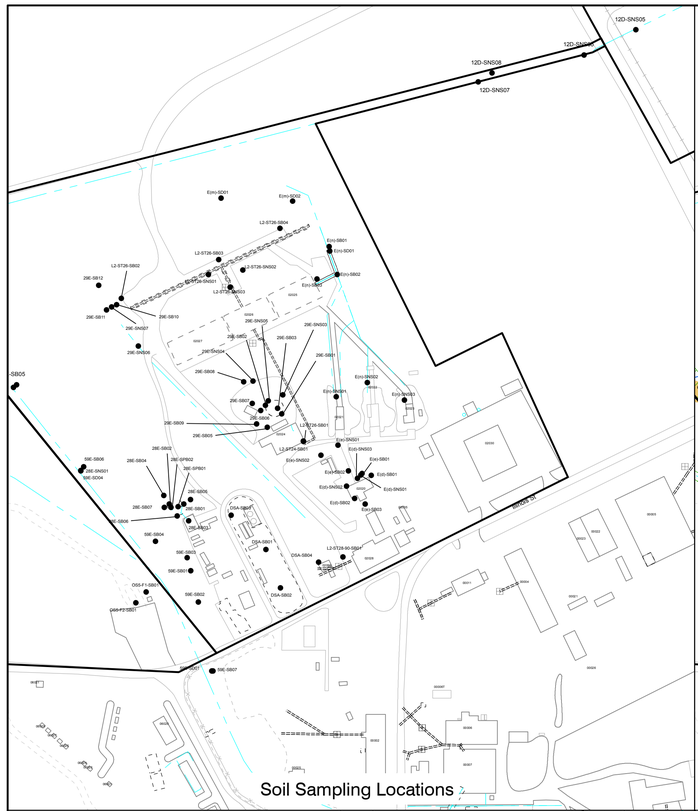
1 inch = 250 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

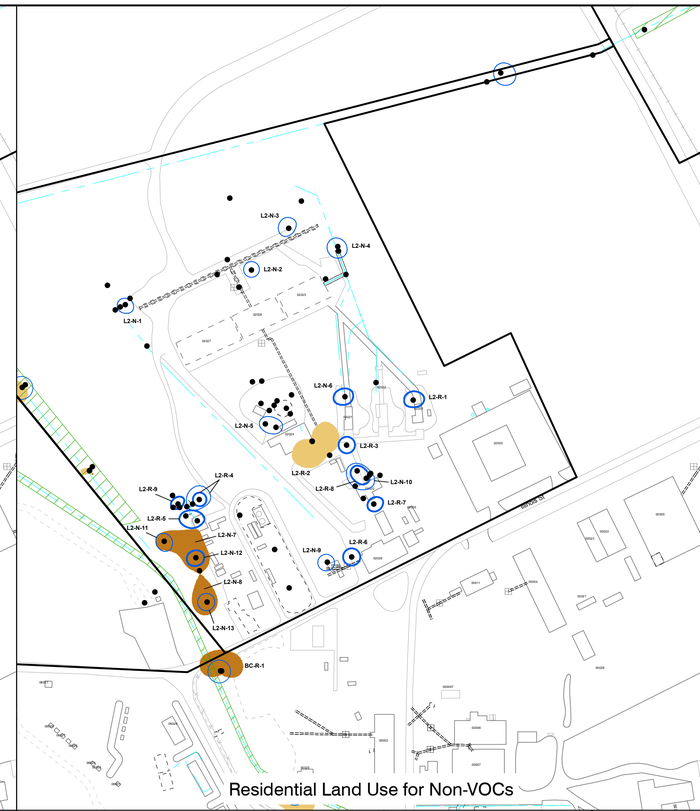
AEROJET
Environmental Remediation

Figure 1-25
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Administration Area West
Boundary Operable Unit

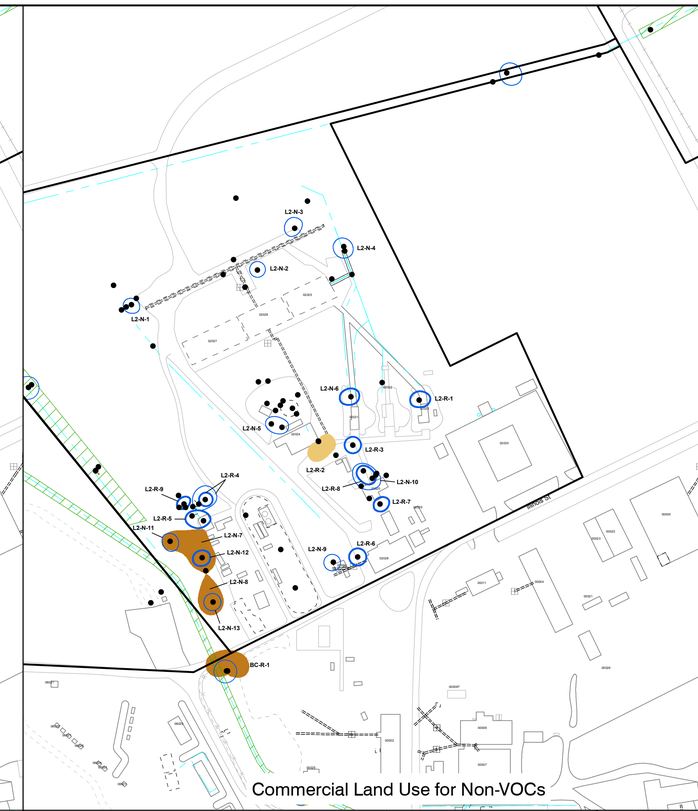
SR10131248 Created by Shaw E & I 9/26/2012



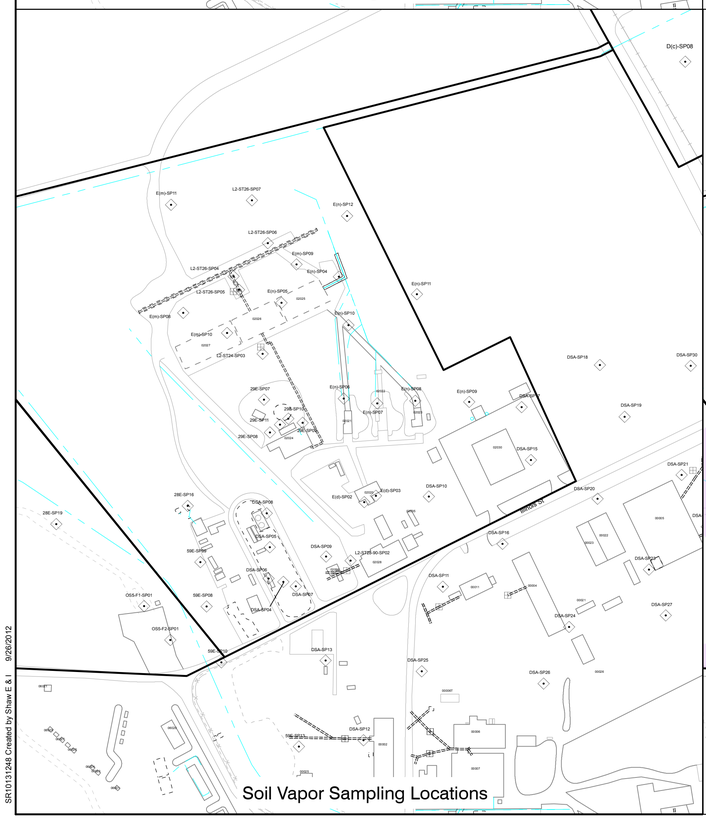
Soil Sampling Locations



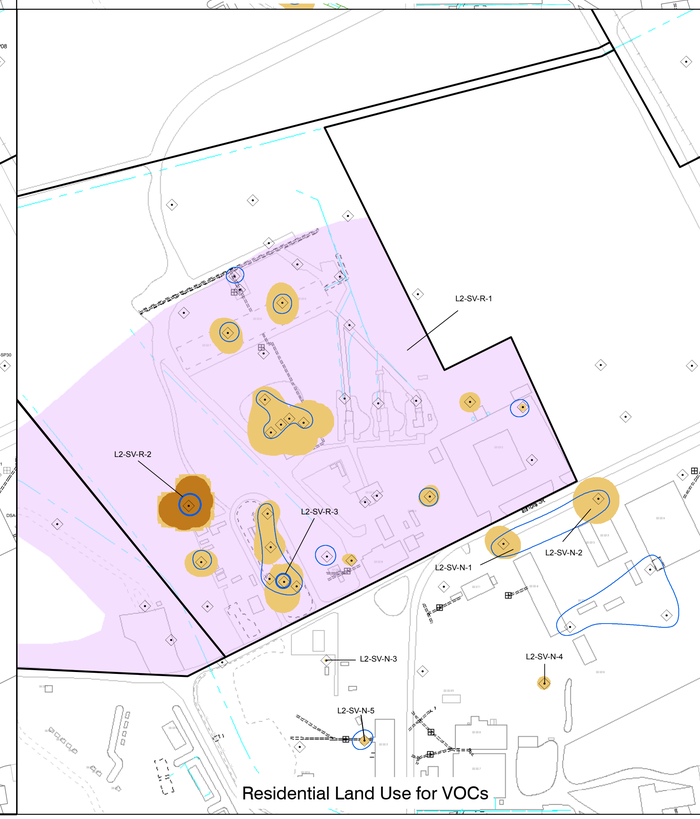
Residential Land Use for Non-VOCs



Commercial Land Use for Non-VOCs



Soil Vapor Sampling Locations



Residential Land Use for VOCs

Commercial Land Use for VOCs

28E-SB01 Soil Boring Location

29E-SP07 Soil Vapor Location

Residential Risk Due to Modeled VOC Migration from Groundwater

High Risk Contour[1]

Low Risk Contour[2]

High Risk to Groundwater

Low Risk to Groundwater

Potential Ecological Concern

Surface Drainage

Fence

Railroad

Road

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) The Line 2 Area does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

N

0 100 200 400 600 800 Feet

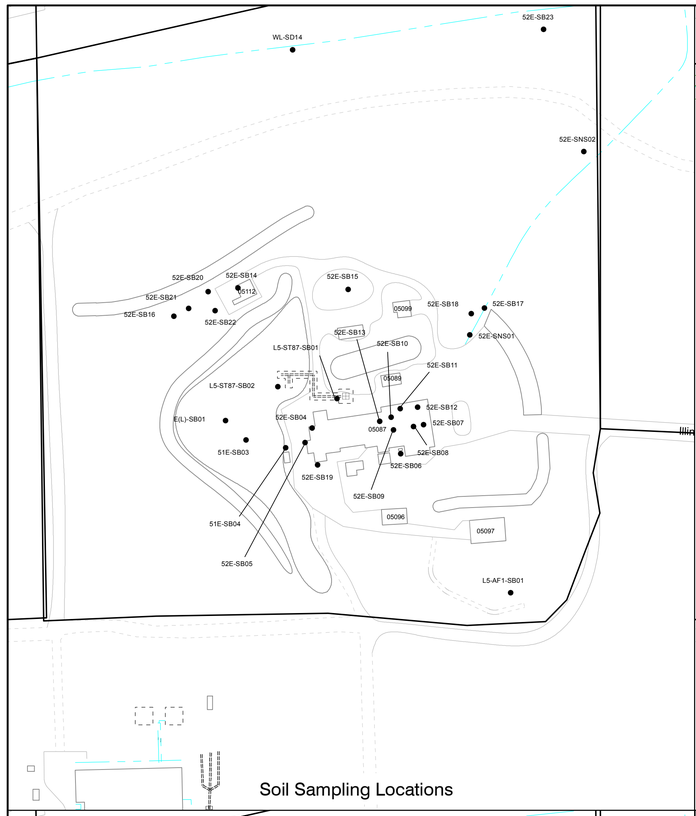
1 inch = 200 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

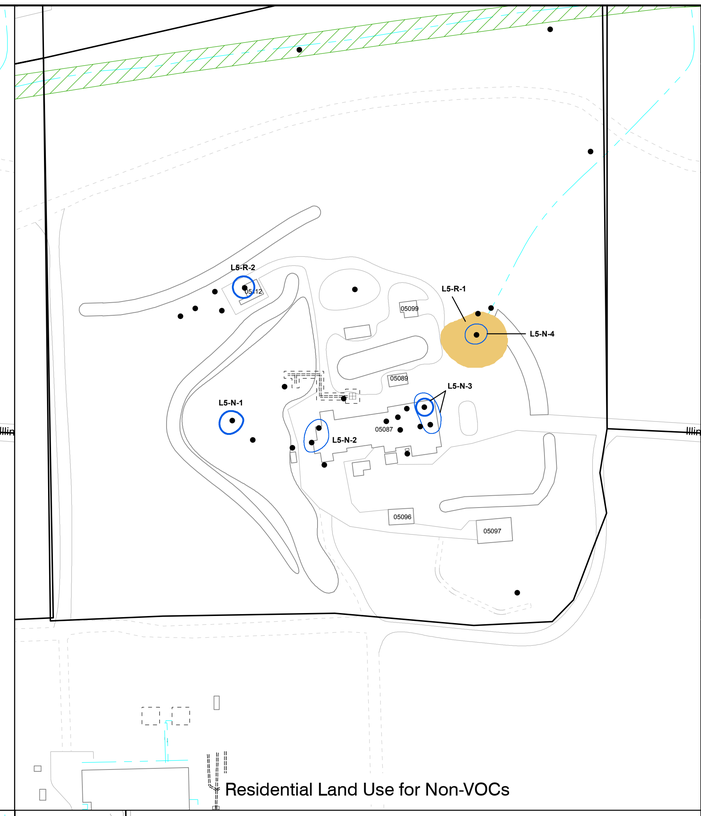
AEROJET
Environmental Remediation

Figure 1-26
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Line 2
Boundary Operable Unit

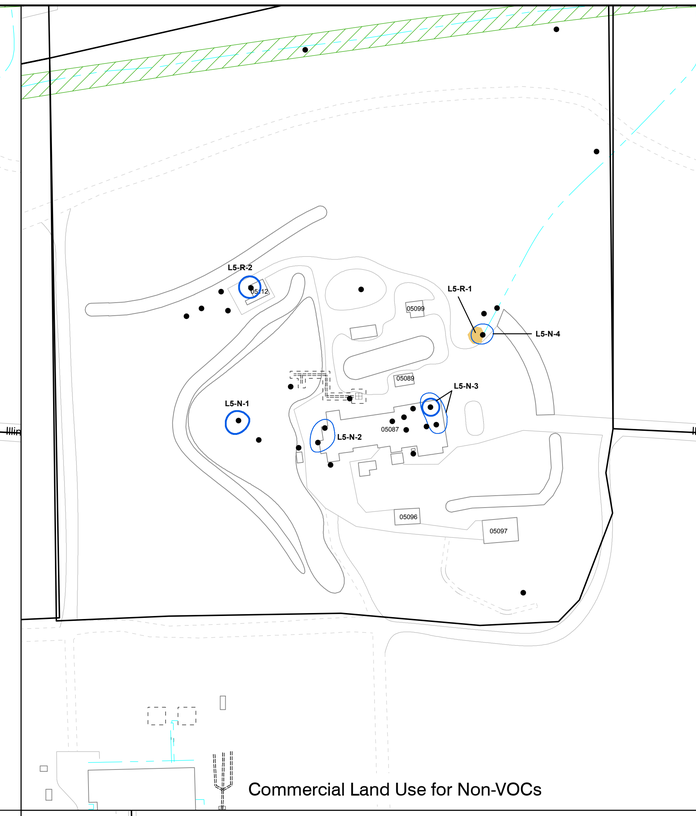
SR10131248 Created by Shaw E & I 9/26/2012



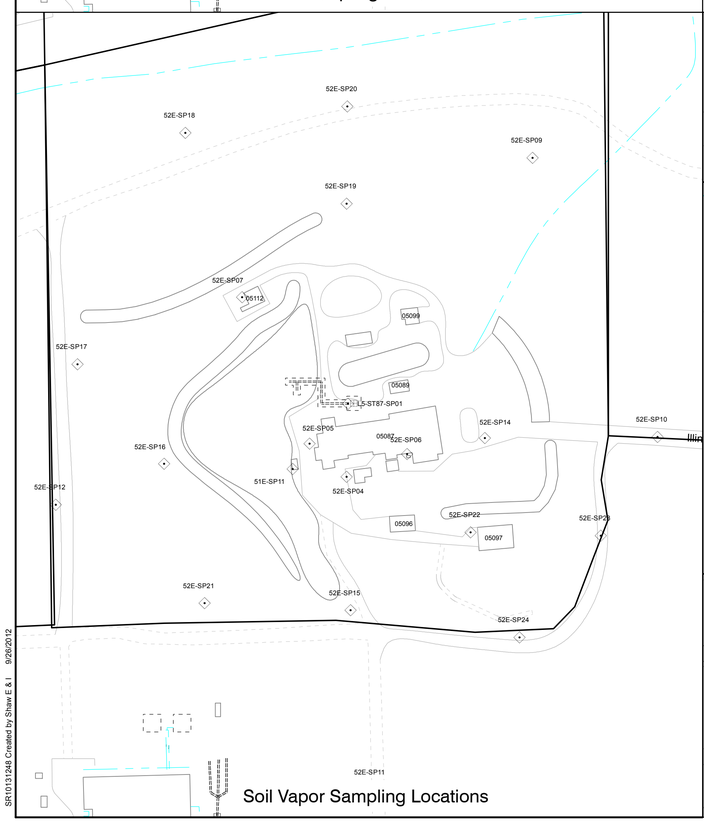
Soil Sampling Locations



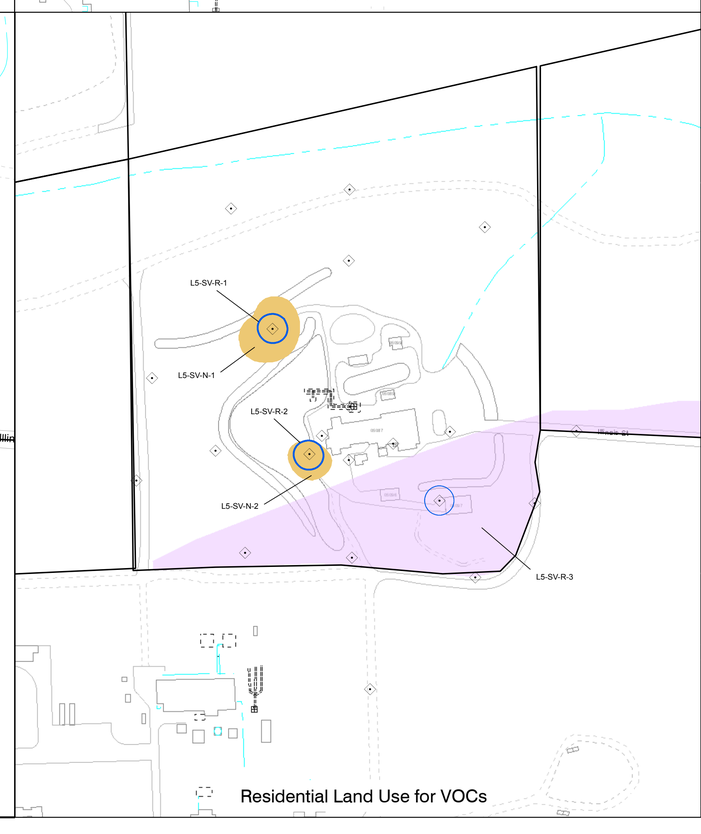
Residential Land Use for Non-VOCs



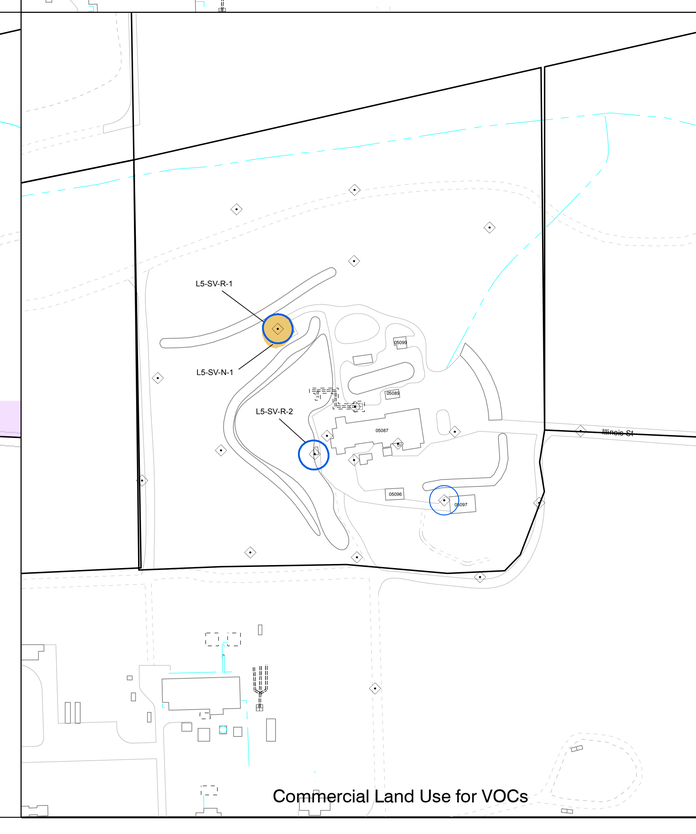
Commercial Land Use for Non-VOCs



Soil Vapor Sampling Locations



Residential Land Use for VOCs



Commercial Land Use for VOCs

28E-SB01 Soil Boring Location

29E-SP07 Soil Vapor Location

Residential Risk Due to Modeled VOC Migration from Groundwater

High Risk Contour[1]

Low Risk Contour[2]

High Risk to Groundwater

Low Risk to Groundwater

Potential Ecological Concern

Surface Drainage

Fence

Railroad

Road

Gravel Road

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) The Line 5 Area does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

N

0 50 100 200 300 400 Feet

1 inch = 100 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 1-27
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Line 5
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/20/2012

28E-SB01 • Soil Boring Location

29E-SP07 ◇ Soil Vapor Location

Residential Risk Due to Modeled VOC Migration from Groundwater

High Risk Contour[1]

Low Risk Contour[2]

High Risk to Groundwater

Low Risk to Groundwater

Potential Ecological Concern

Surface Drainage

Road

Railroad

Fence

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) The Buffalo Creek Area does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

N

0 400 800 1,600 2,400 3,200 Feet

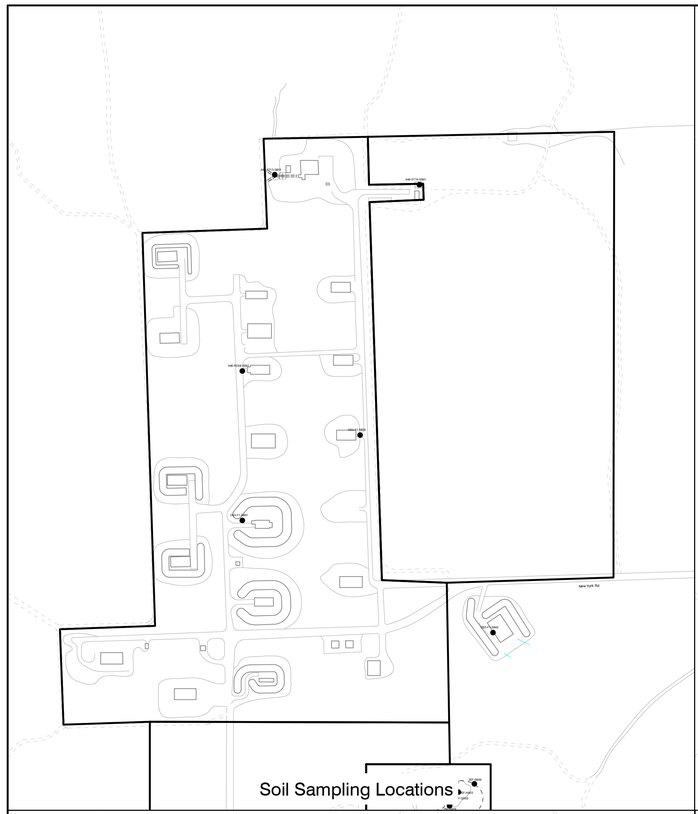
1 inch = 800 feet

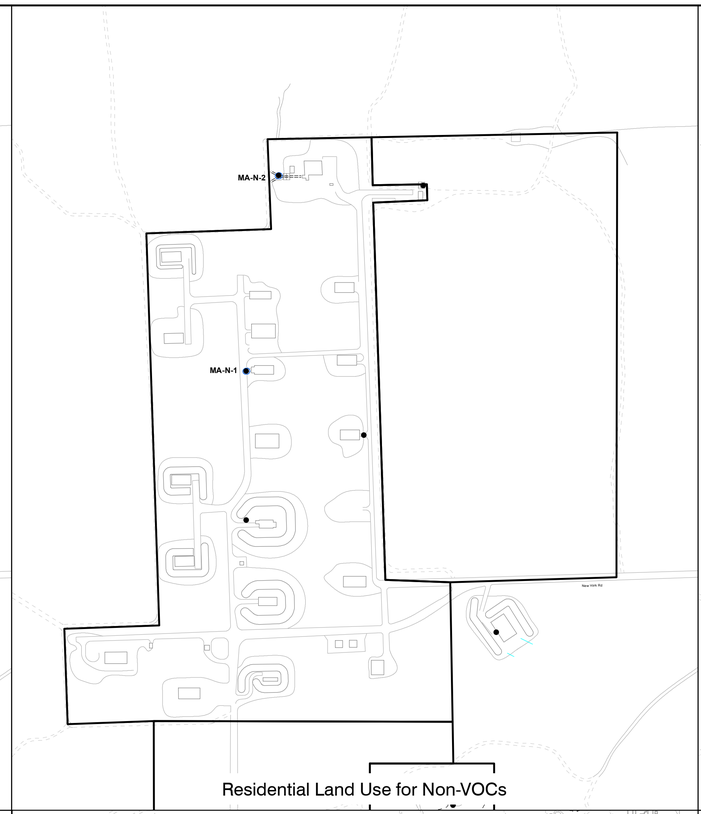
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

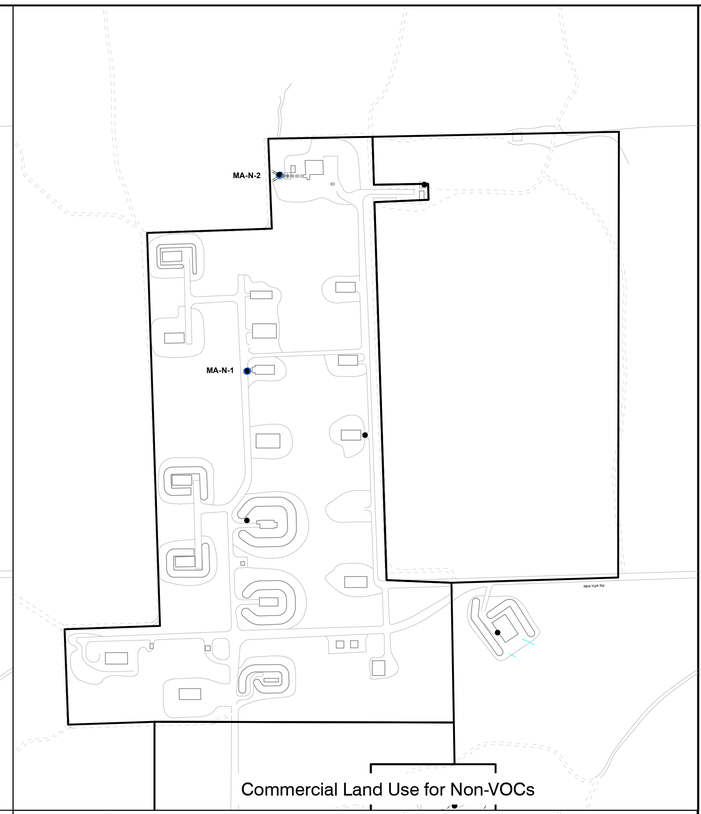
AEROJET
Environmental Remediation

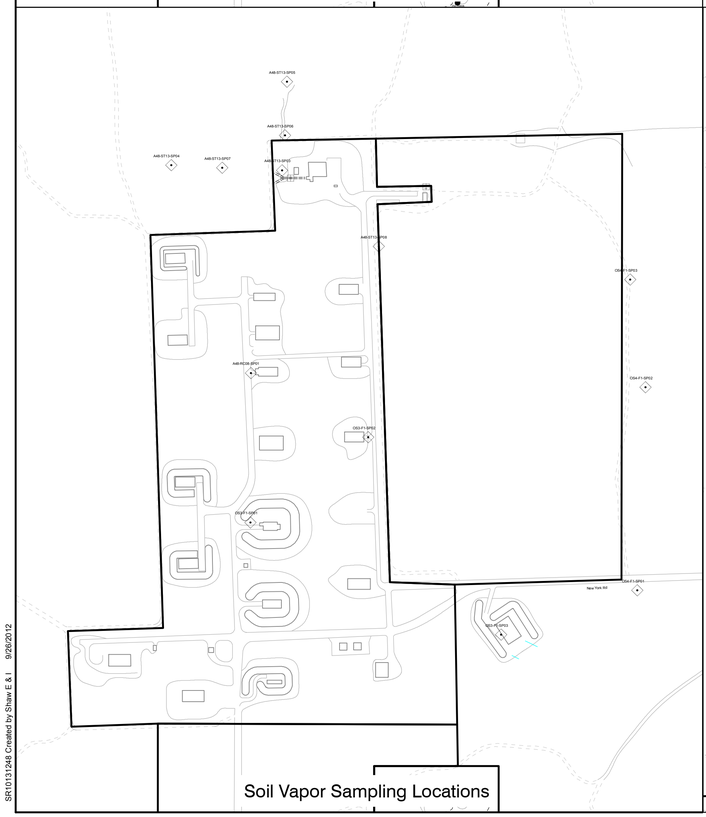
Figure 1-28
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Buffalo Creek
Boundary Operable Unit

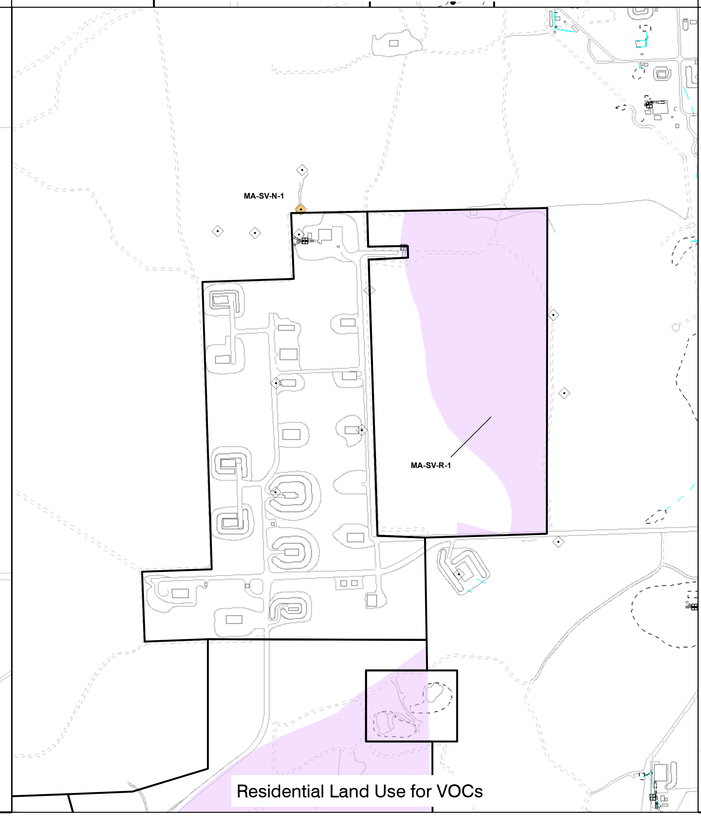
SR10131248 Created by Shaw E & I 9/26/2012

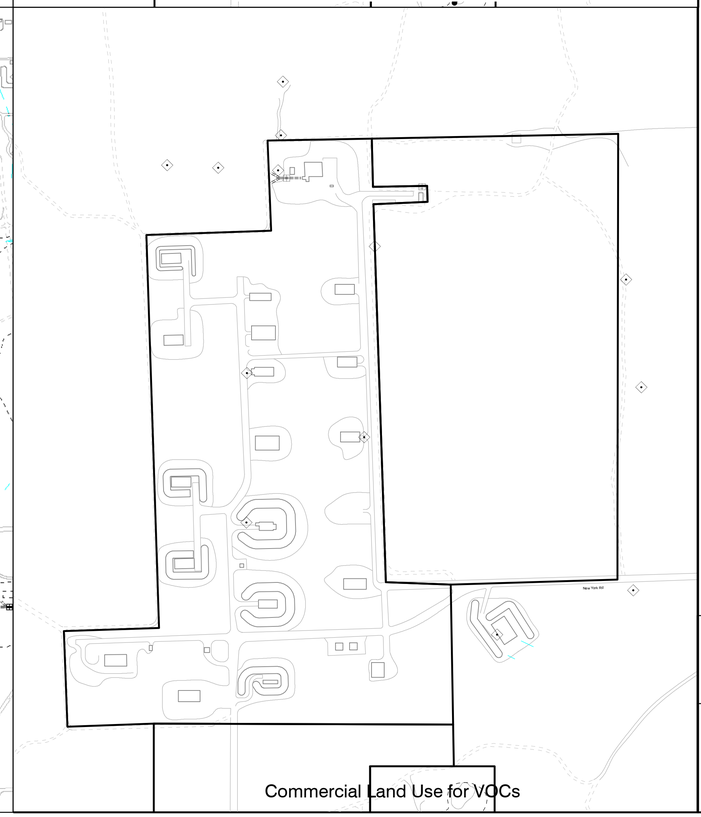












28E-SB01 Soil Boring Location

29E-SP07 Soil Vapor Location

High Risk to Groundwater

Low Risk to Groundwater

Low Risk Contour[1]

Residential Risk Due to Modeled VOC Migration from Groundwater

Surface Drainage

Fence

Railroad

Road

Gravel Road

Management Area/Open Space Boundary

Structure

Notes:

1) 10^{-6} cancer risk.

2) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

3) Shallow soil is between surface and 12 feet below ground surface.

4) The Magazine Area does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

0 200 400 800 1,200 1,600 Feet

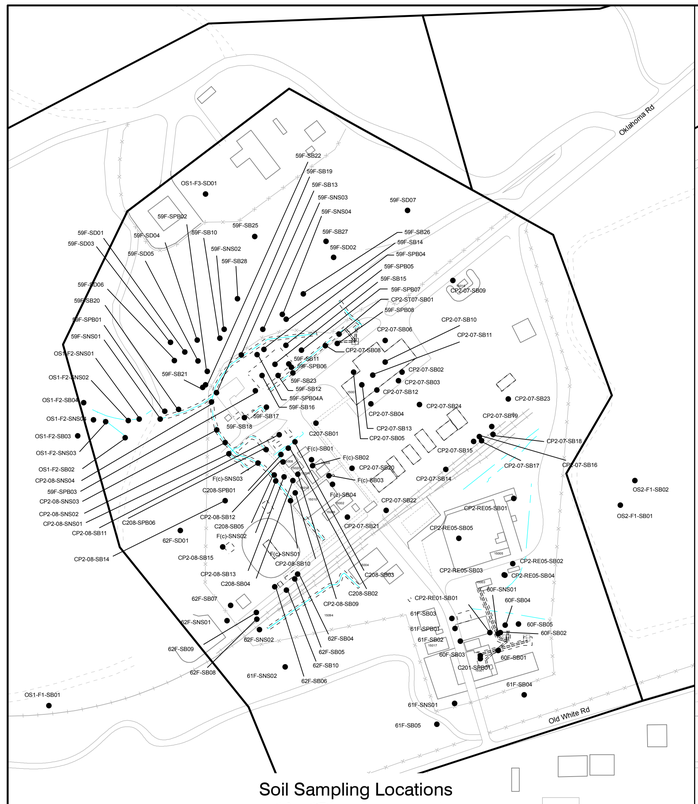
1 inch = 400 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

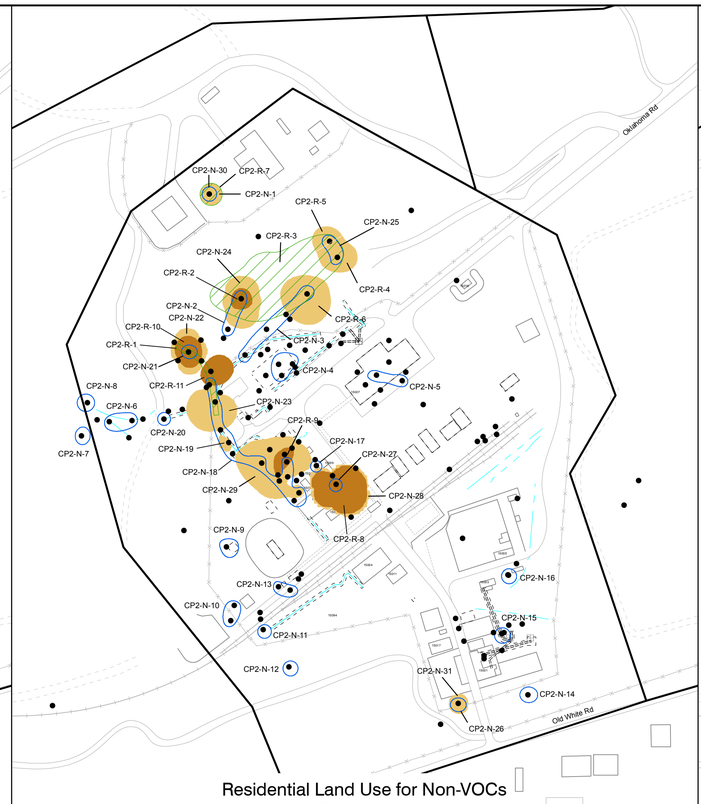
AEROJET
Environmental Remediation

Figure 1-29
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Magazine Area, Open Space Areas 3 and 4
Boundary Operable Unit

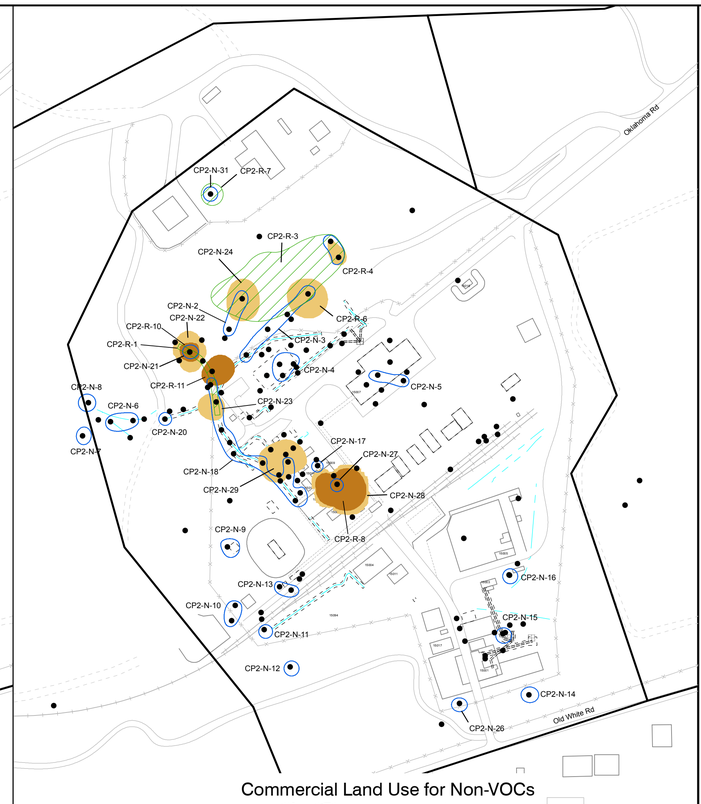
SR10131248 Created by Shaw E & I 9/26/2012



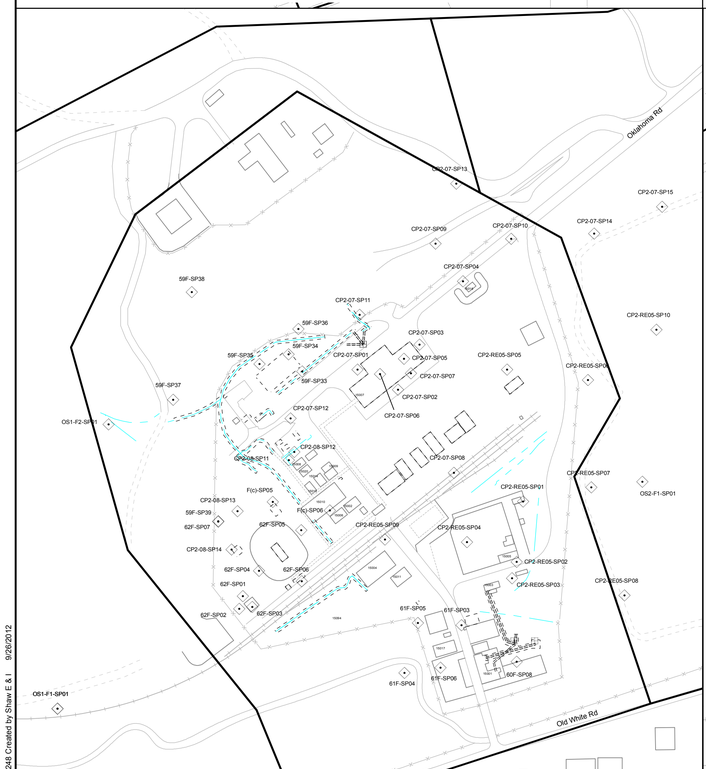
Soil Sampling Locations



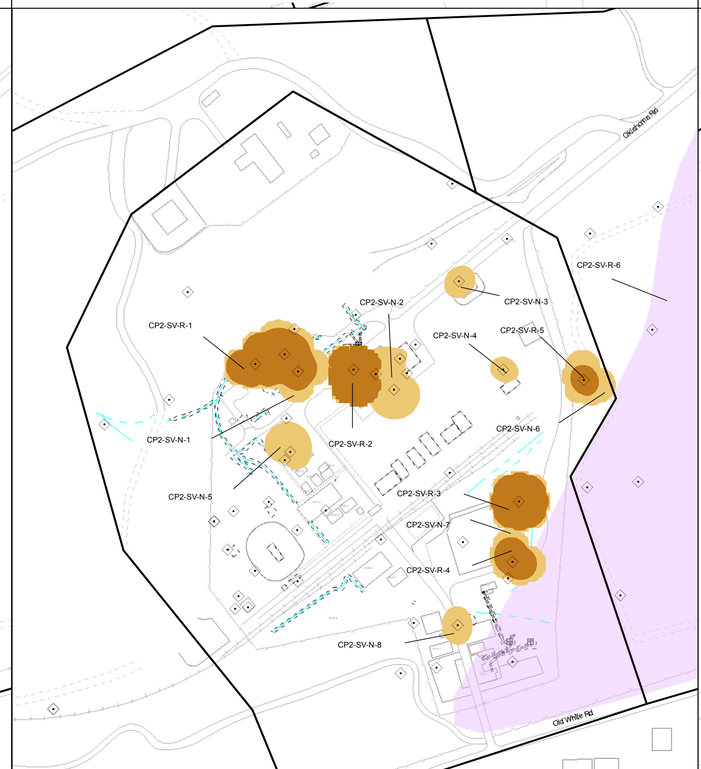
Residential Land Use for Non-VOCs



Commercial Land Use for Non-VOCs



Soil Vapor Sampling Locations



Residential Land Use for VOCs

Commercial Land Use for VOCs

- Soil Boring Location
- Soil Vapor Location
- Residential Risk Due to Modeled VOC Migration from Groundwater
- High Risk Contour[1]
- Low Risk Contour[2]
- High Risk to Groundwater
- Low Risk to Groundwater
- Potential Ecological Concern
- Surface Drainage
- Fence
- Railroad
- Road
- Gravel Road
- Management Area/Open Space Boundary
- Structure
- Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) The Chemical Plant 2 Area does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

0 100 200 400 600 800 Feet

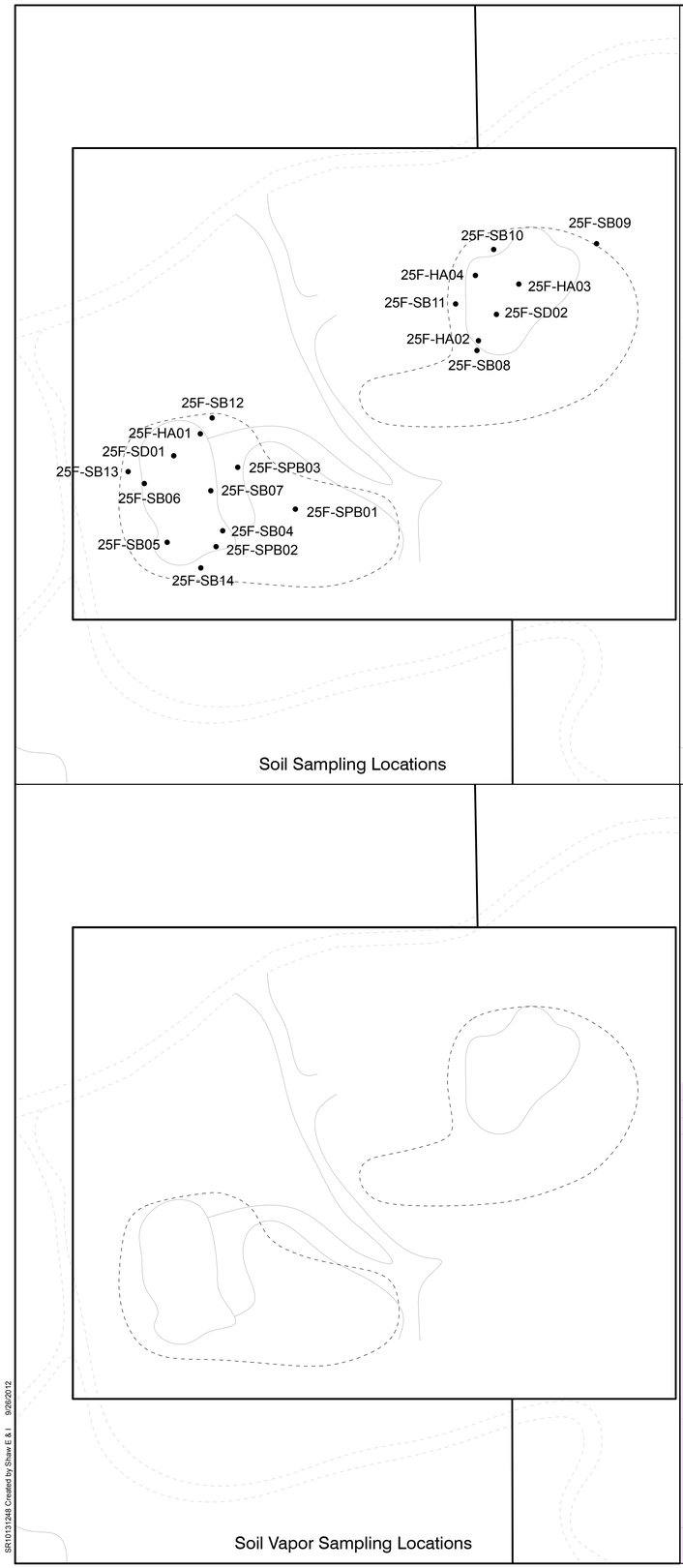
1 inch = 200 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 1-30
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Chemical Plant 2 Area
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012



28E-SB01 Soil Boring Location

29E-SP07 Soil Vapor Location

Residential Risk Due to Modeled VOC Migration from Groundwater

High Risk Contour[1]

Low Risk Contour[2]

High Risk to Groundwater

Low Risk to Groundwater

Potential Ecological Concern

Surface Drainage

Road

Railroad

Fence

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

1) 10^{-4} cancer risk, HI > 1 non-cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

3) The residential land use contours from the HHRA include risk associated with both residential and construction worker scenarios.

4) The commercial land use contours from the HHRA include risk associated with both commercial and construction worker scenarios.

5) Shallow soil is between surface and 12 feet below ground surface.

6) The Dredge Pit Area does not include groundwater concentrations that exceed commercial risk due to modeled VOC concentrations.

7) µg/dL = micrograms per deciliter.

N

0 40 80 160 240 320 Feet

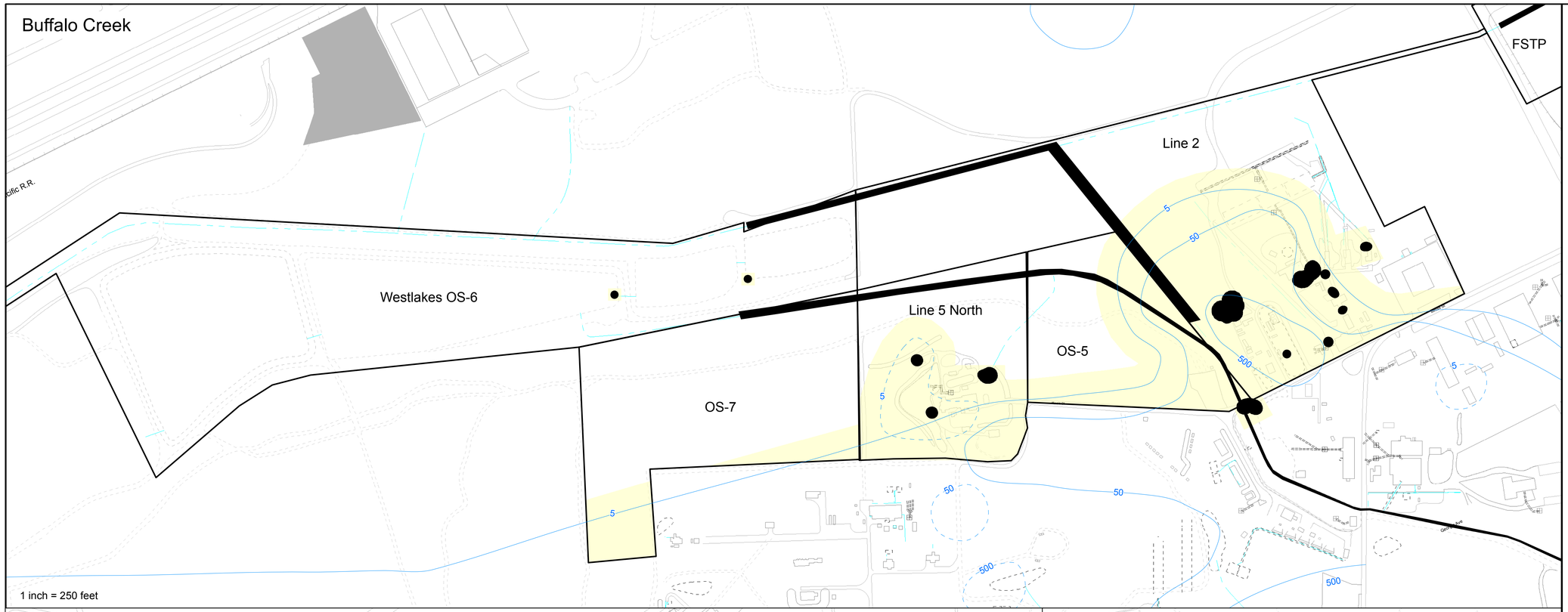
1 inch = 80 feet

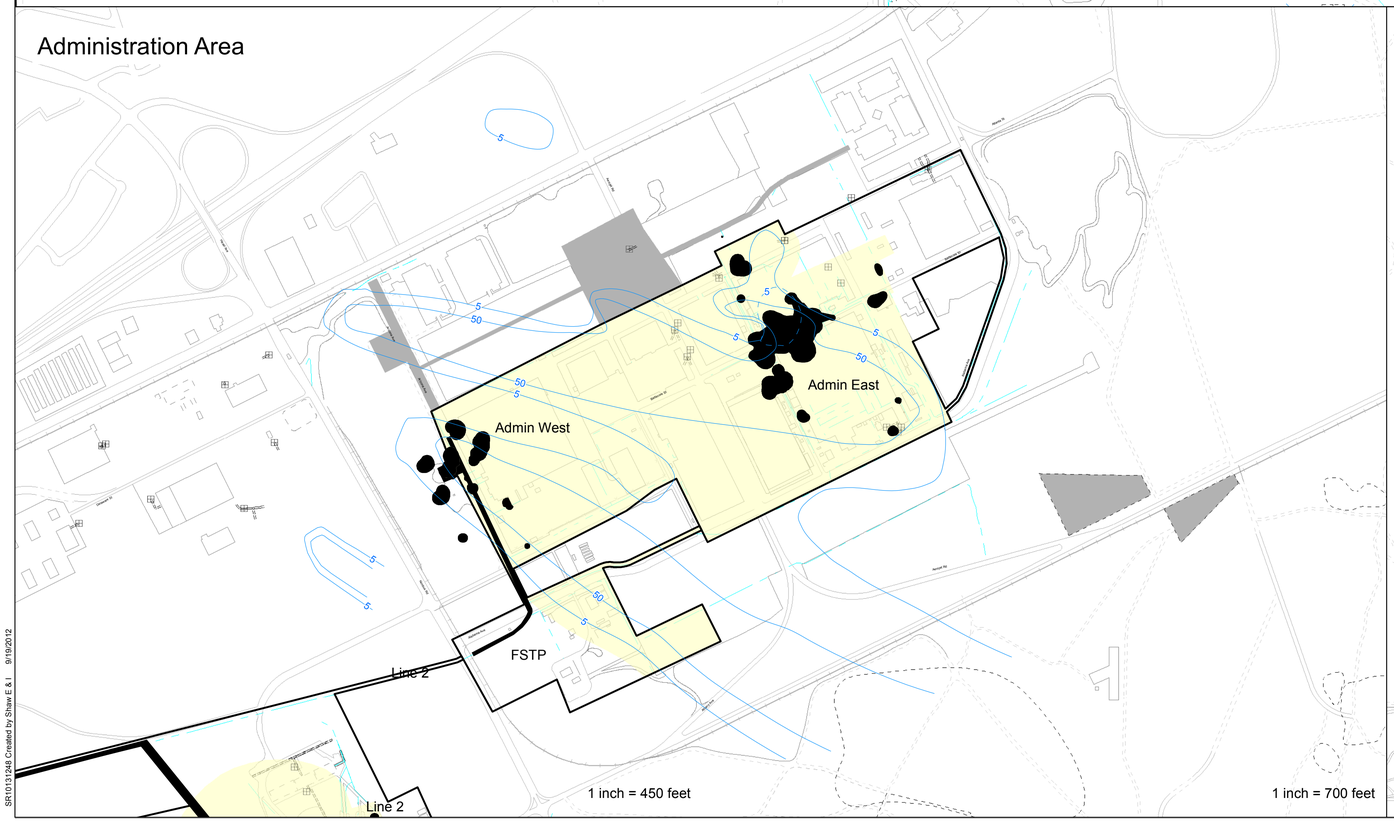
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

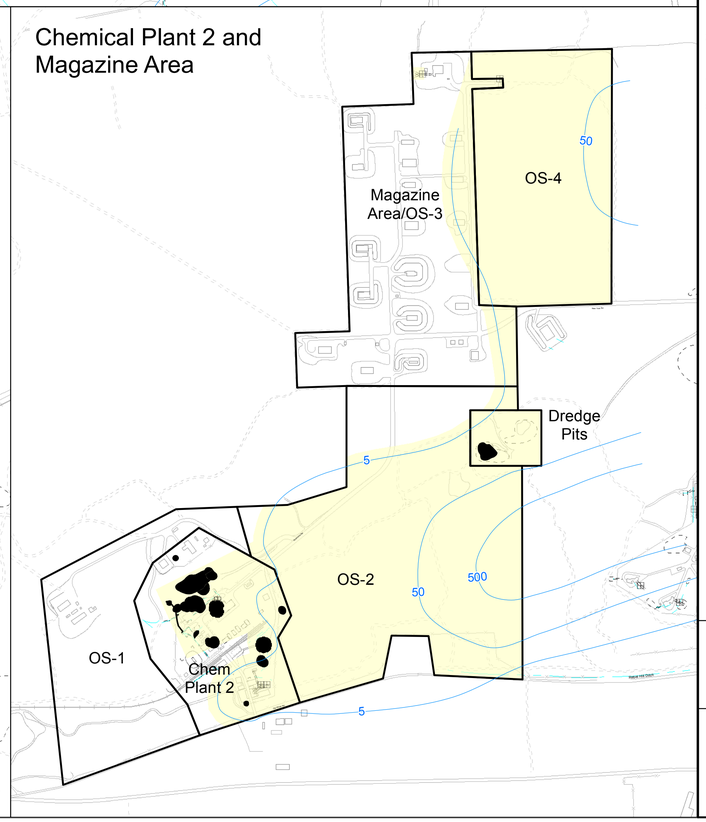
AEROJET
Environmental Remediation

Figure 1-31
Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments
Dredge Pit and Eastern Basin
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012







Retained Remedial Area for Groundwater[1]

Retained Remedial Areas for Soil and Soil Vapor[2]

First Water TCE Contour[3]

Perched TCE Contour[3]

Source Area

Surface Drainage

Road

Railroad

Fence

Management Area/Open Space Boundary

Structure

Removed Structure

PGOU

Notes:

1) Will be addressed by institutional controls, which may include:
- Restricted residential land use where residual Chemicals of Concern (COCs) would remain in place at concentrations that are above the levels that would allow for unrestricted use;
- Restricted commercial/industrial land use in areas where existing chemical concentrations exceed risk-based levels for commercial/industrial uses; and
- Required appropriate health and safety and materials management procedures for any excavations conducted in conjunction with subsurface infrastructure upgrades, repairs, or replacements in areas of residual COCs.

2) For more detail on retained areas, see Section 6 figures 6-3, 6-4, 6-6, 6-7, 6-8, 6-11, and 6-13.

3) For more detail on inferred contours, see Section 1 figures 1-15 through 1-23. Contour concentrations are given in µg/L.

4) OS = Open Space

5) FSTP = Former Sewage Treatment Plant

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 1-32

Retained Remedial Areas

Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/19/2012

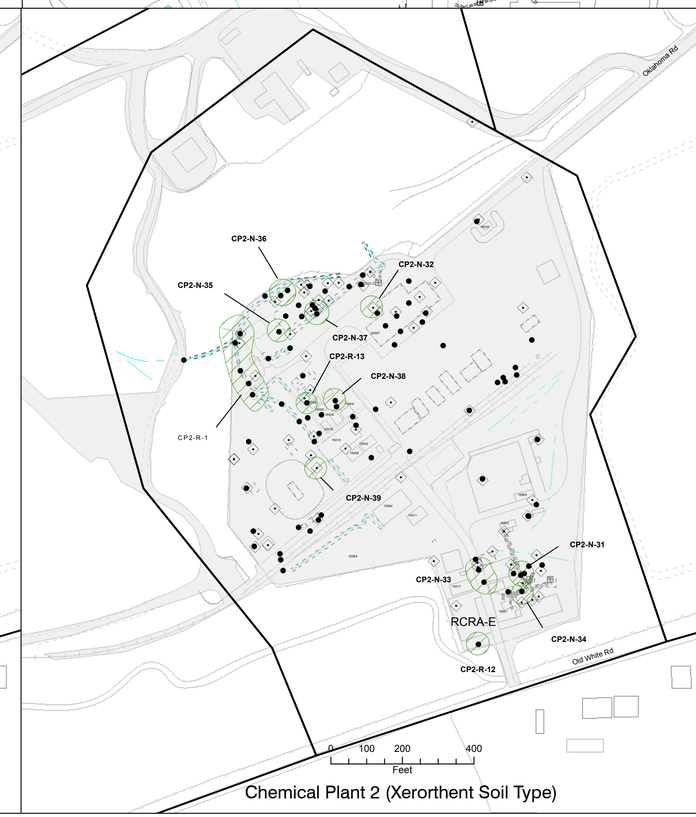
Administration Area East

Administration Area West

Line 02

Line 5 North

Chemical Plant 2 (RCRB Soil Type)



Chemical Plant 2 (Xerorthent Soil Type)

Facility Area Soil Sample Location

Facility Area Soil Vapor Sample Location

Management Area Boundary

Potential Ecological Concern[1, 3]

Facility Area

Removed Structure

Structure

Surface Drainage

Fence

Railroad

Road

Notes:

1) In Administration Area East, Administration Area West (except around the FSTP), and Chemical Plant 2 (except around RCRA-E), sufficient risk is present to warrant action and each area will either be excavated for other purposes or deed restrictions will be put in place to prevent the area from reverting back to ecological habitat.
2) FSTP = Former Sewage Treatment Plant
   RCRA-E = Resource Conservation and Recovery Act
3) Although Areas of Potential Ecological Concern are identical for the RCRB and Xerorthent soil type Plots for Chem Plant 2, this information is provided to document that inorganic concentrations in soil samples were compared with the two different soil-type-specific background screening concentrations for each inorganic COPEC.

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 1-33
Summary of Facility Area Non-VOC and VOC Ecological Risk Characterization

Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012

Notes:

[1]Retained Remedial Areas located under facility buildings were drawn based on krigging and in some cases the data points were outside the building. If the building foundations are removed, these areas will be sampled to confirm the presence of COCs. The inaccessible portion of the retained remedial areas will be tracked through the Superfund process.

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 1-34
Locations Where Hazard Quotient Exceeded 10 for Ecological Risk in Relation to Recommended Remedial Areas
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012

2.0 Identification and Screening of Technologies

This section includes discussions of RAOs, potential ARARs, GRAs that will satisfy the RAOs, and identification and screening of technology types and process options.

2.1 Remedial Action Objectives

The initial step in identifying remedial alternatives in the FS is to formulate RAOs. RAOs are media-specific goals designed to protect human health and the environment. RAOs specify the COCs and media of interest, exposure pathways, and remediation goals that permit a range of alternatives to be developed on the basis of chemical-specific ARARs and site-specific, risk-related factors.

As discussed previously, soil, soil vapor and groundwater media are of concern for the BOU FS. The following preliminary RAOs have been identified by Aerojet for soil, soil vapor, and groundwater:

- Protect human health and the environment from exposure to concentrations of COCs in soil, soil vapor, and groundwater that pose an unacceptable risk.
- Develop land use controls to ensure current and future land uses that:
  - Are acceptable based upon the presence of residual COCs;
  - Do not result in exposure to chemicals at concentrations greater than unacceptable risk levels; and
  - Do not affect the integrity of existing or proposed containment or remediation systems.
- Contain and/or control migration of site-related chemicals from source areas in BOU to minimize future migration of COCs until cleanup is achieved.
- Reduce or contain the chemical mass from BOU soil sources, so as to reduce or eliminate degradation of beneficial uses of groundwater from BOU source areas and to assist site-wide groundwater remedies with restoration of beneficial uses of groundwater.

2.2 Potential Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, 42 U.S.C. Section 9621, states that remedial actions on CERCLA sites must attain (or justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are ARARs. Applicable requirements are those cleanup standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or

other circumstance at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well-suited to the conditions of the particular site.

Pursuant to EPA guidance, ARARs generally are classified into three categories: chemical-specific, location-specific, and action-specific requirements. Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set numerical health- or risk-based concentration limits or discharge limitations for specific hazardous substances. Location-specific ARARs are those requirements that relate to the geographical or physical position of the site, rather than the nature of the COCs or the proposed site remedial actions. Action-specific ARARs are requirements that define acceptable handling, treatment, and disposal procedures for hazardous substances.

A requirement may not meet the definition of an ARAR, but still may be useful in assessing whether to take action at a site or to what degree action is necessary. This can be particularly true when there are no ARARs for a site, action, or chemical. Such requirements are called "to be considered" (TBC) criteria. TBC criteria are nonpromulgated advisories or guidance issued by a federal or state government that are not legally binding, but that may provide useful information or recommended procedures for remedial action. Although TBCs do not have the status of ARARs, they are considered together with ARARs to establish the required level of cleanup for protection of human health or the environment. The critical difference between a TBC and an ARAR is that one is not required to comply with or meet a TBC when deciding on a remedial action. However, should a TBC be established as a cleanup standard in the ROD, then the TBC effectively produces the same results as an ARAR.

A description of specific potential ARARs for soil/soil vapor and groundwater within the BOU are provided on Tables A-1 and A-2, respectively, in Appendix A.

2.3 Identification of General Response Actions, Technologies, and Process Options

In this section, GRAs, technologies, and process options are described and an overview of the process used to identify and screen technologies is provided. The overview is followed by a detailed discussion of the GRAs, and the identification and screening of technology types and possible process options.

2.3.1 General Response Actions

After RAOs are established for a site or OU, media-specific GRAs are developed to satisfy the RAOs for the exposure area. GRAs are media-specific actions that have the ability to meet the RAOs for the exposure area. Once GRAs are determined, a screening of potential technologies and process options can be conducted in the context of the GRAs. Technologies that pass the screening steps and the GRAs will be used to develop a series of remedial alternatives that could be applied to the exposure area to meet the RAOs. The RAOs for the BOU FS were described previously in Section 2.1.

Several GRAs were identified in the *RI/FS Work Plan Source Area Operable Units* (Aerojet et al., 2005), which covers the BOU. These GRAs include:

- ***No Further Action:*** Evaluation of a "no action" alternative, or a no further action alternative if remedial actions have already been implemented, is required under the National Contingency Plan (NCP) (Title 40 Code of Federal Regulations [CFR] 300.430);
- ***Institutional Controls:*** This response action consists of exposure prevention through administrative methods (such as deed restrictions) that prohibit activities that could cause unacceptable risk to human health;
- ***Monitored Natural Attenuation:*** This response action consists of allowing natural processes to reduce chemical concentrations over time (including biodegradation, dispersion, sorption, volatilization, and dilution) and associated monitoring to confirm the processes and to evaluate whether RAOs are being achieved;
- ***Physical Containment:*** This response action consists of reducing the migration and/or availability of the COCs to the extent required to meet RAOs; and
- ***Contaminant Mass Reduction:*** This response action reduces the mass of COCs.

Based on the current understanding of the COCs and environmental conditions associated with the BOU and EPA's presumptive remedies (EPA 1993a, 1993b, 1996, 1999), GRAs that could be implemented to achieve the RAOs for soil and soil vapor are included in Figure 2-1 and for groundwater in Figure 2-2. For soil and soil vapor, the GRAs include the following:

- ***No-Action:*** No attempt is made to satisfy the RAOs and no remedial measures are implemented. No-Action is required for consideration by the NCP as a basis against which the other alternatives are compared.
- ***Institutional Controls:*** Non-engineering methods by which access to COCs in soil is physically or administratively restricted or regulated, and/or monitored.

- ***Operational Controls:*** These controls would include engineered methods such as access restrictions (e.g., fencing) and engineering controls (e.g., modifications to existing building ventilation systems).
- ***Physical Containment:*** Containment is EPA's Presumptive Remedy for low-level threat metals in soils. Technologies would prevent direct contact with COCs in soils, immobilize COCs in-place, limit migration of vapors to the surface, and/or prevent infiltration of surface water.
- ***In Situ Treatment:*** Would involve physical, chemical, biological, and/or thermal methods to induce vapor flow, remove or treat in-place vapor and/or liquid in the vadose zone, or flush COCs from the soil for subsequent treatment.
- ***Contaminant Mass Reduction:*** Physical, chemical, and/or biological methods by which COCs are removed from the soil and treated aboveground or disposed off site.

For groundwater, the GRAs include the following:

- ***No-Action:*** No attempt is made to satisfy the RAOs and no remedial measures are implemented. No-Action is required for consideration by the NCP as a basis against which the other alternatives are compared.
- ***Institutional Controls:*** Non-engineering methods by which access to COCs in groundwater is physically or administratively restricted or regulated, and/or monitored.
- ***Operational Controls:*** Would include methods such as engineering controls (e.g., modifications to existing building ventilation systems).
- ***Monitoring:*** Short- and long-term monitoring of groundwater and soil vapor.
- ***Domestic Wellhead Treatment:*** Users of individual wells are protected as COCs are removed prior to use.
- ***Monitored Natural Attenuation:*** May be implemented in conjunction with other GRAs – COCs are allowed to naturally attenuate via natural subsurface processes.
- ***Technical Impracticability:*** Waiver sought if subsurface or COC-related factors would limit success of remedial technology.
- ***Physical Containment:*** Actions that result in COCs in groundwater being contained, thereby minimizing or eliminating the migration of COCs and preventing exposure to COCs.
- ***In Situ Treatment:*** COCs are treated in situ via physical, chemical, and/or biological processes.
- ***Groundwater Extraction and Treatment:*** Engineered methods whereby groundwater is removed from the subsurface where COCs are removed prior to reuse of the treated water.

2.3.2 Technologies and Process Options

For each GRA, broad technology groups and specific process options that could be used to implement these actions are identified. Technologies refer to general categories (e.g., chemical treatment or biological treatment). Process options refer to the specific processes within each technology type (EPA, 1988). As discussed in Section 3, the No-Action GRA is included to provide a reference with which to compare the other alternatives that are developed.

Evaluation of potentially applicable technology types and process options is a key step in the FS process. The criteria for identifying potentially applicable technologies are provided in EPA guidance (EPA, 1988) and in the NCP (EPA, 1990b). A strong statutory preference for remedies that are reliable and provide long-term protection is identified in Section 121 of CERCLA, as amended. The primary requirements for a final remedy are that it be both protective of human health and the environment and cost effective. Hence, candidate technologies and process options need to be capable of satisfying these key factors. Summaries of potentially applicable remedial technology types and process options for soil and groundwater media are illustrated in Figures 2-1 and 2-2, respectively.

2.4 Technical Implementability Screening of Remediation Technologies and Process Options

The universe of potentially applicable technology types and process options applicable to each identified GRA are initially reduced by evaluating the options with respect to technical implementability. EPA presumptive remedy guidance documents (EPA, 1993a, 1993b, 1996, 1999) were used where appropriate to identify technologies and process options.

In accordance with EPA guidance (EPA, 1988), technologies and process options for the soil response actions were identified and screened for technical implementability. Screening results are summarized in Figure 2-1. Results of the technical implementability screening of the technologies and process options for the groundwater GRAs are included in Figure 2-2.

Process options for soil remediation that were not retained as a result of the technical implementability screening (Figure 2-1) include the following:

- Those that could open new pathways for the unwanted spread of COCs (pneumatic fracturing); are not yet sufficiently demonstrated (enhanced in situ bioremediation);
- Those where organics that are amenable to the technology are not contributing to the unacceptable risk (coupled infiltration/shallow groundwater extraction and treatment, and deep vadose zone in situ treatment);
- Those that are not applicable to the nature and extent of COCs in the BOU (in situ thermal technologies of electrical resistance heating, radio frequency/electromagnetic heating, and hot air/steam injection);

- Those that require a large soil volume or COC concentrations to justify the capital cost (on-site landfill and off-site incineration); or
- Those that are only applicable to "principal threat metals."

Process options for groundwater remediation that were not retained as a result of the technical implementability screening (Figure 2-2) include the following:

- Those that are not applicable to BOU (i.e., domestic wellhead treatment);
- Those applicable to remediating dense nonaqueous phase liquid (DNAPLs) (i.e., TI waiver, Containment Zone, DNAPL source depletion monitoring, and DNAPL remediation technologies) since DNAPLs were not encountered in the RI;
- Those that are difficult to install in dredge tailings or to sufficient depth (e.g., vertical barriers and interceptor trenches);
- Those not applicable to the COCs identified in the RI (e.g., electrochemical processes, aeration of metals, chemical precipitation, ex situ aerobic or anaerobic bioreactors); and
- Deep well injection because of the difficulty of obtaining regulatory agency acceptance and the permeability of underlying deep aquifers is not sufficient.

2.5 Evaluation of Retained Process Options

Technologies and process options considered to be technically implementable are evaluated in greater detail on the basis of effectiveness, implementability (both technical and administrative), and relative cost, as defined by the following factors:

- ***Effectiveness*** - In terms of protecting human health and the environment in both the short term and long term;
- ***Implementability*** - In terms of technical feasibility, resource availability, and administrative feasibility; and
- ***Cost*** - In a comparative manner (i.e., low, moderate, or high) for technologies of similar performance and/or implementability.

These evaluation criteria are applied only to the GRAs and technologies being evaluated for the BOU and not to possible combinations of these technologies and process options that might be combined to form remedial alternatives.

Technologies and process options that are not effective in protecting human health and the environment, that cannot be implemented because of the physical characteristics of the site or COCs, or that have a cost that is an order of magnitude greater than a similar technology are eliminated during this phase of the screening. In accordance with EPA guidance (1988),

effectiveness is the major emphasis of this screening evaluation. Less weight is given to cost and implementability. The technologies and process options that are retained after the effectiveness, implementability, and cost screenings are assembled into a range of remedial alternatives in Section 3.

The evaluations of soil/soil vapor and groundwater remediation process options for effectiveness, implementability, and cost are presented in Figures 2-3 and 2-4. In accordance with EPA guidance (1988), representative process options are selected to simplify the development and evaluation of alternatives. However, the specific process option used to implement a remedial action may not be selected until the remedial design phase. Selection of a representative process option does not preclude the application of other retained process options at the site.

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
No Action	None	None	No action taken.	Potentially applicable. Baseline for comparison.
Institutional Controls	Governmental Controls	Ordinances	Law enacted by a municipal body (e.g. City Council or County Commission) governing matters such as zoning, safety and building regulations that are not already covered by State or federal laws.	Potentially applicable. Aerojet property is designated as a "Special Planning Area" (SPA) by Sacramento County Ordinance, Title V, Chapter 8, Article 3. Ordinance identifies existing permitted uses and "provides a regulatory mechanism for making land use decisions that maintain a safe environment in which the property can be used given the special requirements of the property owner."
		Zoning Restrictions/ Overlay Districts	Zoning restrictions/overlay districts on allowable uses and restricting residential uses to areas meeting standards for unrestricted use.	Potentially applicable.
		Land Use Restrictions	Building permit notifications/restrictions identifying potential for contamination, existence of restrictions on groundwater and land uses, and requiring evaluation of suitability of particular parcels for proposed structures/uses.	Potentially applicable. General Land Use Plan for City of Rancho Cordova recognizes Aerojet SPA for portion of Aerojet property within municipal boundaries of Rancho Cordova.
	Proprietary Controls	Environmental Covenant	Environmental covenant restricting land uses to prevent residential uses in areas with chemical concentrations above risk-based levels for unrestricted use; prevent commercial/industrial uses in areas with chemical concentrations above risk-based levels for commercial/industrial uses; and/or require notification of intent to perform any subsurface excavation and requiring evaluation of appropriate health and safety and materials management requirements.	Potentially applicable. "Declaration of Covenants and Environmental Restrictions" dated 6/19/01 for the Carve Out Areas executed by and among Aerojet, RWQCB and USEPA includes various restrictions on groundwater use including restrictions on drilling or use of wells for purposes of extracting water, installation or operation of recharge basins or injection wells or sustained construction dewatering. Portions of the Carve-Out Property are subject to more restrictive covenants restricting land use.
		Environmental Easement	Providing an easement to EPA, RWQCB and/or Sacramento County over areas subject to restricted uses in order to insure adherence to covenants and governmental controls.	Potentially applicable.
	Enforcement and Permit Tools	AOCs and/or CDs	Can be developed under Sections 104 and 106(a) of CERCLA, Unilateral Administrative Orders (UAOs), Administrative Orders on Consent (AOCs), and Consent Decrees (CDs). Tools issued or negotiated to compel a landowner to limit certain site activities. Only bind parties named in enforcement document; therefore will require parties to implement Institutional Controls that apply to the property itself in order to bind subsequent land owners. Will require adoption of an institutional controls implementation and management plan and monitoring and reporting of current and proposed land uses relative to land use restrictions.	Potentially applicable. Aerojet subject to partial Consent Decree (PCD) which identifies areas subject to excavation restrictions and other environmental restrictions. Aerojet SEOP for Soil Excavation and Grading Requirements defines requirements for approval of soil excavations and surface grading at Sacramento Site as a whole and identifies specific requirements/permits necessary to conduct excavation or grading in restricted areas identified in the PCD.
	Informational Devices	Deed notices	Deed notice identifying presence of residual or capped contamination, land use restrictions and/or requirements for land use.	Potentially applicable.
		Registries of contaminated properties	Entry on the registries of hazardous waste sites.	Potentially applicable. Site listed in Geo-Tracker database GIS of environmental data and DTSC EnviroStor Data Management System/GIS registry of hazardous waste sites/sites that have known CoPC's.
		Advisories	County advisory identifying presence of contamination, land use restrictions and requirements for land use. Listing on excavation notification services - would notify contractors of potential for soil or groundwater CoPCs at property and notify landowner of potential excavation activities.	Potentially applicable. Presence of CoPCs and restrictions on land/groundwater uses at Aerojet Site are identified in Sacramento County and local municipality planning documents including Cordova Community Plan, Easton Place Land Use Master Plan, and Sacramento County Water Agency Groundwater Management Plan.

