FIRST FIVE-YEAR REVIEW REPORT FOR
AEROJET GENERAL CORPORATION SUPERFUND SITE
SACRAMENTO COUNTY, CALIFORNIA

PREPARED BY

U.S. Army Corps of Engineers, Seattle District

FOR

U.S. Environmental Protection Agency

Region IX

Approved by: _____

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Date: September 22, 2016

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Executive Summary

This is the first Five-Year Review of the Aerojet General Corporation Superfund Site (Site) located in Rancho Cordova, California. The purpose of this Five-Year Review is to review information to determine if the remedies in place are and will continue to be protective of human health and the environment.

Aerojet Rocketdyne, Inc. (formerly known as Aerojet General Corporation), a subsidiary of Aerojet Rocketdyne Holdings, Inc. (formerly known as GenCorp, Inc.; referred to as Aerojet in this document) began operations in Rancho Cordova, near Sacramento, California after acquiring approximately 8,500 acres of real property in December 1950. Since the early 1950s, the Aerojet Site has been devoted to the development of rocket propulsion systems to support national defense, space exploration, and satellite deployment activities. Industrial activities at the Aerojet Site have included solid rocket motor manufacturing and testing, liquid rocket engine manufacturing and testing, and chemical manufacturing. Chemicals used in the manufacturing and testing areas on the Aerojet Site have included chlorinated solvents, propellants, metals, oxidizers, and a variety of chemicals produced in the chemical operations areas. Throughout Aerojet's operational history, some wastes were disposed of on the property in surface impoundments, landfills, deep injection wells, septic tanks and associated leach fields, and open burn areas. Although numerous chemicals were used on the Aerojet Superfund Site, trichloroethene (TCE), tetrachloroethene (PCE), perchlorate, and n-nitrosodimethylamine (NDMA) are the most prevalent chemicals encountered at concentrations that exceed applicable regulatory levels. Historical operations at the Aerojet Superfund Site have resulted in the discharge of some of these chemicals to the vadose zone and percolation into the underlying groundwater. Since 1979, Aerojet has investigated the Site to determine the nature and extent of the chemicals present, and to identify and implement mitigation measures to protect public health and the environment.

The Aerojet Superfund Site was placed on the National Priorities List (NPL) on August 8, 1983. Portions of the state-led Inactive Rancho Cordova Test Site (IRCTS) are also considered part of the Aerojet NPL site where hazardous substances originally on the Aerojet facility migrated to or otherwise came to be located on the IRCTS. On June 23, 1989, a Partial Consent Decree (PCD) was entered by the U.S. District Court. The PCD obligates Aerojet to complete an RI/FS for the 8,500-acre main facility, portions of the 3,820-acre IRCTS area, and three other smaller parcels (Areas 39, 40, and 41) near the main Aerojet facility, where open burning was conducted. Aerojet constructed five groundwater extraction and treatment (GET) systems prior to the PCD. Requirements for the operation, maintenance, and effectiveness evaluation of the GET systems were incorporated in the PCD.

The PCD was modified in 2001 to allow the completion of the RI/FS through an OU approach and the exclusion of 2,600 acres from the boundaries of the Aerojet Superfund Site. The 2,600 acres were removed from the Superfund Site following the completion of a thorough review that indicated that the lands were not used for industrial purposes, and were deemed appropriate for carve out (known as "Carve-Out Lands").

In 2001, EPA selected the following remedy in the Record of Decision (ROD) for the Western Groundwater Operable Unit (OU-3) to protect long-term human health and the environment:

- Containment of contaminated groundwater by extraction and treatment;
- Institutional controls to prevent exposure to contaminated groundwater
- Establishment of a groundwater management zone
- Development of short- and long-term water replacement contingency plans and a groundwater monitoring plan

In 2011, EPA selected the following interim groundwater remedy and final soil remedy in the ROD for the Perimeter Groundwater Operable Unit (OU-5):

- Groundwater
    - Containment of contaminated groundwater and mass removal in the ugradient portions of the plumes by groundwater extraction and treatment;
    - Institutional controls to prevent exposure to contaminated groundwater
    - Establishment of a groundwater management zone
    - Development of short- and long-term water replacement contingency plans and a groundwater monitoring plan
- Soil
    - Excavation in soil Areas 10D and 11D
    - Excavation in soil Areas C4 and C41 and land use restrictions if waste is left in place deeper than 10 feet below ground surface
    - Soil vapor extraction and temporary land use restrictions until cleanup is achieved in soil Areas 32D, 34D, 35D, and 38D
    - Soil vapor mitigation systems and permanent land use restrictions in soil Areas 7D, 33D, and the Former Company Store

The containment system, conveyance, treatment plant, and treated water disposition components of the OU-3 remedy consist of six groundwater extraction and treatment (GET) systems. Restrictions on the use of groundwater and discharges to groundwater for the Aerojet Site and the "Carve-Out Lands" are stipulated by the 1989 PCD and the 2001 modified PCD. Groundwater use within OU-3 and outside Aerojet property is regulated under Sacramento County Ordinance. The Sacramento County Environmental Management Department manages a “Consultation Zone” that requires Sacramento County to consult with the Regional Water Quality Control Board (RWQCB), Central Valley Region and/or the Department of Toxic Substances Control prior issuing a permit to drilling a well within 2,000 feet of chemicals in groundwater. Groundwater management of OU-3 is currently documented in Performance Evaluation Reports, Groundwater Model Update Reports, annual Groundwater Monitoring Plans, and the Short-term Water Replacement Contingency Plan (SWRCP) and Long-term Water Replacement Contingency Plan (LWRCP) for OU-3 and OU-5.

The containment system, conveyance, treatment plant, and treated water disposition components of the OU-5 remedy currently consist of four GET systems. Institutional controls in the form of deed

restrictions, which include restrictions on the use of groundwater and discharges to, are currently on the Aerojet Site through the Partial Consent Decree Paragraph 11 or on lands removed from the Superfund Site through the Environmental Restrictions of the 2002 Stipulation and Order Modifying the Partial Consent Decree. Groundwater use within OU-5 and not within Aerojet property is regulated under the previously described Sacramento County Ordinance. Groundwater management of OU-5 is also documented in Performance Evaluation Reports, Groundwater Model Update Reports, annual Groundwater Monitoring Plans, and the SWRCP for OU-3 and OU-5. The soil excavations have been completed. The full-scale soil vapor extraction system has been recently installed. The soil land use restrictions have not yet been implemented.

In 2015, EPA released guidance on how to evaluate the vapor intrusion pathway, which modifies the protocol for evaluating potential vapor intrusion impacts and would be more protective than previous procedures. Given the changes in toxicity and assessment procedures, there may be a potential for unacceptable risk associated with vapor intrusion from off-gasing of TCE from the shallow aquifer in OU-3, OU-5 and OU-6, and from TCE sources in vadose zone soil stranded after the water table dropped in the Aerojet area. This relatively large geographic area contains residences and workspaces that overlie shallow groundwater plumes.

The remedy is not functioning as intended by the RODs. Containment gaps have been identified in multiple areas in both OU-3 and OU-5, indicating that containment is not being achieved as required by the RODs. Land use restrictions for soil areas in OU-5 have not yet been implemented. The cleanup levels, toxicity data, and exposure assumptions used at the time of the RODs are no longer valid:

- The federal and state maximum contaminant levels (MCLs) for chloroform have changed since the OU-3 ROD was completed;
- Due to changes in TCE toxicity data, along with its presence above vapor intrusion screening levels in shallow groundwater in portions of the site below residences and inadequate documentation of the soil gas investigations in OU3 that concluded that vapor intrusion is not a risk for indoor air, reassessment of the vapor intrusion pathway is warranted for both OU-3 and OU-5;
- The selected performance standards for cadmium and mercury in residential soils are above their non-cancer regional screening levels (RSLs); and,
- The selected performance standards for 1,1,1-trichloroethane in residential and commercial/industrial soil vapor are above their non-cancer RSLs.

Protectiveness determinations for the remedies at OU-3 and OU-5 at the Aerojet Superfund Site cannot be made at this time until further information is obtained. Further information will be obtained by reassessing the vapor intrusion pathway. It is expected that these actions will take approximately one year to complete, at which time a protectiveness determination will be made.

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List of Acronyms and Abbreviations

µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
ARAR	Applicable or relevant and appropriate requirements
bgs	below ground surface
BMI	Benthic macroinvertebrate
CADHS	California Department of Health Services
CalEPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCR	California Code of Regulations
CDPH	California Department of Public Health
CFR	Code of Federal Regulations
COC	Contaminant of concern
COPC	Contaminants of potential concern
DCA	Dichloroethane
DCE	Dichloroethene
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
Freon 113	1,1,2-trichloro-1,2,2-trifluoroethane
FS	Feasibility Study
FYR	Five-Year Review
GET	Groundwater extraction and treatment
GMP	Groundwater Monitoring Plan
GMZ	Groundwater management zone
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IC	Institutional Control
IRCTS	Inactive Rancho Cordova Test Site
IRIS	Integrated Risk Information System
LUC	Land Use Control
LWRCP	Long-term Water Replacement Contingency Plan
mg/kg	milligrams per kilogram
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
NDMA	N-nitrosodimethylamine
ng/L	nanograms per liter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OMMP	Operations, Maintenance, and Monitoring Plan
ORD	EPA Office of Research and Development
OU	Operable Unit
OU-3	Western Groundwater Operable Unit
OU-5	Perimeter Groundwater Operable Unit
P&T	Pump and treat
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate

PHG	Public Health Goal
PQL	Practical quantitation level
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfC	Reference concentration
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
RWQCB	Regional Water Quality Control Board, Central Valley Region
SPZ	Special Planning Zone
SVE	Soil vapor extraction
SWB	State Water Resources Control Board
SWRCP	Short-term Water Replacement Contingency Plan
TBC	To-be-considered criteria
TCA	Trichloroethane
TCE	Trichloroethene
TMDL	Total maximum daily load
TTHM	Total trihalomethanes
UCL	Upper confidence limit
USC	United States Code
UU/UE	Unlimited use and unrestricted exposure
UV/OX	Ultraviolet oxidation
VISL	Vapor Intrusion Screening Level
VOC	Volatile organic compound

1. Introduction

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, 40 Code of Federal Regulation (CFR) Section 300.430(f)(4)(ii) of the National Contingency Plan (NCP) and EPA policy.

This is the first FYR for the Aerojet General Corporation (Aerojet) Superfund Site (Site). The triggering action for this statutory review is the initiation of the remedial action. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of nine operable units (OUs). Two are addressed in this FYR: the Western Groundwater OU (OU-3) and the Perimeter Groundwater OU (OU-5). OU-3 addresses groundwater contamination on the western side of the Site, including groundwater beneath the Boundary OU (OU-6). OU-5 addresses groundwater around the north, east, and south sides of the Aerojet property that are not addressed by OU-3 and addresses soil in one section of the Aerojet property. The seven OUs that are not addressed in this FYR are:

- Sitewide OU (OU-1) – OU-1 is reserved for the sitewide final ROD integrating remedial actions for all of the OUs. Because Records of Decision (RODs) for several other OUs have not been completed, there is no ROD for OU-1.
- American River OU (OU-2) – OU-2 has been merged into OU-5.
- Area 41 Cavitt Ranch (OU-4) – There is no ROD for OU-4.
- Boundary OU (OU-6) – The Final ROD for OU-6 was completed in August 2015, but no actions have been taken toward remedy implementation. This FYR describes the selected remedy for OU-6, but no evaluation of the OU-6 remedy is provided.
- Island OU (OU-7) – There is no ROD for OU-7.
- Eastern OU (OU-8) – There is no ROD for OU-8.
- Central OU (OU-9) – There is no ROD for OU-9.

The Aerojet General Corporation Superfund Site Five-Year Review was led by Carmen Santiago-Ocasio, Remedial Project Manager (RPM) at EPA Region 9. Participants included Aaron King (Environmental Engineer) and David Sullivan (Geologist) with the U.S. Army Corps of Engineers, Peter Phillips (Environmental Project Manager/Senior Geologist) with Gilbane Federal, Bill Schneider (Consulting

Hydrogeologist subcontracted to Gilbane Federal, and Lynn Keller, RPM at EPA Region 9. The review began on 11/3/2015.