MATCH A

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

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Environmental Remediation

FIGURE 2-1
Technical Implementability Screening of Soil Remediation Technologies and Process Options

SR10131886 BOU FIGURE 2-1 p. 1 2/22/12 FENNESSY, CHRISTOPHER 7:15:46 AM AEROJET SUPERFUND SITE, SACRAMENTO COUNTY, CA

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
	MATCH A			
	Monitoring and Reporting	Monitoring of land uses	Monitoring by Aerojet of land uses and documentation of acceptability of land uses in areas of remaining contamination. Could include (1) visual and/or aerial photograph inspection of existing land uses, (2) monitoring by County/Cities/Aerojet of building rezoning and subdivision and platting applications, hearings, hearings and decisions; and grading/building permit applications and issuances, and (3) participation by Aerojet in County/Cities long-range land-use planning activities involving BOU properties to insure that the CoPC issues and land use restrictions are identified and considered in Plans.	Potentially applicable.
		Indoor air sampling	Indoor air sampling to document absence of vapor intrusion and/or levels of contaminants in indoor air that do not pose an unacceptable risk.	Potentially applicable.
		Soil Vapor/soil monitoring	Monitoring to provide data to demonstrate decline of chemical concentrations in soil vapor/soil and lack of migration from BOU specific sources.	Potentially applicable.
Operational Controls	Access Restrictions	Fencing	Secure fencing system such as chain-link fencing constructed around a property or area to limit access.	Potentially applicable. Perimeter fence already in place. Additional interior fencing could be installed to further limit access.
	Engineering Controls	Building ventilation	Modification and monitoring of existing building heating, ventilation, and air conditioning (HVAC) systems to insure sufficient air exchange rates to limit vapor intrusion and indoor air exposures to safe levels based on the latest modified EPA version of the Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings calculations.	Potentially applicable.
Physical Containment	Horizontal Barriers	Capping/cover systems	Containment is EPA Presumptive Remedy for low-level threat metals in soil sites. Capping can limit contaminant mobility and mitigate potential migration via air, surface water and groundwater by attenuating vapor migration and controlling stormwater run-on and runoff and precipitation-enhanced percolation that may carry contaminants into groundwater. Caps/covers can range from a one-layer system of vegetated soil or concrete/asphalt to a complex multi-layer system of soils and geosynthetics. Materials used in the construction of multi-layer caps include low-permeability and high-permeability soils and low-permeability geosynthetic products. Low-permeability materials divert water and prevent its passage into waste (barrier layer) while high permeability materials (drainage layer) carry water away that percolates into the cap. Other materials may be used to increase slope stability.	Potentially applicable. Caps are most effective where most of the underlying waste is above the water table. Vegetation, which has a tendency for deep root penetration, must be eliminated from the cap area. Precautions must be taken to assure that the integrity of the cap is not compromised by land use activities. Prevents direct contact with chemicals in soil and limits migration of chemical vapors to the surface and infiltration of surface water and formation of leachate.
		Vapor barriers	HDPE lining material or spray-applied liquid (e.g., Liquid Boot® and Geo-Seal™) membranes are installed as gas vapor barriers underneath houses, buildings, parking lots, and other structures. May be used in conjunction with building ventilation, soil vapor extraction, and sub-slab depressurization systems.	Potentially applicable. Would prevent vapor intrusion into buildings.
	MATCH B			

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-1

Technical Implementability Screening of Soil Remediation Technologies and Process Options

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
	MATCH B			
	Immobilization	In-situ solidification/ stabilization	Solidification/stabilization (S/S) reduces the mobility of heavy metal and high molecular weight organic compound CoPCs through both physical and chemical means by binding them in-place in an insoluble matrix within their "host" medium (e.g., soil) instead of removing them through chemical or physical treatment. CoPCs are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization). Auger/caisson systems and injector head systems are techniques used to apply S/S agents in-situ. S/S processes include bituminization, emulsified asphalt, modified sulfur cement, polyethylene extrusion, pozzolan/Portland cement, catalyzed polymerization, sludge stabilization, soluble phosphates, and vitrification.	Potentially applicable. Implementation of S/S is highly dependent on the physical properties of the soil. Leachability testing is typically performed to measure the immobilization of contaminants. Depth of contaminants may limit some types of application processes. Reagent delivery and effective mixing may be difficult. The solidified material may hinder future site use. Processing of contamination below the water table may require dewatering.
		Soil vapor extraction (SVE)	EPA Presumptive Remedy for VOC's in soil. Vacuum is applied to soil using vertical extraction wells or horizontal vents (installed in trenches or horizontal borings) to create a pressure/concentration gradient to induce the controlled flow of air and remove volatile and some semivolatile contaminants from impacted soil. Offgas may have to be treated to recover or destroy the contaminants. Geomembrane covers can be placed over the soil surface to prevent short circuiting and to increase the radius of influence of the wells. Air sparging (AS) coupled with SVE can be effective for facilitating extraction of contamination in low permeability soils and the saturated zone. With AS, injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes contaminants by volatilization. The injected air helps to flush the contaminants up into the unsaturated zone where they are recovered via SVE.	Potentially applicable. Heterogeneous air flow yields low efficiency for AS. Effective in remediating site contaminants and has been proven during Interim Remedial Actions. Because of heterogeneity of soil conditions in the various Management Areas, pilot testing will be necessary in certain areas to assess radius of influence (ROI) and vapor flow rate. If VOCs are located beneath structures or buildings, installation of horizontal wells may be difficult to implement because of foundations; therefore vertical wells and associated piping may have to be constructed inside the building or structure/building removed to effectively remediate where vapor intrusion into buildings is resulting from volatilization of CoPCs from groundwater.
In-Situ Treatment	Physical	Sub-slab depressurization	An SVE system is used to remove VOC vapors from the vadose zone beneath building slabs or foundations.	Potentially applicable.
		Dual-phase extraction	Dual-phase extraction (DPE) uses a high vacuum system to remove liquid and gas from low permeability or heterogeneous formations. Vacuum extraction wells include a screened section in the zone of contaminated soils and groundwater, removing contaminants from above and below the water table. DPE lowers the water table around the well, exposing more of the formation. Contaminants in the newly exposed vadose zone are then accessible to SVE. Once above ground, the extracted vapors or liquid-phase organics and groundwater are separated and treated.	Potentially applicable; however DPE is designed for relatively low permeability systems, otherwise it is not possible to sustain a high vacuum. Less effective for perchlorate, 1,4-dioxane, and NDMA as they would only be removed in the dissolved phase and not the vapor phase.
	MATCH C	MATCH C		

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-1

Technical Implementability Screening of Soil Remediation Technologies and Process Options

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
MATCH C		MATCH C		
In-Situ Treatment	Chemical	Fracturing	Pneumatic fracturing (PF), blast-enhanced fracturing, and the Lasagna™ process are enhancement technologies designed to increase the efficiency of other in-situ technologies in difficult soil conditions. Fracturing extends and enlarges existing fissures and introduces new fractures, primarily in the horizontal direction. When fracturing has been completed, the formation is then subjected to SVE. In the PF process, fracture wells are drilled in the vadose zone and left uncased for most of their depth. A packer system is used to isolate small 2-foot intervals so that short bursts (~20 sec) of less than 200 psi compressed air can be injected into the interval to fracture the formation. The process is repeated for each interval within the contaminated depth. Blast-enhanced fracturing uses detonation of explosives in boreholes in fractured bedrock formations to increase well yields, hydraulic conductivity values, and capture zones. Lasagna™ combines electroosmosis with hydraulic fracturing to create sorption/degradation zones horizontally in the subsurface soil.	Not retained. Fractures will close in non-clayey soils. Investigation of possible underground utilities, structures, or trapped free product is required. The potential exists to open new pathways for the unwanted spread of contaminants (e.g., DNAPLs).
		Chemical oxidation	In-situ chemical oxidation (ISCO) involves injecting chemical oxidants into the vadose zone and/or groundwater to oxidize organic contaminants. Common oxidants are hydrogen peroxide-based Fenton's reagent, potassium permanganate (KMnO4), sodium permanganate, and sodium persulfate (for 1,4-dioxane). Ozone can also oxidize organic contaminants in-situ, but it has been used less frequently. Complete mineralization to carbon dioxide and water is the desired endpoint of an ISCO process.	Potentially applicable. Matching the oxidant and in situ delivery system to the contaminants and the site conditions is critical to successful implementation and achieving performance goals. Can be large oxidant demand for native organic matter in the formation. ISCO requires strict health and safety procedures for high-pressure injection.
		Soil flushing	In-situ soil flushing is the extraction of contaminants from soil with water or other reagent (surfactant or co-solvent) solutions that have properties specific to the contaminant(s) of concern and the geosystem under consideration. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from the underlying aquifer, treated above ground, and when possible, recycled.	Potentially applicable. Works best and is most cost-effective in soils having moderate to high permeability. Heterogeneous geosystems having significant permeability contrasts may impede injected solutions from significantly contacting contaminants present in lower permeability zones. Injected chemical solutions and mobilized contaminant must be recovered and not allowed to migrate vertically or horizontally. Selection of a surfactant/co-solvent solution requires significant laboratory batch and column studies and field trials.
	Biological	Enhanced in-situ bioremediation	Enhanced bioremediation is a process in which indigenous or inoculated micro-organisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or groundwater, converting them to innocuous end products. Nutrients, oxygen, or other amendments may be used to enhance bioremediation and contaminant desorption from subsurface materials. Enhanced in-situ bioremediation of soil typically involves the percolation or injection of groundwater or uncontaminated water mixed with nutrients and saturated with dissolved oxygen. Sometimes acclimated microorganisms (bioaugmentation) and/or another oxygen source such as hydrogen peroxide are also added. An infiltration gallery or spray irrigation is typically used for shallow soils, and injection wells are used for deeper soils. Under aerobic conditions, oxygen (electron acceptor) and nutrients are added while under anaerobic conditions an electron donor and/or anaerobic electron acceptor with nutrients are added.	Not retained. Not yet sufficiently demonstrated for unsaturated zone soil.
MATCH D		MATCH D		

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-1

Technical Implementability Screening of Soil Remediation Technologies and Process Options

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
MATCH D	MATCH D			
In-Situ Treatment	Biological	Coupled infiltration/shallow groundwater extraction and treatment	Infiltration is accelerated by applying water (and possibly electron donor) to soil surface such that the infiltrating water is captured by shallow groundwater extraction wells and treated biologically either in-situ with radial biobarrier or ex-situ in recharge wells or infiltration trenches. Applicable where groundwater is present at shallow depths. A field trial is in progress.	Not retained as organics amenable to this technology are not contributing to unacceptable risk.
		Deep vadose zone in-situ treatment	Water and electron donor are added to deep vadose zone through injection wells to flush/treat residual contaminants. Can be coupled with groundwater extraction and treatment as a discharge point. Difficult to control with thick vadose zone and heterogeneous soils.	Not retained as organics in deep vadose zone are not contributing to unacceptable risk.
	Thermal	Electrical resistance heating	Uses an electrical current to heat less permeable soils such as clays and fine-grained sediments so that water and contaminants trapped in these relatively conductive regions are vaporized and ready for vacuum extraction. Electrodes are placed directly into the tight soil matrix so that electrical current passes through the soil, creating a resistance that then heats the soil. The heat dries out the soil causing it to fracture. Fractures make the soil more permeable allowing the use of SVE to remove the contaminants. The heat created by electrical resistance heating also forces trapped liquids to vaporize and move to the steam zone for removal by SVE. Six-phase soil heating (SPSH) is a typical electrical resistance heating which uses low-frequency electricity delivered to six electrodes in a circular array to heat soils. With SPSH, the temperature of the soil and contaminant is increased, thereby increasing the vapor pressure and removal rate of the contaminant. SPSH also creates an in situ source of steam to strip contaminants from soil.	Not retained. Debris or other large objects buried in the media can cause operating difficulties. Soil with highly variable permeabilities may result in uneven delivery of gas flow to the contaminated regions. Soil that has a high organic content has a high sorption capacity of VOCs, which results in reduced removal rates. Performance in extracting certain contaminants varies depending upon the maximum temperature achieved in the process selected. Soil that is tight or has high moisture content has a reduced permeability to air, hindering the operation of thermally enhanced SVE and requiring more energy input to increase vacuum and temperature. Thermally enhanced SVE is not effective in the saturated zone; however, lowering the aquifer can expose more media to SVE.
		Radio frequency/ electro magnetic heating	Radio frequency heating (RFH) uses electromagnetic energy to heat soil to over 300 °C and enhance SVE by heating a discrete volume using rows of vertical electrodes embedded in the soil. Heated soil volumes are bounded by two rows of ground electrodes with energy applied to a third row midway between the ground rows. The three rows act as a buried triplate capacitor. When energy is applied to the electrode array, heating begins at the top center and proceeds vertically downward and laterally outward through the soil volume. RFH enhances SVE in four ways: (1) contaminant vapor pressure and diffusivity are increased by heating, (2) soil permeability is increased by drying, (3) increasing the volatility of the contaminant from in situ steam stripping by the water vapor; and, (4) a decrease in the viscosity which improves mobility. RFH is self limiting; as the soil heats and dries, current will stop flowing.	Not retained. See above.
	MATCH E			

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-1
Technical Implementability Screening of Soil Remediation Technologies and Process Options

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
		MATCH E		
		Hot air/steam injection	Hot air or steam is injected below the contaminated zone, heating up the soil and enhancing the release of contaminants from the soil matrix. VOCs and SVOCs are stripped from the contaminated zone and brought to the surface using SVE.	Not retained. See above. Also, hot air injection has limitations due to low heat capacity of air.
Contaminant Mass Reduction	Physical	Excavation/On-site landfill	A RCRA-permitted cell is constructed on-site and filled with excavated contaminated soil from one or more locations on site. Excavation must be backfilled with clean soil.	Not retained. Insufficient volume of soil in BOU to justify cost of construction and operation/maintenance of on-site landfill. On-site cell must be closed and maintained.
		Excavation/Off-site disposal	Contaminated material is excavated/removed and transported to and incorporated into an existing RCRA permitted Class I or Class II commercial off-site treatment and/or disposal facility. Excavation must be backfilled with clean soil.	Potentially applicable. Constraints include issues such as transportation routes and risks, costs for off-site disposal and regulator/community acceptance. Removes contaminant source and eliminates need for further in situ remedies.
		Excavation/Above-ground SVE	Excavated soils are placed in piles or cells on a lined treatment area that includes a leachate collection system. Piping is placed within the soil as the piles or cells are constructed such that vapor can be withdrawn from the soil via vacuum. Piles are typically covered with a geomembrane to control runoff, evaporation, and volatilization and promote solar heating. Vapor leaving the soil is treated to remove or destroy VOCs before they are discharged to the atmosphere. Boidegradation can be promoted by controlling moisture, heat, nutrients, oxygen, and pH. Treated soil is backfilled into excavation.	Potentially applicable. Amendments may need to be mixed with tight soil to promote vapor flow. This static treatment process may result in less uniform treatment than processes that involve periodic mixing.
		Reclamation/Recovery	Excavated soil undergoes physical separation, soil washing, leaching and/or hydrometallurgical processes separation processes for removing contaminated concentrates from soils, leaving relatively uncontaminated fractions that can then be regarded as treated soil. Presumptive remedy for principal threat metals in soils, when feasible, permanent treatment that separates metal contaminants from soil in the form of metal, metal oxide, or other useful products having potential market value. Usually preceded by physical separation and concentration. Remaining soil is backfilled into excavation.	Not retained, since technology is applicable to "principle threat metals", i.e., higher concentration metals in soil, or lower concentrations of volatile metals (e.g., mercury) or economical metals (e.g., gold). Principal threat metals in soil do not exist in BOU.
	Chemical	Low temperature thermal desorption (LTTD)	EPA Presumptive Remedy for VOCs in soil. Low temperature thermal desorption (LTTD) is a physical separation process, not designed to destroy organics. Excavated soil is heated to between 200 to 600 °F to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to a gas treatment system. Bed temperatures and residence times designed into LTTD systems volatilize selected contaminants but will typically not oxidize them. Common designs are the thermal screw and rotary dryer, that can be indirect- or direct-fired. If LTTD is conducted on-site, treated soil is backfilled into excavation.	Potentially applicable. There are specific particle size and materials handling requirements that can impact applicability or cost at specific sites. Dewatering may be necessary to achieve acceptable soil moisture content levels. Heavy metals in the feed may produce a treated solid residue that requires stabilization. Clay and silty soils and high humic content soils increase reaction time as a result of binding of contaminants.
	MATCH F	MATCH F		

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-1

Technical Implementability Screening of Soil Remediation Technologies and Process Options

SOIL GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
MATCH F	MATCH F			
Contaminant Mass Reduction	Chemical	Solidification/Stabilization	Presumptive remedy for principal threat metals in soils. Includes processes that change the physical or chemical properties that impact leaching characteristics of a treated waste or reduce its bioavailability and concentration. Usually involves mixing excavated soil with reagent (e.g., cement kiln dust, fly ash, blast furnace slag) in a reactor vessel such as a pug mill blender and solidifying the material within the contaminated soils. Solidified/stabilized soil can be backfilled into excavation or transported offsite for disposal.	Not retained, since technology is applicable to “principle threat metals”, which do not exist in BOU. The presence of organics or other compounds may interfere with process (e.g., bonding). Treatability testing needed.
		Excavation/Incineration offsite	Soils containing organic contaminants would be excavated and transported to an offsite incinerator where high temperatures (1,400 to 2,200 °F) are used to volatilize and combust (in the presence of oxygen) halogenated and other refractory organics. Incineration is an EPA Presumptive Remedy for VOCs in soil. Designs include rotary kiln, fluidized bed, infared combustion, and circulating bed combustor. The destruction and removal efficiency (DRE) for properly operated incinerators exceeds the 99.99% requirement for hazardous waste and can be operated to meet the 99.9999% requirement for PCBs and dioxins. Off gases and combustion residuals generally require treatment. There are specific feed size and materials handling requirements that can impact applicability or cost at specific sites. Excavation must be backfilled with clean soil.	Not retained. Concentration of contaminants in BOU soil do not warrant need for incineration. There are specific feed size and materials handling requirements that can impact applicability or cost at specific facilities.
	Biological	Excavation/Composting or Biological Treatment	Soils would be excavated and placed adjacent to the excavation or transported a short distance. Composting: Aerated static pile (compost is formed into piles and aerated with blowers or vacuum pumps), mechanically agitated in-vessel (compost is placed in a reactor vessel where it is mixed and aerated), and windrow (compost is placed in long piles and periodically mixed with mobile equipment) composting are controlled biological processes by which organic contaminants are converted by microorganisms (under aerobic and anaerobic thermophilic conditions) to innocuous, stabilized byproducts. Soils are excavated and mixed with bulking agents and organic amendments, such as wood chips, animal, and vegetative wastes, to enhance the porosity of the mixture to be decomposed. Aboveground biological reduction: A drip irrigation system is placed over the excavated soil pile to introduce water and electron donor and the pile is covered with a polyethylene liner material or excavated soil is mixed with water and electron donor and placed in above ground cells constructed of polyethylene liner material and allowed to react for a period of time. Treated soil is backfilled into excavation.	Potentially applicable for perchlorate. Aerojet has had success in reducing perchlorate in surface soil (less than 2 ft thick) and excavated soil through use of indigenous bacteria present in the soil, an electron donor such as cow manure and moisture as amendments in a composting configuration. Not retained for metals, as metals are not treated by this method. Not retained for halogenated compounds because of limited effectiveness. Composting results in a volumetric increase in material because of the addition of amendment material. Substantial space may be required for composting.

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-1

Technical Implementability Screening of Soil Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
No Further Action	None	None	No further action taken. Operation of existing Interim Actions would continue.	Potentially applicable.
Institutional Controls	Governmental Controls	Ordinances	Law enacted by a municipal body (e.g. City Council or County Commission) governing matters such as zoning, safety and building regulations that are not already covered by State or federal laws. Water or well use restrictions such as the Sacramento County limitation on the drilling of new wells and use of groundwater, and the California Dept of Health Services (DHS) program of monitoring and oversight of public water systems.	Potentially applicable. Aerojet property is designated as a "Special Planning Area" (SPA) by Sacramento County Ordinance, Title V, Chapter 8, Article 3. Ordinance identifies existing permitted uses and "provides a regulatory mechanism for making land use decisions that maintain a safe environment in which the subject property can be used given the special requirements of the property owner." County adopted Consultation Zones policy requiring special review by regulatory agencies for well permits located within 2,000 feet of a known contaminant plume.
		Zoning Restrictions/ Overlay Districts	Zoning restrictions/overlay districts on allowable uses and restricting residential uses to areas meeting standards for unrestricted use.	Potentially applicable.
		Land Use Restrictions	Building permit notifications/restrictions identifying potential for contamination, existence of restrictions on groundwater and land uses, and requiring evaluation of suitability of particular parcels for proposed structures/uses.	Potentially applicable. General Land Use Plan for City of Rancho Cordova recognizes Aerojet SPA for portion of Aerojet property within municipal boundaries of Rancho Cordova.
	Proprietary Controls	Environmental Covenant	Environmental covenant restricting land uses to prevent residential uses in areas with chemical concentrations above risk-based levels for unrestricted use; prevent commercial/industrial uses in areas with chemical concentrations above risk-based levels for commercial/industrial uses; and/or require notification of intent to perform any subsurface excavation and requiring evaluation of appropriate health and safety and materials management requirements.	Potentially applicable. "Declaration of Covenants and Environmental Restrictions" dated 6/19/01 for the Carve Out Areas executed by and among Aerojet, RWQCB and USEPA includes various restrictions on groundwater use including restrictions on drilling or use of wells for purposes of extracting water, installation or operation of recharge basins or injection wells or sustained construction dewatering. Portions of the Carve-Out Property are subject to more restrictive covenants restricting land use.
		Environmental Easement	Providing an easement to EPA, RWQCB and/or Sacramento County over areas subject to restricted uses in order to insure adherence to covenants and governmental controls.	Potentially applicable. "Declaration of Covenants and Environmental Restrictions" provides access necessary for oversight of implementation of groundwater remediation.
	Enforcement and Permit Tools	AOCs and/or CDs	Can be developed under Sections 104 and 106(a) of CERCLA, Unilateral Administrative Orders (UAOs), Administrative Orders on Consent (AOCs), and Consent Decrees (CDs). Tools issued or negotiated to compel a landowner to limit certain site activities. Only bind parties named in enforcement document; therefore will require parties to implement Institutional Controls that apply to the property itself in order to bind subsequent land owners. Will require adoption of an institutional controls implementation and management plan and monitoring and reporting of current and proposed land uses relative to land use restrictions.	Potentially applicable. Aerojet subject to Partial Consent Decree (PCD) which identifies ares subject to excavation restrictions and other environmental restrictions. Aerojet SEOP for Soil Excavation and Grading Requirements defines requirements for approval of soil excavations and surface grading at Sacramento Site as a whole and identifies specific requirements/permits necessary to conduct excavation or grading in restricted areas identified in the PCD.
	Informational Devices	Deed notices	Deed notice identifying presence of residual or capped contamination, land use restrictions and/or requirements for land use.	Potentially applicable.

MATCH A

MATCH A

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
	MATCH A	MATCH A		
	Informational Devices	Registries of contaminated properties	Entry on the registries of hazardous waste sites.	Potentially applicable. Site listed in Geo-Tracker database GIS of environmental data and DTSC EnviroStor Data Management System/GIS registry of hazardous waste sites/sites that have known CoPCs.
		Advisories	County advisory identifying presence of contamination, land use restrictions and requirements for land use. Listing on excavation notification services - would notify contractors of potential for soil or groundwater CoPCs at property and notify landowner of potential excavation activities.	Potentially applicable. Presence of CoPCs and restrictions on land/groundwater uses at Aerojet Site are identified in Sacramento County and local municipality planning documents including Cordova Community Plan, Easton Place Land Use Master Plan, and Sacramento County Water Agency Groundwater Management Plan.
	Monitoring and Reporting	Monitoring of land uses	Monitoring by Aerojet of land uses and documentation of acceptability of land uses in areas of remaining contamination. Could include (1) visual and/or aerial photograph inspection of existing land uses, (2) monitoring by County/Cities/Aerojet of building rezoning and subdivision and platting applications, hearings and decisions; and grading/building permit applications and issuances, and (3) participation by Aerojet in County/Cities long-range planning activities involving BOU properties to insure that the CoPC issues and land use restrictions are identified and considered in Plans.	Potentially applicable.
		Indoor air sampling	Indoor air sampling to document absence of vapor intrusion and/or levels of contaminants in indoor air that do not pose an unacceptable risk.	Potentially applicable.
		Groundwater monitoring	Groundwater monitoring to provide data to demonstrate continued decline of chemical concentrations in groundwater and lack of migration from BOU specific sources.	Potentially applicable. Sampling/analysis of groundwater monitoring wells, extraction wells, and GET facility flow steams is on-going in accordance with requirements of Sampling Plans for OU-3, Exhibits IV and VI to the PCD, American River Study Area, and the NPDES discharge permit for the GET facilities.
Operational Controls	Engineering Controls	Building Ventilation	Modification and monitoring of existing building heating, ventilation, and air conditioning (HVAC) systems to insure sufficient air exchange rates to limit vapor intrusion and indoor air exposures to safe levels based on the latest modified EPA version of the Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings calculations.	Potentially applicable where vapor intrusion into buildings is resulting from volatilization of CoPCs from groundwater.
		Wellfield Management	Controlling pumping of existing irrigation, water supply, and/or groundwater remediation extraction wells to influence plume migration.	Potentially applicable. See "Groundwater Extraction" remedial technology type in this Figure. Existing groundwater extraction wells associated with the various Aerojet GET systems have established hydraulic barriers that prevent contaminant migration.
Monitoring	Monitoring	Groundwater monitoring	Short- and long-term monitoring of groundwater to evaluate contaminant levels, migration, and attenuation.	Potentially applicable.
		Soil vapor monitoring	Soil gas measurements are used to assess VOC off-gassing from groundwater surface or in vadose zone underneath foundations.	Potentially applicable to address VOC migration from groundwater.
Domestic Wellhead Treatment	Wellhead Treatment	Home carbon treatment unit	Placement of treatment processes such as granular activated carbon or individual wells to remove contaminants.	Not retained. Not applicable to BOU.

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
Monitored Natural Attenuation	Natural Attenuation	Groundwater monitoring	Contaminants are allowed to naturally attenuate via natural subsurface processes such as volatilization, chemical reactions with subsurface materials, biodegradation, dispersion, dilution and adsorption. Long-term monitoring is necessary to evaluate changes in concentration and plume size. Contingent action may be required.	Potentially applicable. May be implemented in conjunction with other actions (e.g., onsite containment).
Technical Impracticability	None	Technical Impracticability (TI) Waiver	A waiver is sought if restoration of groundwater to ARARs in a reasonable timeframe is technically impracticable because hydrogeologic limitations and/or contaminant-related factors (such as DNAPLs) limit the success of containment or in-situ treatment of groundwater. Groundwater monitoring is required.	Potentially applicable. An alternative remedial strategy will be required to be implemented if conditions of protectiveness are not being met.
		Containment Zone	Under California State Water Resources Control Board Resolution No. 92-49, a containment zone (CZ) is a specific portion of an aquifer where the RWQCB finds it is unreasonable to remediate groundwater to the level that achieves water quality objectives within a reasonable period based on technical and economic feasibility. Migration of contaminants beyond the boundaries of the CZ in concentrations which exceed water quality objectives must be prevented. A monitoring program must verify containment. Sites where DNAPLS or complex geology (heterogeneity or fractures) indicate that cleanup to water quality objectives cannot reasonably be achieved are examples where the CZ designation may apply.	Potentially applicable.
Physical Containment	Horizontal Barriers	Capping/vapor barriers	A variety of cap or cover systems can be used to mitigate vapor migration into buildings due to volatilization from ground water and to limit infiltration of water that may carry contaminants into groundwater. The design of the cap or cover would depend on the concentrations of contaminants, climate, and geotechnical conditions at the specific site.	Potentially applicable.
	Vertical Barriers	Soil bentonite slurry wall	Mixture of soil and bentonite is used to construct a low conductivity wall that is typically keyed-into bedrock or an impermeable hydrostratigraphic layer. Wall is normally installed by introducing bentonite slurry into a trench as the trench is excavated to hydraulically shore the trench to prevent collapse. Soil from the excavation is mixed above ground with bentonite and the mixture is placed back into the trench, displacing the slurry.	Not retained. Difficult to install under some dredge tailings conditions at Aerojet and to sufficient depth. Not feasible in many areas because of depth to groundwater, vertical depth of contaminants, difficulty of constructing a long trench, and bedrock layer to key into is significantly below contaminated layer.
		Sheet pile wall	Sheet piling barriers are constructed by driving individual sections of interlocking steel sheets into the ground using impact or vibratory hammers to form an impermeable barrier. Joints between individual sheet piles can be filled with grout to provide a better seal.	Not retained. Difficult to install under some dredge tailings conditions at Aerojet and to sufficient depth. Not feasible in many areas because of depth to groundwater, vertical depth of contaminants, difficulty of constructing a long trench, and bedrock layer to key into is significantly below contaminated layer.
		HDPE wall	Either bentonite or biopolymer slurry is pumped into a trench as the trench is excavated to hydraulically shore the trench to prevent collapse. Interlocking panels of high density polyethylene (HDPE) are lowered into the slurry-filled trench. After the panels have been installed, the trench is backfilled with the excavated soil and the slurry displaced.	Not retained. Difficult to install under some dredge tailings conditions at Aerojet and to sufficient depth. Not feasible in many areas because of depth to groundwater, vertical depth of contaminants, difficulty of constructing a long trench, and bedrock layer to key into is significantly below contaminated layer.

MATCH B

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
		MATCH B		
		Grout Curtain	Grout is injected into the natural formation in-situ to fill interstitial void spaces and significantly reduce the hydraulic conductivity of the soil, forming a vertical barrier to groundwater flow.	Not retained. Only applicable to low permeable zones. Not implementable under some dredge tailings conditions at Aerojet. Process would be less effective with respect to perchlorate, NDMA, and 1,4-dioxane, as these contaminants would only be removed in the dissolved phase and not both the dissolved and vapor phases.
In Situ Treatment	Physical Treatment	Dual phase extraction	A high vacuum is applied to extraction wells screened in both the vadose and saturated zones to simultaneously remove all nearby fluids, typically both liquids and gases. The technology is designed for relatively low permeability site conditions, otherwise it is not possible to sustain a high vacuum.	Potentially applicable, but only to low permeable zones. Process would be less effective with respect to perchlorate, NDMA, and 1,4-dioxane, as these contaminants would only be removed in the dissolved phase and not both the dissolved and vapor phases.
		Air sparging	Air is injected into the groundwater via well injection points or within a sparge trench. Volatile chemicals are stripped from the water and soil into the soil vapor and extracted from the subsurface by a surface vapor extraction system.	Applicable for dissolved-phase volatile organics and potentially for petroleum product LNAPL source areas (where provision of oxygen promotes aerobic biodegradation). Oxygenation of solvent DNAPL zones not likely to stimulate biodegradation unless other organic compounds are present to support co-metabolic degradation. May be difficult to implement in most areas because of depth to groundwater and heterogeneous subsurface matrix. Heterogeneous air flow yields low efficiency. Adding oxygen might cause iron fouling at injection points.
		In-well aeration/stripping	Air-lift pumping in a well with two screened intervals results in recirculation of groundwater through the aquifer and well. in addition, air-bubble stripping within the well removes VOCs from the groundwater. A low vacuum head is used to extract vapors to the surface for treatment.	Potentially applicable for VOCs removal only. Vapor-phase VOCs may require treatment. Introduction of oxygen may cause fouling.
	Chemical Treatment	In-well oxidation	Combined with the in-well air aeration/stripping process, vapor stream is treated within the well using advanced oxidation process.	Potentially applicable for VOCs removal only.
		Chemical oxidation	In-situ chemical oxidation (ISCO) involves injecting chemical oxidants into the vadose zone and/or groundwater to oxidize organic contaminants. Common oxidants are hydrogen peroxide-based Fenton's reagent, potassium permanganate (KMnO4), sodium permanganate, and sodium persulfate (for 1,4-dioxane). Ozone can also oxidize organic contaminants in-situ, but it has been used less frequently. Complete mineralization to carbon dioxide and water is the desired endpoint of an ISCO process.	Retained for all areas except those where it is shown that reductive dechlorination is occuring. Potentially applicable to depths of 75 feet. Matching the oxidant and in situ delivery system to the contaminants and the site conditions is critical to successful implementation and achieving performance goals. Can be large oxidant demand for native organic matter in the formation.
		Permeable reactive barrier (PRB)	Flow-through permeable reactive barrier in-situ. Also know as passive treatment wall. A "funnel and gate" configuration utilizing impermeable barriers to channel groundwater through a permeable zone that contains zero-valent iron filings or other reactants (e.g., metal oxides and sufides, aluminosilicates, sorbents, organics) is typically constructed. Chlorinated organic contaminants are treated via the reductive dechlorination process with zero-valent iron. Zero-valent iron may contain other metals, such as nickel, to enhance reactivity. Can be applied as a source-zone containment system. Full-scale pilot test currently being conducted at Area 40.	Potentially applicable to depths of about 75 feet. Not effective for 1,2-DCA. PRB may lose its reactive capacity, requiring replacement of the reactive medium. Biological activity or chemical precipitation may limit the permeability of the PRB over time.
	MATCH C	MATCH C		

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
MATCH C		MATCH C		
In Situ Treatment		Nanoscale zero-valent iron	Slurry containing zero-valent iron nanoparticles is injected into a contaminant plume. Nanoparticles remain suspended in the interstitial pore spaces establishing an in-situ treatment zone. Chlorinated organics are treated via the reductive dechlorination process. Technology can also be used for in-situ detoxification of pesticides, immobilization of metals, and transformation of fertilizers. Nanoparticles can be anchored onto LPGAC and ion exchange media for enhanced treatment of specific contaminants.	Not retained as full-scale has not effectively been proven that ZVI can be injected in a porous media for any reasonable distance.
	Biological Treatment	Enhanced in-situ bioremediation	Either oxygen (an electron acceptor) under aerobic conditions, or an electron donor and/or anaerobic electron acceptor under anaerobic conditions, is added with nutrients through recirculation or injection to enhance the naturally occurring microbial population and/or non-indigenous bacteria targeting specific compounds.	Potentially applicable under aerobic conditions, but not all site-related chlorinated VOCs aerobically biodegradable. Under anaerobic conditions, potentially applicable for some chlorinated VOCs and perchlorate (emerging technology for other contaminants, but not yet sufficiently demonstrated). Aerojet had success with full-scale pilot testing of anaerobic dechlorination of TCE and anaerobic biodegradation of perchlorate, but secondary impact of liberation of manganese and iron in the aquifer (rendering the water highly reduced and non-potable) was not acceptable to the regulatory agencies. Implementability issues included well fouling and physically delivering treatment fluids to residual contaminants.
		In-situ bioaugmentation	Microbial cultures that have been specially bred for degradation of specific contaminants or contaminant groups are added to the subsurface through recirculation or injection. Under aerobic conditions, electron acceptors and/or nutrients are typically added with the microbes to enhance biodegradation. Likewise under anaerobic conditions, an electron donor and/or nutrients are added.	Not retained as not applicable under aerobic conditions and not all site-related chlorinated VOCs are aerobically biodegradable.
		Coupled infiltration/shallow groundwater extraction and treatment	Infiltration is accelerated by applying water (and possibly an electron donor) to the soil surface such that the infiltrating water is captured by shallow groundwater extraction wells or trenches. The captured groundwater is either treated biologically in above-ground reactors and recharged, or treated in-situ biologically after the nutrient-amended water is recharged. Applicable where groundwater is present at shallow depths. A field trial is in progress.	Not retained as organics amenable to this technology are not contributing to unacceptable risk.
		Phytoremediation	Vegetation (e.g., trees, grasses) is used to accelerate the biodegradation of contaminants in and around the rhizosphere and to remove, transfer, stabilize, and destroy organic and inorganic contaminants or to influence groundwater flow through enhanced transpiration. Depth to water will be a limiting criterion. May also be used as a hydraulic containment measure. Technology emerging as a means to treat contaminated soil.	Potentially applicable for shallow (<15 ft) slow-moving groundwater, but very depth-limited. Need to assess whether leaves are concentrating the COPC (e.g., perchlorate) and consider that trees are dormant in winter and would not be up-taking water.

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU.

Indicates technology is emerging.

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
Groundwater Extraction and Treatment	Groundwater Extraction	Vertical extraction wells	New vertical extraction wells are installed and the groundwater is pumped to physically remove contaminants from the saturated zone. A hydraulic barrier is established that prevents contaminant migration.	Potentially applicable. Can be applied as a source zone containment system.
		Horizontal extraction wells	Horizontal wells are installed and the groundwater is pumped to physically remove contaminants from the saturated zone. A hydraulic barrier is established that prevents contaminant migration.	Potentially applicable. Can be applied as a source zone containment system.
		Extraction and recharge wells	Wells are installed and groundwater is pumped to establish a hydraulic barrier. Uncontaminated water is recharged to create a hydraulic barrier and increase flow to extraction wells.	Potentially applicable. Can be applied as a containment system.
		Interceptor trenches	Perforated pipe in trenches backfilled with media more porous than surrounding media to collect groundwater. Trench allows for higher rates of groundwater extraction in low conductivity formations.	Not retained because not feasible in most areas because of depth to groundwater, vertical depth of chemicals, and difficulty of constructing long trench. Can be applied as a source zone containment system.
	Ex Situ Physical Treatment	Liquid-phase granular activated carbon (LPGAC)	Contaminated water is passed through adsorbent media, such as granular activated carbon and the contaminant is sorbed onto the media. The adsorbent is replaced and/or regenerated on a regular basis.	Potentially applicable for most organic contaminants and some other polar molecules. EPA Presumptive Technology for treatment of dissolved organic contaminants.
		Air Stripping	Large volumes of air are forced through water in a packed column or by diffused bubble aeration to promote transfer of non-polar VOCs to the air phase. Includes warm water stripping variations.	Potentially applicable for VOC removal only. Air stripping releases VOCs that may require vapor-phase treatment. EPA Presumptive Technology for treatment of dissolved organic contaminants.
		Filtration	Water treated via ex-situ chemical or biological processes is passed through single or multi media filters to remove particulate matter prior to management of treated groundwater.	Potentially applicable.

MATCH D

MATCH D

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
MATCH D		MATCH D		
Groundwater Extraction and Treatment	Ex Situ Physical Treatment	Membrane separation	Contaminated water is passed through semi-permeable membranes which separate contaminants from water based on molecular size, shape, and ionic characteristics. Can be used for volume reduction. Techniques include reverse osmosis, ultrafiltration, nanofiltration, and electrodialysis.	Not retained. Not feasible because of the large flow rate of reject or concentrate streams generated. Also some contaminant concentrations too low for treatment.
		Phase separation	Groundwater and DNAPL are separated using gravity/settling tanks.	Potentially Applicable.
	Ex Situ Chemical Treatment	Ion exchange	Contaminated water is passed through a resin bed capable of exchanging the ions in solution with innocuous ions on the resin. The loaded resin is then either disposed or regenerated and reused.	Potentially applicable for perchlorate removal. Is being used full-scale at several locations at Aerojet. EPA Presumptive Technology for treatment of dissolved metals and some inorganics.
		Ultraviolet irradiation/ chemical oxidation	Ultraviolet light, ozone, and/or hydrogen peroxide are used to destroy organic contaminants. Hydrogen peroxide may be needed for VOC oxidation.	Applicable for VOC and NDMA removal as well as a disinfection process. EPA Presumptive Technology for treatment of dissolved organic contaminants.
		Electrochemical processes	Electrochemical treatment changes the oxidation state of ions in solution to a preferred and treatable state through the application of an electrical current. Generally used to precipitate heavy metals, oxidize trace organics, and coagulate colloids.	Not retained. Not applicable for chemicals of concern.
		Aeration of metals	Aeration promotes chemical oxidation and the formation of insoluble hydroxides.	Not retained. Not applicable for chemicals of concern.
		Chemical precipitation	Soluble contaminants are converted to an insoluble form by a chemical reaction.	Not retained. Not applicable for site-related contaminants.
		pH adjustment	Acid or caustic is added upstream of another process option to enhance the performance of the process option or added downstream of a process option to adjust the pH.	Potentially applicable. Currently used at several Interim Actions.
	Ex Situ Biological Treatment	Aerobic bioreactors	Organics are biologically assimilated and transformed by aerobic microorganisms in Fixed Bed Reactors or Fluidized Bed Reactors.	Not retained. Limited effectiveness for chlorinated VOCs.
		Cometabolic bioreactors (biological reduction)	Chlorinated VOCs are degraded by enzymes produced by aerobic microorganisms during oxidation of a primary substrate. Water contaminated with perchlorate is amended with organic substrate such as ethanol and nutrients and passed upflow through a fluidized bed reactor. Perchlorate is reduced biologically.	Potentially applicable. Currently used to remove perchlorate from Aerojet GET E and F groundwater.
		Buried horizontal flow fixed bed bioreactor	Bioreactor constructed in-situ in rectangular configuration using HDPE liner material and distributor piping or buried cargo containers filled with a variety of media such as gravel/limestone for abiotic or biological reduction of target chemicals. Would be located near source and designed for low flow/high concentration conditions.	Proven effectiveness full-scale (120 gpm) for selenium removal. Currently conducting bench-scale column studies for groundwater stream with high concentrations of perchlorate and TCE.
MATCH E		MATCH E		

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING COMMENTS
Groundwater Extraction and Treatment	MATCH E	MATCH E		
		Anaerobic bioreactors	Organics and perchlorate are biologically assimilated and transformed by anaerobic microorganisms. Nutrient such as brewers yeast required. Additional treatment may be required to reduce organic concentration prior to disposition of treated water.	Not retained. Difficult to implement. Not widely used. Low reaction rates result in longer startup and treatment times. Sensitive to changes in influent flows and concentrations. Polishing of effluent stream may be required.
	Vapor-phase Treatment of Offgases	Direct discharge	The air stream is discharged directly to the atmosphere without treatment.	Potentially applicable. Depends on concentration of the contaminants flow rate, regulatory agency acceptance, and public acceptance.
		Vapor-phase granular activated carbon (VPGAC)	A VOC-contaminated air stream is passed through adsorbent media, such as granular activated carbon. The carbon is replaced and/or regenerated on a regular basis.	Potentially applicable. Water vapor in the gas stream will adversely affect VOC adsorption. Thermal pretreatment to remove water vapor may be required.
		Catalytic oxidation	Vapor-phase VOCs are destroyed by heating the air stream and passing it through a combustion unit in contact with a catalyst bed. The catalyst enhances the thermal oxidation (600 to 900 degrees F) of contaminants to water vapor, carbon dioxide, and hydrochloric acid.	Potentially applicable. The hydrochloric acid by-product in the offgas may require treatment with a scrubber before releasing to the atmosphere.
		Thermal oxidation	VOC-contaminants in an air stream are oxidized by high temperatures (1000 to 1800 degrees F). Combustion by-products may include hydrochloric acid and nitrogen oxides.	Potentially applicable. The hydrochloric acid by-product in the offgas may require treatment with a scrubber. Partial or incomplete combustion of chlorinated chemicals can result in production of chlorine gas and other by-products.
	Disposition of Treated Groundwater	Direct potable water supply	Treated water is delivered or sold to neighboring and regional water purveyors, directly to a point of use in a water distribution system, with wellhead treatment, or through a surface water treatment facility.	Potentially applicable if the entity extracting and directly providing the water is a permitted water supplier with a permit issued by the California Department of Public Health (CDPH) Division of Drinking Water and Environmental Management (DDWEM). If a contaminated groundwater is to be considered as a direct potable water supply after it is treated to remove the contaminant, a permit for the use of the "extremely impaired source" must be obtained from CDPH in accordance with Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Sources.
		Indirect potable water supply	Treated groundwater would be discharged to surface water. Surface water would be treated at the point of use by a responsible water utility.	Potentially applicable.
		Non-potable water reuse	Treated water is reused as irrigation water or within Aerojet's industrial water supply system.	Potentially applicable.
		Streamflow augmentation	Treated groundwater is discharged to surface ditches, storm sewer, or a surface water body.	Potentially applicable.
		Groundwater recharge	Treated groundwater is recharged into the local aquifer.	Potentially applicable.
		Deep well injection	Treated groundwater is injected into a deep aquifer.	Not retained. Not feasible because the permeability of the deep units is not great enough and difficulties associated with obtaining regulatory approvals.

Technology and/or Process Option screened out on the basis of implementability within the various Management Areas of BOU

AEROJET
Environmental Remediation

FIGURE 2-2

Technical Implementability Screening of Groundwater Remediation Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
No Action	None	None	Does not meet Remedial Action Objectives.	As no actions are taken, this action is readily implementable.	No cost	Required to be retained per NCP.
Institutional Controls	Governmental Controls	Ordinances	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Zoning Restrictions/Overlay Districts	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Land Use Restrictions	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
	Proprietary Controls	Environmental Covenant	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Environmental Easement	Long term effectiveness depends on continued future implementation.	Implementability dependent on activity to be undertaken under easement and ease of negotiation with landowner/governmental agency.	Low capital	Potentially applicable.
	Enforcement and Permit Tools	AOCs and/or CDs	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
	Informational Devices	Deed notices	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Registries of contaminated properties	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Advisories	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
	Monitoring and Reporting	Monitoring of land uses	Long term effectiveness depends on continued future implementation.	Easily implemented.	Moderate O&M cost	Potentially applicable.
		Indoor air sampling	Effective at verifying presence and attenuation of VOCs in air. Does not remediate contamination.	Easily implemented.	Low capital and low O&M costs	Applicable for VOCs only.
		Soil vapor/Soil monitoring	Effective at verifying presence and attenuation of contaminants in vadose zone. Does not remediate contamination.	Easily implemented.	Low capital and low O&M costs	Applicable for VOCs only.

Technology and/or Process Option screened out on the basis of effectiveness, implementability and/or costs.

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FIGURE 2-3
Evaluation of Soil Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
Operational Controls	Access Restrictions	Fencing	Effective in preventing access and exposure to contamination.	Easily implemented.	Low capital costs	Potentially applicable.
	Engineering Controls	Building ventilation	Effective at reducing exposure to VOCs. Monitoring will be necessary to verify effectiveness.	Easily implemented, testing of HVAC system in existing building needed to design any improvements.	Low or moderate capital costs depending on existing building HVAC system or whether considered in new building design. Low incremental O&M costs.	Applicable for VOCs only.
Physical Containment	Horizontal Barriers	Capping/cover systems	Effective at limiting physical contact with impacted soils and impeding migration of soil VOCs in soil gas to surface. Effective for limiting infiltration of surface water and potential threats to groundwater. Susceptible to weathering and cracking.	Easily implemented in outdoor areas. Not easily implemented in small areas or within buildings. Restrictions on future land use.	Moderate capital, low O&M	Existing structures may currently serve as effective cap/cover. Inspection of cap/cover required to verify integrity. May not be compatible with future land use.
		Vapor barriers	Effective at preventing soil vapor intrusion into buildings.	Easily implemented during construction of new buildings, difficult for existing buildings.	Moderate capital	Potentially applicable in combination with Institutional Controls.
	Immobilization	In-situ solidification/stabilization	Effective for metal and high molecular weight organic contaminants only.	Highly dependent on soil properties, reagent delivery and effective mixing may be difficult, depth limits application, leachability testing needed.	High capital	Not retained because presence of solidified material may limit future site use, high cost, and difficulty with respect to implementation.

Technology and/or Process Option screened out on the basis of effectiveness, implementability and/or costs.

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Environmental Remediation

FIGURE 2-3
Evaluation of Soil Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
In-Situ Treatment	Physical	Soil Vapor Extraction (SVE)	Proven technolgy to reduce VOC contaminant mass and concentration.	Has been implemented at site. Perched water encountered in pilot tests. Difficult to install extraction system within existing buildings.	Moderate capital and O&M. Capital costs may be higher in areas where there are existing utilities and trenching through existing concrete is necessary for conveyance piping.	Because of varying soil conditions throughout BOU, pilot testing will be necessary to determine design criteria.
		Sub-slab depressurization	Effective at reducing exposure to VOCs. Monitoring will be necessary to verify effectiveness.	Difficult to retrofit existing building, particularly buildings with complex foundations. Knowledge of sub-slab soil and fill conditions is desirable - test borings may be needed. Extent of depressurization and soil gas removal should be kept at a minimum to minimize energy and offgas treatment costs.	High capital and low to moderate O&M.	Potentially applicable if buildings are to remain in service for some time.
		Dual-phase extraction	Particularly effective in low permeability fine-grained soil. Can be used under buildings and other locations that can not be excavated.	Expensive to implement at locations with medium to high permeability soils and difficult to apply where water table fluctuates. In addition to vapors will extract potentially large volume of water that will require treatment. Requires specialized equipment and complex monitoring and control during operation.	Moderate capital and high O&M costs. May be cost effective as a mass removal technique.	Potentially applicable. Pilot testing will be needed to assess effectiveness and implementability.
	Chemical	Chemical oxidation	Effective for destruction of organic contaminants. Sodium persulfate must be used if 1,4-dioxane is of concern. Oxidant dosing needs to consider natural organic content of soil. Delivery system design based on site conditions is critical to providing oxidant opportunity to react with organics of concern. May require multiple applications. Perimeter monitoring points typically needed.	Easily implemented with direct push techniques to depths of 30 feet and to 70 feet with conventional drilling equipment. Difficult to implement below or immediately adjacent to existing buildings. Depending on heterogeneity of soil matrix, effective contact of oxidant difficult to monitor, particularly at deeper depths. Pilot-testing typically required. Multiple applications will require installation of temporary injection wells. Injection of large volumes and multiple applications will require specialized mixing equipment.	Low to moderate capital costs depending on depth and number of applications. Minimal O&M costs for monitoring after application.	None

MATCH A

Technology and/or Process Option screened out on the basis of effectiveness, implementability and/or costs.

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FIGURE 2-3
Evaluation of Soil Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
Contaminant Mass Reduction	Chemical	MATCH A Soil flushing	Effective in soils having moderate to high permeability.	Injected chemicals and mobilized contaminant must be recovered and not allowed to migrate, significant lab and field trials needed to select surfactant or co-solvent solution, difficult to implement in heterogeneous soils.	High capital	Not retained because of implementability concerns and cost.
	Physical	Excavation/off-site disposal	Removes source of contamination in soil. Effective for all contaminants.	Easily implemented in outdoor areas. Depth of impacts may make difficult to implement. If under existing structures, will need to wait to implement until structure demolished.	Relatively high capital, no O&M.	Concentrations of certain contaminants may restrict disposal to Class I landfill.
		Excavation/above-ground SVE	Removes source of contamination in soil. SVE only effective for VOCs.	Easily implemented in outdoor areas. Depth of impacts may make difficult to implement. If under existing structures, will need to wait to implement until structure demolished. Will need area adjacent to excavation to construct SVE cell.	Relatively high capital, moderate O&M.	Potentially applicable for areas where only VOCs in shallow soil are contributing to unacceptable risk.
	Chemical	Low temperature thermal desorption (LTTD)	Effective for organic contaminants only.	Typically implemented where large volumes of soil need to be treated such that it is cost effective to mobilize LTTD unit to site.	High capital	Not retained because of very low potential volume of soil and high cost.
	Biological	Excavation/ Composting	Effective for perchlorate.	Easily implemented in outdoor areas; depending on volume of soil will probably need area adjacent to excavation for composting. Depth of impacts may make it difficult to excavate soils. Composting results in a volumetric increase in material that must be backfilled/compacted in the excavation because of the addition of amendment material. If under existing structures, will need to wait to implement until structure is demolished.	Low capital, low O & M	Retained for perchlorate only.

Technology and/or Process Option screened out on the basis of effectiveness, implementability and/or costs.

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Environmental Remediation

FIGURE 2-3
Evaluation of Soil Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
No Action	None	None	Does not meet Remedial Action Objectives.	As no actions are taken, this action is readily implementable.	No cost	Required to be retained per NCP.
Institutional Controls	Governmental Controls	Ordinances	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Zoning Restrictions/Overlay Districts	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Land Use Restrictions	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
	Proprietary Controls	Environmental Covenant	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Environmental Easement	Long term effectiveness depends on continued future implementation.	Implementability dependent on activity to be undertaken under easement and ease of negotiation with landowner/governmental agency.	Low capital	Potentially applicable.
	Enforcement and Permit Tools	AOCs and/or CDs	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
	Informational Devices	Deed notices	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Registries of contaminated properties	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
		Advisories	Long term effectiveness depends on continued future implementation.	Easily implemented. Specific legal requirements and authority will need to be met.	Low capital	Potentially applicable.
	Monitoring and Reporting	Monitoring of land uses	Long term effectiveness depends on continued future implementation.	Easily implemented.	Moderate O&M cost	Potentially applicable.
		Indoor air sampling	Effective at verifying presence and attenuation of VOCs in air that might be result of VOC migration from groundwater. Does not remediate contamination.	Easily implemented.	Low capital and low O&M costs	Applicable for VOCs only.

MATCH A

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Environmental Remediation

FIGURE 2-4
Evaluation of Groundwater Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
		MATCH A				
Operational Controls	Monitoring and Reporting	Groundwater monitoring	Effective at verifying presence and attenuation of contaminants in groundwater. Does not remediate contamination.	Easily implemented.	Low capital if monitoring wells exist, moderate capital if new wells are needed, low O&M costs.	Applicable for all contaminant parameters.
		Soil vapor monitoring	Effective at verifying presence and attenuation of contaminants in vadose zone that might be result of VOC migration from groundwater. Does not remediate contamination.	Easily implemented.	Low capital and low O&M costs.	Applicable for VOCs only.
	Engineering Controls	Building ventilation	Effective at reducing exposure to VOCs that might be result of VOC migration from groundwater. Monitoring will be necessary to verify effectiveness.	Easily implemented, testing of HVAC system in existing building needed to design any improvements.	Low or moderate capital costs depending on existing building HVAC system or whether considered in new building design. Low incremental O&M costs.	None.
		Wellfield Management	Use of existing irrigation and/or water supply wells could be effective in influencing plume migration. However, COPCs could be drawn into the wells. Operation of irrigation and water supply wells for their intended purpose may not be compatible with controlling plume migration.	Irrigation wells are typically only operated seasonally. Water supply wells used year-round are only operated based on water system demands. Many water supply wells are only used to meet summer peak demands. Use of these wells to influence plume migration would need to be coordinated with the water purveyor. Wellhead treatment would be required if COPCs are drawn into hte wells. If treated water were to be used as a potable water supply, additional permitting would be required of the water purveyor.	Low O&M costs in addition to existing costs to operate the wells. High capital and O&M costs if wellhead treatment were to be necessary.	None.
Monitored Natural Attenuation	Natural Attenuation	Groundwater monitoring	In conjunction with institutional controls, may achieve RAOs.	Implementable.	Low capital and O&M cost.	None.
Technical Impracticability	None	T I Waiver	Contingent action may be required to be implemented if conditions of protectiveness are not being met. In conjunction with institutional controls, may achieve RAOs.	Will require significant administrative efforts to implement.	Low capital if monitoring wells exist. Moderate capital if new wells are needed. Low O&M costs. (Cost wil increase significantly if contingent action required to be implemented.)	None.
		Containment Zone	In conjunction with institutional controls, may achieve RAO.	Will require significant administrative efforts to implement.	Low capital and O&M cost.	None.
Physical Containment	Horizontal Barriers	Capping/Vapor Barriers	Effective at impeding migration of VOCs from groundwater to surface.	Easily implemented during construction of new buildings, difficult for existing buildings.	Moderate capital. Little to no O&M.	May not be compatible with future land use.
In-Situ Treatment	Physical Treatment	Dual-phase extraction	Particularly effective in low permeability fine-grained soil. Can be used under buildings and other locations that can not be excavated.	Expensive to implement at locations with medium to high permeability soils and difficult to apply where water table fluctuates. In addition to vapors will extract potentially large volume of water that will require treatment. Requires specialized equipment and complex monitoring and control during operation.	Moderate capital and high O&M costs. May be cost effective as a mass removal technique.	Potentially applicable. Pilot testing will be needed to assess effectiveness and implementability.
		MATCH B				

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Environmental Remediation

FIGURE 2-4

Evaluation of Groundwater Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
	MATCH B					
In-Situ Treatment	Chemical Treatment	Chemical Oxidation	Effective for destruction of organic contaminants. Sodium persulfate must be used if 1,4-dioxane is of concern. Oxidant dosing needs to consider natural organic content of soil. Delivery system design based on site conditions is critical to providing oxidant opportunity to react with organics of concern. May require multiple applications. Perimeter monitoring points typically needed.	Easily implemented with direct push techniques to depths of 30 feet and to 70 feet with conventional drilling equipment. Difficult to implement below or immediately adjacent to existing buildings. Depending on heterogeneity of soil matrix, effective contact of oxidant difficult to monitor, particularly at deeper depths. Pilot-testing typically required. Multiple applications will require installation of temporary injection wells. Injection of large volumes and multiple applications will require specialized mixing equipment.	Low to moderate capital costs depending on depth and number of applications. Minimal O&M costs for monitoring after application.	None
		Permeable reactive barrier	Effective for passive treatment of VOCs in-situ. Will not remove 1,2-DCA.	Easily implemented using standard backhoe to depths of 27 feet. Deeper trench depths and construction in cobbles, gravels, and sands require special equipment. Biological activity or chemical precipitation may limit permeability of reactive media over time. PRB may lose reactive capacity over time, requiring replacement.	Moderate to high capital costs depending on depth of trench and subsurface conditions. Low O&M costs.	On-going full scale treatability test successful at removing VOCs and perchlorate at Area 40.
	Biological Treatment	Enhanced In-Situ Bioremediation	Concentrations of perchlorate (by enhancing indigenous bacteria) and TCE (through anaerobic dechlorination and use of non-indigenous bacteria) have been reduced to below drinking water standards at Aerojet sites at depths ranging from 85 to 150 ft.	Donor delivery systems are easy to implement. Modeling and monitoring are key components to demonstrating effective capture and removal of COCs as well as distribution of donor. Secondary impacts can include mobilization of iron and manganese. Potential operations issue with biofouling of injection wells.	Moderate capital costs depending on depth; low to moderate O&M costs.	Several successful pilot/demonstration tests have been conducted at Aerojet.
		Phytoremediation	Effective for removal of select organics and inorganics. Contaminants must be no deeper than root structure of vegetation. Need to consider whether leaves are concentrating the COPC and that trees are dormant in winter and would not be up-taking water.	Easily implemented, may require select vegetation for specific contaminants and objectives of application (e.g., if used for hydraulic containment. Soil matrix must be amenable to vegetation growth).	Very low capital cost and O&M costs.	None.
Groundwater Extraction and Treatment	Groundwater Extraction	Vertical extraction wells	Effective method of groundwater extraction; vertical wells are proven technology.	Implementable, limited by permeability of strata.	Low to moderate capital cost, low O&M cost.	None.
		Horizontal extraction wells	Effective method of groundwater extraction from a large area. Horizontal wells are relatively recently developed technology, and may be more effective than vertical wells in certain circumstances.	Implementable, but less so than for vertical wells because requires directional drilling with specialized equipment. May be useful when site access is limited.	Moderate to high capital cost, low O&M cost.	None.
		Extraction and recharge wells	Effective method of groundwater extraction and hydraulic control.	Implementable with regulatory agency acceptance. Could require complex well system.	Moderate capital and high O&M costs.	None.
	Ex Situ Physical Treatment	Liquid-phase granular activated carbon (LPGAC)	Highly effective; adsorbate removal efficiencies above 90% are typical for organic chemicals.	Highly implementable; activated-carbon adsorption for nonpolar dissolved organics is an industry standard. Requires regeneration of carbon (onsite or off-site).	Low capital cost, medium to high O&M costs.	None.
		Air Stripping	Highly effective; VOC removal efficiencies above 90% are typical.	Highly implementable. Air stripping for VOCs is an industry standard. Treatment of effluent air stream may be required prior to discharge.	Capital cost typically low, but O&M costs moderate to high, depending on contaminant concentrations and off-gas treatment.	None. Currently used at Aerojet GET facilities.
	MATCH C	MATCH C				

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Environmental Remediation

FIGURE 2-4

Evaluation of Groundwater Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
MATCH C	MATCH C					
Groundwater Extraction and Treatment	Ex Situ Physical Treatment	Filtration	Highly effective for removal of particulate matter.	Highly implementable.	Low capital and O&M costs.	None. Currently used at Aerojet GET facilities.
	Ex Situ Chemical Treatment	Ion exhange	Highly effective for perchlorate removal full-scale at several Aerojet facilities.	Easily implemented. Used at several Aerojet facilities.	Moderate capital and high O&M costs.	None.
		Ultraviolet irradiation/ chemical oxidation	Highly effective for removal of most VOCs and NDMA and for disinfection.	Implementable. Aqueous stream must be transmissive to UV light which may require pretreating to reduce turbidity. Ongoing cleaning and maintenance of UV reactor and quartz sleeves required.	Moderate costs. Ancillary pretreatment equipment also adds cost.	Currently used at Aerojet GET facilities.
		pH adjustment	Highly effective.	Implementable.	Low capital and O&M costs.	Currently used at Aerojet GET facilities.
	Ex Situ Biological Treatment	Buried horizontal flow fixed bed bioreacton	Effectiveness proven for selenium and currently being evaluated through extensive bench-scale testing for removal of perchlorate and TCE.	Easily Implemented.	Low capital and O&M costs.	None.
	Vapor-Phase Treatment of Off gases	Direct discharge	Effective and reliable discharge method. Does not remove contamination.	May be implemented at sites with regulatory agency acceptance if releases are below *de minimis* quantities.	Low capital and O&M costs.	None.
		Vapor-phase granular activated carbon (VPGAC)	Effective at removing chlorinated VOCs from off-gas emissions.	Highly implementable. Industry standard, in widespread use. May be necessary to pretreat the gas stream to remove water vapor (air/water separator and heater). Contaminants are not destroyed, but are concentrated on the carbon, it is therefore necessary to dispose of or regenerate the carbon.	Low to moderate capital and O&M costs.	None.
MATCH D	MATCH D					

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Environmental Remediation

FIGURE 2-4
Evaluation of Groundwater Remedial Technologies and Process Options

GROUNDWATER GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
MATCH D	MATCH D					
Groundwater Extraction and Treatment	Vapor-Phase Treatment of Off gases	Catalytic oxidation	Effective at removing chlorinated VOCs from off-gas emissions. Control efficiency low for high flow air streams with low concentrations of VOCs.	Highly implementable. Industry standard, in widespread use. May be necessary to treat residual hydrochloric acid with a separate scrubber. Requires careful monitoring to prevent overheating of the catalyst and frequent catalyst replacement if high concentrations of certain chlorinated VOCs.	Moderate to high capital and O&M costs. (High capital and high O&M costs per pound of VOC removed if air stream is high flow w/ low concentrations of VOCs.)	None.
		Thermal oxidation	Effective at removing chlorinated VOCs from off-gas emissions. Control efficiency low for high flow air streams with low concentrations of VOCs.	Highly implementable. Industry standard, in widespread use. May be necessary to treat residual hydrochloric acid with a separate scrubber. Requires much higher temperatures than catalytic oxidation.	Moderate to high capital and O&M costs. (High capital and high O&M costs per pound of VOC removed if air stream is high flow w/ low concentrations of VOCs.) Significant energy cost.	None.
	Disposition of Treated Groundwater	Direct potable water supply	Effective if the treated water achieves drinking water standards. Requires high level of treatment to meet standards.	Implementable. However, Department of Health Services, Office of Drinking Water approval is required.	Low cost, assuming water has been treated to standards.	None.
		Indirect potable supply	Effective. Treated water must meet standards applicable to water body or entity where water is delivered.	Implementable. NPDES permit may be required.	Low cost, assuming water has been treated to standards.	None.
		Non-potable water reuse	Effective. However, requires high level of treatment to meet discharge requirements. Demand may be seasonal.	Implementable. Need to provide for use of water during non-irrigation season. Requires dual distribution system piping.	Low cost, assuming water has been treated to standards required for irrigation.	None.
		Stream flow augmentation	Effective. However, may require high level of treatment to meet discharge requirements.	Implementable. NPDES permit may be required.	Low cost, assuming water has been treated to standards.	None.
		Groundwater recharge	Effective. However, requires high level of treatment and filtration prior to recharge to meet groundwater protective standards.	Implementable with regulatory agency acceptance. Aquifer recharge needs to be integrated with groundwater containment management.	High cost, assuming water has been treated to standards. Ongoing maintenance of recharge wells required.	None.

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FIGURE 2-4

Evaluation of Groundwater Remedial Technologies and Process Options

3.0 Development and Screening of Remedial Alternatives

This section identifies and describes the remedial alternatives potentially applicable to the BOU. Given the variety of site conditions, chemical constituents, and existing and potential future land uses in the BOU, generalized remedial alternatives have been identified for the BOU as a whole. The applicability of these general alternatives to the various MAs encompassed by the BOU is also discussed in this section. Due to the limited number of potential alternatives, no screening of the alternatives was performed and all of the alternatives are subjected to detailed evaluation in Section 4 of this FS pursuant to the nine criteria identified in the NCP. As part of the detailed analysis of alternatives presented in Section 4, specific issues associated with the site conditions, chemical constituents, and land uses in the various MAs within the BOU are described and assessed in terms of the applicability, effectiveness, or cost of the alternatives.

3.1 Listing of Alternatives

The following four general remedial alternatives have been identified for the BOU:

5. No Action;
6. Institutional Controls (ICs);
7. Containment/Operational Controls; and
8. Source Removal/Reduction.

3.2 Description of Alternatives

Details regarding each of the four general remedial alternatives are provided below.

3.2.1 Alternative 1 - No Action Alternative

No engineered measures, ICs, or monitoring would be implemented in the BOU to reduce source area concentrations, prevent chemical migration, restrict or eliminate potential exposures to site chemicals, or reduce exposure of chemical concentrations to potential human or ecological receptors. The No Action Alternative is required by the NCP to provide a baseline for evaluation/comparison of the costs and benefits of other alternatives.

3.2.2 Alternative 2 - Institutional Controls

As discussed in Section 2.0, ICs are non-engineered instruments such as administrative and/or legal controls that minimize the potential for human exposure to COCs by limiting land or resource use (EPA, 2000). At sites where COC/COECs are left in place such that unrestricted land use and unlimited exposure would not be warranted, ICs should be considered to ensure that unacceptable exposure from residual soil, soil vapor or groundwater containing COCs does not occur. Table 3-1 lists the institutional controls to be applied under Controls Alternative.

In some of the BOU MAs, residual COCs are present beneath existing buildings, utility corridors, landscaped areas, and other infrastructure features at levels that could potentially pose a health risk under residential or, in some cases, to commercial/industrial uses. Examples include Admin Areas East and West, the Chemical Plant 2 Area, and the Line 2 Area. (It should be noted that potential ecological concerns for these types of samples are discussed below).

The presence of these buildings and infrastructure features present physical limitations to the implementation and/or potential effectiveness of various engineered controls that might otherwise be applicable for removing or reducing the COCs. For example, the presence of a large office or warehouse building overlying residual non-VOC COCs in shallow, unsaturated soil would prevent, or at a minimum greatly restrict, the applicability of active engineered measures such as soil excavation and disposal or soil treatment. Consequently, the available remedial technologies are unlikely to remove or reduce COCs beneath these buildings to levels that would allow for unrestricted use. Therefore, ICs would be appropriate to prevent exposure and ensure remedial action is taken when the building is removed.

Due to historical chemical migration from other OU's potential source areas, large portions of the BOU have underlying groundwater containing COCs. The groundwater that contains COCs is a potential source for VOC migration into overlying buildings (vapor intrusion). The HHERA evaluated risks posed by the VOC migration from groundwater. In areas that the HHERA indicated a potential significant risk from vapor intrusion from COCs, and the COCs are unlikely to be remedied in the near future to levels below that risk level, ICs would be warranted to restrict property use or to establish management controls (e.g., vapor barriers) that would allow unrestricted use.

Section 1.6 and Appendix D provide an evaluation of soil and soil vapor COPEC concentrations in samples collected from Facility Areas (as defined in ECORP 2005) for potential future ecological exposure should these areas containing buildings, pavement, or other engineered barriers revert to habitat. For those Facility Areas that are retained for potentially unacceptable ecological risk and are not excavated, special land use controls will be put in place to prevent the area from reverting to habitat over time, absent further risk evaluation and Agency approval.

The objectives of ICs that may be applied to the BOU include the following:

- Notice and, as appropriate, restrictions on residential land use (through management controls or use restrictions) where residual COCs would remain in place at concentrations that are above the levels that would allow for unrestricted use;
- Notice, and as appropriate, restrictions on commercial/industrial land use (through management controls or use restrictions) in areas where existing chemical concentrations exceed risk-based levels for commercial/industrial uses;

- Notice and, as appropriate, restrictions on access to or use of groundwater from beneath the BOU;
- Notice and, as appropriate, requirements for appropriate health and safety and materials management procedures for excavations in areas of residual COCs; and
- Notice and, as appropriate, restrictions on land use to prevent disturbed areas from reverting to viable habitat.

The mechanisms that may be used for implementation of ICs for the BOU may include governmental controls, proprietary controls, and informational devices.

3.2.2.1 Governmental Controls

Governmental controls involve obligations under which a government has direct enforcement rights. Governmental controls that could be applied to the BOU include:

- Ordinances that prohibit drilling of water supply wells and use of groundwater;
- Land use restrictions imposed by the local agencies (e.g., zoning restrictions) that specify and control allowable land uses and restrict residential uses to areas meeting standards for unrestricted use;
- Building permit notifications and restrictions; and
- Restrictions on development as contained in deed restrictions for the Carve-Out Property, where the RWQCB has the authority to approve actions.

3.2.2.2 Proprietary Controls

Proprietary controls include environmental covenants or environmental easements that are recorded against a particular piece of property and run with the land. For the BOU, an environmental covenant may be developed to meet each of the IC objectives identified in Section 3.2.2.

To provide for an enforcement mechanism, environmental covenants would be developed in conjunction with environmental easements (or other means of enforcement) to the EPA, RWQCB, Sacramento County, and/or the Cities of Rancho Cordova and Folsom over areas subject to restricted uses. The environmental easements could be developed and granted to the agencies to insure adherence to environmental covenants and governmental controls and to provide the agencies with a mechanism for legal enforcement of the covenants and controls against future property owners. In this respect, the easement/covenant has a “governmental” control aspect that would not be present if the easement were entirely between landowners.

An environmental covenant imposing environmental and land use restrictions and providing access necessary for implementation and oversight of implementation of groundwater

remediation was previously developed for the western and northern portions of the Aerojet property (Carve Out Areas). This *Declaration of Covenants and Environmental Restrictions* (Declaration) dated 19 June 2001 was executed by and among Aerojet ("Covenantor") and the RWQCB and the EPA ("Covenantees") and was recorded in November 2002. This covenant includes various restrictions on groundwater use, including restrictions on drilling or use of wells for purposes of extracting water, installation or operation of recharge basins or injection wells, or sustained construction dewatering. Portions of the Carve-Out Property were subject to more restrictive covenants restricting land use.

3.2.2.3 Informational Devices

Informational devices may also be part of the ICs to be used for the BOU and the site as a whole. These could include deed notices identifying presence of COCs, land use restrictions, and requirements for land use (which were included in the deed restrictions for the Carve-Out areas). Informational devices also consist of inclusion of the site on the State registries of hazardous waste/impacted sites. In this regard, the site is currently listed in the Geo-Tracker database and geographic information system (GIS) of environmental data. Geo-Tracker was developed by the State Water Resources Control Board pursuant to a mandate by the California State Legislature. Geo-Tracker tracks various sites, including Spills-Leaks-Investigations-Cleanups sites such as the Aerojet site. Currently, the site is also listed in the DTSC EnviroStor Data Management System (database) and GIS registry of hazardous waste sites and sites that have known COCs.

At the local level, the presence of COCs and restrictions on land uses and groundwater use at the Aerojet site are identified in various planning documents prepared by Sacramento County and municipalities in the area of the site.

3.2.3 Alternative 3 - Containment/Operational Controls

The third alternative consists of construction of new containment systems, maintenance of existing barriers to COC exposure, and development and implementation of operational controls to reduce or prevent exposure to existing building occupants that may be subject to vapor intrusion. Examples of containment/operational control technologies that may be implemented for the BOU include the following:

- Placement of capping materials (pavement, gravel layer, etc.) over areas with chemicals posing potential risks above commercial/industrial levels;
- Monitoring the presence and thickness and maintenance of new and existing capping materials (e.g., buildings, foundations, roadways, and parking lots) that currently overlie areas of COCs within the BOU to ensure the integrity of the capping materials;
- Modification and monitoring of the heating, ventilation, and air conditioning (HVAC) systems of existing buildings to ensure sufficient air exchange rates to limit vapor

intrusion and reduce indoor air concentrations to safe levels based on EPA's Johnson and Ettinger (J&E) Model (1991) calculations;

- Construction and operation of foundation venting/soil vapor extraction (SVE) systems around and/or beneath existing buildings and adoption of ICs requiring installation of vapor barriers/foundation venting systems in conjunction with new construction located over areas posing a potential risk from vapor intrusion;
- Continued operation of downgradient GET systems that capture groundwater COCs migrating beneath the BOU from upgradient sources and/or collect groundwater COCs originating from BOU "source" areas; and/or
- Groundwater extraction from BOU "source" areas to provide hydraulic containment to prevent or reduce migration of groundwater containing COCs from BOU.

ICs as described in Section 3.2.2 to restrict unacceptable land uses, prevent use of groundwater, require environmental evaluations and additional engineering controls for new construction (e.g., installation of vapor barriers), and to implement additional restrictions to protect the integrity of the cap systems would also be implemented as part of this Containment/Operational Controls alternative.

Such controls may be written to establish a presumptive obligation to implement, subject to the ability of the then owner/developer to seek a variance from such activity. For the BOU, the sites may not be developed for many years and the requirement for a control would appear to be based upon current and anticipated conditions. However, over time, the need for the control may change and there may be a need to provide for a process by which waiver or modification is allowed. Section 6, in describing alternatives, identifies the areas in which existing or new capping systems would be installed and maintained and areas for which vapor intrusion controls (e.g., vapor barrier installations for new construction or HVAC operational modifications and/or perimeter SVE or foundation venting for existing buildings) would be required.

3.2.4 Alternative 4 - Source Removal/Reduction

This alternative would include actions taken to remove either source materials or environmental COCs so as to reduce COC levels to allow for unrestricted use or to levels that would allow for restricted uses. Examples of source removal/reduction actions that would be taken as part of this alternative include:

- Excavation and off-site disposal of soil containing site-related chemicals at concentrations above levels for future use;
- Excavation or vapor extraction of soil containing VOCs at concentrations that present an unacceptable risk from soil vapor migration into indoor air under an unrestricted use scenario; and
- Groundwater extraction to reduce "source" area concentrations.

Figures 6-3, 6-4, 6-6, 6-7, 6-8, 6-11, and 6-12, show the retained risk areas that are carried through in various alternatives for excavation. The following criteria were used to determine the area and depth of excavation:

- For HH risks, 12 feet bgs is the maximum excavation depth.
- For ecological risks 6 feet bgs is the maximum excavation depth.
- For RTG, 12 feet bgs is the maximum excavation depth, however, for sampling locations retained due to continuing RTG present below 12 feet, an alternate remedial method may be proposed.
- If a surface sample is the deepest affected sample, (0.25 feet bgs or less), excavate to a depth of 0.5 foot.
- If 0.5 foot bgs is the deepest affected sample, excavate to 1 foot bgs.
- If the deepest affected sample is 1 foot bgs or greater, the soil would be excavated to a depth of 1 foot below the deepest affected sample (up to 12' bgs) at a minimum and the final depth would be assessed and confirmed during excavation.
- If the affected location is within a ditch, the width of excavation would be based on physical features; the length to be excavated would be 5 feet beyond the last concentration greater than the acceptable risk concentration; depth of excavation would be based on deepest sample depth that exceed the risk-based concentration, following the depth rules above.
- If the affected location is within a year around stream, the excavation width would be based on physical features similar to the ditch above, however the year-around stream maximum excavation depth is 1 foot.
- The excavation extent, other than stated above, was based on the kriged polygon. Some kriged areas were adjusted to accommodate the presence of buildings. For non-VOCs the areas were reviewed to assess whether the chemicals were suspected to have migrated beneath the buildings.

As COCs would remain beneath some of the buildings within the BOU and it may take some time to implement and complete the source removal/reduction activities included in this alternative, this Source Removal/Reduction alternative would also include some of the ICs and containment/operation controls described under the previous two alternatives. Examples would include actions taken with respect to existing occupied buildings such as HVAC operational modifications and/or foundation venting/SVE systems around/beneath existing occupied buildings located over areas that pose a potential risk for commercial use. ICs as described above would also be implemented to restrict unacceptable land uses, prevent groundwater use, require environmental evaluations and engineered controls for new construction, and potentially to

require source removal/reduction in the future in conjunction with building demolition or redevelopment.

The groundwater component under this Source Removal/Reduction alternative is the same as the Containment/Operational Controls alternative, with the exception that the contingent remedy would involve effort to reduce “source area” concentrations in addition to hydraulic containment (Section 3.2.3). As discussed in the RI and Section 1.3.2, Line 2 is the one area (L2-R-9) within BOU where sufficient groundwater monitoring data have been collected, but additional monitoring is needed to evaluate temporal trends. Therefore, prior to implementation of the groundwater component under this Source Removal/Reduction alternative, additional monitoring data would need to be collected and evaluated.

Table 3-1
Summary of Institutional Controls to be Applied Under Institutional Controls Alternative
Aerojet- Boundary Operable Unit Feasibility Study

Institutional Control	Governmental Controls				Proprietary Controls				Informational Devices					
	County Prohibition on Groundwater Use and Well Drilling	Zoning Restrictions/ Overlay District/ Special Planning Area		Building Permit Notices/ Restrictions	Environmental Covenant			Environmental Easement	Deed Notices				State Registries of Contaminated Sites	Identification in Land Use Plans
Area		No Residential	No Commercial		No Residential	No Commercial	Ecological		No Groundwater	No Residential	No Commercial	Ecological		
Open Space 1	X							X	X				X	X
Chemical Plant 2	X	X	X	X	X	X		X	X	X	X		X	X
Open Space 2	X	X	X	X	X	X		X	X	X			X	X
Dredge Pits	X	X		X	X			X	X	X			X	X
Open Space 3	X							X	X				X	X
Magazine Area	X	X		X	X			X	X	X			X	X
Open Space 4	X	X		X	X			X	X	X			X	X
Line 2	X	X	X	X	X	X		X	X	X	X		X	X
Open Space 5	X	X		X	X			X	X	X			X	X
Line 5 North	X	X		X	X			X	X	X			X	X
Open Space 6	X							X	X				X	X
Open Space 7	X	X		X	X			X	X	X			X	X
FSTP	X	X		X	X			X	X	X			X	X
Admin West	X	X	X	X	X	X		X	X	X	X		X	X
Admin East	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes:
Admin = Administration
FSTP = Former sewage treatment plant

4.0 Detailed Analysis of Alternatives

This section presents a detailed analysis of the four alternatives developed in Section 3. The purpose of this detailed analysis is to provide sufficient information to allow comparison of the alternatives based on the standard criteria specified in the NCP.

Detailed evaluation of the final alternatives for a remedial action is a two-stage process. The first stage of the evaluation involves assessing each of the alternatives with respect to nine individual criteria which is presented in this section and is based on the conceptual descriptions of the final alternatives (Section 3).

The second stage of the evaluation process involves grouping of the criteria into a tiered system to reflect their interrelationships and different levels of significance. During the second-stage evaluation, the alternatives are initially evaluated according to the threshold criteria, which must be met; and then the alternatives are compared with each other to identify relative advantages and disadvantages among the different balancing criteria. The purpose of the comparative analysis is to provide information for a balanced remedy selection. The second-stage evaluation of final remedial action alternatives is presented in Section 5.

The NCP [40 CFR Section 300.430(e)(9)(iii)] categorizes the nine evaluation criteria into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Each type of criteria has its own weight when it is evaluated. Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative, and include overall protection of human health and the environment and compliance with ARARs (unless a waiver is obtained).

The nine NCP evaluation criteria include:

Threshold Criteria:

- Overall Protection of Human Health and the Environment; and
- Compliance with ARARs.

Primary Balancing Criteria:

- Long-Term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, or Volume through Treatment;
- Short-Term Effectiveness;
- Implementability; and
- Cost.

Modifying Criteria:

- State Acceptance; and
- Community Acceptance.

Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria represent the main technical criteria upon which the alternative evaluation is based. Modifying criteria include State acceptance and community acceptance, and may be used to modify aspects of the preferred alternative when preparing the proposed plan.

Modifying criteria are generally evaluated after public comment on the OU RI/FS and the Proposed Plan. Accordingly, only the seven threshold and primary balancing criteria are used in the detailed analysis phase. The following sections provide descriptions of the evaluation criteria and the items considered when assessing alternatives with respect to each criterion.

4.1 Description of Evaluation Criteria

The evaluation criteria are described in the following subsections.

4.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion assesses how each alternative provides and maintains adequate protection of human health and the environment. Alternatives are assessed to determine whether they can adequately protect human health and the environment from unacceptable risks posed by chemical concentrations in various media (soil, soil vapor, surface water, and groundwater) present at the site, in both the short and long term. This criterion is also used to evaluate how risks would be eliminated, reduced, or controlled through treatment, engineering, ICs, or other remedial activities. The considerations evaluated during the analysis of each alternative for overall protection of human health and the environment are presented below:

Protection of human health:

- Likelihood that the alternative reduces risk to human health to below risk-based levels.

Protection of the environment:

- Likelihood that the alternative reduces the threat to groundwater by minimizing migration of chemicals. As discussed in the SLERA, there are no completed exposure pathways to groundwater for ecological receptors.
- Likelihood that the alternative would reduce the threat to ecological receptors and that implementation of the alternative would not eliminate the habitat of the receptor to be protected.

4.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This evaluation criterion is used to evaluate if each alternative would attain federal and state ARARs, or whether invoking waivers to specific ARARs is adequately justified. Other information, such as advisories, criteria, or guidance, is considered where appropriate during the ARARs analysis. The considerations evaluated during the analysis of the ARARs applicable to each alternative are presented below. Potential action-, location-, and chemical-specific ARARs for the alternatives presented in this FS are identified in Appendix A.

Chemical-specific ARARs:

- Likelihood that the alternative would achieve compliance with chemical-specific ARARs (e.g., maximum contaminant levels) within a reasonable period of time.
- If it appears that compliance with chemical-specific ARARs would not be achieved, then evaluation of whether a waiver is appropriate.

Location-specific ARARs:

- Determination of whether any location-specific ARARs (e.g., whether facilities would be located in a floodplain and preservation of wetlands) apply to the alternative.
- Likelihood that the alternative would achieve compliance with the location-specific ARAR.
- Evaluation of whether a waiver is appropriate if the location-specific ARAR cannot be met.

Action-specific ARARs:

- Likelihood that the alternative would achieve compliance with action-specific ARARs (e.g., new source air emission rules).
- Evaluation of whether a waiver is appropriate if the action-specific ARAR cannot be met.

Other criteria and guidance:

- Likelihood that the alternative will achieve compliance with other criteria, such as risk-based criteria.

4.1.3 Long-Term Effectiveness and Permanence

This evaluation criterion addresses the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing the remedial action imposed by the alternative. The primary components of this criterion are the magnitude of residual risk remaining at the site after remedial objectives have been met and the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals

and/or untreated wastes. The considerations evaluated during the analysis of each alternative for long-term effectiveness and permanence are presented below. The components addressed for each alternative are described in more detail in the following subsections.

Magnitude of residual risks:

- Identity of remaining risks (risks from treatment residuals), as well as risks from untreated residual concentrations of chemicals; and
- Magnitude of the remaining risks.

Adequacy and reliability of controls:

- Likelihood that the technologies would meet required process efficiencies or performance specifications;
- Type and degree of long-term management required;
- Long-term monitoring requirements;
- Operation and maintenance (O&M) functions that must be performed;
- Difficulties and uncertainties associated with long-term O&M functions;
- Potential need for technical components replacement;
- Magnitude of threats or risks should the remedial action need replacement;
- Degree of confidence that controls can adequately handle potential problems; and
- Uncertainties associated with land disposal of residuals and untreated wastes.

4.1.3.1 Magnitude of Residual Risk

The magnitude of residual risk at the end of remedial activities is measured by numerical standards, or the volume or concentration of COCs remaining. The characteristics (volume, toxicity, and mobility) of the residuals remaining are also evaluated.

4.1.3.2 Adequacy and Reliability of Controls

The adequacy and reliability of controls that are used to either manage treatment residuals or untreated materials that remain after attaining numerical limitations are evaluated. This criterion includes an assessment of containment systems and ICs to evaluate the degree of confidence that they adequately handle potential problems and provide sufficient protection. The criterion also addresses long-term reliability, the need for long-term management and monitoring, and the potential need to replace technical components of the alternative.

4.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the anticipated performance of the treatment technologies employed by each alternative in permanently and significantly reducing toxicity, mobility, and/or volume of COCs associated with the OU. The NCP prefers remedial actions where treatment is used to reduce the principal threats at a site through destruction of toxic chemicals, irreversible reduction in chemical mobility, or reduction of total volume of media containing concentrations of COCs. The considerations evaluated during the analysis of each alternative for reduction of toxicity, mobility, or COC volume present at a given site are presented below.

Treatment process and remedy:

- Likelihood that the treatment process addresses the principal threat; and
- Special requirements for the treatment process.

Relative amount of hazardous material destroyed or treated:

- Portion (mass) of COC that is destroyed; and
- Portion (mass) of COC that is treated.

Reduction in toxicity, mobility, or volume:

- Extent that the total mass of COCs is reduced;
- Extent that the mobility of COCs is reduced; and
- Extent that the volume of COCs is reduced.

Irreversibility of treatment:

- Degree that the effects of the treatment are irreversible.

Type and quantity of residuals remaining following treatment:

- Residuals that would remain;
- Quantities and characteristics of the residuals; and
- Risk posed by the treatment residuals.

Statutory preference for treatment as a principal element:

- Extent to which the scope of the action covers the principal threats; and
- Extent to which the scope of the action reduces the inherent hazards posed by the principal threats at the site.

4.1.5 Short-Term Effectiveness

Short-term effectiveness considers the effect of each remedial alternative on the protection of human health and the environment during the construction and implementation phase. The short-

term effectiveness evaluation only addresses protection prior to meeting the RAOs. The considerations evaluated during the analysis of each alternative for short-term effectiveness are presented below.

Protection of the community during any remedial action:

- Risks to the community that must be addressed;
- How the risks would be addressed and mitigated; and
- Remaining risks that cannot be readily controlled.

Protection of workers during remedial actions:

- Risks to the workers that must be addressed;
- How the risks would be addressed and mitigated and the effectiveness and reliability of measures to be taken; and
- Remaining risks that cannot be readily controlled.

Environmental impacts of any remedial action:

- Environmental impacts that are expected with the construction and implementation of the alternative;
- Mitigation measures that are available and their reliability to minimize potential impacts; and
- Impacts that cannot be avoided, should the alternative be implemented.

Time until RAOs are achieved:

- Time to achieve protection against the threats being addressed;
- Time until any remaining threats are addressed; and
- Time until RAOs are achieved.

4.1.6 Implementability

Implementability evaluates the technical feasibility and administrative feasibility (i.e., the ease or difficulty) of implementing each alternative and the availability of required services and materials during its implementation. The following considerations are evaluated during the analysis of each alternative for implementability.

4.1.6.1 Technical Feasibility

Ability to construct and operate the technology:

- Difficulties associated with the construction; and
- Uncertainties associated with the construction.

Reliability of the technology:

- Likelihood that technical problems would lead to schedule delays.

Ease of undertaking additional remedial action:

- Likely future remedial actions that may be anticipated; and
- Difficulty implementing additional remedial actions.

Monitoring considerations with respect to effectiveness of the remedy:

- Migration or exposure pathways that cannot be monitored adequately; and
- Risks of exposure, should the monitoring be insufficient to detect failure.

4.1.6.2 Administrative Feasibility

Coordination with other agencies:

- Steps required coordinating with regulatory agencies to implement any remedy;
- Steps required establishing long-term or future coordination among agencies; and
- Ease of obtaining permits for off-property activities, if required.

4.1.6.3 Availability of Services and Materials

Availability of treatment, storage capacity, and disposal services:

- Availability of adequate treatment, storage capacity, and disposal services;
- Additional capacity that is necessary;
- Whether lack of capacity prevents implementation; and
- Additional provisions required to ensure that additional capacity is available.

Availability of necessary equipment and specialists:

- Availability of adequate equipment and specialists;
- Additional equipment or specialists that is required;
- Whether there is a lack of equipment or specialists; and
- Additional provisions required to ensure that equipment and specialists are available.

Availability of prospective technologies:

- Whether technologies under consideration are generally available and sufficiently demonstrated to be effective;
- Further field applications needed to demonstrate that the technologies may be used full-scale to treat COCs;
- When technology should be available for full-scale use; and
- Whether more than one vendor would be available to provide a competitive bid.

4.1.7 Cost

In accordance with the NCP as well as the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988) and *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000), estimates of probable capital costs, annual operations, maintenance and monitoring (OM&M) costs, periodic costs, and present worth costs have been prepared for the various alternatives. As specified in the RI/FS guidance (EPA, 1988), the estimated costs were developed to provide a level of accuracy of +50/-30 percent, that is the actual costs can be up to 50 percent higher or 30 percent lower than the estimate costs.

4.1.7.1 Capital and Operation, Maintenance, and Monitoring Costs

Capital costs include (1) direct costs for labor, equipment, materials, subcontractors, contractor markups such as overhead and profit, and professional/technical services that are necessary to support construction of the remedial action, and (2) indirect capital costs that are not part of the actual construction but are necessary to implement the remedial action (e.g., engineering, legal, construction management, and other technical and professional services). OM&M costs would include annual post-construction costs for labor, equipment, materials, subcontractors, and contractor markups such as overhead and profit associated with activities such as monitoring and maintaining the components of the remedial action. Annual OM&M costs would also include expenditures for professional/technical services necessary to support OM&M activities. Periodic costs are those that might occur only once every few years (e.g., five-year reviews, cap/cover repair, and equipment replacement) or expenditures that would occur only once during the entire OM&M period or remedial timeframe (e.g., well abandonment, update of the ICs Plan, and site closeout).

In preparing the cost estimates used in this FS, quantities for labor, equipment, and materials were developed as discussed in Section 3 of this report. Cost data were obtained from a variety of sources including cost estimating guides and references such as unit prices in the latest RS Means Heavy Construction Cost Data, RS Means CostWorks 2010 digital cost data, site-specific vendor and contractor quotes and discussions, experience with actual costs from similar projects, other historical project costs updated to 2010 costs using the Engineering News Record Construction Cost Index, and engineering judgment.

Estimates for professional/technical services cost elements (project management, remedial design, and construction management) were based on the example percentages provided in Exhibit 5-8 in *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000). These percentages of total construction cost are as follows:

Capital Cost Element	Estimated Construction Cost				
	< $100k (%)	$100 – 500k (%)	$500k - $2M (%)	$2M - 10M (%)	> $10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

As discussed in Section 5.5 of *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000), for OM&M costs, project management generally ranges from 5 to 10 percent of total annual OM&M costs.

4.1.7.2 Contingency Costs

A contingency was added as a percentage of the total capital, annual OM&M, and periodic costs to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the data on hand at the time the FS cost estimates are prepared. Contingency is comprised of two elements: scope and bid.

Scope contingency covers unknown costs due to scope changes that may occur during remedial design and represents project risks associated with an incomplete design, since design concepts are not typically developed enough during preparation of the FS to identify all project components or quantities. This type of contingency represents costs, unforeseeable at the time of FS and conceptual design cost estimate preparation, which are likely to become known as the remedial design proceeds. For this reason, scope contingency is sometimes referred to as "design" contingency. In general, scope contingency should decrease as remedial design progresses and should be 0 percent at the 100 percent design stage. At the early stages of remedial design (e.g., during the FS stage, which represents 0 percent to 10 percent design completion), concepts are not typically developed enough to identify all project components or quantities. Higher scope contingency values may be justified for alternatives with greater levels of cost growth potential. A low percentage for scope contingency indicates an opinion that the project scope will undergo minimal change during design. A high percentage indicates an opinion that the project scope may change considerably between the FS and final design. Engineering judgment should be used whenever selecting a scope contingency percentage and the value used should be clearly identified in the cost estimate (EPA, 2000).

Exhibit 5-6 of *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000) provides a range of scope contingencies to consider for various remedial technologies depending upon the degree of certainty or uncertainty associated with the remedial technology. Taking into consideration the technologies that would be included in the alternatives in this FS, a scope contingency factor of 10 percent was selected to be added as a percentage of the total capital, annual OM&M, and periodic costs.

Bid contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial action construction or OM&M proceeds. Bid contingency accounts for changes that occur after a construction or OM&M contract is awarded and represents a reserve for quantity overruns, modifications, change orders, or claims during construction or OM&M. Examples include changes due to adverse weather, material or supply shortages, or new regulations. A bid contingency of 15 percent was included for all of the alternatives in this FS, in accordance with the range of bid contingency factors from *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000).

4.1.7.3 Present Worth and Non-discounted Constant Dollar Costs

A present worth analysis has also been prepared to allow the estimated costs of each alternative to be compared on the basis of a single figure (i.e., a single dollar amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life). In accordance with EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988), a 30 year period of performance was used in the development of the present worth analysis. The use of a 30 year period for the present worth analysis of the cost of alternatives is not intended to imply or otherwise provide a basis to limit future site maintenance and monitoring activities to a 30-year duration. The need for and scope of continued monitoring and maintenance both within and beyond 30 years would be subject to ongoing evaluation as part of the Five Year Review process for the Site.

While the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988) recommends the general use of a 30-year period of analysis for estimating present worth costs during the FS, the more recent *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000) recommends that for projects with durations exceeding 30-years, both a present worth analysis using the project duration and a non-discounted constant dollar cash flow over time scenario should be prepared. Both the present worth and non-discounted constant dollar cash flow analyses have been developed for the alternatives. It should be noted that the 2000 guidance states "Non-discounted constant dollar costs are presented for comparison purposes only and should not be used in place of present value costs in the Superfund remedy selection process."

EPA policy on the use of discount rates for RI/FS present worth cost analyses is stated in the preamble to the NCP (55 FR 8722) and in Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-20 entitled *Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis* (EPA, 1993a). The latest (December 2009) Office of Management and Budget (OMB) Circular A-94 Appendix C 30-year Real Discount Rate for 2010 is 2.7 percent. This rate has been used for the present worth analysis.

4.1.8 State Acceptance

This criterion involves technical and administrative concerns that the State may communicate in its comments concerning each alternative.

4.1.9 Community Acceptance

The preferred alternative(s) for this OU will be presented to the public in a Proposed Plan, which will provide a brief summary of all of the alternatives studied in the detailed analysis of alternatives section of the FS. In accordance with the NCP, the public will have an opportunity to review and comment on the selected remedial alternative(s) presented in the Proposed Plan. The public's comments will be addressed in the responsiveness summary and ROD for the BOU.

4.2 Results of the Detailed Analysis of Alternatives

The following sections present the detailed analysis of the four remedial alternatives using the seven threshold and primary balancing criteria.

4.2.1 Alternative 1 – No Action

No engineered measures, ICs, or monitoring would be implemented in the BOU to reduce source area concentrations, prevent chemical migration, restrict or eliminate potential exposures to site chemicals, or reduce exposure of chemical concentrations to potential human or ecological receptors. The No Action Alternative is required by the NCP to provide a baseline for evaluation/comparison of the costs and benefits of other alternatives.