Table 1-1: Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Aerojet General Corporation		
EPA ID: CAD980358832		
Region: 9	**State:** CA	**City/County:** Rancho Cordova/Sacramento
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**		
Author name (Federal or State Project Manager): Carmen Santiago-Ocasio		
Author affiliation: EPA Region 9		
Review period: 11/3/2015 - 6/30/2016		
Date of site inspection: 11/19/2015		
Type of review: Statutory		
Review number: 1		
Triggering action date: 9/30/2011		
Due date *(five years after triggering action date)*: 9/30/2016		

1.1. Background

Aerojet Rocketdyne, Inc. (formerly known as Aerojet General Corporation), a subsidiary of Aerojet Rocketdyne Holdings, Inc. (formerly known as GenCorp, Inc.; referred to as Aerojet in this document) began operations in Rancho Cordova, near Sacramento, California (Figure 1-1) after acquiring approximately 8,500 acres in December 1950. Operations included manufacturing and testing liquid and solid rocket engines and motors for military and commercial applications, and formulating and producing a number of chemicals, including rocket propellant agents, agricultural pesticides, pharmaceuticals, and other industrial chemicals. The State of California issued waste discharge requirements to Aerojet in May 1952. The Cordova Chemical Company operated chemical manufacturing facilities on the Aerojet complex from 1974 to 1979. On June 14, 2013, it was announced that Aerojet completed the acquisition of the Pratt & Whitney Rocketdyne business (Rocketdyne). Aerojet combined Rocketdyne with Aerojet General Corporation and currently operates as Aerojet Rocketdyne, Inc.

Figure 1-1: Location Map for the Aerojet Superfund Site

Since the early 1950s, the Aerojet Site has been devoted to the development of rocket propulsion systems to support national defense, space exploration, and satellite deployment activities. Industrial activities at the Aerojet Site have included solid rocket motor manufacturing and testing, liquid rocket engine manufacturing and testing, and chemical manufacturing. Chemicals used in the manufacturing and testing areas on the Aerojet Site have included chlorinated solvents, propellants, metals, oxidizers, and a variety of chemicals produced in the chemical operations areas.

Throughout Aerojet's operational history, some wastes were disposed of on the property in surface impoundments, landfills, deep injection wells, septic tanks and associated leach fields, and open burn areas. Although numerous chemicals were used on the Aerojet Superfund Site, trichloroethene (TCE), tetrachloroethene (PCE), perchlorate, and n-nitrosodimethylamine (NDMA) are the most prevalent chemicals encountered at concentrations that exceed applicable regulatory levels. Historical operations at the Aerojet Superfund Site have resulted in the discharge of some of these chemicals to the vadose zone and percolation into the underlying groundwater. Since 1979, Aerojet has investigated the Site to determine the nature and extent of the chemicals present, and to identify and implement mitigation measures to protect public health and the environment.

The Aerojet Superfund Site was placed on the National Priorities List (NPL) on August 8, 1983. The Aerojet Superfund Site includes a large facility with groundwater contamination that has migrated off Aerojet property. EPA and the State of California have negotiated with Aerojet to organize the site into nine OUs, as described above (locations shown on Figure 1-2).

1.2. Physical Characteristics

Currently, Aerojet uses some portions of the facility for ongoing industrial operations. In addition, portions of the facility are leased for use as rangeland where sheep and other livestock may graze. However, much of the facility is currently vacant and provides habitat for a wide variety of plant and wildlife species. The Aerojet Superfund Site is designated by Sacramento County as a Special Planning Zone (SPZ) with multiple uses from propulsion systems testing to office use (Sacramento County Ordinance, Title V, Chapter 8, Article 3 of the Zoning Code of Sacramento County). The SPZ has a provision for future development under the Sacramento County Land Use Master Plan that would allow for residential use. Future development of the Aerojet facility is planned to include residential, commercial/industrial, and recreational properties.

The land immediately adjacent to Aerojet is entirely zoned as heavy and light industrial. The area farther to the west and south of Highway 50 is designated as an industrial office park zone. The area north of Highway 50, south of the American River and west of Sunrise Boulevard, is zoned approximately 90 percent residential and 10 percent commercial. The area to the east of Sunrise Boulevard, south of the American River and north of Highway 50, is approximately 40 percent industrial and 60 percent residential. The American River floodplain and the edges of the adjacent bluffs are designated as recreational zones. The cities of Rancho Cordova and Folsom, along with the communities of Carmichael, Gold River, and the Village of Fair Oaks are generally fully developed with residential, commercial, and industrial properties.

The regional aquifer is extremely large and extends beyond the city of Sacramento, over 15 miles to the west. Much of the aquifer off Aerojet property is currently used for drinking water (over 40 public and domestic water supply wells were located within OU-3 alone at the time of its ROD) and demand on the aquifer is growing. The need for water around the Site is expected to increase over the next 20 years as it is developed. California's ongoing severe drought is an additional burden to this aquifer.

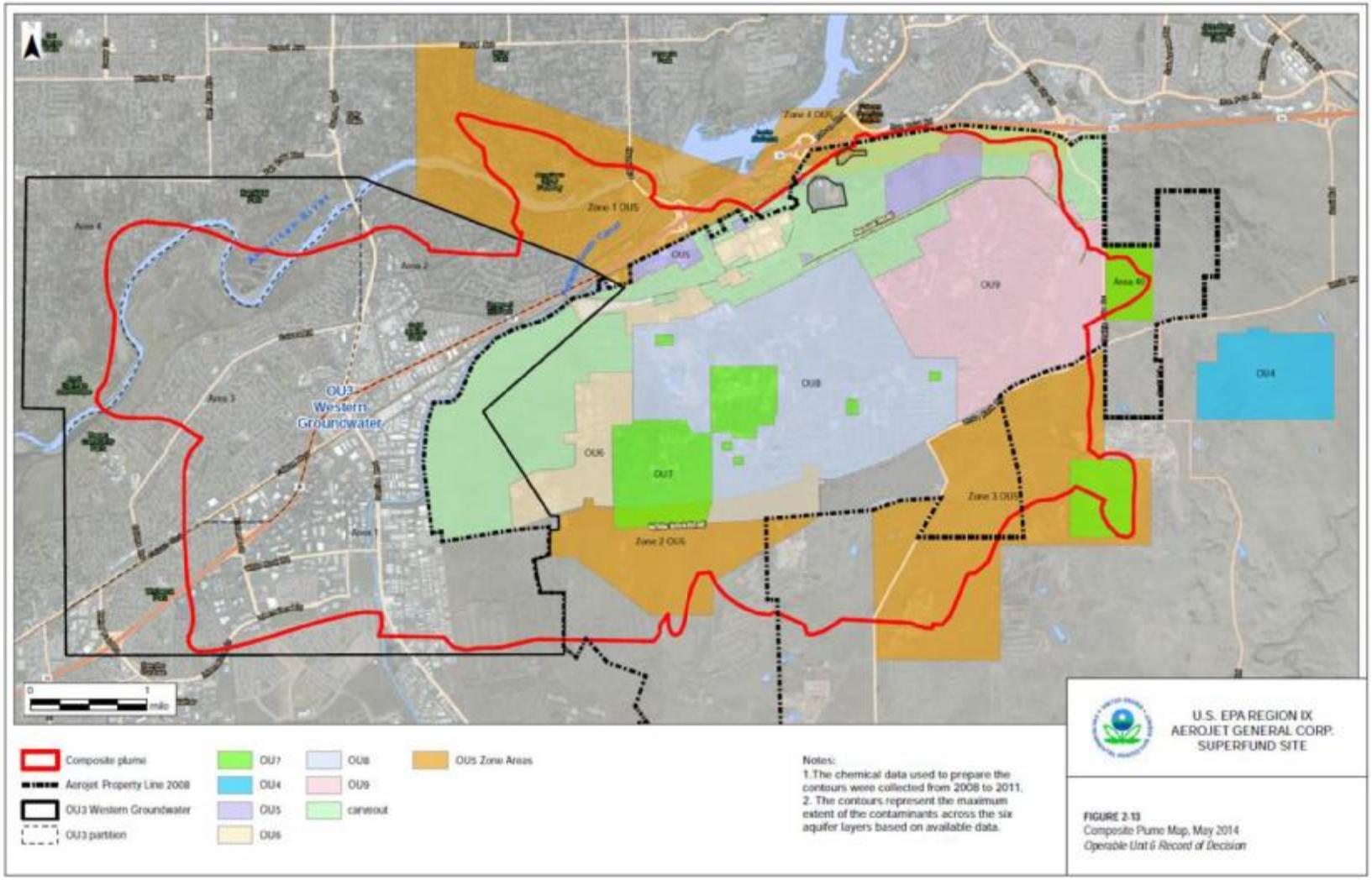

Figure 1-2: Detailed Map of the Aerojet Superfund Site

1.3. Hydrology

The Site is underlain by sedimentary layers except in the eastern portion of the Site where metamorphic bedrock is relatively shallow. The uppermost layers are fluvial deposits ranging in texture from cobble to pebble to silt to clay. Deeper layers are of marine origin and are typically finer grained. The uppermost deposits were dredged for gold through the early 1960s. The depth of dredging typically ranged from 35 to 65 feet, with deeper dredging at several locations. The dredge tailing rows that remain have large cobbles on the surface with a generally well-graded assortment of silt- through gravel-sized material underneath. The dredged layer is water bearing in several limited locations across the site. The aquifer beneath the site has been divided into six hydrostratigraphic layers:

- **Layer A** is the shallowest layer and typically extends from the ground surface to depths of approximately 60 to 155 feet below ground surface (bgs). Layer A includes coarse-grained sand and gravel deposits from the ancestral American River, interbedded with silt and clay. Layer A generally becomes unsaturated from east to west across the Site, though it is also typically unsaturated north and south of the Aerojet property boundary.
- **Layer B** underlies Layer A and is encountered at depths ranging from 55 to 155 feet bgs and ranges from 20 to 110 feet in thickness. Layer B is predominantly comprised of interbedded silt and clay mixtures, with laterally discontinuous sand and gravel channels. Along the western Aerojet property boundary where coarse-grained materials are not present, Layer A is underlain by Layer C. Layer B is mostly saturated across the Site, excluding some limited areas north and south of the Aerojet property boundary.
- **Layer C** is typically encountered at depths ranging from 90 to 155 feet bgs and ranges from 55 to 110 feet in thickness. Layer C is comprised of heterogeneous assemblages of andesitic sand and gravel with interbedded finer-grained silt and clay. Layer C is the first laterally continuous saturated layer across the Site.
- **Layer D** is typically encountered at depths ranging from 170 to 250 feet bgs and ranges from 30 to 150 feet in thickness. Lithologically, Layers C and D are relatively indistinguishable. The permeable sediments in Layers C and D are separated by a 10- to 25-foot-thick layer of silt and/or clay that acts as a lower permeability aquitard. The lateral continuity of the Layer C/D aquitard is undefined.
- **Layer E** is typically encountered at depths ranging from 260 to 360 feet bgs and ranges from 110 to 150 feet in thickness. Layer E is typically finer grained than overlying Layers C and D, and is comprised predominantly of clay and silt. In some areas, ancestral sand and gravel channels occur within the fine-grained sediments.
- **Layer F** has been reached only by a few monitoring wells and is typically encountered at depths ranging from 400 to 470 feet bgs. The sediments in Layer F are typically indurated clay and silt with occasional interbedded sandy silt and silty sand.

In general, the layers thicken and deepen from east to west. Bedrock is present at or very near the ground surface in the easternmost part of the Aerojet Site (e.g., Figure 1-3). The surface elevation varies from approximately 300 feet above sea level in the eastern portion of the Site to less than 100 feet above sea level in the west. The depth to groundwater varies from approximately 30 feet bgs near the American River north of the Site to greater than 150 feet bgs in the southern portion of the off-site area. Generally,

groundwater flows toward the west in all hydrostratigraphic units, though there are localized variations. Because of topography and hydrologic variation across the Site, not all layers may be present or saturated throughout the Site. For instance, along the western boundary of the Site, a majority of the Layer A monitoring wells are dry; therefore, Layer A is not a continuous water-bearing zone through this area.

Figures 1 through 6 of Appendix A present the sitewide potentiometric surface maps for each aquifer layer in October 2015. The Fall 2015 distributions of perchlorate, TCE, and NDMA in groundwater (the three most prevalent contaminants in groundwater) are shown in Figures 7 through 24 of Appendix A.