4.2.1.1 Overall Protection of Human Health and Environment

In portions of the BOU, potential risks from exposure to soil and soil vapor are greater than levels for current and reasonably anticipated land use. Except to the extent that pre-existing ICs exist to prevent exposure, and operation of the existing GET systems in WGOU and PGOU prevent migration of groundwater containing COCs; the No Action alternative does not eliminate, reduce, or control the pathway by which persons could potentially be exposed or groundwater can be impacted.

As no actions (other than the GET systems) would be taken to address site RAOs, this alternative would not be protective of human health and the environment.

4.2.1.2 Compliance with ARARs

Chemical-specific ARARs would not be met within a reasonable time frame. Since there would be no active remediation measures included in the No Action alternative, location- and action-specific ARARs do not apply.

4.2.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term because the current and potential future risks would remain.

Under the No Action alternative, risks posed by COC occurrences in soil would remain essentially unchanged. Risks posed by VOC COCs in soil vapor and COCs in groundwater are expected to gradually decrease as concentrations of those chemicals decrease over time through physical dilution by dispersion and diffusion, and in the case of VOCs in groundwater, reductive dechlorination.

4.2.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The No Action alternative would not provide any reduction in toxicity beyond the natural attenuation of COCs that may occur in the groundwater environment. Other than through operation of the existing boundary groundwater containment systems in WGOU and PGOU, there would be no reduction in toxicity, mobility, and volume through treatment because no additional treatment technologies would be employed. Therefore, the No Action alternative would not address the statutory preference for treatment as a principal element. No treatment residuals would be generated.

4.2.1.5 Short-Term Effectiveness

Because no remedial action other than continued operation of the existing groundwater containment systems would be taken under the No Action alternative, no short-term risks to the community or to workers as a result of implementing the remedial action would occur. Similarly, no environmental impact from construction activities would occur.

The RAO of protecting human health and the environment from exposure to soil and soil vapor containing chemicals at concentrations above risk based levels would not be met under the No Action alternative.

4.2.1.6 Implementability

As no active or passive remedial technologies would be implemented under the No Action alternative, there are no implementability concerns or issues associated with the No Action alternative. There are no impediments to implementing the No Action alternative.

4.2.1.7 Costs

No costs are associated with this alternative, as no remedial actions would be conducted.

4.2.2 Alternative 2 – Institutional Controls

ICs would be developed and applied under Alternative 2. Some of the ICs (not specific to sources, but related to groundwater) would likely be applied generally within the BOU (and potentially to large portions of the Aerojet site that include not only the BOU, but other OUs). Other ICs would be applied to portions of the MAs within the BOU.

4.2.2.1 Overall Protection of Human Health and Environment

Under Alternative 2 (Institutional Controls), the risks would be reduced and controlled through implementation, monitoring, and enforcement of ICs that would only allow land uses compatible with the presence of the types of residual chemicals in soil and would restrict use of the land that could result in exposure to residual concentrations of chemicals at levels that could pose an unacceptable risk. ICs would:

- Notice of and provide restrictions relative to residential land use by restricting land use in areas where residual COCs would remain in place at concentrations that are above the levels that would allow for unrestricted use;
- Notice of and provide restrictions relative to commercial/industrial land use in areas where existing or residual chemical concentrations exceed risk-based levels for commercial/industrial uses;
- Restrict the active conversion, or limit the passive conversion, of Facility Areas to viable habitat, for those Facility Areas with sample results greater than 10 times the soil and/or soil vapor ESLs (e.g., Admin East, and the northern portions of Admin West and Chemical Plant 2);
- Restrict the use of groundwater beneath the BOU; and
- Require appropriate health and safety and materials management procedures for excavations in areas of residual COCs.

Given the presence of these existing ICs and assuming the implementation, monitoring, and enforcement of additional ICs, Alternative 2 would be protective of human health and the environment with the exception of impact to groundwater.

As Alternative 2 relies on ICs to achieve the additional protectiveness, it is not considered to meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks, unless the ICs included requirements for engineered measures (e.g., no first level residential without vapor barrier).

4.2.2.2 Compliance with ARARs

Alternative 2 would comply with chemical-specific ARARs, with the possible exception of Toxic Substances Control Act (TSCA) PCB spill cleanup requirements. There are areas (Sites 11D, 3D, 52D in the Admin Area and Sites 59F and F(c) in the Chemical Plant 2 Area) where PCBs would remain in place at concentrations greater than 10 milligrams per kilogram under this alternative. Since 40 CFR 761 Subpart G only applies to PCB spills after 1987 and the PCBs at those sites are associated with activities conducted prior to 1987, the TSCA regulations would not be applicable. However, they may be considered a relevant and appropriate requirement.

Since Alternative 2 only consists of implementation of ICs, no location-specific ARARs would apply.

Alternative 2 would meet all of the DTSC and the RWQCB land use control action-specific ARARs.

4.2.2.3 Long-Term Effectiveness and Permanence

Magnitude of Residual Risk

While the concentrations of COCs in soil and groundwater would not be reduced through implementation, monitoring, and enforcement of ICs, risk would be reduced by restricting or controlling the land use. As this alternative relies solely on implementation, monitoring, and enforcement of ICs to insure that unacceptable risks do not occur, EPA has not generally considered ICs to be as effective or permanent as alternatives that utilize engineered measures to insure protectiveness.

Adequacy and Reliability of Controls

Several ICs have already been established, implemented, and effective in restricting exposure for a number of years. These include the Sacramento Consultation Zone policy, the environmental covenant for the Carve-Out Areas, the PCD identifying areas subject to excavation restrictions, and Aerojet's standard operating procedure for Soil Excavation and Grading Requirements.

Therefore, assuming implementation, monitoring, and enforcement of additional ICs, it is highly likely that Alternative 2 (Institutional Controls) would meet process effectiveness and permanence.

4.2.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Since Alternative 2 would not involve any new remediation systems, it would not provide any reduction in toxicity beyond the natural attenuation of COCs that may occur in the unsaturated soil and groundwater environments. Other than through operation of the existing boundary groundwater containment systems in WGOU and PGOU, there would be no reduction of

toxicity, mobility, or volume through treatment because no additional treatment technologies would be employed. Since there would be no reduction in the toxicity, mobility, or volume through treatment of COCs under Alternative 2, no treatment residuals would be generated.

4.2.2.5 Short-Term Effectiveness

As there are no active remediation measures included in Alternative 2, it would not pose any unacceptable short-term risks or other adverse environmental impacts. Because no remedial action would be taken other than implementation of additional ICs, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

Implementation, monitoring, and enforcement of ICs limiting these properties to land uses that would not result in exposure to chemicals at concentrations greater than risk-based levels would insure that the RAO of protecting human health and the environment from exposure to soil, soil vapor, and groundwater containing concentrations of chemicals above risk-based levels would be met.

4.2.2.6 Implementability

Technically, Alternative 2 (Institutional Controls) would be easily implemented. There are no technical difficulties associated with implementing additional ICs. Aerojet and the agencies have already negotiated ICs for the Carve-Out Property. For the portions of the BOU under Aerojet's ownership, there would appear to be no institutional impediments to reaching agreements on acceptable language.

The technical and legal professionals are readily available and have been involved in preparing the various existing legal documents.

4.2.2.7 Costs

Estimated capital, annual OM&M, and 30-year present worth costs for Alternative 2 (Institutional Controls), are included on Table 4-1. Detailed cost estimates and a present worth summary are included on Tables B-1a and B-1b in Appendix B.

4.2.3 Alternative 3 – Containment/Operational Controls

Alternative 3 would consist of construction of new containment systems, maintenance of existing barriers to prevent exposure to COCs, and/or possibly the development and implementation of operational controls to reduce or prevent exposure to occupants of existing buildings that may be subject to vapor intrusion. The ICs described in Section 3.2.2 to restrict unacceptable land uses, prevent use of groundwater, require environmental evaluations and additional engineering controls for new construction (e.g., installation of vapor barriers), and to implement additional restrictions to protect the integrity of any cap systems would also be implemented as part of this

Containment/Operational Controls alternative. Alternative 3 may also include contingent actions to control migration of groundwater containing COCs in Line 2 (L2-R-9).

4.2.3.1 Overall Protection of Human Health and Environment

While COCs would remain in place and potential risks from soil and groundwater COCs would not be eliminated under this alternative, the risk of exposure or release would be significantly reduced or eliminated through engineered barriers and/or operational controls. Since this alternative would also include ICs, similar to Alternative 2, risks would be controlled through implementation, monitoring, and enforcement of additional layered ICs that would only allow land uses that are consistent with the potential risks posed. Likewise, the environment including groundwater would be protected by minimizing migration of COCs and the likelihood of direct exposure.

Alternative 3 would meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks. These engineered measures would be augmented through development and application of the ICs identified under Alternative 2. Therefore, Alternative 3 would be protective of human health.

4.2.3.2 Compliance with ARARs

Similar to Alternative 2, Alternative 3 would comply with chemical-specific ARARs except potentially the TSCA PCB spill cleanup requirements as the areas containing PCBs at concentrations above the unrestricted use standards would remain. However, these areas would be capped to prevent exposure.

No specific potential location-specific ARARs that may apply to this alternative were identified.

Like Alternative 2, Alternative 3 would meet all of the DTSC and the RWQCB land use control Action-Specific ARARs. Emissions controls may be needed to ensure compliance with air quality standards if a foundation venting or SVE system is implemented to reduce potential risk from vapor intrusion.

4.2.3.3 Long-Term Effectiveness and Permanence

Magnitude of Residual Risk

Under this Alternative, soil containing PCBs, metals, and VOCs and areas containing VOCs in soil vapor would remain, and therefore residual risk would remain; however, engineered barriers would be put in place to prevent exposures to the COCs. While the concentrations of COCs in soil and groundwater would not be reduced, the presence of engineered barriers combined with implementation, monitoring, and enforcement of additional ICs to control land uses would prevent exposure and reduce risk. Implementation of additional multi-layered ICs would assure that no changes in existing land uses occur and that only those land uses that would not pose a

potential risk would occur in the future. As this alternative relies on both engineered barriers and implementation, monitoring, and enforcement of ICs to insure that unacceptable risks do not occur, it is considered to be effective and permanent.

Adequacy and Reliability of Controls

The presence of both engineered barriers combined with ICs should provide an adequate and reliable means of preventing exposure to and release of COCs. Combining engineered barriers/operational controls with ICs that control land uses should provide overlapping and redundant methods of protection. Long-term protection would be further assured through ongoing monitoring and maintenance of the presence and performance of the engineer barriers and the effectiveness of the ICs.

4.2.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

As this alternative does not include any treatment components, there would be no reduction in toxicity, mobility, or volume through treatment. The presence of engineered caps, vapor barriers, and foundation venting and SVE systems would reduce the mobility of COCs. In addition, operation of foundation venting and SVE systems would result in a minor reduction in the volume of VOCs.

As there would be no reduction in the toxicity, mobility, or volume through treatment, then no treatment residuals would be generated. Vapor withdrawn by foundation venting or SVE systems is expected to contain only very low to minimal concentrations of VOCs.

4.2.3.5 Short-Term Effectiveness

Protection of Community and Workers

The passive or active remediation measures that might be included in Alternative 3 are construction of gravel, asphalt, or other type of cap; vapor barriers; or a foundation venting or SVE system. Alternative 3 would also include continued operation of existing downgradient GET systems and potentially groundwater extraction from an area L2-R-9 to provide hydraulic containment as detailed in Section 6.3.2.1. Construction and operation of these systems would pose minimal short-term risks to workers or the community. Standard Occupational Safety and Health Administration (OSHA) precautions necessary to protect worker safety during construction would be employed. Short-term environmental impact from construction activities is expected to occur.

Installation of a containment system and/or operational controls and implementation, maintenance of existing barriers, monitoring, and enforcement of ICs limiting use of the various BOU properties would insure that the RAOs of protecting human health and the environment from exposure to soil, soil vapor, and groundwater containing concentrations of COCs above acceptable risk-based levels; developing land use controls to insure current and future land uses

are consistent with the presence of residual concentrations of chemicals and do not result in exposure to chemicals at concentrations greater than acceptable risk-based levels; and containment/control of migration of COCs to minimize future migration and protect beneficial uses of groundwater would be met under Alternative 3.

With respect to the time until response objectives would be achieved, it is estimated that it would take approximately 2 to 3 years to conduct the necessary evaluations, prepare remedial designs, and construct the engineered barriers.

4.2.3.6 Implementability

Construction and maintenance of engineered barriers and development and application of ICs is technically feasible. Construction of asphalt or concrete caps and maintenance of existing asphalt and concrete over areas having COCs in the vadose zone can easily be performed. Construction of vapor barriers as part of new construction is a standard technology that does not pose any technical issues relative to implementability. Installation of foundation venting or SVE systems around or beneath existing buildings may be constrained by the presence of extensive underground utilities and landscaping, but these conditions are not expected to prevent or otherwise limit the implementability or effectiveness of these technologies. All of the engineered barriers are based on commercially available, demonstrated technologies that use standard construction equipment and labor. The necessary materials and specialist personnel are easily attainable.

As indicated in Section 4.2.3, the ICs described in Section 3.2.2 would also be implemented as part of this Containment/Operational Controls alternative. There are no technical difficulties associated with implementing additional ICs and ICs could be easily implemented at the site.

There should be no administrative restrictions on implementation of engineered barriers. Permits may be required for discharge of vapor withdrawn by foundation venting or SVE systems.

The technical and legal professionals are readily available and have been involved in preparing the various existing legal documents.

4.2.3.7 Costs

Estimated capital, annual OM&M, and 30-year present worth costs for Alternative 3 (Containment/Operational Controls) are provided on Table 4-1. Detailed cost estimates and a present worth summaries are included in Appendix B on Tables B-2 through B-6.

4.2.4 Alternative 4 – Source Removal/Reduction

Alternative 4 would include actions taken to either remove source materials or reduce the concentrations of COCs to levels that would allow for restricted or unrestricted use. Source

removal/reduction actions that could be taken as part of Alternative 4 would include excavation/off-site disposal of soil containing concentrations of PCBs and metals above those acceptable for unrestricted use; excavation or vapor extraction of soil containing VOCs to levels that do not present a risk through the migration into indoor air under anticipated land use; and/or possibly groundwater extraction to reduce potential "source" area concentrations.

As COCs would remain beneath some of the buildings within the BOU and it may take some time to implement and complete the source removal/reduction activities included in this alternative, this Source Removal/Reduction alternative would also include some of the ICs and containment/operation controls described under Alternatives 2 and 3.

4.2.4.1 Overall Protection of Human Health and Environment

Soil containing COCs would be excavated; SVE would be applied to areas containing VOCs; soil flushing and air sparging/SVE and, if necessary, contingent groundwater containment remedies would be implemented to eliminate other potential sources to groundwater, to remove or reduce the concentrations of COCs to levels that would allow for restricted uses, or in some cases, unrestricted uses and the protection of groundwater. To the extent that the source materials and COCs are removed from the environment, protectiveness and permanence would be achieved; however, COCs might remain in place under some buildings and other structures until such time as these areas are redeveloped. Consequently, the potential risks from COCs in soil and groundwater would not be entirely eliminated under this alternative. Therefore, this alternative would also include ICs, similar to Alternative 2, so that the remaining risks would be controlled through implementation, monitoring, and enforcement of additional layered ICs that would only allow land uses that are consistent with the potential risks posed.

Alternative 4 would meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks. These engineered measures would be augmented through development and application of the ICs identified under Alternative 2. Therefore, Alternative 4 would be protective of human health.

4.2.4.2 Compliance with ARARs

As soil containing PCBs would be excavated and disposed off site under this alternative, this alternative would comply with all chemical-specific ARARs. Like Alternative 2, Alternative 4 would meet all of the DTSC and RWQCB land use control Action-Specific ARARs. Emissions controls may be needed to ensure compliance with air quality standards if a foundation venting or SVE system is implemented to reduce potential risk from vapor intrusion

4.2.4.3 Long-Term Effectiveness and Permanence

The long-term effectiveness of this alternative is high if COCs can be successfully removed from soil, soil vapor, and groundwater or their concentrations in those media reduced. The potential

risks would be permanently eliminated or greatly reduced. As discussed above, the presence of existing buildings and infrastructure would limit the ability to completely remove all of the source materials and affected media. ICs would be used to control land uses until such time as redevelopment allows for removal of the remaining source materials and media containing concentrations of chemicals above risk-based levels.

Magnitude of Residual Risk

The majority of soil containing PCBs and metals would be excavated and disposed off site. However, due to the presence of existing buildings and infrastructure, some source materials and soil containing COCs cannot be removed and therefore residual risk would remain until such time as the buildings/infrastructure in these areas are removed and prior to redevelopment.

Adequacy and Reliability of Controls

Excavation and off-site disposal provides a permanent means of eliminating risks. For areas, where source removal cannot be conducted or where residual concentrations of chemicals above risk-based levels would remain during or after source reduction activities (e.g., SVE), long-term protection would be assured through implementation of ICs.

4.2.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Excavation and disposal is the EPA Presumptive Remedy for soils containing metals and PCBs and SVE is the EPA Presumptive Remedy for soils containing VOCs. These technologies would permanently remove the majority of COCs, thereby reducing toxicity, mobility, and volume. As the excavated materials would be disposed in an off-site, permitted disposal facility, no treatment residuals would remain from excavation.

If SVE is attempted for source removal/reduction, SVE offgas may require treatment through vapor phase granular activated carbon (VPGAC) or, if the VOC amounts in the offgas are high enough, catalytic or thermal oxidation, to remove or reduce levels of VOCs that would otherwise be discharged to the atmosphere. If VPGAC is utilized, it would be shipped to an off-site facility for regeneration or destruction.

4.2.4.5 Short-Term Effectiveness

Protection of Community and Workers

The passive or active remediation measures that might be included in Alternative 4 include excavation and off-site disposal of soil and vapor extraction of VOCs from soil. Alternative 4 would also include continued operation of existing downgradient GET systems and potentially groundwater extraction from BOU “source” areas to reduce source area concentrations. Construction and operation of these systems would pose minimal short-term risks to workers or the community. Standard OSHA precautions necessary to protect worker safety during

construction would be employed. Similarly, no environmental impact from construction activities is expected to occur.

Excavation and off-site disposal of soil, maintenance of existing groundwater barriers, monitoring, and enforcement of ICs limiting use of the various BOU properties would insure that the following RAOs would be met:

- Protection of human health and the environment from exposure to soil, soil vapor, and groundwater containing concentrations of COCs above risk-based levels;
- Development of land use controls to insure current and future land uses are consistent with the presence of residual concentrations of chemicals above acceptable risk based levels and do not result in exposure to chemicals at concentrations greater than acceptable risk-based levels; and
- Containment/control of migration of COCs to minimize future migration and protect beneficial uses of groundwater.

Excavation of soil and sediment containing concentrations of COCs above acceptable risk-based levels along Buffalo Creek would probably severely damage or potentially destroy the existing ecosystem. However, complete natural restoration of the ecosystem is anticipated within a short period of time following excavation activities. Removal of COPECs should result in a healthier ecosystem.

With respect to the time until response objectives would be achieved, it is estimated that it would take approximately 2 to 3 years to conduct the necessary evaluations, prepare remedial designs, and implement the source removal/reduction measures. Operation of source reduction measures such as SVE might require additional time to implement if treatability studies or pilot testing is needed.

4.2.4.6 Implementability

Excavation and off-site disposal of soil containing COCs, implementation of SVE systems, and development and application of ICs are technically feasible. Installation of foundation venting or SVE systems around or beneath existing buildings may be constrained by the presence of extensive underground utilities and landscaping. However, these conditions are not expected to prevent or otherwise limit the implementability or effectiveness of these technologies. SVE for mass removal may be difficult to implement under and around existing buildings because of extensive foundation systems and numerous underground existing utilities. Also heterogeneous soil conditions could greatly influence the effectiveness of SVE for mass removal. To evaluate soil conditions and vapor permeability, pilot testing of SVE systems would be needed to assess design parameters of SVE for mass removal/reductions.

Excavation and off-site disposal and SVE are based on commercially available, demonstrated technologies that use standard construction equipment and labor. The necessary materials and specialist personnel are easily attainable. There are no technical difficulties associated with implementing additional ICs and ICs could be easily implemented at the site.

Alternative 4 would present few administrative difficulties and, other than those activities discussed under Alternative 2 for implementation of ICs, would require minor coordination with other Agencies. Excavation and off-site disposal in a permitted Class II landfill are commercially available demonstrated technologies that involve the use of standard construction equipment and labor. The necessary equipment, materials, and specialist personnel are easily attainable.

There should be no administrative restrictions on implementation of source removal/reduction. Permitting and other evaluations through the United States Fish and Wildlife Service and California Department of Fish and Game would likely be required prior to excavation of Buffalo Creek. Permits may be required for discharge of vapor withdrawn by foundation venting or SVE systems.

The technical and legal professionals are readily available and have been involved in preparing the various existing legal documents.

4.2.4.7 Costs

Estimated capital, annual OM&M, and 30-year present worth costs for Alternative 4 (Source Removal/Reduction) are provided on Table 4-1. Detailed cost estimates and present worth summaries are included in Appendix B on Tables B-7 through B-13.

Table 4-1
Summary of Estimated Costs for Alternatives
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Alternative	BOU-Wide	Administration Area[1]		WLLO[2]		Magazine Area[3]		Chemical Plant 2[4]	
Alt 2 - Institutional Controls									
Capital costs	14,000	Included in BOU-Wide		Included in BOU-Wide		Included in BOU-Wide		Included in BOU-Wide	
O&M costs[5]	3,000								
Present Worth Costs[6]	100,000								
Alt 3 - Containment/Operational Controls									
Capping									
Capital costs		332,000		107,000		Not applicable		89,000	
O&M costs[7]		60,000		19,000				17,000	
Present Worth Costs[6]		571,000		181,000				154,000	
Vapor Barriers[8]		Commercial	Residential	Commercial	Residential	Commercial	Residential	Commercial	Residential
Capital costs		Not applicable	855,000	Not applicable	348,000	Not applicable	Not applicable[14]	Not applicable	Not applicable[14]
Present Worth Costs[6]			589,000		240,000				
Soil Vapor Extraction for Foundation Venting		Commercial	Residential						
Capital costs		1,050,000	Not applicable	Not applicable		Not applicable		Not applicable	
O&M costs[5]		150,000							
Present Worth Costs[6]		4,000,000							
Groundwater Monitoring[9]									
O&M costs[5]		Not applicable		4,000		Not applicable		Not applicable	
Present Worth Costs[6]				19,000					
Alt 4 - Source Removal/Reduction									
Excavation and Offsite Disposal of Soils		Commercial	Residential	Commercial	Residential	Commercial	Residential	Commercial	Residential
Capital costs		812,000	2,105,000	1,641,000	709,000	Not applicable	Not applicable	837,000	Not applicable
Present Worth Costs[6]		812,000	2,105,000	1,641,000	709,000			837,000	
Soil Vapor Extraction to Reduce RTG[10] Source Area Concentrations									
Capital costs		720,000		500,000		Not applicable		Not applicable	
O&M costs[5]		77,000		130,000					
Present Worth Costs[6]		1,210,000		1,320,000					
Other Remedial Alternatives[11, 12, 13]									
Capital costs		160,000		170,000		Not applicable		128,000	
O&M costs[5]		34,000		34,000					
Present Worth Costs[6]		370,000		440,000				128,000	
Groundwater Contingent Remedy[9]									
Capital costs		Not applicable		450,000		Not applicable		Not applicable	
O&M costs[5]				16,000					
Present Worth Costs[6]				650,000					

Notes:

[1] Includes both Admin East and Admin West
[2] Includes Line 02, Line 05N, Westlakes, Buffalo Creek, and Open Spaces 5, 6, and 7
[3] Includes Magazine Area and Open Spaces 3 and 4
[4] Includes Chemical Plant 2, Dredge Pit and Eastern Basin, and Open Spaces 1 and 2
[5] O&M costs are in $/year
[6] Present Worth costs are for 30 years at 2.7% discount rate
[7] O&M costs for Capping are in $ per every 5 years
[8] Costs would probably be borne by developer at time of new construction
[9] Contingent remedy is groundwater extraction for hydraulic containment reduce source area concentrations
[10] RTG = risk to groundwater
[11] AE-R-1 (air sparging/soil vapor extraction)
[12] L2-R-9 (soil flushing with above ground treatment via sulfur oxidizing bioreactor for perchlorate removal and air stripping for VOCs removal)
[13] DPEB-R-1 (fill contaminated area with clean soil)
[14] There are no plans for redevelopment of these areas at this time. Therefore, for this FS, any costs associated with provision of vapor barriers are assumed to occur beyond the 30-year costing period considered in this FS.

5.0 Comparative Analysis of Alternatives

This section presents the comparative analysis for the alternatives evaluated in Section 4. The relative performance of each alternative is evaluated against the performance of the other alternatives for each of the threshold and primary balancing criteria. This comparative analysis identifies the advantages and disadvantages of each alternative to assist in the decision making process leading to the Proposed Plan.

5.1 Threshold Criteria

Two of the nine criteria specified in the NCP relate directly to statutory findings that must ultimately be made in the ROD. These two criteria are (1) overall protection of human health and the environment, and (2) compliance with ARARs. They are classified as threshold criteria, as each alternative must meet these two criteria.

5.1.1 Overall Protection of Human Health and the Environment

Potential risks from exposure to COCs in soil and soil vapor in portions of the MAs within the BOU are greater than levels for current and reasonably anticipated future land use. Under Alternative 1 – No Action, there would be no engineered measures, ICs, or monitoring implemented to reduce source area concentrations, prevent chemical migration, restrict or eliminate potential exposures to COCs, or reduce exposure of chemical concentrations to potential human or ecological receptors. Except to the extent that pre-existing ICs exist to prevent exposure, and operation of the existing boundary groundwater containment systems in WGOU and PGOU prevent migration of groundwater containing COCs, the No Action alternative does not eliminate, reduce, or control the pathway by which persons could potentially be exposed. As no actions would be taken to address site RAOs, Alternative 1 – No Action would not be protective of human health and the environment.

Since existing and additional ICs are a component of Alternatives 2, 3, and 4, risks to human health and the environment (except for the RTG) would be reduced and controlled through the implementation, monitoring, and enforcement of ICs. These ICs would only allow land uses compatible with the presence of the types and concentrations of residual chemicals in soil, would restrict use of the land to those where exposure to residual concentrations of COCs would not pose an unacceptable risk, and would restrict the use of groundwater under the BOU. Therefore, with the exception of protection of groundwater, the ICs component of Alternatives 2, 3, and 4 would be sufficiently protective of human health and the environment with respect to this threshold criterion.

Alternative 3 (Containment/Operational Controls) would consist of construction of new containment systems, maintenance of existing barriers to prevent exposure, and/or possibly the development and implementation of operational controls to reduce or prevent exposure to occupants of existing buildings that may be subject to vapor intrusion. While COCs would remain in place and potential risks to human health and the environment (including risks to groundwater) from soil and groundwater COCs would not be eliminated under Alternative 3, the risk of exposure or release would be significantly reduced or eliminated through engineered barriers and/or operational controls.

Alternative 4 would include actions to remove source materials or reduce COCs to levels that would allow for restricted or unrestricted use and protection of groundwater. Therefore, Alternative 4 would be the most protective of human health and the environment (including groundwater).

Alternative 2 relies solely on ICs to achieve the additional protectiveness, therefore, it is not considered to meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks. Both Alternative 3 (Containment/Operational Controls) and Alternative 4 (Source Removal/Reduction) include remedial actions and would therefore meet the NCP expectation.

5.1.2 Compliance with ARARs

Compliance with ARARs also serves as a threshold criterion that must be met by any alternative for it to be selected as a remedy, unless a ARARs waiver is obtained. Under Alternative 1 (No Action), chemical-specific ARARs would not be met within a reasonable time frame. Since there would be no active remediation measures included in the No Action alternative, location- and action-specific ARARs do not apply. Each of the other alternatives would comply with ARARs.

Alternative 2 (Institutional Controls) would comply with chemical-specific ARARs except those that relate to protection of groundwater and also with the possible exception of the TSCA PCB spill cleanup requirements if the TSCA regulations are considered a relevant and appropriate requirement. Since Alternative 2 only consists of implementation of ICs, no location-specific ARARs would apply. Alternative 2 would meet all of the DTSC and the RWQCB land use control action-specific ARARs.

Similar to Alternative 2, Alternative 3 (Containment/Operational Controls) would comply with chemical-specific ARARs except some provisions of the Porter-Cologne Water Quality Control Act that address protection of the beneficial uses of groundwater and the Anti-degradation Implementation Policy and potentially the TSCA PCB spill cleanup requirements. The areas containing PCBs at concentrations above the unrestricted land use standards would remain, but if

Alternative 3 were to be implemented these areas would be capped to prevent exposure. No specific potential location-specific ARARs that may apply to Alternative 3 were identified. Like Alternative 2, Alternative 3 would meet all of the DTSC and the RWQCB land use control Action-Specific ARARs. Emissions controls may be needed to ensure compliance with air quality standards if a foundation venting or system is implemented to reduce potential risk from vapor intrusion.

Because Alternative 4 would include actions to remove source materials or reduce COCs to levels that would allow for restricted or unrestricted use and protection of groundwater, Alternative 4 (Source Removal/Reduction) would comply with all chemical-specific ARARs. Like Alternatives 2 and 3, Alternative 4 would meet all of the DTSC and RWQCB land use control Action-Specific ARARs. Also, similar to Alternative 3, emission controls may be needed to ensure compliance with air quality standards if a foundation venting or SVE system is implemented to reduce potential risk from vapor intrusion.

Identified potential ARARs are detailed in Appendix A.

5.2 Primary Balancing Criteria

Alternatives 2, 3, and 4 are comparatively analyzed in this section for the next five of the nine criteria, the primary balancing criteria. (Alternative 1, the No Action alternative, is not evaluated with respect to the primary balancing criteria, as it did not meet the initial threshold criteria.) The five primary balancing criteria are:

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility and volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

These five criteria are collectively described as the primary balancing criteria as they provide the primary basis for differentiation among the various alternatives.

5.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is a measure of the following two principal factors:

- Magnitude of residual risk; and
- Adequacy and reliability of controls.

5.2.1.1 Magnitude of Residual Risk

While the concentrations of COCs in soil and groundwater would not be reduced through implementation, monitoring, and enforcement of ICs under Alternative 2, risk would be reduced

by restricting or controlling the land use. As Alternative 2 relies solely on implementation, monitoring, and enforcement of ICs to insure that unacceptable risks do not occur, EPA has not generally considered ICs to be as effective or permanent as alternatives that utilize engineered measures to insure protectiveness.

Under Alternative 3 (Containment/Operational Controls), soil containing PCBs, metals, and VOCs (soil vapor) would remain, and therefore residual risk would remain. However, engineered barriers would be put in place to prevent exposures to the COCs. The presence of engineered barriers combined with implementation, monitoring, and enforcement of additional ICs to control land uses would prevent exposure and reduce risk. Implementation of additional multi-layered ICs would ensure that no changes in existing land uses occur and that only those land uses that would be compatible with the potential risk would occur in the future.

Under Alternative 4 (Source Removal/Reduction), the majority of soil containing PCBs and metals would be excavated and disposed off site, VOCs in soils sites would be addressed with SVE systems, and areas where other COCs may be acting as a source to groundwater would be remediated using other source removal/reduction technologies, thereby permanently eliminating or greatly reducing the potential risks. However, due to the presence of existing buildings and infrastructure, some source materials and soil containing COCs cannot be removed or remedial actions cannot be immediately implemented and therefore residual risk would remain until such time as the buildings/infrastructure are removed prior to redevelopment. ICs would be used to control land uses until such time as redevelopment allows for removal of the remaining source materials and media containing concentrations of chemicals above risk-based levels.

5.2.1.2 Adequacy and Reliability of Controls

Alternatives 2, 3, and 4 all include ICs. Several ICs have already been established, implemented, and effective in restricting exposure for a number of years. These include the Sacramento Consultation Zone policy, the environmental covenant for the Carve-Out lands, the PCD identifying areas subject to excavation restrictions, and Aerojet's Standard Environmental Operating Procedure for Soil Excavation and Grading Requirements. Combining engineered barriers/operational controls with ICs that control land uses under Alternative 3 would provide overlapping and redundant methods of protection. Long-term protection would be further ensured through ongoing monitoring and maintenance of the presence and performance of the engineered barriers and the effectiveness of the ICs. Excavation and off-site disposal under Alternative 4 provides a permanent means of eliminating risks.

Assuming implementation, monitoring, and enforcement of additional ICs, Alternative 2 would meet process effectiveness and permanence. Alternative 3 relies on both engineered barriers and ICs to insure that unacceptable risks do not occur and is therefore considered to be more effective and permanent than Alternative 2. Since Alternative 4 includes a mass

reduction/removal component, it would provide greater long-term effectiveness and permanence than Alternatives 2 and 3.

5.2.2 Reduction in Toxicity, Mobility, or Volume through Treatment

This criterion is a measure of the following five principal factors:

- Statutory preference for treatment as a principal element;
- Irreversibility of treatment;
- Type and quantity of treatment residual;
- Amount of hazardous material destroyed or treated; and
- Reduction in toxicity, mobility, or volume.

Since Alternative 2 would not involve any new remediation systems, it would not provide any reduction in toxicity beyond the natural attenuation of COCs that may occur in the unsaturated soil and groundwater environments. Other than through operation of the existing boundary groundwater containment systems in WGOU and PGOU, there would be no reduction of toxicity, mobility, or volume through treatment because no additional treatment technologies would be employed.

There would also be no reduction in toxicity or volume through treatment under Alternative 3. However, the presence of engineered caps, vapor barriers, and foundation venting and SVE systems would reduce the mobility of COCs. In addition, operation of foundation venting and SVE systems would result in a minor reduction in the volume of VOCs. As there would be no reduction in the toxicity, mobility, or volume through treatment under Alternative 2 and no reduction of toxicity or volume under Alternative 3, then no treatment residuals would be generated. Vapor withdrawn by foundation venting or SVE systems is expected to contain only very low to minimal concentrations of VOCs.

With respect to Alternative 4, excavation and disposal is the EPA's Presumptive Remedy for soils containing metals and PCBs and SVE is the Presumptive Remedy for soils containing VOCs. These technologies would permanently remove the majority of COCs, thereby reducing toxicity, mobility, and volume. As the excavated materials would be disposed of in an off-site, permitted disposal facility, excavation would not result in treatment residuals. If SVE is attempted for source removal/reduction, SVE offgas may require treatment to remove or reduce levels of VOCs that would otherwise be discharged to the atmosphere. If VPGAC is utilized, it would be shipped to an off-site facility for regeneration or destruction.

5.2.3 Short-Term Effectiveness

Short-term effectiveness is a measure of the protection afforded by each alternative during the construction and implementation process. As such, the time until RAOs are achieved is an

important component of this criterion. The availability of equipment and specialists to implement the alternative is also a consideration. This criterion is a measure of the following three principal factors:

- Protection of workers and the community during the remedial action;
- Environmental impacts; and
- Time until remedial response objectives are achieved.

Because no remedial action other than implementation of additional ICs would be taken under Alternative 2, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

Construction and operation of the passive or active remediation measures that might be included in Alternatives 3 and 4 would pose minimal short-term risks to workers and/or the community. Standard OSHA precautions necessary to protect worker safety during construction would be employed. Short-term environmental impact from construction activities is expected to occur.

Implementation, monitoring, and enforcement of ICs limiting properties to land uses that would not result in exposure to chemicals at concentrations greater than risk-based levels (Alternatives 2, 3, and 4) would insure that the RAOs of (1) protecting human health and the environment from exposure to soil, soil vapor, and groundwater containing concentrations of chemicals above acceptable risk-based levels, and (2) developing land use controls to insure current and future land uses are consistent with the presence of residual concentrations of chemicals and do not result in exposure to chemicals at concentrations greater than acceptable risk levels would be met. Additionally, installation and maintenance of a containment system and/or operational controls (Alternative 3) or implementation of source reduction/removal measures (Alternative 4) would insure that the RAO of containment/control of migration of COCs to minimize future migration and protect beneficial uses of groundwater would be met.

With respect to the time until response objectives would be achieved, it is estimated that it would take approximately six months to one year to implement additional ICs (Alternatives 2, 3, and 4) and approximately 2 to 3 years to conduct the necessary evaluations, prepare remedial designs, and construct the engineered barriers (Alternative 3) or implement source reduction/removal measures (Alternative 4). Operation of source reduction measures such as SVE might require additional time to implement if treatability studies or pilot testing is needed.

5.2.4 Implementability

Implementability evaluates the technical and administrative difficulties associated with implementing each alternative. Each of the alternatives is implementable to varying degrees, but

there are several technical and administrative difficulties associated with each of the alternatives evaluated in this FS.

Technically, Institutional Controls (Alternative 2) would be easily implemented, as would the ICs component of Alternatives 3 and 4. There are no technical difficulties associated with implementing additional ICs as no physical facilities would be constructed and Aerojet and the regulatory agencies have already negotiated ICs for the Carve-Out lands. For those portions of the BOU under Aerojet's ownership, there would appear to be no institutional impediments to reaching agreement on acceptable language. Implementation of additional ICs would involve coordination with several regulatory agencies and potentially with several governmental entities. The technical and legal professionals are readily available to implement additional ICs and have been involved in preparing the various existing legal documents.

From an administrative implementability perspective, there are several areas within the BOU where existing buildings or structures would remain in service or would not be demolished until future development plans are implemented. Their presence would prevent the implementation of containment technologies (Alternative 3) and some source reduction/removal technologies (Alternative 4) for several years.

With respect to Containment/Operational Controls (Alternative 3), construction and maintenance of engineered barriers is technically feasible. Construction of asphalt or concrete caps and maintenance of existing asphalt and concrete over areas having COCs in the vadose zone can easily be performed. Construction of vapor barriers as part of new construction is a standard technology that does not pose any technical issues relative to implementability. Installation of foundation venting or SVE systems around or beneath existing buildings may be constrained by the presence of extensive underground utilities and landscaping, but these conditions are not expected to prevent or otherwise limit the implementability or effectiveness of these technologies. All of the containment/operational controls technologies are commercially available and use standard construction equipment and labor. The necessary materials and specialist personnel are easily attainable.

There should be no administrative restrictions on implementation of Containment/Operational Controls under Alternative 3. Permits may be required for discharge of vapor withdrawn by foundation venting or SVE systems.

Excavation and off-site disposal of soil containing COCs and/or implementation of SVE systems under Alternative 4 (Source Reduction/Removal) are technically feasible. SVE for mass removal may be difficult to implement under and around existing buildings because of extensive foundation systems and numerous underground existing utilities. Also heterogeneous soil conditions could greatly influence the effectiveness of SVE for mass removal. To evaluate soil

conditions and vapor permeability, pilot testing of SVE systems would be needed to assess design parameters of SVE for mass reduction/removal.

Alternative 4 would present few administrative difficulties and would require minor coordination with other Agencies. Excavation, off-site disposal in a permitted Class II landfill, and SVE are commercially available demonstrated technologies that involve the use of standard construction equipment and labor. The necessary materials and equipment are easily attainable and specialist personnel are readily available. Permits may be required for discharge of vapor withdrawn by foundation venting or SVE systems.

In summary, from both the administrative and technical perspectives, Alternative 2 (Institutional Controls) would be the easiest to implement, followed by Alternative 3 (Containment/ Operational Controls). Alternative 4 (Source Reduction/Removal) would be the most difficult to implement.

5.2.5 Cost

A summary of the estimated costs associated with each alternative was presented previously on Table 4-1. The cost estimates for each alternative were prepared in accordance with current EPA guidance with respect to level of accuracy and discount rate (i.e., 2.7 percent). For comparison purposes, the estimated total capital cost, estimated annual monitoring costs, estimated annual OM&M costs, and estimated 30-year present worth cost estimates are presented on Table 4-1 for each of the alternatives. The basis for the costs and the methodology and information used to develop the costs are provided in Appendix B.

The 30-year present worth costs for Alternative 2 (Institutional Controls) are less than the other two alternatives. In general, for most of the MAs within the BOU, 30-year present worth costs for Alternative 3 (Containment/Operational Controls) are less than those for Alternative 4 (Source Reduction/Removal).

5.3 Modifying Criteria

The final two of the nine criteria are state acceptance and community acceptance. These two criteria are evaluated following comment on the FS and Proposed Plan and as such are termed modifying criteria.

5.3.1 State Acceptance

This criterion addresses the State's apparent preferences among or concerns about the various alternatives. State Acceptance will be addressed as part of the final decision-making process during the preparation of the ROD.

5.3.2 Community Acceptance

This criterion addresses the community's apparent preferences among or concerns about the various alternatives and will be addressed as part of the final decision-making process during the preparation of the ROD.

6.0 Application of Alternatives to the Boundary Operable Unit

This section summarizes the application of Alternative 2 (Institutional Controls), Alternative 3 (Containment/Operational Controls), and Alternative 4 (Source Removal/Reduction) for retained remedial areas within the BOU. Sections 4.0 and 5.0 evaluate these Alternatives along with Alternative 1 (No Action) in terms of the following threshold and primary balancing criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short Term Effectiveness
- Implementability
- Cost

Due to the number, size and complexity of the BOU remedial areas, to provide a protective, effective, and implementable remedy, individual components of Alternatives 2 through 4 were grouped into four potential Remedial Options (1 through 4) that could potentially be implemented at BOU. Because Alternative 1 (No Action) does not restrict, reduce, or eliminate potential exposures of chemical concentrations to humans or ecological receptors; prevent chemical migration; or reduce potential source area concentrations, it would not apply.

The previous sections evaluated the four potential Remedial Options and showed that they would meet the seven thresholds and primary balancing evaluation criteria as the components of the Alternatives. The following sections discuss the selected Alternative components that make up Remedial Options 1 through 4 for the retained remedial areas, which were defined in Sections 1.5 and 1.6.

Table 6-1 lists the specific components of the Alternatives proposed for each Remedial Option. As shown in Table 6-1, all four Remedial Options would include Institutional Controls (Alternative 2). The Remedial Options are:

- Remedial Option 1 is essentially a combination of Institutional Controls (Alternative 2) and Containment/Operational Controls (Alternative 3).
- Remedial Options 2, 3 and 4 are comprised of combinations of Institutional Controls (Alternative 2), Containment/Operational Controls (Alternative 3) and Source Reduction/Removal (Alternative 4).

Table 6-2 summarizes the cost of implementing each of the Remedial Options across the BOU. Tables 6-3 through 6-5 summarize the cost of implementing remedial actions for soil, soil vapor

and groundwater, respectively. Appendix B, Tables B-1 through B-13 provide detailed cost estimates for the Remedial Options components discussed in the following sections. Figure 6-1 plots retained remedial areas including the areas retained due to VOC concentrations in groundwater that might impact indoor air. In addition, Figure 6-1 shows the areas that will have ICs other than prohibited use of groundwater and ecological ICs. Figures 6-2 through 6-12 show the targeted soil and soil vapor retained remedial areas within the BOU MAs.

6.1 Boundary Operable Unit – BOU-Wide

Several IC components, as well as a Containment/Operation Control component, are already in place at Aerojet sitewide and so apply to the entire BOU. Several additional IC components would be implemented across the entire BOU.

6.1.1 Boundary Operable Unit – BOU-Wide Institutional Controls and Monitoring

The ICs and monitoring already in place for the BOU were discussed in Section 3.2.2 and include:

- Governmental Controls:
  - *Sacramento County Consultation Zone Policy* requiring special review for well permits located within 2,000 feet of a known groundwater chemical plume.
  - Sacramento County Aerojet Special Planning Area (SPA) Ordinance (Sacramento County Zoning Code Title V, Chapter 8, Article 3), which regulates land use and development of the approximately 7,000 acres of the Aerojet property in unincorporated Sacramento County. The General Land Use Plan for the City of Rancho Cordova also recognizes the Aerojet SPA for that portion of the Aerojet property that lies within the municipal boundaries of Rancho Cordova.
- Informational Devices:
  - The Aerojet site is listed in the State Water Resources Control Board Geo-Tracker database and GIS of environmental data. The Aerojet site is also listed in the DTSC EnviroStor database and GIS registry of sites that have known COCs.
  - The presence of COCs and restrictions on land and/or groundwater use at the Aerojet site are identified in several Land Use Plans, including the *Cordova Community Plan*, and the Sacramento County Water Agency *Groundwater Management Plan*.
- Monitoring:
  - Groundwater monitoring is currently being undertaken pursuant to the PCD and the Unilateral Administrative Order and Cleanup and Abatement Order for WGOU (OU-3). Groundwater monitoring for PGOU (OU-5) is also required by the PGOU Administrative Order (EPA, 2011) and will be defined when the remedy has been completed.
  - Surface water is monitored under Aerojet's various NPDES permits.

Figure 6-1 identifies areas within the BOU that would be subject to ICs. ICs will be implemented in remedial areas where a residential risk may exist based on modeling of VOC concentrations in groundwater that may migrate into the vadose zone and pose a possible risk to future indoor air. These remedial areas, AE-SV-R-3, AW-SV-R-1, L2-SV-R-1, L5-SV-R-3, MA-SV-R-1, CP2-SV-R-6 and DPEB-SV-R-1 were shown in purple shading on Figures 1-24 through 1-27 and 1-29 through 1-31. ICs will also be implemented where residential risks potentially exist from non-VOCs in shallow soil (CP2-R-9, shown on Figure 6-11).

Table B-1a provides the estimated costs to implement and maintain the ICs that would apply to the entire Aerojet property. The costs include initial costs to prepare an ICs Plan and set up the components of the ICs program (see description in Table B-1a), annual costs to maintain the program, periodic costs (e.g., prepare the 5-Year Review Report and implement changes to record-keeping systems), and 30-year present worth costs. The total costs in Table B-1a for the entire Aerojet property will be divided equally among the following six OUs: PGOU (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41 (OU-4). Estimated costs for ICs in this FS are those associated with the BOU one-sixth share of the sitewide total and are included as Table B-1b. These costs are listed as BOU-wide costs on Table 4-1 and are included on Table 6-2.

6.1.2 Boundary Operable Unit – BOU-Wide Groundwater Containment/Operational Controls

The Groundwater Containment/Operational Controls component that would apply across the BOU is the continued operation of downgradient GET systems. The GET systems collect groundwater COCs migrating beneath the BOU from upgradient sources and/or collect groundwater COCs originating from BOU "source" areas. The migration of groundwater containing COCs from beneath the BOU source areas to the existing GET facilities is discussed in Sections 1.3.6 and 1.4.1.2. Such action is managed under WGOU and PGOU.

6.2 Admin Area

The Admin Area includes Admin East, Admin West, and the area encompassing the FSTP. As described in the RI and Section 1.4.2, residual COCs are present beneath existing buildings; utility corridors; landscaped areas; capped areas (e.g., asphalt and concrete parking areas, roads, and sidewalks); and other infrastructure features in the Admin Area at concentrations that could potentially pose a risk to human health under a residential use scenario, if exposed (Figures 1-24 and 1-25).

Residual COPECs are also present beneath existing buildings; utility corridors; capped areas (e.g., asphalt and concrete parking areas, roads, and sidewalks); and other infrastructure features in Admin East and the northern section of Admin West (but not the FSTP) at concentrations that could potentially pose a risk to ecological receptors if these Facility Areas revert to habitat

(Section 1.6). Therefore, land use controls are recommended to prevent establishment of ecological habitat in Admin East and the northern section of Admin West.

In some areas, COCs are also detected at concentrations that could pose a risk to human health under a commercial/industrial use scenario if exposed and/or could potentially degrade beneficial uses of groundwater. In Admin East, standard risk analyses of existing soil vapor concentrations indicated that there is a potential for risk to human health under a commercial/industrial use scenario. Since some of these buildings and other existing infrastructure features are currently being used and will continue to be used in the foreseeable future, Aerojet conducted an additional evaluation of this area to evaluate these risks. This evaluation included the replacement of default parameters in the risk equations with site specific parameters (such as ceiling heights, air exchange rates, building uses, etc). This evaluation was included in the BOU RI/FS, and summarized in the HHERA (Section 7.2.5.1 and data were included in Appendix I). Although the risks are within the acceptable risk range, this FS included this area for evaluation of remedial alternatives.

The presence of these buildings and infrastructure features provide protection to commercial users from direct contact to these chemicals in soil and present physical limitations to the implementation and/or potential effectiveness of various engineered controls that might otherwise be applicable for removing or reducing COC concentrations in the case of future land use changes. For example, the presence of a large manufacturing or warehouse building overlying residual COC concentrations in shallow, unsaturated soil would prevent, or at a minimum restrict, the applicability of active engineered measures such as soil excavation and disposal or soil treatment. Consequently, the available remedial technologies are unlikely to remove or reduce COC concentration beneath these buildings to levels that would allow for unrestricted use.

In 2009 and 2010, Aerojet excavated several retained remedial areas. In Admin East, remedial areas AE-C-1 through AE-C-11 (Figure 1-24; Table 1-4) were excavated to a maximum depth of 10 feet as agreed to with the Agencies. Appendix F, Table F-1 lists the confirmation samples results collected during Aerojet's excavation activities in Admin East. Three samples collected exceeded the 90 µg/kg clean up level for PCBs. Sample 11D-PGEX-28 represents the concentrations remaining in place at 10 feet bgs. Sample 11D-PGEX-28SW was collected from the eastern sidewall, which was immediately adjacent a building that could not be undermined. Sample 11D-PGEX-Comp4-SW was collected from the northern sidewall in the Landscaper Area (just east of the 11D drainage ditch), which was immediately adjacent a building that could not be undermined. The removal action and documentation of proper soil disposal are included in the *Final Removal Action Report, Perimeter Groundwater Operable Unit (OU-5), Source Areas 10D and 11D Soil Removal* (Aerojet 2010).

On May 24, 2010, Aerojet received a Notification of Completion for this removal action from EPA (EPA 2010). As these remedial areas have been remediated, the areas are not plotted on Section 6 figures or included in the Remedial Options discussions.

6.2.1 Admin Area - Remedial Option 1

In addition to the BOU-wide Alternative components, the Admin Area's Remedial Option 1 Alternative components would include vapor intrusion mitigation/controls, restrictions preventing establishment of ecological habitat, capping soil vapor areas retained for RTG, capping soil areas retained for HH risk and RTG, and excavation for ecological risk. These components are discussed in the following sections.

6.2.1.1 Admin Area - Vapor Intrusion Mitigation/Controls

Figure 6-2 identifies two areas (AE-SV-R-1 and AE-SV-R-2) within the Admin Area posing a potential risk from vapor intrusion that would be subject to the installation of vapor intrusion controls. Based on modeling using EPA's Subsurface Vapor Intrusion Model and parameters agreed on with the Agencies, the HHRA results indicate that VOCs in soil beneath the south side of Building 20002 and the north side of Building 20004 have the potential to migrate into indoor air at concentrations above acceptable risk-based levels. However, it is relevant to note that parameters used in the model to evaluate the potential VOC migration into indoor air under a commercial use scenario assume typical office building construction. While portions of Buildings 20002 and 20004 include office space, the majority of these buildings consist of former and/or or existing manufacturing areas. These buildings have high roofs, large open spaces, and ventilation systems that include roof ventilators, fans, and slats in walls that allow the movement of air between the inside and outside of the building. Detailed evaluations were undertaken using site specific parameter and are more fully described in the BOU RI/FS, HHERA, Section 7.2.5.1 and Appendix I, and show that current risks are acceptable. However, in the event a facility is modified or replaced, one of the following engineering controls would be appropriate:

- Requiring that the HVAC system in those buildings overlying areas containing VOCs at concentrations that modeling indicates the potential for VOC migration into indoor areas, be operated or, if necessary, modified to provide sufficient air exchange to sufficiently dilute VOC concentrations to further reduce risk levels for commercial/industrial use;
- Retrofitting of a foundation venting system within or immediately below the building foundation or around the perimeter of the building (or around the perimeter of that portion of the building overlying areas having VOCs in soil vapor above risk-based levels), application of vacuum to prevent vapor intrusion into the building and collect and contain the VOCs, thereby further reducing the potential VOC migration within the buildings; and/or

- Creating a building use plan that prevents building modifications that could increase vapor concentrations to unacceptable levels for commercial/industrial uses (e.g., identifying areas where office space is not allowed).

To estimate costs associated with vapor intrusion controls other than those listed above, it was assumed that the existing buildings and surrounding infrastructure in Admin East, Admin West, and the FSTP Area would be demolished and vapor barriers would be installed under new residential and/or commercial structures during construction. It should be noted that, as stated in the Environmental Impact Report for the planned Glenborough at Easton development, installation of moisture barriers is a requirement for any new construction to protect inhabitants from exposure to mold and chemicals.

Moisture barriers and vapor barriers are essentially identical except that vapor barriers require utility penetrations to be taped and sealed. Therefore, the cost estimates for vapor barriers assumed that moisture barriers would be installed by the developer as part of any new construction. The estimated cost for vapor barriers presented includes only the incremental costs associated with sealing utility penetrations and based on existing land use plans, assumes that these costs would not be incurred until 15 years in the future when property redevelopment is anticipated. Prior to redevelopment within the BOU, VOC data would be reviewed for proposed building sites to determine if vapor barriers are still appropriate/adequate/needed.

Table B-2 provides a detailed capital and present worth cost estimate, including the area of vapor barrier coverage.

6.2.1.2 Admin Area - Capping for Risk to Groundwater from Soil Vapor

Figure 6-2 identifies the retained remedial areas for VOCs in Admin East. Five of the remedial areas (AE-SV-R-4 through AE-SV-R-8) have VOC concentrations in soil vapor that would require remedial action to eliminate the potential RTG. Under Remedial Option 1, these areas would be addressed by capping to reduce infiltration and minimize the RTG. Table 6-4 summarizes remedial costs associated with each retained soil vapor remedial areas. Table B-3a provides the detailed capital, OM&M, and present worth cost estimates.

6.2.1.3 Admin Area - Capping for Human Health Soil Risks and Risk to Groundwater from Soil

Figure 6-3 identifies nine retained remedial areas for non-VOCs in Admin Area East that have non-VOC concentrations in soil that pose a potential HH risk (AE-R-2 through AE-R-6, and AE-R-8 and AE-R-9), or RTG (AE-R-1 and AE-R-7) from metals, SVOCs, TPH, and/or PCBs. Figure 6-4 identifies the retained 14 remedial areas for non-VOCs in Admin West. The remedial areas have non-VOC concentrations in soil that pose a potential HH risk (AW-R-1 through AW-R-4, AW-R-6 through AW-R-8, and AW-R-11 through AW-R-14), ecological risk (AW-R-10), or RTG (AW-R-5 and AW-R-9) from metals, SVOCs, and/or PCBs.

Under Remedial Option 1, these areas (except for AW-R-10, see Section 6.2.1.4) would be capped to limit the potential for direct contact with COCs in soil to reduce the HH risk or limit the potential for infiltration of water through the soil and thereby reduce the RTG from COCs in soil. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Tables B-3a and B-3b provide the detailed total capital and present worth cost estimates for the capping component of Remedial Option 1 for BOU remedial areas.

6.2.1.4 Admin Area - Excavation for Ecological Risk

Figure 6-4 shows the retained remedial area, AW-R-10, where non-VOC concentrations in soils would pose an ecological risk from metal, SVOCs, and/or PCBs. Under Remedial Option 1, this area would be designated for excavation and disposal of soil, as capping is not an appropriate remedy for ecological risk.

6.2.1.5 Admin Area – Land Use Controls to Prevent Ecological Exposure to Residual COCs beneath Facility Areas

Figures 6-3 and 6-4 identify the areas for ecological ICs. Land use controls to prevent establishment of ecological habitat in Admin East and the northern section of Admin West are recommended, as residual COCs are present beneath existing buildings; utility corridors; capped areas (e.g., asphalt and concrete parking areas, roads, and sidewalks); and other infrastructure features in these Admin Areas at concentrations that could potentially pose a risk to ecological receptors if these Facility Areas revert to habitat (Section 1.6).

The ecological land use controls would consist of (1) an ecological covenant to preclude reestablishment of habitat; and (2) an ecological deed notice to identify those Admin areas where potential ecological risks may occur if existing facility structures revert to habitat. Areas with these types of land use controls should also undergo five-year reviews to ensure that such controls are effective in maintaining engineering barriers to limit ecological exposure to COCs in soil and/or soil vapor.

6.2.2 Admin Area – Remedial Option 2

The Admin Area's Remedial Option 2 includes each of the components of Remedial Option 1 listed in Section 6.2.1 and includes the groundwater remediation component described below.

6.2.2.1 Admin Area - Groundwater Remediation

Figure 6-3 shows remedial area AE-R-1 in Admin Area East that was retained due to RTG from TPH-D and TPH-MO in deep soil. The COCs were too deep for excavation and detected in underlying groundwater. Based on these impacts, the groundwater component would include air sparging coupled with SVE for this remedial area. Table B-11 provides the detailed capital, OM&M, and present worth cost estimates.

6.2.3 Admin Area – Remedial Option 3

The Admin Area's Remedial Option 3 includes each of the components of Remedial Option 1 (Section 6.2.1) and 2 (Section 6.2.2) with the exception of capping soil vapor areas retained for RTG that was a component of Remedial Option 1. Soil vapor remedial areas retained for RTG would be addressed using SVE as described below.

6.2.3.1 Admin Area – Soil Vapor Extraction for Risk to Groundwater

Figure 6-2 identifies the retained remedial areas for VOCs in Admin East. Five of the remedial areas (AE-SV-R-4 through AE-SV-R-8) have VOC concentrations in soil vapor that would require remedial action to eliminate the potential RTG. At these remedial areas, VOC source removal/reduction to address the RTG would be accomplished using SVE.

Under Remedial Option 3, soils containing COCs in the vicinity of remedial areas AE-SV-R-4 through AE-SV-R-8 would be capped and SVE wells and associated equipment would be installed. Table 6-4 summarizes remedial costs associated with each retained soil vapor remedial areas. Table B-8 provides the detailed capital, OM&M, and present worth cost estimates.

6.2.4 Admin Area – Remedial Option 4

The Admin Area's Remedial Option 4 includes each of the components of Remedial Options 1 through 3 (Sections 6.2.1, 6.2.2 and 6.2.3, respectively) with the exception of capping soil remedial areas retained for HH risk and/or RTG due to presence of non-VOC COCs that were a component of Remedial Option 1. Soil remedial areas retained for HH risk and/or RTG would be addressed by excavating and disposing affected soil as discussed below. The installation of SVE to reduce RTG due to presence of VOC COCs described in Section 6.2.3 would need to be conducted following the completion of excavation activities.

6.2.4.1 Admin Area – Soil Excavation for Human Health Risk, Ecological Risk and Risk to Groundwater

Figure 6-3 identifies nine retained remedial areas for non-VOCs in Admin Area East that have non-VOC concentrations in soil that pose a potential HH risk (AE-R-2 through AE-R-6, and AE-R-8 and AE-R-9), or RTG (AE-R-1 and AE-R-7) from metals, SVOCs, and/or PCBs. With the exception of remedial area AE-R-1 discussed in Section 6.2.2.1, these retained remedial areas could be excavated to eliminate risks.

Most of these remedial areas are physically accessible at this time; however, there are several areas where existing buildings or infrastructure surrounding the buildings would prevent excavation or require the use of additional engineering controls. In some locations, excavation of soils containing COCs would therefore need to be completed following removal of the existing facilities and prior to redevelopment. Table 4-1 presented the estimated costs to implement the excavation and disposal component of Alternative 4 (Source Removal/Reduction) for the Admin

Area. Tables 6-3 summarizes remedial costs associated with each retained soil remedial area. Table B-7 provides detailed capital and present worth cost estimates for the retained remedial areas. Table B-7 also provides the estimated volumes of soil that would be excavated, the estimated excavation floor areas, and the sidewall lengths where confirmation samples would be collected for each of the remedial areas.

Figure 6-4 shows 14 retained remedial areas for non-VOCs in Admin West that have non-VOC concentrations in soil that pose a potential HH risk (AW-R-1 through AW-R-4, AW-R-6 through AW-R-8, and AW-R-11 through AW-R-14), ecological risk (AW-R-10), or RTG (AW-R-5 and AW-R-9) from metals, SVOCs, and/or PCBs. With the exception of remedial area AW-R-14 these retained remedial areas could be excavated to eliminate risks.

AW-R-14 is not completely characterized for the COC driving the HH risk, hexavalent chromium. Additional sampling is recommended to determine the appropriate remedy for the remedial area and whether excavation is appropriate.

Excavation for the ecological risk at remedial area AW-R-10 was previously discussed in Section 6.2.1.4 (Remedial Option 1). All remedial areas are physically accessible at this time. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas, Table B-7 provides the detailed capital and present worth cost estimates for the retained remedial areas. Table B-7 also provides the estimated volumes of soil that would be excavated, the estimated excavation floor areas, and the sidewall lengths where confirmation samples would be collected for each of the remedial areas.

6.3 WLLO Area

The WLLO Area includes Line 2, Line 5 North, Buffalo Creek, Westlakes/OS6, OS5, and OS7. As described in the RI, the majority of the buildings and facilities in these areas are abandoned or used infrequently.

Residual COCs are present in soil at several scattered areas at concentrations that could potentially pose a health risk under a future residential use scenario (Figures 1-26 through 1-28). Additionally, the VOCs are present in groundwater beneath portions of Line 2, Line 5 North, OS5, and a limited portion of OS7 at concentrations suggesting that VOCs could potentially migrate through the vadose zone and result in indoor air concentrations above risk-based levels under a residential use scenario. As discussed in Section 1.4.1.2, VOCs in groundwater beneath Line 2, Line 5 North, OS5, and OS7 are generally due to migration from upgradient sources within the Central Disposal Area. Groundwater beneath the WLLO Area flows towards and is contained by the downgradient GET extraction systems and COCs are treated in the GET treatment facilities. COCs identified in the WLLO Area include VOCs, SVOCs, metals, and/or PCBs (Figures 1-26 through 1-28).

VOCs are also present in soil vapor at one location in Line 2 (L2-SV-R-1) at concentrations that could potentially pose a HH risk under a commercial use scenario combined with a high RTG (Figures 1-26 and 6-5). Additionally, VOCs in soil vapor could potentially pose a high RTG in one location in Line 2 (L2-SV-R-2) and two locations in Line 5 North (L5-SV-R-1 and L5-SV-R-2) (Figures 1-26, 1-27 and 6-5). PCBs and silver in the Buffalo Creek sediments could pose a potential risk to ecological receptors (Figures 1-28 and 6-8). It should be noted that the results of the HHRA indicated that PCBs in sediment in Buffalo Creek could potentially pose a risk to human health under a recreational use scenario, which included wading.

In 2010 and 2011, Aerojet excavated several retained remedial areas. The Buffalo Creek remedial area BC-C-1 (Figure 1-28; Table 1-8) was included. In the Buffalo Creek Area, the goal was to protect ecological receptors in aquatic environments, which are only exposed to the top 1-foot of sediment. The top 1-foot of sediment was excavated and backfilled with 1 to 2 feet of cobbles to prevent exposure to the chemicals remaining in place. The removal of the upper foot of sediment general removed the majority of exposure in soils. The confirmation samples collected for Buffalo Creek are listed on Table E-1 and represent the concentrations present in remaining in-place soils. The removal action and documentation of proper soil disposal are included in the *Buffalo Creek Soil and Vegetation Removal Report* (Aerojet 2011).

As this remedial area has been remediated, the area is not plotted on Section 6 figures or included in the Remedial Options discussions.

6.3.1 WLLO Area – Remedial Option 1

In addition to the BOU-wide Alternative components, the WLLO Area's Remedial Option 1 Alternative components would include vapor intrusion mitigation/controls, groundwater monitoring (L2-R-9), capping soil vapor areas retained for RTG, capping soil areas retained for HH risk and/or RTG, and excavation for areas retained for ecological risk. These components are discussed in the following sections.

6.3.1.1 WLLO Area - Vapor Intrusion Mitigation/Controls

Figure 6-5 identifies the one area (L2-SV-R-1) within the WLLO Area where the VOCs migration into indoor air poses a potential unacceptable risk to human health under a residential scenario and would be subject to the installation of vapor intrusion controls. As discussed in Section 6.2.2, costs for vapor intrusion controls would only include the incremental costs associated with upgrading the developer-installed moisture barriers to vapor barriers and would not be incurred until redevelopment of the property occurs.

Based on the existing land use plans, it is anticipated that construction in the WLLO area will occur in 15 years and the costs presented in Table 6-2 reflect this anticipated timeframe. Prior to redevelopment within the BOU, VOC data would be reviewed for proposed building sites to

determine if vapor barriers are appropriate/adequate/needed. Table 4-1 presented the estimated costs to install vapor barriers as part of any new residential construction. Table B-2 provides detailed capital and present worth cost estimates, including the area of vapor barrier coverage.

6.3.1.2 WLLO Area – Groundwater Monitoring

As discussed in the RI and Section 1.4.1.2, there is one area in WLLO (L2-R-9) where sufficient groundwater monitoring data have been collected, but additional monitoring is needed to evaluate temporal trends in the FWBZ (Figure 6-6). Therefore under Remedial Option 1, the groundwater component would involve collection and evaluation of additional monitoring data from existing FWBZ monitoring wells. The assumed monitoring schedule for L2-R-9 is to monitor five existing monitoring wells for perchlorate and VOCs annually for five years.

Table 4-1 presented estimated costs to implement the groundwater monitoring component of Remedial Option 2 for WLLO. Table 6-5 summarizes remedial costs associated with each retained groundwater remedial areas. Table B-5 provides the detailed monitoring and present worth cost estimates. Remedial Option 1 would rely on the downgradient GET systems for containment and treatment of groundwater beneath the WLLO.

6.3.1.3 WLLO Area - Capping for Risk to Groundwater from Soil Vapor

Figure 6-5 identifies four retained remedial areas in Lines 2 and 5 North in the WLLO Area where VOCs in soil vapor would require remedial action to eliminate the potential RTG (L2-SV-R-1, L2-SV-R-2, L5-SV-R-1 and L5-SV-R-2).

Under Remedial Option 1, each of these remedial areas would be addressed by capping the area to reduce infiltration and minimize the RTG. Table 6-4 summarizes remedial costs associated with each retained soil vapor remedial areas. Table B-3a provides the detailed capital, OM&M, and present worth cost estimates to implement the capping component of Remedial Option 1 for Line 2 and Line 5 North.

6.3.1.4 WLLO Area - Capping for Human Health Soil Risks and Risk to Groundwater from Soil

Figure 6-6 identifies nine retained remedial areas in Line 2 that contain non-VOC concentrations in soil that pose a potential HH risk (L2-R-2) or RTG (L2-R-1, and L2-R-3 through L2-R-9). Figure 6-7 identifies two retained remedial areas (L5-R-1 and L5-R-2) in Line 5 North where non-VOC concentrations in soil pose either a potential HH risk (L5-R-1) or a RTG (L5-R-2).

Under Remedial Option 1, these 11 areas would be capped to limit the potential for direct contact with the soil to reduce the HH risk or limit the potential for infiltration of water through the soil and thereby reduce the RTG from the soil. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-3b provides the detailed capital and present worth cost estimates for the remedial areas to be capped in Line 2 and Line 5 North.

6.3.1.5 WLLO Area - Excavation for Ecological Risk

Figure 6-8 shows three retained remedial areas in Buffalo Creek/West Lakes where non-VOC concentrations in soil pose a potential ecological risk (BC-R-1, BC-R-2, and WL-R-1) or a potential combined HH and ecological risk (BC-R-1).

Under Remedial Option 1, these remedial areas would be excavated to eliminate risks and are physically accessible at this time. Table 4-1 presented estimated costs to implement the excavation and disposal component of Remedial Option 1 for the WLLO Area. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-7 provides the detailed capital and present worth cost estimates for the retained ecological remedial areas. Table B-7 also provides the estimated volumes of soil that would be excavated, the estimated excavation floor areas, and the sidewall lengths where confirmation samples would be collected for each of the remedial areas.

6.3.2 WLLO Area – Remedial Option 2

The WLLO Area's Remedial Option 2 would include each of the components of Remedial Option 1 listed in Section 6.3.1 and also would include implementing the contingent groundwater hydraulic containment, if necessary, and, instead of capping, the perchlorate in soil posing a RTG at L2-R-9 would be flushed to groundwater, captured and treated (Table 6-1) as described below.

6.3.2.1 WLLO Area – Contingent Groundwater Hydraulic Containment

If the COCs concentrations or extent in FWBZ groundwater in the vicinity of L2-R-9 increases over time, a contingent hydraulic containment remedy would be implemented. The hydraulic containment remedy would consist of installing a groundwater extraction well and conducting a pumping test in the newly installed well. Based on the pumping test results, an appropriately-sized pump would be installed in the well and piping would be installed to convey the extracted groundwater to the ARGET pipeline system for treatment at ARGET. Table 4-1 presented estimated costs to implement the groundwater contingent hydraulic containment component of Remedial Option 2 for Line 2. Table 6-5 summarizes remedial costs associated with each retained groundwater remedial areas. Table B-6 provides the detailed capital, OM&M, and present worth cost estimates.

6.3.2.2 WLLO Area – Soil Flushing and Groundwater Remediation

Figure 6-6 shows the retained remedial area L2-R-9 where perchlorate in soil is a risk to perched groundwater at depths too deep for excavation (15-50 feet bgs). Under this remedy, perchlorate would be flushed from the soil using recharged treated groundwater. The flushing water would be extracted from the perched water zone using groundwater extraction wells, and then treated aboveground using a sulfur oxidizing bioreactor (for perchlorate removal) and air stripping (for VOC removal), and recharged to the area above the impacted soil via ponding, shallow recharge

wells or a trench. This technology has been evaluated for other areas in the vicinity of the Aerojet site and eliminated due to depth of impacted soil (>50 feet bgs). Although this technology has limited application, it has been successful during treatability studies conducted at the Aerojet site on shallow impacted soil (<50 feet bgs). Success was achieved by ensuring the area of recharge blankets the area to be treated.

Table 4-1 presented estimated costs to implement the soil flushing and groundwater remediation component of Remedial Option 2 for the WLLO Area. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-12 provides the detailed capital, OM&M and present worth cost estimates for remedial area L2-R-9.

6.3.3 WLLO Area – Remedial Option 3

The WLLO Area's Remedial Option 3 would include each of the components of Remedial Options 1 (Section 6.3.1) and 2 (Section 6.3.2) with the exception of capping soil vapor areas retained for RTG that was a component of Remedial Option 1. Soil vapor remedial areas retained for RTG would be addressed using SVE, as described below.

6.3.3.1 WLLO Area – Soil Vapor Extraction for Risk to Groundwater

Figure 6-5 shows four retained remedial areas in Lines 2 and 5 North where VOC concentrations in soil vapor pose a potential RTG (L2-SV-R-2, L5-SV-R-1 and L5-SV-R-2) or a potential combined HH risk and RTG (L2-SV-R-1).

Under Remedial Option 3, these remedial areas would be addressed by VOC source removal/reduction that would be accomplished using SVE to reduce risk. Table 4-1 presented estimated costs to implement the SVE component of Remedial Option 3 for the WLLO Area. Table 6-4 summarizes remedial costs associated with each retained soil vapor remedial area. Tables B-9 and B-10 provide detailed capital, OM&M, and present worth cost estimates for Line 2 and Line 5 North, respectively.

6.3.4 WLLO Area – Remedial Option 4

The WLLO Area's Remedial Option 4 would include each of the components of Remedial Options 1 through 3 (Sections 6.3.1, 6.3.2, and 6.3.3, respectively) with the exception of capping soil areas retained for HH risk and RTG that were a component of Remedial Option 1. These soil remedial areas retained for HH risk and RTG would be addressed by excavating and disposing soil as discussed below.

6.3.4.1 WLLO Area – Soil Excavation for Human Health Risk and Risk to Groundwater

Figure 6-6 shows nine retained remedial areas in Line 2 that contain non-VOC concentrations in soil that pose a RTG (L2-R-1 and L2-R-3 through L2-R-9) and the HH risk (L2-R-2). Figure 6-7

shows two retained remedial areas in Line 5 North where non-VOC concentrations in soil pose a potential HH risk (L5-R-1) and RTG (L5-R-2).

Under Remedial Option 4, each of these remedial areas except L2-R-9 would be excavated to reduce risk. Most of these areas are physically accessible at this time; however, there are several areas where existing buildings or infrastructure surrounding the building would prevent excavation or require the use of additional engineering controls. Non-VOC concentrations in soil at remedial area L2-R-9 are too deep for excavation; therefore, the remedy presented in Remedial Option 2 would still be implemented under Remedial Option 4.

Table 4-1 presented estimated costs to implement the excavation and disposal component of Remedial Option 4 for the WLLO Area. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-7 provides the detailed capital and present worth cost estimates for retained remedial areas. Table B-7 also provides the estimated volumes of soil that would be excavated, the estimated excavation floor areas, and the sidewall lengths where confirmation samples would be collected for each of the remedial areas.

6.4 Magazine Area

The Magazine Area includes the Magazine Area/OS3, and OS4. As discussed in the RI, the Magazine Area is still used for materials storage associated with ongoing operations at the Aerojet facility.

Residual VOCs are present at concentrations that could potentially pose an unacceptable risk to human health under a residential use scenario near a former septic system associated with Building 48013 (Figures 1-29 and 6-9). Additionally, as shown in Figure 6-9, VOCs are present in groundwater beneath OS4 at concentrations that modeling indicates may migrate through the vadose zone and result in indoor air concentrations that could pose an unacceptable risk to residential users. The presence of VOCs in groundwater beneath OS4 is due to migration from source areas upgradient and east of the Magazine Area.

6.4.1 Magazine Area – Remedial Option 1

In addition to BOU-wide Alternative components, the Magazine Area's Remedial Option 1 would include vapor intrusion mitigation/controls. This component is discussed in the following section.

6.4.1.1 Magazine Area - Vapor Intrusion Mitigation/Controls

Figure 6-9 identifies areas within the Magazine Area where the VOCs migration into indoor air poses a potential unacceptable risk to human health under a residential scenario and would be subject to the installation of vapor intrusion controls. These include a small area along the

eastern edge of the Magazine Area and roughly 75 percent of OS4 overlying groundwater having VOCs that could pose an unacceptable risk under a future residential use scenario.

For the purposes of estimating cost in this FS for implementation of vapor intrusion controls under a future residential use scenario, it was assumed vapor barriers would be installed under any new residential structures during construction in those areas shown in Figure 6-9. Prior to redevelopment within the BOU, VOC data will be reviewed for proposed building sites to determine if vapor barriers are still appropriate/adequate/needed.

As discussed in Section 6.2.2, costs for vapor intrusion controls would only include the incremental costs associated with upgrading the developer-installed moisture barriers to vapor barriers and would not be incurred until redevelopment of the property occurs. There are no plans for redevelopment of the Magazine Area at this time. Therefore, any costs associated with provision of vapor barriers are assumed to occur beyond the 30-year costing period considered in this FS.

6.4.2 Magazine Area Components of Remedial Option 2

Remedial Option 2 is not applicable to Magazine Area.

6.4.3 Magazine Area Components of Remedial Option 3

Remedial Option 3 is not applicable to Magazine Area.

6.4.4 Magazine Area – Remedial Option 4

Remedial Option 4 is not applicable to Magazine Area.

6.5 Chemical Plant 2 Region

The Chemical Plant 2 region includes Chemical Plant 2, the Dredge Pit and Eastern Basin, OS1, and OS2. As described in the RI, buildings and facilities in this area are mostly inactive and abandoned. Some buildings may be used for the temporary storage of materials, but none are continuously occupied. There are no COCs in soil or groundwater associated with OS1.

Areas where residual COCs are present at concentrations that could potentially pose a risk to human health under residential and commercial use scenarios are shown in Figures 1-30 and 1-31. Figures 1-30 and 1-31 also show that groundwater containing VOCs at concentrations that modeling indicates may migrate upward from groundwater and result in indoor air concentrations that could pose a risk to human health under a residential use scenario is present beneath the southern portion of Chemical Plant 2, the Dredge Pit and Eastern Basin, and under the majority of OS2. COCs identified at source areas within the Chemical Plant 2 region include VOCs, primarily 1,2-DCA; metals; and PCBs (Figures 1-30 and 1-31).

6.5.1 Chemical Plant 2 – Remedial Option 1

In addition to the BOU-wide Alternative components, the Chemical Plant 2 region's Remedial Option 1 Alternative components would include vapor intrusion mitigation/controls, capping soil areas for HH risk and RTG, and excavation/backfilling for ecological risk in selected source areas. These components are discussed in the following sections.

6.5.1.1 Chemical Plant 2 Region- Vapor Intrusion Mitigation/Controls

Figure 6-10 identifies areas within the Chemical Plant 2 where the VOCs migration into indoor air poses a potential unacceptable risk to human health under a residential scenario and would be subject to the installation of vapor intrusion controls, which includes most of the former operations areas encompassed by Chemical Plant 2 and, due to the presence of VOCs in groundwater, the Dredge Pits and most of OS2.

As discussed in Section 6.2.2, costs for vapor intrusion controls would only include the incremental costs associated with upgrading the developer-installed moisture barriers to vapor barriers and would not be incurred until redevelopment of the property occurs. Prior to redevelopment within the BOU, VOC data will be reviewed for proposed building sites to determine if vapor barriers are appropriate/adequate/needed. There are no plans for redevelopment of the Chemical Plant 2 region at this time. Therefore, costs associated with provision of vapor barriers are assumed to occur beyond the 30-year costing period considered in this FS.

6.5.1.2 Chemical Plant 2 Region – Capping for Human Health Soil Risks from Soil

Figure 6-11 shows 11 retained remedial areas in Chemical Plant 2. Eight of eleven areas contain non-VOC concentrations in soil that pose potential HH risk (CP2-R-2, CP2-R-4 through CP2-R-6, and CP2-R-8 through CP2-R10).

Under Remedial Option 1, remedial areas CP2-R-2, CP2-R-4 through CP2-R-6, CP2-R-8, and CP2-R-10 would be capped to limit the potential for direct contact with the soil to reduce the HH risk, and remedial area CP2-R-9 would be contained through the use of ICs. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-3b provides the detailed capital and present worth cost estimates for the remedial areas to be capped.

6.5.1.3 Chemical Plant 2 Region – Excavation/Backfilling for Ecological Risk

Figure 6-11 shows 11 retained remedial areas in Chemical Plant 2. Three of these eleven retained remedial areas (CP2-R-1, CP2-R-3 and CP2-R-7) contained non-VOCs in soil that pose a potential ecological risk. Under Remedial Option 1, these remedial areas would be excavated to reduce risk.

Table 4-1 presented estimated costs to implement the excavation and disposal component of Remedial Option 1 for the Chemical Plant 2 region. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-7 provides the detailed capital and present worth cost estimates for the retained excavation remedial areas. Table B-7 also provides the estimated volumes of soil that would be excavated, the estimated excavation floor areas, and the sidewall lengths where confirmation samples would be collected for each of the remedial areas.

Figure 6-12 shows retained remedial area DPEB-R-1 where metals, di-n-butyl phthalate and Prowl® in soil pose a potential ecological risk. Under Remedial Option 1, DPEB-R-1 would be addressed by backfilling with clean soil to achieve a fill depth of six feet to isolate the affected soil from potential ecological receptors. Table 4-1 presented estimated costs to implement the backfilling component of Remedial Option 1 for the Dredge Pit/Eastern Basin area. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-13 provides the detailed capital, OM&M, and present worth cost estimates.

6.5.2 Chemical Plant 2 Region Components of Remedial Option 2

Remedial Option 2 is not applicable to the Chemical Plant 2 region.

6.5.3 Chemical Plant 2 Region Components of Remedial Option 3

Remedial Option 3 is not applicable to the Chemical Plant 2 region.

6.5.4 Chemical Plant 2 –Remedial Option 4

The Chemical Plant 2 region's Remedial Option 4 would include each of the components of Remedial Option 1 listed in Section 6.5.1 with the exception of capping the soil areas retained for HH risk or for RTG. The soil remedial areas retained for HH risk or RTG would be addressed by excavating and disposing soil as discussed below.

6.5.4.1 Chemical Plant 2 Area - Soil Excavation for Human Health Risk, Ecological Risk or Risk to Groundwater

Figure 6-11 shows 11 retained remedial areas in Chemical Plant 2 where non-VOC concentrations in soil pose a potential HH risk (CP2-R-2, and CP2-R-4 through CP2-R-6, CP2-R-8, CP2-R-10, and CP2-R-11) or ecological risk (CP2-R-1, CP2-R-3, and CP2-R-7).

Under Remedial Option 4, these remedial areas would be excavated to reduce risk and most of these remedial areas are physically accessible at this time.

Table 4-1 presented estimated costs to implement the excavation and disposal component of Remedial Option 4 for the Chemical Plant 2 region. Table 6-3 summarizes remedial costs associated with each retained soil remedial areas. Table B-7 provides the detailed capital and

present worth cost estimates for the retained remedial areas. Table B-7 also provides the estimated volumes of soil that would be excavated, the estimated excavation floor areas, and the sidewall lengths where confirmation samples would be collected for each of the remedial areas.

6.6 Summary and Recommendations

The BOU RI/FS process consisted of preparation of the RI, HHERA (including RTG evaluation), and FS for the BOU at the Aerojet Superfund Site. The results of these activities are reported in Volumes I, II, and III of this RI/FS report, respectively. Based on evaluation of the RI and HHERA, this FS serves as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions at the eight MAs and seven OS Areas within the BOU. It also provides options for appropriate remedial actions for retained remedial areas within the Management and OS Areas.

Table 1-3 lists the recommended retained remedial areas along with the COPECs and COCs for HH and RTG. For each remedial area, all risk drivers, HH, Eco, and RTG were identified and included in Table 1-3 for the co-located remedial areas are included to ensure all COC and COPEC analyses on confirmation samples are considered.

Table 6-1
Components Comprising Remedial Options 1 Through 4
Aerojet- Boundary Operable Unit Feasibility Study

Alternative	Component of Alternative	Remedial Option 1	Remedial Option 2	Remedial Option 3	Remedial Option 4
2	Institutional Controls	X	X	X	X
3	Groundwater Containment/Operational Controls[1]	X	X	X	X
3	Vapor Intrusion Mitigation/Controls[2]	X	X	X	X
3	Capping Soil Vapor Areas for Risk to Groundwater	X	X	X	X
3	Capping Soil for Human Health Risk	X	X	X	
3	Capping Soil for Risk to Groundwater	X	X	X	
4	Excavation for Ecological Risk[3]	X	X	X	X
3	Groundwater Monitoring[4]	X	X	X	X
4	Groundwater Remediation		X	X	X
3	Groundwater Hydraulic Containment[5]		X	X	X
4	SVE for Risk to Groundwater			X	X
4	Soil Excavation for Human Health Risk				X
4	Soil Excavation for Risk to Groundwater				X

Notes:

[1] = Containment/operational controls are the continued operation of downgradient GET systems that collect groundwater COCs migrating beneath BOU from upgradient sources and/or collect groundwater COCs originating from BOU "source" areas

[2] = Implemented in areas not selected for other soil vapor remedy

[3] = Capping not appropriate for ecological areas, in Dredge Pit/Eastern Basin area, ecological risk will be addressed by backfilling with clean fill rather than excavation

[4] = Implemented for selected existing monitoring wells within specified source areas only

[5] = Implemented only if groundwater concentrations or extent of COCs in groundwater increase over time in the selected groundwater monitoring areas

Table 6-2
Summary of Remedial Options Estimated Costs
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Option 1- Institutional Controls, Vapor Barriers, Cap/Excavate Soil, Cap Soil Vapor Areas for Protection of Groundwater, and Groundwater Monitoring

	Institutional Controls			Vapor Barriers (Admin Area and WLLO)			Cap/Excavate Soil				Cap Soil Vapor Areas for Protection GW				Groundwater Monitoring				Active RA for Other Concerns		
Type of Remedial Area	Capital Cost	O&M/yr	NPW (30yr)	Acres	Capital Cost	NPW (30yr)	Acres	Capital Cost	O&M/5 yrs	NPW (30yr)	Acres	Capital Cost	O&M/5 yrs	NPW (30yr)	Monitoring	Capital Cost	O&M/yr	NPW (30yr)	Capital Cost	O&M/yr	NPW (30yr)
Institutional Controls - BOU Wide	$14,000	$3,000	$100,000				#REF!														
Protection of Groundwater							0.47	$42,900	$7,700	$76,300	0.51	$63,000	$8,700	$97,000	$19,000						
Residential only							0.06	$5,800	$1,000	$10,300											
Other							3.63	$331,000	$59,500	$589,000											
Excavation for ecological - capping not appropriate							6.18	$2,438,000	$0	$2,438,000											
Ecological Backfill Only																			$128,000		$128,000
Detected COCs but recommended for no action							8.72														
Remedy Previously Completed							7.69														
Vapor Intrusion Controls				55.2	$1,200,000	$830,000															
	Institutional Controls			**Vapor Barriers**			**Excavation**	**Capping**			**Capping for Soil Vapor**				**Monitoring**				**Active RA for Other Concerns**		
NPW Cost by Remedy	$100,000			$830,000			$2,438,000	$676,000			$97,000				$19,000				$128,000		
Total NPW Cost Option 1	$4,290,000																				

Remedial Option 2 - Institutional Controls, Vapor Barriers, Cap/Excavate Soil, Cap Soil Vapor Areas for Protection of Groundwater, Groundwater Monitoring and Contingent Remedy, Active Remedial Action for Other Groundwater Concerns

	Institutional Controls			Vapor Barriers (Admin Area and WLLO)			Cap/Excavate Soil				Cap Soil Vapor Areas for Protection GW				Groundwater Monitoring and Contingent Remedy				Active RA for GW or Other Concerns		
Type of Remedial Area	Capital Cost	O&M/yr	NPW (30yr)	Acres	Capital Cost	NPW (30yr)	Acres	Capital Cost	O&M/5 yrs	NPW (30yr)	Acres	Capital Cost	O&M/5 yrs	NPW (30yr)	Monitoring	Capital Cost	O&M/yr	NPW (30yr)	Capital Cost	O&M/yr	NPW (30yr)
Institutional Controls - BOU Wide	$14,000	$3,000	$100,000				#REF!														
Protection of Groundwater							0.45	$40,800	$7,000	$73,000	0.51	$63,000	$8,700	$97,000	$19,000	$450,000	$16,000	$650,000	$330,000	$68,000	$810,000
Residential only							0.06	$5,800	$1,000	$10,300											
Other							3.63	$331,000	$59,500	$589,000											
Excavation for ecological - capping not appropriate							6.18	$2,438,000	$0	$2,438,000											
Ecological Backfill Only																			$128,000		$128,000
Detected COCs but recommended for no action							8.72														
Remedy Previously Completed							7.69														
Vapor Intrusion Controls				55.2	$1,200,000	$830,000															
	Institutional Controls			**Vapor Barriers**			**Excavation**	**Capping**			**Capping for Soil Vapor**				**Monitoring**	**Groundwater Contingent Remedy**			**Active RA for GW or Other Concerns**		
NPW Cost by Remedy	$100,000			$830,000			$2,438,000	$672,000			$97,000				$19,000	$650,000			$938,000		
Total NPW Cost Option 2	$5,740,000																				

Remdial Option 3 - Institutional Controls, Vapor Barriers, Cap/Excavate Soil, SVE for Protection of Groundwater, Groundwater Monitoring and Contingent Remedy, Active Remedial Action for Other Groundwater Concerns

	Institutional Controls			Vapor Barriers (Admin Area and WLLO)			Cap/Excavate Soil				Soil Vapor - SVE for Protection of GW				Groundwater Monitoring and Contingent Remedy				Active RA for Other GW Concerns		
Type of Remedial Area	Capital Cost	O&M/yr	NPW (30yr)	Acres	Capital Cost	NPW (30yr)	Acres	Capital Cost	O&M/5 yrs	NPW (30yr)	Acres	Capital Cost	O&M/yr	NPW (30yr)	Monitoring	Capital Cost	O&M/yr	NPW (30yr)	Capital Cost	O&M/yr	NPW (30yr)
Institutional Controls - BOU Wide	$14,000	$3,000	$100,000				26.72														
Protection of Groundwater							0.45	$40,800	$7,000	$73,000	0.51	$1,220,000	$207,000	$2,530,000	$19,000	$450,000	$16,000	$650,000	$330,000	$68,000	$810,000
Residential only							0.06	$5,800	$1,000	$10,300											
Other							3.63	$331,000	$59,500	$589,000											
Excavation for ecological - capping not appropriate							6.18	$2,438,000	$0	$2,438,000											
Ecological Backfill Only																			$128,000		$128,000
Detected COCs but recommended for no action							8.72														
Remedy Previously Completed							7.69														
Vapor Intrusion Controls				55.2	$1,200,000	$830,000															
	Institutional Controls			**Vapor Barriers**			**Excavation**	**Capping**			**SVE for Protection of GW**				**Monitoring**	**Groundwater Contingent Remedy**			**Active RA for GW or Other Concerns**		
NPW Cost by Remedy	$100,000			$830,000			$2,438,000	$672,000			$2,530,000				$19,000	$650,000			$938,000		
Total NPW Cost Option 3	$8,180,000																				

Remedial Option 4 - Institutional Controls, Vapor Barriers, Soil Excavation, SVE for Protection of Groundwater, Groundwater Monitoring and Contingent Remedy, Active Remedial Action for Other Groundwater Concerns

	Institutional Controls			Vapor Barriers (Admin Area and WLLO)			Soil Excavation				Soil Vapor - SVE for Protection of GW				Groundwater Monitoring and Contingent Remedy				Active RA for GW or Other Concerns		
Type of Remedial Area	Capital Cost	O&M/yr	NPW (30yr)	Acres	Capital Cost	NPW (30yr)	Acres	Capital Cost		NPW (30yr)	Acres	Capital Cost	O&M/yr	NPW (30yr)	Monitoring	Capital Cost	O&M/yr	NPW (30yr)	Capital Cost	O&M/yr	NPW (30yr)
Institutional Controls - BOU Wide	$14,000	$3,000	$100,000				26.36														
Protection of Groundwater							0.45	$664,000		$664,000	0.51	$1,220,000	$207,000	$2,530,000	$19,000	$450,000	$16,000	$650,000	$330,000	$68,000	$810,000
Residential only							0.29	$10,000		$10,000											
Ecological Only							6.18	$2,438,000		$2,438,000											
Other							3.04	$2,546,000		$2,546,000									$23,000		$23,000
Ecological Backfill Only																			$128,000		$128,000
Detected COCs but recommended for no action							8.72														
Remedy Previously Completed							7.69														
Vapor Intrusion Controls				55.2	$1,200,000	$830,000															
	Institutional Controls			**Vapor Barriers**			**Excavation**				**SVE for Protection of GW**				**Monitoring**	**Groundwater Contingent Remedy**			**Active RA for GW or Other Concerns**		
NPW Cost by Remedy	$100,000			$830,000			$5,658,000				$2,530,000				$19,000	$650,000			$961,000		
Total NPW Cost Option 4	$10,750,000																				

Table 6-3
Remedial Costs Associated with Retained Soil Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Aerojet Remediation Category	Total Area (acres)	Planned Development	Appendix B Table	Capping Area (Acres)	Weighted Capping Estimated Capital Cost	Weighted OM&M Costs (every 5 years)	Weighted Capping 30 Year NPW Cost	Appendix B Table	Excavation Area (acres)	Excavation Depth (feet, bgs)	Weighted Estimated Capital Cost	Comment	Appendix B Table	Other Remedial Technology Estimated Capital Cost	Other Remedial Technology OM&M Costs	Other Remedial Technology 30 Year NPW Cost
AE-R-7	RTG	0.046	Not Planned	B-3b	0.046	$4,175	$751	$7,433	B-7	0.046	12	$98,000					
AW-R-5	RTG	0.042	Easton Place	B-3b	0.042	$3,828	$688	$6,817	B-7	0.042	2	$15,000					
AW-R-9	RTG	0.015	Easton Place	B-3b	0.015	$1,367	$246	$2,433	B-7	0.015	3.5	$9,000					
L2-R-1	RTG	0.040	Westborough II	B-3b	0.040	$3,622	$651	$6,450	B-7	0.040	3.5	$25,000					
L2-R-3	RTG	0.038	Westborough II	B-3b	0.038	$3,480	$626	$6,197	B-7	0.038	3.5	$24,000					
L2-R-4	RTG	0.082	Westborough II	B-3b	0.082	$7,447	$1,339	$13,260	B-7	0.082	12	$174,000					
L2-R-5	RTG	0.028	Westborough II	B-3b	0.028	$2,586	$465	$4,604	B-7	0.028	12	$60,000					
L2-R-6	RTG	0.042	Westborough II	B-3b	0.042	$3,790	$681	$6,748	B-7	0.042	5.5	$41,000					
L2-R-7	RTG	0.030	Westborough II	B-3b	0.030	$2,756	$495	$4,907	B-7	0.030	12	$64,000					
L2-R-8	RTG	0.047	Westborough II	B-3b	0.047	$4,330	$778	$7,709	B-7	0.047	12	$102,000					
L2-R-9	RTG	0.023	Westborough II	B-3b	0.023	$2,080	$374	$3,704	NA	NA	0	NA	Cap Opt 1 only; Soil Flush Opts 2-4	B-12	$170,000	$34,000	$440,000
L5-R-2	RTG	0.011	Westborough II	B-3b	0.011	$1,008	$181	$1,795	B-7	0.011	12	$24,000					
WL-R-1	RTG	0.026	Westborough II	B-3b	0.026	$2,387	$429	$4,251	B-7	0.026	6	$28,000					
RTG Subtotals		*0.469*			*0.469*	*$42,855*	*$7,705*	*$76,306*		*0.447*		*$664,000*			*$170,000*	*$34,000*	*$440,000*
AW-R-3	Residential Only	0.025	Easton Place	B-3b	0.025	$2,261	$407	$4,026	B-7	0.025	1.5	$7,000					
AW-R-4	Residential Only	0.039	Easton Place	B-3b	0.039	$3,524	$634	$6,274	B-7	0.039	0.5	$3,000					
Residential Only Subtotals		*0.063*			*0.063*	*$5,785*	*$1,040*	*$10,300*		*0.063*		*$10,000*			*$0*	*$0*	*$0*
AW-R-10	Ecological	1.131	Easton Place		NA	NA	NA	NA	B-7	1.131	2	$403,000					
BC-R-1	Ecological	2.647	Open Space		NA	NA	NA	NA	B-7	2.647	2.5	$1,179,000					
BC-R-2	Ecological	1.209	Open Space		NA	NA	NA	NA	B-7	1.209	2	$431,000					
CP2-R-1	Ecological	0.126	Not Planned		NA	NA	NA	NA	B-7	0.126	2	$45,000					
CP2-R-3	Ecological	1.066	Not Planned		NA	NA	NA	NA	B-7	1.066	2	$380,000					
CP2-R-7	Ecological	0.069	Not Planned		NA	NA	NA	NA	B-7	0.069	1.25	$15,000					
Ecological Only Subtotals		*6.178*			*0.000*	*$0*	*$0*	*$0*		*6.178*		*$2,438,000*			*$0*	*$0*	*$0*
AE-R-2	Other	0.418	Not Planned	B-3b	0.418	$38,173	$6,864	$67,969	B-7	0.418	6	$447,000					
AE-R-3	Other	0.074	Not Planned	B-3b	0.074	$6,798	$1,222	$12,104	B-7	0.074	4	$53,000					
AE-R-4	Other	0.050	Not Planned	B-3b	0.050	$4,527	$814	$8,060	B-7	0.050	6	$53,000					
AE-R-5	Other	0.211	Not Planned	B-3b	0.211	$19,238	$3,459	$34,255	B-7	0.211	2	$75,000					
AE-R-6	Other	0.097	Not Planned	B-3b	0.097	$8,868	$1,595	$15,791	B-7	0.097	4	$69,000					
AE-R-8	Other	0.213	Not Planned		NA	NA	NA	NA	B-7	0.213	2	$76,000					
AW-R-1	Other	0.258	Easton Place	B-3b	0.258	$23,580	$4,240	$41,985	B-7	0.258	2	$92,000					
AW-R-11	Other	0.227	Easton Place	B-3b	0.227	$20,718	$3,725	$36,889	B-7	0.227	2	$81,000					
AW-R-12	Other	0.093	Easton Place	B-3b	0.093	$8,534	$1,534	$15,195	NA	NA	2	NA	Included AW-R-10				
AW-R-13	Other	0.023	Easton Place	B-3b	0.023	$2,071	$372	$3,688	NA	NA	2	NA	Included AW-R-10				
AW-R-2	Other	0.070	Easton Place	B-3b	0.070	$6,385	$1,148	$11,369	B-7	0.070	2	$25,000					
AW-R-6	Other	0.289	Easton Place	B-3b	0.289	$26,395	$4,746	$46,998	B-7	0.289	2	$103,000					
AW-R-7	Other	0.459	Easton Place	B-3b	0.459	$41,930	$7,539	$74,658	B-7	0.459	6	$491,000					
AW-R-8	Other	0.410	Easton Place	B-3b	0.410	$37,422	$6,728	$66,631	B-7	0.410	12	$876,000					
CP2-R-10	Other	0.056	Not Planned	B-3b	0.056	$5,137	$924	$9,147	NA	NA	1.25	NA	Included CP2-R-1				
CP2-R-11	Other	0.139	Not Planned	B-3b	0.139	$12,715	$2,286	$22,640	NA	NA	2	NA	Included CP2-R-1				
CP2-R-2	Other	0.065	Not Planned	B-3b	0.065	$5,971	$1,074	$10,632	NA	NA	2	NA	Included CP2-R-3				

Table 6-3
Remedial Costs Associated with Retained Soil Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Aerojet Remediation Category	Total Area (acres)	Planned Development	Appendix B Table	Capping Area (Acres)	Weighted Capping Estimated Capital Cost	Weighted OM&M Costs (every 5 years)	Weighted Capping 30 Year NPW Cost	Appendix B Table	Excavation Area (acres)	Excavation Depth (feet, bgs)	Weighted Estimated Capital Cost	Comment	Appendix B Table	Other Remedial Technology Estimated Capital Cost	Other Remedial Technology OM&M Costs	Other Remedial Technology 30 Year NPW Cost
CP2-R-4	Other	0.184	Not Planned	B-3b	0.184	$16,770	$3,015	$29,860	B-7	0.184	6	$196,000					
CP2-R-5	Other	0.080	Not Planned	B-3b	0.080	$7,346	$1,321	$13,081	B-7	0.080	2	$29,000					
CP2-R-6	Other	0.183	Not Planned	B-3b	0.183	$16,691	$3,001	$29,718	B-7	0.183	2	$65,000					
CP2-R-8	Other	0.301	Not Planned	B-3b	0.301	$27,525	$4,949	$49,010	B-7	0.301	2	$107,000					
CP2-R-9	Other	0.066	Not Planned		NA	NA	NA	NA	NA	NA	0	NA	ICs only				
L2-R-2	Other	0.226	Westborough II	B-3b	0.226	$20,649	$3,713	$36,767	B-7	0.226	3	$121,000					
L5-R-1	Other	0.129	Westborough II	B-3b	0.129	$11,763	$2,115	$20,945	B-7	0.129	1.5	34,000					
Other Subtotals		*3.904*			*3.625*	*$331,035*	*$59,520*	*$589,423*		*3.461*		*$2,546,000*			*$0*	*$0*	*$0*
Other Remediation																	
AE-R-1	RTG	0.032	Industrial		NA						0	N/A	AS/SVE	B-11	$160,000	$34,000	$370,000
AE-R-9	Other	0.034	Not Planned		NA	NA	NA	NA	NA	NA	0	NA	Water Jetting Culvert	B-15	$8,000	$0	$8,000
AW-R-14	Other	0.234	Easton Place	B-3b	0.234	$21,325	$3,834	$37,971	NA	NA	0	NA	Addl. Sampling Only	B-14	$15,000	$0	$15,000
DPEB-R-1	Ecological	0.550	Not Planned		NA						0	N/A	Fill w/ clean soil	B-13	$128,000	$0	$128,000
Other Remediation Subtotals		*0.583*			*0.234*	*$21,325*	*$3,834*	*$37,971*							*$311,000*	*$34,000*	*$521,000*
Totals		*11.198*			*4.391*	*$401,000*	*$72,100*	*$714,000*		*10.149*		*$5,658,000*			*$481,000*	*$68,000*	*$961,000*

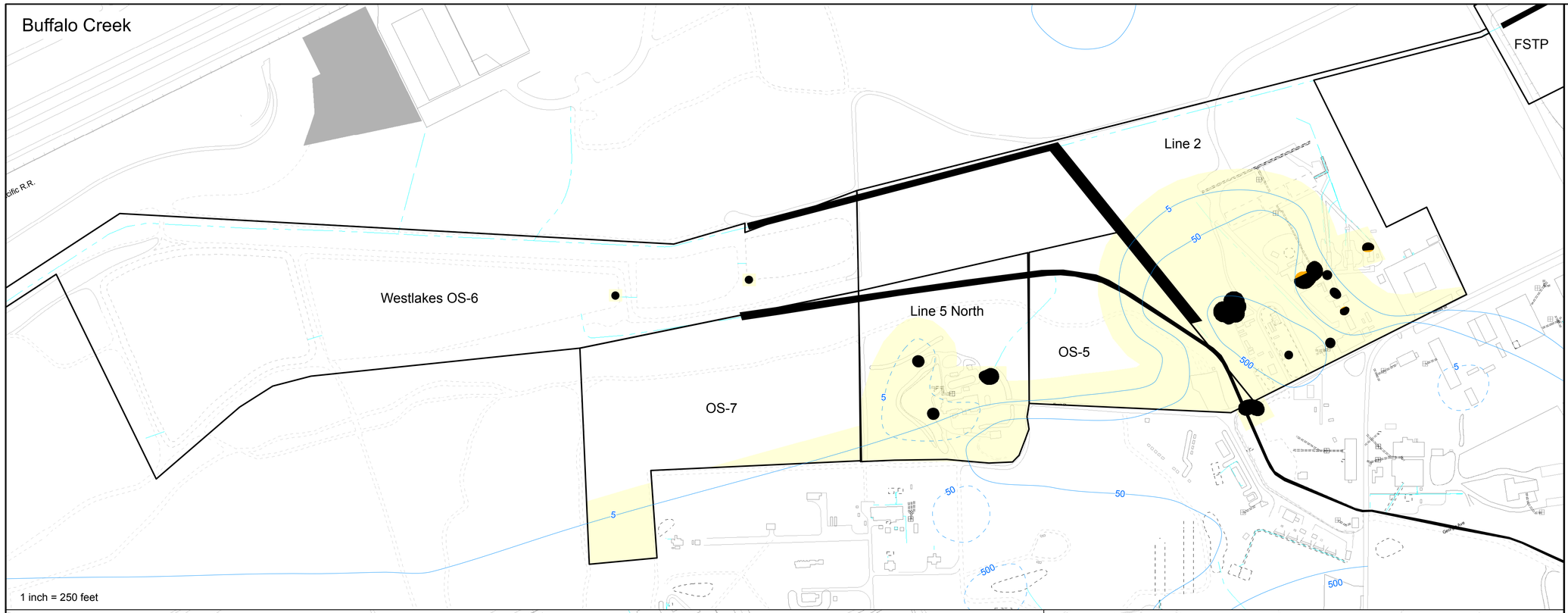
Table 6-4
Remedial Costs Associated with Retained Soil Vapor Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

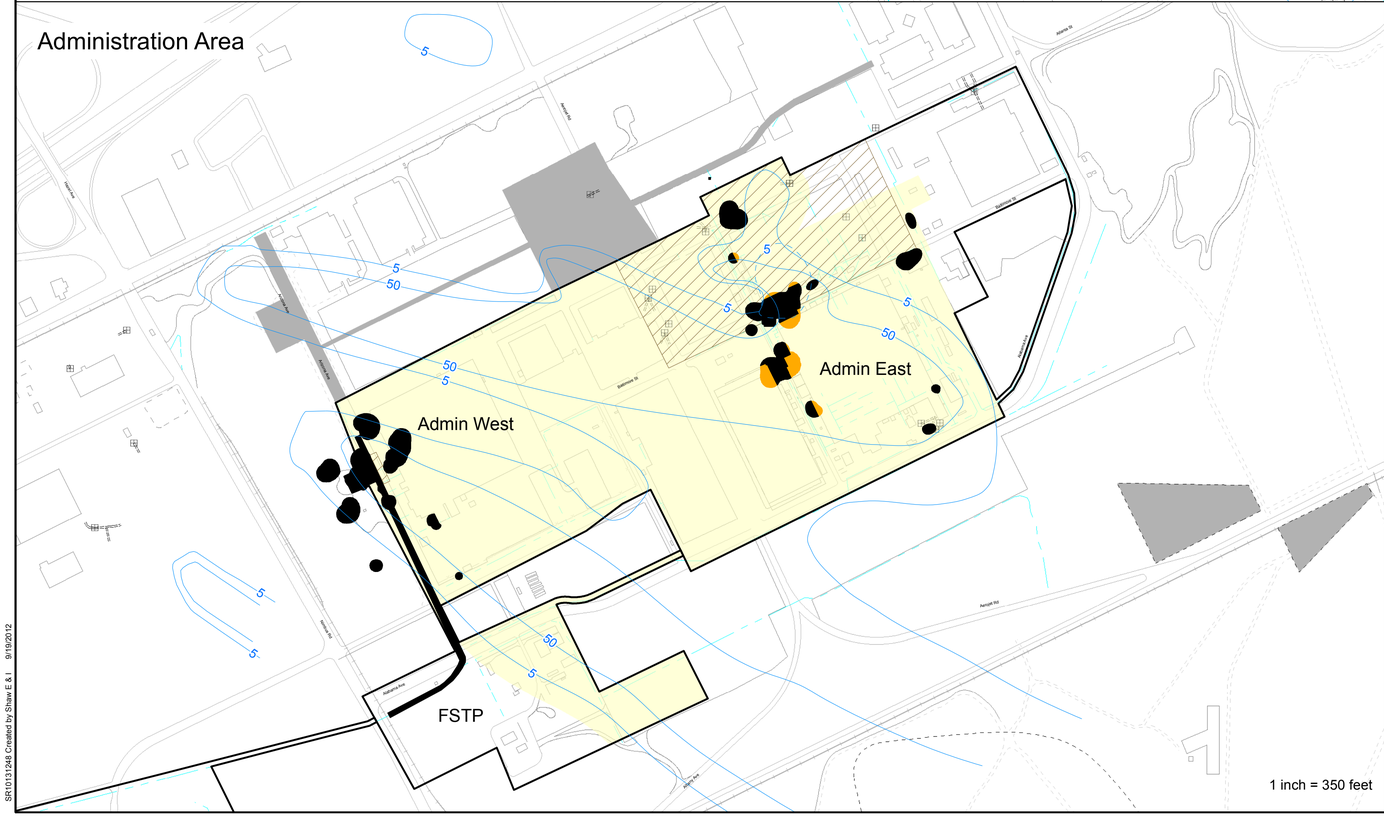
Remedial Area Number	Remediation Category	Total Area (acres)	Planned Development	Appendix B Table	Weighted Capping Estimated Capital Cost	Weighted OM&M Costs (every 5 years)	Weighted Capping 30 Year NPW Cost	Appendix B Table	Soil Vapor Extraction Estimated Capital Cost	Soil Vapor Extraction OM&M Costs for 7 years ($/yr)	Soil Vapor Extraction 30 Year NPW Cost
Soil Vapor											
AE-SV-R-4	RTG-VOCs	0.071	Not Planned	B-3a	$8,800	$1,200	$13,600	B-8	$720,000	$77,000	$1,210,000
AE-SV-R-5	RTG-VOCs	0.055	Not Planned	B-3a	$6,900	$900	$10,600	B-8	Included in AA-SV-R-4		
AE-SV-R-6	RTG-VOCs	0.068	Not Planned	B-3a	$8,500	$1,200	$13,000	B-8	Included in AA-SV-R-4		
AE-SV-R-7	RTG-VOCs	0.041	Not Planned	B-3a	$5,100	$700	$7,900	B-8	Included in AA-SV-R-4		
AE-SV-R-8	RTG-VOCs	0.063	Not Planned	B-3a	$7,800	$1,100	$12,000	B-8	Included in AA-SV-R-4		
L2-SV-R-2	RTG-VOCs	0.065	Westborough II	B-3a	$8,100	$1,100	$12,400	B-9	$390,000	$77,000	$880,000
L2-SV-R-3	RTG-VOCs	0.029	Westborough II	B-3a	$3,600	$500	$5,500	B-9	Included in L2-SV-R-1		
L5-SV-R-1	RTG-VOCs	0.057	Westborough II	B-3a	$7,100	$1,000	$11,000	B-10	$110,000	$53,000	$440,000
L5-SV-R-2	RTG-VOCs	0.057	Westborough II	B-3a	$7,100	$1,000	$11,000	B-10	Included in L5-SV-R-1		

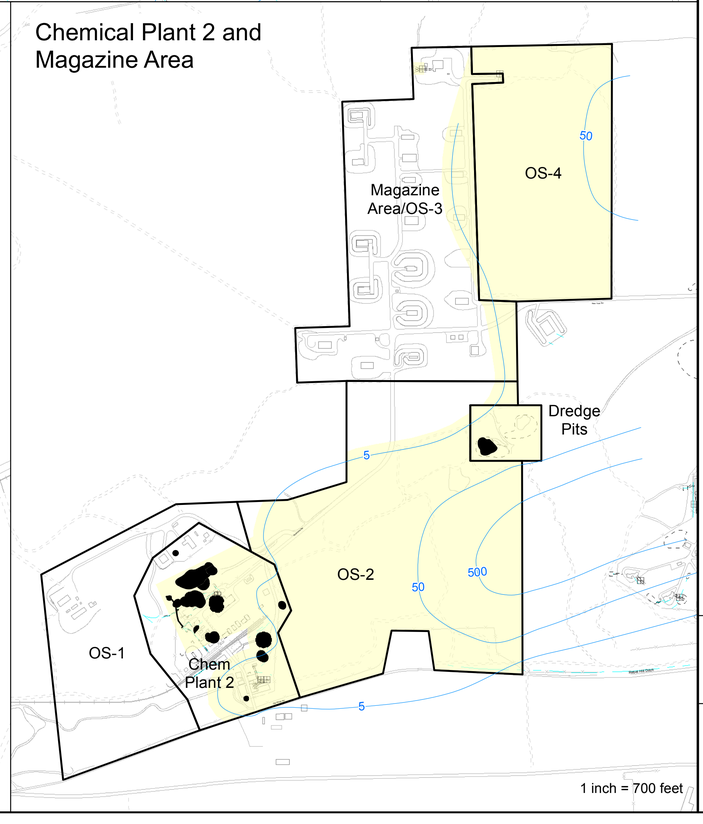
No. of Remedial Areas	Total Area (acres)	Capping Estimated Capital Cost ($)	Capping OM&M Costs ($)	Capping 30 Year NPW Cost ($)	SVE Estimated Capital Cost ($)	OM&M Costs ($)	30 Year NPW Cost
8	0.506	$63,000	$8,700	$97,000	$1,220,000	$207,000	$2,530,000

Table 6-5
Remedial Costs Associated with Retained Groundwater Remedial Areas
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Remediation Category	Total Area (acres)	Planned Development	Appendix B Table	Estimated Costs Monitoring		Appendix B Table	Estimated Costs Contingent Remedy		
					Annual Costs ($/yr)	30-year Present Worth Costs		Estimated Capital Costs ($)	Annual OM&M Costs for 25 Years ($/yr)	30-year Present Worth Costs
Groundwater										
Line 2 SA 28E	RTG - Perchlorate, VOCs or NDMA	N/A	Westborough II	B-5	$4,000	$19,000	B-6	$450,000	$16,000	$650,000







Institutional Control Other Than Prohibited Use of Groundwater[1]

Ecological Institutional Control[2]

Retained Remedial Areas for VOCs and Non-VOCs – Accessible[3]

Retained Remedial Areas for Non-VOCs – Inaccessible[3, 4]

First Water TCE Contour[5]

Perched TCE Contour[5]

Source Area

Surface Drainage

Road

Railroad

Fence

Leach Line

Septic Tank

Management Area/Open Space Boundary

Structure

Removed Structure

PGOU

Notes:

1) Institutional controls may include:
- Restricted residential land use where residual Chemicals of Concern (COCs) would remain in place at concentrations that are above the levels that would allow for unrestricted use;
- Restricted commercial/industrial land use in areas where existing chemical concentrations exceed risk-based levels for commercial/industrial uses; and
- Required appropriate health and safety and materials management procedures for any excavations conducted in conjunction with subsurface infrastructure upgrades, repairs, or replacements in areas of residual COCs.

2) Sufficient risk is present to warrant action and each area will either be excavated for other purposes or deed restrictions will be put in place to prevent the area from reverting back to ecological habitat.

3) For more detail on retained areas, see Section 6 figures 6-3, 6-4, 6-6, 6-7, 6-8, 6-11 and 6-13.

4) Retained Remedial Areas located under facility buildings were drawn based on krigging and in some cases the data points were outside the building. If the building foundations are removed, these areas will be sampled to confirm the presence of COCs. Institutional controls will be in place that may include those listed in note 1. The inaccessible portion of the retained remedial areas will be tracked through the Superfund process.

5) For more detail on inferred contours, see Section 1 figures 1-15 through 1-23. Contour concentrations are given in µg/L.

6) OS = Open Space

7) FSTP = Former Sewage Treatment Plant

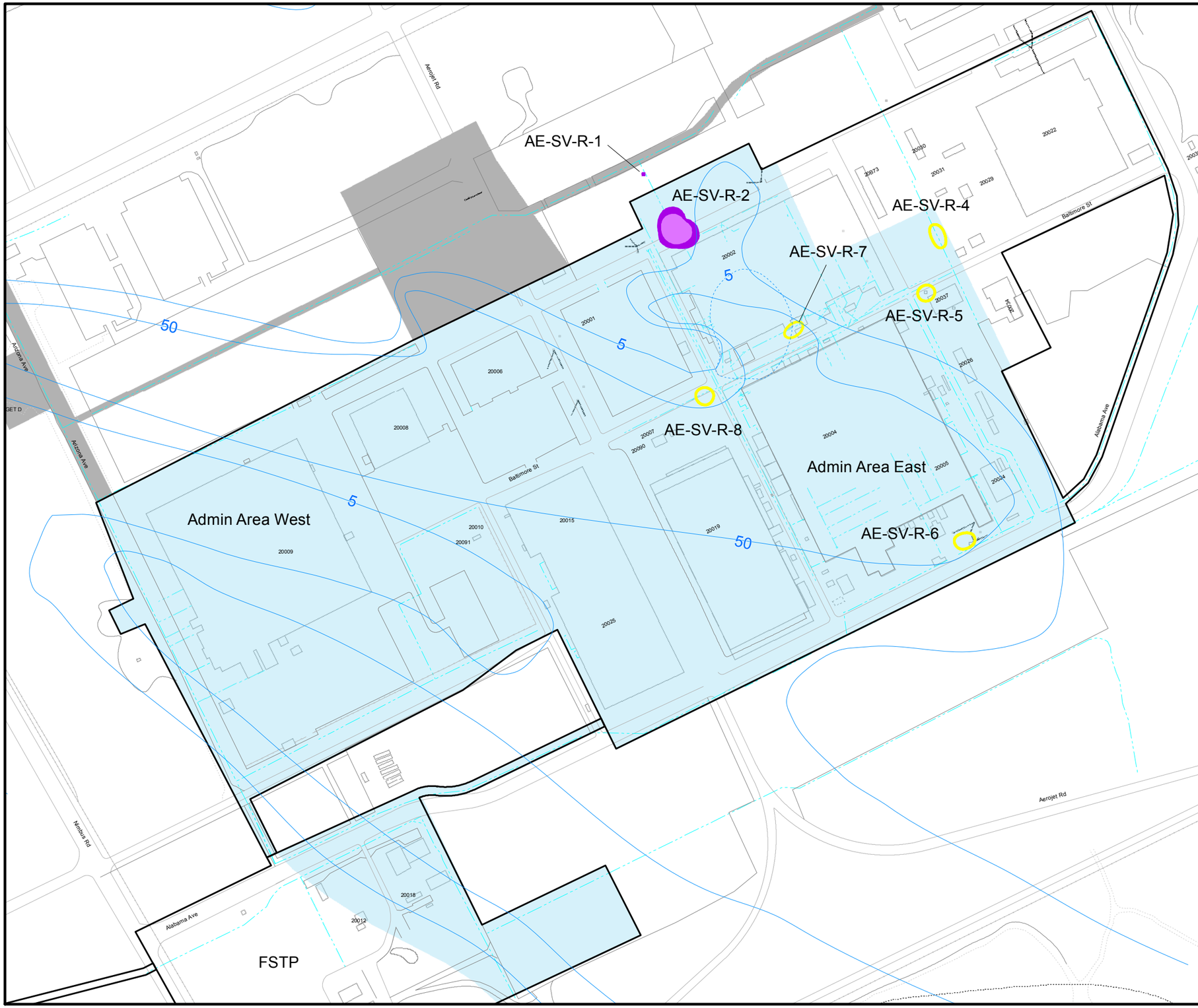
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-1

Institutional Controls and
Retained Remedial Areas
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/19/2012



Vapor Intrusion Controls Residential[1]
Commercial Vapor Remedial Area
Residential Vapor Remedial Area
Vapor Remedial Areas for RTG[2]
First Water TCE Contour[3]
Perched TCE Contour[3]
Source Area
Surface Drainage
Road
Gravel Road
Railroad
Fence
Management Area/Open Space Boundary
Structure
Removed Structure
PGOU

Notes:

1) Encompasses AE-SV-R-3 (Figure 1-24) and AW-SV-R-1 (Figure 1-25). Residential vapor intrusion controls based on extent of groundwater TCE concentrations exceeding screening level of 11 µg/L (5 µg/L contour used) and includes a 100-foot buffer contours from Section 1 graphical risk summaries.
2) RTG = risk to groundwater
3) TCE = trichloroethylene. For more detail on inferred contours, see Section 1 figures 1-15 through 1-23. Contour concentrations are given in µg/L.
4) FSTP = Former Sewage Treatment Plant

N

0 400 800
Feet

1 inch = 335 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

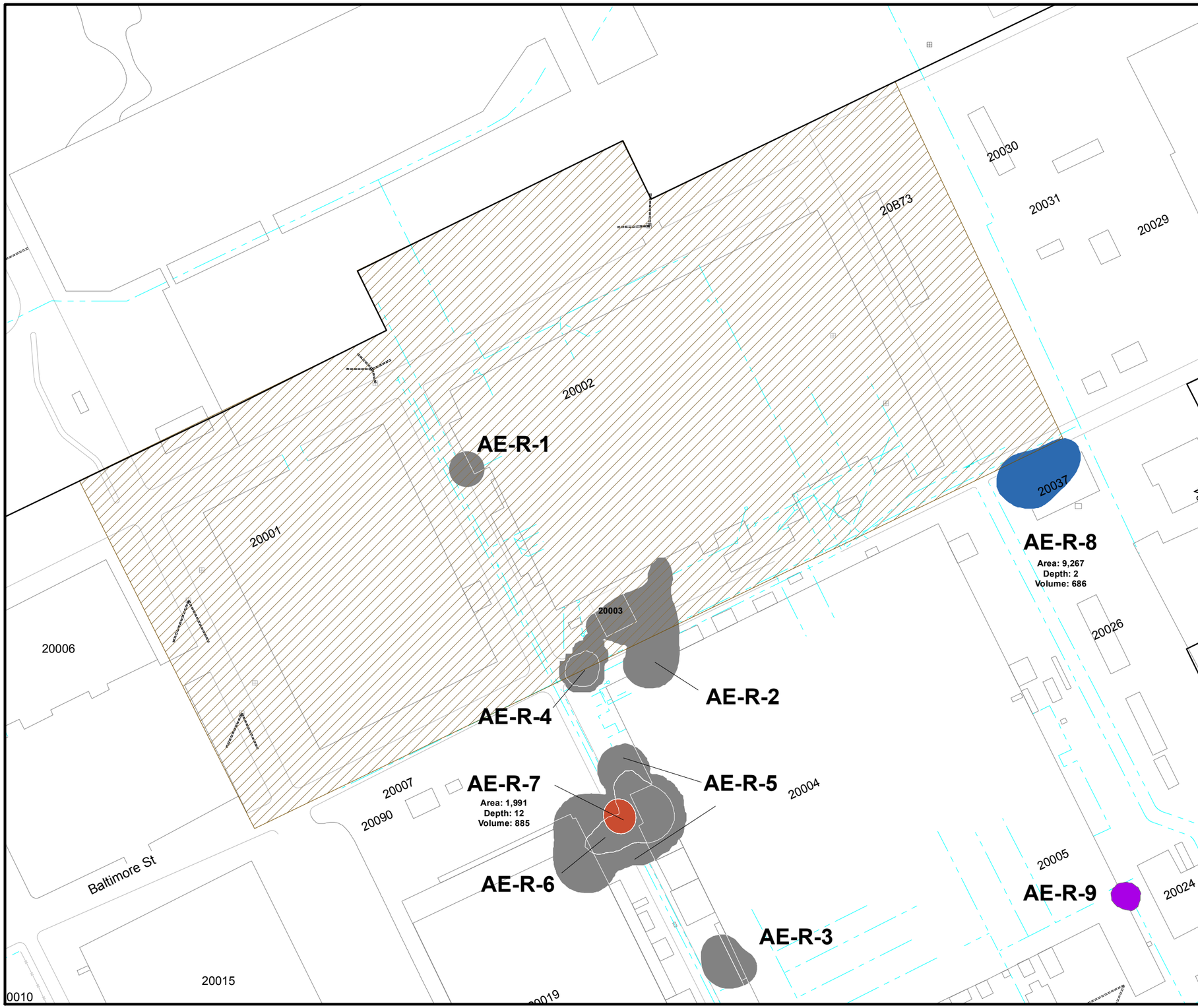
AEROJET
Environmental Remediation

Figure 6-2

Retained Remedial Areas - VOCs

Administration Area
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/19/2012



0- to 2-Foot Excavation

> 6- to 12-Foot Excavation

Inaccessible with Deed Restrictions[1]

Other remedial/containment alternative[2]

Ecological Institutional Control

Surface Drainage

Road

Management Area/Open Space Boundary

Structure

Notes:

Area is in square feet
Depth is feet below ground surface
Volume is in cubic yards

[1]Inaccessible areas include areas where chemicals are under facility buildings or in areas where utilities limit the ability to successfully remediate the area. Retained Remedial Areas located under facility buildings were drawn based on kriging and in some cases the data points were located outside the building. If the building foundations are removed, these areas will be sampled to confirm the presence and extent of COCs. Institutional controls will be in place that may include deed restrictions or other non-engineering methods by which access to COCs in soil is physically or administratively restricted or regulated, and/or monitored. The inaccessible portion of the Retained Remedial Areas will be tracked through the Superfund process.

[2]This area is intended to remain commercial/industrial; since the impact is so limited, the sediment will be removed and the culvert will be cleaned. Alternatively, deed restrictions will need to be developed to prevent residential redevelopment and/or specify the requirements for residential redevelopment (culvert cleaning or capping).

N

0 150 300
Feet

1 inch = 150 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

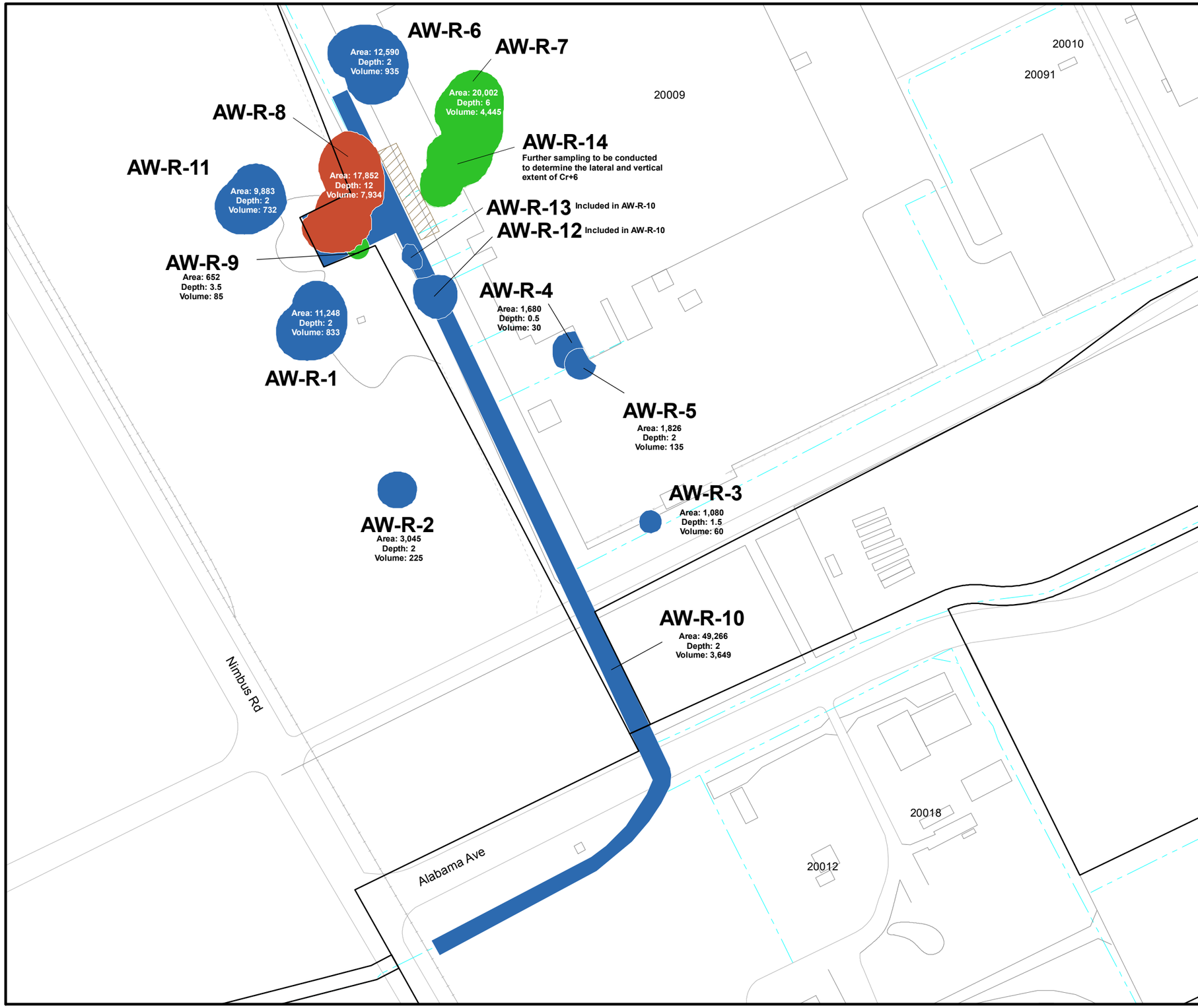
AEROJET
Environmental Remediation

Figure 6-3

Retained Remedial Areas - Non-VOCs

Administration Area East Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012



0- to 2-Foot Soil Impact
> 2- to 6-Foot Soil Impact
> 6- to 12-Foot Impact
Ecological Institutional Control
Surface Drainage
Road
Gravel Road
Railroad
Fence
Management Area/Open Space Boundary
Structure

Notes:

Area is in square feet
Depth is feet below ground surface
Volume is in cubic yards

N

0 160 320
Feet

1 inch = 160 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

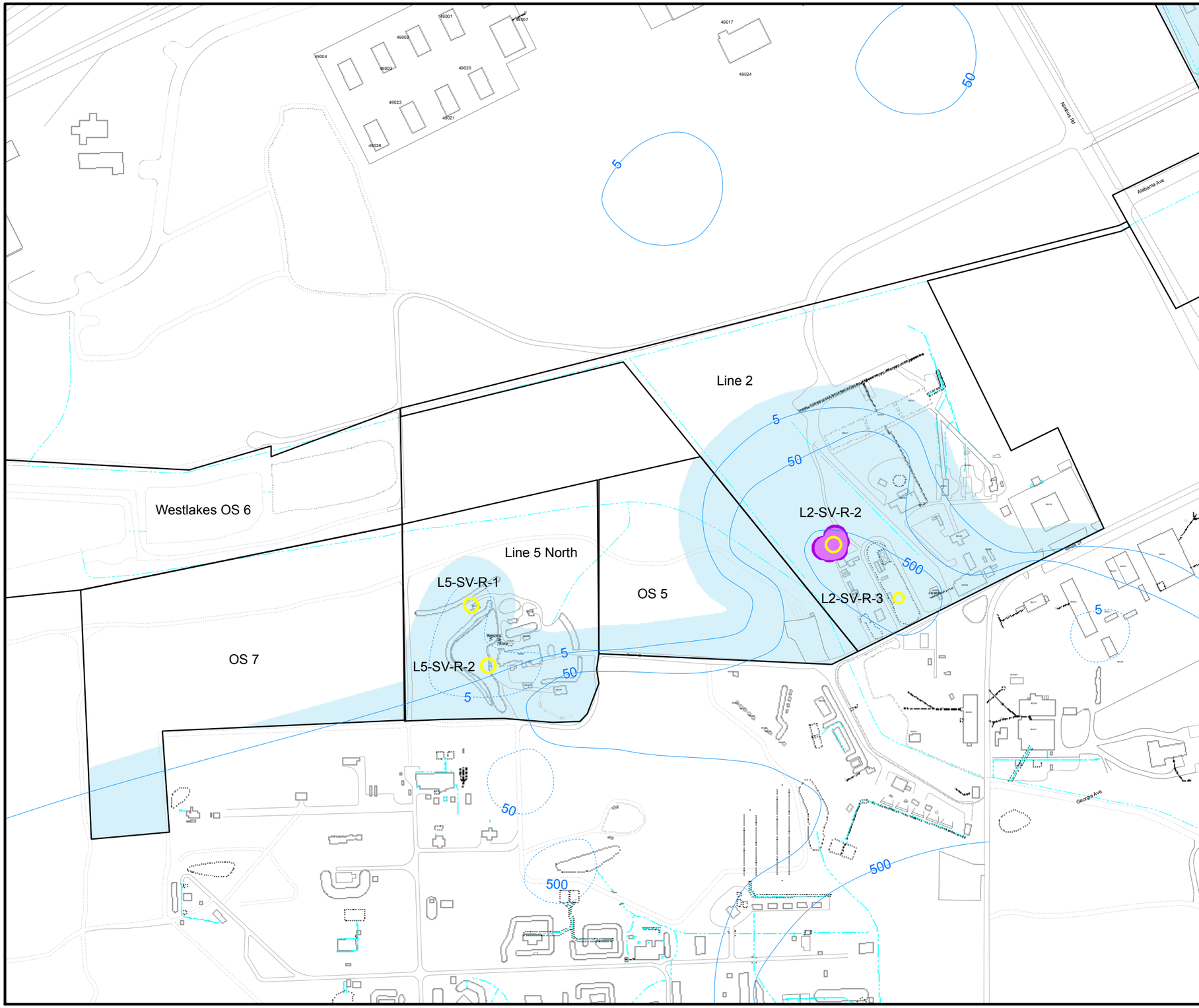
AEROJET
Environmental Remediation

Figure 6-4

Retained Remedial Areas - Non-VOCs

Administration Area West Boundary Operable Unit

SR10131248 Created by Shaw E & I 3/20/2012



Vapor Intrusion Controls Residential[1]
Commercial Vapor Remedial Area
Residential Vapor Remedial Area
Vapor Remedial Areas for RTG[2]
First Water TCE Contour[3]
Perched TCE Contour[3]
Source Area
Surface Drainage
Road
Gravel Road
Railroad
Fence
Management Area/Open Space Boundary
Structure
Removed Structure

Notes:

1) Encompasses L2-SV-R-1 (Figure 1-26) and L5-SV-R-3 (Figure 1-27). Residential vapor intrusion controls based on extent of ground-water TCE concentrations exceeding screening level of 11 µg/L (5 µg/L contour used) and includes a 100-foot buffer.
2) RTG = risk to groundwater
3) TCE = trichloroethylene. For more detail on inferred contours, see Section 1 figures 1-15 through 1-23. Contour concentrations are given in µg/L.

0 400 800
Feet

1 inch = 400 feet

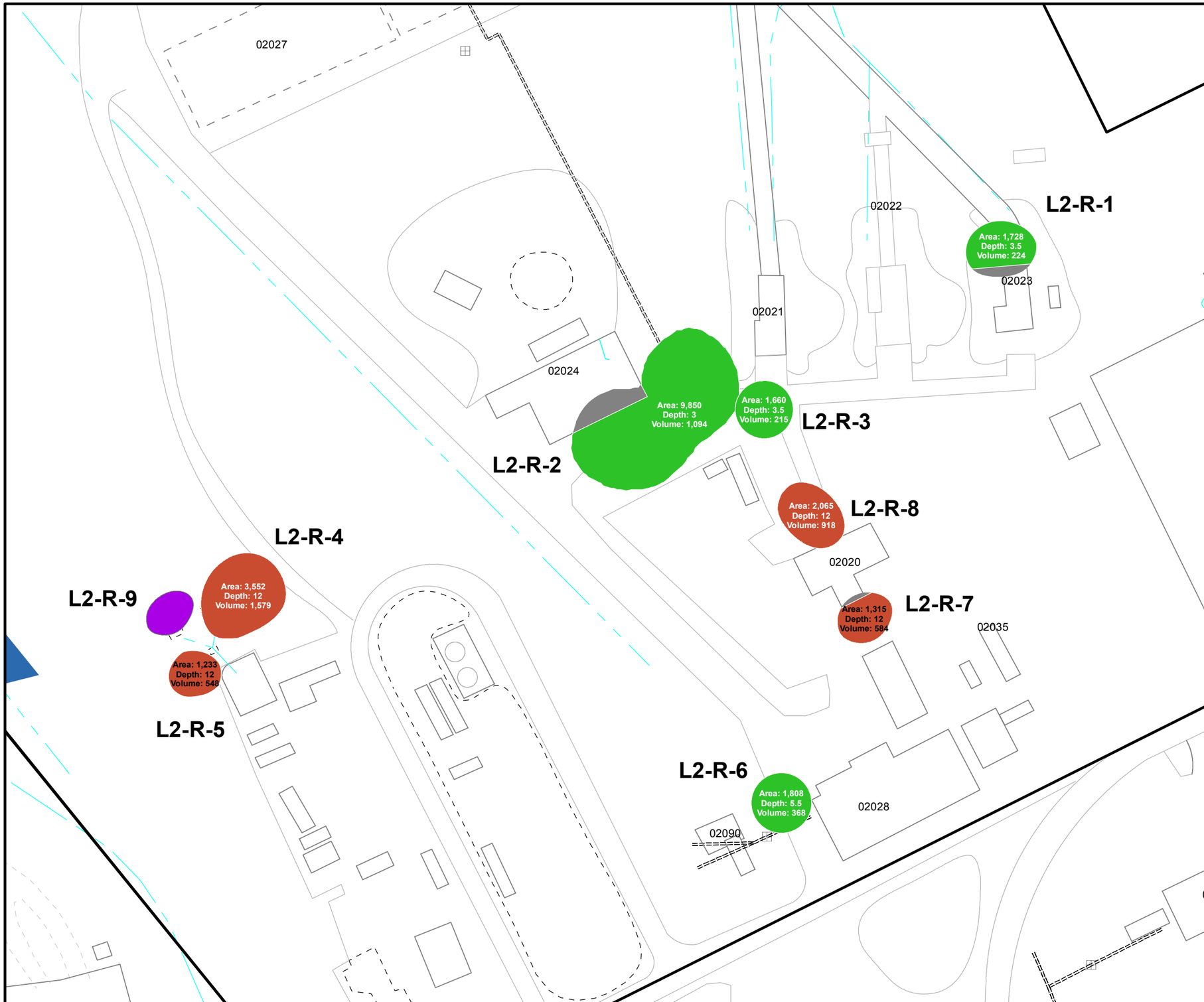
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-5

Retained Remedial Areas - VOCs

WLLO Area
Boundary Operable Unit



> 2- to 6-Foot Soil Impact

> 6- to 12-Foot Soil Impact

Other remedial/containment alternative

Inaccessible[1]

Source Area

Surface Drainage

Road

Gravel Road

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

Area is in square feet
Depth is feet below ground surface
Volume is in cubic yards

[1]Retained Remedial Areas located under facility buildings were drawn based on krigging and in some cases the data points were outside the building. If the building foundations are removed, these areas will be sampled to confirm the presence of COCs. Institutional controls will be in place that may include those listed in note 1. The inaccessible portion of the retained remedial areas will be tracked through the Superfund process.

N

0 80 160
Feet

1 inch = 80 feet

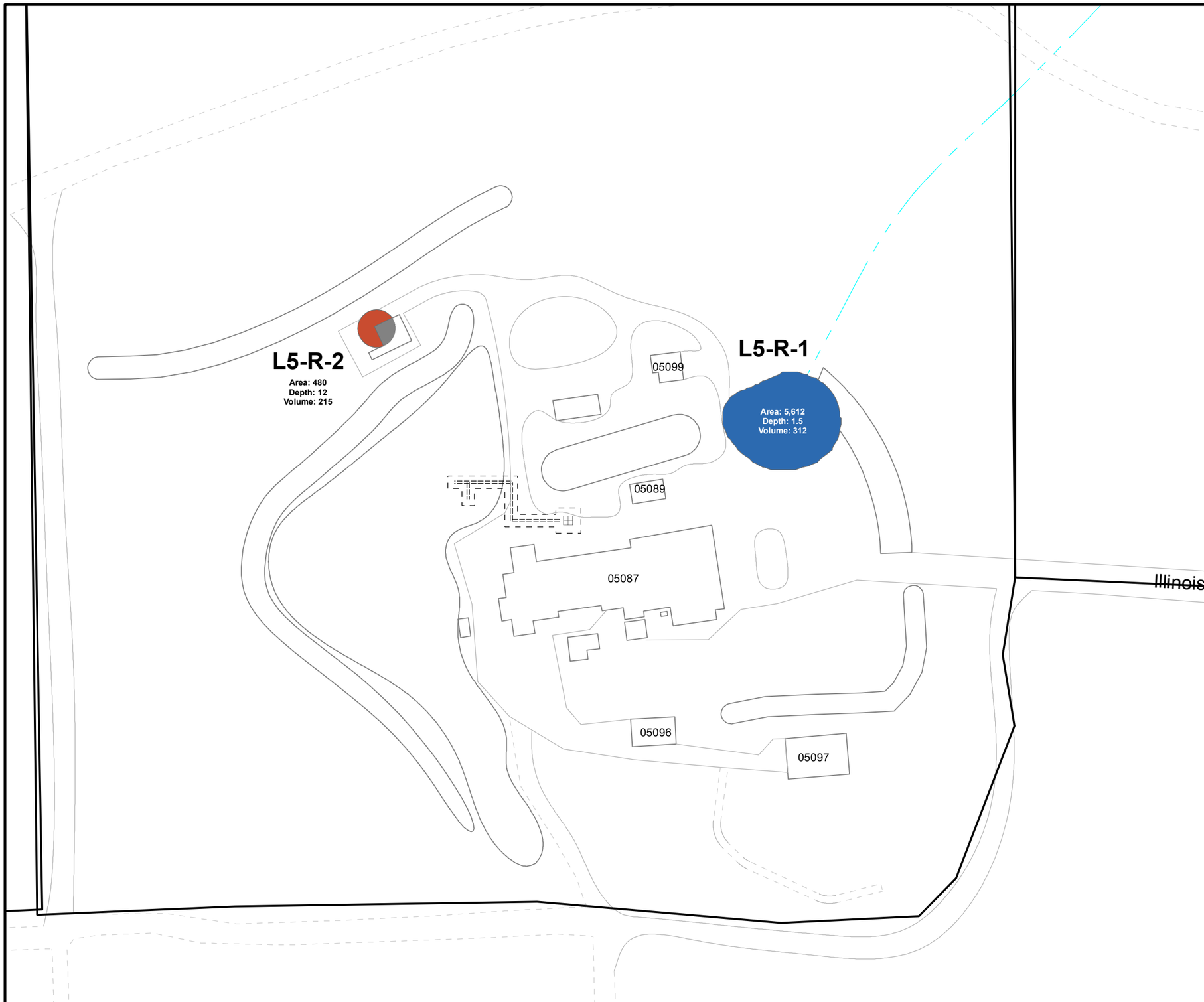
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-6

Retained Remedial Areas - Non-VOCs

Line 2
Boundary Operable Unit



0- to 2-Foot Soil Impact

> 6- to 12-Foot Soil Impact

Inaccessible with Deed Restrictions[1]

Source Area

Surface Drainage

Road

Gravel Road

Management Area/Open Space Boundary

Structure

Notes:

Area is in square feet
Depth is feet below ground surface
Volume is in cubic yards

[1]Inaccessible areas include areas where chemicals are under facility buildings or in areas where utilities limit the ability to successfully remediate the area. Retained Remedial Areas located under facility buildings were drawn based on kriging and in some cases the data points were located outside the building. If the building foundations are removed, these areas will be sampled to confirm the presence and extent of COCs. Institutional controls will be in place that may include deed restrictions or other non-engineering methods by which access to COCs in soil is physically or administratively restricted or regulated, and/or monitored. The inaccessible portion of the Retained Remedial Areas will be tracked through the Superfund process.

N

0 80 160
Feet

1 inch = 80 feet

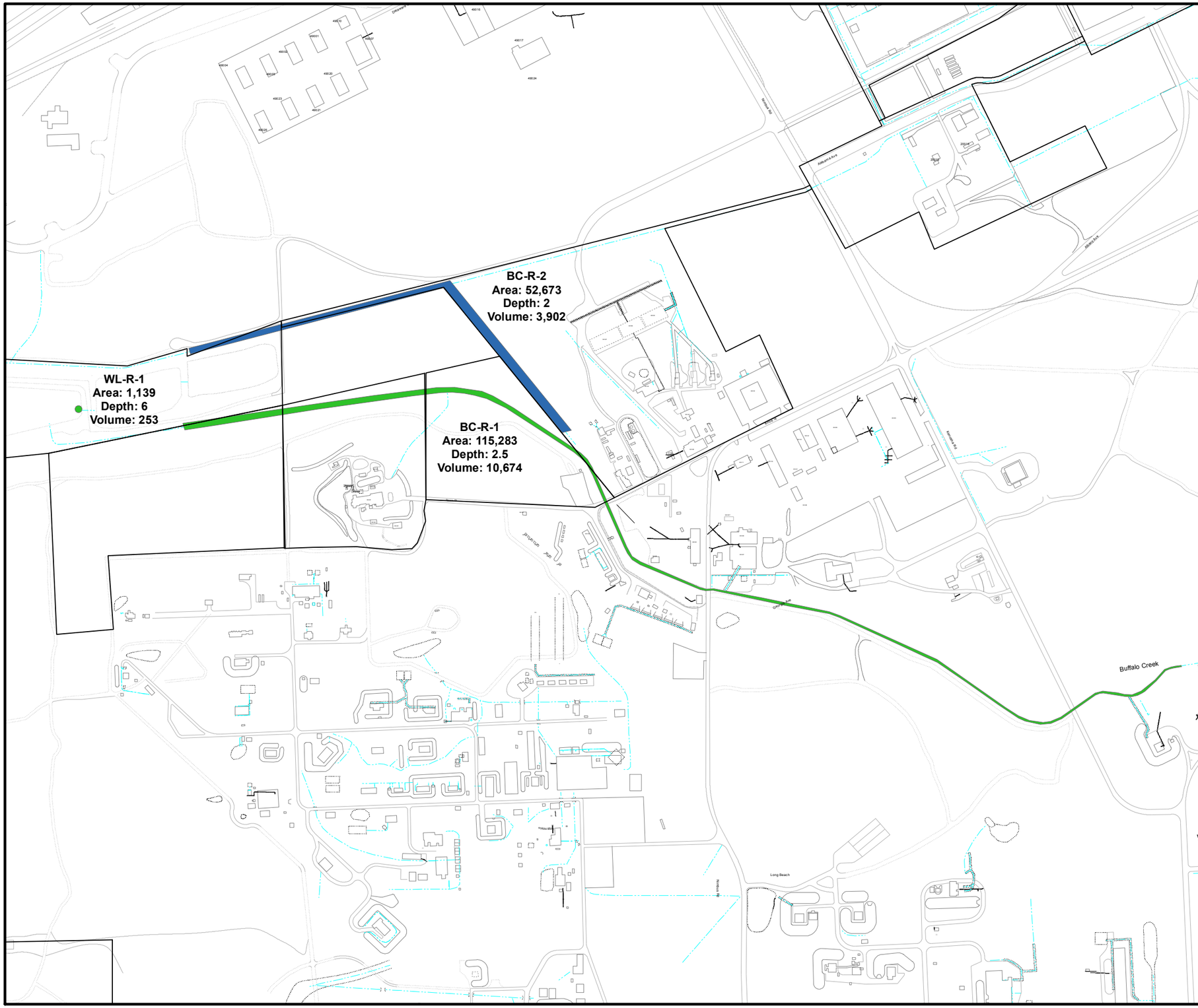
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-7

Retained Remedial Areas - Non-VOCs

Line 5
Boundary Operable Unit



0- to 2-Foot Soil Impact

> 2- to 6-Foot Soil Impact

Source Area

Surface Drainage

Road

Gravel Road

Railroad

Fence

Management Area/Open Space Boundary

Structure

Removed Structure

Notes:

Area is in square feet
Depth is feet below ground surface
Volume is in cubic yards

0 550 1,100
Feet

1 inch = 550 feet

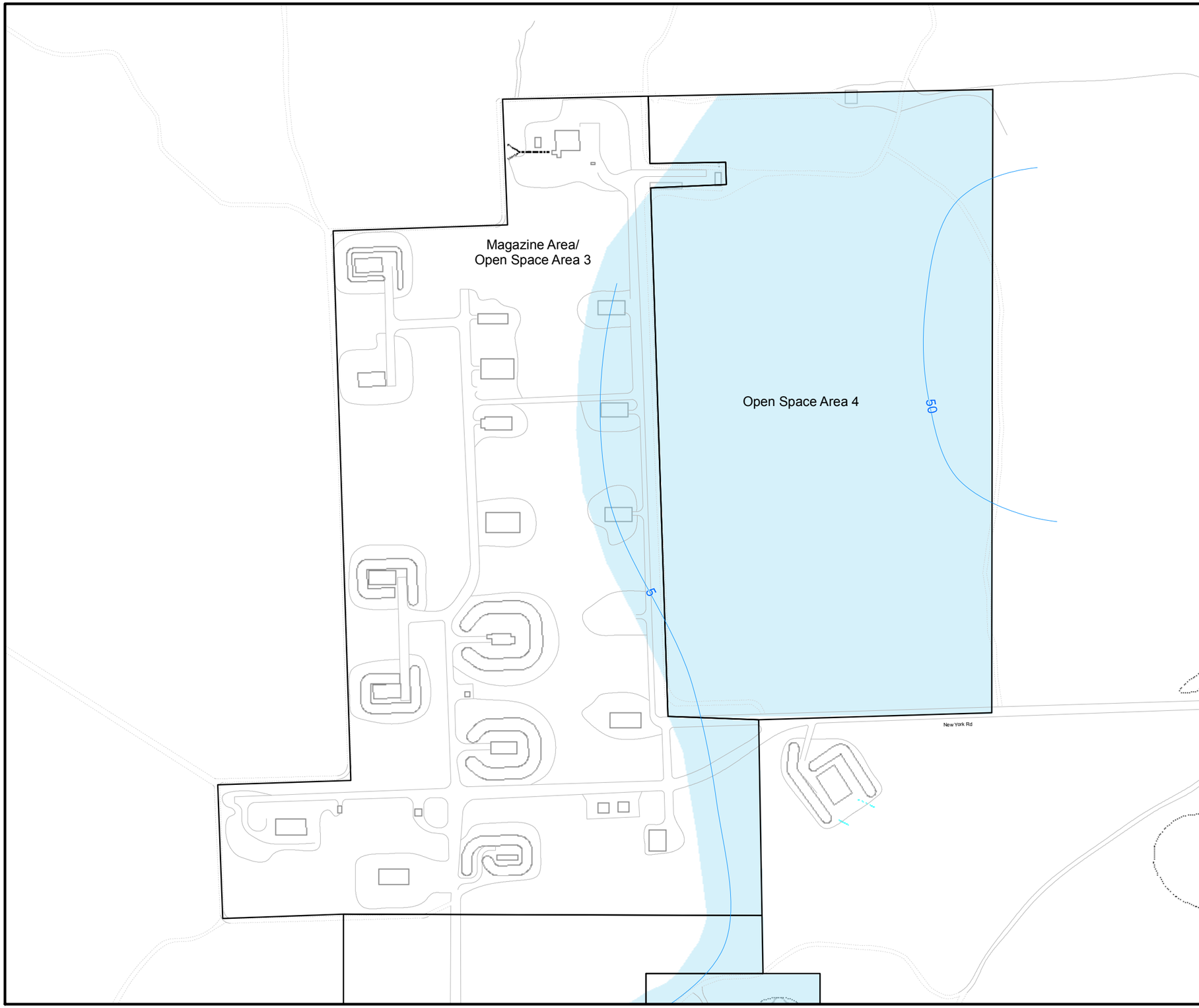
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-8

Retained Remedial Areas - Non-VOCs

Buffalo Creek
Boundary Operable Unit



Vapor Intrusion Controls Residential[1]
First Water TCE Contour[2]
Source Area
Surface Drainage
Road
Gravel Road
Management Area/Open Space Boundary
Structure
Removed Structure

Notes:

1) Residential vapor intrusion controls based on extent of groundwater TCE concentrations exceeding screening level of 11 µg/L (5 µg/L contour used) and includes a 100-foot buffer
2) TCE = trichloroethylene. For more detail on inferred contours, see Section 1 figures 1-15 through 1-23. Contour concentrations are given in µg/L.

N

0 400 800
Feet

1 inch = 400 feet

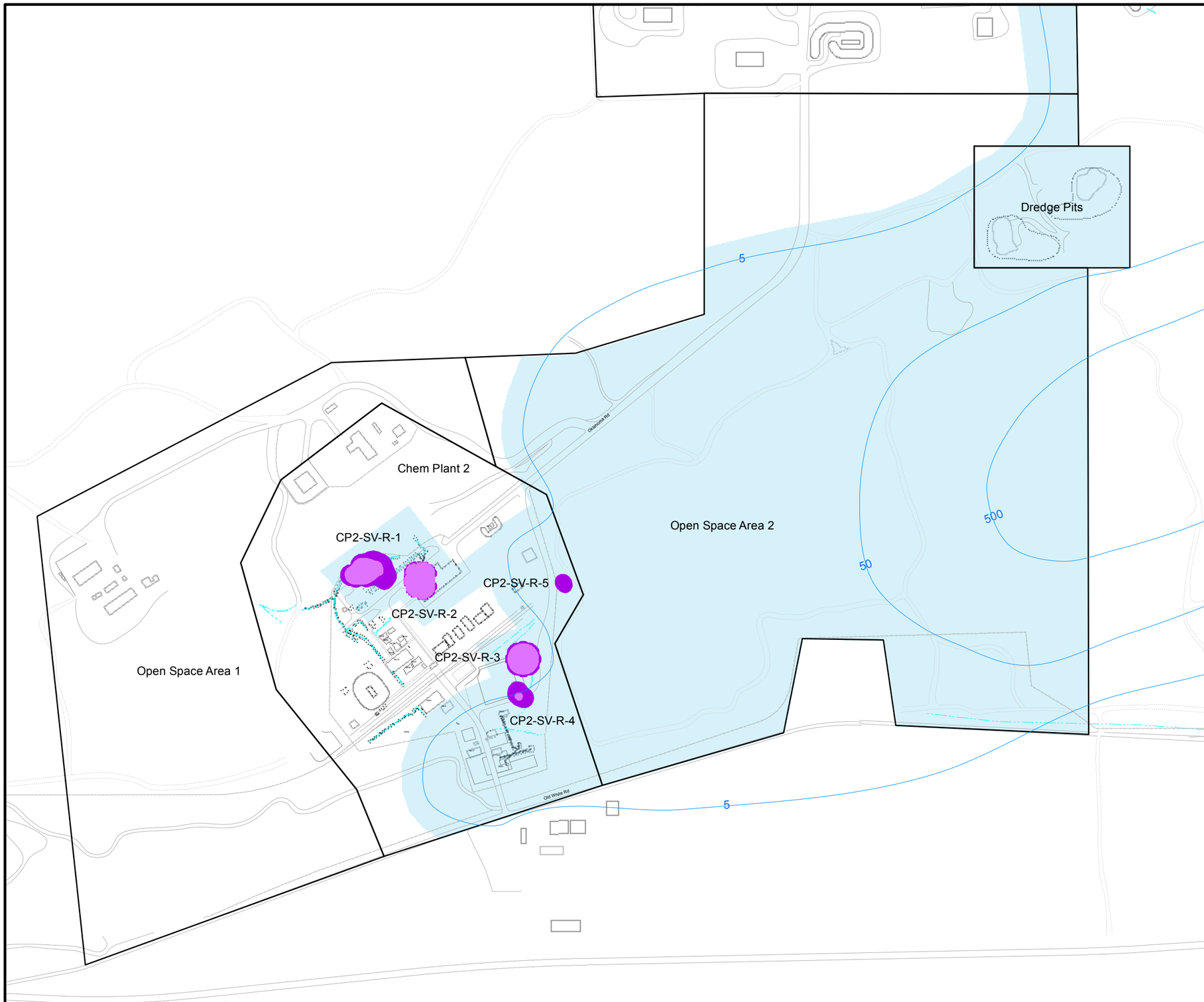
Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-9

Retained Remedial Areas - VOCs

Magazine Area, Open Space Areas 3 and 4 Boundary Operable Unit



Vapor Intrusion Controls Residential[1]
Commercial Vapor Remedial Area
Residential Vapor Remedial Area
First Water TCE Contour[2]
Perched TCE Contour[2]
Source Area
Surface Drainage
Road
Gravel Road
Railroad
Fence
Management Area/Open Space Boundary
Structure
Removed Structure

Notes:

1) Encompasses CP2-SV-R-6 (Figure 1-30). Residential vapor intrusion controls based on extent of groundwater TCE concentrations exceeding screening level of 11 µg/L (5 µg/L contour used) and includes a 100-foot buffer
2) TCE = trichloroethylene. For more detail on inferred contours, see Section 1 figures 1-15 through 1-23. Contour concentrations are given in µg/L.

N

0 450 900
Feet

1 inch = 450 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-10

Retained Remedial Areas - VOCs

Chemical Plant 2 Area
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012

> 2- to 6-Foot Soil Impact

0- to 2-Foot Soil Impact

Human Health Institutional Control

Source Area

Surface Drainage

Road

Gravel Road

Railroad

Fence

Management Area/Open Space Boundary

Structure

Notes:

Area is in square feet
Depth is feet below ground surface
Volume is in cubic yards

N

0 150 300
Feet

1 inch = 150 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure 6-11

Retained Remedial Areas - Non-VOCs

Chemical Plant 2 Area
Boundary Operable Unit

SR10131248 Created by Shaw E & I 9/26/2012

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Appendix A
Applicable or Relevant and Appropriate Requirement Analysis

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Chemical-Specific ARARs	Agency	Reference	Description	Comment
Hazardous Waste - Identification	USEPA/ DTSC	40 CFR 261/ 22 CCR 66261	Sets standards for classification of hazardous wastes. Establishes constituent levels for characteristic wastes and lists of wastes considered to be hazardous wastes.	All wastes generated during site activities must be evaluated to determine if they are hazardous.
Hazardous Waste - Land Disposal Restrictions (LDR)	USEPA/ DTSC	40 CFR 268/ 22 CCR 66268	Sets land disposal restriction constituent concentrations and treatment standards.	Hazardous wastes generated during site activities must meet LDR standards prior to land disposal.
Toxic Substances Control Act - PCB Spill Cleanup Requirements	USEPA	40 CFR 761 Subpart G	Sets cleanup requirements for PCB spills.	Establishes federal definition of "clean soil" as 1 mg/kg PCBs in soil for protection of human health.
Chemical-Specific TBCs	**Agency**	**Reference**	**Description**	**Comment**
Preliminary Remediation Goals (PRGs)	USEPA	PRG Table - October 2004	Sets a PRG for potential industrial and residential uses for a variety of compounds.	May be used for general risk screening purposes or to set initial cleanup goals.
Proposed Corrective Action Rule (40 CFR 264 Subpart S) Action Levels	USEPA	55 FR 30798	Sets action levels for certain chemicals in soil; exceeding action levels may trigger requirements for additional investigation or remediation.	May be used in determining whether contamination poses potential threat to human health or the environment.
Designated Level Methodology for Waste Classification and Cleanup Level Determination	RWQCB	CVRWQCB June 1989	Guidance on how to classify wastes under the definitions contained in the Chapter 15 regulations to select appropriate disposal practices protective of beneficial uses of waters of the state.	
Action-Specific ARARs	**Agency**	**Reference**	**Description**	**Comment**
Air Resources Act	CA Air Resources Board/ SMAQMD	Health & Safety Code, Div. 26, Sec. 39000 et seq.	Regulates both vehicular and nonvehicular sources of air contaminants in California. Defines relationship of California Air Resources Board and local or regional air pollution control districts. Establishes ambient air quality standards and permit procedures.	Applicable to air emission sources. The Sacramento Metropolitan Air Quality Management District (SMAQMD) is the enforcement agency.
Air - Permits; exemptions	SMAQMD	Rule 201	Specifies emissions units that are not required to obtain an Authority to Construct or a Permit to Operate.	Sources deemed by the air pollution control officer that emit any pollutants without the benefit of air pollution control devices and would not exceed 2 pounds in any 24-hour period are not required to obtain an authority to construct or permit to operate.
Air - New Source Review	SMAQMD	Rule 202	Requires review of new stationary air pollution sources to prevent exceedances of ambient air quality standards. Requires Best Available Control Technology for emissions in excess of 10 lbs/day for reactive organic compounds; 10 lbs/day for particulates; 3.3 lbs/day for lead; and 5.5 lbs/day for vinyl chloride.	Applicable to new sources of air emissions that are subject to Rule 201 (General Permit Requirements) and that emit or may emit any affected pollutants.
Air - Opacity	SMAQMD	Rule 401	Sets limits for opacity of emissions (Number 1 on the Ringelmann chart).	Applicable to emissions of visible air contaminants. Associated with dust-producing actions.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Air - Nuisance	SMAQMD	Rule 402	Prohibits discharge of air contaminants in quantities that cause injury, detriment, or nuisance.	Applicable to emissions of air contaminants that may cause injury, detriment, nuisance, or annoyance to any considerable number of persons or the public, or that endanger the comfort, health, or safety of any such persons or the public, or which cause or have natural tendency to cause injury or damage to business or property.
Air - Particulate Matter	SMAQMD	Rule 404	Limits permissible discharges of particulate matter.	Applicable to any construction activities that result in emissions of dust.
Air - Dust and Condensed Fumes	SMAQMD	Rule 405	Limits permissible emissions of dusts and condensed fumes based on process throughput rates.	Applicable to any activity discharging in excess of specified emission rates.
OSHA Hazardous Waste Operations and Emergency Response	Cal/OSHA	29 CFR 1910.120/ 8 CCR 5192	Worker training and health and safety plan requirements for site cleanup operations.	Applicable to on-site workers engaged in site cleanup operations.
OSHA Excavation Standards	Cal/OSHA	29 CFR 1926/ 8 CCR 1540 and 341	Includes requirements for benching, sloping or shoring of excavations to prevent cave-ins; entry into any excavation deeper than 5 feet requires a permit.	Applicable to excavation activities.
OSHA Heavy Equipment Operation Standards	Cal/OSHA	29 CFR 1926/ 8 CCR 1590 and 3649	Requirements for safe operation of haulage, earthmoving, industrial trucks and tractors.	Applicable to activities involving the use of heavy equipment.
OSHA Head, Eye, Face, and Hearing Protection Standards	Cal/OSHA	29 CFR 1926 Subpart E/ 8 CCR 3381, 3382, 5162, and 5097.	Specific details regarding personal protective equipment and noise levels for hearing protection for workers.	Applicable to activities where employees may encounter hazards requiring the use of personal protective equipment or hearing protection.
OSHA Worker Protection Programs	Cal/OSHA	29 CFR 1910.1200/ 8 CCR 5194 and 3203	Written program requirements include hazard communication, and illness and injury prevention plan.	Employees who may be exposed to hazardous substances must be informed of those hazards in accordance with hazard communication requirements. All employers must develop illness and injury prevention plan for providing information on safe and healthy work practices.
Hazardous Waste	DTSC	22 CCR 66260	Provides definitions of terms used in the hazardous waste regulations under Title 22 of the California Code of Regulations.	Applicable to activities generating wastes; wastes must be classified using generator knowledge or waste analysis.
Hazardous Waste Identification	DTSC	22 CCR 66261	Sets standards for classification of RCRA hazardous wastes and California hazardous wastes and requirements for recycling and reclamation of RCRA and California hazardous wastes.	Wastes generated during site activities (including residues from treatment operations) must be evaluated to determine if hazardous.
Hazardous Waste Generator Standards	DTSC	22 CCR 66262	Requirements for generation, on-site management, and off-site transportation of RCRA and non-RCRA hazardous waste.	Wastes generated during site activities must be managed in accordance with these standards if determined to be a hazardous waste.
Hazardous Waste	DTSC	40 CFR 265, 264/ 22 CCR 66265, 66264	Requirements for management/storage of hazardous waste in containers.	Applicable to any hazardous wastes accumulated or stored in containers.
Hazardous Waste	DTSC	40 CFR 264 and 265 Subpart B/ 22 CCR 66264 and 66265	General facility standards for on-site treatment, storage, or disposal of hazardous waste.	Applicable to alternatives involving treatment, storage, or disposal of hazardous waste.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Hazardous Waste	DTSC	40 CFR 264, 265 Subpart C/ 22 CCR 66264 and 66265	Preparedness and prevention requirements applicable to on-site treatment, storage, and disposal of hazardous waste. Applies to generators and TSDs.	Applicable to alternatives involving treatment, storage, or disposal of hazardous waste.
Hazardous Waste	DTSC	40 CFR 264, 265 Subpart D/ 22 CCR 66264 and 66265	Contingency plan requirements applicable to on-site treatment, storage, and disposal of hazardous waste. Applies to generators and TSDs.	Applicable to alternatives involving treatment, storage, or disposal of hazardous waste.
Hazardous Waste	DTSC	40 CFR 264, 265 Subpart E/ 22 CCR 66264 and 66265	Manifesting, record keeping, and reporting requirements applicable to TSDs.	Applicable to alternatives involving treatment, storage, or disposal of hazardous waste.
Hazardous Waste	USEPA/ DTSC	40 CFR 264, 265 Subpart F/ 22 CCR 66264 and 66265	Establishes monitoring requirements for facilities that treat, store, or dispose of hazardous waste.	Applicable to alternatives involving treatment, storage, or disposal of hazardous waste.
Hazardous Waste	USEPA/ DTSC	40 CFR 264, 265 Subpart G/ 22 CCR 66264 and 66265	Closure and post-closure requirements for hazardous waste treatment, storage, and disposal in new on-site units.	Applicable to alternatives involving creation of new treatment, storage, or disposal units.
Hazardous Waste	USEPA/ DTSC	40 CFR 264, 265 Subpart L/ 22 CCR 66264 and 66265	Requirements for storage of hazardous waste in a waste pile for greater than 90 days.	Applicable to alternatives in which hazardous waste is stored in a waste pile for greater than 90 days.
Hazardous Waste	USEPA/ DTSC	40 CFR 264, 265 Subpart N/ 22 CCR 66264 and 66265	Requirements for hazardous waste landfills.	Applicable to alternatives involving land disposal of hazardous waste.
Hazardous Waste	DTSC	Health and Safety Code 25123.3	Remediation waste staging requirements allowing the temporary accumulation of non-RCRA contaminated soil provided that certain conditions are met.	Applicable to activities that involve temporary accumulation of non-RCRA contaminated soil. Requires an impermeable surface, controls to prevent dispersion or runoff, inspections, and certification.
Hazardous Waste - Land Disposal Restrictions	DTSC	22 CCR 66268	Establishes land disposal restrictions and treatment standards for hazardous wastes applicable to generators.	Any hazardous wastes generated as a result of on-site activities or by treatment systems must meet LDR requirements.
Land Use Controls	DTSC	CCC section 1471	Allows an owner of land to make a covenant to restrict use of land for the benefit of a covenantee. The covenant runs with the land to bind successive owners.	In the event a remedy is selected that does not result in unrestricted use, a LUC between Aerojet and DTSC will be signed and recorded with Sacramento County prior to DTSC certification that the removal action has been completed.
Land Use Controls	DTSC	CHSC 25222.1 and 25355.5	Authorizes DTSC to enter into an agreement with a land owner to restrict the present and future use of land.	
Land Use Controls	DTSC	CHSC 25233	Provides a process and criteria for requesting a variance from a land use restriction.	
Land Use Controls	DTSC	CHSC 25234	Provides a process and criteria for requesting the removal or termination of land use restrictions.	
Hazardous Material/Hazardous Waste Transportation Requirements	USEPA/ DOT	40 CFR 262/49 CFR 172/ 22 CCR 66262	Requirements for packaging, labeling, placarding and transporting hazardous waste.	Any hazardous wastes shipped off site for disposal must meet the requirements for hazardous waste shipping and transportation.
Discharge of Waste to Land	RWQCB	23 CCR Chapter 15	Waste and site classifications of waste landfills, including allowable soluble constituent concentrations.	Applicable to on-site land disposal of wastes.
OSHA Worker Lead Exposure Standard	Cal-OSHA	29 CFR 1910.1025/ 8 CCR 5216	Specific standard for occupational exposure to lead; includes requirements for monitoring and protective equipment. The PEL for lead is currently 50 µg/m3 for an 8-hour TWA.	If concentrations of lead in air exceed the PEL, control measures will be required. This applies to dust-producing actions.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
OSHA Worker Vinyl Chloride Exposure Standard	Cal-OSHA	29 CFR 1910.1017/ 8 CCR 5210	Specific standard for occupational exposure to vinyl chloride; includes requirements for monitoring, protective equipment and decontamination. The PEL for vinyl chloride is currently 1 ppm for an 8-hour TWA.	If concentrations of vinyl chloride in air exceed the PEL, control measures will be required. This applies to actions that may encourage offgassing of VOCs.
OSHA Permissible Exposure Limits	Cal-OSHA	29 CFR 1910.1001/ 8 CCR 5155	Requirements for controlling employee exposure to airborne contamination during work operations; sets PELs for specified contaminants and workplace monitoring requirements.	If concentrations of any specified contaminants in air exceed the PEL, control measures (administrative or engineering controls, or personal protective equipment) will be required. This applies to dust-producing actions or actions that may encourage offgassing of VOCs.
Water Protection Porter-Cologne Water Quality Control Act Basin Plan for Central Valley Region	RWQCB	CWC Sections 13240, 13241, 13242, 13243	Establishes water quality objectives, including narrative and numerical standards, that protect the beneficial uses of surface and ground waters in the region. Describes implementation plans and other control measures designed to ensure compliance with statewide plans and policies and provide comprehensive water quality planning. Includes implementation actions for setting soil cleanup levels for soils that threaten water quality.	Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including, for example, a new discharge of contaminated soils or in-situ treatment or containment of contaminated soils, that may affect water quality must not result in water quality exceeding water quality objectives. Implementation plans and other policies and requirements may also apply.
Water Protection Porter-Cologne Water Quality Control Act Policy for Investigation and Cleanup of Contaminated Sites	RWQCB	CWC Sections 13000, 13304, 13240, 13241, 13242, 13243	Establishes and describes policy for investigation and remediation of contaminated sites. Includes implementation actions for setting groundwater and soil cleanup levels.	Cleanup levels for soils should be equal to levels that would achieve background concentrations in groundwater unless such levels are technically and economically infeasible to achieve. In such cases, soil cleanup levels are such that groundwater will not exceed applicable groundwater quality objectives.
Water Protection Porter-Cologne Water Quality Control Act Policy for Application of Water Quality Objectives	RWQCB	CWC Sections 13240, 13241, 13242, 13243	This policy defines water quality objectives and explains how the Regional Water Board applies numerical and narrative water quality objectives to ensure the reasonable protection of beneficial uses of water and how the Regional Water Board applies Resolution No. 68-16 to promote the maintenance of existing high quality waters.	Applies to all cleanups of discharges that may affect water quality.
Water Protection Porter-Cologne Water Quality Control Act Antidegradation Policy	SWRCB	CWC Sections 13000, 13140, 13263, 13304	Requires that high quality surface and groundwaters be maintained to the maximum extent possible. Degradation of waters will be allowed (or allowed to remain) only if it is consistent with the maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial uses, and will not result in water quality less than that prescribed in RWQCB and SWRCB policies. If degradation is allowed, the discharge must meet best practicable treatment or control, which must prevent pollution or nuisance and result in the highest water quality consistent with maximum benefit to the people of the state.	Applies to the discharges of waste to waters, including discharges to soil that may affect surface or groundwaters. In-situ cleanup levels for contaminated soils must be set so that groundwaters will not be degraded, unless degradation is consistent with the maximum benefit of the people of the state. If degradation is allowed, the discharge must meet best practical treatment or control, and result in the highest water quality possible consistent with the maximum benefit to the people of the state. In no case may water quality objectives be exceeded.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Water Protection Porter-Cologne Water Quality Control Act SWRCB Resolution No. 92-49 (as amended April 21, 1994)	SWRCB	CWC Sections 13000, 13140, 13240, 13260, 13263, 13267, 13300, 13304, 13307	Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, dischargers must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Requires the application of Title 23, CCR, Section 2550.4 requirements to cleanups.	Applies to all cleanups of discharges that may affect water quality.
Water Protection Porter-Cologne Water Quality Control Act Resolution No. 88-63 (Sources of Drinking Water Policy) (as contained in the RWQCB's Water Quality Control Plan)	SWRCB	CWC Sections 13000, 13140, 13240	Specifies that, with certain exceptions, all ground and surface waters have the beneficial use of municipal or domestic water supply.	Applies in determining beneficial uses for waters that may be affected by discharges of waste.
Wastes Staff Report The Designated Level Methodology for Waste Classification and Cleanup Level Determination	RWQCB		Provides guidance on how to classify wastes according to Title 27, CCR, Division 2, Subdiv.1/Title 23, CCR, Division 3, Chapter 15, Article 10	Performance standard to be considered in determining the classification of wastes and contaminated soils.
Water Protection Staff Report A Compilation of Water Quality Goals	RWQCB		Provides guidance on selecting numerical values to implement narrative water quality objectives contained in the Basin Plan.	Performance standard to be considered in selecting appropriate numerical values to implement the Basin Plan for setting cleanup levels and discharge limits. The numerical values contained in the staff report may be applicable, relevant and appropriate, or TBC, depending on the source of the values.
Waste Management Porter-Cologne Water Quality Control Act Title 27, CCR, Division 2, Subdiv. 1 (Section 20080 et seq.), Title 23 CCR, Division 3, Chapter 15, (Section 2510 et seq.)		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13304	Establishes waste and siting classification systems and minimum waste management standards for discharges of waste to land for treatment, storage, and disposal. Engineered alternatives that are consistent with Title 27/Title 23 performance goals may be considered. Establishes corrective action requirements for responding to leaks and other unauthorized discharges.	Applies to all discharges of waste to land for treatment, storage, or disposal that may affect water quality. The application of some of the specific sections of Title 27/Title 23 to different situations is discussed below. Provisions of Title 23 apply to hazardous waste and provisions of Title 27 apply to designated and nonhazardous waste.
Waste Management Porter-Cologne Water Quality Control Act Title 23, CCR, Section 2520, 2521		CWC Sections 13140-13147, 13172, 13260, 13263, 13269	Requires that hazardous waste be discharged to Class I waste management units that meet certain design and monitoring standards.	Applies to discharges of hazardous waste to land for treatment, storage, or disposal.
Waste Management Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20200(c), 20210		CWC Sections 13140-13147, 13172, 13260, 13263, 13269	Requires that designated waste be discharged to Class I or Class II waste management units.	Applies to discharges of designated waste (nonhazardous waste that could cause degradation of surface or groundwater) to land for treatment, storage, or disposal.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Waste Management Porter-Cologne Water Quality Control Act Title 27, CCR Section 20230		CWC Sections 13140-13147, 13172, 13260, 13263, 13269	Requires that inert waste does not need to be discharged at classified units.	Applies to discharges of inert waste to land for treatment, storage, or disposal.
Nonhazardous Solid Waste Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20200(c), 20220		CWC Sections 13140-13147, 13172, 13260, 13263, 13269	Requires that nonhazardous solid waste be discharged to a classified waste management unit.	Applies to discharges of nonhazardous solid waste to land for treatment, storage, or disposal.
Storm Water Porter-Cologne Water Quality Control Act 40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by California Storm Water Permit for Industrial Activities, Order #97-03-DWQ.	SWRCB	CWC Sections 13260, 13263, 13370.5, 13372, 13373, 13374, 13375, 13376, 13377, 13383	Regulates pollutants in discharge of storm water associated with hazardous waste TSDs, wastewater treatment plants, landfills, land application sites, and open dumps. Requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.	Applies to storm water discharges from industrial areas. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.
Storm Water Porter-Cologne Water Quality Control Act 40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by California Storm Water Permit for Industrial Activities, Order #92-08-DWQ.	SWRCB	CWC Sections 13260, 13263, 13370.5, 13372, 13373, 13374, 13375, 13376, 13377, 13383	Regulates pollutants in discharge of storm water associated with construction activity (clearing, grading, or excavation) involving the disturbance of 5 acres or more. Requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.	Applies to construction areas over 5 acres in size. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.
Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20080(g), Title 23, CCR, Section 2510(g)		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13304	Requires monitoring. If water quality is threatened, corrective action consistent with Title 27, Title 23 is required.	Applies to areas of land where discharges had ceased as of November 27, 1984 (the effective date of the revised Title 27/Title 23 regulations).
Remediation and Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR Section 20090(d) Title 23 CCR, Section 2511(d)		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13304	Actions taken by public agencies to clean up unauthorized releases are exempt from Title 27/Title 23 except that wastes removed from immediate place of release and discharged to land must be managed in accordance with classification (Title 27 CCR, Section 20200/Title 23 CCR, Sections 2520) and siting requirements of Title 27 or Title 23 and wastes contained or left in place must comply with Title 27 or Title 23 to the extent feasible.	Applies to remediation and monitoring of sites.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Existing Waste Management Units Porter-Cologne Water Quality Control Act Title 27, CCR Section 20080(d) Title 23 CCR, Section 2510(d)		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13304	Requires closure of existing waste management units according to Title 27/Title 23.	Applies to "existing" waste management units (i.e., areas where waste was discharged to land on or before November 27, 1984, but that were not closed, abandoned, or inactive prior to that date).
Surface Impoundments Porter-Cologne Water Quality Control Act Title 27, CCR Section 21400 Title 23, CCR Section 2582		CWC Sections 13140-13147, 13172, 13260, 1323, 13269	Requires surface impoundments to be closed by removing and treating all free liquid and either removing all remaining contamination or closing the surface impoundment as a landfill.	If water quality is threatened, this section is relevant and appropriate for natural topographic depressions, excavations, and diked areas where wastes containing free liquids were discharged.
Groundwater Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR Sections 20385-20435 Title 23, CCR Section 2550		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Where groundwater monitoring is required under 2510 or 2511 of Ch 15 (and equivalent for Title 27), applies to authorized waste management units as well as unauthorized discharges of waste to land and to closed abandoned inactive units.	Applies to all areas in which waste has been discharged to land to determine the threat to water quality.
Detection Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR Section 20385 Title 23, CCR Section 2550.1		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires detection monitoring. Once a significant release has occurred, evaluation or corrective action monitoring is required.	Applies to all areas in which waste has been discharged to land to determine the threat to water quality.
Water Quality Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20390 Title 23, CCR, Section 2550.2		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires establishment of water quality protection standard consisting of a list of constituents of concern, concentration limits, compliance monitoring points and all monitoring points. This section further specifies the time period that the standard shall apply.	Applies to all areas in which waste has been discharged to land where groundwater is threatened.
Constituents of Concern in Soil Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20395 Title 23, CCR, Section 2550.3		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires development of a list of constituents of concern that include all waste constituents, that are reasonably expected to be present in the soil from discharges to land, and could adversely affect water quality.	Applies to all areas in which waste has been discharged to land where groundwater is threatened.
Concentration Limits Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20400 Title 23, CCR, Section 2550.4		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Concentration limits must be established for groundwater, surface water, and the unsaturated zone. Must be based on background, equal to background, or for corrective actions, may be greater than background, not to exceed the lower of the applicable water quality objective or the concentration technologically or economically achievable. Specific factors must be considered in setting cleanup standards above background levels.	If water quality is threatened, this section applies in setting soil cleanup levels for all cleanups of discharges of waste to land.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Detection Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20420 Title 23, CCR, Section 2550.8		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires detection monitoring to determine if a release has occurred.	Applies to all areas where waste has been discharged to land and groundwater is threatened.
Point of Compliance Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20405 Title 23, CCR, Section 2550.5		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires identification of the point of compliance, hydraulically downgradient from the area where waste was discharged to land.	Applies to all areas in which waste has been discharged to land where groundwater is threatened.
Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20410 Title 23, CCR, Section 2550.6		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup levels.	Applies to all soil cleanup activities.
Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20415 Title 23, CCR, Section 2550.7		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires general soil, surface water, and groundwater monitoring.	Applies to all areas where waste has been discharged to land.
Detection Monitoring Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20420 Title 23, CCR, Section 2550.8		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires detection monitoring to determine if a release has occurred.	Applies to all areas where waste has been discharged to land and groundwater is threatened.
Releases Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20425 Title 23, CCR, Section 2550.9		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires an assessment of the nature and extent of the release, including determination of the spatial distribution and concentration of each constituent.	Applies to sites at which monitoring results show statistically significant evidence of a release.
Corrective Action Measures Porter-Cologne Water Quality Control Act Title 27, CCR, Section 20430 Title 23, CCR, Section 2550.10		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires implementation of corrective action measures that ensure that cleanup levels (i.e., water quality protection standard established under Section 2550.2) are achieved throughout the zone affected by the release by removing the waste constituents or treating them in place. Source control may be required. Also requires monitoring to determine the effectiveness of the corrective actions.	If water quality is threatened, this section applies to all soil cleanup activities.