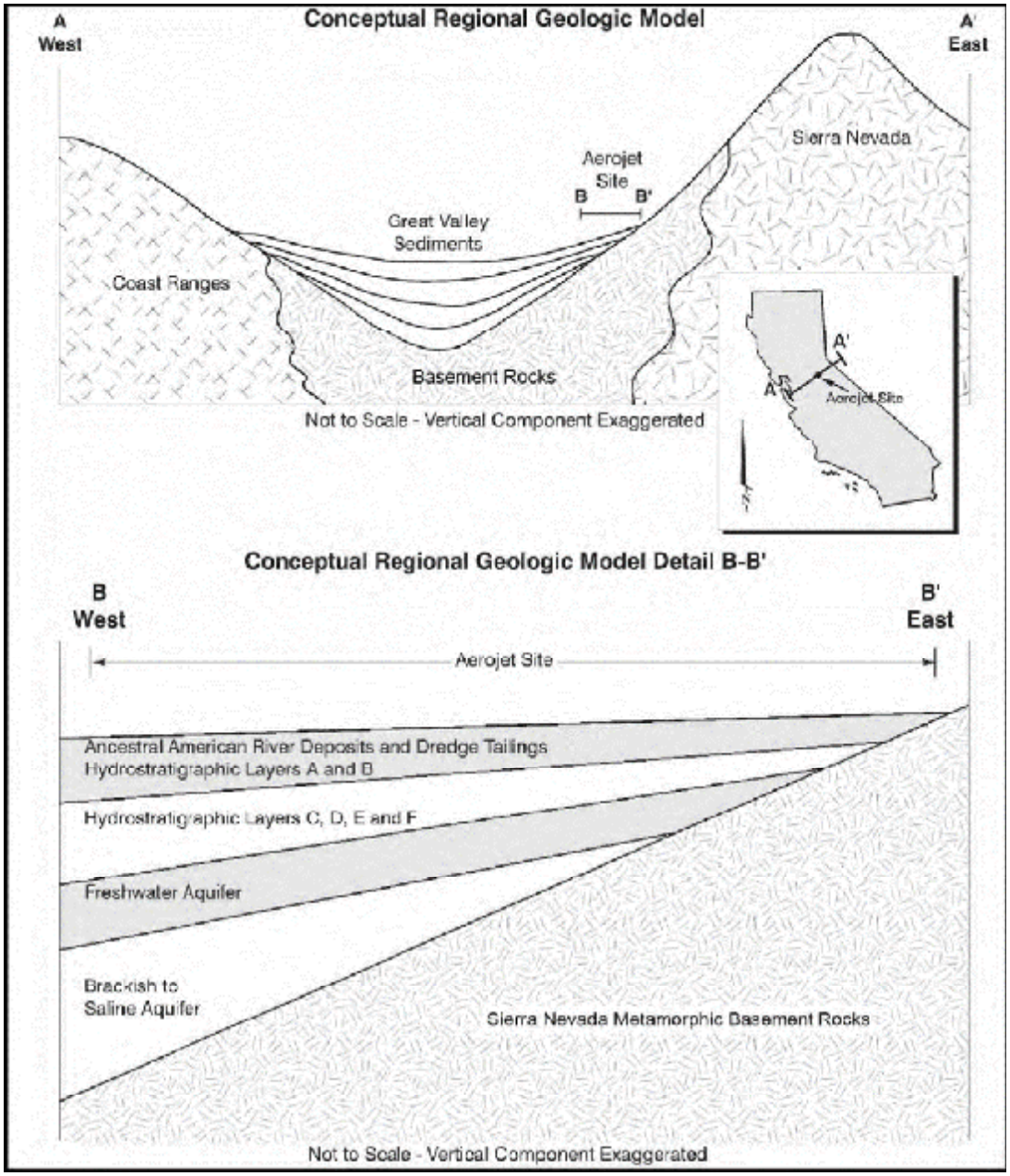

Figure 1-3: Conceptual Model of Groundwater Structure

2. Remedial Actions Summary

2.1. Basis for Taking Action

Groundwater is contaminated primarily with perchlorate, NDMA, and volatile organic compounds (VOCs) above protective levels. Groundwater in OU-3 is used as a source of potable and non-potable water. There are no municipal water supply wells within the OU-5 area, but there are some domestic wells; the aquifer is designated as a drinking water source, and the pollution is part of an aquifer that is being used for drinking water purposes downgradient. Furthermore, the OU-5 groundwater must be contained to prevent further contamination of the existing drinking water aquifer.

Soil in many areas of OU-5 is contaminated above protective levels with one or more of the following: dioxins/furans, metals, perchlorate, VOCs, phthalates, and polychlorinated biphenyls (PCBs). Action is necessary at these areas to protect future residents or workers from exposure through direct contact, ingestion, and/or inhalation of soil-related chemicals of concern (COCs).

Soil, sediment, and soil vapor in many areas of OU-6 are contaminated above protective levels with one or more of the following: PCBs, polycyclic aromatic hydrocarbons (PAHs), VOCs, metals, pesticides, perchlorate and dioxins/furans. Action is necessary at these areas to protect construction workers, commercial/industrial workers, and/or future residents from exposure to 1) soils through direct contact and inhalation of fugitive dust, 2) sediments through direct contact during recreational wading, and 3) soil vapor through inhalation of COCs in ambient (indoor and outdoor) air. Furthermore, action is necessary in drainage ditches with the potential for contaminant migration to downgradient habitats and in habitat areas with unacceptable ecological risks under current conditions.

2.2. Remedy Selection

Records of Decision (RODs) for Western Groundwater Operable Unit (OU-3), Perimeter Groundwater Operable Unit (OU-5), and the Boundary Operable Unit (OU-6) have been signed.

2.2.1. Western Groundwater Operable Unit (OU-3)

The OU-3 ROD was signed in July 2001. The Remedial Action Objectives (RAOs) for OU-3 are stated in the ROD as follows:

1. Protect human health and the environment from exposure to contaminated groundwater;
2. Achieve full containment of the contaminated groundwater to minimize future migration of contaminants until cleanup is accomplished;
3. Protect public drinking water wells through short-term and long-term contingency plans for alternative water supplies; and
4. Restore both on-property and off-property western groundwater within OU-3 to beneficial uses.