Table A-1 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Requirements "To be Considered" (TBCs)
Boundary Operable Unit RI/FS
Aerojet Superfund Site
Sacramento, California

Action-Specific ARARs (cont'd)	Agency	Reference	Description	Comment
Closure Requirements Porter-Cologne Water Quality Control Act Title 27, CCR, Sections 20950; 22207(a); 22212(a); and 22222 Title 23, CCR, Sections 2550.0(b); 2580; 2580(f)		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	General closure requirements, including continued maintenance of waste containment, drainage controls, and groundwater monitoring throughout the closure and post-closure maintenance periods.	Applies to partial or final closure of waste management units.
Closure Requirements Porter-Cologne Water Quality Control Act Title 27, CCR, Section 21090		CWC Sections 13140-13147, 13172, 13260, 13263, 13267, 13269	Requires a final cover for landfills constructed in accordance with specific prescriptive standards, to be maintained as long as wastes pose a threat to water quality.	If water quality is threatened, this section is relevant and appropriate for wastes contained or left in place at the end of remedial actions that could affect water quality. Includes closure of landfills and other areas where wastes have been discharged to land.

Notes and Key:

mg/kg = Milligrams per kilogram
$\mu g/m^3$ = Micrograms per cubic meter
lbs = Pounds
ARARs = Applicable or relevant and appropriate requirements
CA = California
Cal-OSHA = California Occupational Safety and Health Administration
CCC = California Civil Code
CCR = California code of regulations
CFR = Code of federal regulations
CHSC = California Health and Safety Code
CWC = California water code
DOT = Department of Transportation
DTSC = California Department of Toxic Substances Control
FR = Federal Register
LDR = Land disposal restrictions
LUC = Land use control
OSHA = Federal Occupational Safety and Health Administration
PCB = Polychlorinated biphenyls
PEL = Permissible exposure limits
POU = Perimeter Operable Unit
ppm = Parts per million
PRG = Preliminary remediation goal
RCRA = Resource Conservation and Recovery Act
RI/FS = Remedial Investigation/Feasibility Study
RWQCB = California Regional Water Quality Control Board
SMAQMD = Sacramento Metropolitan Air Quality Management District
SWRCB = State Water Resources Control Board
TBCs = To be considered
TSDs = Treatment, storage, and disposal facilities
TWA = Time weighted average
USEPA = United States Environmental Protection Agency
VOCs = Volatile organic compounds

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Safe Drinking Water Act (40 CFR 141)	42 USC Section 300(f) et. seq.	Establishes national drinking water standards in the form of Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) (Table A-2).	Applicable – at the point groundwater is delivered to a drinking water distribution system. Relevant and Appropriate – for in situ groundwater that is or has a potential to be used for drinking water.	Applicable to water systems serving over 25 persons. Relevant and appropriate for smaller systems. Establishes MCLs that apply to many of the site-related chemicals (see also Table A-2). All MCLs (organic, inorganic, etc.) are potentially applicable if the selected remedial action includes reinjection of treated water or discharge of treated water to surface water.
California Safe Drinking Water Act (California Health & Safety Code Section 4010 et. seq.)	Title 22 CCR Chapter 15, Section 64400 et seq.	Establishes California primary and secondary MCLs (Table A-2). State MCLs or Secondary MCLs that are more stringent than federal MCLs, or that are not addressed by federal MCLs are potential applicable or relevant and appropriate requirements (ARARs).	This act is legally applicable for an aquifer and associated distribution and pre-treatment system that are currently defined as a "public water system." If it is only a potential "public water system," then the act is relevant and appropriate.	It is Aerojet's opinion that this requirement is only applicable to public water systems at the point groundwater is delivered to a drinking water distribution system. Aerojet believes this requirement is relevant and appropriate for in situ groundwater that is or has a potential to be used for drinking water.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13240, 13241, 13242, 13243)	Water Quality Control Plan (Basin Plan) for the Regional Water Quality Control Board (RWQCB), Central Valley Region (CVR), adopted in accordance with Sections 13240 and 13050	Establishes water quality objectives (WQOs), including narrative and numerical standards that protect the beneficial uses and WQOs of surface and ground waters in the region. Describes implementation plans and other control measures designed to ensure compliance with state-wide plans and policies and provide comprehensive water quality planning.	Applicable to groundwater remedial actions and discharge to surface water Groundwater uses and WQOs are applicable requirements for development of ground-water cleanup levels and remedial actions.	Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies and WQOs to protect those uses. Any activity, including, but not limited to, the discharge of contaminated soils or waters or in situ treatment or containment of contaminated soils or waters, must not result in actual water quality exceeding WQOs. Specific portions of the Basin Plan that are potentially applicable include: (continued below)

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13240, 13241, 13242, 13243) (cont.)	RWQCB CVR Basin Plan (cont.)	Defines beneficial uses for surface water and groundwater in the basin. Establishes WQOs, including narrative and numeric standards, to protect the beneficial uses and WQOs of surface and ground waters in the region. Describes implementation plans and other control measures designed to ensure compliance with state-wide plans and policies. Establishes WQOs, including narrative and numeric standards, to protect the beneficial uses and WQOs of surface and ground waters in the region. Describes implementation plans and other control measures designed to ensure compliance with state-wide plans and policies. See Table A-2 for WQOs	These are also potential applicable if the selected remedial action includes reinjection of treated water. Surface water uses and WQOs are potentially applicable requirements if the selected remedial action includes discharge of treated water to surface water. Basin Plan policies and procedures for establishment of cleanup levels are also applicable.	• Beneficial uses of waters in the basin including: *Ground water:* – Municipal and domestic supply (MUN), – Agricultural supply (AGR), – Industrial service supply (IND), and – Industrial process supply (PRO). *Surface water:* – MUN, AGR, IND; – Recreation (REC); and – Freshwater habitat (WARM) and (COLD), Wildlife habitat (WILD), Migration of aquatic organisms (MIGR), and Spawning (SPWN). • WQOs to protect these uses including: *Ground water:* – Numerical standards for bacteria, chemical constituents (MCLs), and radioactivity; and – Narrative standards for tastes and odors and toxicity. *Surface water:* – Numerical limits for bacteria, chemical constituents, dissolved oxygen, pH, radioactivity, salinity, temperature and turbidity; and – Narrative standards for biostimulatory substances, color, floating material, oil and grease, sediment, settleable material, suspended material, tastes and odor, and toxicity. Basin Plan also requires that any activity, including, but not limited to, the discharge of contaminated soils or waters or in situ treatment or containment of contaminated soils or waters, must not result in actual water quality exceeding WQOs.

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240)	State Water Resources Control Board (SWRCB) Resolution No. 88-63 "Sources of Drinking Water Policy" (contained in the CVR Basin Plan)	Specifies that, with certain exceptions, all ground and surface waters must have the beneficial use of municipal or domestic water supply.	Applicable to determination of beneficial uses for waters that may be affected by discharges of wastes. While it is the State's position that this is an ARAR, since this resolution is only a policy and not a promulgated standard, it is Aerojet's opinion that this Resolution is a "To Be Considered" (TBC) criteria and not an ARAR.	This policy is used by the RWQCB in determining beneficial uses for waters. The beneficial uses established in the Basin Plan are based on this policy. The beneficial uses in the Basin Plan represent a site-specific determination and therefore are more appropriate than this general policy. This policy also establishes the basis for exceptions to the general designation of beneficial uses.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13263, 13304)	SWRCB Resolution No. 68-16 "Statement of Policy With Respect to Maintenance of High Quality of Waters in California " ("Anti-degradation Implementation Policy") (contained in the RWQCB CVR Basin Plan).	Requires that quality of high quality surface and ground waters be maintained to the maximum extent possible. *Degradation of waters will be allowed only if :* – It is consistent with the maximum benefit to the people of the state; – It does not unreasonably affect present and anticipated beneficial uses; and – It does not result in water quality less than that prescribed in RWQCB and SWRCB policies. If degradation is allowed, the discharge must meet best practicable treatment or control, which must prevent pollution or nuisance and result in the highest water quality consistent with maximum benefit to the people of the state.	Potentially applicable if the selected remedial action includes disposal of wastes into waters of the State.	Applicable to discharge of treated water to surface water or groundwater (reinjection) as this policy requires waste discharges to meet best practical treatment or control standards, and result in the highest water quality possible that is consistent with the maximum benefit to the people of the state.

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13263, 13304)	RWQCB, CVR Basin Plan (cont.) "Antidegradation Policy"	Defines the RWQCB policy with respect to implementation of the SWRCB Antidegradation Policy contained in SWRCB Resolution 68-16. Requires that high quality surface and ground waters be maintained to the maximum extent possible. Degradation of waters will be allowed (or allowed to remain) only if it is consistent with the maximum benefit to the people of the state, does not unreasonably affect present and anticipated beneficial uses, and does not result in water quality less than that prescribed in RWQCB and SWRCB policies	Potentially applicable for disposal of wastes into waters of the state.	Applies to discharges of waste to waters, including discharges to soil that may affect surface or ground waters. In situ cleanup levels for contaminated ground waters must be set at background level, unless allowing continued degradation is consistent with the maximum benefit of the people of the state. If degradation of waters is allowed, or allowed to remain, the discharge must meet best practical treatment or control standards, which must prevent pollution or nuisance, and result in the highest water quality possible that is consistent with the maximum benefit to the people of the state. In no case may WQOs be exceeded.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13240, 13241, 13242, 13243)	RWQCB, CVR Basin Plan, (cont.) "Policy for Application of Water Quality Objectives"	This policy requires achievement of WQOs at all points within a surface water or ground water resource for which beneficial uses have been designated rather than just at the points of use. This policy also explains how the RWQCB applies numeric and narrative WQOs to ensure the reasonable protection of beneficial uses of water. This policy also explains how the RWQCB applies Resolution No. 68-16 to promote the maintenance of existing high-quality waters.	WQOs are applicable for development of ground-water cleanup levels and remedial actions. Also potential TBCs if the selected remedial action includes reinjection of treated water. Surface water WQOs are applicable if the selected remedial action includes discharge of treated water to surface water.	This policy requires maintenance of background water quality to comply with the antidegradation policy. This policy requires WQOs to be the least stringent limits to be imposed on water quality and indicates that background represents the most stringent limits to be imposed on ambient water quality. The Basin Plan includes both numeric and narrative WQOs. This policy explains how the RWQCB evaluates compliance with the narrative WQOs through use of other standards, criteria, advisories, etc., as presented in *"A Compilation of Water Quality Goals."* This policy also presents a methodology for assessing compliance with the narrative WQO for toxicity. NOTE: As the *"Compilation of Water Quality Goals"* is only a guidance document and not a promulgated standard, it is Aerojet's opinion that this compilation is a "To Be Considered" criteria and not an ARAR.

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13304, 13240, 13241, 13242, 13243)	RWQCB, CVR Basin Plan, "Policy for Investigation and Cleanup of Contaminated Sites."	This policy establishes and describes the RWQCB required procedures for investigation and remediation of contaminated sites. This policy also includes implementation actions for setting groundwater and soil cleanup standards..	Applicable to groundwater remedial actions. While it is the State's position that this policy is an ARAR, it does not contain numeric standards but only presents procedures for identification of cleanup levels. As CERCLA establishes procedures for identification of cleanup levels at NPL sites, it is Aerojet's opinion that this is a TBC criteria, not an ARAR.	Cleanup standards for water should be equal to background concentrations unless such levels are technically and economically infeasible to achieve. In such cases, cleanup standards should not exceed applicable WQOs.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240, 13260, 13263, 13267, 13300, 13304, 13307)	RWQCB, CVR Basin Plan (cont.) SWRCB Resolution No. 92-49 (As amended April 21, 1994 and October 2, 1996) "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304" Also Title 23 CCR Chapter 22, Section 2907	Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, dischargers must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Requires the application of Title 23, CCR, Section 2550.4 requirements to groundwater cleanups. This policy does not contain numeric standards but does present procedures for identification of cleanup levels.	Applicable requirement for groundwater remedial actions. While it is the State's position that this policy is an ARAR, it does not contain numeric standards but only presents procedures for identification of cleanup levels. As CERCLA establishes procedures for identification of cleanup levels at NPL sites, it is Aerojet's opinion that this policy is a TBC criteria, not an ARAR.	These policies and procedures require cleanup of a discharge and abatement of effects of past, current or possible discharges of waste that creates or threatens to create a condition of pollution or nuisance. These policies and procedures establish procedures for investigation, evaluation of cleanup and abatement alternatives, implementation of cleanup and abatement actions including conformance with Resolution No. 68-16. These policies and procedures require cleanup and abatement that promotes attainment of either background water quality, or the best water quality which is reasonable (but not greater than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards) if background levels cannot be restored. Note: These policies and procedures also address designation and implementation of containment zones, which are discussed in Table A-5 under potential action-specific requirements.

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13304, 13240, 13241, 13242, 13243)	RWQCB, CVR Basin Plan, "Policy for Investigation and Cleanup of Contaminated Sites."	This policy establishes and describes the RWQCB required procedures for investigation and remediation of contaminated sites. This policy also describes the RWQCB requirements for setting cleanup levels for groundwater and soil contamination.	Applicable to groundwater remedial actions. While it is the State's position that this policy is an ARAR, it does not contain numeric standards but only presents procedures for identification of cleanup levels. As CERCLA establishes procedures for identification of cleanup levels at NPL sites, it is Aerojet's opinion that this is a TBC, not an ARAR.	This policy requires establishment of cleanup levels for groundwater based on: – Background concentrations – WQOs – Concentrations that do not pose a significant risk to human health or the environment – Technologic and economic feasibility of attaining background. *This policy requires achievement of background levels when feasible. Otherwise, this policy requires achievement of water quality objectives and risk-based levels that do not pose a significant risk to human health or the environment.* This policy also requires compliance with groundwater cleanup levels throughout the pollutant plume.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140 -13147, 13172, 13260, 13263, 13267, 13304).	Title 27, CCR, Section 20400 Title 23, CCR, Section 2550.4	Concentration limits must be established for groundwater, surface water, and the unsaturated zone. Limits must be based on background, equal to background, or for corrective actions, may be greater than background, not to exceed the lower of the applicable WQO or the concentration technologically or economically achievable. This regulation presents procedures for identifying concentration limits for cleanup and abatement of discharges from facilities that treat, store, or dispose of hazardous waste at Class I waste management units. SWB Resolution 92-49 also requires use of these regulations for development of cleanup levels other than background.	Potentially Applicable for identification of ground water cleanup levels. As this regulation does not contain numeric standards, it is not a chemical-specific ARAR but may be an action-specific ARAR.	This regulation requires cleanup to background concentration levels, or a concentration limit greater than background if – It is technologically and economically infeasible to achieve background, and – The constituent will not pose a substantial present or potential hazard to human health or the environment as long as the concentration limit greater than background is exceeded. *This regulation lists the various factors to be considered in setting a concentration limit greater than background. This regulation also requires concentration limits that are greater than background to be set at the lowest levels that are economically and technologically achievable.*

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Staff Report to the RWQCB - CVR	"A Compilation of Water Quality Goals"	Provides guidance on selecting numeric values to implement narrative WQOs contained in the Basin Plan.	While it is the State's position that this is an ARAR, as an individual document, it is Aerojet's opinion that this information is a TBC criteria.	This document is not a promulgated regulation and therefore in itself is not an ARAR but may be a TBC. This document should be considered in selecting appropriate numeric values to implement the narrative WQOs in the Basin Plan. The numeric values contained in the staff report may be ARARs or TBCs depending on the source of the values.
	National Pollutant Elimination Discharge System (NPDES Permit)	These regulations set forth the requirements for discharge to surface water and the Establishment of numeric limits and monitoring requirements for such discharges.	Applicable – if the selected remedial action includes discharge of treated water to surface water.	Discharge of treated groundwater to surface water may require obtaining a new NPDES permit or revision of Aerojet's existing NPDES permit. The NPDES permit will specify the numeric standards required to be met in water that is to be discharged to surface water as well as the monitoring requirements for such a discharge.
California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)	Title 22 CCR Chapter 3 Section 12000 et seq.	These regulations identify chemicals known to cause cancer or reproductive toxicity. This act prohibits discharge or release of significant amounts of the identified chemicals. Significant amounts are generally defined as levels that pose no significant risk of cancer. For drinking water, significant levels are defined as California MCLs, drinking water action levels when MCLs don't exist, or discharge limits allowed by a Basin Plan or waste discharge permit.	The numeric limits and notification requirements are potentially relevant and appropriate if the selected remedial action includes use of treated groundwater as drinking water supply. The numeric limits and prohibition on discharge of significant amounts of these chemicals are applicable to discharge or reinjection of treated water.	These regulations make it illegal to expose persons to significant amounts of chemicals known to cause cancer or reproductive toxicity without prior notification, or to discharge significant amounts of these chemicals to sources of drinking water. The numeric limits and notification requirements are applicable to the water suppliers at the point that groundwater is delivered to a water system for public consumption. The numeric limits and prohibition on discharge of significant amounts of these chemicals are applicable to discharge of treated water to surface water or reinjection of treated groundwater. The numeric limits and notification requirements are applicable to remedial actions, if any, that include use of treated water for municipal or domestic supply.

Table A-2: Summary of Potential Chemical Specific Requirements For Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Description	Preliminary ARAR Determination	Comments
Clean Water Act Section 304(a)(1)	National Ambient Water Quality Criteria	Establishes water quality criteria, which are non-enforceable guidance developed under CWA §304 and are used by the State, in conjunction with designated use for a stream segment, to establish water quality standards under CWA §303.	Neither applicable nor relevant and appropriate for groundwater. Potentially relevant but likely not appropriate for discharge of treated water to surface water.	These criteria are published by EPA to protect human health and welfare and freshwater and marine aquatic life from pollutants in surface waters and therefore are not applicable to groundwater. Ambient water quality criteria are based on consumption of drinking water and aquatic organisms (primarily fish) and consumption of fish alone and therefore are not relevant to groundwater in the BOU. Although potentially relevant, ambient water quality criteria are not appropriate requirements as the RWQCB has adopted numeric standards for the surface waters in the area which represent site-specific water quality standards which are more appropriate requirements.
EPA Superfund guidance	US EPA Region 9 Preliminary Remediation Goals (PRGs)	EPA has developed preliminary remediation goals that are risk-based levels that are used to screen sites that may require additional investigation or possible remediation. PRGs are also used to screen lists of site-related chemicals to identify potential chemicals of concern.	To Be Considered	EPA Region 9 PRGs are guidance levels, not promulgated standards, and therefore are not an ARAR; however, the PRGs may be TBCs for identification of potential groundwater cleanup levels.
California Health & Safety Code Section 116455	California Department of Health Services (DHS) Drinking Water Notification (formerly Action) Levels	DHS has established drinking water notification (formerly) action levels based mainly on health effects, but in some cases based on organoleptic (taste- and odor-based) values for chemicals without MCLs.	To Be Considered	Notification levels (NLs) are advisory to water suppliers and therefore would not be ARARs. They are potential TBCs for identifying potential groundwater cleanup levels. Of particular interest in this matter are the NLs for perchlorate and NDMA.
Calderon-Sher Safe Drinking Water Act of 1996	California Public Health Goals (PHGs) developed by The California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA).	*OEHHA has adopted PHGs for chemicals in drinking water.* PHGs are levels of drinking water contaminants at which adverse health effects are not expected to occur from a lifetime of exposure.	To Be Considered	PHGs are non-enforceable risk-based goals and therefore are not ARARs, but are TBCs for identifying potential groundwater cleanup levels.

Table A-3: Summary of Preliminary Potential Chemical-Specific ARARs and TBCs for Contaminants of Concern in Groundwater
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Contaminant of Concern	Federal Primary MCL	Federal MCLG	California Primary MCL	California PHGs	California DHS Action Levels	California Proposition 65 Levels[a]	USEPA Region 9 PRGs[b]
Carbon tetrachloride	5	0	0.5	0.1	-	2.5	0.17
Chloroform	80 [c]	70	100 [c]	-	-	10	0.53
1,1-Dichloroethane	-	-	5	3	-	50	2
1,2-Dichloroethane	5	0	0.5	0.4	-	5	0.12
1,1-Dichloroethene	7	7	6	10	-	-	340
1,2-Dichloroethene (cis)	7	70	6	-	-	-	61
1,2-Dichloroethene (trans)	1	100	10	-	-	-	120
1,4-Dioxane	-	-	-	-	3	15	6.1
Nitrate [d]	10,000	10,000	45,000 [e]	10,000	-	-	10,000
Nitrite [d]	1,000	1,000	1,000	1,000	-	-	1,000
Total Nitrate and Nitrite [d]	10,000	-	10,000	10,000	-	-	NA
NDMA	-	-	-	-	0.01	0.02	0.0013
Perchlorate	-	-	-	6	6	-	3.6
Tetrachloroethene	5	0	5	0.06	-	7	0.66
1,1,2-Trichloroethane	5	3	5	NA	-	5	0.2
Trichloroethene	5	0	5	0.8	-	25	0.028
Freon-113	-	-	1,200	4,000	-	-	59,000
Vinyl chloride	2	0	0.5	0.05	-	1.5	0.02
Benzene	5	0	1	0.15	-	-	-
Bromodichloromethane [c]	80	0	80	-	-	-	-
Methylene chloride	5	0	5	4	-	-	-
Diesel	-	-	-	-	-	-	-
Kerosene	-	-	-	-	-	-	-
Aluminum	-	-	1,000	600	-	-	-
Chromium	100	100	50	-	-	-	-
Hexavalent chromium	-	-	50	-	-	-	-
Iron	-	-	-	-	-	-	-
Manganese	-	-	-	-	500	-	-
Silver	-	-	-	-	-	-	-
Vanadium	-	-	-	-	50	-	-
Zinc	-	-	-	-	-	-	-

Table A-3: Summary of Preliminary Potential Chemical-Specific ARARs and TBCs for Contaminants of Concern in Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Chemical of Concern	IRIS RfD as Drinking Water Levels[f,g]	IRIS $1x10^{-6}$ Incremental Cancer Risk[f]	Cal/EPA Cancer Potency Factors as Drinking Water Levels[f,h]	EPA DWHAs or SNARLs – non-carcinogenic[f,i]	EPA DWHAs or SNARLs – carcinogenic[f,i]	NAS SNARLs non-carcinogenic[f]	NAS SNARLs carcinogenic[f,i]	Taste & Odor Thresholds[f]
Carbon tetrachloride	4.9	0.3	0.23	200[j]	0.3	200[k]	4.5	520
Chloroform	70	-	1.1	70[j]	-	-	0.26 / 5.6	2,400
1,1-Dichloroethane	-	-	6.1	-	-	-	-	-
1,2-Dichloroethane	-	0.4	0.74	7[j]	0.4	-	0.71	7,000
1,1-Dichloroethene	35	-	-	100	0.06	100	-	1,500
1,2-Dichloroethene (cis)	-	-	-	70	-	-	-	-
1,2-Dichloroethene (trans)	140	-	-	100	-	-	-	260
1,4-Dioxane	-	3	1.3	400[j]	3	-	-	230,000
Nitrate [d]	11,000	-	-	10,000[j]	-	-	-	-
Nitrite [d]	700	-	-	1,000[j]	-	-	-	-
Total Nitrate and Nitrite	-	-	-	-	-	-	-	-
NDMA	-	0.0007	0.0022	-	-	-	-	-
Perchlorate	0.2	-	-	20 – 40	-	-	-	-
Tetrachloroethene	70	-	0.065	10	-	-	3.6	170
1,1,2-Trichloroethane	2.8	0.6	0.49	3	0.6	-	-	-
Trichloroethene	-	-	2.7	-	3	-	1.5	310
Freon-113	210,000	-	-	-	-	-	-	>300,000
Vinyl chloride	21	0.48 / 0.24	0.13	3,000[j]	0.02	-	1.1	3,400
Benzene	28	-	-	200	-	-	-	170
Bromodichloromethane [c]	140	-	-	6,000	-	-	-	-
Methylene chloride	420	-	-	2,000	-	5,000	-	9,100
Diesel	56 to 140	-	-	100	-	-	-	100
Kerosene	-	-	-	100	-	-	-	100
Aluminum	-	-	-	-	-	5,000	-	-
Chromium	-	-	-	-	-	1,000	-	-
Hexavalent chromium	21	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-
Manganese	980	-	-	-	-	-	-	-
Silver	35	-	-	100	-	-	-	-
Vanadium	63	-	-	-	-	-	-	-
Zinc	2,100	-	-	2,000	-	-	-	-

Table A-3: Summary of Preliminary Potential Chemical-Specific ARARs and TBCs for Contaminants of Concern in Groundwater (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Notes: All values are in units of µg/L.
NA = not available.
[a] Converted to concentration based on 2 liters per day consumption.
[b] Lower of the integrated cancer risk (1×10^{-6}) and chronic hazard quotient (HQ = 1) for tap water.
[c] For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane).
[d] Expressed as N.
[e] Expressed as NO_3.
[f] Obtained from a Compilation of Water Quality Goals, Marshack, 2003 and 2004.
[g] Assumes 70 kg body weight, 2 liters/day water consumption, and 20% relative source contribution from drinking water.
[h] Assumes 70 kg body weight and 2 liters/day water consumption.
[i] One-in-a-Million Incremental Cancer Risk.
[j] 10-day exposure where noted, all others are lifetime exposures.
[k] 7-day exposure where noted, all others are lifetime exposures.

MCL – Maximum Contaminant Level
MCLG – Maximum Contaminant Level Goal
PHG – Public Health Goal
DHS – Department of Health Services
PRG – Preliminary Remediation Goal
NDMA – N-Nitrosodimethylamine
IRIS – Integrated Risk Information System
RfD – Reference dose
DWHA – Drinking Water Health Advisory
SNARL – Suggested No Adverse Risk Level
NAS – National Academy of Sciences

Table A-4: Discharge Limitations for American River Study Area Interim Groundwater Extraction and Treatment System
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Groundwater Treatment System (Inlet and Outlet) Monitoring

Constituents	Units	Type of Sample	Sampling Frequency
Electrical Conductivity @25°C[1]	umhos/cm	Grab	Weekly
Flow	MGD	Meter	Continuous
Total Dissolved Solids	mg/L	Grab	Monthly
Acute Toxicity[2,3]	% survival	Grab	Monthly
Volatile Organics[4]	µg/L	Grab	Weekly
Semi-volatile Organics[5]	µg/L	Grab	Monthly
1,4-dioxane[6]	µg/L	Grab	Monthly
Perchlorate[7]	µg/L	Grab	Monthly
Total Copper	mg/L	Grab	Quarterly
Total Lead	mg/L	Grab	Quarterly
Total Zinc	mg/L	Grab	Quarterly
Hardness (as $CaCO_3$)	mg/L	Grab	Quarterly
Temperature	°F/°C	Grab	Weekly
Dissolved Oxygen	mg/L	Grab	Quarterly
pH[1]	pH units	Grab	Weekly
NDMA[8]	µg/L	Grab	Monthly

Receiving Water Monitoring[9,10]

Constituents	Units	Type of Sample	Sampling Frequency
Dissolved Oxygen	mg/L	R-1,R-2	Monthly
pH	pH units	R-1,R-2	Monthly
Turbidity	NTU	R-1,R-2	Monthly
Temperature	°F/°C	R-1,R-2	Monthly
Electrical Conductivity	umhos/cm	R-1,R-2	Monthly
Total Copper	mg/L	R-1,R-2	Quarterly
Total Lead	mg/L	R-1,R-2	Quarterly
Total Zinc	mg/L	R-1,R-2	Quarterly
NDMA[8]	µg/L	R-2	Monthly
Perchlorate[7]	µg/L	R-2	Monthly
Volatile Organics[4]	µg/L	R-1,R-2	Monthly
Hardness (as $CaCO_3$)	mg/L	R-1,R-2	Monthly

Effluent Limitations (ARSA Facility)

Constituents	Units	Daily Maximum	Monthly Average
Total Copper	µg/L	17	11
Total Lead	µg/L	15	2.5
Total Zinc	µg/L	110	100
Volatile Organics	µg/L	0.5	
1,2-DCA	µg/L	0.5	0.38
Perchlorate	µg/L	18	10
1,4-dioxane	µg/L	10	3

Table A-4: Discharge Limitations for American River Study Area Interim Groundwater Extraction and Treatment System (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Three Species Chronic Toxicity Monitoring

Chronic toxicity monitoring shall be conducted to determine whether the effluent is contributing to toxicity in the American River. The testing shall be conducted as specified in EPA 600/4-89-001. Chronic toxicity samples shall be collected at the discharge of the Ground Water Treatment Plant prior to entering Buffalo Creek. Samples collected from the outlet of the treatment unit shall be representative of the volume and quality of the discharge. The time of collection for samples shall be recorded. Chronic toxicity monitoring shall include the following:

Species:	*Pimephales promelas, Ceriodaphnia dubia, Selenastrum capriocornutum*
Frequency:	Once per Quarter for one year
Dilution Series:	100 percent effluent

Monitoring of Discharge to Sailor Bar Park

The Discharger shall sample the discharge to pond in Sailor Bar Park for volatile organic constituents and NDMA as listed above in the table for the groundwater treatment system monitoring. The sample shall be collected and analyzed on a monthly basis from the discharge prior to it entering the pond.

Notes:
All Metals analyses shall be by atomic adsorption methods or a method with an equivalent practical quantitation limit. In addition, chronic toxicity monitoring for the treatment system is also required, and detailed below.

1 Field measurements.
2 The analyses shall be performed in accordance with EPA/600/4-90/027, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*
3 Sampling of effluent only.
4 Test method to be by EPA Methods 601 and 602, or 8010 and 8020, or 500 series with a practical quantitation level no greater than 0.5 μg/L. All concentrations between the detection level and practical quantitation level shall be reported as trace.
5 Test method to be EPA Method 8270 or equivalent. All peaks shall be reported and tentatively identified. All concentrations between the detection limit and the practical quantitation limit shall be reported as trace values.
6 A practical quantitation level of 10 μg/L. All concentrations between the detection level and quantitation level shall be reported as trace.
7 A practical quantitation level of 4 μg/L. All concentrations between the detection level and quantitation level shall be reported as trace.
8 NDMA analysis with a minimum practical quantitation level of 0.033 μg/L. All concentrations between the detection level and quantitation level shall be reported as trace.
9 All receiving water samples shall be grab samples. Receiving water monitoring shall include at least the following:

Table A-4: Discharge Limitations for American River Study Area Interim Groundwater Extraction and Treatment System (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Station	Description
R-1	At least 100 feet upstream on the American River from the confluence with Buffalo Creek.
R-2	Downstream on the American River at the pedestrian bridge crossing just downstream of the Sunrise Bridge overcrossing.

10 In conducting the receiving water sampling, a log shall be kept of the receiving water conditions in the American River. Attention shall be given to the presence or absence of:

a. Floating or suspended matter
b. Discoloration
c. Bottom Deposits
d. Aquatic life
e. Visible films, sheens or coatings
f. Fungi, slimes, or objectionable growths
g. Potential nuisance conditions

Notes on receiving water conditions shall be summarized in the monitoring report.

Table A-5: Potential Location-Specific ARARs
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Location	Description	Preliminary ARAR Determination	Comments
Porter-Cologne Water Quality Control Act (California Water Code Section 13000 et seq.)	California Water Code Section 13243	Areas of waste discharge	The RWQCB may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.	Applicable to groundwater remedial action.	Applies to groundwater remedial action.
22 CCR 66264.18(b)	22 CCR 66264.18(b)	Within 100-year flood plain	A RCRA facility located in a 100-year flood plain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood.	Potentially applicable	Some locations considered for groundwater treatment facilities may be located in the 100-year flood plain. No new permanent building is proposed in the 100-year flood-plain zone. However, if a RCRA hazardous waste facility is located in a 100-year flood plain, it must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood.
National Archaeological and Historical Preservation Act (16 USC Section 469)	36 CFR Part 65	Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeological data may require actions to recover and preserve artifacts.	Potentially applicable	The proposed remedial alternatives will not alter or destroy any known prehistoric or historic archeological features west of the Aerojet Sacramento facility site. Areas west of the Aerojet Sacramento facility are essentially completely developed. However, because there is always a possibility that buried historic or prehistoric remains could be discovered during construction, mitigation measures to protect the area would be required if such a discovery were uncovered.
National Historic Preservation Act Section 106 (16 USC Section 470 et seq)	36 CFR Part 800	Historic project owned or controlled by a federal agency	Property included in or eligible for the National Register of Historic Places may require action to preserve historic properties.	Potentially applicable	If historic properties are impacted during the implementation of the remedial action, these requirements may be applicable.

Table A-5: Potential Location-Specific ARARs (continued)
Boundary Operable Unit RI/FS
Aerojet Superfund Site, Sacramento, California

Source or Authority	Requirement, Standard, or Criterion	Location	Description	Preliminary ARAR Determination	Comments
Substantive portions of the Endangered Species Act of 1973 (16 USC 1531 et seq.) Substantive portions of the California Endangered Species Act Substantive portions of the Native Plant Protection Act	50 CFR Part 200, 50 CFR Part 402 Substantive portions of the California Endangered Species Act Substantive portions of the Native Plant Protection Act	Critical habitat upon which endangered species or threatened species depend	Requires action to conserve endangered species or threatened species, including consultation with the Department of the Interior, Fish and Wildlife Service.	Potentially applicable	Two endangered floral species are known to occur within Sacramento County: the Sacramento Orcutt grass (Orcuttia Viscida) and the Boggs Lake hedge hyssop (Gratiola Heterosepala). Four endangered wildlife species are expected to occur within 25 miles of the Aerojet Sacramento facility: Bald Eagle, Peregrine Falcon, Giant Garter Snake, and the Valley Elderberry Longhorn Beetle. The Aerojet Sacramento facility may be a habitat for the Burrowing Owl, a species of concern in California. Consultations between Department of Toxic Substances Control (DTSC) and Department of Fish and Game will be conducted if such species are affected by remedial actions.
Fish and Game Commission Wetlands Policy (adopted 1987) included in Fish and Game Code Addenda	40 CFR Part 6 Appendix A	Wetlands	Actions must be taken to ensure that "no net loss" of wetlands acreage or habitat value occurs. Actions must be taken to restore and enhance California's wetland acreage and habitat value. Actions must be taken to avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible.	TBC Potentially applicable	This policy is not a regulatory program and will be considered as a TBC criteria. These requirements would be applicable if groundwater treatment facilities or associated facilities were constructed in wetlands.
Fish and Wildlife Coordination Act (16 USC 661 et seq.)	40 CFR Part 6 §302	Areas affecting stream or river	Restrictions on diversion, channeling or other activity that modifies a stream or river and affects fish or wildlife.	Potentially applicable to any remedial action components that may be constructed in or along a creek or river	Requires action to protect fish or wildlife.

Appendix B
Detailed Costs for Remedial Alternatives

Table B-1a Estimated Cost of Sitewide Institutional Controls
Initial Institutional Controls Activities Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
SITEWIDE[1] INITIAL INSTITUTIONAL CONTROLS ACTIVITIES[2] COST ESTIMATE				
Preliminary				
Preparing/negotiating documents that establish ICs (Attorney)	20	hours	300	6,000
Enacting and modifying State and local laws/regulations	20	hours	300	6,000
Amending local by-laws, rules, regs, ordinances (e.g., zoning overlays)	8	hours	300	2,400
Obtain local regulatory approval of proposed legal documents	20	hours	300	6,000
Perform title searches, research land plans, records of prior interests/encumbrances, deeds, cure title defects that may impair establishment of Ics (Aerojet assigned IC Coordinator)	80	hours	85	6,800
Initial training of registry, property records office about ICs for initial recordation purposes	16	hours	85	1,400
Filing and recording property law-based ICs w/ property records office	6	hours	85	500
Providing financial assurances to regulators or parties	0	hours	300	0
Filing fees	1	lump sum	1,000	1,000
Planning				
Prepare comprehensive Institutional Controls Plan (Attorney)	60	hours	300	18,000
Prepare comprehensive Institutional Controls Plan (Project Manager)	80	hours	120	9,600
Public Information				
Plan the "who, what, where, when, and how" to inform Public	6	hours	150	900
Determine optimal media and frequency for informing Public	4	hours	150	600
Develop content for communications about ICs	4	hours	150	600
Record-Keeping Systems				
Planning for record-keeping systems	2	hours	85	200
Determine if existing record-keeping systems can accommodate land use restriction and contamination information	2	hours	85	200
Contact State registry of sites	4	hours	85	300
Determine need/ability to maintain all info in one system	2	hours	85	200
Acquire/develop/modify manual or automatic record-keeping system	8	hours	85	700
Purchase hardware or find unused hardware capacity	1	lump sum	1,000	1,000
Acquire new or allocate existing space for storing records	2	hours	85	200
Administration/Funding				
Plan for long-term funding; specify who will be responsible for financing various IC-related activities	4	hours	120	500
Develop estimate of annual cost of IC activities	4	hours	120	500
Monitoring				
Create schedule/assign responsibility for monitoring activities	4	hours	120	500
Determine what monitoring data will be collected/how recorded	2	hours	300	600
Inspection				
Train inspectors	6	hours	85	500
Enforcement				0
Determine which Agency/Dept has authority/resposibility to enforce each IC	2	hours	300	600
Assign enforcement responsibilities; training in IC enforcement	2	hours	120	200
Establish contact with entities implementing ICs	16	hours	85	1,400
Determine how to communicate enforcement information among Agencies	4	hours	120	500
Indirect costs (copying, materials/supplies, travel costs)	1	lump sum	1,000	1,000
Capital Costs Subtotal - Initial Institutional Controls Activities				$69,000
Capital Cost Contingency (scope and cost) 20%				$14,000
TOTAL - ESTIMATED CAPITAL COST (SITEWIDE)				**$83,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

[2] *As defined in "Estimating the Cost of Institutional Controls", Environmental Law Institute and Resources for the Future (2005).*

Specific Institutional Controls include State and local government land use controls; proprietary or property-law based controls; governmental controls; enforcement tools; and informational devices.

Table B-1a Estimated Cost of Sitewide Institutional Controls
Annual Institutional Controls Activities Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
SITEWIDE[1] ANNUAL INSTITUTIONAL CONTROLS ACTIVITIES[2] COST ESTIMATE				
Planning				
Verifying that Institutional Controls Plan is still accurate	2	hours	85	200
Public Information				
Deliver tailored ongoing information programs to help lower risk of exposure for each segment of public	8	hours	85	700
Ensure that public health organizations, hospitals, fire/emergancy response are informed about the site	8	hours	85	700
Coordinate Agency communications concerning ICs	4	hours	85	300
Record-Keeping Systems				
Managing and maintaining record-keeping systems	16	hours	85	1,400
Coordinate sharing of data among federal, State, local govts, landowners and non-governmental organizations who may maintain records about the site	8	hours	85	700
Convert/reformat State/local govt data into format required by EPA for exporting data to its system(s)	4	hours	85	300
Maintain QA/QC for data	2	hours	85	200
Administration/Funding				
Including cost of IC activities in annual budget requests	2	hours	85	200
Obtaining funds as needed for annual activities	2	hours	85	200
Reporting on status and funding of sites and IC programs for an entity	2	hours	85	200
Monitoring				
Coordinate monitoring of sites covered by multiple juristictions	8	hours	85	700
Collect monitoring data and input into record-keeping system	40	hours	85	3,400
Report results	16	hours	85	1,400
Inspection				
Visit sites regularly to confirm acceptable land uses	24	hours	85	2,000
Visit sites to inspect monitoring equipment, signs, and other ICs (may be conducted simultaneously w/ inspections of engineered controls)	16	hours	85	1,400
Enforcement				
Obtain/interprete inspection and monitoring data	8	hours	85	700
Evaluate data to ensure site compliance	4	hours	85	300
Communicate enforcement info and planned actions w/ other Agencies	6	hours	85	500
Indirect costs (copying, materials/supplies, travel costs)	1	lump sum	1,000	1,000
			Subtotal - Annual Institutional Controls Activities	$16,500
			Annual Cost Contingency (scope and cost) 20%	$3,300
			TOTAL - ESTIMATED ANNUAL COST (SITEWIDE)	**$20,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

[2] *As defined in "Estimating the Cost of Institutional Controls", Environmental Law Institute and Resources for the Future (2005).*

Table B-1a Estimated Cost of Sitewide Institutional Controls
Periodic Institutional Controls Activities Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
SITEWIDE[1] PERIODIC INSTITUTIONAL CONTROLS ACTIVITIES[2] COST ESTIMATE				
Planning				
Adding to/revising Institutional Controls Plan in response to change in circumstances (e.g., change in land use or site ownership)	16	hours	85	1,400
Public Information				
Revise/deliver public info about ICs; refresh/update public info	8	hours	85	700
Assess effectiveness of programs and improving them	8	hours	120	1,000
Provide updated education for federal, State, and local govt staff and the public about ICs and related laws and programs	8	hours	85	700
Record-Keeping Systems				
Respond to requests for info from govt agencies, potential lenders, insurers, purchasers, general public	16	hours	85	1,400
Enter/update data in systems as needed (when ICs are implemented at a site or when a site changes hands)	8	hours	85	700
Upgrading hardware and software	4	hours	85	300
Training new staff; training when system changes	8	hours	85	700
Tracking property transactions and parcel divisions	8	hours	85	700
Re-parceling property if/when a landowner wants to change land uses. Survey related properties.	16	hours	85	1,400
Propagating new and updated IC information through all land-use related offices.	8	hours	85	700
Administration/Funding				
Obtaining funds as needed for periodic activities	2	hours	85	200
Monitoring				
Provide monitoring-related ongoing training, specialized training, and outreach to affected regulatory bodies such as EPA, RWQCB, DTSC, and local governments	8	hours	85	700
Inspection				
Visiting sites in response to information about possible changes in land use or other issues	8	hours	85	700
Prepare 5 - year Review Report per CD/UAO (Project Manager)	24	hours	120	2,900
Prepare 5 - year Review Report per CD/UAO (Aerojet Coordinator)	80	hours	85	6,800
Enforcement				
Issue orders, negotiate, litigate with landowner/user who is out of compliance	24	hours	85	2,000
Update property records, hazardous site registry	16	hours	85	1,400
Communicate updated information to other Agencies	8	hours	85	700
Repair damage resulting from a failed IC, including damage to the site itself, abutting land, or other land	8	hours	85	700
Determine cause of IC failure and whether new/revised ICs needed	8	hours	120	1,000
Take steps to design/implement/effectuate new ICs, if appropriate, including obtaining funding to pay the costs of such steps	16	hours	120	1,900
Indirect costs (copying, materials/supplies, travel costs)	1	lump sum	1,500	1,500
Subtotal - Periodic Institutional Controls Activities				$30,200
Cost Contingency (scope and cost) 20%				$6,000
TOTAL - ESTIMATED PERIODIC COST (SITEWIDE)				**$36,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

[2] *As defined in "Estimating the Cost of Institutional Controls", Environmental Law Institute and Resources for the Future (2005).*

Table B-1a Estimated Cost of Sitewide Institutional Controls
Present Worth Cost Estimate

YEAR	*n*	P/F(*i* =2.7%)	INITIAL IC ACTIVITIES COSTS ($)	ANNUAL IC ACTIVITIES COSTS ($/yr)	PERIODIC IC ACTIVITIES COSTS ($)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
SITEWIDE[1] PRESENT WORTH COST ESTIMATE								
2011	0	1.00000	83,000			83,000	83,000	83,000
2012	1	0.97371		20,000		20,000	19,500	103,000
2013	2	0.94811		20,000		20,000	19,000	122,000
2014	3	0.92318		20,000		20,000	18,500	141,000
2015	4	0.89891		20,000	36,000	56,000	50,300	191,000
2016	5	0.87528		20,000		20,000	17,500	209,000
2017	6	0.85227		20,000		20,000	17,000	226,000
2018	7	0.82986		20,000		20,000	16,600	243,000
2019	8	0.80805		20,000		20,000	16,200	259,000
2020	9	0.78680		20,000	36,000	56,000	44,100	303,000
2021	10	0.76612		20,000		20,000	15,300	318,000
2022	11	0.74598		20,000		20,000	14,900	333,000
2023	12	0.72636		20,000		20,000	14,500	348,000
2024	13	0.70727		20,000		20,000	14,100	362,000
2025	14	0.68867		20,000	36,000	56,000	38,600	401,000
2026	15	0.67057		20,000		20,000	13,400	414,000
2027	16	0.65294		20,000		20,000	13,100	427,000
2028	17	0.63577		20,000		20,000	12,700	440,000
2029	18	0.61906		20,000		20,000	12,400	452,000
2030	19	0.60278		20,000	36,000	56,000	33,800	486,000
2031	20	0.58694		20,000		20,000	11,700	498,000
2032	21	0.57151		20,000		20,000	11,400	509,000
2033	22	0.55648		20,000		20,000	11,100	520,000
2034	23	0.54185		20,000		20,000	10,800	531,000
2035	24	0.52761		20,000	36,000	56,000	29,500	561,000
2036	25	0.51373		20,000		20,000	10,300	571,000
2037	26	0.50023		20,000		20,000	10,000	581,000
2038	27	0.48708		20,000		20,000	9,700	591,000
2039	28	0.47427		20,000		20,000	9,500	601,000
2040	29	0.46180		20,000	36,000	56,000	25,900	627,000
			TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**879,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS (site-wide):					**630,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-1b Estimated Cost of Institutional Controls (Boundary OU Share of Total)
Initial Institutional Controls Activities Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
SITEWIDE[1] INITIAL INSTITUTIONAL CONTROLS ACTIVITIES[2] COST ESTIMATE				
Preliminary				
Preparing/negotiating documents that establish ICs (Attorney)	20	hours	300	6,000
Enacting and modifying State and local laws/regulations	20	hours	300	6,000
Amending local by-laws, rules, regs, ordinances (e.g., zoning overlays)	8	hours	300	2,400
Obtain local regulatory approval of proposed legal documents	20	hours	300	6,000
Perform title searches, research land plans, records of prior interests/encumbrances, deeds, cure title defects that may impair establishment of Ics (Aerojet assigned IC Coordinator)	80	hours	85	6,800
Initial training of registry, property records office about ICs for initial recordation purposes	16	hours	85	1,400
Filing and recording property law-based ICs w/ property records office	6	hours	85	500
Providing financial assurances to regulators or parties	0	hours	300	0
Filing fees	1	lump sum	1,000	1,000
Planning				
Prepare comprehensive Institutional Controls Plan (Attorney)	60	hours	300	18,000
Prepare comprehensive Institutional Controls Plan (Project Manager)	80	hours	120	9,600
Public Information				
Plan the "who, what, where, when, and how" to inform Public	6	hours	150	900
Determine optimal media and frequency for informing Public	4	hours	150	600
Develop content for communications about ICs	4	hours	150	600
Record-Keeping Systems				
Planning for record-keeping systems	2	hours	85	200
Determine if existing record-keeping systems can accommodate land use restriction and contamination information	2	hours	85	200
Contact State registry of sites	4	hours	85	300
Determine need/ability to maintain all info in one system	2	hours	85	200
Acquire/develop/modify manual or automatic record-keeping system	8	hours	85	700
Purchase hardware or find unused hardware capacity	1	lump sum	1,000	1,000
Acquire new or allocate existing space for storing records	2	hours	85	200
Administration/Funding				
Plan for long-term funding; specify who will be responsible for financing various IC-related activities	4	hours	120	500
Develop estimate of annual cost of IC activities	4	hours	120	500
Monitoring				
Create schedule/assign responsibility for monitoring activities	4	hours	120	500
Determine what monitoring data will be collected/how recorded	2	hours	300	600
Inspection				
Train inspectors	6	hours	85	500
Enforcement				0
Determine which Agency/Dept has authority/resposibility to enforce each IC	2	hours	300	600
Assign enforcement responsibilities; training in IC enforcement	2	hours	120	200
Establish contact with entities implementing ICs	16	hours	85	1,400
Determine how to communicate enforcement information among Agencies	4	hours	120	500
Indirect costs (copying, materials/supplies, travel costs)	1	lump sum	1,000	1,000
Capital Costs Subtotal - Initial Institutional Controls Activities				$69,000
Capital Cost Contingency (scope and cost) 20%				$14,000
TOTAL - ESTIMATED CAPITAL COST (SITEWIDE)				$83,000
TOTAL - ESTIMATED CAPITAL COST FOR BOU (1/6th of Sitewide Capital Cost)				**$14,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

[2] *As defined in "Estimating the Cost of Institutional Controls", Environmental Law Institute and Resources for the Future (2005).*

Specific Institutional Controls include State and local government land use controls; proprietary or property-law based controls; governmental controls; enforcement tools; and informational devices.

Table B-1b Estimated Cost of Institutional Controls (Boundary OU Share of Total)
Annual Institutional Controls Activities Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
SITEWIDE[1] ANNUAL INSTITUTIONAL CONTROLS ACTIVITIES[2] COST ESTIMATE				
Planning				
Verifying that Institutional Controls Plan is still accurate	2	hours	85	200
Public Information				
Deliver tailored ongoing information programs to help lower risk of exposure for each segment of public	8	hours	85	700
Ensure that public health organizations, hospitals, fire/emergancy response are informed about the site	8	hours	85	700
Coordinate Agency communications concerning ICs	4	hours	85	300
Record-Keeping Systems				
Managing and maintaining record-keeping systems	16	hours	85	1,400
Coordinate sharing of data among federal, State, local govts, landowners and non-governmental organizations who may maintain records about the site	8	hours	85	700
Convert/reformat State/local govt data into format required by EPA for exporting data to its system(s)	4	hours	85	300
Maintain QA/QC for data	2	hours	85	200
Administration/Funding				
Including cost of IC activities in annual budget requests	2	hours	85	200
Obtaining funds as needed for annual activities	2	hours	85	200
Reporting on status and funding of sites and IC programs for an entity	2	hours	85	200
Monitoring				
Coordinate monitoring of sites covered by multiple juristictions	8	hours	85	700
Collect monitoring data and input into record-keeping system	40	hours	85	3,400
Report results	16	hours	85	1,400
Inspection				
Visit sites regularly to confirm acceptable land uses	24	hours	85	2,000
Visit sites to inspect monitoring equipment, signs, and other ICs (may be conducted simultaneously w/ inspections of engineered controls)	16	hours	85	1,400
Enforcement				
Obtain/interprete inspection and monitoring data	8	hours	85	700
Evaluate data to ensure site compliance	4	hours	85	300
Communicate enforcement info and planned actions w/ other Agencies	6	hours	85	500
Indirect costs (copying, materials/supplies, travel costs)	1	lump sum	1,000	1,000
			Subtotal - Annual Institutional Controls Activities	$16,500
			Annual Cost Contingency (scope and cost) 20%	$3,300
			TOTAL - ESTIMATED ANNUAL COST (SITEWIDE)	$20,000
			TOTAL - ESTIMATED ANNUAL COST FOR BOU (1/6th of Sitewide Annual Cost)	**$3,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

[2] *As defined in "Estimating the Cost of Institutional Controls", Environmental Law Institute and Resources for the Future (2005).*

Table B-1b Estimated Cost of Institutional Controls (Boundary OU Share of Total)
Periodic Institutional Controls Activities Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
SITEWIDE[1] PERIODIC INSTITUTIONAL CONTROLS ACTIVITIES[2] COST ESTIMATE				
Planning				
Adding to/revising Institutional Controls Plan in response to change in circumstances (e.g., change in land use or site ownership)	16	hours	85	1,400
Public Information				
Revise/deliver public info about ICs; refresh/update public info	8	hours	85	700
Assess effectiveness of programs and improving them	8	hours	120	1,000
Provide updated education for federal, State, and local govt staff and the public about ICs and related laws and programs	8	hours	85	700
Record-Keeping Systems				
Respond to requests for info from govt agencies, potential lenders, insurers, purchasers, general public	16	hours	85	1,400
Enter/update data in systems as needed (when ICs are implemented at a site or when a site changes hands)	8	hours	85	700
Upgrading hardware and software	4	hours	85	300
Training new staff; training when system changes	8	hours	85	700
Tracking property transactions and parcel divisions	8	hours	85	700
Re-parceling property if/when a landowner wants to change land uses. Survey related properties.	16	hours	85	1,400
Propagating new and updated IC information through all land-use related offices.	8	hours	85	700
Administration/Funding				
Obtaining funds as needed for periodic activities	2	hours	85	200
Monitoring				
Provide monitoring-related ongoing training, specialized training, and outreach to affected regulatory bodies such as EPA, RWQCB, DTSC, and local governments	8	hours	85	700
Inspection				
Visiting sites in response to information about possible changes in land use or other issues	8	hours	85	700
Prepare 5 - year Review Report per CD/UAO (Project Manager)	24	hours	120	2,900
Prepare 5 - year Review Report per CD/UAO (Aerojet Coordinator)	80	hours	85	6,800
Enforcement				
Issue orders, negotiate, litigate with landowner/user who is out of compliance	24	hours	85	2,000
Update property records, hazardous site registry	16	hours	85	1,400
Communicate updated information to other Agencies	8	hours	85	700
Repair damage resulting from a failed IC, including damage to the site itself, abutting land, or other land	8	hours	85	700
Determine cause of IC failure and whether new/revised ICs needed	8	hours	120	1,000
Take steps to design/implement/effectuate new ICs, if appropriate, including obtaining funding to pay the costs of such steps	16	hours	120	1,900
Indirect costs (copying, materials/supplies, travel costs)	1	lump sum	1,500	1,500
Subtotal - Periodic Institutional Controls Activities				$30,200
Cost Contingency (scope and cost) 20%				$6,000
TOTAL - ESTIMATED PERIODIC COST (SITEWIDE)				$36,000
TOTAL - ESTIMATED PERIODIC COST FOR BOU (1/6th of Sitewide Periodic Cost)				**$6,000**

[1] *The total Institutional Controls costs included in this table will be divided equally among the following Operable Units (OUs): Perimeter (OU-5), Boundary (OU-6), Island (OU-7), Eastern (OU-8), Central (OU-9), and Area 41.*

[2] *As defined in "Estimating the Cost of Institutional Controls", Environmental Law Institute and Resources for the Future (2005).*

Table B-1b Estimated Cost of Institutional Controls (Boundary OU Share of Total)
Present Worth Cost Estimate

YEAR	*n*	P/F(*i* =2.7%)	INITIAL IC ACTIVITIES COSTS ($)	ANNUAL IC ACTIVITIES COSTS ($/yr)	PERIODIC IC ACTIVITIES COSTS ($)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE (BOU Share of Total)								
2011	0	1.00000	14,000			14,000	14,000	14,000
2012	1	0.97371		3,000		3,000	2,900	17,000
2013	2	0.94811		3,000		3,000	2,800	20,000
2014	3	0.92318		3,000		3,000	2,800	23,000
2015	4	0.89891		3,000	6,000	9,000	8,100	31,000
2016	5	0.87528		3,000		3,000	2,600	34,000
2017	6	0.85227		3,000		3,000	2,600	37,000
2018	7	0.82986		3,000		3,000	2,500	40,000
2019	8	0.80805		3,000		3,000	2,400	42,000
2020	9	0.78680		3,000	6,000	9,000	7,100	49,000
2021	10	0.76612		3,000		3,000	2,300	51,000
2022	11	0.74598		3,000		3,000	2,200	53,000
2023	12	0.72636		3,000		3,000	2,200	55,000
2024	13	0.70727		3,000		3,000	2,100	57,000
2025	14	0.68867		3,000	6,000	9,000	6,200	63,000
2026	15	0.67057		3,000		3,000	2,000	65,000
2027	16	0.65294		3,000		3,000	2,000	67,000
2028	17	0.63577		3,000		3,000	1,900	69,000
2029	18	0.61906		3,000		3,000	1,900	71,000
2030	19	0.60278		3,000	6,000	9,000	5,400	76,000
2031	20	0.58694		3,000		3,000	1,800	78,000
2032	21	0.57151		3,000		3,000	1,700	80,000
2033	22	0.55648		3,000		3,000	1,700	82,000
2034	23	0.54185		3,000		3,000	1,600	84,000
2035	24	0.52761		3,000	6,000	9,000	4,700	89,000
2036	25	0.51373		3,000		3,000	1,500	91,000
2037	26	0.50023		3,000		3,000	1,500	93,000
2038	27	0.48708		3,000		3,000	1,500	95,000
2039	28	0.47427		3,000		3,000	1,400	96,000
2040	29	0.46180		3,000	6,000	9,000	4,200	100,000
			TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**137,000**		
				TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS (BOU):				**100,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-2 Estimated Costs for Alternative 3: Vapor Barriers (Residential Use Scenario)
All Management Areas

Management Area	Total Area		Area with No Vapor Controls		Total Area with Vapor Controls*		Residential Development Density	Area for Vapor Barriers		Estimated Incremental Cost	Estimated Capital and Non-Discounted Costs for Vapor Barriers ($)	Estimated Present Worth[1] Cost for Vapor Barriers ($)
	acres	ft^2	acres	ft^2	acres	ft^2		ft^2	acres	per ft^2		
Administration Area	122	5,314,300	24	1,040,300	98.1	4,274,000	40%	1,710,000	39.3	$0.50	$855,000	$589,000
WLLO												
Line 02	36	1,568,200	16	715,600	19.6	852,600	40%	341,000	7.8	$0.50	$171,000	$118,000
Line 05 North	15	653,400	6	280,200	8.6	373,200	40%	149,000	3.4	$0.50	$75,000	$52,000
Westlakes	58	2,526,500	58	2,526,500			40%					
Open Space (OS) Area 5	13	566,300	5	211,100	8.2	355,200	40%	142,000	3.3	$0.50	$71,000	$49,000
Open Space Area 7	23	1,001,900	19	846,400	3.6	155,500	40%	62,000	1.4	$0.50	$31,000	$21,000
								2,404,000	55.2		$348,000	$240,000
Magazine												
Magazine Area & OS 3	101	4,399,600	85	3,718,700	15.6	680,900	40%	272,000	6.2	$0.50	Not applicable[2]	Not applicable[2]
Open Space Area 4	76	3,310,600	1	62,500	74.6	3,248,100	40%	1,299,000	29.8	$0.50	Not applicable[2]	Not applicable[2]
CP-2												
Chemical Plant 2	49	2,134,400	26	1,133,600	23.0	1,000,800	40%	400,000	9.2	$0.50	Not applicable[2]	Not applicable[2]
Dredge Pit	8.6	375,100	0	0	8.6	375,100	40%	150,000	3.4	$0.50	Not applicable[2]	Not applicable[2]
Open Space Area 1	49	2,134,400	49	2,134,400			40%					
Open Space Area 2	133	5,793,500	16	690,100	117.2	5,103,400	40%	2,041,000	46.9	$0.50	Not applicable[2]	Not applicable[2]
TOTALS:	**684**	**29,778,200**	**307**	**13,359,400**	**377**	**16,418,800**		**6,566,000**	**151**		**$1,200,000**	**$830,000**

Notes and Key:

Estimated cost of vapor barrier: It is assumed that for any future residential development that would require vapor intrusion controls shown on Figures 6-2, 6-5, 6-9, 6-11, and 6-14, the developer would install a moisture barrier with taped seams as part of any new construction and the costs of the materials and installation for the moisture barrier would be borne by the developer. It is further assumed that the only difference between a moisture barrier and a vapor barrier is that seals/taping be provided around any utility penetrations (e.g., plumbing piping) of the moisture barrier. Based on a verbal quotation from Regenesis, the estimated cost to install a moisture barrier under a future residential scenario is $3.00 per square foot. For purposes of estimating costs for this FS, it is assumed that the incremental material and labor cost for sealing/taping utility penetrations is $0.50 per square foot.

ft^2 = square feet

acre = 43,560 square feet

[1] Assumes vapor barriers not installed until development occurs in 15 years. P/F factor for i=2.7% and n=year 15 is 0.68867

[2] There are no plans for redevelopment of these areas at this time. Therefore, for this FS, any costs associated with provision of vapor barriers are assumed to occur beyond the 30-year costing period considered in this FS.

**Aerojet's real estate department assumes a density of 5 homes per acre for mixed use redevelopment and 8 homes per acre in pure residential areas. Assuming that the largest home footprint is 2,000 ft^2, and adding a 10% factor for the vapor barrier area, and 8 homes per acre, the result is that 40% per acre would require vapor barriers.*

Table B-3a Estimated Cost for Capping 8 Sites (Capping for Risk to Groundwater from VOCs)
Overall Capital Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
Total Area over capping is estimated to be necessary:	22,100	sq ft		
DIRECT CAPITAL COST				
Surveying/site layout (8 areas in 3 mngmt areas; 1 day AE, 1 day L2/L5)	2	day	1,500	3,000
Lateral Delineation Sampling (4 sampling locations/remedial area):				
Hand augering (1 sampling location/hr)	36	hour	100	3,600
Sample analysis (incl. 1 field duplicate/10 investigative samples)	40	each	100	4,000
Data validation/management	5	sample lot	200	1,000
Reporting (assumes 1 hr/remedial area)	9	hour	125	1,100
Purchase and place 2" layer baserock for asphalt surface[1]	136	cu yd	24.38	3,300
Place 2" asphalt-concrete surface over baserock	2,456	sq yd	7.57	18,600
			SUBTOTAL - DIRECT CAPITAL COSTS	34,600
INDIRECT CAPITAL COST				
Project Management	*1*	*%*	*10*	*3,500*
Engineering Design[3]	*1*	*%*	*20*	*6,900*
Construction Management[3]	*1*	*%*	*15*	*5,200*
			SUBTOTAL - INDIRECT CAPITAL COST	15,600
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	50,000
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*12,500*
			TOTAL - ESTIMATED CAPITAL COSTS and NON-DISCOUNTED COSTS	63,000

Table B-3a Estimated Cost for Capping 8 Sites (Capping for Risk to Groundwater from V
Estimated 5-year Operation and Maintenance Costs

Description	Quantity	Units	Unit Rate	Estimated Cost
Routine Inspections/Sealcoating				
Existing Paved Surfaces				
Inspection	2	hour	75	200
Crack Sealing:				
Area for crack sealing	0.507	acres		
Estimated lineal feet of crack per acre	1,400	lf/acre		
Sealing random cracks min 1/2" to 1-1/2" wide	710	lin ft	1.53	1,100
Sealcoating:				
Prepare and clean surface for sealcoating	2,456	sq yd	0.17	400
Sealcoating, 2 coat coal tar pitch emulsion	2,456	sq yd	1.54	3,800
Estimated 5-year O&M Costs - Subtotal				5,500
Project Management		*%*	*10*	*600*
Construction Management		*%*	*15*	*800*
Estimated 5-year O&M Costs - Subtotal (including indirect costs)				6,900
Contingency (10% scope + 15% bid)		*%*	*25*	*1,700*
Estimated 5-year O&M Costs - Total				8,600

Table B-3a Estimated Cost for Capping 8 Sites (Capping for Risk to Groundwater from VOCs)
Present Worth Cost Estimate

Year	n	P/F(i=2.7%)	Estimated Capital Costs ($)	Operation and Maintenance Costs ($ every 5 years)	Total Estimated Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2011	0	1.00000	63,000		63,000	63,000	63,000
2012	1	0.97371			0	0	63,000
2013	2	0.94811			0	0	63,000
2014	3	0.92318			0	0	63,000
2015	4	0.89891		8,600	8,600	7,700	70,700
2016	5	0.87528			0	0	70,700
2017	6	0.85227			0	0	70,700
2018	7	0.82986			0	0	70,700
2019	8	0.80805			0	0	70,700
2020	9	0.78680		8,600	8,600	6,800	77,500
2021	10	0.76612			0	0	77,500
2022	11	0.74598			0	0	77,500
2023	12	0.72636			0	0	77,500
2024	13	0.70727			0	0	77,500
2025	14	0.68867		8,600	8,600	5,900	83,400
2026	15	0.67057			0	0	83,400
2027	16	0.65294			0	0	83,400
2028	17	0.63577			0	0	83,400
2029	18	0.61906			0	0	83,400
2030	19	0.60278		8,600	8,600	5,200	88,600
2031	20	0.58694			0	0	88,600
2032	21	0.57151			0	0	88,600
2033	22	0.55648			0	0	88,600
2034	23	0.54185			0	0	88,600
2035	24	0.52761		8,600	8,600	4,500	93,100
2036	25	0.51373			0	0	93,100
2037	26	0.50023			0	0	93,100
2038	27	0.48708			0	0	93,100
2039	28	0.47427			0	0	93,100
2040	29	0.46180		8,600	8,600	4,000	97,100
			Total Estimated Non-Discounted Costs:		115,000		
				Total Estimated 30-year Present Worth Costs:			97,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-3b Estimated Cost for Capping 48 Sites
Overall Capital Cost Estimate

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
Total Area over capping is estimated to be necessary:	191,291	sq ft		
DIRECT CAPITAL COST				
Surveying/site layout (41 areas in 5 mngmt areas; 1 day ea mngmt area)	5	day	1,500	7,500
Lateral Delineation Sampling (4 sampling locations/remedial area):				
Hand augering (1 sampling location/hr)	164	hour	100	16,400
Sample analysis (incl. 1 field duplicate/10 investigative samples)	181	each	100	18,100
Data validation/management	21	sample lot	200	4,200
Reporting (assumes 1 hr/remedial area)	41	hour	125	5,100
Purchase and place 2" layer baserock for asphalt surface[1]	1,181	cu yd	24.38	28,800
Place 2" asphalt-concrete surface over baserock	21,255	sq yd	7.57	160,900
			SUBTOTAL - DIRECT CAPITAL COSTS	241,000
INDIRECT CAPITAL COST				
Project Management	*1*	*%*	*8*	*19,300*
Engineering Design[3]	*1*	*%*	*15*	*36,200*
Construction Management[3]	*1*	*%*	*10*	*24,100*
			SUBTOTAL - INDIRECT CAPITAL COST	79,600
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	321,000
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*80,300*
			TOTAL - ESTIMATED CAPITAL COSTS and NON-DISCOUNTED COSTS	401,000

Table B-3b Estimated Cost for Capping 48 Sites
Estimated 5-year Operation and Maintenance Costs

Description	Quantity	Units	Unit Rate	Estimated Cost
Routine Inspections/Sealcoating				
Existing Paved Surfaces				
Inspection	7	hour	75	500
Crack Sealing:				
Area for crack sealing	4.391	acres		
Estimated lineal feet of crack per acre	1,400	lf/acre		
Sealing random cracks min 1/2" to 1-1/2" wide	6,148	lin ft	1.53	9,400
Sealcoating:				
Prepare and clean surface for sealcoating	21,255	sq yd	0.17	3,600
Sealcoating, 2 coat coal tar pitch emulsion	21,255	sq yd	1.54	32,700
Estimated 5-year O&M Costs - Subtotal				46,200
Project Management		*%*	*10*	*4,600*
Construction Management		*%*	*15*	*6,900*
Estimated 5-year O&M Costs - Subtotal (including indirect costs)				57,700
Contingency (10% scope + 15% bid)		*%*	*25*	*14,400*
Estimated 5-year O&M Costs - Total				72,100

Table B-3b Estimated Cost for Capping 48 Sites
Present Worth Cost Estimate

Year	n	P/F(i=2.7%)	Estimated Capital Costs ($)	Operation and Maintenance Costs ($ every 5 years)	Total Estimated Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2011	0	1.00000	423,000		423,000	423,000	423,000
2012	1	0.97371			0	0	423,000
2013	2	0.94811			0	0	423,000
2014	3	0.92318			0	0	423,000
2015	4	0.89891		77,400	77,400	69,600	492,600
2016	5	0.87528			0	0	492,600
2017	6	0.85227			0	0	492,600
2018	7	0.82986			0	0	492,600
2019	8	0.80805			0	0	492,600
2020	9	0.78680		72,100	72,100	56,700	549,300
2021	10	0.76612			0	0	549,300
2022	11	0.74598			0	0	549,300
2023	12	0.72636			0	0	549,300
2024	13	0.70727			0	0	549,300
2025	14	0.68867		72,100	72,100	49,700	599,000
2026	15	0.67057			0	0	599,000
2027	16	0.65294			0	0	599,000
2028	17	0.63577			0	0	599,000
2029	18	0.61906			0	0	599,000
2030	19	0.60278		72,100	72,100	43,500	642,500
2031	20	0.58694			0	0	642,500
2032	21	0.57151			0	0	642,500
2033	22	0.55648			0	0	642,500
2034	23	0.54185			0	0	642,500
2035	24	0.52761		72,100	72,100	38,000	680,500
2036	25	0.51373			0	0	680,500
2037	26	0.50023			0	0	680,500
2038	27	0.48708			0	0	680,500
2039	28	0.47427			0	0	680,500
2040	29	0.46180		72,100	72,100	33,300	713,800
			Total Estimated Non-Discounted Costs:		861,000		
				Total Estimated 30-year Present Worth Costs:			714,000

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-4 Estimated Costs for Alternative 3: Soil Vapor Extraction for Foundation Venting - Admin Area
Preliminary Capital Cost Estimate
Commercial Scenario (Bldgs 20002 and 20004)

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
DIRECT CAPITAL COST				
Pre-Construction Activities				
RD/RA Workplan	1	LS	10,000	10,000
SVE pilot testing	1	LS	50,000	50,000
			SUBTOTAL	**60,000**
System Construction 24 SVE wells; 720 cfm				
Surveying/site layout	1	DAY	1,500	1,500
Assumed number of shallow (10 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	24	number		
Assumed number of deeper (20 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	0	number		
Shallow SVE well installation	240	FT	110	26,400
Deeper SVE well installation	0	FT	110	0
SVE wellhd fittings (shutoff and sample valves, sample port, FERNCOs, reducers, bushings)	24	EA	70	1,700
Aboveground conveyance piping and supports from SVE wells to treatment compound	0	LF	6	0
Trench for 6-inch SVE conveyance piping; including piping (2.5' W x 2' D)	1,350	LF	40	54,000
Sand bedding for SVE conveyance piping and fill (2.5' W x 2' D), includes 15% expansion	276	CY	30	8,300
Core drilling through concrete slab for SVE wells	0	EA	100	0
Disposal of trench spoils and drill cuttings - assume Subtitle D landfill	279	CY	50	14,000
Precast manhole, frame, and cover (over SVE wellhead in road)	24	EA	1,200	28,800
Valve box and locking cover (for shutoff valves in road)	24	EA	200	4,800
Asphalt repair over trench	375	sq yd	48.50	18,200
Construct slab on-grade for blower and treatment equipment	576	sq ft	25	14,400
Fencing around remediation equipment, and gate (8' H chain link)	96	LF	75	7,200
Vacuum blower (Roots 418 RAM) 1,100 cfm, 30 hp, moisture knockout vessel	1	EA	11,800	11,800
Insulated sound enclosure to house SVE blower	1	EA	4,700	4,700
Thermal oxidizer and scrubber rental for first 6 mos operation, incl. scrubber caustic use	6	mo	15,000	90,000
Shipping of rented oxidizer/scrubber	2	EA	3,500	7,000
Propane use during thermal oxidizer rental (assumes 720,000 BTU/hr for 6 mos.)	34,000	gal	3.00	102,000
Vapor-phase granular activated carbon (VPGAC) vessels; 2 @ 5,000 lbs	2	EA	15,000	30,000
Initial load of VPGAC	10,000	lb	1.10	11,000
Equipment rental for installation of blower, oxidizer, VPGAC vessels, MH frames/covers	8	day	2,000	16,000
Misc. piping, supports, valves in treatment compound	1	LS	4,000	4,000
Labor for installation (piping, supports, equipment, wellheads) labor - 2 persons 32 days	512	hour	50	25,600
Blower equipment control panel	1	LS	4,500	4,500
Electrical main disconnect and breaker panel	1	LS	5,000	5,000
Electrical and controls wiring installation and testing; incl area lighting	1	LS	40,000	40,000
Startup/troubleshooting	5	DAY	800	4,000
Vapor flow meter, sample port, vacuum gauge (at each well and SVE blower inlet)	25	EA	600	15,000
Misc. monitoring equipment/magnahelics	1	LS	2,000	2,000
Final surveying	0.5	DAY	1,500	800
			SUBTOTAL	**553,000**
Miscellaneous Costs				
Baseline TO-15 soil vapor sampling and analysis from each SVE well and blower inlet	25	EA	350	8,800
Remedial Action Summary (Construction Completion Report)	1	LS	10,000	10,000
Operation, Maintenance, and Monitoring Manual	1	LS	10,000	10,000
Regulatory Oversight	3.5	month	16,000	56,000
			SUBTOTAL	**85,000**
			SUBTOTAL - DIRECT CAPITAL COST	**698,000**
INDIRECT CAPITAL COST				
Project Management	*1*	*%*	*6*	*33,200*
Engineering Design	*1*	*%*	*12*	*66,400*
Construction Management	*1*	*%*	*8*	*44,200*
			SUBTOTAL - INDIRECT CAPITAL COST	**144,000**
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	**842,000**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*210,500*
			TOTAL - CAPITAL COST ESTIMATE	**1,053,000**

Note: Percentages for Indirect Capital Costs and Contingency estimates are from Section 5 of USEPA, 2000.

Table B-4 Estimated Costs for Alternative 3: Soil Vapor Extraction for Foundation Venting - Admin Area
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
Commercial Scenario (Bldgs 20002 and 20004)

	QUANTITY		COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($)**
ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				
Labor:				
Technician	0.20	%FTE	135,200	27,000
Engineering, includes progress reporting to Agencies	0.10	%FTE	208,000	20,800
Data validation and management	14	lot	150	2,200
Monthly system vapor sampling and analysis	24	EA	350	8,400
Annual vapor sample from each SVE well and analysis	24	EA	350	8,400
Field instrument rental (PID/FID)	12	day	100	1,200
VPGAC use (assumes replacement every 6 months)	20,000	lb	1.10	22,000
Repair and replacement of equipment and misc. materials/field supplies	1	LS	7,500	7,500
Electrical power				
SVE blower (30 hp, 25.2 running hp)	164,900	KWH	0.12	19,800
Area lighting, assume 2 KW, 12 hrs/day	8,760	KWH	0.12	1,100
SUBTOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				**118,400**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*29,600*
TOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COST ESTIMATE				**148,000**

Note: Assumes SVE system offgas will be treated with thermal oxidation for first 6 months of operation when offgas concentrations are expected to be high, then treatment will be switched to vapor-phase granular activated carbon.

Table B-4 Estimated Costs for Alternative 3: Soil Vapor Extraction for Foundation Venting - Admin Area
Present Worth Cost Estimate
Commercial Scenario (Bldgs 20002 and 20004)

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	O&M AND MONITORING COSTS ($/yr)[1]	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	1,053,000		1,053,000	1,053,000	1,053,000
2012	1	0.97371		148,000	148,000	144,000	1,197,000
2013	2	0.94811		148,000	148,000	140,000	1,337,000
2014	3	0.92318		148,000	148,000	137,000	1,474,000
2015	4	0.89891		148,000	148,000	133,000	1,607,000
2016	5	0.87528		148,000	148,000	130,000	1,737,000
2017	6	0.85227		148,000	148,000	126,000	1,863,000
2018	7	0.82986		148,000	148,000	123,000	1,986,000
2019	8	0.80805		148,000	148,000	120,000	2,106,000
2020	9	0.78680		148,000	148,000	116,000	2,222,000
2021	10	0.76612		148,000	148,000	113,000	2,335,000
2022	11	0.74598		148,000	148,000	110,000	2,445,000
2023	12	0.72636		148,000	148,000	108,000	2,553,000
2024	13	0.70727		148,000	148,000	105,000	2,658,000
2025	14	0.68867		148,000	148,000	102,000	2,760,000
2026	15	0.67057		148,000	148,000	99,000	2,859,000
2027	16	0.65294		148,000	148,000	97,000	2,956,000
2028	17	0.63577		148,000	148,000	94,000	3,050,000
2029	18	0.61906		148,000	148,000	92,000	3,142,000
2030	19	0.60278		148,000	148,000	89,000	3,231,000
2031	20	0.58694		148,000	148,000	87,000	3,318,000
2032	21	0.57151		148,000	148,000	85,000	3,403,000
2033	22	0.55648		148,000	148,000	82,000	3,485,000
2034	23	0.54185		148,000	148,000	80,000	3,565,000
2035	24	0.52761		148,000	148,000	78,000	3,643,000
2036	25	0.51373		148,000	148,000	76,000	3,719,000
2037	26	0.50023		148,000	148,000	74,000	3,793,000
2038	27	0.48708		148,000	148,000	72,000	3,865,000
2039	28	0.47427		148,000	148,000	70,000	3,935,000
2040	29	0.46180		148,000	148,000	68,000	4,003,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**5,345,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**4,000,000**

[1] *Assumes foundation venting system would operate over entire 30-year costing period.*

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-5 Estimated Costs for Alternatives 3 and 4: Groundwater Monitoring
Estimated Annual Monitoring Costs
WLLO Area (Line 2 Site 28E)

	QUANTITY		COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($)**
ANNUAL MONITORING COSTS				
Labor				
Field Technician Labor and Sampling Equipment (5 wells)	5	per well	150	750
Analytical [includes 1 duplicate and field blank]				
Volatile organic compounds	7	ea	125	875
Perchlorate	7	ea	40	280
N-Nitrosodimethylamine	0	ea	300	0
Full electronic data packages (% of analytical costs)	$1,155	%	10%	116
Data validation and management	1	ea	200	200
Reporting	8	hours	125	1,000
		SUBTOTAL - ANNUAL MONITORING COSTS		3,200
	Contingency (10% scope + 15% bid)	*%*	*25*	*800*
		TOTAL - ANNUAL MONITORING COST ESTIMATE		**4,000**

Costing Assumptions:

Sample 5 wells annually for VOC and perchlorate analysis for 5 years

Table B-5 Estimated Costs for Alternatives 3 and 4: Groundwater Monitoring
Present Worth Cost Estimate
WLLO Area (Line 2 Site 28E)

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000		4,000	4,000	4,000	4,000
2012	1	0.97371		4,000	4,000	3,900	7,900
2013	2	0.94811		4,000	4,000	3,800	11,700
2014	3	0.92318		4,000	4,000	3,700	15,400
2015	4	0.89891		4,000	4,000	3,600	19,000
2016	5	0.87528			0	0	19,000
2017	6	0.85227			0	0	19,000
2018	7	0.82986			0	0	19,000
2019	8	0.80805			0	0	19,000
2020	9	0.78680			0	0	19,000
2021	10	0.76612			0	0	19,000
2022	11	0.74598			0	0	19,000
2023	12	0.72636			0	0	19,000
2024	13	0.70727			0	0	19,000
2025	14	0.68867			0	0	19,000
2026	15	0.67057			0	0	19,000
2027	16	0.65294			0	0	19,000
2028	17	0.63577			0	0	19,000
2029	18	0.61906			0	0	19,000
2030	19	0.60278			0	0	19,000
2031	20	0.58694			0	0	19,000
2032	21	0.57151			0	0	19,000
2033	22	0.55648			0	0	19,000
2034	23	0.54185			0	0	19,000
2035	24	0.52761			0	0	19,000
2036	25	0.51373			0	0	19,000
2037	26	0.50023			0	0	19,000
2038	27	0.48708			0	0	19,000
2039	28	0.47427			0	0	19,000
2040	29	0.46180			0	0	19,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**20,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**19,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-6 Estimated Costs for Alternative 3: Groundwater Containment (Contingent Remedy)
Preliminary Capital Cost Estimate
Line 02 Site 28E

DESCRIPTION		QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
RD/RA Workplans					
Workplans		16	hours	125	2,000
	Subtotal - Workplans				2,000
Extraction Wells					
Surveying		0.5	day	1,500	750
Extraction wells - drilling and development	No. Wells				
Shallow well	1	100	ft	200	20,000
Deeper (200 gpm)	0	200	ft	200	0
Aquifer pumping test and data reduction		1	LS	6,000	6,000
Well pump discharge piping, 3" SS threaded		100	lin ft	40	4,000
Pumps, incl. elec. cable		1	ea	7,500	7,500
Wellhead vault: H-20 traffic rated		1	ea	5,000	5,000
Flow meter		1	ea	1,500	1,500
Misc. wellhead piping and valves		1	ea	400	400
Electrical disconnect switch at well vault		1	ea	500	500
Installation (pump, wellhead piping/valves)		1	LS	2,000	2,000
One-time initial extraction well sampling		1	ea	650	700
Power service drop (SMUD transformer) - 13.2 KVA to 480 v; assumes OHE nearby		1	ea	10,000	10,000
Buried electrical power to well (480v, 3-phase)		200	lin ft	12	2,400
Buried electrical power to beyond first well (480v, 3-phase)		0	lin ft	10	0
Buried instrumentation and control wiring		0	lin ft	3	0
Electrical pull boxes every 400'		1	ea	500	500
Control panel w/ motor starter for pump		1	ea	3,000	3,000
Controls for well pumps		0	ea	500	0
Electrical and controls installation		1	LS	2,000	2,000
Startup and troubleshooting		1	LS	2,000	2,000
Service road to extraction well		100	lin ft	10	1,000
	Subtotal - Extraction Wells				69,000
Piping					
Surveying		0.5	day	1,500	750
Single-walled untreated groundwater piping system					
6-inch diameter untreated groundwater to GET D pipeline		3,960	lin ft	48	190,080
	Subtotal - Piping				191,000
Sitework					
Aggregate base course - area around well 50' x 50' x 6"		46	cu yd	45	2,083
Security fence around wellhead area - 6' high chain link w/ gate		200	lin ft	25	5,000
	Subtotal - Sitework				7,000
Post-Construction Reports and Regulatory Oversight					
Regulatory Oversight		0	week	4000	0
Construction Completion Report		6	hour	125	750
Operation, Maintenance, and Monitoring Manual		8	hour	125	1,000
	Subtotal - Post Construction Reports and Regulatory Oversight				2,000
	Estimated Construction Costs - Subtotal				**271,000**
	Project Management		*%*	*8*	*21,700*
	Engineering Design		*%*	*15*	*40,700*
	Construction Management		*%*	*10*	*27,100*
	Estimated Project Capital Costs - Subtotal				**360,500**
	Contingency (10% scope + 15% bid)		*%*	*25*	*90,000*
	Estimated Project Capital Costs - Total				**450,000**

Table B-6 Estimated Costs for Alternative 3: Groundwater Containment (Contingent Remedy)
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
Line 02 Site 28E

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST ($)	COST TOTAL COST ($/yr)
Extraction well maintenance (once per every 5 years)	0.2	year	3,200	640
Labor - assume 2 hours per week	104	hour	50	5,200
Monitoring:				
Monthly sample from extraction well - VOCs and perchlorate analysis	12	EA	165	2,000
Field instrument rental	12	day	25	300
Full electronic data packages (% of analytical costs)	$2,000	%	10%	200
Data validation and management	4	ea	200	800
Annual reporting	1	ea	2,500	2,500
Equipment Maintenance - percent of capital costs	$7,500	%	3%	200
Equipment Replacement - percent of capital costs	$7,500	%	3%	200
Electrical power:				
Well pump - assume 10 gpm; 100 ft TDH	2,500	KWH	0.12	300
Area lighting, assume 1 KW, 12 hrs/day	4,380	KWH	0.12	500
SUBTOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				12,800
Contingency (10% scope + 15% bid)		*%*	*25*	*3,200*
TOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COST ESTIMATE				**16,000**

Table B-6 E
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rth Cost Estimate
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n	P/F(*i* =2.7%)	CAPITAL COSTS ($)	O&M AND MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
RTH COST ESTIMATE						
0	1.00000			0	0	0
1	0.97371			0	0	0
2	0.94811			0	0	0
3	0.92318			0	0	0
4	0.89891			0	0	0
5	0.87528	450,000	16,000	466,000	408,000	408,000
6	0.85227		16,000	16,000	14,000	422,000
7	0.82986		16,000	16,000	13,000	435,000
8	0.80805		16,000	16,000	13,000	448,000
9	0.78680		16,000	16,000	13,000	461,000
10	0.76612		16,000	16,000	12,000	473,000
11	0.74598		16,000	16,000	12,000	485,000
12	0.72636		16,000	16,000	12,000	497,000
13	0.70727		16,000	16,000	11,000	508,000
14	0.68867		16,000	16,000	11,000	519,000
15	0.67057		16,000	16,000	11,000	530,000
16	0.65294		16,000	16,000	10,000	540,000
17	0.63577		16,000	16,000	10,000	550,000
18	0.61906		16,000	16,000	10,000	560,000
19	0.60278		16,000	16,000	10,000	570,000
20	0.58694		16,000	16,000	9,000	579,000
21	0.57151		16,000	16,000	9,000	588,000
22	0.55648		16,000	16,000	9,000	597,000
23	0.54185		16,000	16,000	9,000	606,000
24	0.52761		16,000	16,000	8,000	614,000
25	0.51373		16,000	16,000	8,000	622,000
26	0.50023		16,000	16,000	8,000	630,000
27	0.48708		16,000	16,000	8,000	638,000
28	0.47427		16,000	16,000	8,000	646,000
29	0.46180		16,000	16,000	7,000	653,000
	TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**850,000**		
		TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**650,000**

n this cost estimate summary is based on the best available information regarding the anticipated scope
lternative. Changes in the cost elements are likely to occur as a result of new information and data
the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is a
de engineering estimate that is expected to be within -30 to +50 percent of the actual project cost

Table B-7 Estimated Costs for Alternative 4: Excavation and Landfill Disposal of Soils
Excavation Description
BOU-Wide Consolidated Excavation and Disposal Scenario

Remedial Area Number	Estimated Floor Area (sq ft)	Depth (ft)	Contaminated Volume Bank (bcy)	Contaminated Volume Loose (Lcy)	1:1 sideslope Area (sq ft)	Total Volume Bank (bcy)	Non-Contaminated Volume Bank (bcy)	Non-Contaminated Volume Loose (Lcy)	Sidewall Length (LF)	Estimated Weighted Capital Cost per Remedial Area ($)
Admin East										
AE-R-2	18,210	6	4,047	5,261	23,890	5,310	1,263	1,642	960	447,000
AE-R-3	3,240	4	480	624	3,710	550	70	91	240	53,000
AE-R-4	2,160	6	480	624	2,700	600	120	156	190	53,000
AE-R-5	9,180	2	680	884	9,970	740	60	78	800	75,000
AE-R-6	4,230	4	627	815	5,210	770	143	186	490	69,000
AE-R-7	1,990	12	884	1,150	3,060	1,360	476	618	200	98,000
AE-R-8	9,270	2	687	893	10,190	760	73	95	370	76,000
	48,280		7,880	10,250	58,730	10,090	2,210	2,870	3,250	
Admin West										
AW-R-1	11,250	2	833	1,083	11,640	860	27	35	400	92,000
AW-R-2	3,050	2	226	294	3,250	240	14	18	200	25,000
AW-R-3	1,080	1.5	60	78	1,230	70	10	13	130	7,000
AW-R-4	1,680	0.5	31	40	1,730	31	0	0	210	3,000
AW-R-5	1,830	2	136	176	1,990	150	14	19	160	15,000
AW-R-6	12,590	2	933	1,212	13,010	960	27	36	420	103,000
AW-R-7	20,000	6	4,444	5,778	21,800	4,840	396	514	610	491,000
AW-R-8	17,850	12	7,933	10,313	21,260	9,450	1,517	1,972	580	876,000
AW-R-9	650	3.5	84	110	860	110	26	33	120	9,000
AW-R-10	49,270	2	3,650	4,745	52,920	3,920	270	351	3,670	403,000
AW-R-11	9,880	2	732	951	10,250	760	28	37	370	81,000
	129,130		19,060	24,780	139,940	21,390	2,330	3,030	6,870	
Line 2										
L2-R-1	1,730	3.5	224	292	2,020	260	36	46	170	25,000
L2-R-2	9,850	3	1,094	1,423	10,480	1,160	66	85	420	121,000
L2-R-3	1,660	3.5	215	280	1,920	250	35	45	160	24,000
L2-R-4	3,550	12	1,578	2,051	4,950	2,200	622	809	250	174,000
L2-R-5	1,230	12	547	711	2,100	930	383	498	160	60,000
L2-R-6	1,810	5.5	369	479	2,250	460	91	119	170	41,000
L2-R-7	1,310	12	582	757	2,220	990	408	530	170	64,000
L2-R-8	2,070	12	920	1,196	3,160	1,410	490	637	200	102,000
	23,210		5,530	7,190	29,100	7,660	2,130	2,770	1,700	
Line 5										
L5-R-1	5,610	1.5	312	405	5,820	320	8	11	280	34,000
L5-R-2	480	12	213	277	1,190	530	317	412	140	24,000
	6,090		530	680	7,010	850	330	420	420	

Table B-7 Estimated Costs for Alternative 4: Excavation and Landfill Disposal of Soils
Excavation Description
BOU-Wide Consolidated Excavation and Disposal Scenario

Remedial Area Number	Estimated Floor Area (sq ft)	Depth (ft)	Contaminated Volume Bank (bcy)	Contaminated Volume Loose (Lcy)	1:1 sideslope Area (sq ft)	Total Volume Bank (bcy)	Non-Contaminated Volume Bank (bcy)	Non-Contaminated Volume Loose (Lcy)	Sidewall Length (LF)	Estimated Weighted Capital Cost per Remedial Area ($)
Buffalo Creek										
BC-R-1	115,280	2.5	10,674	13,876	131,000	12,130	1,456	1,893	12,580	1,179,000
BC-R-2	52,670	2	3,901	5,072	54,870	4,060	159	206	2,200	431,000
WL-R-1	1,140	6	253	329	1,530	340	87	113	140	28,000
	169,090		14,830	19,280	187,400	16,530	1,700	2,210	14,920	
Chem Plant 2										
CP2-R-1	5,470	2	405	527	6,280	470	65	84	820	45,000
CP2-R-3	46,430	2	3,439	4,471	47,280	3,500	61	79	900	380,000
CP2-R-4	8,000	6	1,778	2,311	9,040	2,010	232	302	350	196,000
CP2-R-5	3,500	2	259	337	3,740	280	21	27	240	29,000
CP2-R-6	7,960	2	590	767	8,340	620	30	39	380	65,000
CP2-R-7	2,990	1.25	138	180	2,990	140	2	2	200	15,000
CP2-R-8	13,130	2	973	1,264	13,570	1,000	27	36	440	107,000
	87,480		7,580	9,860	91,240	8,020	440	570	3,330	
Totals	463,280		55,410	72,040	513,420	64,540	9,140	11,870	30,490	6,120,000

Notes and Key:
bcy = bank cubic yards (in-place cubic yards)
Lcy = loose cubic yards (bank cubic yards plus a 30% swell factor)
The number of significant digits shown above are for calculation purposes only and should not be construed to to indicate that these numbers are accurate or precise to one foot or cubic yard. Actual values are likely only accurate to 100 sq ft or 100 cu yds.

Table B-7 Estimated Costs for Alternative 4: Excavation and Landfill Disposal of Soils
Preliminary Capital Cost Estimate
BOU-Wide Consolidated Excavation and Disposal Scenario

Description	Number	Quantity	Units	Unit Rate	Estimated Cost
RD/RA Workplans					
Workplans		1	each	25,000	25,000
Subtotal - Workplans					25,000
Excavation and Disposal					
Assumptions:					
1:1 side slope					
3 cy backhoe loads articulated trucks to transport non-contaminated soil to on-site stockpile area					
Front-end loader at on-site stockpile area to maintain stockpile(s) during excavation					
Backhoe loads contaminated soil into highway trucks (max 17 cy capacity)					
Highway trucks haul contaminated soil to Forward, Inc. Landfill (approx 65 miles one-way)					
Sheepsfoot vibratory compactor with blade used to place and compact fill in 12" lifts					
Front end loader used to move stockpiled soil to compactor					
Soil swell factor of 30%					
Weight of 1 bcy = 1.5 tons					
Surveying (pre- and post-excavation)		10	day	1,500	15,000
Equipment mobilization/demobilization		12	round trips	420	5,000
Establish staging area for non-contaminated soil		8	lump sum	1,000	8,000
Excavation of non-contaminated soil overburden:		9,140	bcy		
3 cy backhoe Cat 330 CL (260 cy/hr from Means)	1	40	hour	285	11,400
Articulated trucks	2	40	hour	225	18,000
Front end loader	1	40	hour	155	6,200
Water truck	1	5	day	560	2,800
Excavation of contaminated soil:		55,410	bcy		
3 cy backhoe (260 cy/hr, but limited by truck loading 15 Lcy/10 min = 90 lcy/hr)	1	810	hour	285	230,900
Highway trucks haul 65 miles to Class II landfill for disposal		83,115	tons	15	1,246,700
Water truck	1	102	day	560	57,100
Contaminated soil disposal (Class II Landfill)		83,115	tons	21	1,745,400
Backfill (assumes compaction testing not needed):					
Clean fill to replace contaminated soil - delivered to site		72,040	lcy		
Stockpiled non-contaminated soil		11,870	lcy		
Total volume of soil to be backfilled/compacted		83,910	lcy		
Sheepsfoot vibratory high speed compactor with blade 825B[1]: 1,203 cy/hr	1	83,910	lcy	0.81	68,000
Front end loader to move stockpiled soil to sheepsfoot (assumes 200 lcy/hr)	1	59	hour	155	9,200
Material costs for clean fill to replace contaminated soil		72,040	lcy	7.30	525,900
Water truck		8	day	560	4,500
Subtotal - Excavation and Disposal					3,954,100
Excavation and Confirmatory Sampling and Analysis					
Stockpile sampling of soil from suspected contaminated areas - (1 sample/100 bcy)					
Cubic yards of soil		55,410	bcy		
Various parameters		554	each	100	55,400
Excavation floor confirmatory sampling - (1 sample per 1,000 sq ft)					
Square feet		463,280			
Various parameters		463	each	100	46,300
Data validation and data management		101,700	%	10	10,200
Subtotal - Excavation and Confirmatory Sampling					111,900
Post-Construction Reports					
Construction Completion Report		1	each	25,000	25,000
Subtotal - Post Construction Reports					25,000
Estimated Construction Costs - Subtotal					**4,116,000**
Project Management			*%*	*5*	*206,000*
Engineering Design			*%*	*8*	*329,000*
Construction Management			*%*	*6*	*247,000*
Estimated Project Capital Costs - Subtotal					**4,898,000**
Contingency (10% scope + 15% bid)			*%*	*25*	*1,225,000*
Estimated Project Capital Costs - Total					**6,120,000**

Notes and Key:

Excavation Floor Confirmation Samples assumes 1 sample per 1,000 sf

[1] *assumes 4 passes are required for compaction, machine travels at 6.5 mph, and compacted lift thickness is 10 inches.*

Table B-7 Estimated Costs for Alternative 4: Excavation and Landfill Disposal of Soils
Present Worth Cost Estimate
BOU-Wide Consolidated Excavation and Disposal Scenario

Year	*n*	P/F(*i*=2.7%)	Estimated Capital Costs: Excavate and Dispose Soils ($)	Total Estimated Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2011	0	1.00000	6,120,000	6,120,000	6,120,000	6,120,000
2012	1	0.97371		0	0	6,120,000
2013	2	0.94811		0	0	6,120,000
2014	3	0.92318		0	0	6,120,000
2015	4	0.89891		0	0	6,120,000
2016	5	0.87528		0	0	6,120,000
2017	6	0.85227		0	0	6,120,000
2018	7	0.82986		0	0	6,120,000
2019	8	0.80805		0	0	6,120,000
2020	9	0.78680		0	0	6,120,000
2021	10	0.76612		0	0	6,120,000
2022	11	0.74598		0	0	6,120,000
2023	12	0.72636		0	0	6,120,000
2024	13	0.70727		0	0	6,120,000
2025	14	0.68867		0	0	6,120,000
2026	15	0.67057		0	0	6,120,000
2027	16	0.65294		0	0	6,120,000
2028	17	0.63577		0	0	6,120,000
2029	18	0.61906		0	0	6,120,000
2030	19	0.60278		0	0	6,120,000
2031	20	0.58694		0	0	6,120,000
2032	21	0.57151		0	0	6,120,000
2033	22	0.55648		0	0	6,120,000
2034	23	0.54185		0	0	6,120,000
2035	24	0.52761		0	0	6,120,000
2036	25	0.51373		0	0	6,120,000
2037	26	0.50023		0	0	6,120,000
2038	27	0.48708		0	0	6,120,000
2039	28	0.47427		0	0	6,120,000
2040	29	0.46180		0	0	6,120,000
		Total Estimated Non-Discounted Costs:		**6,120,000**		
				Total Estimated 30-year Present Worth Costs:		**6,120,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-8 Estimated Costs for Alternative 4: Soil Vapor Extraction - Admin Area
Preliminary Capital Cost Estimate
AE-SV-R-4 through AE-SV-R-8 Risk to Groundwater Only

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
DIRECT CAPITAL COST				
Pre-Construction Activities				
RD/RA Workplan	1	LS	10,000	10,000
SVE pilot testing	1	LS	50,000	50,000
			SUBTOTAL	**60,000**
System Construction 10 SVE wells; 300 cfm				
AQMD Permit-to-Construct (assumes no permits required: CERCLA site)	0	LS	5,000	0
Well permits (assumes no permits required: CERCLA site)	0	EA	1,000	0
Surveying/site layout (assumes includes final surveying)	1	DAY	1,500	1,500
Assumed number of shallow (10 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	4	number		
Assumed number of deeper (20 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	6	number		
Shallow SVE well installation	40	FT	110	4,400
Deeper SVE well installation	120	FT	110	13,200
SVE wellhd fittings (shutoff and sample valves, sample port, FERNCOs, reducers, bushings)	10	EA	70	700
Aboveground conveyance piping and supports from SVE wells to treatment compound	0	LF	6	0
Trench for 6-inch SVE conveyance piping; including piping (2.5' W x 2' D)	2,670	LF	40	106,800
Sand bedding for SVE conveyance piping and fill (2.5' W x 2' D), includes 15% expansion	546	CY	30	16,400
Core drilling through concrete slab for SVE wells	0	EA	100	0
Disposal of trench spoils and drill cuttings - assume Subtitle D landfill	548	CY	50	27,400
Precast manhole, frame, and cover (over SVE wellhead in road)	10	EA	1,200	12,000
Valve box and locking cover (for shutoff valves in road)	10	EA	200	2,000
Asphalt repair over trench	742	sq yd	48.50	36,000
Construct slab on-grade for blower and treatment equipment	256	sq ft	25	6,400
Fencing around remediation equipment, and gate (8' H chain link)	64	LF	75	4,800
Vacuum blower (Rotron EN757) 300 cfm, 7.5 hp, moisture knockout vessel	1	EA	9,100	9,100
Insulated sound enclosure to house SVE blower	1	EA	3,500	3,500
Thermal oxidizer and scrubber rental for first 6 mos operation, incl. scrubber caustic use	6	mo	3,500	21,000
Shipping of rented oxidizer/scrubber	2	EA	2,000	4,000
Propane use during thermal oxidizer rental (assumes 300,000 BTU/hr for 6 mos.)	14,200	gal	3.00	42,600
Vapor-phase granular activated carbon (VPGAC) vessels; 2 @ 500 lbs	2	EA	2,800	5,600
Initial load of VPGAC	1,000	lb	1.10	1,100
Equipment rental for installation of blower, oxidizer, and VPGAC vessels	1	day	2,000	2,000
Misc. piping, supports, valves in treatment compound	1	LS	1,000	1,000
Labor for installation (piping, supports, equipment) labor - 2 persons 12 days	192	hour	50	9,600
Blower equipment control panel	1	LS	3,500	3,500
Electrical main disconnect and breaker panel	1	LS	5,000	5,000
Electrical and controls wiring installation and testing; incl area lighting	1	LS	25,000	25,000
Startup/troubleshooting	3	DAY	800	2,400
Vapor flow meter, sample port, vacuum gauge (at each well and SVE blower inlet)	11	EA	600	6,600
Misc. monitoring equipment/magnahelics	1	LS	1,000	1,000
Final surveying (included in site layout surveying above)	0	DAY	1,500	0
			SUBTOTAL	**375,000**
Miscellaneous Costs				
Baseline TO-15 soil vapor sampling and analysis from each SVE well and blower inlet	11	EA	350	3,900
Remedial Action Summary (Construction Completion Report)	1	LS	7,500	7,500
Operation, Maintenance, and Monitoring Manual	1	LS	7,500	7,500
			SUBTOTAL	**19,000**
			SUBTOTAL - DIRECT CAPITAL COST	**454,000**
INDIRECT CAPITAL COST				
Project Management	*1*	*%*	*8*	*30,000*
Engineering Design	*1*	*%*	*15*	*56,300*
Construction Management	*1*	*%*	*10*	*37,500*
			SUBTOTAL - INDIRECT CAPITAL COST	**124,000**
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	**578,000**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*144,500*
			TOTAL - CAPITAL COST ESTIMATE	**720,000**

Note: Percentages for Indirect Capital Costs and Contingency estimates are from Section 5 of USEPA, 2000.

Table B-8 Estimated Costs for Alternative 4: Soil Vapor Extraction - Admin Area
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
AE-SV-R-4 through AE-SV-R-8 Risk to Groundwater Only

	QUANTITY		COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($)**
ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				
Labor:				
Technician	0.15	%FTE	135,200	20,300
Engineering, includes progress reporting to Agencies	0.08	%FTE	208,000	15,600
Data validation and management	13	lot	150	2,000
Annual AQMD Permit-to-Operate (assumes no permits required: CERCLA site)	0	LS	2,500	0
Monthly system vapor sampling and analysis (for compliance with AQMD permit - system influent and effluent samples each month)	24	EA	350	8,400
Annual vapor sample from each SVE well and analysis	10	EA	350	3,500
Field instrument rental (PID/FID)	12	day	100	1,200
VPGAC use (assumes replacement every 6 months)	2,000	lb	1.10	2,200
Repair and replacement of equipment and misc. materials/field supplies	1	LS	2,000	2,000
Electrical power				
SVE blower (7.5 hp, 6.9 running hp)	45,200	KWH	0.12	5,400
Area lighting, assume 2 KW, 12 hrs/day	8,760	KWH	0.12	1,100
SUBTOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				**61,700**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*15,400*
TOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COST ESTIMATE				**77,000**

Note: Assumes SVE system offgas will be treated with thermal oxidation for first 6 months of operation when offgas concentrations are expected to be high, then treatment will be switched to vapor-phase granular activated carbon.

Table B-8 Estimated Costs for Alternative 4: Soil Vapor Extraction - Admin Area
Present Worth Cost Estimate
AE-SV-R-4 through AE-SV-R-8 Risk to Groundwater Only

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	O&M AND MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	720,000		720,000	720,000	720,000
2012	1	0.97371		77,000	77,000	75,000	795,000
2013	2	0.94811		77,000	77,000	73,000	868,000
2014	3	0.92318		77,000	77,000	71,000	939,000
2015	4	0.89891		77,000	77,000	69,000	1,008,000
2016	5	0.87528		77,000	77,000	67,000	1,075,000
2017	6	0.85227		77,000	77,000	66,000	1,141,000
2018	7	0.82986		77,000	77,000	64,000	1,205,000
2019	8	0.80805			0	0	1,205,000
2020	9	0.78680			0	0	1,205,000
2021	10	0.76612			0	0	1,205,000
2022	11	0.74598			0	0	1,205,000
2023	12	0.72636			0	0	1,205,000
2024	13	0.70727			0	0	1,205,000
2025	14	0.68867			0	0	1,205,000
2026	15	0.67057			0	0	1,205,000
2027	16	0.65294			0	0	1,205,000
2028	17	0.63577			0	0	1,205,000
2029	18	0.61906			0	0	1,205,000
2030	19	0.60278			0	0	1,205,000
2031	20	0.58694			0	0	1,205,000
2032	21	0.57151			0	0	1,205,000
2033	22	0.55648			0	0	1,205,000
2034	23	0.54185			0	0	1,205,000
2035	24	0.52761			0	0	1,205,000
2036	25	0.51373			0	0	1,205,000
2037	26	0.50023			0	0	1,205,000
2038	27	0.48708			0	0	1,205,000
2039	28	0.47427			0	0	1,205,000
2040	29	0.46180			0	0	1,205,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**1,260,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**1,210,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-9 Estimated Costs for Alternative 4: Soil Vapor Extraction - WLLO Area (Line 2)
Preliminary Capital Cost Estimate
L2-SV-R-1 and L2-SV-R-2

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
DIRECT CAPITAL COST				
Pre-Construction Activities				
RD/RA Workplan	1	LS	10,000	10,000
SVE pilot testing	1	LS	50,000	50,000
			SUBTOTAL	**60,000**
System Construction 9 SVE wells; 270 cfm				
AQMD Permit-to-Construct (assumes no permits required: CERCLA site)	0	LS	5,000	0
Well permits (assumes no permits required: CERCLA site)	0	EA	1,000	0
Surveying/site layout (assumes includes final surveying)	1	DAY	1,500	1,500
Assumed number of shallow (10 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	1	number		
Assumed number of deeper (20 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	8	number		
Shallow SVE well installation	10	FT	110	1,100
Deeper SVE well installation	160	FT	110	17,600
SVE wellhd fittings (shutoff and sample valves, sample port, FERNCOs, reducers, bushings)	9	EA	70	600
Aboveground conveyance piping and supports from SVE wells to treatment compound	650	LF	6	3,900
Trench for 6-inch SVE conveyance piping; including piping (2.5' W x 2' D)	0	LF	40	0
Sand bedding for SVE conveyance piping and fill (2.5' W x 2' D), includes 15% expansion	0	CY	30	0
Core drilling through concrete slab for SVE wells	0	EA	100	0
Disposal of trench spoils and drill cuttings - assume Subtitle D landfill	2	CY	50	100
Precast manhole, frame, and cover (over SVE wellhead in road)	0	EA	1,200	0
Valve box and locking cover (for shutoff valves in road)	0	EA	200	0
Asphalt repair over trench	0	sq yd	48.50	0
Construct slab on-grade for blower and treatment equipment	256	sq ft	25	6,400
Fencing around remediation equipment, and gate (8' H chain link)	64	LF	75	4,800
Vacuum blower (Rotron EN757) 270 cfm, 7.5 hp, moisture knockout vessel	1	EA	9,100	9,100
Insulated sound enclosure to house SVE blower	1	EA	3,500	3,500
Thermal oxidizer and scrubber rental for first 6 mos operation, incl. scrubber caustic use	6	mo	3,500	21,000
Shipping of rented oxidizer/scrubber	2	EA	2,000	4,000
Propane use during thermal oxidizer rental (assumes 270,000 BTU/hr for 6 mos.)	12,700	gal	3.00	38,100
Vapor-phase granular activated carbon (VPGAC) vessels; 2 @ 500 lbs	2	EA	2,800	5,600
Initial load of VPGAC	1,000	lb	1.10	1,100
Equipment rental for installation of blower, oxidizer, and VPGAC vessels	1	day	2,000	2,000
Misc. piping, supports, valves in treatment compound	1	LS	1,000	1,000
Labor for installation (piping, supports, equipment) labor - 2 persons 12 days	192	hour	50	9,600
Blower equipment control panel	1	LS	3,500	3,500
Electrical main disconnect and breaker panel	1	LS	5,000	5,000
Electrical and controls wiring installation and testing; incl area lighting	1	LS	25,000	25,000
Startup/troubleshooting	3	DAY	800	2,400
Vapor flow meter, sample port, vacuum gauge (at each well and SVE blower inlet)	10	EA	600	6,000
Misc. monitoring equipment/magnahelics	1	LS	1,000	1,000
Final surveying (included in site layout surveying above)	0	DAY	1,500	0
			SUBTOTAL	**174,000**
Miscellaneous Costs				
Baseline TO-15 soil vapor sampling and analysis from each SVE well and blower inlet	10	EA	350	3,500
Remedial Action Summary (Construction Completion Report)	1	LS	7,500	7,500
Operation, Maintenance, and Monitoring Manual	1	LS	7,500	7,500
Regulatory Oversight	0.0	month	16,000	0
			SUBTOTAL	**19,000**
			SUBTOTAL - DIRECT CAPITAL COST	**253,000**
INDIRECT CAPITAL COST				
Project Management	*1*	*%*	*8*	*13,900*
Engineering Design	*1*	*%*	*15*	*26,100*
Construction Management	*1*	*%*	*10*	*17,400*
			SUBTOTAL - INDIRECT CAPITAL COST	**57,000**
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	**310,000**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*77,500*
			TOTAL - CAPITAL COST ESTIMATE	**390,000**

Note: Percentages for Indirect Capital Costs and Contingency estimates are from Section 5 of USEPA, 2000.

Table B-9 Estimated Costs for Alternative 4: Soil Vapor Extraction - WLLO Area (Line 2)
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
L2-SV-R-1 and L2-SV-R-2

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST ($)	COST TOTAL COST ($)
ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				
Labor:				
Technician	0.15	%FTE	135,200	20,300
Engineering, includes progress reporting to Agencies	0.08	%FTE	208,000	15,600
Data validation and management	13	lot	150	1,900
Annual AQMD Permit-to-Operate (assumes no permits required: CERCLA site)	0	LS	2,500	0
Monthly system vapor sampling and analysis (for compliance with AQMD permit - system influent and effluent samples each month)	24	EA	350	8,400
Annual vapor sample from each SVE well and analysis	9	EA	350	3,200
Field instrument rental (PID/FID)	12	day	100	1,200
VPGAC use (assumes replacement every 6 months)	2,000	lb	1.10	2,200
Repair and replacement of equipment and misc. materials/field supplies	1	LS	2,000	2,000
Electrical power				
SVE blower (7.5 hp, 6.9 running hp)	45,200	KWH	0.12	5,400
Area lighting, assume 2 KW, 12 hrs/day	8,760	KWH	0.12	1,100
SUBTOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				**61,300**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*15,300*
TOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COST ESTIMATE				**77,000**

Note: Assumes SVE system offgas will be treated with thermal oxidation for first 6 months of operation when offgas concentrations are expected to be high, then treatment will be switched to vapor-phase granular activated carbon.

Table B-9 Estimated Costs for Alternative 4: Soil Vapor Extraction - WLLO Area (Line 2)
Present Worth Cost Estimate
L2-SV-R-1 and L2-SV-R-2

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	O&M AND MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	390,000		390,000	390,000	390,000
2012	1	0.97371		77,000	77,000	75,000	465,000
2013	2	0.94811		77,000	77,000	73,000	538,000
2014	3	0.92318		77,000	77,000	71,000	609,000
2015	4	0.89891		77,000	77,000	69,000	678,000
2016	5	0.87528		77,000	77,000	67,000	745,000
2017	6	0.85227		77,000	77,000	66,000	811,000
2018	7	0.82986		77,000	77,000	64,000	875,000
2019	8	0.80805			0	0	875,000
2020	9	0.78680			0	0	875,000
2021	10	0.76612			0	0	875,000
2022	11	0.74598			0	0	875,000
2023	12	0.72636			0	0	875,000
2024	13	0.70727			0	0	875,000
2025	14	0.68867			0	0	875,000
2026	15	0.67057			0	0	875,000
2027	16	0.65294			0	0	875,000
2028	17	0.63577			0	0	875,000
2029	18	0.61906			0	0	875,000
2030	19	0.60278			0	0	875,000
2031	20	0.58694			0	0	875,000
2032	21	0.57151			0	0	875,000
2033	22	0.55648			0	0	875,000
2034	23	0.54185			0	0	875,000
2035	24	0.52761			0	0	875,000
2036	25	0.51373			0	0	875,000
2037	26	0.50023			0	0	875,000
2038	27	0.48708			0	0	875,000
2039	28	0.47427			0	0	875,000
2040	29	0.46180			0	0	875,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**930,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**880,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-10 Estimated Costs for Alternative 4: Soil Vapor Extraction - WLLO Area (Line 5)
Preliminary Capital Cost Estimate
L5-SV-R-1 and L5-SV-R-2

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
DIRECT CAPITAL COST				
Pre-Construction Activities				
RD/RA Workplan	1	LS	5,000	5,000
SVE pilot testing (no pilot testing, just install the 2 SVE wells)	0	LS	20,000	0
			SUBTOTAL	**5,000**
System Construction 2 SVE wells; 60 cfm				
AQMD Permit-to-Construct (assumes no permits required: CERCLA site)	0	LS	5,000	0
Well permits (assumes no permits required: CERCLA site)	0	EA	1,000	0
Surveying/site layout	0.5	DAY	1,500	800
Assumed number of shallow (10 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	1	number		
Assumed number of deeper (20 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	1	number		
Shallow SVE well installation	10	FT	110	1,100
Deeper SVE well installation	20	FT	110	2,200
SVE wellhd fittings (shutoff and sample valves, sample port, FERNCOs, reducers, bushings)	2	EA	70	100
Aboveground conveyance piping and supports from SVE wells to treatment compound	320	LF	6	1,900
Trench for 6-inch SVE conveyance piping; including piping (2.5' W x 2' D)	0	LF	40	0
Sand bedding for SVE conveyance piping and fill (2.5' W x 2' D), includes 15% expansion	0	CY	30	0
Core drilling through concrete slab for SVE wells	0	EA	100	0
Disposal of trench spoils and drill cuttings - assume Subtitle D landfill	0.4	CY	50	20
Precast manhole, frame, and cover (over SVE wellhead in road)	0	EA	1,200	0
Valve box and locking cover (for shutoff valves in road)	0	EA	200	0
Asphalt repair over trench	0	sq yd	48.50	0
Construct slab on-grade for blower and treatment equipment	144	sq ft	25	3,600
Fencing around remediation equipment, and gate (8' H chain link)	48	LF	75	3,600
Vacuum blower (Rotron DR303) 60 cfm, 3 hp, moisture knockout vessel	1	EA	6,000	6,000
Insulated sound enclosure to house SVE blower	1	EA	2,700	2,700
Vapor-phase granular activated carbon (VPGAC) vessels and initial carbon; 2 @ 110 lbs	2	EA	825	1,700
Equipment rental for installation of blower, oxidizer, and VPGAC vessels	1	day	500	500
Misc. piping, supports, valves in treatment compound	1	LS	500	500
Labor for installation (piping, supports, equipment) labor - 2 persons 8 days	128	hour	50	6,400
Blower equipment control panel	1	LS	3,000	3,000
Electrical main disconnect and breaker panel	1	LS	5,000	5,000
Electrical and controls wiring installation and testing; incl area lighting	1	LS	10,000	10,000
Startup/troubleshooting	2	DAY	800	1,600
Vapor flow meter, sample port, vacuum gauge (at each well and SVE blower inlet)	3	EA	600	1,800
Misc. monitoring equipment/magnahelics	1	LS	500	500
Final surveying (assume included in initial survey above)	0	DAY	1,500	0
			SUBTOTAL	**53,000**
Miscellaneous Costs				
Baseline TO-15 soil vapor sampling and analysis from each SVE well and blower inlet	3	EA	350	1,100
Remedial Action Summary (Construction Completion Report)	1	LS	2,000	2,000
Operation, Maintenance, and Monitoring Manual	1	LS	2,000	2,000
Regulatory Oversight	0	week	4,000	0
			SUBTOTAL	**5,000**
			SUBTOTAL - DIRECT CAPITAL COST	**63,000**
INDIRECT CAPITAL COST				
Project Management	*1*	*%*	*10*	*5,300*
Engineering Design	*1*	*%*	*20*	*10,600*
Construction Management	*1*	*%*	*15*	*8,000*
			SUBTOTAL - INDIRECT CAPITAL COST	**24,000**
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	**87,000**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*21,800*
			TOTAL - CAPITAL COST ESTIMATE	**110,000**

Note: Percentages for Indirect Capital Costs and Contingency estimates are from Section 5 of USEPA, 2000.

Table B-10 Estimated Costs for Alternative 4: Soil Vapor Extraction - WLLO Area (Line 5)
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
L5-SV-R-1 and L5-SV-R-2

	QUANTITY		COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($)**
ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				
Labor:				
Technician	0.10	%FTE	135,200	13,500
Engineering, includes progress reporting to Agencies	0.05	%FTE	208,000	10,400
Data validation and management	12	lot	150	1,800
Annual AQMD Permit-to-Operate (assumes no permits required: CERCLA site)	0	LS	2,500	0
Monthly system vapor sampling and analysis (for compliance with AQMD permit - system influent and effluent samples each month)	24	EA	350	8,400
Annual vapor sample from each SVE well and analysis	2	EA	350	700
Field instrument rental (PID/FID)	12	day	100	1,200
VPGAC drum replacement (assumes replacement every 6 months)	4	EA	825	3,300
Repair and replacement of equipment and misc. materials/field supplies	1	LS	500	500
Electrical power				
SVE blower (3 hp, 2.8 running hp)	18,300	KWH	0.12	2,200
Area lighting, assume 1 KW, 12 hrs/day	4,380	KWH	0.12	500
SUBTOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				**42,500**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*10,600*
TOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COST ESTIMATE				**53,000**

Table B-10 Estimated Costs for Alternative 4: Soil Vapor Extraction - WLLO Area (Line 5)
Present Worth Cost Estimate
L5-SV-R-1 and L5-SV-R-2

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	O&M AND MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	110,000		110,000	110,000	110,000
2012	1	0.97371		53,000	53,000	52,000	162,000
2013	2	0.94811		53,000	53,000	50,000	212,000
2014	3	0.92318		53,000	53,000	49,000	261,000
2015	4	0.89891		53,000	53,000	48,000	309,000
2016	5	0.87528		53,000	53,000	46,000	355,000
2017	6	0.85227		53,000	53,000	45,000	400,000
2018	7	0.82986		53,000	53,000	44,000	444,000
2019	8	0.80805			0	0	444,000
2020	9	0.78680			0	0	444,000
2021	10	0.76612			0	0	444,000
2022	11	0.74598			0	0	444,000
2023	12	0.72636			0	0	444,000
2024	13	0.70727			0	0	444,000
2025	14	0.68867			0	0	444,000
2026	15	0.67057			0	0	444,000
2027	16	0.65294			0	0	444,000
2028	17	0.63577			0	0	444,000
2029	18	0.61906			0	0	444,000
2030	19	0.60278			0	0	444,000
2031	20	0.58694			0	0	444,000
2032	21	0.57151			0	0	444,000
2033	22	0.55648			0	0	444,000
2034	23	0.54185			0	0	444,000
2035	24	0.52761			0	0	444,000
2036	25	0.51373			0	0	444,000
2037	26	0.50023			0	0	444,000
2038	27	0.48708			0	0	444,000
2039	28	0.47427			0	0	444,000
2040	29	0.46180			0	0	444,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**480,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**440,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-11 Estimated Costs for Alternative 4: Air Sparging/SVE
Preliminary Capital Cost Estimate
AE-R-1 Other Remedial Alternative

Costing assumptions:
- TPH-D and -MO in unsaturated zone and groundwater; DTW = 37 ft
- Assume for TPH: Henry's Law > 100 atm; boiling range < 250-300 deg C; vapor pressures > 0.5 mm Hg; therefore amenable to air sparging
- Intrinsic permeability is w/in range of effectiveness for air sparging
- Dissolved iron content < 20 mg/L
- SVE wells at AE-R-1 would tie-in to header system for AE-R-1 thru AE-R-6
- AS blower would be located in same compound as SVE blower and offgas treatment
- Zone of Influence for AS wells of 25 ft and 5 scfm per well
- Radius of Influence for SVE wells of 50 ft and 30 scfm per well

	QUANTITY		ESTIMATED COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($)**
Pre-Construction Activities				
RD/RA Workplan	1	LS	5,000	5,000
AS pilot testing (in conjunction w/ SVE pilot testing in Admin East area)	1	LS	20,000	20,000
Subtotal - Pre-Construction Activities				25,000
System Construction 4 AS wells and 4 SVE wells				
AQMD Permit-to-Construct (assumes no permits required: CERCLA site)	0	LS	5,000	0
Well permits (assumes no permits required: CERCLA site)	0	EA	1,000	0
Surveying/site layout	0.5	DAY	1,500	800
Assumed number of shallow (10 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	2	number		
Assumed number of deeper (20 ft) SVE wells or trenches [assume 50 ft ROI; 30 cfm/well]	2	number		
Shallow SVE well installation	20	FT	110	2,200
Deeper SVE well installation	40	FT	110	4,400
Assumed number of AS well points: 45 ft depth w/ 2 ft screened interval at bottom	4	number		
AS well installation	180	FT	110	19,800
SVE wellhd fittings (shutoff and sample valves, sample port, FERNCOs, reducers, bushings)	4	EA	70	300
AS wellhd fittings (shutoff and sample valves, p. gauge, rotameter, GSP fittings)	4	EA	200	800
Trench for 6-inch SVE conveyance piping; including piping (2.5' W x 2' D) - common	0	LF	40	0
Sand bedding for SVE conveyance piping and fill (2.5' W x 2' D), includes 15% expansion	0	CY	30	0
6-inch PVC SVE header piping - connect with piping from AA-SV-R-2 area	0	LF	6.00	0
2-inch GSP compressed air AS header piping from AS blower - in same trench as SVE piping	900	LF	5.45	4,900
Disposal of trench spoils and drill cuttings - assume Subtitle D landfill	0.8	CY	50	40
Precast manhole, frame, and cover (over AS and SVE wellheads in road or sidewalk)	8	EA	1,200	9,600
Valve box and locking cover (for SVE shutoff valves in road)	4	EA	200	800
Asphalt repair over trench	0	sq yd	48.50	0
Construct slab on-grade for blower and treatment equipment	0	sq ft	25	0
Fencing around remediation equipment, and gate (8' H chain link)	0	LF	75	0
Air Sparge blower w/ 10 hp motor	1	EA	7,500	7,500
Insulated sound enclosure to house AS blower	1	EA	2,700	2,700
Misc. piping, supports, valves in treatment compound	1	LS	500	500
Labor for installation (piping, supports, equipment) labor - 2 persons 8 days	128	hour	50	6,400
Additions to SVE equipment control panel	1	LS	2,000	2,000
Electrical and controls wiring installation and testing	1	LS	1,000	1,000
Startup/troubleshooting	1	DAY	800	800
Misc. monitoring equipment/pressure magnahelic	1	LS	500	500
Final surveying (assume included in initial survey above)	0	DAY	1,500	0
Subtotal - System Construction				65,000
Miscellaneous Costs				
Baseline TO-15 soil vapor sampling and analysis from each SVE well and blower inlet	5	EA	350	1,800
Remedial Action Summary (Construction Completion Report)	16	hour	125	2,000
Operation, Maintenance, and Monitoring Manual	24	hour	125	3,000
Regulatory Oversight	0	week	4,000	0
Subtotal - Miscellaneous Costs				7,000
Estimated Construction Costs - Subtotal				**97,000**
Project Management	*1*	*%*	*8*	*7,800*
Engineering Design	*1*	*%*	*15*	*14,600*
Construction Management	*1*	*%*	*10*	*9,700*
Estimated Project Capital Costs - Subtotal				**129,100**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*32,300*
Estimated Project Capital Costs - Total				**160,000**

Note: Percentages for Indirect Capital Costs and Contingency estimates are from Section 5 of USEPA, 2000.

Table B-11 Estimated Costs for Alternative 4: Air Sparging/SVE
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
AE-R-1 Other Remedial Alternative

	QUANTITY		COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($/yr)**
ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				
Labor:				
Technician	0.05	%FTE	135,200	6,800
Engineering, includes progress reporting to Agencies	0.01	%FTE	208,000	2,100
Data validation and management	12	lot	150	1,900
Annual AQMD Permit-to-Operate (assumes no permits required: CERCLA site)	0	LS	2,500	0
Monthly system vapor sampling and analysis	24	EA	350	8,400
Annual vapor sample from each SVE well and analysis	4	EA	350	1,400
Field instrument rental (PID/FID) - included w/ AE SVE system	0	day	100	0
Repair and replacement of equipment and misc. materials/field supplies	1	LS	500	500
Electrical power				
AS blower (10 hp, assume 7.5 running hp)	49,100	KWH	0.12	5,900
Area lighting, assume 1 KW, 12 hrs/day - included w/ AE SVE system	0	KWH	0.12	0
SUBTOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS				**27,000**
Contingency (10% scope + 15% bid)	*1*	*%*	*25*	*6,800*
TOTAL - ANNUAL OPERATION, MAINTENANCE, AND MONITORING COST ESTIMATE				**34,000**

Table B-11 Estimated Costs for Alternative 4: Air Sparging/SVE
Present Worth Cost Estimate
AE-R-1 Other Remedial Alternative

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	O&M AND MONITORING COSTS ($/yr)	TOTAL ESTIMATED COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	160,000		160,000	160,000	160,000
2012	1	0.97371		34,000	34,000	33,000	193,000
2013	2	0.94811		34,000	34,000	32,000	225,000
2014	3	0.92318		34,000	34,000	31,000	256,000
2015	4	0.89891		34,000	34,000	31,000	287,000
2016	5	0.87528		34,000	34,000	30,000	317,000
2017	6	0.85227		34,000	34,000	29,000	346,000
2018	7	0.82986		34,000	34,000	28,000	374,000
2019	8	0.80805			0	0	374,000
2020	9	0.78680			0	0	374,000
2021	10	0.76612			0	0	374,000
2022	11	0.74598			0	0	374,000
2023	12	0.72636			0	0	374,000
2024	13	0.70727			0	0	374,000
2025	14	0.68867			0	0	374,000
2026	15	0.67057			0	0	374,000
2027	16	0.65294			0	0	374,000
2028	17	0.63577			0	0	374,000
2029	18	0.61906			0	0	374,000
2030	19	0.60278			0	0	374,000
2031	20	0.58694			0	0	374,000
2032	21	0.57151			0	0	374,000
2033	22	0.55648			0	0	374,000
2034	23	0.54185			0	0	374,000
2035	24	0.52761			0	0	374,000
2036	25	0.51373			0	0	374,000
2037	26	0.50023			0	0	374,000
2038	27	0.48708			0	0	374,000
2039	28	0.47427			0	0	374,000
2040	29	0.46180			0	0	374,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**398,000**		
				TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:			**370,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-12 Estimated Costs for Alternative 4: Soil Flushing at L2-R-9
Preliminary Capital Cost Estimate
Line 2 Other Remedial Alternative

Costing assumptions:
- Flushing unsaturated zone using 2 upgradient recharge and 2 downgradient extraction wells
- Surface area approximately 100' x 100'. Perchlorate present from 11' bgs to groundwater surface at 50' bgs
- "Aboveground" treatment using sulfur oxidizing bioreactor for perchlorate removal and air stripping for VOCs
- Influent perchlorate concentrations are such that 70 mg/L sulfate discharge will be met
- Approximately 9 years of operation would be required to flush

Description	Number	Quantity	Units	Unit Rate	Estimated Cost ($)
RD/RA Workplans					
Workplans		16	each	125	2,000
Subtotal - Workplans					2,000
Soil Flushing System					
Surveying (pre- and post-construction)		0.5	day	1,500	750
Extraction wells - drilling and development	No. Wells				
Relatively shallow	4	60	feet	110	26,400
Aquifer pumping test and data reduction		2	day	1,000	2,000
Well pump discharge piping, 3" SS threaded		240	lin ft	40	9,600
Extraction well pumps, incl. elec. cable		2	each	2,000	4,000
Flow meter		2	each	500	1,000
Misc. wellhead piping and valves		2	each	400	800
Concrete vault at wellheads		4	each	500	2,000
Electrical disconnect switch at wellhead		2	each	500	1,000
Installation (pump, wellhead piping/valves)		4	LS	500	2,000
One-time initial extraction and recharge well sampling:					
Perchlorate		4	each	40	200
Cations/anions		4	each	50	200
VOCs		4	each	125	500
Buried PE piping (extraction wells to treatment, treated water to recharge wells)		400	lin ft	2	800
Concrete slab-on-grade for air stripper and elec equipment 10' x 10'		100	sq ft	25	2,500
Backhoe and operator (tank burial, piping trenching)		16	hour	185	3,000
2,400 gal buried fiberglass bioreactor tank		1	each	3,500	3,500
Sulfur		8.8	tons	340	2,990
Walnut shell media		41	50# bag	9.00	370
Shallow tray air stripper (Breeze low profile Series 3)		1	each	8,000	8,000
VOC risk assessment for air stripper		1	each	2,500	2,500
Transfer pump to recharge wells		1	each	1,200	1,200
Misc. aboveground piping, valves, supports		1	LS	400	400
Equipment, piping, and electrical installation		32	hour	75	2,400
Control panel		1	each	3,500	3,500
Motor starters for extraction and recharge pumps		3	each	500	1,500
Main disconnect and breaker panel		1	each	2,500	2,500
Power service drop (SMUD transformer) - assumes overhead power adjacent to site		1	each	10,000	10,000
Buried electrical power to wells		300	lin ft	12	3,600
Subtotal - Soil Flushing System Construction					99,000
Post-Construction Reports and Regulatory Oversight					
Regulatory Oversight		0	week	4,000	0
Construction Completion Report		8	hour	125	1,000
Operation, Maintenance, and Monitoring Manual		16	hour	125	2,000
Subtotal - Post Construction Reports and Regulatory Oversight					3,000
Estimated Construction Costs - Subtotal					**104,000**
Project Management			*%*	*8*	*8,300*
Engineering Design			*%*	*15*	*15,600*
Construction Management			*%*	*10*	*10,400*
Estimated Project Capital Costs - Subtotal					**138,300**
Contingency (10% scope + 15% bid)			*%*	*25*	*34,600*
Estimated Project Capital Costs - Total					**170,000**

Table B-12 Estimated Costs for Alternative 4: Soil Flushing at L2-R-9
Estimated Annual Operation, Maintenance, and Monitoring (OM&M) Costs
Line 2 Other Remedial Alternative

Description	Number	Quantity	Units	Unit Rate	Estimated OM&M Cost ($/yr)
Extraction well maintenance (once per every 5 years)	2	0.2	year	3,200	1,280
Electric utilities:					
Extraction well pump - assumes 2 running hp	2	26,175	kwh	0.12	3,100
Air stripper blower - assumes 2.8 running hp	1	18,322	kwh	0.12	2,200
Recharge pump - assumes 2 running hp	1	13,087	kwh	0.12	1,600
Equip Maintenance (@ % of new equipment capital)		15,700	%	3	500
Equipment Replacement (@ % of new equipment capital)		15,700	%	3	500
Reactor media replacement (@ 3% loss per year):					
Sulfur		0.3	tons	340	100
Walnut shells		1	cu ft	3.20	0
Labor:					
Operator labor (assume 4 hours/week)		208	hours	65	13,500
Annual maintenance (2 persons; 2 days)		32	hours	65	2,100
Monitoring:					
Influent and effluent of treatment facilities (assumes 2 each/month)					
Perchlorate	2	12	each	40	500
Cations/anions	2	12	each	50	600
VOCs	2	12	each	125	1,500
Subtotal - Estimated OM&M Costs					27,500
Contingency (10% scope + 15% bid)			*%*	*25*	*6,900*
Estimated OM&M Costs - Total					**34,000**

Table B-12 Estimated Costs for Alternative 4: Soil Flushing at L2-R-9
Present Worth Cost Estimate
Line 2 Other Remedial Alternative

Year	*n*	P/F(*i*=2.7%)	Estimated Capital Costs Soil Flushing ($)	Operation, Maintanance and Monitoring Costs ($/year)	Total Estimated Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2011	0	1.00000	170,000		170,000	170,000	170,000
2012	1	0.97371		34,000	34,000	33,100	203,000
2013	2	0.94811		34,000	34,000	32,200	235,000
2014	3	0.92318		34,000	34,000	31,400	266,000
2015	4	0.89891		34,000	34,000	30,600	297,000
2016	5	0.87528		34,000	34,000	29,800	327,000
2017	6	0.85227		34,000	34,000	29,000	356,000
2018	7	0.82986		34,000	34,000	28,200	384,000
2019	8	0.80805		34,000	34,000	27,500	412,000
2020	9	0.78680		34,000	34,000	26,800	439,000
2021	10	0.76612			0	0	439,000
2022	11	0.74598			0	0	439,000
2023	12	0.72636			0	0	439,000
2024	13	0.70727			0	0	439,000
2025	14	0.68867			0	0	439,000
2026	15	0.67057			0	0	439,000
2027	16	0.65294			0	0	439,000
2028	17	0.63577			0	0	439,000
2029	18	0.61906			0	0	439,000
2030	19	0.60278			0	0	439,000
2031	20	0.58694			0	0	439,000
2032	21	0.57151			0	0	439,000
2033	22	0.55648			0	0	439,000
2034	23	0.54185			0	0	439,000
2035	24	0.52761			0	0	439,000
2036	25	0.51373			0	0	439,000
2037	26	0.50023			0	0	439,000
2038	27	0.48708			0	0	439,000
2039	28	0.47427			0	0	439,000
2040	29	0.46180			0	0	439,000
			Total Estimated Non-Discounted Costs:		**476,000**		
					Total Estimated 30-year Present Worth Costs:		**440,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-13 Estimated Costs for Alternative 4: Fill Contaminated Area with Clean Soil
Contaminated Area To-Be-Filled Description
DPEB-R-1

Remedial Area Number	Estimated Floor Area (sq ft)	Depth (ft)	Area to be Filled Volume Bank (bcy)	Area to be Filled Volume Loose (Lcy)
DPEB-R-1	23,976	6	5,328	6,926
	23,980		5,330	6,930

Notes and Key:
bcy = bank cubic yards (in-place cubic yards)
Lcy = loose cubic yards (bank cubic yards plus a 30% swell factor)
The number of significant digits shown above are for calculation purposes only and should not be construed to indicate that these numbers are accurate or precise to one foot or cubic yard. Actual values are likely only accurate to 100 sq ft or 100 cu yds.

Table B-13 Estimated Costs for Alternative 4: Fill Contaminated Area with Clean Soil
Preliminary Capital Cost Estimate
DPEB-R-1

Description	Number	Quantity	Units	Unit Rate	Estimated Cost ($)
RD/RA Workplans					
Workplans (assume included in Engineering Design costs)		0	hours	125	0
Subtotal - Workplans					0
Soil Fill Contaminated Area					
Assumptions:					
End-dump or side-dump highway trucks haul clean fill from area near GET B approx. 6 miles to Dredge Pit site					
Truck soil volume capacity = approx. 17 loose cu yd					
10 mins to load truck; 5 mins to dump load near Sheepsfoot; 15 mins each way on road: assume 10 round-trips per 8 hr day					
Sheepsfoot vibratory compactor with blade used to place and compact fill in approximate 12" lifts					
Front end loaders used to assist compactor in placing clean soil					
Soil swell factor of 30%					
Weight of 1 bcy = 1.5 tons					
Surveying (pre- and post-soil filling)		1	day	1,500	1,500
Equipment mobilization/demobilization		3	round trips	420	1,300
Excavate and transport soil:					
Volume of clean fill required:		6,930	lcy		
3 cy backhoe (260 cy/hr, but limited by truck loading 17 lcy/10 min = 100 lcy/hr)	1	68	hour	285	19,400
Truck hauling	5	68	hour	90	30,600
Backfill (assumes compaction testing not needed):					
Sheepsfoot vibratory high speed compactor w/ blade e.g., Cat 815E[1]: but production limited to 100 lcy/hr	1	9	day	1,400	12,600
Water truck	1	9	day	560	5,000
Subtotal - Soil Fill of Contaminated Area					70,400
Post-Construction Reports					
Construction Completion Report (assume included in Construction Management Costs)		0	hours	125	0
Subtotal - Post Construction Reports					0
Estimated Construction Costs - Subtotal					**70,400**
Project Management			*%*	*10*	*7,000*
Engineering Design			*%*	*20*	*14,100*
Construction Management			*%*	*15*	*10,600*
Estimated Project Capital Costs - Subtotal					**102,100**
Contingency (10% scope + 15% bid)			*%*	*25*	*25,500*
Estimated Project Capital Costs - Total					**128,000**

Notes:

[1] *assumes 4 passes are required for compaction, machine travels at 6.5 mph, and compacted lift thickness is 10 inches.*

Table B-13 Estimated Costs for Alternative 4: Fill Contaminated Area with Clean Soil
Present Worth Cost Estimate
DPEB-R-1

Year	*n*	P/F(*i*=2.7%)	Estimated Capital Costs Soil Filling ($)	Total Estimated Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2011	0	1.00000	128,000	128,000	128,000	128,000
2012	1	0.97371		0	0	128,000
2013	2	0.94811		0	0	128,000
2014	3	0.92318		0	0	128,000
2015	4	0.89891		0	0	128,000
2016	5	0.87528		0	0	128,000
2017	6	0.85227		0	0	128,000
2018	7	0.82986		0	0	128,000
2019	8	0.80805		0	0	128,000
2020	9	0.78680		0	0	128,000
2021	10	0.76612		0	0	128,000
2022	11	0.74598		0	0	128,000
2023	12	0.72636		0	0	128,000
2024	13	0.70727		0	0	128,000
2025	14	0.68867		0	0	128,000
2026	15	0.67057		0	0	128,000
2027	16	0.65294		0	0	128,000
2028	17	0.63577		0	0	128,000
2029	18	0.61906		0	0	128,000
2030	19	0.60278		0	0	128,000
2031	20	0.58694		0	0	128,000
2032	21	0.57151		0	0	128,000
2033	22	0.55648		0	0	128,000
2034	23	0.54185		0	0	128,000
2035	24	0.52761		0	0	128,000
2036	25	0.51373		0	0	128,000
2037	26	0.50023		0	0	128,000
2038	27	0.48708		0	0	128,000
2039	28	0.47427		0	0	128,000
2040	29	0.46180		0	0	128,000
		Total Estimated Non-Discounted Costs:		**128,000**		
					Total Estimated 30-year Present Worth Costs:	**128,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-14 Estimated Costs for Additional Soil Sampling - Remedial Area AW-R-14
Preliminary Capital Cost Estimate
Admin West Area (AW-R-14)

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST ($)	COST TOTAL COST ($)
Direct Push Borings				
Mobilization/demobilization	1	LS	500	500
Direct push equipment (6 borings to 30', 3 borings/day)	6	boring	600	3,600
Investigative Derived Waste (IDW)	2	drum	300	600
Labor				
Field Geologist Labor and Sampling Equipment	2	day	1,000	2,000
Analysis of soil samples for Cr^{+6}				
Samples at 5', 10', 15', 20', 25', and 30'	36	ea	90	3,240
Field duplicates (one per every 10 samples)	4	ea	90	360
Full electronic data packages (% of analytical costs)	$3,600	%	10%	360
Data validation and management	2	sample lots	200	400
Reporting	8	hours	125	1,000
			Estimated Capital Costs - Subtotal	12,100
Contingency (10% scope + 15% bid)		*%*	*25*	*3,000*
			Estimated Project Capital Costs - Total	**15,000**

Table B-15 Estimated Costs for Culvert Sediment Removal - Remedial Area AE-R-9
Preliminary Capital Cost Estimate
Admin East Area (AE-R-9)

	QUANTITY		COST	
DESCRIPTION	**NUMBER**	**UNIT**	**UNIT COST ($)**	**TOTAL COST ($)**
Water Jet Culvert Cleaning				
Mobilization/demobilization	1	LS	500	500
Water Jet Equipment	200	feet	22	4,400
Labor				
Field Geologist Oversight	1	day	1,000	1,000
Reporting	4	hours	125	500
			Estimated Capital Costs - Subtotal	6,400
Contingency (10% scope + 15% bid)		*%*	*25*	*1,600*
			Estimated Project Capital Costs - Total	**8,000**

Notes:
[1] assumes 200 feet of culvert jetted

Table B-15 Estimated Costs for Culvert Sediment Removal - Remedial Area AE-R-9
Present Worth Cost Estimate
Admin East Area (AE-R-9)

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	8,000		8,000	8,000	8,000
2012	1	0.97371			0	0	8,000
2013	2	0.94811			0	0	8,000
2014	3	0.92318			0	0	8,000
2015	4	0.89891			0	0	8,000
2016	5	0.87528			0	0	8,000
2017	6	0.85227			0	0	8,000
2018	7	0.82986			0	0	8,000
2019	8	0.80805			0	0	8,000
2020	9	0.78680			0	0	8,000
2021	10	0.76612			0	0	8,000
2022	11	0.74598			0	0	8,000
2023	12	0.72636			0	0	8,000
2024	13	0.70727			0	0	8,000
2025	14	0.68867			0	0	8,000
2026	15	0.67057			0	0	8,000
2027	16	0.65294			0	0	8,000
2028	17	0.63577			0	0	8,000
2029	18	0.61906			0	0	8,000
2030	19	0.60278			0	0	8,000
2031	20	0.58694			0	0	8,000
2032	21	0.57151			0	0	8,000
2033	22	0.55648			0	0	8,000
2034	23	0.54185			0	0	8,000
2035	24	0.52761			0	0	8,000
2036	25	0.51373			0	0	8,000
2037	26	0.50023			0	0	8,000
2038	27	0.48708			0	0	8,000
2039	28	0.47427			0	0	8,000
2040	29	0.46180			0	0	8,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**8,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**8,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Table B-14 Estimated Costs for Additional Soil Sampling - Remedial Area AW-R-14
Present Worth Cost Estimate
Admin West Area (AW-R-14)

YEAR	*n*	P/F(*i* =2.7%)	CAPITAL COSTS ($)	MONITORING COSTS ($/yr)	SUBTOTAL COSTS ($)	PRESENT WORTH OF COSTS ($)	CUMULATIVE PRESENT WORTH ($)
PRESENT WORTH COST ESTIMATE							
2011	0	1.00000	15,000		15,000	15,000	15,000
2012	1	0.97371			0	0	15,000
2013	2	0.94811			0	0	15,000
2014	3	0.92318			0	0	15,000
2015	4	0.89891			0	0	15,000
2016	5	0.87528			0	0	15,000
2017	6	0.85227			0	0	15,000
2018	7	0.82986			0	0	15,000
2019	8	0.80805			0	0	15,000
2020	9	0.78680			0	0	15,000
2021	10	0.76612			0	0	15,000
2022	11	0.74598			0	0	15,000
2023	12	0.72636			0	0	15,000
2024	13	0.70727			0	0	15,000
2025	14	0.68867			0	0	15,000
2026	15	0.67057			0	0	15,000
2027	16	0.65294			0	0	15,000
2028	17	0.63577			0	0	15,000
2029	18	0.61906			0	0	15,000
2030	19	0.60278			0	0	15,000
2031	20	0.58694			0	0	15,000
2032	21	0.57151			0	0	15,000
2033	22	0.55648			0	0	15,000
2034	23	0.54185			0	0	15,000
2035	24	0.52761			0	0	15,000
2036	25	0.51373			0	0	15,000
2037	26	0.50023			0	0	15,000
2038	27	0.48708			0	0	15,000
2039	28	0.47427			0	0	15,000
2040	29	0.46180			0	0	15,000
		TOTAL - ESTIMATED NON-DISCOUNTED COSTS:			**15,000**		
			TOTAL - ESTIMATED 30-year PRESENT WORTH COSTS:				**15,000**

The information in this cost estimate summary is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. In accordance with USEPA Guidance, this is an order-of-magnitude engineering estimate that is expected to be within -30 to +50 percent of the actual project cost.

Appendix C
Response to Agencies Comments on the Final Feasibility Study for Boundary Operable Unit (OU6) – September 2011

Responses to Agency Comments

Volume III: Feasibility Study for the

Boundary Area Operable Unit

Aerojet Superfund Site, Sacramento County, California

EPA Comments

General Comments

Comment 1. **The summary in Section 1 with the corresponding tables and figures is difficult to follow. It is recommended that future FS documents adopt the format used in the BOU RI for summarizing risks, and that the retention rationale be reevaluated to make the document more user-friendly and easier for public review.**

Response: Comment noted. In future FS documents, Aerojet will work with the Agencies to make the document more user-friendly and easier to review.

Comment 2. **Hardcopy vs. pdf: Please clarify the version of this document. The pdf file name indicates it as "Final", however the cover and title pages do not specify the document version, and Section 1 indicates that tables and figures will be renumbered to be consecutive in the Final. If this is the Final, this has not been done.**

Response: This version was considered a "revised Draft." The pdf file contained a typographical error. The next version will be "Final" after receiving the Agencies' approval to these comment responses.

Comment 3. **There are several areas in the FS that have been remediated through excavation, prior to completing this version of the FS. Please provide information on where the final confirmation data that supports the no action decision can be found. In addition, the documentation should include ecological and human health risk estimates from any residual contamination remaining on site and the rationale to support no action with residual contamination remaining on site. Also, these excavated areas should not be included in this FS as "retained" areas. Please update the tables to reflect that the areas have been excavated, and that meet all criteria for no action, are shown as not retained areas. Also, for the excavated areas where contamination remains in place, further explanation is needed to support a retained or not retained decision.**

Response: The documents providing details of these remedial actions are:

- Final Removal Action Report, Perimeter Groundwater Operable Unit (OU-5), Source Areas 10D and 11D Soils Removal (Aerojet. May 7, 2010)
- Buffalo Creek Soil and Vegetation Removal Report (Aerojet. February 3, 2011)

The Final FS will include the documentation for risk areas where excavations have been completed and no additional work is required. The tables and figures will be revised to include a third designation "C" (remediation completed) to identify areas where risk was identified and has already been addressed by recently completed excavation work. Table F-1 has been added to the text and includes post excavation confirmation sample results along with the action levels.

Comment 4. **Please explain why risk clusters for Non-VOC areas are given a remedial area identifier (e.g., AE-R-1) in Figures 1-29 through 1-37, but VOC risk clusters in the same figures are not assigned a remedial area identifier until Figure 1-38. It would appear the VOC risk clusters should be labeled similarly to the Non-VOC areas in Figures 1-29 through 1-37. Please number the not retained areas for VOCs on the lower half of Figures 1-29 through 1-37, and add these areas, along with the rationale for not retaining these areas, to Tables 1-14 through 1-16. Currently, any conclusions regarding the exclusion of these areas from further evaluation in the FS have not been reviewed.**

Response: Remedial area identifiers will be provided for the VOC portion of Figures 1-24 through 1-31 (formerly 1-29 through 1-36). However, the approach will differ from that used to number the non-VOCs risk areas.

As appropriate, a MA or MA subarea VOC risk areas for residential land use will have a retained area identified as having a "Risk Due to the Modeled VOC Migration from Groundwater" (shaded purple areas). The low and high human health risk areas and the low RTG areas that are found within the purple area will not be individually identified as they will be retained as part of the purple area.

The purple areas will be labeled and listed on Tables 1-14 through 1-20 with the rationale for retention of this area. These areas will be addressed by the deed restrictions and do not require additional remedial evaluation. The high RTG areas on the VOC panels will be labeled as retained and accompanying rationale will be listed along with appropriate data in Tables 1-14 through 1-20.

The human health risks and high risk to groundwater outside the purple area will be identified as retained or not retained and accompanying rationale listed with appropriate data in Tables 1-14 through 1-20. The low RTG will not be retained. Also, see RWQCB Specific Comment 8.

Section 1.4.1.1**, Groundwater**, seventh paragraph, will be modified as follows:

Passive volatilization into indoor air and inhalation by residents or workers assumes VOCs in the groundwater volatilize upward and into the indoor breathing space for inhalation by residents or workers. Risk posed by VOC inhalation resulting from the migration of VOCs from groundwater into indoor air for residential use is presented in the figures by showing the lateral extent of TCE in the FWBZ and perched groundwater. The maximum depth to the FWBZ beneath each MA was assumed to be 30 feet for conservatism. The modeled DTSC default concentrations were used ~~as opposed to those values calculated from using site-specific parameters~~. TCE concentrations greater than 11 micrograms per liter (µg/L) in groundwater at depths less than 30 feet bgs could potentially result in indoor air concentrations above acceptable levels for residential use. The TCE 5 µg/L contour was used with an additional 100-foot buffer zone to show the lateral extent of VOCs that pose a risk due to volatilization of chemicals in groundwater into indoor air. This area is depicted on the GRSs figures using purple shading. An exception occurs in the Admin Area where the shading is truncated by the BOU boundary. For commercial use, the risk posed by VOC inhalation resulting from VOC migration from groundwater was evaluated based on the soil vapor data. Use of actual soil vapor data eliminates a significant variable, modeling of groundwater to soil vapor, which provides more accurate risk calculations.

See Response to EPA Specific Comment 3

Comment 5. **The text in Section 1.5.2, Page 1-23, second paragraph, states that each Non-VOC risk contour, risk to groundwater (RTG) contour, and ecological areas were assigned a unique identification number. However, there are multiple areas were the identified areas overlap and contain the same borings, or in some cases, are the exact same areas (e.g., RE-N-17 and RE-R-15). Please provide an explanation in the text on how remedial areas were identified.**

Response: The figures have been revised to provide greater clarification. The human health risk areas remain light brown for low risk and dark brown for high risk. Where the human health risk areas merged into adjacent areas, a thin space was inserted to separate the areas. The RTG areas were revised, using a thick blue contour for high RTG and a thin blue contour for low RTG. The ecological risk areas remain the green hatched areas.

Each of these HH, RTG and ecological areas are identified on the non-VOC portion of the GRS figures. The labeling for the VOC portion is described in the Response to EPA General Comment 4. The risk area designations were assigned on the residential land use panel of the figure and the same area designation was used on the commercial land use panel, where appropriate. The revision had increased the number of RAs and the number of the corresponding tables. The RA numbers will change for many of the areas due to this revision. We note in the RTCs the old and new numbers, where needed for comparison to the revised attached figures and tables.

Section 1.4.1.2, last paragraph, the text will be revised as follows:

The GRS identifies areas of ecological concerns that were recommended for SMDPs and are plotted as green-hatched areas. The green hatched areas are plotted on ~~all~~ the non-VOC figures for residential and commercial scenarios. The SLERA did not evaluate the ecological risk for facility samples. The facility samples were reviewed as part of the FS for ecological impacts and are presented in Section 1.6. ~~Note that the green-hatched areas do not distinguish between non-VOCs or VOC risks.~~

Section 1.5.2, second paragraph, the text will be revised as follows:

Each non-VOC HH, RTG or ecological risk ~~contour or overlapping group of risk contours or green-hatched~~ area was assigned a unique identification number (Figures 1-24 through 1-31). The identification numbers indicate the MAs, R for retained or N for not retained and sequential numbering of either retained or not retained areas. For example L2-R-3 would be Line 2, retained, third area. For areas where recent excavation work addressed the identified risk, a C (remediation completed) was used to denote the area as opposed to an R (retained).

Comment 6. **There are several issues associated with Tables 1-3 through 1-10. Examples are given to help clarify the comment for each issue, but the comment's intent is not limited to that specific example. In general, the issues described below pertain to all the tables.**

Response: An Appendix was added to the document that explains how the risk tables were construction in greater detail to provide additional clarification.

a). It is unclear why certain borings are included in multiple remedial areas, especially when they are being evaluated for the same risk. For example, AE-R-2 contains borings 03D-SB05, 03D-SB06, and 03D-SB33, which is listed as risk addressed HH. The area AE-R-3 is also listed as HH, but it contains the same borings as AE-R-2. In addition, AE-R-4 only contains boring 03D-SB33, but this boring has already been included in the evaluations for areas AE-R-2 and AE-R-3. Please

explain the rationale for using borings in multiple remedial areas when they are evaluated for the same risk type (HH, RTG, or ecological risks).

Response: Please see Responses to EPA General Comments 4 and 5. In addition, the tables were revised to list only data related to one risk type, HH, RTG, or ecological risk on a single row. The approach to listing the borings associated with the risk areas will be provided in a new Appendix to the document.

b). The human health risks or RTGs for each area are not presented in a consistent manner. For example, area AE-R-2 and AE-R-3 are both addressed for HH (based on the header of the second column "Risk Addressed".) Both areas contain sample locations 03D-SB005, 03D-SB06, and 03D-SB33. However, the RTG for AE-R-2 is listed as "NA", while the RTG for AE-R-3 is 5. Also, areas AE-N-4 and AE-N-5 are evaluated for RTG, but AE-N-4 presents risks numbers, while AE-N-5 lists "NA" for human health risks. AE-N-4 only contains soil boring 03D-SB43, which presents the risk, and AE-N-5 includes the same boring (along with several others), but does not present the HH risks. Please review the tables make them consistent in regards to how information is presented. To make the tables more user friendly, it is recommended that "NA" not be used, and every column is filled with the applicable data.

Response: Please see Responses to EPA General Comments 4 and 5. In addition, the "NA" will be removed and replaced with "-". An additional column has also been added to identify remedial areas that are colocated with the listed entry and is noted as "Colocated Remedial Area."

c). These tables are difficult to follow and can be misleading to the reader. For example, 03D-SB068 is included in retained area AE-R-6 for risks to human health, but it is also included in not retained area AE-N-6 due to low risks to groundwater. Using this logic, it seems like each boring or area should be repeated three times on the tables, for HH, RTG, and ecological evaluations. However, this was not done consistently and it makes it difficult to determine if each area was appropriately evaluated for each risk (HH, RTG, and Ecological), especially since sometimes all the results are shown, and sometime they are not (refer to comment 6b above). Please revise the tables to present a remedial area, whether retained or not retained, and discuss all three risk types (HH, RTG, and ecological) for that single area.

Response: See Responses to EPA General Comments 4, 5, 6a and b. The GRS figures summarize the type of risk identified in the HHERA (Volume II of the RI). Where a risk type was not identified, there is not a need to discuss the sample

results and rationale for not retaining an area that was not identified on the figures.

Specific Comments

Comment 1. **Section 1. It would be very helpful to have a section that describes what is presented in the Tables and Figures either as part of Section 1.4.1 or preceding it. The Section 1 tables and figures are used to together to define risk; graphically present that risk, and show what areas are being retained for further evaluation. Items that should be included here are scattered throughout Sections 1.4.1, 1.5.1, and 1.5.2. Consolidating the following would make this section much easier to follow:**

Information presented in Sections 1.4.1, 1.5.1, and 1.5.2 cannot be readily combined as suggested. Section 1.4.1 summarizes the GRS figures construction approach. It provides the background information from the HHERA on how the risk contours were drawn and provides the criteria for the assignment of HH and RTG high and low risk contours, and ecological areas of concern. The GRS figures present the conclusions of the HHERA, which are brought forward as the starting point for the FS.

Sections 1.5.1, 1.5.2, and 1.5.3 describe the criteria used to select the risk areas for further evaluation in the FS, retained (R), not retained (N) or remediation completed (C). As there are some differences in criteria with each media, the three sections are organized by single media, soil, soil vapor and groundwater.

Section 1.4.1 was revised to address changes to the GRS figures as follows:

This section summarizes ~~describes~~ the process <u>used in the HHERA</u> to complete the GRS figures ~~and the approach taken in this FS to recommend the risk areas that are carried through the FS process.~~

Figures 1-24 through 1-31 present the GRSs of the human health (HH), ecological, and groundwater risks by MA/OS Areas. The figures contain colored ~~in~~ contours or hatched areas, ~~which were layered in such a way as to attempt to expose all~~ to indicate risk types present in ~~one~~ a location. <u>The risk areas are color coded to identify the type of risk, HH (brown), RTG (blue) and ecological (green).</u>

<u>Table 1-2 defines the data presented in each frame in the</u> GRS. The GRS figures include the combinations of risk associated with the upper 12 feet of soil for HH~~RA~~ and the upper 6 feet of soil for <u>ecological</u> ~~the SLERA~~. Soil results from all depths were evaluated for the RTG. However, the RTG contours for non-VOC were plotted only for risks identified in the upper 12 feet. Non-VOC RTG detections found only below 12 feet bgs are listed in Section 8.0 of the HHERA. Four such locations were present in BOU. Three

of the sampling locations (51D-SB05, 51D-SB08, and 51D-SB09) were in Admin East and the fourth (52D-SB18) was located in Admin West. ~~Table 1-2 defines the data presented in each frame in the GRS.~~

Section 1.4.1.1, **Soil and Soil Vapor,** first paragraph, will be edited as follows for further clarification:

As part of the BOU HHRA, media specific ILCRs and HIs for soil and soil vapor were calculated on a point-by-point basis and are presented in Section 5.0 of the HHERA. These HHRA calculated ~~M~~media-specific ILCRs and HIs were ~~calculated for~~ used in this FS to better understand the relative level of risk posed by chemicals in soil and soil vapor. This approach focused the FS on evaluating technologies and processes capable of remediating chemicals in those media.

a). Table description would include information on what is in the tables, how the tables are set up, acronyms used, and how the table correlates to the figure.

Response: A detailed description of the summary risk tables and how they relate to the GRS figures has been added as an Appendix. Table 1-12 defines all the acronyms used on the tables. Additionally, the text has been revised as follows:

Section 1.5.1, seventh paragraph to end of bullets text will be edited as follows:

~~Table 1-14 through 1-16 list data associated with targeted retained soil vapor remedial areas~~. Each of the VOC HH or high RTG contours ~~risk area~~ is assigned a unique identification numbers (Figure 1~~-381~~-24 through 1-31). The identification numbers indicate MA, soil vapor identifier "SV", and "R" for retained or "N" for not-retained and sequential numbering of either the retained or not-retained areas (e.g. CP2-SV-R-1 for Chemical Plant 2 first retained remedial area).

To assist in the review, Tables 1-14 through 1-20 were compiled with data associated with each of the identified remedial area on Figures 1-24 through 1-31. Table 1-14 through 1-20 provide a summary of risk data for the VOC compounds and other tabulated information, which include the following:

- *Remedial area number*
- *Colocated remedial areas*
- *Risk addressed*
- *Sample locations*
- *COCs posing high HH risk or high RTG*

- *Maximum ILCR*
- *Maximum HI*
- *Maximum RTG Ranking*
- *Maximum concentrations*
- *Depth of maximum concentration*
- *Depths of samples with high HH or high RTG*
- *Depth to groundwater*
- *Degree of isolation*
- *Anticipated future use*
- *Site access issues*
- *Rationale for recommending site to be retained/not retained for remedial action*
- *Retained, or not retained*

The table's rationale column also presents additional information on the COCs, local groundwater impacts and potential alternatives to be evaluated. Figure 1-32~~9~~ indicates the areas that are retained for further evaluation.

Section 1.5, last paragraph the following text will be inserted:

Table 1-12 is an acronym list for these tables. Table 1-13 provides references to the data sources (i.e., figures and tables) in the RI and HHERA. These references are provided for additional site-specific information.

Section 1.5.2, third paragraph to end of bullets text will be edited as follows:

To assist in the review, Tables 1-4 through 1-11 were compiled with data associated with each of the identified soil remedial area on Figures 1-24 through 1-31. ~~Table 1-112 is an acronym list for these tables. Table 1-123 provides references to the data sources (i.e., figures and tables) in the RI and HHERA. These references are provided for additional site specific information.~~ Tables 1-4 through 1-11 provide a summary of risk data for the non-VOC compounds and other tabulated information, which include the following:

- *Remedial area number*
- *Colocated remedial area number(s)*
- *Risk addressed ~~by the remedial area~~*
- *Sample locations ~~within the area~~*
- *COCs exceeding HH risk levels*
- *Maximum ILCR*
- *Maximum HI*

- *COPECs exceeding SLERA risk levels*
- *Maximum HQ*
- *COCs w/ potential RTG*
- *Maximum RTG score*
- *Depth to groundwater*
- *Degree of isolation*
- *Anticipated future use*
- *Site access issues*
- *Rationale for recommending site to be retained/not retained for remedial action*
- *Retained, not retained or remediation completed*

~~For each area, an additional~~ The table column ~~provides the"~~ "rationale for ~~the retained or not retained~~ recommending ~~ation~~ site to be retained/not retained for remedial action" provides additional information ~~of the remedial area~~ for further evaluation. The following criteria were used in selecting whether to recommend that the area be retained:

- *(Bullets skipped)*

The retained areas for non-VOCs are carried forward through the FS for remedial alternatives evaluation and are identified in the last column ~~in~~of Tables 1-4 through 1-11. Figure 1-32~~9~~ indicates the areas that are retained for further evaluation.

b). Figure description would include the criteria used to define "high" vs. "low" risk (summarized on Table 1-2), how "Remedial Areas" were defined, and how areas of "Potential Ecological Concern" were determined.

Response: See Response to EPA Specific Comment 1. Table 1-2 and Section 1.4.1 summarize the approach the HHERA used to create the GRS figures, which were approved by the Agencies. This section provides information on how the high versus low risk areas were drawn and the how the potential ecological concerns were determined. For greater detail, the reviewer is directed to the HHERA, Volume II of the RI/FS.

Comment 2. Section 1.4.1.2.

a). Please explain why ecological risks were not contoured similar to HH risk and RTG.

Response: The ecological risk "green-hatched areas" were reproduced directly from the graphical risk summary figures in Section 9.0 of the HHERA. The description of the methods used in determining ecological risk was included in Section 7.0 of the HHERA. Ecological risks were not contoured (as human health risks were) because there are not equivalent high risks (cancer risk >1E-4) and low risks (cancer risk >1E-6) for ecological receptors (cancer risk is not an endpoint of concern for ecological receptors). The SLERA identified "green hatched areas" as areas of ecological concern because there was a preponderance of sample results greater than 10 times the ESL, while also taking into consideration other lines of evidence (see Response to EPA Specific Comment 2b below.

b). Please explain how the "green hatched" areas of "potential ecological concern" were determined. There appear to be many instances where locations with risks >10x the ecological screening levels (ESLs) are not included in these areas.

Response: See Response to EPA Specific Comment 2a. Additionally, ecological risk is based on many factors and just because an isolated location exceeds 10 times the ESL does not necessarily mean that a remedy is warranted or the isolated sample(s) is an area of ecological concern. As stated in Section 1.4.1.2:

"The SLERA for the MAs within the BOU integrated the results of the calculated risk posed by COPECs in soil vapor, soil, sediment, and surface water with other critical factors including present and future land use; location, size, and quality of habitat; presence or absence of special status species (e.g., threatened or endangered species); magnitude and spatial distribution of COPEC concentrations; and potential for ecological recovery."

Additionally, Aerojet identified all locations in the Non-Facility Area that had a hazard quotient greater than 10 and evaluated each location to determine if remedial action was warranted. Figure 1-33, which shows all Non-Facility Area sample locations where the hazard quotient was greater than 10, was added to Section 1.0 and an analysis of each of these areas was added as Appendix D.

In discussions with the Agencies regarding the response to this comment, the Agencies specifically identified the presence of toluene in soil vapor at location DSA-SP19 as a location that required further analysis for burrowing raptors. The following analysis was provided to the Agencies and accepted:

Aerojet reviewed the Biological Resource Assessment (Final Remedial Investigation/Feasibility Study Field Sampling Plan for Boundary Operable Unit, Aerojet Superfund Site, Appendix B, July 31, 2006) for the BOU and found that the Burrowing Owl has not been observed on the Aerojet property;

however it has been observed in close enough proximity that the Aerojet property is within its feeding area.

Additionally, Aerojet calculated an EPC based upon an average home range of 595 acres (Table 6-1 of the draft BERA work plan). Since Line 2 is only about 1/10th of this home range, all Line 2 recent RI soil vapor toluene data (except for the samples within the area that is going to be remediated for VOCs [28E-SP01 and 28E-SP16]) were used to calculate the EPC. The shallowest soil vapor data was used for each location where there were multiple depths, since it is not likely that VOCs would concentrate as long as land is still open space (habitat for burrowing owl). For the 59 remaining toluene sample locations, the detection frequency was 86 percent and the 95 percent UCL EPC was 124 $\mu g/m^3$ (using ProUCL software). The mean of the detected toluene values was 53 $\mu g/m^3$.

Using the Edwards Air Force Base ESL of 84 µg/m3, the HQ = 1.52. Using the Montgomery Watson (2011) TRV-low and TRV high ESLs of 170 and 420 µg/m3, the revised owl HQs would be 0.7 to 0.3, respectively.

Therefore, the likelihood of a burrowing owl establishing a home in the Line 2 area in the 5 acre area delineated by the detections of toluene above the Edwards Air Force Base ESL is low. If a burrowing owl did establish a home in this area, the HQ (using Edwards Air Force Base ESL) based on an EPC = 124 $\mu g/m^3$ is 1.5; therefore, remedial action for this receptor is not necessary.

c). It would be helpful if the green hatched areas of "Potential Ecological Concern" were given their own Remedial Area number with a notation that samples may be included in other Remedial Areas. This would allow for easier tracking of the areas throughout the FS process. This appears to have been done for the Administration Area West (AW-R-10) and Dredge Pit and Eastern Basin (DPEB-R-1). Please apply to the rest of the Management Areas.

Response: The green hatched areas were each given their own RA number. Updated tables will identify the remedial areas that are for ecological risk only.

d). The bulleted list indicates that if ecological risks were greater than 10x the ESLs, and greater than 2x background for inorganics, the area was retained for active remediation. There are several instances where the SLERA indicated a given media would be retained for SMPD for further action and where sample locations have chemicals of potential ecological concern (COPECs) that exceed ESLs by >10x, but the locations are not included in the area of "Potential Ecological Concern" or the Remedial Area was not retained for further action

(noted in MA-specific comments below). If additional criteria were used to remove areas from remediation based on ecological risks, they need to be stated here and in the tables for each Management Area.

Response: See Response for EPA Specific Comment 2b. Section 1.4.1.2, third paragraph, last sentence will be revised to:

Areas subject <u>to consideration</u> for active remediation were identified based on the following criteria:

The following bullet will be added to the list of bullets after the third paragraph:

- *Critical factors that were evaluated to determine if remedial action was necessary for areas where the chemical concentration exceeded an HQ>10, included present and future land use; location, size, and quality of habitat; presence or absence of special status species (e.g., threatened or endangered species); magnitude and spatial distribution of COPEC concentrations; and potential for ecological recovery.*

Additionally, the following will be inserted prior to the last paragraph of Section 1.4.1.2:

Each location outside facility areas, where a sample contained a chemical that exceeded the ESL by >10 times was evaluated. This detailed evaluation is presented in Appendix D, Table D5 and Table D-6.

Comment 3. **Section 1.5.1, Page 1-22-23. The bulleted list showing the approach used to identify areas for further evaluation does not contain the risk to human health from VOCs in soil vapor. a) Please add the risks to human health as a criterion that was used to determine further evaluation for VOCs and b) a corresponding discussion (as was done for soil vapor for ecological risk and RTG). c) The final paragraph on Page 1-23 should include reference to Figure 1-38 as well as Figure 1-39.**

Response: a) Section 1.5.1, bullets: The following bullets will be added:

- *<u>Based on modeled VOC migration from groundwater, areas with impacted groundwater concentrations that could pose a potential indoor or outdoor air risk to residential use were retained along with the low and high HH and low RTG contained within those areas (purple areas) as one remedial area.</u>*

- *<u>Anywhere soil vapor VOC concentrations pose a HH risk and were outside the purple area with risk due to the modeled VOC migration from groundwater, the areas are retained.</u>*

b) Section 1.5.1, sixth paragraph: The following text was inserted:

For HH, if the HH risk was at the low end of the risk range (i.e., $<1\times10^{-5}$) and the data point was isolated, the area was not recommended for retention.

c) See EPA Response to Specific Comment 1a.