The remedy selected included containment of the contaminated groundwater on the western side of Aerojet (see Figure 1-2) to prevent further contamination of the aquifer and restoration of the aquifer between the on and off-property controls. Treatment of extracted groundwater included biological

treatment for perchlorate, ultraviolet oxidation (UV/OX) treatment for NDMA, and liquid-phase granular activated carbon or air stripping for residual VOCs to meet cleanup levels, and discharge of the treated water to either surface water or to the drinking water system. The cleanup levels established in the OU-3 ROD are listed in Table 2-1. In addition, the OU-3 ROD allowed an evaluation of in-situ bioremediation or a combination of pump and treat (P&T) and in-situ bioremediation in the deeper groundwater layers to determine whether these components can be effectively and economically implemented to expedite remediation of the groundwater. To prevent any adverse effect on the sphere of influence of the remedy, a groundwater management zone (GMZ) within OU-3 was established to maintain water levels.

Table 2-1: Cleanup Levels for OU-3 Groundwater

Contaminant of Concern	Cleanup Level (µg/L)	Basis for Cleanup Level
Perchlorate	4.0[a]	Low end of ORD Range
n-nitrosodimethylamine (NDMA)	0.0013[b]	PRG
Trichloroethene (TCE)	5	Federal MCL
Tetrachloroethene (PCE)	5	Federal MCL
1,1-Dichloroethane (DCA)	5	California MCL
1,2-DCA	0.5	California MCL
1,1,2-Trichloroethane (TCA)	5	Federal MCL
1,1-Dichloroethene (DCE)	6	California MCL
1,2-DCE	6	California MCL
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	1,200	California MCL
Chloroform	100	California MCL
Vinyl chloride	0.5	California MCL
Carbon tetrachloride	0.5	California MCL
Nitrate (as Nitrogen)	10,000	Federal MCL
Nitrite (as Nitrogen)	1,000	Federal MCL

ORD = EPA Office of Research and Development, PRG = Preliminary Remediation Goal, MCL = Maximum Contaminant Level

Notes:

[a] Low end of ORD range in guidance letter from 6/18/1999

[b] Enforceable level at the time was 0.005 µg/L, but the NDMA Practical Quantitation Level (PQL) is/was being improved. The best available monitoring technology shall be used until a PQL of 0.0013 µg/L is achieved.

The remedy also included contingency measures and notification plans to prevent exposure while the remedy is operating. Contingency planning documents are 1) a Short-Term Water Replacement Contingency Plan (SWRCP) to provide the interim water replacement until the long-term water replacement contingency plan can provide permanent replacement water, 2) a Long-Term Water Replacement Contingency Plan (LWRCP) for the permanent replacement of private and public drinking water and irrigation water supply wells which may continue to be lost due to Aerojet contamination, and 3) a Groundwater Monitoring Plan.

Finally, the remedy included the following institutional controls (ICs):

- Sacramento County's continued review of new well drilling permit applications.
- An annual notification in local newspapers showing the OU-3 area of groundwater contamination, the requirement for a permit for any well within OU-3, and a point of contact for a permit.
- Written notification to drinking water suppliers if treated groundwater discharged directly to the water supply system exceeds California Department of Public Health (CDPH; formerly the California Department of Health Services [CADHS]) drinking water action levels.
- Any lease or sale of Aerojet-owned land overlaying the contaminated groundwater shall have the following restrictions:
    - No extraction of groundwater;
    - No recharge of groundwater unless and until expressly permitted in writing by the Regional Water Quality Control Board (RWQCB);
    - No injection into the groundwater; and
    - No sustained extraction of groundwater encountered during construction without written approval by the RWQCB.

2.2.2. Perimeter Groundwater Operable Unit (OU-5)

An Interim ROD for groundwater and Final ROD for soil for OU-5 was signed in February 2011.

2.2.2.1 OU-5 Groundwater

The RAOs for the interim OU-5 groundwater remedy are stated in the ROD as follows:

1. Protect human health and the environment by preventing exposure to contaminated groundwater through restricting withdrawal of the water within the containment area for purposes other than remediation;
2. Achieve containment of the contaminated groundwater that exceeds the groundwater containment standards to prevent future migration of contaminants until cleanup levels are achieved to protect long-term beneficial uses of the groundwater; and
3. Remove contaminant mass from the aquifer through extraction and treatment of highly contaminated groundwater at or near the up-gradient portions of the OU-5 groundwater zones. This action will improve the efficiency and effectiveness of contaminant containment of OU-5 groundwater.

The remedy selected includes containment of the contaminated groundwater with mass removal through groundwater extraction and treatment. The remedy serves to inhibit downgradient migration of contamination into OU-5 from source areas and removes substantial contaminant mass, improving the long-term effectiveness by reducing the cost and difficulty of operating existing extraction and treatment facilities by preventing highly contaminated groundwater from reaching these systems. The containment levels established in the OU-5 ROD are listed in Table 2-2. The extracted water will be treated with biological treatment or resin adsorption for perchlorate; UV/OX for NDMA; and carbon filtration,

chemical oxidation, UV/OX or air stripping for VOCs and 1,4-dioxane. Treated water will be used for non-potable purposes such as industrial process and cooling purposes, discharge to surface water, or discharge to land.

Table 2-2: Containment Levels for OU-5 Groundwater

Contaminant of Concern	Containment Level (µg/L)	Basis for Containment Level
Perchlorate	6	California MCL
NDMA	0.003	California PHG
TCE	5	Federal MCL
1,1,2,2-Tetrachloroethane	1	California MCL
1,1,2-TCA	5	Federal MCL
1,1-DCE	6	California MCL
1,2-DCA	0.5	California MCL
cis-1,2-DCE	6	California MCL
trans-1,2-DCE	10	California MCL
1,4-Dioxane	1	CDPH Notification Level
Bromodichloromethane	80[a]	Federal MCL
Carbon tetrachloride	0.5	California MCL
Chloroform	80[a]	Federal MCL
Dibromochloromethane	80[a]	Federal MCL
Methylene chloride	5	Federal MCL
PCE	5	Federal MCL
Vinyl chloride	0.5	California MCL

MCL = Maximum Contaminant Level, PHG = Public Health Goal, CDPH = California Department of Public Health
Notes:
[a] The federal MCL establishes a limit of 80 µg/L for the sum of the concentration for all four major trihalomethanes: chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

As described in the Western Groundwater Remedy above, this ROD also required several contingency plans be developed and implemented including an SWRCP, LWRCP, and Groundwater Monitoring Plan.