Comment 4. **Section 1.5.2, second set of bullets defining rationale. Bullet 1 uses "just" above 1E-6; please define "just" in a quantitative manner.**

Response: Section 1.5.2, first bullet of second set will be revised as follows:

- *If the HH risk was ~~just above 1E-6~~ at the low end of the risk range (i.e., less than 1×10^{-5}), HI<1 and had a low RTG, the area was not recommended for retention.*

Comment 5. **Section 1.6 and Appendix D. Chemical Plant 2 Area. The discussion does not address samples with exceedances >10x the ESLs for Aroclors (shown on Appendix D, Figure 31). Please expand the discussion to include Aroclors and whether any of the locations will be addressed as part of remedial actions for human health. If none of the locations will be remediated, land use controls for current exposures may be warranted.**

Response: See Response for EPA Specific Comment 2b. Additionally, see the discussion presented in Section 1.6 regarding the evaluation of COPECs in Samples collected from BOU Facility Areas.

Comment 6. **Section 1. Wrap up. It would be very helpful to include a subsection at the end of Section 1 that summarizes each MA; how many remedial areas were recommended for further evaluation, how many were dropped, and which ones have already been remediated. Existing text has limited discussion and one is left with trying to work through the tables and figures to figure out what is moving forward, what has been excavated, and what is being dropped.**

Response: The tables are organized by the RA numbers and additionally the column on the farthest right are organized by the three designations R, N, or C. These designations are grouped together for each MA and easily identify the areas that are retained (R) for further evaluation.

Comment 7. **Section 2.3.1, Page 2-4 and Figures 2-2 and 2-4. There is a reference to the Operational Control Response Action for Groundwater that gives "modifications to existing building ventilation systems" as its example. This is cut and pasted from the Soil and Soil Vapor Response Action summary, where it belongs. It seems inappropriate to simply repeat this example for Groundwater; it would be more appropriate to use an**

example that pertains to groundwater. In the Groundwater summary there is already a separate entry for Wellhead Treatment. Therefore, a more suitable Response Action example would be to address wellfield management (controlling pumping in irrigation or supply wells that can influence plume migration).

Response: The following text has been incorporated into Figure 2-2: "*Controlling pumping of existing irrigation, water supply, and/or groundwater remediation extraction wells to influence plume migration.*"

The following text has been incorporated into Figure 2-4: *"Use of existing irrigation and/or water supply wells could be effective in influencing plume migration. However, COPCs could be drawn into the wells. Operation of irrigation and water supply wells for their intended purpose may not be compatible with controlling plume migrations."*

Comment 8. **Section 6.2.1.2, Page 6-6. Please add TPH to the list of constituents that pose a potential RTG. Currently, only metals, SVOCs, and PCBs are listed.**

Response: Section 6.2.1.3, first paragraph: The text will be revised as follows:

Figure 6-3 identifies nine retained remedial areas for non-VOCs in Admin Area East that have non-VOC concentrations in soil that pose a potential HH risk (AE-R-2 through AE-R-6, and AE-R-8 through AE-R-9), or RTG (AE-R-1 and AE-R-7) from metals, SVOCs, TPH, and/or PCBs.

Comment 9. **Sections 6.2.1.4, 6.2.1.5, and 6.2.4.1, Administration Area Remedial Options. Remedial options that include excavation of the ditch, land use controls in facility areas, and 5-year reviews (as noted in Options 1 and 4) are acceptable for protection of ecological receptors. Please include any changes to retained Remedial Areas made in response to Comments 17 and 18 into Figures 6-3 and 6-4 and the final selected remedial option.**

Response: Comment noted.

Comment 10. **Section 6.3.1.5, WLLO Area Remedial Options. Remedial options for protection of ecological receptors are only described under Remedial Option 1 which entails excavation of ditches. This option is acceptable**

Response: Comment noted

Comment 11. **Sections 6.5.1.3 and 6.5.4.1, Chemical Plant 2 Remedial Options.**

a). Please explain why remedial options for the Dredge Pits and Eastern Basin are discussed with Chemical Plant 2. These two MAs do not border each other.

Response: These two MAs were grouped together in the RI; therefore, this grouping was carried forward into the FS.

b). Remedial Option 1 for Chemical Plant 2 for protection of ecological receptors entails excavation of soils from retained Remedial Areas. This option is acceptable for ecological purpose so long as changes made to Remedial Areas in response to Comment 19 are included in the final selected remedy and shown on Figure 6-12.

Response: Comment noted.

Comment 12. Figures 1-29 through 1-36. The risk to groundwater appears to be represented twice. Based on the text in Section 1.4.1.1, top of page 1-16, "…risks are illustrated in the figures by filled, colored-coded contours for soil and soil vapor having chemicals at concentrations that result in low risk (light brown) for an ILCR greater than 1 x 10-6 or high risk (dark brown) for an ILCR greater than 1 x 10-4 or lead that results in blood lead above 10 mg/dL." However, the legend on the figures shows that the dark brown area can also represent high risks to groundwater. It is unclear why the filled, colored areas, which were generated using a kriging program to represent human health risk, are also representing high risks to groundwater. For example, for the retained area AE-R-1, the ILCR risk is low (2 x 10-7), but the area is dark brown and has a black solid line around it to represent risk to groundwater. Based on the information presented, AE-R-1 should have a black line around it; it is not clear why it is dark brown. Please provide an explanation in the text that clearly describes what is represented on the figures and how the figures and tables relate to each other. In addition, please define in the legend on the figures what the "Risk to Groundwater" line represents. It would be helpful if it matched the areas considered to have a high RTG. For example, AE-N-10 has a low risk to HH and a low RTG (rank of 4, based on Table 1-3), but it has a black line around it, indicating it is considered a risk to groundwater. Also, AE-N-9 is shown on the figure in dark brown, indicating a high risk to human health. However, based on Table 1-3, the HH is less than 1x10-6. Please provide a more detailed explanation in the text that explains how the text, tables, and figures relate to one another. Also, please clarify the "risk to groundwater" line on the figures compared to the colored areas that represent HH risks.

Response: See Responses to EPA General Comments 4, 5, 6b.

Comment 13. **Figures 1-29 through 1-34.**

a). Each figure should contain a Note that defines areas of "Potential Ecological Concern"

Response: Potential Ecological Concerns will be noted with a number and the note will state:

Areas with potential ecological risk that were identified in the SLERA.

b). Note 2 should include point of departure for noncancer risk, lead risk, and groundwater risk

Response: A non-cancer HI<1 or blood lead level <10 µg/dL would not be plotted on the figures, as they are below regulatory risk levels. Figures will be revised as describe in EPA General Comment 6a. Notes 1 and 2 will be revised as follows:

1) 10^{-4} cancer risk, HI > 1 non cancer risk, and blood lead level > 10 µg/dL.

2) 10^{-6} cancer risk.

c). Note 6 regarding Line Area 02 should only appear on figures for Line Area 02

Response: Note 6 will be removed from all figures except Figure 1-26.

d). Given the large number of MAs and Remedial Areas, it would be very helpful to indicate on the figures the areas that have already been remediated

Response: See Response to EPA General Comment 5.

Comment 14. **Figure 2-1. There is an Engineering Controls – Building Ventilation Technology Description reference to the Johnson & Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings. The most recent J&E Model that EPA uses is the 2004 version. There is also a substantial body of guidance on vapor intrusion at both the California (DTSC) and US Federal level, existing and soon to be updated. This suggests the FS reference to the early J&E Model alone may not be up to date, or able to fully address applicable conditions.**

Response: The "Technology Description" text on both Figures 2-1 and 2-2 for the "Building Ventilation" process option will be revised to indicate that the latest modified EPA version of the J&E model would be used.

Comment 15. **Table 1-3. It is unclear why RE-R-15 is retained, has a ILCR greater than 1x10-6, and has 1,1,2,2-PCA identified as a COC, but RE-N-17 is not retained, that is has an ILCR greater than 1x10-6 and 1,1,2,2-PCA identified as a COC. Both areas are in the exact same location. Both areas on Table 1-3 are evaluated for risks to human health, based on the header in the first column, but it is not clear why the samples from the same location were evaluated separately. Please combine RE-N-17 into RE-R-15 and keep the area as retained.**

Response: Due to renumbering remediation complete (C) areas RA, AE-R-15 will be renumbered as AE-R-3 in the final FS (see Response to EPA General Comment 5). AE-R-3 was retained due to a high risk (2E-3) for resident and commercial worker (7E-4) based on data for PAHs from boring 03D-AH01. AE-N-17 however, only slightly exceeded $1x10^{-6}$ (3E-6) and was based on the low risk data for 1,1,2,2-PCA from borings 03D-SB01 and nearby boring 03D-AH01. Because the kriged areas are not the same size, the area of low risk was not retained, but the smaller area of high risk was retained.

Comment 16. **Table 1-3. There is a lot of uncertainty associated with the nature and extent of contamination at AE-N-10. While the human health risk is within the risk range based on the contamination from this single boring, there are no samples within 100 feet of 03D-SB22. The maximum concentration beneath the building has likely not been identified (there is no supporting information to indicate the maximum concentration has been identified), and therefore, the nature and extent has not been determined. It is recommended that this area be retained due to these uncertainties.**

Response: As described in the sample design for the Final BOU RIFS Work Plan (Aerojet, 2006), this boring was collected inside the building near the former 5 axis mill sump in the east central portion of Building 20002. The sample was a judgmental sampling location collected in an attempt to sample the highest concentrations in the area. There is no reason to suspect that higher concentrations would be found farther away from the sump. Therefore, we continue to recommend that the RA remain as "not retained."

Comment 17. **Table 1-3, Figure 1-29, and Figure 6-3, Administration Area East.**

a). Table 1-3. AE-N-12. The rationale indicates that this remedial area was "not retained". Samples 11D-SNS16, 11D-SNS17, and 11D-SNS22 are all located in the drainage ditch which is labeled as an area of "Potential Ecological Concern" and had HQs>10x the ESLs for Aroclors. Please review and correct or clarify the rationale.

Response: Location AE-N-12 now AE-C-2 was not retained for RTG only. These boring locations were excavated along with portions of AE-C-5, which will be renamed AE-C-2 in the Final FS. Also, see Responses to EPA General Comments 3, 4, and 5.

b). AE-N-13 (now AE-C-5). **Same question as for AE-N-12.**

Response: See Response to EPA Specific Comment 17a above.

c). AE-N-14 and AE-N-15. Samples for these areas are borings, but appear to be within the ditch and have a 1 foot bgs sampling interval. Why were these samples not evaluated for ecological risk? If the evaluation was not conducted because area was excavated, please indicate this in Table 1-3 and on Figure 1-29.

Response: AE-N-14 (RTG) and AE-N-15 now AE-R-8 (HH) are not encompassed by AE-R-13 now AE-C-5 (ecological) as previously depicted. However, after further review of the area, the open drainage ditch identified as AE-C-5 does not continue toward the west. It is a subsurface culvert. The figure has been updated as follows:

- Green-hatching was removed from the subsurface culvert area.
- AE-R-13 was renamed AE-C-5
- AE-N-15 was renamed AE-R-8 and is now retained.
- AE-R-11 was renamed AE-N-15 and is no longer retained.

Rationale for these changes to be "retained" and "not-retained" are included in Table 1-4.

Comment 18. Table 1-4, Figure 1-30, and Figure 6-4, Administration Area West.

a). AW-N-6, AW-N-7, AW-N-10, and AW-N-13. Each of these areas are coded as "not retained" , however, they are located in the drainage ditch and the rationale column indicates that ecological COPECs will be addressed with AW-R-14. There is no AW-R-14 on table or figure. Please review and correct or clarify rationale. It would also be helpful to add a letter in the rationale column that indicates that the area is being remediated with another area and is discussed with that area.

Response: The table has been corrected. All references to AW-R-14 have been changed to AW-R-10, which is the RA where the ecological concerns are addressed.

b). Figure 1-30. Remedial Area AW-R-10 for the "Commercial Land Use for Non-VOCs" is labeled as AR-R-10. Please correct the figure.

Response: The figure has been corrected and will be included in the final document.

Comment 19. Table 1-9, Figure 1-35, and Figure 6-11, Chemical Plant 2.

a). CP2-R-2. This area lies underneath the area marked as "Potential Ecological Concern" in Figure 1-35 and has several COPECs >10x ESLs. Rationale column indicates "this area was not selected for further action in the SLERA." The SLERA indicates that soils were retained under SMDP to determine if further action was necessary. Please revise or clarify.

Response: Remedial areas were drawn based upon risk contours. Sample location 59F-SB28 was evaluated for both human health and ecological risks. This location poses a risk to both human health and ecological receptors. The ecological risk contour (CP2-R-3) extended from this location farther to the east than the human health risk contour (CP2-R-2), so different contours (risk areas) were drawn. Since CP2-R-2 is smaller than CP2-R-3, it is encompassed by CP2-R-3, the area marked as "Potential Ecological Concern". Table 1-10 CP2-R-2, rationale will be revised as follows:

A-1254 exceeded the ~~residential (3E-5) and commercial worker (9E-6) ILCR and~~ residential child (2.5E+0) HI in the 1-foot sample at sampling location 59F-SB28. ~~BEHP, Dieldrin, Endrin aldehyde, A-1254, Cr, Cu, Ni, and Zn were retained as COPECs in the 1-foot bgs sample at 59F-SB28. Cd, Ni, Hg, and Tl were retained in the 0.5- and 2.5-foot samples at sampling location 59F-SNS02. This area was not selected for further action in the SLERA. A-1254 (2,800 µg/kg) and Dieldrin (5.4 µg/kg) were detected in the 1-foot bgs sample at sampling location 59F-SB28 above their PGW SLs (34 µg/kg and 4.2 µg/kg, respectively) and were ranked as moderate RTG.~~ At a minimum, the area will be capped or excavated to 2 feet bgs and the vertical extent will be assessed during excavation. If capping selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping. Confirmation of remedy for HH will be tracked under CP2-R-3.

b). CP2-R-3. Rationale indicates that this area was selected for further action in the SLERA. Please expand the area of "Potential Ecological Concern" as shown in Figure 1-35, Figure 1-39, and Figure 6-10 to include this Remedial Area.

Response: Figures will be modified to ensure risk area identifier clearly points to risk area. On Figure 1-30, CP2-R-3, the entire green-hatched area, as well as the other non-VOC and VOC retained areas are correctly depicted. CP2-R-3 is not shown on Figure 6-10 because the figure only shows retained remedial areas for VOCs and the CP2-R-3 COCs are non-VOCs. It is correctly shown on Figure 6-11.

c). CP2-R-4 and CP2-R-5. Rationale indicates the area was not retained in the SLERA however Aroclor concentrations are >10x the ESLs. Please revise or explain.

Response: See response for EPA Specific Comment 2a and b.

d). CP2-R-6. Rationale indicates that this area will be handled with CP2-R-5. See preceding comment on area CP2-R-5.

Response: This was a typographical error; however, based on the revised RA numbering format described in EPA General Comment 6a, the rationale will be revised as follows:

A-1254 exceeded the resident (2E-5) and commercial worker (5E-6) ILCR in the 1-foot bgs sample at sampling location 59F-SB26~~. Ecological COPECs are addressed in Remedial Area CP2-R-5 CP2-R-3 above. A-1254 and the listed PAHs were ranked as moderate RTGs.~~ No deeper samples were collected at this location. At a minimum, the area will be capped or excavated to 2 feet bgs and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1254 impact will be determined prior to capping. Confirmation of remedy for HH will be tracked under CP2-R-3.

e). CP2-N-1, CP2-N-6, CP2-N-12, CP-N-14, CP2-N-22, and CP2-N-23. Rationale for each of these Remedial Areas indicate that they were not retained in the SLERA, however each has COPECs with HQs>10x the ESL. Please review and clarify or correct.

Response: See Response for EPA Specific Comment 2a and b.

f). CP2-N-2, CP2-N-3. Remedial areas are listed as RTG only, however each have sample locations that were evaluated in the SLERA and had HQs>10x the ESLs. Please review and clarify or correct.

Response: See Response for EPA Specific Comment 2a and b.

g). CP2-N-21. Rationale indicates ecological risks will be addressed with CP2-R-2. Remedial Area CP2-N-21 overlaps CP2-R-1 not CP2-R-2. Please verify and correct or add explanation.

Response: CP2-N-21 has now been re-numbered as CP2-R-10. Based on the revised RA numbering strategy described in EPA General Comment 6a, descriptions of this boring are now included in four locations as follows: CP2-R-1 (ecological risk) CP2-R-10 (high HH risk), CP2-N-21 (RTG) and CP2-N-22 (low HH risk). The rationale for CP2-N-21 will be revised to read:

A-1248 exceeded the HI for RC (1.4E+1) and the ILCR for resident (2.3E-4) risk level in the 0.25-foot bgs sample, but not in the 1.5- or 5-foot bgs samples. This area will be capped or excavated to 2 feet bgs in Remedial Area CP2-R-1 for ecological risk. The HH risk will be capped or excavated to 1.25 feet bgs and implemented as part of the CP2-R-1 remedy. If excavation is selected as the remedial option, the lateral and vertical extent of contamination will be assessed during excavation for CP2-R-1. Because the sample was collected within a drainage feature, the kriged extent shown on Figure 6-11 will not necessarily be excavated. The additional kriged area was not included in the excavation volume estimate.

Comment 20. **Table 1-10, Figure 1-36, and Figure 6-13, Dredge Pit and Eastern Basin. Green hatched area of "Potential Ecological Concern" should include locations 25F-SB14 and 25F-SPB01. Both have COPECs with HQs>10x the ESLs.**

Response: Table 1-11, Figure 1-31 and Figure 6-12 have been updated to include locations 25F-SB14 and 25F-SPB01 within the green hatched area.

Comment 21. **Tables 1-3, 1-4, and 1-10. The anticipated or likely future use of an area should not be used to support a "not retained" decision, as future use could change and if residual contamination exceeds unrestricted use, then a remedy is required to be in place to prevent inappropriate future use of the site. Please delete the statement that the likelihood for residential re-use is low from the rationale for areas AE-N-10, AW-N-11, AW-N-17, AW-N-18, DPEB-N-2, and DPEB-N-3. Also, please delete the statement that the anticipated future use of area AE-N-16 is commercial.**

Response: As Aerojet plans to continue doing business at this location into the future, we believe that these statements are appropriate and should remain. Institutional Controls will be in place to prevent inappropriate use in the future including deed restrictions.

Aerojet will prepare figures identifying areas with deed restrictions or other institutional controls. Aerojet's Site Remediation Group reviews and approves all authorization requests for soil excavation or building demolitions. The review of these figures will be included in existing and future authorizations requests.

Comment 22. **Table 1-7, Buffalo Creek and West Lakes. The rationale column for BC-R-2 does not include the planned remedial action. Please add it to the table.**

Response: The remedial action information was inadvertently truncated. The missing text reads: "*The area will be excavated to a depth of 2 feet bgs, 1 foot below the*

deepest sample exceeding ecological risk levels. The lateral and vertical extent of COPECs will be assessed during excavation."

Comment 23. **Tables 1-2 to 1-16.**

a). Please review row heights in printed form. Text in some rows is cut off (e.g., Table 1-3, AE-R-3 and Table 1-7, BC-R-2 and WL-R-2).

Response: The tables in the final document will be reviewed to make sure that the text rows are not truncated.

b). It would be very helpful to add additional coding in the "Retained/Not Retained" field that indicates if the Remedial Area has already been remediated or if the area is being remediated as part of another area.

Response: See Response to EPA General Comment 3.

c). The phrase "this area was (was not) selected for further action in the SLERA" is used in the Rationale field for each Remedial Area within a MA. This is misleading as it implies that each Remedial Area was evaluated as unique entity in the Screening Level Ecological Risk Assessment (SLERA; ERM 2011) and a decision to retain or not was made on the Remedial Area level. Please add a qualifying statement in Section 1.4 or 1.5.

Response: The phrase has been removed from the tables.

d). There are numerous instances where a Remedial Area was not retained for further action for ecological receptors, however one or several of the sample locations within that Remedial Area have COPECs with HQs>10x the ESL. Please review and correct or clarify rationale.

Response: See Response for EPA Specific Comment 2b.

Comment 24. **a) Table 1-4. It is unclear why area AW-N-11 was not retained. The human health risk is greater than 1x10-4 and the HI is greater than 1 in two samples from the same depth intervals in the same area. The rationale column states that this is the result of samples collected at a depth that exceeds the retention criteria of 5 feet. However, the HH results are shown on the figures to 12 feet bgs, based on the text on page 1-15.**

Response: AW-N-11 is now AW-R-14 and retained for HH risk due to a single detection of Cr^{+6} from a sample collected at depth (11 feet bgs). The surrounding borings did not contain Cr^{+6} above risk levels. Additional sampling will be recommended for this area to assess whether remedial action should be

recommended or if this is an isolated occurrence of Cr^{+6}. The table will be revised to include additional sampling for AW-R-14

b) In addition, the RTG is listed a low to negligible, but the contaminant of concern is hexavalent chromium, which is extremely mobile and soluble. While the other soil samples from these borings did not contain concentrations of hexavalent chromium greater than cleanup levels, due to the mobility and solubility of this COC, there should be groundwater data supporting the low RTG conclusion. Because of the high risk to human health and the high risk to groundwater, it is recommended that AW-N-11 be retained for evaluation.

Response: The RA for low RTG was renumbered as AW-N-26. The RTG ranking was low because $Cr^{+}6$ did not exceed PGW SSLs in deeper samples and was not detected in groundwater. Based on lack of PGW SSL exceedances at depth, we continue to recommend that the RA should not be retained for RTG.

However, AW-N-26 lies within AW-R-14, where additional sampling to evaluate Cr^{+6} in the area will be completed to assess whether additional action may be required. See Response to RWQCB Specific Comment 24a.

Comment 25. **Tables 1-4, 1-5, 1-6. In order to cap several of these areas, including but not limited to AW-R-1, AW-R-2, AW-R-3, AW-R-6, AW-R-7, L2-R-1, L2-R-3, L2-R-6, L2-R-7, L5-R-1, L5-R-2, CP2-R-4, CP2-R-5, and CP2-R-7, the lateral extent needs to be identified. Please add that the lateral extent will be defined before capping, if it is selected as the final remedy. In addition, add lateral extent, along with the vertical extent, to the excavation portion of the remedy in the rationale column.**

Response: The rational column in the summary risk tables will be revised. An example of the revised language is provided for AW-R-1 as follows:

A-1260 exceeded ILCR for the resident (9E-6) and commercial (3E-6) receptors in the 1-foot bgs sample and no deeper samples were collected. ~~A-1260, Cd, Cr, and Zn were retained as COPECs in the 1-foot sample at sample location 05D-SB07. This area was not selected for further action in the SLERA. A-1260 was ranked as a moderate RTG and Cd was ranked as a low RTG. A-1248 (800 µg/kg), and Cd (2.6 mg/kg) exceeded their PGW SLs (34 µg/kg and 1.2 mg/kg, respectively) in the 1-foot sample, and no deeper samples were collected. No data were available to assess if A-1260 or Pb were present in groundwater.~~ At a minimum, the area will be capped or excavated to a depth of 2 feet bgs and, the lateral and vertical extent of A-1260 impact will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of A-1260 impact will be determined prior to capping.

Comment 26. **Table 1-14. For area AA-SV-R-1, the human health risk numbers are missing from the table. Please add the risk numbers.**

Response: The Administration Area soil vapor risks have been separated into Admin East (Table 1-14) and Admin West (Table 1-15). Because of the separation, AA-SV-R-1 has been re-numbered to AE-SV-R-1. The human health risk numbers will be added to the table for area AE-SV-R-1.

RWQCB Comments

General Comments

Comment 1a. **Risk to Groundwater Evaluation. The risk to groundwater evaluation used the Johnson and Ettinger (J&E) model to provide a value for VOCs in the vadose zone associated with the release of VOCs from the groundwater. The J&E model was used with default inputs for soil types, porosity, etc. However, Aerojet produced a report in April 2008 that demonstrated that the using the default parameters in the J&E model overestimated the concentrations of VOCs in the vadose zone when compared to actual measured concentrations. It was apparent from that report that the overestimation was on the range of a factor of 2 to 6 (using site-specific input parameters). This overestimation is readily observed in Section 8 of the risk assessment where in many cases the concentration predicted by the model was in excess of the measured concentration. This resulted in a net negative value in the vadose zone for concentrations that would potentially impact groundwater. In nearly all cases, reducing the calculated concentration by a factor of 2 to 6 eliminated the negative value. An attempt was made to re-evaluate the risk to groundwater posed by VOCs, focusing on areas that would potentially shift from the low threat category to moderate risk/high risk when the concentration in the vadose zone associated with groundwater VOCs was reduced. The results of that evaluation led to Regional Water Board staff recommending a couple additional or expanded areas of remediation as stated in some of the specific comments below.**

Response: The text regarding the soil vapor modeling referenced in the FS, which originated from the HHERA is not clearly presented. In Section 1.4.1.3, second paragraph of the FS, the text states:

> "The PGW SVSLs for VOCs in soil vapor and PGW SSLs for chemicals in soils were developed using site specific and/or conservative parameters, which would likely result in an overestimation of the potential risk for those chemicals to impact surface water and groundwater".

The text does not state which parameters used default data and if the default parameters were used for the soil vapor to groundwater modeling or the soil to groundwater modeling. Appendix K of the HHERA, however, does provide further clarification regarding the soil vapor modeling. In this appendix, the soil vapor equilibrium calculations (Johnson et al., 1999) are detailed and the Johnson and Ettinger (J&E) model parameters are provided. The input assumptions for the J&E modeling state that the soil physical properties were those proposed in the Central Disposal Unit Vapor Intrusion Evaluation (Aerojet, 2008) or "site-specific" parameters. Additionally, VLEACH

modeling, also discussed in Section 8.0 of the HHERA utilized the Aerojet site-specific data for parameters such as soil moisture content, bulk density, and porosity. The site-specific values were also used for the Appendix K J&E modeling.

The net negative value in the vadose zone for concentrations that would potentially impact groundwater are suspected to be due to other factors such as soil heterogeneity, laboratory variability, variability in conditions during sampling. However, as stated these models were run using conservative assumptions and most likely are overestimating the potential risk.

Section 1.4.1.3, second paragraph, the text will be corrected as follows:

The PGW SVSLs for VOCs in soil vapor and PGW SSLs for chemicals in soil were developed using site-specific ~~default~~ and/or conservative parameters, which would likely result in an overestimation of the potential risk for those chemicals to impact surface water and groundwater.

Comment 1b **In determining the concentration of contaminant in soil vapor due to the concentrations in groundwater the concentration in groundwater in the first water bearing zone was used. In the Administration East area there is a fairly extensive perched groundwater layer and the concentration in that layer should have been used where appropriate. As an example, at 3D-SP102 a concentration of 140,000 ug/L PCE was used when the concentration of PCE measured in 3D-SP102 in the perched zone was 5400 ug/L. The 140,000 ug/L value is likely from a well screened in the first water-bearing zone for Administration East. This does not change the conclusion of the remedy for this particular area, but does illustrate the need to check concentrations in perched groundwater, where appropriate, when analyzing the risk posed to groundwater. Thus, there remain three areas within the Administration East area that have significant concentrations that warrant active remedial action – 1) the corridor between Buildings 20002 and 20004 extending west of boring 03D-SP107 east to east of boring A20-RB37-SP01 and extending beneath Building 20002; 2) the area beneath and south of Building 20004 inclusive of borings A20-ST05-SP01, 03D-SP129, 03D-SP128, 03D-SP147, and potentially 03D-SP138; and 3) the northern vinyl chloride area.**

Response: Attachment A to these responses to comments includes a table that provides a comparison of perched groundwater concentrations versus first water-bearing zone concentrations for each soil vapor location underlain by perched groundwater. The soil vapor equilibration concentration is also provided for each. The green highlighted rows indicate that the soil vapor concentration minus the perched groundwater to soil vapor equilibrium concentration was greater than the PGW SSLs and greater than the same calculation for first

water bearing zone (which means there is a higher likelihood that there is a source in soil vapor). Two locations were identified as a source in soil vapor that pose a high risk to groundwater, 03D-SP100, which is contained within remedial area AE-SV-R-7, and DSA-SP24, which is located within Central Operable Unit and will be further evaluated in OU-9.

Comment 2. **In many instances there is a need to place deed restrictions on certain portions of the property where no remedial action is proposed or concentrations of pollutants will remain in-place that are not a human health risk but are a potential adverse risk to water quality or potential adverse ecological risk if the soils are removed and placed where exposure could take place. Those deed restrictions would cover excavation and placement of the excavated soils. In the summary tables for remedy action there should be a statement on whether or not these restrictions will be placed on the area.**

Response: See Response to EPA Specific Comment 21. However, we do not agree an additional deed restriction is required as suggested by the comment. During development, shallow (≤12 feet bgs) or deep (>12 feet bgs) soil may be brought to the surface.

For shallow soil, the risks to human health, ecological (0-6 feet bgs), and groundwater have been evaluated and remedy decisions made. For those areas not brought forward to the FS (not proposed for further remedial action evaluation), additional deed restrictions do not appear warranted based upon the discussions in Section 1.0 tables.

Deeper soil was only evaluated for risk to groundwater. It is possible that during construction activities, these deeper soils may be brought to the surface and spread locally. Best management practices are required during any development project to protect waters of the state, so surface runoff of these soils is not a complete pathway.

Risks to human health or ecological receptors were not evaluated for deeper soil; however, all chemicals were screened against very conservative screening levels during the RI to ensure the extents of the chemical impacts were defined well enough for evaluation. There were only a few locations where chemicals in deeper soil exceeded protection of groundwater or human health screening levels. These chemicals/areas include:

- PCBs and TPH in Admin East. This area is not planned for redevelopment.
- PCBs in Admin West. This impact is limited to the impact from the former Air Force, Plant 70 PCB spill. This area maintains a deed restriction requiring a cap.

- Miscellaneous metals (thallium, manganese, and aluminum) and perchlorate in Line 2. The locations where metals were detected above screening levels are very sporadic. Perchlorate only exceeded the protection of groundwater screening levels; therefore, no human health issues arise if the soils are brought to the surface. There are two main locations where perchlorate was detected above the screening levels, just north of the former paint wash down pad, where active perchlorate remediation is identified as an option in the FS and just north of Building 02020.

Of the areas listed above, the only definable area that is in a location that has development plans and is not being addressed by another action is the Line 2 area north of Building 02020. As stated above, if development activities result in this soil being brought to the surface, the risk to groundwater will not change and Agency-imposed best management practices will prevent impacts to surface water. Only one location E(e)-SB03 contained perchlorate (1.7 mg/Kg) at a concentration above the perchlorate ESL (1.17 mg/Kg). Based upon the limited extent and minimal exceedance of the ESL, deed restrictions do not appear warranted for soils in this location.

Comment 3. **Sites with a high risk to groundwater are proposed for remediation. To what concentration will remediation be require to attain? How will it be determined to what lateral and vertical extent the remediation will take place?**

Response: Remedial action goals are not within the scope of the FS. Prior to beginning remedial actions, Aerojet will prepare a RD/RA Work Plan, which will include remedial action goals and approach to evaluate lateral and vertical extent of remedial action.

Comment 4. **There is a new CHHSL for lead of 80 mg/kg and this should be used in determining areas of concern for remediation due to lead contamination.**

Response: RAs were not based on chemical screening levels but evaluation of the HH, RTG or ecological risks. The CHHSL for lead was revised after the completion of the HHERA. A discussion on the change in the CHHSL for lead was included in Section 7.0 (Uncertainty Section) of the HHERA. This does not affect the risk management decision.

Attachment B contains figures showing where lead was detected between 80 and 150 mg/kg. However, the majority of the soil samples detected in this range are in areas that are retained or were removed as part of previous excavation activities.

There are a few isolated lead detections between 80 and 150 mg/kg in soil samples. However, as the Blood Lead Model that is used to derived the CHSSL of 80 mg/kg in soil is a probabilistic model, and guidance for probabilistic lead models like the Integrated Exposure Uptake Biokinetic (IEUBK) for children and LeadSpread model for adults recommend use of average site lead concentrations as input (not maximum values, or even 95 percent UCL EPC upper bound concentrations), the finding of a few isolated sample results that exceed a level of 80 mg/kg in soil may typically be discounted.

The cleanup goals for RAs will be determined in the future in consultation with the Agencies.

Comment 5. **General Comment. For areas of soil contamination remaining below the buildings, how will the area that be deed restricted and future remediation be determined as the extent in most cases is not defined sufficiently?**

Response: See Response to EPA Specific Comment 21. Aerojet anticipates a deed restriction covering the entire building footprint for any building that has soil beneath it that requires remedy.

Specific Comments

Comment 6. **Page 1-20 Section 1.4.1.3, VOC Risk to Groundwater Contours. It is stated in the first paragraph the contribution to VOCs in soil needs to be corrected to exclude the volatilization of VOCs in groundwater into the soil column and that required modeling. Which model was used to derive the correction factor? The site-specific attenuation factors developed in Aerojet's Johnson and Ettinger (J&E) evaluation should be used as that evaluation demonstrated that the default values were too conservative in predicting concentrations of VOCs in the vadose zone due to concentrations in the groundwater. One of the conclusions of that evaluation was that the concentrations that would be found in soil vapor from off-gassing off of groundwater were actually lower than that predicted by the J&E model using the default inputs, including attenuation factors. Thus, if one to were to use the default J&E outputs, too high a concentration of VOCs would be estimated to be present in the soil vapor. This would lead to a greater correction factor being applied and a lower risk to groundwater estimated. The site-specific J&E modeling should be used to develop the correction factor.**

Response: See Response to RWQCB General Comment 1.

Comment 7. **Page 1-20, Section 1.4.1.3, VOC Risk to Groundwater Contours. Some of the decision criteria rely on detection/non-detection of the contaminant in**

groundwater. Care must be given in this evaluation based on the distance from soil source area to groundwater monitor well, groundwater flow direction at the source area and depth of screened interval for the well in assessing groundwater impacts associated with the site.

Response: The criteria was originally presented in the HHERA, Section 8.1.2.1 and summarized in the Section 1.4.1.3, VOC Risk to Groundwater. Both documents indicate that if the compound was not detected in groundwater within 250 feet of the soil vapor sampling location, the modified VOC concentration was considered a low risk. This distance was considered conservative. It took in consideration the possibility for a structural feature (e.g., a building) to impede recharge, which would have the effect of protecting groundwater, but would not impede diffusion.

Comment 8. **Page 1-22, Section 1.5.1, paragraph 2, second bullet. Only the high risk-to-groundwater VOC areas are retained. Why aren't the moderate risk-to-groundwater sites retained?**

Response: The RTG evaluation completed in the HHERA combined the moderate and low RTG areas and assigned the areas as low risk on the GRS figures. To address the comment, Section 1.5.1, third paragraph will be revised as follow:

The moderate and low risks for VOCs were combined to form the low RTG areas contoured on the GRS figures. These low risk areas do not indicate a local chemical source in the vadose zone that would migrate to groundwater, based on the criteria listed in Section 1.4.1.3. Therefore the low RTG areas are not retained for evaluation of remedial alternatives because VOCs in soil vapor were either in equilibrium with groundwater or do not appear to be local sources. The high risk areas indicate there is a potential source that might migrate to groundwater.

In addition, the text will be revised to clarify the combining of the risks for both VOCs and non-VOCs.

Section 1.4.1.3, **High Risk**, first paragraph after bullet, the text will be revised as follows:

The high risk areas for VOCs were contoured as high risk on the GRS figures. ~~The low risk contour areas grouped the low and moderate risk areas together inside the low risk contour.~~ Moderate and low risk areas for VOCs were combined and mapped as the low risk contours on the GRS figures. The contours were based on the evaluation completed in Section 8.0 of the HHERA.

The moderate and low risks were combined as these areas do not indicate a local chemical source in the vadose zone that would migrate to groundwater,

based on the criteria listed above. The high risk areas indicate there is a potential source that might migrate to groundwater.

For the non-VOC a ranking classification was used. Any ranking with a value greater than 6 was identified as high risk. Below is an explanation of the types of conditions that would have a ranking of 6, where within the parenthesis lists "(Groundwater Impact Rank – Vertical Definition Rank):"

- (6-0 or 4-2) Chemical concentrations appear to be increasing from up-gradient to down-gradient of this sample location; however, the chemical was only detected above the PGW SSL in shallow (<1/2 the distance from ground surface to groundwater) soil with at least 1 deeper samples that do not contain that chemical.
- (3-3) Low solubility chemical detected in deepest sample, but deepest sample was shallow (<1/2 the distance from ground surface to groundwater) and chemical detected in groundwater, but well definition does not allow for determination of down-gradient impacts.
- (1-5) Chemical detected above the PGWSSL in deepest sample, which was collected at depth > ½ the distance from ground surface to groundwater, but the chemical was either not detected in groundwater or it was detected in groundwater at concentration <ARAR and source appears to be upgradient.

The above conditions would be reviewed, but generally not retained.

Section 1.4.1.3, **Non-VOC Risk to Groundwater Contours**, first bullet onward, the text will be revised as follows:

- *A ranking (from 0-5) of the vertical definition of the compound in the vadose zone.*
  - *The rankings of 0 to 2 indicate chemicals detected in soil are not impacting groundwater at that location. In all cases, there was a sample at a deeper depth from the same borehole that did contain chemical concentrations above PGW SSLs or, for metals, were not detected above background concentrations. Therefore, the chemical impact was bounded above the water table.*
  - *A rank of 3 was applied to either:*
    - *Locations where chemicals were detected at concentrations above the PGW SSL at depths greater than half the distance from the surface to groundwater, but the chemical was not detected in at least*

one sample collected below the deepest sample with a detected concentration.

- *For low mobility chemicals, where the lowest detection was less than half the distance to groundwater.*

- *A ranking (0,1,3,4,6) of the presence, or absence, of the compound in groundwater.*
  - *The ranking of 0 or 1 indicated that groundwater was not impacted or impacts were below the appropriate ARARs, within 100 to 250 feet of the soil sample exceeding a PGW SSL or where the groundwater impact was attributable to an upgradient source.*
  - *The ranking of 3 indicated that a compound was detected above the PGW SSL, but either no wells were available to confirm if groundwater was impacted or the detections could not be distinguished from an upgradient source.*
  - *The ranking of 4 indicated that a compound was detected above the PGW SSL, and was detected in the nearest groundwater sample between 100 or 250 feet downgradient of the area, but could not be definitively associated with the investigated feature.*
  - *The ranking of 6 indicated that a compound was detected above the PGW SSL and was detected in a groundwater sample within 100 feet downgradient of the area at a concentration greater than groundwater concentration upgradient of the investigated feature.*

For both rankings, a higher ranking indicates that the concentration of a compound detected at concentrations above its PGW SSL potentially poses a higher RTG.

The final cumulative ranking ranged from 0 to 11, which were classified into negligible, low, moderate, and high risk for non-VOCs. Generally, rankings of 0 to 2 were classified as negligible and are not included in the GRS figures. The low and moderate classifications (3 through 6 rankings) were combined into the low RTG contours ~~with one exception~~. The high classification (>6 ranking) were contoured as high RTG contours ~~with one exception~~.

Similar to the VOCs, the final ranking scheme combined the low or moderate risk for non-VOCs because there is not a local chemical source in the vadose zone that would migrate to groundwater, based on the criteria listed above. The high risk areas indicate there is a potential source that might migrate to groundwater. However, as there was more variability in this scheme, each

ranking was reviewed and an exception was found for both the low/moderate and high classification.

Comment 9. **Page 1-22, Section 1.5.1, paragraph 2. Three are two bullets listed under this paragraph that discuss areas identified for retention for evaluation due to VOCs. There is no retention for VOCs that are shown to pose an unacceptable risk to indoor air or ambient air. Which areas will be retained due to potential human health-related impacts?**

Response: See Response to EPA General Comment 4, "or outdoor" was inserted into one of the bullets added for this comment.

Section 1.4.1.1, **Groundwater**, first paragraph, the text is revised as follows:

Risk estimates associated with direct contact with groundwater, and model inputs associated with estimating indirect exposures to groundwater were calculated on a sample-by-sample basis in the HHERA. As identified in the facility-wide Conceptual Site Model, potentially complete and significant groundwater pathways include presumed domestic use by current/future residents or commercial/industrial workers, passive volatilization into indoor and outdoor air and inhalation by residents or workers, and dermal contact during construction work.

The estimated theoretical hazards and risks for outdoor air rarely exceeded de minimus risk metrics (HI = 1.0, ILCR = 10-6). In all cases where both indoor and outdoor air pathways were assessed, the relative contributions to risks from theoretical indoor air exposures were greater than the relative outdoor contributions by more than 1 to 2 orders of magnitude. Therefore, the discussions focus on the more conservation exposure of indoor air.

Comment 10. **Page 1-24, Section 1.5.2, first paragraph, fifth bullet. This bullet states that at sites where the TPH concentrations were diesel and/or motor oil and the concentrations were not increasing, the site was not retained. Was it meant to say – increasing with depth? In addition, it should be noted that depending on the TPH concentrations that are allowed to remain, that there would be restrictions on the property regarding future removal and subsequent disposal of the soils.**

Response: The bullet will be revised as follows:

If the RTG area was only based on the concentrations of TPH as diesel and/or TPH as motor oil, the area was not recommended for retention unless the concentrations were increasing with depth, or TPH was encountered at depth and had impacted the groundwater.

As agreed to in the January 18, 2012 meeting with the EPA and RWQCB, RWQCB will provide a TPH concentration or mass per unit area, above which, deed restrictions would be required regarding future removal and subsequent disposal of TPH-affected soil.

Comment 11. **Page 1-24, Section 1.5.2, first paragraph, last bullet. As with the first comment, factors numerous factors that can effect the evaluation of the impact on groundwater from a given site need to be carefully evaluated.**

Response: Comment noted.

Comment 12. **Page 1-24, Section 1.5.3, first sentence. It is stated that the only risk posed by groundwater is from VOC volatilization into indoor air. What about exposure to VOCs in ambient air by human and/or other ecological receptors?**

Response: The HHERA evaluated on a sample-by-sample basis, the ambient (indoor and outdoor) air for all receptors. See Response to RWQCB Comment 9.

Section 1.5.1, provided the conclusion from the SLERA that no areas were retained due to soil vapor concentrations, which would be greater than those modeled from groundwater concentration; therefore is not considered a risk for ecological receptors.

Comment 13. **It would be good to have on Figures 1-29 through 1-36 retention and non-retention area designations for the VOC areas in a manner similar to what has been done for the non-VOCs on the same figures.**

Response: See Response to EPA General Comment 4.

Comment 14. **Tables 1-3 through 1-16, and Figures 1-29 through 1-36. In many instances it is difficult to discern the differentiation of the retained/not retained areas and the corresponding remedial area number. The revised adjusted example figure supplied subsequent to the FS improves the delineation. In subsequent RI/FS reports using shading for human health risk and different colored hatching for high/low ecological risk and risk to groundwater would be preferred. In that manner, the areas will be better distinguished for what the risk is and whether it is high or low.**

Response: See Response to EPA General Comment 5.

In addition, for ease of review it might be better to discuss areas by grouping them together and providing a figure that highlights that grouping with contaminant concentration information. As an example, grouping AE-R-2, AE-R-3, AE-R-4, AE-N-4 and AE-N-5 together as a remediation cluster and having the text/table discuss the "whys" for the

area to be remediated. The figure would provide an outline of the area within the remediation cluster that would be remediated. Similarly, in Administration Area East, grouping AE-R -9,10,11,13,16 and AE-N-11,12,13,14,15; AE-R-1 and AE-N-2,3; and, AE-R-5,6,7,8,15 and AE-N-6,7,17 into three remediation clusters for discussion.

Response: We have made revisions to ease the review. See Response to EPA General Comment 6a. We will consider different grouping approaches and work with the Agencies to improve the presentation in future FSs.

Comment 15. **Figures 1-29 through 1-36. As commented in the RI document, the delineation of the areas of impacts for VOCs appears rather stunted in many instances. As an example, the results of three sample locations (A20-ST02-SP02, A20-ST02-SP03 and 51D-SP04 were grouped appropriately together to show an area of potential threat to groundwater from VOCs in the vadose zone. The line defining the area of impact is rather narrow in width and makes a right-angled turn to the north. The rationale behind the delineation is not clear.**

Similarly, the delineation of risk to groundwater appears to be more narrowly defined than the risk to human health. The risk-to-groundwater areas have little lateral dispersion from the sample location, while the areas of risk to human health have a much larger lateral dispersion around the sample location.

Response: Risk contours were taken directly from figures presented in the HHERA Section 9.0. A change in the shape or size of the contoured areas, however, would not affect the results of the FS or whether the area was retained or not retained. Remedial action levels will be defined in the PP/ROD and cleanup will be implemented to these values.

Comment 16. **Tables 1-3 through 1-16. In most areas of proposed soil remediation for non-VOCs there are statements that the vertical extent of contamination will need to be determined and this will occur during the excavation. In a majority of the cases, the horizontal extent also has not been adequately determined and will need to be ascertained during excavation. This comment applies not just to sites where excavation will occur, but also to sites where capping is proposed.**

Response: See Response to EPA Specific Comment 25 and RWQCB Specific Comment 15.

Comment 17. Specific Comment. Table 1-3 and Figure 1-29.

a. AE-R-8 could easily connect to AE-R-5 as the contaminant is the same –PCBs, the distance is relatively short and there are no samples taken between the designated areas.

Response: Table 1-4, AE-R-8: The data for RA AE-R-8, which was renumbered AE-N-19, was erroneously based on boring 03D-SB02, instead of boring 03D-SB50. Boring 03D-SB02 is included in AE-R-5.

b. AE-R-5 and AE-R-6 could be combined for evaluation and remedy planning purposes.

Response: As discussed in Table 1-4, AE-R-5 will be excavated to 2 feet, while AE-R-6 will be excavated to 4 feet. Because the excavation depths vary there are differing costs for each area. However, this will not affect remedy planning for these areas.

c. At AE-R-7, why not excavate to 15 feet as elevated PCBs that pose a threat to groundwater exist at 15 feet, instead of the 12-foot excavation depth proposed in the table.

Response: As there are no samples below 15 feet, the depth is not known, so excavation to 15 feet would not necessarily complete the remedial action. Confirmation sampling will assist in the determining the depth of excavation. Additionally, the area is surrounded by buildings and other infrastructure and excavation to greater depths may be problematic.

d. At AE-N-18 it is stated that excavation will be initially to 2 feet, however the area will not be retained?

Response: The reference to excavation will be removed in the revised tables.

e. AE-N-10 should be retained as there is a paucity of data in the vicinity of the boring associated with this area and there is no reason to believe this is the highest concentration of contaminants in soil in the east-central portion of the building. As the remedial action on this area would likely be excavation after building removal, keeping it on the list for evaluation after building removal is appropriate.

Response: See Response for EPA Specific Comment 16. Aerojet believes that the soil beneath Buildings 20002 and 20004 were very well characterized based upon the number of soil borings and soil vapor samples collected from beneath the building slabs and the data generated from these samples. Aerojet believes that the sample location representing AE-N-10 was collected at a location that would represent the highest chemical concentrations from the activity being

investigated. Therefore, this would be the highest risk area. Based upon the risks, remedy is not recommended for this location.

Comment 18. Specific Comment. Table 1-4 and Figure 1-30.

a. In general, the area to west of the drainage ditch appears to have low level PCB contamination at least as far north as AW-N-2 and as far south as AW-R-2. It could easily be conjectured that at all of the area between those points (and potentially farther north, south, west and east to the ditch) contains unacceptable levels of PCBs given this is an open field (along with the plating waste pit) with the original source of the PCBs adjacent to Building 20009. This should be considered during evaluation of the remedy for this area.

Response: As discussed in EPA Specific Comment 25, the lateral and vertical extent of COCs will be evaluated as part of confirmation sampling for the remedy.

b. At AW-N-12 lead at 150 mg/kg is above the CHHSL.

Response: See Response to RWQCB General Comment 4.

c. AW-R-13 is not shown on Figure 1-3, but is mentioned in the write-up for AW-R-9 which states that the remedy for AW-R-13 takes care of the risk to groundwater at the listed locations.

Response: This was a typographical error. The rationale will be revised to read:

The remedy proposed for RA AW-R-10 addresses the RTG for the <u>majority of the</u> listed sample locations. Sample locations that exceed HH or ecological risks are shown in separate RAs and included in other remedial areas. Of these borings, only sample location 06D-SNS09, 06D-SNS10 and 06D-SNS11 were ranked as moderate RTG for ClO4. ClO4 was detected above its PGW SSL (60 µg/kg) and at 2.5-foot bgs samples from locations 06D-SNS09 (1,300 µg/kg), 06D-SNS10 (530 µg/kg), and 06D-SNS11 (1,900 µg/kg). The remainder of the borings and the compounds—B(a)P, B(b&k)F, B(b)F, Sb, Cd, Cr, $Cr+^{6}$, and Pb—were ranked as low or negligible RTGs in Table 8.3-1 of the HHERA (Volume II). The area surrounding sample locations 06D-SNS09, 06D-SNS10, and 06D-SNS11 will be capped or excavated to a minimum depth of 3.5 feet bgs and the lateral and vertical extent of ClO4 impact will be assessed during excavation. If capping is selected as the final remedy the lateral extent of ClO4 impact will be determined prior to capping.

d. AW-N-11 – if pavement is removed, then the concentrations of hexavalent chromium at 11 feet are a threat to groundwater. In addition, deed restrictions for digging in this area will need to be applied. This area should be retained.

Response: See response for EPA Specific Comment 24a.

e. For AW-N-13 it is stated that one of the areas will be addressed by the excavation to 2-feet in AW-R-14. There is no AW-R-14. In addition, there is quite a bit of data for lead in shallow soils that exceeds the CHHSL, but no remedial action is proposed. This area should be re-evaluated for remedy.

Response: See Response for EPA Specific Comment 18a.

f. For AW-N-14 it is also stated that the AW-R-14 remedy will take care of the contamination in the upper 2 feet. Is AW-R-14 supposed to be AW-R-10?

Response: See Response for EPA Specific Comment 18a.

g. The extent of contamination at AW-R-3 appears rather limited as this sample is from a ditch. Do we know the source of the PCBs in the ditch? It would be good to know so as an estimate to how far upstream of the sample point the contamination may extend. In addition, it is likely that the contamination extends to the 5D ditch that the drainage enters.

Response: Section 4.3.4.4 of the Final Remedial Investigation Report states "The absence of Aroclor 1260 in upstream sample 5D-SNS19 indicates that the source of PCBs is located between those two sampling locations. Potential sources of Aroclor 1260 include the SMUD Substation or from historical activities associated with Building 20009." As stated previously, the lateral and vertical extent of COC/COPECs will be determined during excavation or the lateral extent will be determined if capping is selected as the final remedy.

Comment 19. Specific Comment. Table 1-5 and Figure 1-31.

a. The areas of L2-R-4, L2-R-5 and L2-R-9 could easily have been grouped into a single area for evaluation and remedy assessment

Response: See Response for EPA General Comment 6a and RWQCB Comment 15.

Comment 20. Specific Comment. Table 1-7 and Figure 1-33

a. The areas WL-R-1 and WL-R-2 could likely be much larger than depicted on the figure as these are surface impoundments and the density of sampling is rather low.

Response: See Response for RWQCB Comment 15.

b. What is the anticipated remedial action BC-R-2?

Response: See Response to EPA Specific Comment 22.

Comment 21. Specific Comment. Table 1-9 and Figure 1-35.

a. At CP2-N-1 PROWL was detected in a surface soil sample. This sample location is isolated from the rest of the sampling and it is not certain that there are higher concentrations of contaminants in the vicinity of this sample point. The source of PROWL is not known and it appears that the sample point was placed to look at the extent of contamination associated with the low-lying area to the south.

Response: CP2-N-1 is represented by the sample OS1-F3-SD01. Open Space Area 1 (OS1), feature 3 (F3) was identified in the field during the RI sampling event. The location was selected for investigation because it was a drainage area from building operations north of CP2. This sample was collected from the lowest area within the drainage area (visual determination), so this should be the location of highest concentration of hydrophilic compounds.

b. At CP2-R-6 it is stated that the ecological risk is being addressed by the remedial area for CP2-R-2. That should be CP2-R-3. In addition the depiction on the figure shows that CP2-R-3 does not include all of the area of CP2-R-6. Are all of the ecological risks for CP2-R-6 actually addressed at the remedy for CP2-R-3?

Response: The text will be corrected to state CP2-R-3. The text was inadvertently truncated the missing text stated: "*At a minimum, the area will capped or be excavated to a depth of 2 feet bgs and lateral and vertical extent will be assessed during excavation if capping is selected as the final remedy the lateral extent of impacts from COPEC will be determined prior to capping"*

c. AT CP2-N-3 it is stated that soils at 59F-SB26 are addressed by CP2-R-8. That should be CP2-R-3.

Response: The line will be removed from the rationale based on the revised RA numbering scheme discussed in EPA General Comment 6a. CP2-N-3 now only discusses RTG and will be revised as shown below.

The RTG contaminants were low mobility/solubility compounds (A-1254, SVOCs and metals), ranked as a low to moderate RTG, and contamination was only in shallow soil samples; therefore, this RA was not recommended for retention. The compounds A-1254 (1,100 µg/kg), B(a)A (170 µg/kg), B(a)P (150J µg/kg), B(b)F (230J µg/kg), and I(1,2,3-cd)P (100 µg/kg) were detected at 1-foot bgs in sampling location 59F-SB26 above their PGW SSLs (34 µg/kg, 29 µg/kg, 2.9 µg/kg, 29 µg/kg, and 29 µg/kg, respectively) and were ranked as

moderate RTGs. Cd (0.84 mg/kg) exceeded its PGW SSL (0.72 mg/kg) at 5 feet bgs in sampling location 59F-SB13. B(a)P (6.8 µg/kg) at 0.5 foot bgs, Cd (0.83 mg/kg), and Tl (3.2 mg/kg) at 2.5 feet bgs exceeded their PGW SSLs (2.9 µg/kg, 0.72 mg/kg and 2.5 mg/kg, respectively) at sampling location 59F-SNS03; TI (3.2 mg/kg) also exceeded the PGW SSL at 0.5 foot bgs at sampling location 59F-SNS04. B(a)P, Cd, and Tl at sampling locations 59F-SNS03 and 59F-SNS04 were all ranked as low RTGs. Cd and Tl metals were considered to be "outside range of statistical background but suspected to be naturally occurring" (see PGW Evaluation in HHERA Volume II). B(a)P and the metals generally have low solubility and mobility. ~~Sampling location 59F-SB26 is addressed in Remedial Area CP2-R-8 above.~~

d. CP2-R-4 and CP2-R-5 should be combined for evaluation and remedy determination.

Response: See Response for EPA General Comment 6a. As stated previously, the lateral and vertical extent of COCs will be determined during excavation or the lateral extent will be determined if capping is selected as the final remedy.

e.

1) For CP2-N-21 lead exceeds its CHHSL of 80 mg//kg and should be assessed accordingly.

Response: See Response for RWQCB General Comment 4.

2) It is also stated that the ecological risks will be addressed by CP2-R-2. Should that not be CP2-R-1?

Response: There is a typographical error; CP2-R-2 will be revised in the text to CP2-R-1.

3) In addition, the area of CP2-N-21 exceeds that of CP-R-1 and so are all of the ecological risks addressed by CP2-R-1?

Response: CP2-N-21 is now CP2-R-10 and will be retained along with CP2-R-1. However, the one remedy will address both areas. The rationale for CP2-R-10 will be revised to read:

A-1248 exceeded the HI for RC (1.4E+1) risk level in the 0.25-foot bgs sample, but not in the 1.5- or 5-foot bgs samples. This area will be capped or excavated to 2 feet bgs in remedial area CP2-R-1 for ecological risk. The HH risk will be capped or excavated to 1.25 feet bgs and implemented as part of the CP2-R-1 remedy. If excavation is selected as the remedial option the lateral and vertical extent of contamination will be assessed during excavation for CP2-R-1. Because the sample was collected within a drainage feature, the

kriged extent shown on Figure 6-11 will not necessarily be excavated. The additional kriged area was not included in the excavation volume estimate.

4) Would it not be better to have retained this area and then state that the remedy is included with the CP2-R-1?

See Response to the RWQCB Specific Comment 21. e. 3).

f. CP2-N-22 should be added to the CP2-N-21 area for analysis and remedy evaluation.

Response: CP2-N-22 is now CP2-R-11 and will be retained along with CP2-R-1. However, the one remedy will address both areas. The rationale will be revised to read:

Ba (3.4E+0) exceeds the construction worker HI in the 1-foot sample at sample location 59F-SPB02, but does not exceed in 5- or 10-foot samples. This area will be capped or excavated to 2 feet bgs and implemented as part of the CP2-R-1 remedy and the lateral and vertical extent will be assessed during excavation. If capping is selected as the final remedy, the lateral extent of impacts from BA will be determined prior to capping. If excavation is selected as the remedial option the lateral and vertical extent of contamination will be assessed during excavation for CP2-R-1. Because the sample was collected within a drainage feature, the kriged extent shown on Figure 6-11 will not necessarily be excavated. The additional kriged area was not included in the excavation volume estimate.

g. Will not the remedy for CP2-R-1 take care of the concentrations in the CP2-N-23 area as the sample comes from the same drainage ditch as that being cleaned up under CP2-R-1?

Response: Correct, the following sentence will be added to the CP2-N-23 rationale:

This area was identified for further action in the SLERA and the ecological risks will be addressed in CP2-R-1.

h. For CP2-R-7, there is no proposed action in the "Rationale" column.

Response: CP2-R-7 has been renamed as CP2-N-31. The risk at this RA is residential and the Chemical Plant 2 Area will remain commercial so this area is not retained at this time. The rationale will read:

HH risk was just above 1E-6 and HI<1; therefore, this RA was not recommended for retention. B(a)P, B(b&k)F, and PCP were the main compounds that together caused an ILCR exceedence (2E-6) at sample location 61F-SNS01; however, no single compound's risk exceeds 1E-6. The

human health risk contour is based upon a residential scenario. The risk to human health (residential) extends to a depth of 0.5 foot below ground surface. This area is intended to remain commercial/industrial; therefore, deed restrictions will need to be developed to prevent residential redevelopment and/or specify the requirements for residential redevelopment (excavation to 1.5 feet bgs or capping).

Comment 22. **Figure 1-40. Not all of the areas within areas are designated facility areas and have ecological risks are shown on this figure. As an example, the 5D ditch is shown to have ecological issues along its entire length (Figure 1-30). However, on Figure 1-40 only a short section of 5D alongside Building 20009 is depicted to have ecological issues. Is it due to that the area depicted as Facility Area is not precisely represented on the figure and 5D is outside of the Facility Area?**

Response: Figure 1-33 (previously 1-40) depicts the results of the facility samples screening presented in Section 1.6. The green-hatched area on Figure 1-33 will be addressed by a minimum of a deed restriction to prevent these areas from reverting back to habitat. The ecological risks (green hatched areas) on Figure 1-25 were identified in the SLERA and were carried over with the GRS figures. Some samples are in close proximity and the mapping of the ecological concern areas may overlap however, the evaluated sample results were only used on one figure.

Comment 23. **Specific Comment. Figure 2-2. Enhanced in-situ bioremediation is screened out as a remedial technology. Aerojet has pilot-tested this technology and showed it to be potentially viable.**

Response: The final FS will also screen out advance bioremediation. Additional rationale will be provided to support this screening decision. The following text will be inserted to Figure 2-2:

Aerojet had success with full-scale pilot testing of anaerobic dechlorination of TCE and anaerobic biodegradation of perchlorate, but secondary impact of liberation of manganese and iron in the aquifer (rendering the water highly reduced and non-potable), well fouling, and ability to physically deliver the treatment fluids to residual contaminants were identified as issues that require resolution. The industry has not identified a solution for these issues to date; therefore, this technology has been screened out.

Comment 24. **Specific Comment. Figure 2-2. How is Building Ventilation a groundwater remediation option? It is an indoor air remedial measure to protect occupants from VOCs emanating from both vadose zone and groundwater source areas. It does not address the pollution in groundwater.**

Response: As indicated in the comment Building Ventilation addresses the migration of VOCs from impacted groundwater and the vadose zone. Institutional controls are in place for the areas of impacted groundwater, which addresses exposure to the groundwater.

Comment 25. Specific Comment. Figure 2-2. Direct potable supply is only an option if the entity extracting and directly providing the water is a permitted water supplier with a permit issued by the California Department of Public Health. Aerojet does not meet that requirement.

Response: The following text was added to Figure 2-2:

Potentially applicable if the entity extracting and directly providing the water is a permitted water supplier with a permit issued by the California Department of Public Health (CDPH) Division of Drinking Water and Environmental Management (DDWEM). If a contaminated groundwater is to be considered as a direct potable water supply after it is treated to remove the contaminant, a permit for the use of the "extremely impaired source" must be obtained from CDPH in accordance with Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Sources.

Comment 26. Page 6-3, Top of Page. Surface water is monitored under Aerojet's various NPDES permits.

Response: Section 6.1.1, third bullet, Monitoring: a sub-bullet will be added as follows:

– *Surface water is monitored under Aerojet's various NPDES permits.*

Comment 27. Page 6-6, Section 6.2.1.2. Remedial Area AA-SV-R-3 is one of four areas listed in this section that would require remedial action due to risk to groundwater quality. Under this remedial option the areas would be capped. As AA-SV-R-3 is within the area that is undergoing remediation for VOCs based on human health risk, capping of this area would appear to be unnecessary if active remediation of the area is selected for protection of human health. Table 1-14 states that AA-SV-R-3 will have an appropriate source removal/reduction in the area of high risk to groundwater and human health risk to decrease the mass in this area. Therefore, capping is not an alternative that will be pursued for AA-SV-R-3.

Response: Due to the reassigning of RAs, the Admin Area VOC tables were separated into Admin East (Table 1-14) and Admin West (Table 1-15). All "AA" designations have been changed to "AE" (east) or "AW" (west).

As shown Figure 1-24, AE-SV-R-3 is now the large area that will be addressed for HH using institutional controls for vapor intrusion. The five areas that

require remedial action for high RTG are now AE-SV-R-4 through AE-SV-R-8. The Table 1-14 text for each of these five RAs now states:

Capping, or an appropriate source removal/reduction alternative to decrease VOC mass, will be implemented in the area of high RTG (See Section 6.0).

Comment 28. **Figure 6-2. AA-SV-R-6 should be expanded to include the areas around 03D-SP128, 03D-SP129 and 03D-SP147 as it appears that there is an unacceptable elevated risk to groundwater associated with the VOCs in the vadose zone that are likely all originated, at least in part, to the same source area near A20-ST05-SP01. AA-SV-R-3 should be expanded to the northwest to include 03D-SP93 and 03D-SP94.**

Response: Please see Response to EPA General Comment 4. These borings have a low RTG and are located within the RA that will have a deed restriction (AE-SV-R-3).

Comment 29. **Figure 6-4. The areas of AW-R-1, AW-R-2, AW-R-8, AW-R-9 and AW-R-11 could likely be placed into a single remediation area as there is little sampling indication that there are clean areas between those remediation areas. In fact, the excavation could extend all the way up to AW-N-2. In addition, AW-R-3 is likely to extend upstream some distance and all the way downstream to AW-R-10 (as indicated in comments above).**

Response: See Response for EPA General Comment 6a and Response to RWQCB Comment 1b. As stated previously, the lateral and vertical extent of COCs will be determined during excavation or the lateral extent will be determined if capping is selected as the final remedy.

Comment 30. **There are five ARAR tables in Appendix A. Table A-1 is a Summary of Potential ARARs. Table A-2 is a summary of potential chemical- specific requirements for groundwater. Table A-3 is a summary of preliminary potential chemical-specific ARARs and TBCs for chemicals of concern in groundwater. Table A-5 is a summary of potential location-specific ARARs. Table 6 is a summary of preliminary potential action-specific ARARs. It is difficult to determine if all of our ARARs (included in the attachments to this letter) have been included in the tables. We request that the language and description of our ARARs found in our tables be carried over to your tables. A table should also be provided to us that includes the ARAR number on our ARAR table and where on your tables the ARAR can be found.**

It would be useful to divide the ARARs in tables with listings for requirements that apply to groundwater, those that apply to soils/sediments an those that cover both.

There are number of our requirements on Table A-2 that Aerojet has qualified as being TBCs and that we have designated as requirements (i.e., Resolution No. 92-49 listed as an ARAR in OU-3). It will be impossible to determine compliance with ARARs until ARARs have been finalized. Aerojet cannot make the claim in the FS that the remedy complies with all ARARs if there is disagreement on what the ARARs are.

Response: Aerojet has replaced the ARARs tables with the table(s) that were included in the PGOU ROD. We believe that the table(s) is/are consistent with EPA's views on ARARs.

Comment 31. Table A-3.

a. CDPH no longer has "Action Levels" and uses the term "Notification Levels."

Response: See Response to RWQCB Comment 30.

b. The PHG for TCE is 1.7 µg/L.

Response: See Response to RWQCB Comment 30.

c. There is no primary MCL for hexavalent chromium

Response: See Response to RWQCB Comment 30.

d. The PHG for hexavalent chromium is 0.02 µg/L.

Response: See Response to RWQCB Comment 30.

e. The draft PHG for perchlorate is 1 µg/L.

Response: See Response to RWQCB Comment 30.

f. The draft PHG for chloroform is 1 µg/L

Response: See Response to RWQCB Comment 30.

g. The draft PHG for bromoform is 5 µg/L.

Response: See Response to RWQCB Comment 30.

h. The draft PHG for dibromochloromethane is 0.7 µg/L

Response: See Response to RWQCB Comment 30.

i. The draft PHG for bromodichloromethane is 0.4 µg/L

Response: See Response to RWQCB Comment 30.

j. The draft PHG for Total THMs is 0.8 µg/L.

Response: See Response to RWQCB Comment 30.

Comment 32. Table A-4. This table includes information from an older version of Aerojet's NPDES and should use the current version.

Response: Table A-4 will be updated based on the new 12-2011 NPDES permit.

DTSC Comments

General Comments

Comment 1. **Overall HERO is satisfied with the level of conservancy employed in the decision making process used to determine which areas of the Boundary Operable Unit would be retained and remediated. Recent changes in toxicity criteria and risk assessment guidelines have resulted in some inaccuracies within the document in terms of actual risk and hazard values (see Specific comments below). However, the level of conservancy used to develop the remedial investigation screening levels (RISLs) insured that the areas that presented an unacceptable risk (even under new criteria) were retained.**

Response: Comment noted.

Comment 2. **The introductory summary sections at the beginning of the report are lacking in detail and do not summarize the results of the FS. ERAS recommends that an executive summary be added to the beginning of the report, and that the results (a brief description of whether or not an area was retained/not retained and why, and the recommended remedial option) for each area should be added to the summary.**

Response: An Executive Summary, which summarizes the results of the FS, has been added to the beginning of the document.

Comment 3. **The figures in Chapter 6 that show the areas retained for remediation are lacking in terms of level of detail. The Feasibility Study figures should be more like the maps/figures for the HHERA (see figures 6.1-6.8) and should be presented at a similar scale to facilitate comparison of sample locations/risk-based exceedances in the HHERA and retained/non-retained areas for the FS. ERAS found comparing the Chapter 6 figures to the risk assessment maps was difficult, and this could be easily fixed by simply using the same area map templates that were used in the HHERA. The difficulty in comparing the maps in the HHERA to the maps in the FS makes determining concurrence with the proposed remediation areas unnecessarily difficult.**

Response: Section 6.0 figures are showing the remedial areas for all receptors, human health, ecological, and groundwater. The level of detail required for each type of figure in the HHERA varied, which resulted in different scales for each type of figure. Therefore, a uniform scale could not be used. The scale selected for the Section 6.0 figures was selected to most accurately display the remedial areas. The shapes of the remedial areas are displayed on Section 1.0 figures exactly the way they were presented in Section 9.0 of HHERA with the

exception of adding areas that had been inadvertently left off the HHERA figures. From Section 1.0 figures, you can correlate sample locations versus remedial areas. The shapes and locations of the remedial areas in Section 1.0 figures are the same as the shapes and locations in the FS Section 6.0 figures.

Comment 4. **ERAS notes that the reasons given to justify no further evaluation in the FS for locations where HQs are > 10; conservatism of the ESLs, site use factors, etc., are factors that would be quantitatively evaluated in a Baseline Ecological Risk Assessment (BERA). Aerojet has chosen not to do a BERA for the BOU areas (with the exception of Area 39) and instead has chosen to go straight to the FS/remediation phase. ERAS therefore, would not recommend relying on these qualitative statements, which are not scientific/management decision-making without additional evaluation to quantify these factors. ERAS recommends that areas in the FS for which ESLs are greater than 10 should either be evaluated further through additional risk assessment processes or retained for remediation in the FS.**

Response: Aerojet has completed additional evaluations for all locations where the HQ>10 and the location was not selected for further remedy. This information was presented to the Agencies in July and August 2012 and has been included in Appendix D.

Comment 5. **Prowl is a relatively common pesticide contaminant at the Chemical Plant 2 area with a short environmental half-life of 34 days. Aerojet suggests the short half-life is a justification for non-retention. ERAS would not support using this assumption without evidence, but would recommend that if the area sampling was conducted several years ago, a time frame which represents many half-lives for Prowl, that doing additional sampling first to more accurately estimate the need for remediation would be appropriate.**

Response: The locations in Chemical Plant 2 that contained Prowl at concentrations above ecological screening levels were: 59F-SD01, 59F-SPB02, CP2-08-SNS04, and 59F-SB22. All of these locations are addressed with remedial area CP2-R-1, which includes Prowl as a COPEC. All the locations within Chemical Plant 2 where Prowl presents a risk to ecological receptors will be remediated. The half-life of Prowl is not used as justification for a recommendation of non-retention.

Specific Comments

Comment 1. **Section 1.4.1.1: It is stated that the lead criteria used to make the countour lines is the 10 ug/dl increase in blood lead. As previously discussed in the RI, HERO no longer recommends use of the 10 ug/dl threshold but**

rather a benchmark change of 1 ug/dl of blood lead (http://oehha.ca.gov/risk/chhsl051809.html). Aerojet is aware of these changes and addressed the updated risk assessment criteria in the uncertainty section of the RI. This comment is for information purposes only.

Response: Comment noted.

a. HERO would like clarification as to why the decision was made to evaluate the inhalation risk posed by VOCs in groundwater differently for commercial use versus residential use. Residential risk was evaluated from groundwater data and the commercial risk was evaluated based on the soil vapor data. HERO suggests consistency and/or the use of whichever media is the most conservative.

Response: Aerojet feels that the most accurate risk calculations utilize actual media specific data, in this case soil vapor data. Modeling of groundwater data to soil vapor data introduces another level of inaccuracy to the risk calculation. Therefore, Aerojet has recommended the use of soil vapor data for the calculation of risk due to the inhalation of indoor air. However, during the preparation of the risk assessment, the EPA required assessment of groundwater data for residential risks. Aerojet feels this is overly conservative.

Comment 2. **US EPA IRIS recently (9/28/2011) released a new toxicological assessment for trichloroethene (TCE). The new IRIS RfC is 0.002mg/m^3, the new IUR is 4x10^{-6} (ug/m^3)$^{-1}$. The IRIS RfC and IUR values are more conservative than OEHHA's and HERO recommends that the IRIS toxicity values be applied to sites. Please note that US EPA has identified that TCE is carcinogenic by a mutagenic mode of action for induction of kidney tumors, and that age-dependent adjustment factors (ADAFs) should be used for the kidney cancer component of the total cancer risk when estimating age-specific cancer risks. The toxicological assessment can be found at the following web links: http://cfpub.epa.gov/ncea/iris/ index.cfm?fuseaction=iris.show QuickView&substance_nmbr+0199, http://www.epa.gov/iris/subst/0199.htm, and http://epa.cov/iris/supdocs/0199index.html. Additionally the USEPA Regional Screening Levels (RSL) table was updated in November of 2011: http://www.epa.gov/region9/superfund/prg/index.html.**

a. The new toxicity criteria greatly affects the hazard index assocated with TCE. For Example: Table 1-14: Remedial area AA-SV-R-6, TCE was present at 700,000ug/m^3. The maximum HI listed for this RA is 1.2 however with the new toxicity criteria the HI would be 270. This RA was retained so the change in HI has no effect on the decision to retain the area. This serves as an example only.

b. The RISL for soil vapor used for TCE was 961 ug/m3. This value was based off of the previous USPEA Indoor Air Screening Level of 0.96 ug/m3 with an attenuation factor of 0.001 applied. In order to determine if the RISL remained protective of human health, HERO used default Johnson and Ettinger (J&E) residential parameters (with the new TCE toxicity criteria) to estimate the risk and hazard associated with TCE in soil vapor at 961 ug/m3. The incremental cancer risk is 1x10-6 and the hazard quotient is 0.4. While these values are protective of human health, specific attention must be paid to cumulative cancer risks and hazard index when TCE is co-located with other chemicals of concern.

In terms of groundwater, remedial locations were retained if TCE was >/= 5 ug/L. A conservative depth to groundwater of 30 ft was used to calculate an acceptable TCE concentration in groundwater to minimize risk to residential receptors via the indoor air pathway. HERO used the updated J&E spreadsheet (http://www.dtsc.ca.gov/AssessingRisk/JE_Models.cfm) and determined that using default settings, 30 foot depth to groundwater, and TCE at 5 ug/L, the incremental cancer risk is 5x10-7 and the hazard quotient is 0.15.

Response: Thank you for evaluating the impact the new TCE toxicity data may have on the BOU RI/FS. Your evaluation concludes that the conservatism in the initial evaluation was warranted and sufficient.

To capture your evaluation, the following new section, Section 1.5.4, will be added to the Final BOU FS:

"Section 1.5.4 TCE Toxicity Uncertainty

On September 28,2011, EPA released a new toxicological assessment for TCE. The new Integrated Risk Information System (IRIS) Reference Concentration (RfC) is 0.002 mg/m^3, the new Inhalation Unit Risk (IUR) is 4×10^{-6} (µg/m^3)$^{-1}$. The IRIS RfC and IUR values are more conservative than those used in the RI and risk assessment to select remedial areas. DTSC's Health and Ecological (HERO) conducted an evaluation to determine if the soil vapor screening level of 961 µg/m^3 and the groundwater screening level of 5 µg/L were conservative enough to ensure the revised toxicity data would not result in additional areas requiring remedy, which were not originally identified in the RI.

HERO's evaluation concluded the following

- *Soil vapor - The RISL for soil vapor used in the RI for TCE (961 µg/m^3) was based off of the previous USPEA Indoor Air Screening Level of 0.96 µg/m^3 with an attenuation factor of 0.001 applied. HERO used default Johnson and Ettinger (J&E) residential parameters (with the new TCE toxicity criteria) to estimate the risk and hazard associated with TCE in soil vapor at 961 µg/m^3. The results of this evaluation indicate that even with the new TCE toxicity criteria, the incremental cancer risk is not above 1×10^{-6} and the HQ is 0.4.*

- *Groundwater – The RI assumed a conservative depth to groundwater of 30 feet and retained any location where TCE was present in groundwater at a concentration ≥ 5 µg/L for further evaluation in the FS. HERO used the updated J&E spreadsheet and determined that using default settings, 30 foot depth to groundwater, and a TCE concentration equal to 5 µg/L, the incremental cancer risk is 5×10^{-7} and the HQ is 0.15.*

Therefore, the TCE evaluation conducted in the BOU RI and risk assessment were sufficiently conservative to be in line with the recently released IRIS TCE toxicity data."

Comment 3. **Section, Page 1-22. "The SLERA did not recommend remedial action." The conclusions of each SLERA do not necessarily make recommendations regarding remedial action; instead it recommends either no further action or a "Scientific/Management Decision Point" (SMDP) regarding whether or not additional action is recommended.**

From Page 6-1 of the SLERA:

"At the conclusion of these two steps of the SLERA, a Scientific/Management Decision Point (SMDP) is reached (USEPA, 1997c). The first SMDP is a risk management review of the findings of the SLERA that leads to one of the following conclusions:

Ecological risks are negligible and there is no need for remediation; The information is inadequate and further work is required to address data gaps; or The information indicates a potential risk and a more thorough evaluation is warranted."

Please revise to better reflect the SLERA methodology, as it is not clear from the description if a risk management decision was made or the decision was made unilaterally by the author(s) of the report.

Response: To ensure consistency of terminology between the risk assessment and the FS, Section 1.5.1, fourth paragraph, last two sentences were revised to:

"The SLERA for Line 2 soil vapor stated "VOCs in soil vapor do not represent widespread contamination, and as such, are not considered to pose ecological risks at the population level." The SLERA for Line 2 also recommended no further action for soil vapor."

Comment 4. **Section 1.6 (Evaluation of COPECs in Samples Collected from BOU Facility Areas) Page 1-26. "In addition, as shown in Table D-2, these five samples are either very isolated or moderately isolated; the ESLs used for the HQ estimations were overly conservative for mercury; and/or the home range of some of the modeled receptors (e.g., two acres for the American robin) would be expected to significantly reduce exposure to COPECs." While not disagreeing with the qualitative generalities in the above statement, which are restated in many of the individual area evaluations, ERAS recommends that areas in which ESLs were found to be exceeded by 10x or more should either be evaluated further in a risk assessment process or should proceed to remedial evaluation in the FS.**

Response: See response to DTSC General Comment 4.

Comment 5. **Section 1.6 (Evaluation of COPECs in Samples Collected from BOU Facility Areas). Page 1-26. "Facility Areas within Chemical Plant 2 have 11 samples with elevated ESL exceedences (Figure 1-40) not within an area already retained for human health concerns; however, as a result of a detailed evaluation that looked at isolation as well as many other factors, special land use controls and five-year reviews do not appear warranted." The "detailed evaluation" noted in this sentence needs to be described in the text in more detail; currently the sentence reproduced above is the extent of the explanation in the FS, and this is insufficient for an evaluation by the agencies. If this is specifically referring to the evaluation in Appendix D, then that should be noted. ERAS notes that in the HHERA the Chemical Plant 2 facility is described as "surrounded by ecologically significant terrestrial and seasonal habitat", as well as potential habitat for the Valley Elderberry Beetle (VELB), and that the abandoned buildings were being utilized by birds and bats for nesting. Numerous constituents of potential concern were identified within the facility areas of the site for soil, soil vapor, and sediments and included pesticides, PCBs, metals, and VOCs. ERAS recommends that this issue regarding the evaluation be clarified so that the agencies can assess the any potential need for additional evaluation.**

Response: A summary of the detailed evaluation is presented in Appendix D, Table D-4. Section 1.6, **Conclusions and Recommendations**, second bullet, last sentence has been revised as follows:

"*Facility Areas within Chemical Plant 2 have 11 samples with elevated ESL exceedences (Figure 1-33) not within an area already retained for HH risk; however, as a result of a detailed evaluation (Table D-4) that looked at isolation as well as many other factors, special land use controls and five-year reviews do not appear warranted*."

Comment 6. **Table 1.7 (Summary of Risks and Rationale for Remedial Action- Buffalo Creek and Westlakes). ERAS did not find surface water samples that were collected at Westlakes (WL-SW03 and WL-SW04) listed in the table. Both of these samples contained concentrations of COPECs that exceeded ESLs by > 10x, including copper (4100 ug/L), aluminum (5200 ug/L) and lead (140 ug/L). Please add these samples to the summary table.**

Response: The tables in Section 1.0 only present summaries of risks for areas identified as requiring further evaluation. Since locations WL-SW03 and WL-SW04 were not identified in the risk assessment as locations that required further evaluation in the FS, these locations were not discussed in Section 1.0. However, in response to other DTSC and EPA comments regarding the need for further evaluation of sample locations posing an HQ>10, Table D-6 has been added to the FS which provides further evaluation of surface water sample locations WL-SW03 and WL-SW04.

Comment 7. **Figure 6-12 (Retained Remedial Areas-Non VOCs, Chemical Plant 2). ERAS compared the retained areas to the map of exceedances of risk characterization (Figure 8-1 in the HHERA) and notes that multiple areas of potential risk (more than 10x the ESL) appear to have not been retained, most notably the drain area that crosses the retained area CP2-R-1. Several exceedances were noted in this area, both for PCBs and pesticides, and these appear to be unbounded to the west, making the extent of the soil contamination uncertain. See also EPA specific comment 19, dated 12/20/2011.**

Response: A detailed evaluation of all locations posing an HQ>10 for ecological receptors and not already included in a remedial area was performed and has been added to the FS as Table D-6.

Comment 8. **Figure 6-12 (Retained Remedial Areas, Chemical Plant 2). Some of the areas retained for ecological risk based on non-VOC impacts (CP2-R-2, CP2-R-3, and CP2-R-6 are immediately adjacent (possibly even slightly overlapping) with a VOC source area (this can be seen in Figure 1-35 of the report). The potential for post-remediation recontamination of these areas with VOCs, and any mitigating factors that could be used to minimize possible future re-contamination, should be discussed.**

Response: See response to DTSC Specific Comment 5.

Comment 9. **Figure 6-13 (Retained Areas, non-VOCs, Dredge Pit and Eastern Basin). This map is completely lacking in detail and is presented at a different scale than maps in the HHERA, which makes comparison of the area retained on figure 6- 13 of the FS and the sample location map (see HHERA figure 6.8-3) difficult. ERAS recommends consistent use of maps in the future. Also, the retained area legend lists the purple colored areas as "other remedial/containment alternative"; the meaning of which is unclear. "Other" than what? Please clarify, perhaps simply referring to it as the "Area Retained for Remedial Action" or similar would make this more clear. Finally, it appears that sample locations 25F-SB14 and 25F-SPB01 were not included in the remediation area. These two samples contained Prowl pesticide at 770 mg/kg and 520 mg/kg respectively, exceeding both the avian and mammalian ESLs, and neither are bounded to the south or east. Please modify the retained area to include these locations.**

Response: The significant feature shown on both Figure 6.8-3 of the HHERA and Figure 6-12 of the FS is the source area boundary. This provides a very good point of reference to correlate the two figures. Additionally, Figure 1-31 shows this feature along with all sample locations. Figures 1-31 and 6-12 both show the same remedial area.

The purple shading in the legend on Figure 6-12 has been revised to state “Area to be backfilled with 6 feet of clean fill material”.

The remedial area DPEB-R-1 has been expanded to include sample locations 25F-SB14 and 25F-SPB01.