The remedy also included ICs. These restrictions are implemented through a recorded Declaration of Covenants and Environmental Restrictions as covenants running with the land. Any lease or sale of Aerojet property overlying the contaminated groundwater in OU-5 shall be subject to the following restrictions:

- No recharge of groundwater unless and until expressly permitted in writing by EPA and the RWQCB;
- No injection into the groundwater unless approved in writing by EPA and the RWQCB; and
- No sustained extraction of groundwater encountered during construction without written approval by EPA and the RWQCB; written notice of the groundwater contamination is required to each buyer, lessee, renter, and mortgagee of any of these lands and every lease, deed, mortgage, or instrument conveying any part of these lands shall expressly provide that it is subject to this Declaration of Covenants and Environmental Restrictions.

2.2.2.2 OU-5 Soil

The RAOs for the final OU-5 soil remedy are stated in the ROD as follows:

1. Eliminate exposure to concentrations of pollutants in soils and related drainage ditch sediments that pose an unacceptable risk for present and future occupants of the property and ecological receptors on the property;
2. Prevent migration of VOCs and perchlorate in the soil that would impact long-term beneficial uses of groundwater;
3. Control perchlorate in subsurface soil below the depth that can be removed by excavation, which may migrate to the shallow groundwater, through containment of the OU-5 groundwater; and
4. Prevent exposure to VOCs in soils or soil vapor exceeding the EPA health-based ambient air screening levels for residential land use. Potential exposure pathways include inhalation (breathing), ingestion, and skin contact. Where commercial or industrial cleanup criteria are used, the land will be restricted to commercial or industrial use through a land use covenant.

The OU-5 remedy included soil excavation or soil vapor extraction (SVE) to allow for unrestricted use of the land based on residential risk levels. The area-specific soil cleanup requirements are presented in Table 2-3, and the location of the areas are shown in Figure 2-1. The soil and soil vapor performance standards established in the OU-5 ROD for these areas are listed in Table 2-4 and

Table 2-5, respectively. The landfill in the northern portion of OU-5 (Zone 4) is not included in the remedy. EPA will review the monitoring results of the solid waste landfill closure to ensure both soil and groundwater protectiveness from this potential source of contamination. If potential risks from the landfill are not adequately addressed, EPA will consider additional remedial actions.

Table 2-3: Area-Specific Soil Remedy Components

Area	Excavation required to performance standards in Table 2-4	Install and operate a SVE to the performance standards in Table 2-5	Soil vapor mitigation methods as necessary, until the cleanup is complete	Land Use Restrictions[1]
Areas 10D and 11D	Yes	No	No	No.
Areas C4 and C41	Yes	No	No	If waste is left in place deeper than ten feet, land use controls will be necessary to protect against exposure resulting from excavation to depths greater than ten feet.
Areas 32D, 34D, 35D, and 38D (also referred to as Area 49 or Area 49000)	No	Yes, A temporary asphalt cap shall be constructed over the surface to improve capture of the VOCs	Yes	Land use will be restricted to commercial or industrial use until cleanup is achieved.
Areas 7D, 33D, and Former Company Store	No	No[2]	Yes	Yes, land use will be residential or restricted to industrial /commercial, as appropriate.

Notes:
[1] Implement restrictions on the future use of contaminated soil areas that have not attained residential cleanup objectives through a recorded Declaration of Covenants and Environmental Restrictions
[2] The Remedial Investigation (RI) concluded that neither soil excavation nor soil vapor extraction would be protective until levels of VOCs in the groundwater are reduced by controlling sources outside OU-5