ATTACHMENT A

Results of Protection of Groundwater Evaluation for Constituents in Soil Vapor above Perched Groundwater

Table A-1 **Results of Protection of Groundwater Evaluation for Constituents in Soil Vapor in Perched Groundwater**
Administration Area East
Boundary Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Sample Location	Depth (ft bgs)	VOC	PGW SSL (µg/m3)	Soil Vapor Concentration (µg/m3)	Average Depth to FWBZ Water (ft bgs)	Estimated FWBZ GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	Average Depth to Perched Water (ft bgs)	Estimated Perched GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	SV-GWeq (perched) > SV-GWeq (FWBZ)	If True, SV-GWeq (perched) - PGW SSL	Further Evaluation?	Currently Included in SV RTG Remedial Area?	Do Perched GW Contours Indicate a Potential Source?	Ranking
3D-SP84	15	PCE	57	77	30	0	0	17	5.3	1,166	FALSE	---	---	---	---	---
	15	VC	235	420	30	13	2,210	17	0	0	TRUE	185	Yes	No	No	Moderate
3D-SP88	10	PCE	57	580	30	5	650	17	0.4	88	TRUE	435	Yes	No	No	Moderate
3D-SP89	10	PCE	57	33,000	30	8.5	1,105	17	0.43	95	TRUE	32,848	Yes	No	No	Moderate
3D-SP90	10	PCE	57	270	30	8	1,040	17	0.5	110	TRUE	103	Yes	No	No	Moderate
	10	TCE	527	560	30	10	1,238	17	2	415	TRUE	-382	No	---	---	---
	10	VC	235	250	30	10	1,700	17	1	280	TRUE	-265	No	---	---	---
3D-SP92	10	PCE	57	140	30	50	6,500	17	40	8,800	FALSE	---	---	---	---	---
3D-SP93	15	Benzene	35	210	30	0	0	17	0	0	FALSE	---	---	---	---	---
	15	PCE	57	290	30	100	13,000	17	10	2,200	TRUE	-1,967	No	---	---	---
3D-SP94	15	PCE	57	7,100	30	22	2,860	17	0.5	110	TRUE	6,933	Yes	No	No	Moderate
3D-SP95	10	PCE	57	150,000	30	75	9,750	17	100	22,000	FALSE	---	---	---	---	---
	10	TCE	527	5,700	30	75	9,281	17	25	5,188	TRUE	-15	No	---	---	---
	10	VC	235	1,500	30	50	8,500	17	5.3	1,484	TRUE	-219	No	---	---	---
3D-SP96	10	Benzene	35	36	30	0	0	17	0	0	FALSE	---	---	---	---	---
	10	PCE	57	95	30	0.5	65	17	0	0	TRUE	38	Yes	No	No	Low
	17	PCE	57	68	30	0.5	65	17	0	0	TRUE	11	Yes	No	No	Low
3D-SP99	10	PCE	57	280,000	30	50	6,500	17	300	66,000	FALSE	---	---	---	---	---
	10	TCE	527	940	30	25	3,094	17	4.2	872	TRUE	-459	No	---	---	---
3D-SP100	10	PCE	57	430,000	30	2200	286,000	17	450	99,000	TRUE	330,943	Yes	AE-SV-R-7	Yes	High
	10	TCE	527	580	30	16	1,980	17	3	623	TRUE	-570	No	---	---	---
3D-SP102	10	PCE	57	30,000,000	30	140000	18,200,000	17	5400	1,188,000	TRUE	28,811,943	Yes	AE-SV-R-7	Yes	High
3D-SP103	10	PCE	57	830,000	30	50	6,500	17	50	11,000	FALSE	---	---	---	---	---
	10	TCE	527	1,700	30	20	2,475	17	1	208	TRUE	966	Yes	No	No	Moderate
3D-SP104	10	PCE	57	640,000	30	360	46,800	17	5100	1,122,000	FALSE	---	---	---	---	---
	10	TCE	527	14,000	30	200	24,750	17	400	83,000	FALSE	---	---	---	---	---
3D-SP105	10	cis-1,2-DCE	1,641	2,000	30	940	49,538	17	120	10,580	TRUE	-10,221	No	---	---	---
	10	PCE	57	580,000	30	360	46,800	17	9400	2,068,000	FALSE	---	---	---	---	---
	10	TCE	527	16,000	30	200	24,750	17	420	87,150	FALSE	---	---	---	---	---
3D-SP106	15	PCE	57	7,200	30	5	650	17	9.8	2,156	FALSE	---	---	---	---	---
	15	VC	235	250	30	0	0	17	7.5	2,100	FALSE	---	---	---	---	---
3D-SP107	10	PCE	57	98,000	30	17	2,210	17	3	660	TRUE	97,283	Yes	AE-SV-R-8	Yes	High
	10	TCE	527	86,000	30	190	23,513	17	1	208	TRUE	85,266	Yes	AE-SV-R-8	No	Moderate
3D-SP108	10	PCE	57	9,500	30	8.7	1,131	17	22	4,840	FALSE	---	---	---	---	---
3D-SP109	10	PCE	57	18,000	30	460	59,800	17	200	44,000	TRUE	-26,057	No	---	---	---
	10	TCE	527	2,300	30	100	12,375	17	50	10,375	TRUE	-8,602	No	---	---	---
	10	VC	235	550	30	17	2,890	17	0.5	140	TRUE	175	Yes	No	No	Moderate

Table A-1 **Results of Protection of Groundwater Evaluation for Constituents in Soil Vapor in Perched Groundwater**
Administration Area East
Boundary Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Sample Location	Depth (ft bgs)	VOC	PGW SSL (µg/m3)	Soil Vapor Concentration (µg/m3)	Average Depth to FWBZ Water (ft bgs)	Estimated FWBZ GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	Average Depth to Perched Water (ft bgs)	Estimated Perched GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	SV-GWeq (perched) > SV-GWeq (FWBZ)	If True, SV-GWeq (perched) - PGW SSL	Further Evaluation?	Currently Included in SV RTG Remedial Area?	Do Perched GW Contours Indicate a Potential Source?	Ranking
3D-SP110	10	PCE	57	11,000	30	1400	182,000	17	300	66,000	TRUE	-55,057	No	---	---	---
	10	TCE	527	930	30	240	29,700	17	50	10,375	TRUE	-9,972	No	---	---	---
3D-SP111	10	PCE	57	56,000	30	60	7,800	17	60	13,200	FALSE	---	---	---	---	---
3D-SP112	10	PCE	57	240	30	30	3,900	17	20	4,400	FALSE	---	---	---	---	---
3D-SP113	10	PCE	57	270	30	4	520	17	2	440	TRUE	-227	No	---	---	---
3D-SP115	10	PCE	57	650	30	1.4	182	17	0	0	TRUE	593	Yes	No	No	Low
3D-SP116	10	PCE	57	150	30	1	130	17	0.73	161	FALSE	---	---	---	---	---
3D-SP117	10	PCE	57	1,000	30	10	1,300	17	4	880	TRUE	63	Yes	No	No	Moderate
3D-SP118	10	PCE	57	14,000	30	50	6,500	17	30	6,600	FALSE	---	---	---	---	---
3D-SP119	10	PCE	57	10,000	30	7	910	17	5	1,100	FALSE	---	---	---	---	---
	10	TCE	527	6,400	30	70	8,663	17	1	208	TRUE	5,666	Yes	No	No	Moderate
3D-SP120	10	PCE	57	180	30	60	7,800	17	20	4,400	TRUE	-4,277	No	---	---	---
3D-SP121	15	cis-1,2-DCE	1,641	2,300	30	4.8	253	17	30	2,645	FALSE	---	---	---	---	---
	15	PCE	57	320,000	30	140	18,200	17	4	880	TRUE	319,063	Yes	No	No	Moderate
	15	TCE	527	10,000	30	11	1,361	17	1	208	TRUE	9,266	Yes	No	No	Moderate
	15	VC	235	2,500	30	0.5	85	17	0.5	140	FALSE	---	---	---	---	---
3D-SP122	10	PCE	57	10,000	30	0.5	65	17	0.56	123	FALSE	---	---	---	---	---
3D-SP123	10	PCE	57	180	30	0	0	17	0	0	FALSE	---	---	---	---	---
3D-SP135	10	PCE	57	8,600	30	1.5	195	17	35	7,700	FALSE	---	---	---	---	---
3D-SP137	10	PCE	57	740	30	5	650	17	0	0	TRUE	683	Yes	No	No	Low
3D-SP138	10	PCE	57	60	30	0.5	65	17	0	0	TRUE	3	Yes	No	No	Low
	10	TCE	527	3,400	30	100	12,375	17	0	0	TRUE	2,873	Yes	No	No	Low
3D-SP142	10	PCE	57	790	30	4.2	546	17	0	0	TRUE	733	Yes	No	No	Low
3D-SP143	10	PCE	57	1,000	30	7	910	17	0	0	TRUE	943	Yes	No	No	Low
3D-SP144	10	PCE	57	1,100	30	0	0	17	0	0	FALSE	---	---	AE-SV-R-1	---	---
3D-SP145	10	PCE	57	98	30	1.7	221	17	0	0	TRUE	41	Yes	No	No	Low
3D-SP146	10	PCE	57	6,400	30	1	130	17	0	0	TRUE	6,343	Yes	No	No	Low
	10	TCE	527	4,100	30	60	7,425	17	0	0	TRUE	3,573	Yes	No	No	Low
50D-SP01	10	PCE	57	140	30	2	260	17	0	0	TRUE	83	Yes	No	No	Low
51D-SP04	10	PCE	57	110	30	0	0	17	0	0	FALSE	---	---	---	---	---
A20-ST01-2-SP01	10	PCE	57	380	30	6	780	17	0	0	TRUE	323	Yes	No	No	Low
A20-ST01-3-SP01	10	PCE	57	64	30	2	260	17	0	0	TRUE	7	Yes	No	No	Low
A20-ST01-SP01	10	PCE	57	200	30	0.7	91	17	0	0	TRUE	143	Yes	No	No	Low
A20-ST06-SP01	10	PCE	57	900	30	1.5	195	17	0	0	TRUE	843	Yes	No	No	Low

Table A-1 **Results of Protection of Groundwater Evaluation for Constituents in Soil Vapor in Perched Groundwater**
Administration Area East
Boundary Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Sample Location	Depth (ft bgs)	VOC	PGW SSL (µg/m3)	Soil Vapor Concentration (µg/m3)	Average Depth to FWBZ Water (ft bgs)	Estimated FWBZ GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	Average Depth to Perched Water (ft bgs)	Estimated Perched GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	SV-GWeq (perched) > SV-GWeq (FWBZ)	If True, SV-GWeq (perched) - PGW SSL	Further Evaluation?	Currently Included in SV RTG Remedial Area?	Do Perched GW Contours Indicate a Potential Source?	Ranking
A20-ST14-SP01	10	PCE	57	840	30	0.5	65	17	0	0	TRUE	783	Yes	No	No	Low
A20-ST14-SP02	10	PCE	57	760	30	0	0	17	0	0	FALSE	---	---	---	---	---

Notes
PCE = tetrachloroethylene TCE = trichloroethylene cis-1,2-DCE = cis-1,2-dichloroethylene
PGW SSL = Protection of groundwater soil vapor screening level
SV = soil vapor
µg/m^3 = micrograms per cubic meter
ft bgs = feet below ground surface
GW = groundwater
SV GW Equilibrium Conc = the modeled soil vapor concentration at 10 ft bgs that would be in equilibrium with and derived from the groundwater
SV - GWeq = Measured soil vapor concentration minus the SV GW equilibrium concentration

Table A-2 Results of Protection of Groundwater Evaluation for Constituents in Soil Vapor in Perched Groundwater
Administration Area West
Boundary Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Sample Location	Depth (ft bgs)	VOC	PGW SSL (µg/m^3)	SV Conc. (µg/m^3)	Average Depth to FWBZ Water (ft bgs)	Estimated FWBZ GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	Average Depth to Perched Water (ft bgs)	Estimated Perched GW Concentration (µg/L)	SV GW Equilibrium Concentration (µg/m^3)	SV-GWeq (perched) > SV-GWeq (FWBZ)	If True, SV-GWeq (perched) - PGW SSL	Further Evaluation ?	Currently Included in SV RTG Remedial Area?	Do Perched GW Contours Indicate a Potential Source?	Ranking
52D-SP24	10	PCE	57	130	30	5.3	689	17	0	0	TRUE	73	Yes	No	No	Low
	10	TCE	527	1,800	30	170	21038	17	0	0	TRUE	1273	Yes	No	No	Low
52D-SP25	10	TCE	527	1,200	30	170	21038	17	0	0	TRUE	673	Yes	No	No	Low
52D-SP26	10	PCE	57	79	30	5.3	689	17	0	0	TRUE	22	Yes	No	No	Low
	10	TCE	527	1,100	30	170	21038	17	3.6	747	TRUE	-174	No	No	No	Moderate
52D-SP29	10	Benzene	35	81	30	0	0	17	0	0	FALSE	---	---	---	---	---
	10	PCE	57	65	30	5	650	17	0	0	TRUE	8	Yes	No	No	Low
	10	TCE	527	2,600	30	170	21038	17	0.21	43.575	TRUE	2029.425	Yes	No	No	Moderate
52D-SP32	10	PCE	57	98	30	1	130	17	0	0	TRUE	41	Yes	No	No	Low
	10	TCE	527	780	30	50	6188	17	0	0	TRUE	253	Yes	No	No	Low
52D-SP33	10	PCE	57	92	30	1	130	17	0	0	TRUE	35	Yes	No	No	Low
52D-SP34	10	PCE	57	59	30	0	0	17	0	0	FALSE	---	---	---	---	---
52D-SP35	10	PCE	57	97	30	1.2	156	17	0	0	TRUE	40	Yes	No	No	Low
52D-SP36	10	PCE	57	76	30	0.5	65	17	0	0	TRUE	19	Yes	No	No	Low
52D-SP38	10	PCE	57	61	30	0	0	17	0	0	FALSE	---	---	---	---	---
52D-SP41	10	PCE	57	87	30	0	0	17	0	0	FALSE	---	---	---	---	---
52D-SP42	10	PCE	57	68	30	0.5	65	17	0	0	TRUE	11	Yes	No	No	Low
52D-SP43	10	PCE	57	120	30	0	0	17	0	0	FALSE	---	---	---	---	---
8D-SP08	10	Benzene	35	66	30	0	0	17	0	0	FALSE	---	---	---	---	---
	10	PCE	57	71	30	0.5	65	17	0	0	TRUE	14	Yes	No	No	Low
AW-8D-SP10	10	Benzene	35	57	30	0	0	17	0	0	FALSE	---	---	---	---	---
D(b)-SP03	10	PCE	57	130	30	0	0	17	0	0	FALSE	---	---	---	---	---
	10	TCE	527	1100	30	5	618.8	17	0	0	TRUE	573	Yes	No	No	Low
D(b)-SP04	10	PCE	57	120	30	0	0	17	0	0	FALSE	---	---	---	---	---
D(b)-SP06	10	PCE	57	68	30	0	0	17	0	0	FALSE	---	---	---	---	---
D(c)-SP05	10	Benzene	35	49	30	0	0	17	0	0	FALSE	---	---	---	---	---
D(c)-SP06	10	TCE	527	690	30	2	248	17	0	0	TRUE	163	Yes	No	No	Low
D(c)-SP11	10	Benzene	35	35	30	0	0	17	0	0	FALSE	---	---	---	---	---
D(c)-SP12	10	PCE	57	69	30	0	0	17	0	0	FALSE	---	---	---	---	---

PCE = tetrachloroethylene TCE = trichloroethylene
PGW SSL = Protection of groundwater soil vapor screening level
µg/m^3 = micrograms per cubic meter
ft bgs = feet below ground surface
GW = groundwater
SV GW Equilibrium Conc = the modeled soil vapor concentration at 10 ft bgs that would be in equilibrium with and derived from the groundwater
SV - GWeq = Measured soil vapor concentration minus the SV GW equilibrium concentration

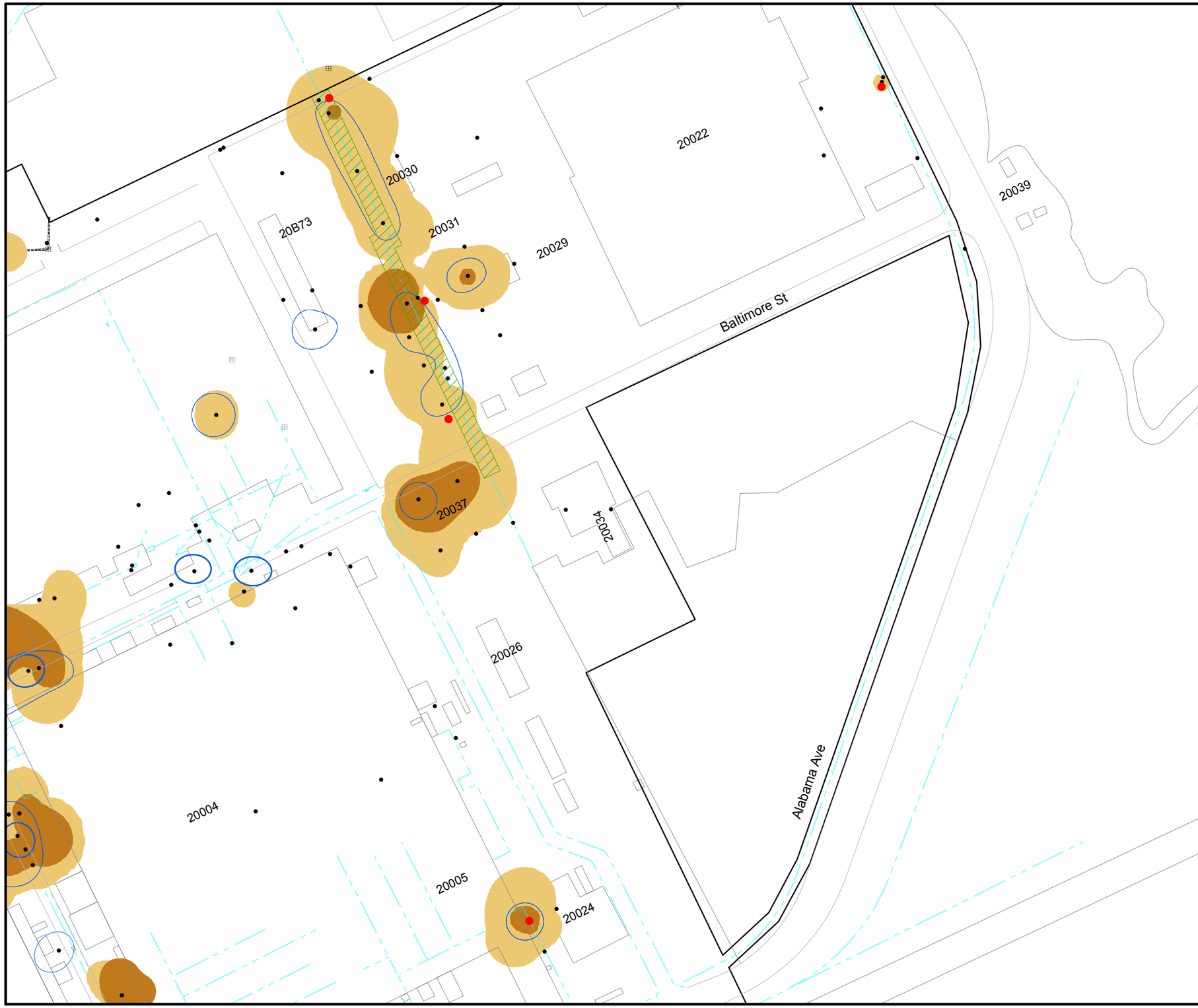
Table A-3 Results of Protection of Groundwater Evaluation for Constituents in Soil Vapor in Perched Groundwater
WLLO Area
Boundary Operable Unit Risk Assessment
Aerojet Superfund Site
Sacramento County, California

Sample Location	Depth (ft bgs)	VOC	PGW SSL ($\mu g/m^3$)	SV Conc. ($\mu g/m^3$)	Average Depth to FWBZ Water (ft bgs)	Estimated FWBZ GW Concentration ($\mu g/L$)	SV GW Equilibrium Concentration ($\mu g/m^3$)	Depth of Perched Water Sample (ft bgs)	Estimated Perched GW Concentration ($\mu g/L$)	SV GW Equilibrium Concentration ($\mu g/m^3$)	SV-GWeq (perched) > SV-GWeq (FWBZ)	If True, SV-GWeq (perched) - PGW SSL	Further Evaluation ?	Currently Included in SV RTG Remedial Area?	Do Perched GW Contours Indicate a Potential Source?	Ranking
LINE 02																
DSA-SP17	10	TCE	527	2,400	45	1.8	152.28	43	0	0	TRUE	1873	Yes	No	No	Low
	20	TCE	527	1,300	45	1.8	152.28	43	0	0	TRUE	773	Yes	No	No	Low
	30	TCE	527	910	45	1.8	152.28	43	0	0	TRUE	383	Yes	No	No	Low
DSA-SP23	30	TCE	527	1,200	45	50	4230	45	3.9	332	TRUE	342	Yes	No	No	Moderate
DSA-SP24	30	TCE	527	1,700	45	60	5076	45	5.1	434	TRUE	740	Yes	No	Yes	High
Line 05 North																
51E-SP11	20	TCE	527	7,800	65	13	772	35	13	1398	FALSE	---	---	---	---	---
52E-SP07	20	TCE	527	27,000	65	9.8	582	35	9.8	1054	FALSE	---	---	---	---	---

TCE = Trichloroethene
PGW SSL = Protection of groundwater soil vapor screening level
$\mu g/m^3$ = micrograms per cubic meter
ft bgs = feet below ground surface
GW = groundwater
SV GW Equilibrium Conc = the modeled soil vapor concentration at 10 ft bgs that would be in equilibrium with and derived from the groundwater
SV - GWeq = Measured soil vapor concentration minus the SV GW equilibrium concentration

ATTACHMENT B

Figure Showing Lead Detections between 80 and 150 mg/kg.



Lead Between 80 and 150 mg/kg
Soil Boring Location
High Risk Contour (Residential)
Low Risk Contour (Residential)
High Risk to Groundwater
Low Risk to Groundwater
Potential Ecological Concern
Surface Drainage
Road
Railroad
Fence
Structure
Removed Structure
Management Area/Open Space Boundary

See Figure 1-29, "Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments" for sample location names.

N

0 150 300
Feet

1 inch = 150 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure B-1

Lead Between 80 and 150 mg/kg

Administration Area East Boundary Operable Unit

SR10131248 Created by Shaw E & I 3/22/2012

Lead Between 80 and 150 mg/kg
Soil Boring Location
High Risk Contour (Residential)
Low Risk Contour (Residential)
High Risk to Groundwater
Low Risk to Groundwater
Potential Ecological Concern
Surface Drainage
Road
Railroad
Fence
Structure
Removed Structure
Management Area/Open Space Boundary

See Figure 1-30, "Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments" for sample location names.

N

0 150 300
Feet

1 inch = 150 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

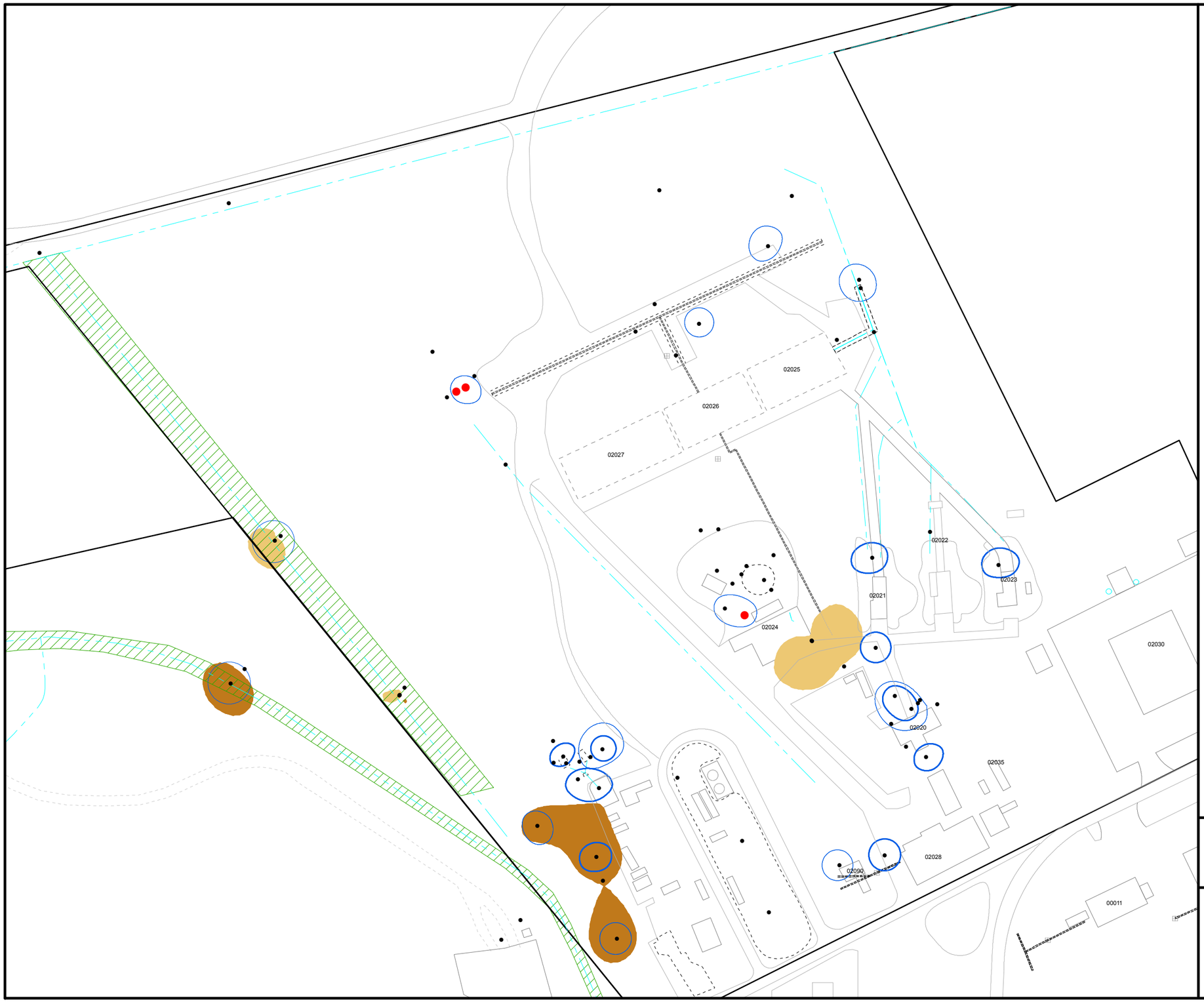
AEROJET
Environmental Remediation

Figure B-2

Lead Between 80 and 150 mg/kg

Administration Area West Boundary Operable Unit

SR10131248 Created by Shaw E & I 3/22/2012



Lead Between 80 and 150 mg/kg
Soil Boring Location
High Risk Contour (Residential)
Low Risk Contour (Residential)
High Risk to Groundwater
Low Risk to Groundwater
Potential Ecological Concern
Surface Drainage
Road
Railroad
Fence
Structure
Removed Structure
Management Area/Open Space Boundary

See Figure 1-31, "Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments" for sample location names.

N

0 150 300
Feet

1 inch = 150 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

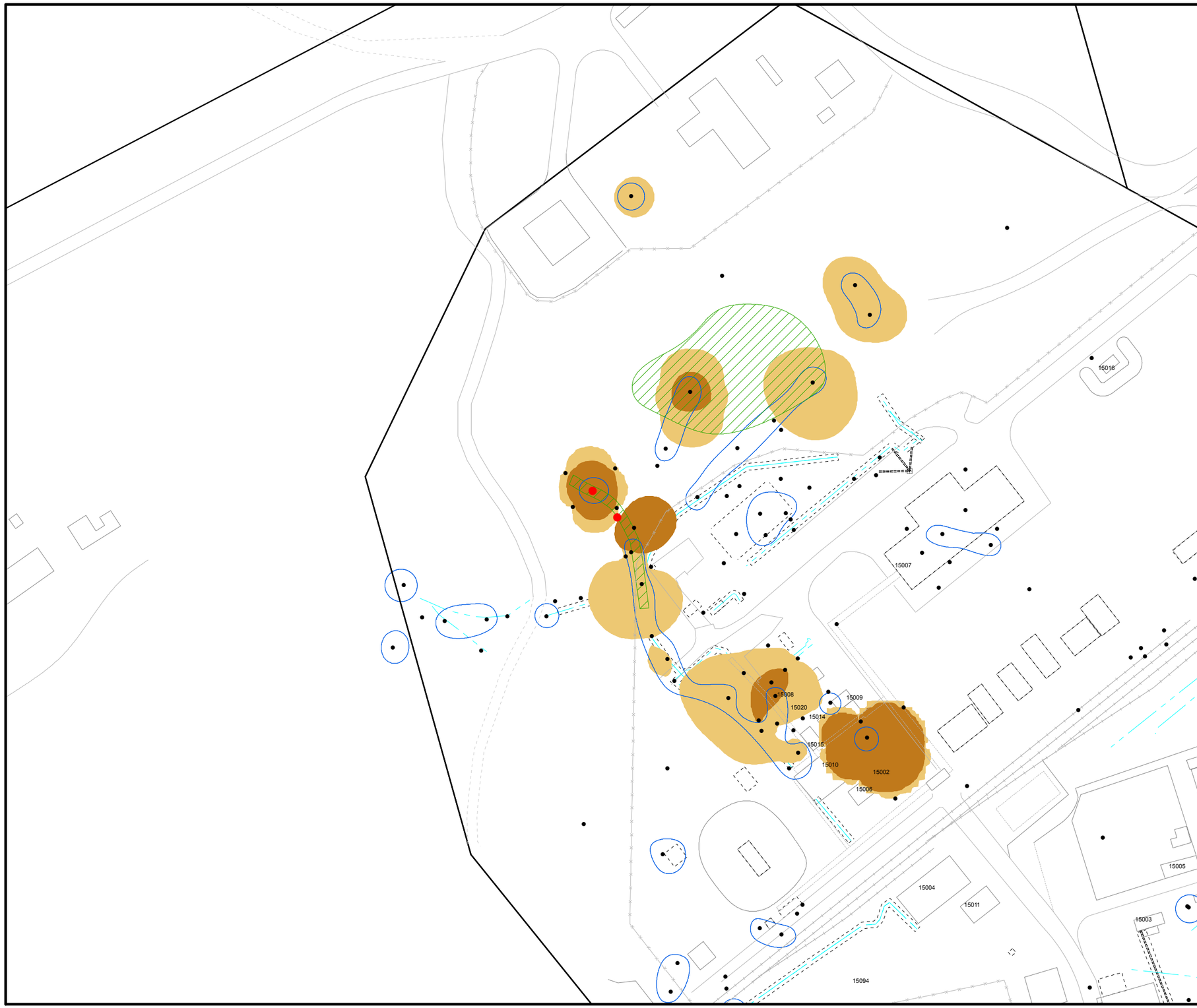
AEROJET
Environmental Remediation

Figure B-3

Lead Between 80 and 150 mg/kg

Line 02
Boundary Operable Unit

SR10131248 Created by Shaw E & I 3/22/2012



Lead Between 80 and 150 mg/kg
Soil Boring Location
High Risk Contour (Residential)
Low Risk Contour (Residential)
High Risk to Groundwater
Low Risk to Groundwater
Potential Ecological Concern
Surface Drainage
Road
Railroad
Fence
Structure
Removed Structure
Management Area/Open Space Boundary

See Figure 1-35, "Summary of Human Health, Ecological, and Protection of Groundwater Risk Assessments" for sample location names.

N

0 150 300
Feet

1 inch = 150 feet

Projection: NAD_1927_StatePlane_California_II_FIPS_0402_Feet

AEROJET
Environmental Remediation

Figure B-4

Lead Between 80 and 150 mg/kg

Chemical Plant 2
Boundary Operable Unit

SR10131248 Created by Shaw E & I 3/22/2012

Appendix D
Ecological Evaluation of Samples Collected from BOU Facility (Non-Habitat) Areas and Habitat Area Samples Greater than 10 Times ESL

Table D-1
Summary of Samples from Facility and Ecological Risks and Rationale for Remedial Action or Land Use Control - Southern Area of Administration Area West
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Sample Location	COPECs from Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	COPECs in Habitat Exceeding SLERA Risk Levels[1]	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
AW-N-27	08D-GS02 08D-SB02	DnBP A-1254	DnBP 377 (A) A-1254 27 (A)	None	NA	DnBP - MI A-1254 - VI	Commercial	DnBP was a COPEC with concentrations of 3.81 mg/kg in the 08D-GS02 0-foot bgs and the 0.01-foot bgs samples, and A-1254 was a COPEC with a concentration of 0.27 mg/kg, all which were > 10x ESL. HQs for potential avian risk from DnBP were 377 at both soil depths at 08D-GS02. HQs for potential avian risk from A-1254 were 27 at 08D-SB02. DnBP exceedances were moderately isolated, with other DnBP sample results at AAW > 10x the ESL in the southern area being 0.865 mg/kg (1 ft), 2.46 mg/kg (5 ft) at 08D-AH01, and 1.59 mg/kg (5 ft) at 08D-AH02. The A-1254 exceedance was very isolated, with no other sample results at AAW > 10x the ESL. The DnBP avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove. The A-1254 avian ESL was derived in the Eco White Paper using a TRV of 0.072 mg/kg-day for a ringed dove.	N
AW-N-28	09D-SNS03	Hg	14510 (A) 569 (M)	None	NA	MI	Commercial	Hg was a COPEC with a concentration of 0.74 mg/kg, which was > 10x ESL, in the 3-foot bgs sample at sampling location 09-SNS03. HQs were 14510 and 569 for potential avian and mammalian risk, respectively. Hg exceedances were moderately isolated, with two other Hg sample results at AAW > 10x the ESL in the southern area being 0.57 mg/kg at 08D-GS01 (0.01 ft) and 0.19 mg/kg at 08D-SB06 (1 ft). Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for soil is overly conservative, as methylation is not expected in the terrestrial environment. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 57 and <1 for the robin and shrew, respectively. It	N
AW-N-29	08D-AH02	DnBP	DnBP 127 (A)	None	NA	MI	Commercial	DnBP was a COPEC with a concentration of 1.59 mg/kg, which was > 10x ESL, in the 5-foot bgs sample at sampling location 08D-AH02, with an HQ of 127, for potential avian risk. DnBP exceedances were moderately isolated, with other DnBP sample results at AAW > 10x the ESL being 0.865 mg/kg (1 ft) and 2.46 mg/kg (5 ft) at 08D-AH01 (1 ft), 3.81 mg/kg (0-0.01 ft) at 08D-GS02, and 1.59 mg/kg (5 ft) at 08D-AH02. The avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove.	N
AW-N-30	08D-AH01	DnBP	5 ft-bgs 196 (A) 1 ft-bgs 69 (A)	None	NA	MI	Commercial	DnBP was a COPEC with concentrations of 2.46 mg/kg in the 5-foot bgs sample 08D-AH01 and 0.865 mg/kg in the 1-foot bgs sample, which were > 10x ESL. HQs for potential avian risk were 69 and 196, respectively. DnBP exceedances were moderately isolated, with other DnBP sample results at AAW > 10x the ESL being 1.59 mg/kg (5 ft), and 3.81 mg/kg (0-0.01 ft) at 08D-GS02. The avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove.	N
AW-N-31	08D-GS01	Cd, Hg, Ag	Hg 11176 (A) Hg 438 (M) Ag 18 (A) Cd 14 (M)	None	NA	Ag, Cd - VI Hg - MI	Commercial	Hg, Ag, Cd were COPECs with concentrations of 0.57 mg/kg, 76.5 mg/kg, and 5.06 mg/kg, which were > 10x ESL, in the 0.01-foot bgs sample at sampling location 08D-GS01. HQs for potential avian risks for Hg and Ag were 11176 and 18, respectively. HQs for potential mammalian risks for Hg and Cd were 438 and 14, respectively. Ag and Cd exceedances were very isolated, with no other sample results at AAW > 10x the ESL in the southern area. Hg exceedances were moderately isolated, with one other Hg sample result at AAW > 10x the ESL being 0.74 mg/kg at 08D-G-S02 (3 ft). The avian Hg ESL was based on a Woodcock TRV of 0.064 mg/kg-day (ORNL, 1997) and the Ag ESL was based on a TRV of 2.02 mg/kg-day for a turkey (EcoSSL). The mammalian Hg ESL was based on a short-tailed shrew TRV of 0.352 mg/kg-day and the mammalian Cd ESL was based on a rat TRV of 7.7 mg/kg-day (EcoSSL). Using alternate, yet still conservative, ESLs based on mercuric chloride TRVs from LANL (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 44 and <1 for the robin and shrew, respectively. The use of a methylmercury TRV for soil is overly conservative, as methylation is not expected in the terrestrial environment. It is	N

Notes:
1 - References for these columns can be found in Table 1-13. M = Mammal; A = Avian; P = Plant; I = Soil Invertebrate.
See Table 1-12 for a list of acronyms

Table D-2
Summary of Samples from Facility and Ecological Risks and Rationale for Remedial Action or Land Use Control- Line 02
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Sample Location	COPECs from Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	COPECs in Habitat Exceeding SLERA Risk Levels[1]	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
L2-N-14	29E-SB05	Sb	33 (M)	None	NA	VI	Mixed Use	Adjacent building, excavation may impact structure.	Sb was the only COPEC collected from Facility areas, with maximum concentration of 9.0 mg/kg, that was > 10x ESL, in the 2-foot bgs sample at sampling location 29E-SB05, with an HQ of 33, for potenital mammalian wildlife risk. Sb exceedance was very isolated, with no other Sb sample results at Line 2 being > 10x the ESL, except for the same sample at a depth of 5 ft bgs (4.3 mg/kg). Background RCRB BTV for Sb was 1.3 mg/kg.	N
L2-N-15	E(n)-SNS01	Zn	60.7 (A) 35.4 (M) 23.3 (I) 17.5 (P)	None	NA	VI	Mixed Use	No	Zn was the only COPEC collected from Facility areas, with maximum concentration of 2800 mg/kg, that was > 10x ESL, in the 0.5-foot bgs sample at sampling location E(n)-SNS01, with a max HQ of 60.7, for potenital avian wildlife risk. Background RCRB BTV for Zn was 100 mg/kg.	N
L2-N-16	DSA-SB03	Mo	46.5 (P) 19.6 (M)	None	NA	VI	Mixed Use	No	Mo was the only COPEC collected from Facility areas, with maximum concentration of 93 mg/kg, that was > 10x ESL, in the 2-foot bgs sample at sampling location DSA-SB03, with an HQ of 46.5, for potenital plant risk and HQ of 19.6 for potential mammal risk. Mo exceedance was very isolated, with no other Mo sample results at Line 2 being > 10x the ESL. Background xero BTV for Mo was 0.63 mg/kg.	N
L2-N-17	29E-SB01 29E-SB02	DnBP	430 (A)	None	NA	MI	Mixed Use	No	DnBP was a COPEC collected from Facility areas, with maximum concentration of 5.38 mg/kg, that was > 10x ESL, in the 5-foot bgs sample at sampling location 29E-SB02, with an HQ of 430, for potenital avian risk. DnBP exceedances were moderately isolated, with other DnBP sample results at Line 2 > 10x the ESL being 4.41 mg/kg at 29E-SB01 (1 ft) and 0.67 mg/kg at 29E-SB02 (3 ft). The avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove.	N

Notes:
1 - References for these columns can be found in Table 1-13. M = Mammal; A = Avian; P = Plant; I = Soil Invertebrate.
See Table 1-12 for a list of acronyms

Table D-3
Summary of Samples from Facility and Ecological Risks and Rationale for Remedial Action or Land Use Control - Line 5 North
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Sample Location	COPECs from Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	COPECs in Habitat Exceeding SLERA Risk Levels[1]	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Site Access Issues?	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
L5-R-3	52E-SNS01	Cd DnOP	Cd 13.3 (M) DnOP 96 (A)	None	None	VI	Residential	No	L5-R-1 is already retained for human health concerns; therefore, as there are elevated Cd and Di-n-octalphthalate (DnOP) ecological hazards, area is already being addressed in the FS.	R for HHRA
L5-N-5	51E-SB02	Cd	15.6 (M)	None	None	VI	Residential	No	Cd was the only COPEC collected from Facility areas, with maximum concentration of 5.61 mg/kg, that was > 10x ESL, in the 1-foot bgs sample at sampling location 51E-SB02, with an HQ of 15.6, for potenital mammalian wildlife risk. Cd exceedance was very isolated, with no other Cd sample results at Line 5 North being > 10x the ESL, except for 52E-SNS01 at a depth of 0.5 ft bgs (4.8 mg/kg). Background Xero BTV for Cd was 1.2 mg/kg.	N

Notes:
1 - References for these columns can be found in Table 1-13. M = Mammal; A = Avian; P = Plant; I = Soil Invertebrate.
See Table 1-12 for a list of acronyms

Table D-4
Summary of Samples from Facility and Ecological Risks and Rationale for Remedial Action or Land Use Control - Chemical Plant 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Sample Location	COPECs from Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	COPECs in Habitat Exceeding SLERA Risk Levels[1]	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
CP2-R-1	59F-SB19 CP2-08-SNS02	Prowl A-1254	17.6 (M) 12 (A) 2.9 (M)	None	NA	MI NI	Commercial	CP2-R-1 is already retained for human health concerns; therefore, as there are elevated Prowl and Aroclor-1254 ecological hazards, area can be expanded and addressed in the FS.	R
CP2-R-12	61F-SNS01	Hg	31373 (A) 1230 (M)	None	NA	VI	Commercial	CP2-R-7 is already retained for human health concerns; therefore, as there are elevated Hg ecological hazards, area is already being addressed in the FS.	R
CP2-R-13	CP2-08-SB12	A-1254	190 (A)	None	NA	NI	Commercial	CP2-R-9 is already retained for human health concerns; therefore, as there are elevated Aroclor-1254 ecological hazards, area can be slightly expanded and addressed in the FS.	R
CP2-N-31	60F-SNS01	Hg	5098 (A) 200 (M)	None	NA	MI	Commercial	Hg was a COPEC with a concentration of 0.26 mg/kg, which was > 10x ESL, in the 1-foot bgs sample at sampling location 60F-SNS01. HQs were 5098 and 200 for potential avian and mammalian risk, respectively. Hg exceedances were moderately isolated, with two other Hg sample results at CP2 > 10x the ESL in the southern area being 3.45 mg/kg at 60F-SB01 (1 ft) and 61F-SNS01 (0.5ft), but 61F-SNS01 will be addressed for human health concerns. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 20 and <1 for the robin and shrew, respectively. The use of a methylmercury TRV for soil is overly conservative, as methylation is not expected in the terrestrial environment. It is unlikely that one or two relatively small isolated areas with elevated Hg HQs will impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for RCRB soil was 0.87 mg/kg.	N
CP2-N-32	CP2-07-SP01	Vinyl chloride	11 (M, A)	None	NA	VI	Commercial	Vinyl chloride was a COPEC in this soil vapor (10 ft) sample, with a concentration of 6400 ug/m^3 and associated HQ of 11 for burrowing mammals (and burrowing birds, based on surrogate approach, as only mammal inhalation toxicity study available). Detections of vinyl chloride in other CP-2 vapor samples do not occur, so this VOC is very isolated. Alternative ESL (TRV) recommended by Santa Susana Field Laboratory (CA) for vinyl chloride range from 550 to 2700 ug/m^3, for low TRV to high TRV. Based on these alternative ESLs (TRVs), HQs would range from 2.4 to 12. In addition, burrowing wildlife such as the short-tailed shrew, California ground squirrel, and weasel have home ranges of approximately 1.0, 0.5, and 25 acres, and a burrowing owl has a home range of approximately 40 acres. Therefore, an area use factor approach would reduce potential vinyl chloride exposure to wildlife by a considerably amount.	N
CP2-N-33	61F-SPB01 61F-SPB02	DnBP	1136 (A) 102 (A)	None	NA	VI	Commercial	DnBP was a COPEC with concentrations of 14.2 mg/kg and 1.27 mg/kg, which were > 10x ESL, at sampling locations 61F-SPB01 (1 ft) and 61F-SPB02 (5 ft), respectively. HQs for potential avian risk were 1136 and 102, respectively. DnBP exceedances were very isolated, with no other DnBP sample results at CP2 > 10x the ESL. The avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove.	N
CP2-N-34	60F-SB01	Hg Tl BEHP	Hg 67647 (A) Hg 2654 (M) Tl [1 ft-bgs] 36 (P) Tl [5 ft-bgs] 34.2 (P) BEHP 27 (A) Tl [1 ft-bgs] 17 (M) Tl [5 ft-bgs] 16 (M)	None	NA	Hg - MI BEHP - VI Tl - VI	Commercial	Hg, Tl, and BEHP were COPECs with concentrations of 3.45 mg/kg, 36 mg/kg, and 1.09 mg/kg, which were > 10x ESL, in the 1-foot bgs sample at sampling location 60F-SB01. Tl was a COPEC with a concentration of 34.2 mg/kg, which was > 10x ESL, in the 5-foot bgs sample at sampling location 60F-SB01. HQs were 67647 and 2654 for potential Hg avian and mammalian risk, respectively. The HQs were 36 and 34.2 for potential Tl plant risk at 1 ft and 5 ft, respectively; and 17 and 16 for potential Tl mammalian risk at 1 ft and 5 ft, respectively. The HQ was 27 for potential BEHP avian risk. Hg exceedances were moderately isolated, with two other Hg sample results at CP2 > 10x the ESL being 0.26 mg/kg at 60F-SNS01 (1 ft) and 61F-SNS01 (0.5ft), Hg at 60F-SNS01 was below the Hg BTV of 0.87 mg/kg for RBRC soil and 61F-SNS01 will be addressed for human health concerns. BEHP exceedances were very isolated, with no other BEHP sample results at CP2 > 10x the ESL. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 265 and 2 for the robin and shrew, respectively. The use of a methylmercury TRV for soil is overly conservative, as methylation is not expected in the terrestrial environment. It is unlikely that one or two relatively small isolated areas with elevated Hg HQs will impact robin populations since the robin's average home range is approximately two acres. The BEHP avian ESL was derived in the Eco White Paper using a TRV of 1.1 mg/kg-day for a ringed dove. The Tl BTV for Xero soil was 3.3 mg/kg. Tl was identified as a chemical that was not site related during the SLERA.	N

Table D-4
Summary of Samples from Facility and Ecological Risks and Rationale for Remedial Action or Land Use Control - Chemical Plant 2
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Sample Location	COPECs from Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	COPECs in Habitat Exceeding SLERA Risk Levels[1]	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
CP2-N-35	59F-SPB03	B	86 (P) 2.2 (I)	None	NA	VI	Commercial	Boron was a COPEC with concentration of 43.1 mg/kg, with estimated HQ of 86 for plants and 2.2 for invertebrates. Background concentrations of boron are as elevated as 28.1 mg/kg for Xero soil type (therefore less than 2X background). Remediation to protect common plants and soil invertebrates is typically not warranted. No other boron detections above ESLs in the area, so very isolated.	N
CP2-N-36	59F-SPB04 59F-SPB04A	Tl	27 (P) 13 (M) 28 (P) 14 (M)	None	NA	VI	Commercial	Thallium was a COPEC in these surface (1 ft) and subsurface (5 ft) samples, with concentrations of 27.1 mg/kg and 28.3 mg/kg, and associated HQs of 27-28 for plants and 13-14 for mammals. Background concentrations of thallium are as elevated as 3.3 mg/kg for Xero soil type. Remediation to protect common plants is typically not warranted. No other thallium detections above ESLs in the area, so very isolated. Tl was identified as a chemical that was not site related during the SLERA.	N
CP2-N-37	59F-SB23	Prowl	18 (M) 13 (A)	None	NA	MI	Commercial	Prowl was a COPEC in this surface (1 ft) sample, with a concentration of 11 mg/kg and associated HQ of 18 for mammals and 13 for birds. There are Prowl detections nearby in 59F-SB19 and 59F-SB06, so moderately isolated. The calculated half-life of Prowl (pendimethalin) in a field study (almond orchard in California) was 34 days (USEPA ERED Case Study No. 0817), therefore, current level from 2005 detection expected to be below ESLs.	N
CP2-N-38	F(C)-SB01	Hg	28800 (A) 1130 (M)	None	NA	MI	Commercial	Hg was a COPEC with a concentration of 1.47 mg/kg, which was > 10x ESL, in the 1-foot bgs sample at sampling location F(C)-SB01. HQs were 28800 and 1130 for potential avian and mammalian risk, respectively. Hg exceedances were moderately isolated, with other Hg detections nearby. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 113 and <1 for the robin and shrew, respectively. The use of a methylmercury TRV for soil is overly conservative, as methylation is not expected in the terrestrial environment. It is unlikely that one or two relatively small isolated areas with elevated Hg HQs will impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for RCRB soil was 0.87 mg/kg, therefore detection was < 2X background.	N
CP2-N-39	62F-SP05	Toluene	11 (M, A)	None	NA	VI	Commercial	Toluene was a COPEC in this soil vapor (10 ft) sample, with a concentration of 900 ug/m^3 and associated HQ of 11 for burrowing mammals (and burrowing birds, based on surrogate approach, as only mammal inhalation toxicity study available). Detections of toluene in CP-2 vapor samples are limited, so toluene contamination in soil vapor is very isolated. Alternative ESL (TRV) recommended by Santa Susana Field Laboratory (CA) for toluene range from 170 to 420 ug/m^3, for low TRV to high TRV. Based on these alternative ESLs (TRVs), HQs would range from 2.1 to 5.3. In addition, burrowing wildlife such as the short-tailed shrew, California ground squirrel, and weasel have home ranges of approximately 1.0, 0.5, and 25 acres, and a burrowing owl has a home range of approximately 40 acres. Therefore, an area use factor approach would reduce potential toluene exposure to wildlife by a considerably amount.	N

Notes:
1 - References for these columns can be found in Table 1-13. M = Mammal; A = Avian; P = Plant; I = Soil Invertebrate.
See Table 1-12 for a list of acronyms

Table D-5
Summary of Sample Locations with SLERA Hazard Quotient Greater Than 10, for Locations Not in an Ecological or Facility Area
Aerojet - Boundary Operable Unit Feasibility Study

Sample Location	Media	Region	Drivers	COPECs Exceeding SLERA HQ of 10	Rationale for Recommending Location to be Retained (R)/Not Retained (N) for Remedial Action
03D-SNS34	Soil	Admin East	Inorganics PCBs/Organics PCBs/Pesticides	Zn, dimethyl phthalate, A-1254, A-1260	Encompassed by retained area AE-R-9
05D-SB06	Soil	Admin West	Inorganics PCBs/Organics	Cd, Cr, Hg, A-1254	Encompassed by retained area AW-R-2
05D-SB07	Soil	Admin West	Inorganics PCBs/Organics	Cr, A-1260	Encompassed by retained area AW-R-1
05D-SB08	Soil	Admin West	Inorganics	Hg	N. See Table D-6. In existing development plans
05D-SB09	Soil	Admin West	PCBs/Organics	A-1254	Encompassed by retained area AW-R-11
05D-SB10	Soil	Admin West	Inorganics	Hg	N. See Table D-6. In existing development plans
05D-SNS01	Soil	Admin West	Inorganics	Hg	N. See Table D-6.
05D-SNS08	Soil	Admin West	Inorganics	Hg	N. See Table D-6.
05D-SNS18	Soil	Admin West	Inorganics	Hg	Encompassed by retained area AW-R-3
05D-SNS19	Soil	Admin West	Inorganics	Hg	N. See Table D-6.
06D-SB04	Soil	Admin West	Inorganics	Hg	Encompassed by retained area AW-R-8
06D-SB05	Soil	Admin West	Inorganics	Cd, Hg	Encompassed by retained area AW-R-8
06D-SNS01	Soil	Admin West	Inorganics	Sb, B, Cd, Cr, Cu, Mn, Ni, Zn	Encompassed by retained area AW-R-8
06D-SNS02	Soil	Admin West	Inorganics	Cr	Encompassed by retained area AW-R-8
09D-SNS02	Soil	Admin West	Inorganics	Hg	N. See Table D-6. Surrounded by up-stream (9D-SD01) and down-stream (09D-SNS06) locations that do not pose risk
D(B)-SD01	Soil	Admin West	Inorganics PCBs/Organics	Cd, Zn, A-1260	Encompassed by retained area AW-R-5
D(C)-SB01/ DC-AH01	Soil	Admin West	Organics	DnBP	N. Historic data. See Table D-6. Down-stream location (D(c)-SNS01) not of concern.
D(D)-SD01	Soil	Admin West	Inorganics	Hg, Sb, Zn	N. See Table D-6. Drainage inlet. No habitat. Water goes either north or south, where sediment samples indicate less than 10x eco risk.
59E-SW01	Surface Water	Buffalo Creek	Inorganics	Al	Encompassed by retained area BC-R-1
BC-SD03	Soil	Buffalo Creek	Inorganics	Ag	Encompassed by retained area BC-R-3.
WL-SW01	Surface Water	Buffalo Creek	Inorganic	Ba	N. See Table D-6
WL-SW05	Surface Water	Buffalo Creek	Inorganic	Al	N. See Table D-6
WL-SW08	Surface Water	Buffalo Creek	Inorganic	Al, Ba, B, Pb	N. See Table D-6
59F-SNS02	Soil	Chem Plant 2	Inorganics	Hg	N. See Table D-6

Table D-5
Summary of Sample Locations with SLERA Hazard Quotient Greater Than 10, for Locations Not in an Ecological or Facility Area
Aerojet - Boundary Operable Unit Feasibility Study

Sample Location	Media	Region	Drivers	COPECs Exceeding SLERA HQ of 10	Rationale for Recommending Location to be Retained (R)/Not Retained (N) for Remedial Action
59F-SNS03	Soil	Chem Plant 2	Inorganics	Hg	N. See Table D-6. Although encompassed by retained area CP2-SV-R-1, this R-1 Area is for SV, not soil.
61F-SB04	Soil	Chem Plant 2	Inorganics	Hg	N. See Table D-6
61F-SNS02	Soil	Chem Plant 2	Inorganics	Hg	N. See Table D-6
OS1-F2-SNS01	Soil	Chem Plant 2	Inorganics	Hg	N. See Table D-6
OS1-F2-SNS03	Soil	Chem Plant 2	Inorganics	Hg, B	N. See Table D-6
OS1-F2-SNS04	Soil	Chem Plant 2	Inorganics	B	N. See Table D-6
OS1-F3-SD01	Soil	Chem Plant 2	PCBs/Pesticides	A-1254	Encompassed by retained area CP2-R12.
25F-HA04	Sediment	Dredge Pit	Organics	Phenol	N. See Table D-6. Historic data. Surrounded by 25F-SB10, 25F-SB11, 25F-HA03, and 25F-SD02
28E SP16	Soil Vapor	Line 02	VOCs	TCE, PCE, Toluene	Encompassed by retained area L2-SV-R-1
59E-SB01	Soil	Line 02	Organics	DnBP	N. See Table D-6
59E-SB03	Soil	Line 02	Inorganics	Sb	N. See Table D-6
59E-SB04	Soil	Line 02	Inorganics	Li	N. See Table D-6
DSA SP19	Soil Vapor	Line 02	VOCs	Toluene	N. See Table D-6. In carveout. Surrounded by DSA SP15, DSA SP18, DSA SP20, DSA SP21 and DSA SP30, which are <10x ESL.
OS3-F1-SB03	Soil	Magazine Area	Inorganics	B	N. See Table D-6
WL-SB05	Soil	West Lake	Inorganics	Hg	N. See Table D-6
WL-SB10	Soil	West Lake	Inorganics	Hg	N. See Table D-6
WL-SD08	Soil	West Lake	Inorganics	B	N. See Table D-6
WL-SD12	Sediment	West Lake	Inorganics	Ag	Encompassed by retained area BC-R-2.
WL-SW03	Surface Water	West Lake	Inorganics	Al	N. See Table D-6
WL-SW04	Surface Water	West Lake	Inorganics Organics	Al, Cu, Pb, BEHP	N. See Table D-6

Notes:
References for these columns can be found in Table 1-13
See Table 1-12 for a list of acronyms

Table D-6
Summary of Samples from Non-Facility Areas and Ecological Risks and Rationale for Remedial Action or Land Use Control
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Region	Sample Location	COPECs from Non-Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
None	Admin West	05D-SNS19	Hg	6667 (A) 262 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.34 mg/kg, which was > 10x ESL, in this surface ditch sample. HQs were 6670 and 262 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 200 feet to the east at 0.39 mg/kg at D(d)-SD01. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a ditch sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 26 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 2.6. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg.	N
None	Admin West	05D-SNS01	Hg	10250 (A) 412 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.536 mg/kg, which was > 10x ESL, in this historic (1993) surface ditch sample (that was resampled as 05D-SNS08). HQs were 10250 and 412 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, as the Hg resampling result was > 10x the ESL at approximately this same location at (0.34 mg/kg at 05D-SNS08) and at 05D-SB10 located 200 ft to the southwest at 0.3 mg/kg. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a ditch sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 41 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 4.1. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg.	N
None	Admin West	05D-SNS08	Hg	6667 (A) 262 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.34 mg/kg, which was > 10x ESL, in this 2005 replacement (confirmation) surface ditch sample for historic (1993) 05D-SNS01. HQs were 6667 and 262 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, as another Hg sample result > 10x the ESL was located at 05D-SB10 located 200 ft to the southwest at 0.3 mg/kg. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a ditch sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 26 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 2.6. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg.	N
None	Admin West	09D-SNS02	Hg	2608 (A) 102 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.133 mg/kg, which was > 10x ESL, in this historic (1993) surface ditch sample. HQs were 2608 and 102 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 450 ft north at 0.34 mg/kg at 05D-SNS19. This sample was surrounded by up-stream (9D-SD01) and down-stream (09D-SNS06) locations that do not pose elevated risk. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a ditch sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 10 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.0. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample is less than twice background.	N

Table D-6
Summary of Samples from Non-Facility Areas and Ecological Risks and Rationale for Remedial Action or Land Use Control
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Region	Sample Location	COPECs from Non-Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
None	Admin West	D(C)-SB01/ DC-AH01	DnBP	167 (A)	VI	Commercial	DnBP was a COPEC with a concentration of 2.1 mg/kg, which was > 10x ESL, in this historic 1992 0-1-foot bgs sample, with an HQ of 167, for potential avian risk (American robin). DnBP exceedances were very isolated, with no other DnBP sample results in this Area > 10x the ESL. The avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres.	N
None	Admin West	D(D)-SD01	Hg Sb Zn	Hg 7647 (A) Hg 300 (M) Zn 24 (A) Zn 14 (M) Sb 10 (M)	MI to VI	Commercial	Hg was a COPEC with a concentration of 0.39 mg/kg, which was > 10x ESL, in this surface ditch sample. HQs were 7647 and 300 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, as the closest Hg sample result > 10x the ESL was located at 150 west at 0.34 mg/kg at 05D-SNS19. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a ditch sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 30 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 3. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg. Zn was a COPEC with a concentration of 1100 mg/kg, that was > 10x ESL, and estimated HQs of 24 and 14, for potential avian and mammalian risk, respectively. The Zn exceedance was very isolated, with the closest Zn sample result > 10x the ESL located 1000 ft to the west at 3600 mg/kg at D(b)SD01. Background RCRB BTV for Zn was 100 mg/kg. Sb was a COPEC with a concentration of 2.8 mg/kg, with an HQ of 10 for potential mammalian risk. Background RCRB BTV for Sb was 1.3 mg/kg. The Sb exceedance was very isolated, as the closest Sb sample result > 10x the ESL was located 1100 ft southwest at 6.95 mg/kg at 12D-SNS01. This sample location is a drainage inlet, with no habitat present. Water flows either north or south, where sediment sample results indicate less than 10x eco risk.	N
None	Admin West	05D-SB08	Hg	5490 (A) 215 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.28 mg/kg, which was > 10x ESL, in this surface soil sample. HQs were 5490 and 215 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 150 ft to the northeast at 0.17 mg/kg at 06D-SB06. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 22 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 2.2. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg. This sample is also located in an area of existing development plans, so wildlife habitat is expected to be minimal in the future.	N

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Remedial Area Number	Region	Sample Location	COPECs from Non-Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
None	Admin West	05D-SB10	Hg	5882 (A) 231 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.30 mg/kg, which was > 10x ESL, in this surface soil sample. HQs were 5882 and 231 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 350 ft to the southeast at 1.2 mg/kg at 06D-SNS08. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 23 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 2.3. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg. This sample is also located in an area of existing development plans, so wildlife habitat is expected to be minimal in the future.	N
None	Line 02	59E-SB01	DnBP	40 (A)	VI	Commercial	DnBP was a COPEC with a concentration of 0.504 mg/kg, which was > 10x ESL, in this historic (1993) 0-1-foot bgs sample at this sample location, with an HQ of 40, for potential avian risk (American robin). DnBP exceedances were very isolated, with no other DnBP sample results at Line 02 > 10x the ESL. The avian ESL was derived in the Eco White Paper using a TRV of 0.11 mg/kg-day for a ringed dove. It is unlikely that one relatively small isolated area with an elevated DnBP HQ would impact robin populations since the robin's average home range is approximately two acres. More recent sample results in this Area has all been nondetect for DnBP.	N
None	Line 02	59E-SB03	Sb	13 (M)	VI	Commercial	Sb, at a concentration of 3.5 mg/kg in the 2-foot bgs sample at this sample location had an HQ of 13, for potential mammalian wildlife risk. The Sb exceedance was very isolated, with no other Sb sample results at Line 02 being > 10x the ESL. Background RCRB BTV for Sb was 1.3 mg/kg.	N
None	Line 02	59E-SB04	Li	13.5 (P)	VI	Commercial	Lithium, at a concentration of 27 mg/kg in the 2.5-foot bgs sample at this sample location had an HQ of 13.5, for potential plant risk. The Li exceedance was very isolated, with no Li sample results at Line 02 being > 10x the ESL. Background Li for California soil is 23 mg/kg (Kearney Foundation, 1996). The plant ecotoxicity benchmark for Li, as reported in Efroymson et al. (1997), is less than this background value and was considered to be low in confidence by the authors. As the soil concentrations are less than twice background (as is the case for Li), further action is not necessary.	N
None	Line 02	DSA-SP19	Toluene	10 (Burrowing Wildlife)	VI	Commercial	Toluene was a VOC COPEC in this soil vapor sample, at a concentration of 870 ug/m^3, for potential risk to burrowing mammals and/or avian receptors. The toluene exceedance was very isolated, with the only other toluene sample with > 10x the ESL at Line 2 located 1200 ft to the west at 28E-SP16 at 5900 ug/m^3. The toluene ESL of 84 ug/m^3 from Edward Air Force Base is outdated, and the currently recommended SV ESL for toluene ranges from 170 to 420 ug/m^3 (TRV-low to TRV-high; MWH, 2011). Use of these alternative ESLs result in toluene HQs of 2.1 to 5. The toluene exposure point concentration (EPC), for Line 2, was estimated at 124 ug/m^3, based on samples not planned for remediation, and using the shallowest soil vapor result where multiple depth samples existed. As the burrowing owl home range is 595 acres (Johnsgard [1990] and Mallette and Gould [1980]), and the Line 2 area is only about 1/10th of this home range, use of an EPC, rather than a single sample result, is appropriate to for more realistically assessing potential adverse effects. Using the alternative MWH (2011) TRVs, the estimated owl HQ drops below 1.	N

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None	Chem Plant 2	59F-SNS02	Hg	2550 (A) 100 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.13 mg/kg, which was > 10x ESL, in this subsurface sample. HQs were 2550 and 100 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 100 feet to the east at 0.16 mg/kg at 59F-SNS03. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 10 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.0. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, equal to the measured sample concentration.	N
None	Chem Plant 2	59F-SNS03	Hg	3137 (A) 123 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.16 mg/kg, which was > 10x ESL, in this subsurface sample. HQs were 3137 and 123 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 100 ft to the west at 0.13 mg/kg at 59F-SNS02. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 12 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.2. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample result is less than twice background.	N
None	Chem Plant 2	61F-SB04	Hg	8824 (A) 346 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.45 mg/kg, which was > 10x ESL, in this surface sample. HQs were 8824 and 346 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 700 feet to the west at 0.21 mg/kg at 61F-SNS02. Sample 61F-SB05 located 300 ft away and downstream did not pose elevated Hg risk. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 35 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 3.5. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg.	N
None	Chem Plant 2	61F-SNS02	Hg	4120 (A) 162 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.21 mg/kg, which was > 10x ESL, in this surface sample. HQs were 4120 and 162 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 700 feet to the east at 0.45 mg/kg at 61F-SB04. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 16 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.6. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample results is less than twice background.	N

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None	Chem Plant 2	OS1-F2-SNS01	Hg	2940 (A) 115 (M)	MI	Commercial	Hg was a COPEC with a concentration of 0.15 mg/kg, which was > 10x ESL, in this surface sample. HQs were 2940 and 115 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 100 feet to the west at 0.18 mg/kg at OS1-F2-SNS03. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 11.5 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.2. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample results is less than twice background.	N
None	Chem Plant 2	OS1-F2-SNS03	Hg B	Hg 3530 (A) Hg 138 (M) B 52 (P)	MI	Commercial	Hg was a COPEC with a concentration of 0.18 mg/kg, which was > 10x ESL, in this surface sample. HQs were 3530 and 138 for potential avian and mammalian risk, respectively. The Hg exceedance was moderately isolated, with another Hg sample result > 10x the ESL located 100 feet to the east at 0.15 mg/kg at OS1-F2-SNS01. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a soil sample is overly conservative, as methylation is not expected in terrestrial environments. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 14 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.4. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample results is less than twice background. Boron was a COPEC with concentration of 26 mg/kg, with estimated HQ of 52 for plants. Background concentration of boron is 28.1 mg/kg for Xero soil type (therefore this sample result is less than background). Remediation to protect common plants is typically not warranted. The boron exceedance was moderately isolated, with two other boron sample results > 10x the ESL located 300 feet to the northeast at 33 and 51.6 mg/kg.	N
None	Chem Plant 2	OS1-F2-SNS04	B	44 (P)	MI	Commercial	Boron was a COPEC in this subsurface soil sample with a concentration of 22 mg/kg, and an estimated HQ of 44 for plants. Background concentration of boron is 28.1 mg/kg for Xero soil type (therefore this sample result is less than background). Remediation to protect common plants is typically not warranted. The boron exceedance was moderately isolated, with two other boron sample results > 10x the ESL located 350 feet to the northeast at 26 and 225 mg/kg.	N
None	Chem Plant 2	OS1-F3-SD01	A-1254	16 (A)	MI	Commercial	A-1254 was a COPEC with a concentration of 0.16 mg/kg, which was > 10x ESL in this surface sediment sample. The HQ was 16 for potential avian risk. The A-1254 exceedance was moderately isolated, with four other sample results in the Area > 10x the ESL, located approximately 300 to 400 ft to the southeast, at 0.35, 0.54, 1.1, and 2.8 mg/kg. The A-1254 avian ESL was derived in the Eco White Paper using a TRV of 0.072 mg/kg-day for a ringed dove. If the robin LOAEL TRV of 0.41 mg/kg from LANL (2011) is used, the HQ would drop to < 1. This sample was collected from a seasonally inundated surface water area, however exposure by birds is possible, as area is dry at times, and even if wet, birds would be exposed during foraging activities.	Y

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None	Buffalo Creek/ West Lake	WL-SB05	Hg	4118 (A) 162 (M)	VI	Commercial	Hg was a COPEC with a concentration of 0.21 mg/kg, which was > 10x ESL, in this surface (sediment) sample. HQs were 4118 and 162 for potential avian and mammalian risk, respectively. The Hg exceedance was very isolated, with the only other Hg sample result > 10x the ESL located 2125 feet to the east at 0.15 mg/kg at WL-SB10. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a seasonally inundated sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 16 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.6. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample result is less than twice background.	N
None	Buffalo Creek/ West Lake	WL-SB10	Hg	2941 (A) 115 (M)	VI	Commercial	Hg was a COPEC with a concentration of 0.15 mg/kg, which was > 10x ESL, in this surface (sediment) sample. HQs were 2941 and 115 for potential avian and mammalian risk, respectively. The Hg exceedance was very isolated, with the only other Hg sample result > 10x the ESL located 2125 feet to the west at 0.21 mg/kg at WL-SB05. Mammalian and avian Hg ESLs were based on methylmercury TRVs for the short-tailed shrew (TRV of 0.352 mg/kg-day) and Woodcock (TRV of 0.064 mg/kg-day) [ORNL, 1997]. The use of a methylmercury TRV for a seasonally inundated sample may be overly conservative, as methylation is not expected in intermittent flow regimes. Using alternate, yet still conservative, LANL ESLs based on mercuric chloride TRVs (LANL, 2010) [0.013 mg/kg for an insectivorous bird, American robin; and 1.7 mg/kg for an insectivorous small mammal, montane shrew] results in HQs of 11.5 and <1 for the robin and shrew, respectively. If the robin LOAEL TRV of 0.13 mg/kg is used (LANL, 2011), the HQ would drop to 1.2. It is unlikely that one relatively small isolated area with elevated Hg HQs would impact robin populations since the robin's average home range is approximately two acres. The Hg BTV for Xero soil is 0.13 mg/kg, so this sample results is less than twice background.	N
None	Buffalo Creek/ West Lake	WL-SD08	B	58 (P)	VI	Commercial	Boron was a COPEC in this surface soil (sediment) sample with a concentration of 29 mg/kg, and an estimated HQ of 58 for plants. Background concentrations of boron are as elevated as 28.1 mg/kg for Xero soil type (therefore this sample result is less than twice background). Remediation to protect common plants is typically not warranted. The boron exceedance was very isolated, with no other boron sample results > 10x the ESL in the West Lake Area.	N
None	Magazine Area	OS3-F1-SB03	B	42 - 46 (P)	VI	Commercial	Boron was a COPEC in this subsurface soil sample with concentrations of 21 to 23 mg/kg in surface and subsurface soil samples, and estimated HQs of 42 to 46 for plants. Background concentrations of boron are as elevated as 28.1 mg/kg for Xero soil type (therefore these sample results are less than background). Remediation to protect common plants is typically not warranted. The boron exceedance was very isolated, with no other boron sample results > 10x the ESL in the Magazine Area.	N
None	Buffalo Creek	WL-SW01	Ba	15 (Aquatic Life)	VI	Commercial	Ba was a COPEC in surface water, with a total concentration of 60 ug/L and dissolved concentration of 54 ug/L in this water body. The Ba exceedance was very isolated, with the closest sample result > 10x the ESL located 4000 ft to the northeast at 48 ug/L at WL-SW02. The HQ was 15 using the chronic criterion of 4 ug/L. If the acute Ba criterion of 110 ug/L is used, the HQ drops to < 1. Remediation of surface water is not practicable, and it is expected that remediation of other areas of Buffalo Creek will result in water quality improvements.	N

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None	West Lake	WL-SW-03	Al	13 (Aquatic Life)	MI	Commercial	Al was a COPEC in surface water, with a total concentration of 1100 ug/L and dissolved concentration of 170 ug/L in this seasonally present water body. The Al exceedance was moderately isolated, with the closest sample result > 10x the ESL located 1270 ft to the southwest at 5200 ug/L at WL-SW04. The HQ was 13 using the chronic criterion of 87 ug/L. If the acute Al criterion of 750 ug/L is used, the HQ drops to 1.5. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are 2 and < 1, respectively. Remediation of surface water is not practicable, and it is expected that remediation of other areas of Buffalo Creek will result in water quality improvements. The aluminum exceedance is likely not a concern, as the criterion of 87 µg/l is based on a toxicity test with striped bass in water with pH that ranged from 6.5 to 6.6 and a hardness less than 10 mg/L. As stated in USEPA (2012), data in Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia (May 1994), which was used for the criterion development, indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified. As the site-specific hardness in the West Lakes is likely greater than 10 mg/L, aluminum is not expected to be toxic to sensitive aquatic life in this Area.	N
None	West Lake	WL-SW-04	Al Cu Pb BEHP	Al 60 Cu 456 Pb 56 BEHP 37 (Aquatic Life)	MI to VI	Commercial	Al was a COPEC in surface water, with a total concentration of 5200 ug/L and dissolved concentration of 67 ug/L in this seasonally present water body. The Al exceedance was moderately isolated, with the closest sample result > 10x the ESL located 1270 ft to the northeast at 1100 ug/L at WL-SW03. The HQ was 60 using the chronic criterion of 87 ug/L. If the acute Al criterion of 750 ug/L is used, the HQ drops to 7. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are both < 1. See Al toxicity uncertainties discussed for WL-SW03. Cu was a COPEC in surface water, with a total concentration of 4100 ug/L and dissolved concentration of 24 ug/L in this seasonally present water body. The Cu exceedance was moderately isolated, similar to the Al result. The HQ was 456 using the chronic criterion of 9 ug/L. If the acute Cu criterion of 13 ug/L is used, the HQ drops to 315. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are 2.7 and 1.8, respectively. Pb was a COPEC in surface water, with a total concentration of 140 ug/L and dissolved concentration of 2.4 ug/L in this seasonally present water body. The Pb exceedance was moderately isolated, similar to the Al result. The HQ was 56 using the chronic criterion of 2.5 ug/L. If the acute Pb criterion of 65 ug/L is used, the HQ drops to 2.2. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are both < 1. BEHP was a COPEC in surface water, with a total concentration of 110 ug/L in this seasonally present water body. The BEHP exceedance was very isolated, as no other samples in West Lake had a BEHP exceedance more than 10x the ESL. The HQ was 37 using the chronic criterion of 3 ug/L. If the acute BEHP criterion of 400 ug/L is used, the HQ drops to < 1. Remediation of surface water is not practicable, and it is expected that remediation of other areas of Buffalo Creek will result in water quality improvements.	N
None	Buffalo Creek	WL-SW-05	Al	23 (Aquatic Life)	MI	Commercial	Al was a COPEC in surface water, with a total concentration of 2000 ug/L and dissolved concentration of 470 ug/L in this seasonally present water body. The Al exceedance was moderately isolated, with the closest sample result > 10x the ESL located 440 ft to the north at 2100 ug/L at WL-SW06. The HQ was 23 using the chronic criterion of 87 ug/L. If the acute Al criterion of 750 ug/L is used, the HQ drops to 2.7. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are 5.4 and < 1, respectively. See Al toxicity uncertainties discussed for WL-SW03. Remediation of surface water is not practicable, and it is expected that remediation of other areas of Buffalo Creek will result in water quality improvements.	N

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Summary of Samples from Non-Facility Areas and Ecological Risks and Rationale for Remedial Action or Land Use Control
Aerojet - Boundary Operable Unit Feasibility Study

Remedial Area Number	Region	Sample Location	COPECs from Non-Facility Areas Exceeding 10x Eco ESL	Maximum HQ[1]	Degree of Isolation	Anticipated Future Use	Rationale for Recommending Site to be Retained/Not Retained for Remedial Action or Land Use Controls	Retained or Not Retained
None	Buffalo Creek	WL-SW-08	Al Ba B Pb	Al 20 Ba 11 B 14 Pb 10 (Aquatic Life)	MI to VI	Commercial	Al was a COPEC in surface water, with a total concentration of 1700 ug/L and dissolved concentration of 360 ug/L in this seasonally present water body. The Al exceedance was moderately isolated, with the closest sample result > 10x the ESL located 1600 ft to the east at 2100 ug/L at WL-SW06. The HQ was 20 using the chronic criterion of 87 ug/L. If the acute Al criterion of 750 ug/L is used, the HQ drops to 2.3 If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are 4.1 and < 1, respectively. See Al toxicity uncertainties discussed for WL-SW03. Ba was a COPEC in surface water, with a total concentration of 44 ug/L and dissolved concentration of 35 ug/L in this seasonally present water body. The Ba exceedance was moderately isolated, with the closest sample result > 10x the ESL located 1150 ft to the west at 48 ug/L at WL-SW02. The HQ was 11 using the chronic criterion of 4 ug/L. If the acute Ba criterion of 110 ug/L is used, the HQ drops to < 1. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are both < 1. Boron was a COPEC in surface water, with a total concentration of 23 ug/L and dissolved concentration of 21 ug/L in this seasonally present water body. The boron exceedance was very isolated, with no other sample results > 10x the ESL in the Buffalo Creek Area. The HQ was 14 using the chronic criterion of 1.6 ug/L. If the acute boron criterion of 30 ug/L is used, the HQ drops to < 1. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are 13 and < 1, respectively. Pb was a COPEC in surface water, with a total concentration of 26 ug/L and dissolved concentration of 3.3 ug/L in this seasonally present water body. The Pb exceedance was very isolated, as no other samples in Buffalo Creek Area had a Pb exceedance more than 10x the ESL. The HQ was 10 using the chronic criterion of 2.5 ug/L. If the acute Pb criterion of 65 ug/L is used, the HQ drops to < 1. If dissolved concentrations are used (the bioavailable fraction), the chronic and acute HQs are 1.3 and < 1, respectively. Remediation of surface water is not practicable, and it is expected that remediation of other areas of Buffalo Creek will result in water quality improvements.	N
None	Dredge Pit	25F-HA04	Phenol	11 (B)	VI	Commercial	Phenol was a COPEC with a concentration of 4.6 mg/kg, which was > 10x ESL in this sediment sample collected from a water body in the Dredge Pit. The HQ was 11 for potential benthic invertebrate risk. The phenol exceedance was very isolated, with no other sample results in the Area > 10x the ESL. The phenol benthic ESL of 0.42 mg/kg was derived in the Eco White Paper using a screening value from Washington State (ORNL, 1997 Table 2, based on data from 1992).	N

Notes:
1 - References for these columns can be found in Table 1-13. M = Mammal; A = Avian; P = Plant; I = Soil Invertebrate.
See Table 1-12 for a list of acronyms
Regional background mercury data for Alder Creek CA sediment is approximately 0.5 to 0.6 mg/kg (Bureau of Reclamation website), therefore, many mercury results presented above are below regional background (as discussed during the Agency conference call on 8/8/2012).

Appendix E
Construction of Summary Soil and Soil Vapor Risk Tables and Relation to GRS Figures

Construction of Summary Soil and Soil Vapor Risk Tables and Relation to GRS Figures

This appendix explains the construction of the risk summary tables and how they relate to the graphical risk summary (GRS) figures (Figures 1-24 through 1-31) first presented in the HHERA (Volume II of the RI). It further explains how the data from the borings that defined the risk contours on the GRS figures are used to build the risk summary tables. The soil and soil vapor boring locations are shown on two of the panels on the GRS figures. Acronyms listed on the table and in this Appendix are found on Table 1-12.

The boring data were obtained from HHERA tables to provide background on the contaminants, and the potential risks posed for the three types of risk areas identified on the GRS figures, human health (HH), risk to groundwater (RTG) and ecological.

Each risk area defined in Section 9 of the HHERA was assigned a Remedial Area (RA) number on the GRS figures, which are coded as to the type of risk, HH is brown filled contours, RTG is blue contours, and ecological is green-hatched areas. There are two exceptions. An RA is assigned to Management Area (MA) regions where the groundwater concentrations potentially pose a risk for residential use due to the modeled VOC migration from groundwater. These areas are coded using purple shading on the GRS figures. The low and high human health risk areas within the purple area are included with this RA. The second exception is for low RTG due to VOCs concentrations, an RA number was not assigned to these areas and these areas were not retained. Rationale for not retaining the VOC low RTG areas is discussed in Section 1.5.1.

The RA numbering scheme indicates the MAs, R for retained or N for not retained and sequential numbering of either retained or not retained areas. For example L2-R-3 would be Line 2, retained, third area. For areas where recent excavation work addressed the identified risk, a C (remediation completed) was used to denote the area as opposed to an R (retained).

The risk summary tables are organized by the RA numbers. The “Collocated Remedial Area” column identifies other RAs that are collocated, or overlapping for reference. Each RA entry is associated with only one risk type. The risk type is noted in the “Risk Addressed” column.

An example of the use of a GRS figure in conjunction with its associated risk table is provided following the remaining table columns descriptions discussed below.

Sample Location Column

The “Sample Location” column lists the borings used to provide information for the risk areas on the table. Each soil boring was reviewed to assess if the sampling data applied to the risk

addressed and was appropriate to include on the summary table. The data were used to support the recommendation to retain or not retained an RA. All borings were reviewed that were within a single risk type area, which for:

- High HH, were all the borings within the dark brown filled-in contour
- Low HH, were all the borings within the light brown filled-in contour and would also include borings in high HH contour, if present
- Low HH, note the values were not provided for the maximum ILCR or HI if one boring defined both a High and Low HH, the values are listed in the High HH area
- High RTG, were all the borings within a thick dark blue contour
- Low RTG, were all the borings within a thin light blue contour and would include borings in the high RTG area, if present
- Ecological risk, were the all borings within the green-hatched area

For each RA, with the exception of the purple shaded areas, the appropriate HHERA table was used to determine if the sampling results from the borings located within the RA exceeded the screening levels for the risk being addressed. The tables that were used for the evaluation are:

- HHRA Health Risk Summary Tables Section 5.0, Volume II, which include Receptor-specific (e.g., resident, construction worker, commercial worker, recreator) risks.
- RTG Risk Summary Tables Section 8.0, Volume II
- Ecological Risk Summary Tables and "Exceedances of Risk Characterization" figures for the MA (Section 6.0, Volume II) associated with the MA to determine if an ecological risk greater than 10x an ESL is present for each of the sampling locations in the list.

Based on the HHERA table review, a boring was not listed on the summary table "Sample Location" column for:

- High HH areas, if the sampling results from the boring did not exceed a high HH risk (i.e., increased lifetime cancer risk (ILCR) >1E-4 or hazard index (HI)>1)
- Low HH areas, if the sampling results from the boring did not have a low human health risk (i.e., ILCR>1E-6 and <1E-4)
- High RTG areas, if the sampling results from the boring were not considered a high potential risk to groundwater

- Low RTG areas for non-VOCs, if the sampling results from the boring were considered negligible or a high potential risk to groundwater (which would be listed with the high RTG area, if present)
- Ecological risk areas, if sampling results do not have a risk greater than 10 times ESL.

Note, where a high HH risk is solely due to an HI exceedance (i.e., HI>1), and an ILCR was not above 1E-6; a low HH risk area would not surround the high HH risk area as an HI<1 has no risk to the receptor.

For HH and RTG areas where a boring is located within the contour, but did not have sampling results that exceeded a screening criteria; the inclusion of the boring within the contour is likely an artifact of kriging.

In summary, the "Sample Location" column on Tables 1-4 through 1-11 and 1-14 through 1-20 lists the borings, which had soil or soil vapor sample(s) that were within the RA's addressed risk range.

Risk Columns

Tables 1-4 through 1-11 and 1-14 through 1-20 present the HH, RTG and ecological risk information. The risk driving compounds, associated risk levels and their concentrations were obtained from the HHERA tables and figures described above. The risk information provided on the tables is described below.

Summary of Soil Risks and Rationale for Remedial Action - Tables1-4 through 1-11

Tables 1-4 through 1-11 list the risks for the non-VOC results for soil data. The columns "COCs Exceeding HH Risk Levels", COPECs Exceeding SLERA Risk Levels" and "COCs w/Potential RTG" list all compounds that exceeded the respective risk range for the risk type addressed in the RA. The risk ranges were listed in the bullets above.

The highest risk value reported from the HHERA tables for HH, (ICLR and/or HI), ecological (HQ) and RTG (RTG score) was listed in the appropriate column, "Maximum ICLR," "Maximum HI", "Maximum HQ or "Maximum RTG Score," respectively. The "Rationale for Recommending Site to be Retained/Not Retained for Remedial Action" ("Rationale") column discusses the concentrations of the COCs and COPECs.

Summary of Soil Vapor Risks and Rationale for Remedial Action - Tables1-14 through 1-20

Tables 1-14 through 1-20 list the risks for the VOC results for soil vapor data. The column "COCs Posing High HH Risk or High RTG" lists all compounds that exceeded either the

appropriate HH risk range or was a high potential RTG depending on which risk type was addressed in the RA. The risk ranges were listed in the bullets above.

The highest risk value reported from the HHERA tables for HH, (ICLR and/or HI), and RTG (RTG ranking) was listed in the appropriate column, "Maximum ICLR," "Maximum HI", "Maximum RTG Ranking," respectively. Additionally, for the soil vapor tables, the "Maximum Concentration" of the COCs was listed on the table.

The SLERA did not identify ecological risk areas due to the presence of VOCs, which is discussed in Section 1.5.1. The low RTG areas for VOCs did not receive RA numbers, as discussed above. The rationale for not retaining these areas was provided in Section 1.5.1. These risk areas are not identified on the GRS figures or listed on Tables 1-14 through 1-20.

Sample Depths

For the soil tables, Tables 1-4 through 1-11, pertinent soil sample depth information was included in the discussion in the "Rationale" column. The depths of the maximum concentrations and concentration trends with depth were also noted in the "Rationale" column.

For soil vapor, Tables 1-14 through 1-20, two columns provide depth information, which are self-explanatory, the "Depth of Maximum Concentration" and the "Depths of Samples with High HH or High RTG.

The "Depth to Groundwater" is listed in all tables.

Additional Information for Remedy Consideration

Additional information was provided to assist in evaluations of remedies. For "Degree of Isolation", the GRS figures were reviewed to indicate if the RA extent was spatially near other RAs, which was qualitatively noted as not isolated, moderately isolated or very isolated.

The "Anticipated Future Use" column was populated with information obtained from the Aerojet Land Use Plan *(Easton Place and Glenborough at Easton Land Use Master Plans, Aerojet General Corporation, Sacramento County. May 23, 2005)*. The "Site Access Issues?" column provides observation of potential access issues that may need to be addressed if a remedy is implemented.

Rationale for Recommending Site to be Retained/Not Retained for Remedial Action

The "Rationale" column summarizes information and details about the RA. The column cells provide the rationale for retaining or not retaining an area. The criteria for recommendations for retention are discussed in Section 1.5 and included in the column.

The final column on the right indicates if the area was retained (R), not retained (N) or remediation completed (C), which correspond to the RA number.

For an example of the use of a GRS figure in conjunction with its associated risk table, the reader is referred to Figure 1-24 and Table 1-4. On Figure 1-24, an area is shown in the west-central portion of Admin East that contains collocated remedial areas AE-R-2, AE-R-3, AE-R-4, AE-N-4 and AE-N-5. Review of Table 1-4 summarizes the risk associated with each of these areas.

As shown in Table 1-4, remedial areas AE-R-2 through AE-R-4 were HH risk areas recommended for retention, while AE-N-4 and AE-N-5 were RTG areas not recommended for retention. Table 1-4 lists the sample locations associated with each area, for example, remedial area AE-R-3 consists of sample locations 03D-SB05 and 03D-SB06, which are also shown on the left hand panel of Figure 1-24. Because of the differing risk type and excavation depths, sample locations can be associated with more than one remedial area. Sample location 03D-SB-20 is listed for the retained HH area AE-R-2 and also listed for the non-retained RTG area AE-N-5.

Table 1-4 lists the COCs associated with the three retained areas (1,1,2,2-PCA, A-1254, and Fe) and two non-retained areas (A-1254, TPH-D and TPH-Mo), the maximum RTG score, depth to water, degree of isolation, site access issues, rationale for recommending retention of AE-R-2 through AE-R-4 and non-retention of AE-N-4 and AE-N-5 and, finally, the recommendation/status (retained, not retained, or remediation completed).

Appendix F
Results of Confirmation Samples for 2010 Excavation Activities

Table F-1
Results of Confirmation Samples for 2010 Excavation Activities
Aerojet - Boundary Operable Unit Feasibility Study

Sample ID	Sample Date	Action Level:	PCBs (µg/kg)							Metals (mg/kg)						
			90										127			
		Sample Depth	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc
Administration Area East																
11D-PGEX-08	11/4/2009	2	<13	<27	<13	<13	<13	13 J	15							
11D-PGEX-09	11/4/2009	2	<14	<28	<14	<14	<14	<14	12 J							
11D-PGEX-11	11/6/2009	4	<14	<28	<14	<14	<14	15	9.3 J							
11D-PGEX-12	11/6/2009	4	<14	<28	<14	<14	<14	<14	2.8 J							
11D-PGEX-13	11/6/2009	4	<14	<28	<14	<14	<14	19	34							
11D-PGEX-17	11/9/2009	2	<15	<30	<15	<15	<15	<15	11 J							
11D-PGEX-23	11/16/2009	8	<13	<27	<13	<13	<13	79	15							
11D-PGEX-24	11/16/2009	8	<13	<26	<13	<13	<13	<13	36							
11D-PGEX-26	11/18/2009	10	<15	<29	<15	<15	<15	72	17							
11D-PGEX-27	11/20/2009	0.25	<15	<29	<15	<15	<15	<15	8.5 J							
11D-PGEX-28	11/30/2009	10	<14	<28	<14	<14	<14	530	210							
11D-PGEX-28SW	11/30/2009	5	<14	<27	<14	<14	<14	270	58							
11D-PGEX-COMP3	11/6/2009	2	<13	<27	<13	<13	<13	<13	36							
11D-PGEX-COMP51	11/17/2009	4	<14	<27	<14	<14	<14	<14	10 J							
11D-PGEX-COMP5S	11/17/2009	2	<14	<27	<14	<14	<14	<14	15							
11D-PGEX-COMP7	11/24/2009	8	<13	<27	<13	<13	<13	<13	42							
11D-PGEX-COMP7S	11/24/2009	4	<15	<30	<15	<15	<15	<15	13 J							

Table F-1
Results of Confirmation Samples for 2010 Excavation Activities
Aerojet - Boundary Operable Unit Feasibility Study

Sample ID	Sample Date	Action Level:	PCBs (µg/kg)							Metals (mg/kg)						
			90										127			
		Sample Depth	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc
Buffalo Creek																
BC-BOUEX-01	11/19/2010	1	<13	<26	<13	<13	<13	<13	<13	<0.27	1100	130	11	31	<0.27	300
BC-BOUEX-02	11/19/2010	1	<14	<29	<14	<14	<14	<14	<14	<0.3	49	37	78	35	0.34	52
BC-BOUEX-03	11/19/2010	1	<13	<27	<13	<13	<13	<13	<13	<0.28	36	28	4.6	42	0.95	43

µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
J = Estimated concentration below the reporting limit
Non-detect results are indicated by < followed by the reporting limit
Bolded - results above action level of 90 ug/kg;
11D-PGEX-28 represents inplace soils at 10 feet; excavation completed to 10 feet below ground surface
11D-PGEX-28SW is the southwest sidewall sample adjacent building that could not be undermined

Figure 6-12

Retained Remedial Areas - Non-VOCs

Dredge Pit and Eastern Basin Boundary Operable Unit

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