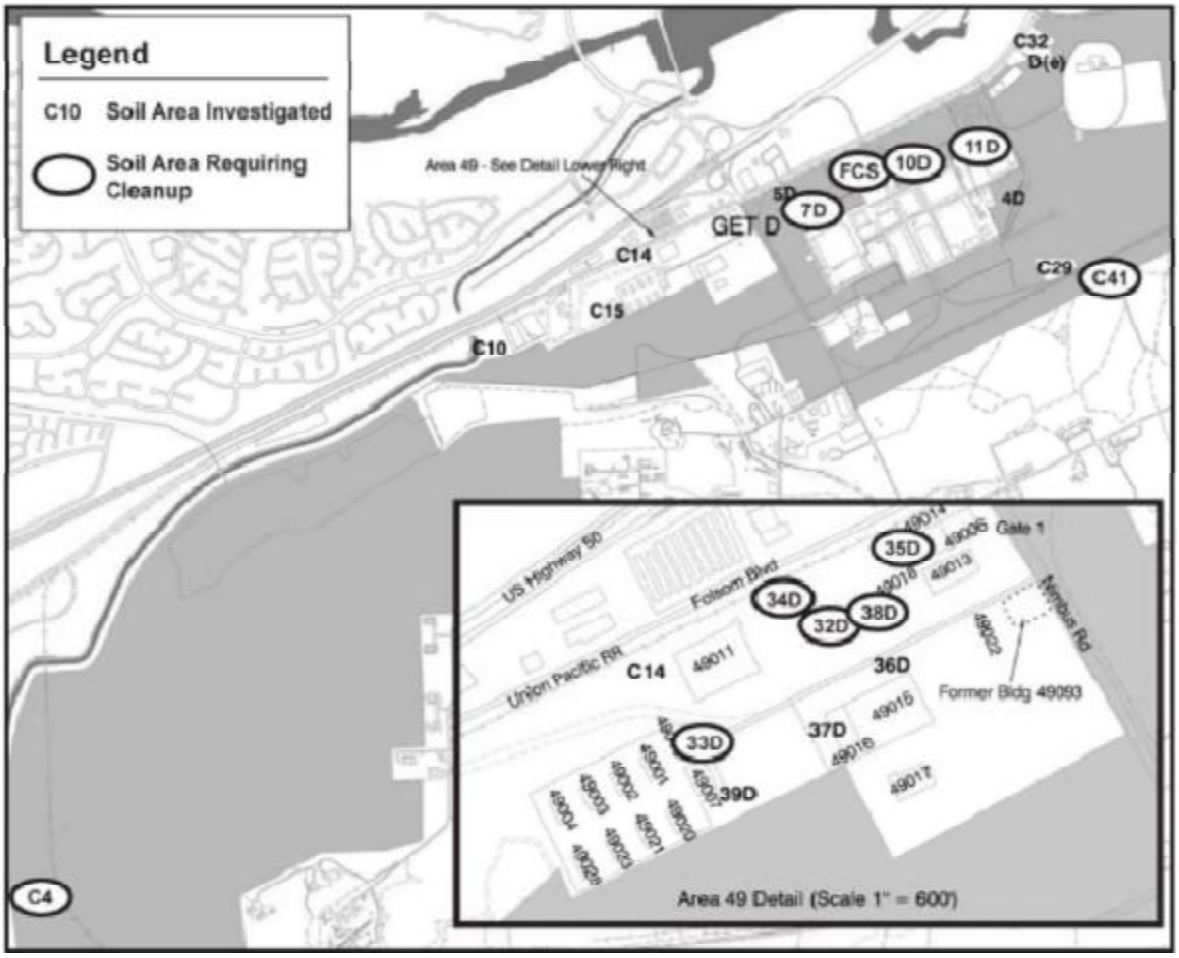

Figure 2-1: Contaminated Soil Areas in OU-5

Table 2-4: Performance Standards for OU-5 Surface Soils

Contaminant of Concern	Unrestricted Use Level - Residential Use		Restricted Use – Commercial Use	
	Soil Concentration (mg/kg)	Risk Basis	Soil Concentration (mg/kg)	Risk Basis
2,3,7,8-TCDD (Dioxin)	3.9×10^{-6}	Cancer	1.6×10^{-5}	Cancer
Antimony	31	Non-cancer	120	Non-cancer (construction worker)
Bis(2-ethylhexyl)phthalate	35	Cancer	123	Cancer
Cadmium	48	Cancer (construction worker)	48	Cancer (construction worker)
Diethyl phthalate	49,000	Non-cancer	186,000	Non-cancer (construction worker)
Di-n-butyl phthalate	6,110	Non-cancer	23,280	Non-cancer (construction worker)
Hexavalent chromium	1.4	Cancer (construction worker)	1.4	Cancer (construction worker)
Lead	127	Non-cancer	531	Non-cancer (construction worker)
Mercury	23.5	Non-cancer	84	Non-cancer (construction worker)
Perchlorate[a]	55	Non-cancer	210	Non-cancer (construction worker)
PCB-1254	0.09	Cancer	0.3	Cancer
PCB-1260	0.09	Cancer	0.3	Cancer
Silver	390	Non-cancer	1,500	Non-cancer (construction worker)
Zinc	23,400	Non-cancer	90,000	Non-cancer (construction worker)

mg/kg = milligrams per kilogram, TCDD = tetrachlorodibenzo-p-dioxin, PCB = polychlorinated biphenyl

Notes:

[a] Perchlorate in the soil at Area C41 poses a potential risk for transport into the groundwater. Perchlorate cleanup goal for protection of groundwater quality is 0.06 mg/kg.

Table 2-5: Performance Standards for Ambient Air Vapor Levels of VOC COCs at OU-5

Contaminant of Concern	Unrestricted Use Level - Residential Use		Restricted Use – Industrial Use	
	Soil Vapor Health-Based Levels (µg/m^3)	Risk Basis	Soil Vapor Health-Based Levels (µg/m^3)	Risk Basis
Benzene	0.31	Cancer 10^{-6} risk level	1.6	Cancer 10^{-6} risk level
Chloroform	0.11	Cancer 10^{-6} risk level	0.53	Cancer 10^{-6} risk level
cis-1,2-Dichloroethene[a]	110	Non-cancer	0.21	Non-cancer
1,1,1-Trichloroethane	5,200	Non-cancer	22,000	Non-cancer
Trichloroethene	1.2	Cancer 10^{-6} risk level	6.1	Cancer 10^{-6} risk level
Tetrachloroethene	0.41	Cancer 10^{-6} risk level	2.1	Cancer 10^{-6} risk level

µg/m^3 = micrograms per cubic meter
Notes:
[a] For cis-1,2-DCE, the OU-5 ROD shows the Soil Vapor Health-Based Levels for the Residential and Industrial Uses as 1.1E02 and 2.1E-01. It is unusual for the Industrial Use Health-Based Level to be less than the Residential Use Health-Based Level, so it is suspected that there is a typographical error in the ROD for one of the levels shown.

2.2.3. Boundary Operable Unit (OU-6)

The Final ROD for OU-6 was completed in August 2015. The RAOs for the OU-6 remedy are stated in the ROD as follows:

1. Prevent present and future worker and resident exposure to COCs in soils within the upper 12 feet and ecological receptors within the upper 6 feet that pose an unacceptable risk;
2. Prevent migration of COCs in soil and soil vapor to groundwater for areas that could impair beneficial uses and to be consistent with current and future sitewide groundwater remedies;
3. Prevent exposure to VOCs in ambient air at levels exceeding the health-based ambient air screening levels for the current and planned future land use; and
4. For contaminated soil and soil vapor, the RAOs are based on site-specific potential exposure information as used in the HHRA and ERA and on current values for the hazards posed by the COCs. The soil and soil vapor cleanup levels are calculated to reduce human health and ecological risks to protective levels for unrestricted future land use.

Eighty-one areas in OU-6 were identified for remedial action. The selected remedies for OU-6 include:

- Alternative 2 – Institutional Controls (ICs)
- Alternative 3 – Containment and Engineering Controls, incorporating Alternative 2 ICs
    - Placement of new capping materials
    - Integrity monitoring of new and existing capping materials
    - Modifications of existing HVAC systems to limit vapor intrusion

- Construction and operation of foundation venting systems around and/or beneath existing and new buildings to reduce or prevent VOC intrusion

- Alternative 4 – Source Removal/Reduction
  - Excavation (with ex situ treatment via soil flushing or air stripping if necessary) or
  - Soil vapor extraction (SVE)

The remedy (or alternative) chosen for a specific area in OU-6 depended on the exposures and risks associated with that area. Alternative 2 was chosen for three areas, Alternative 3 was chosen for 11 areas, Alternative 4 using excavation (with ex situ treatment via soil flushing or air stripping if necessary) was chosen for 51 areas, and Alternative 4 using SVE was selected for 16 areas. Performance standards of soil and soil vapor for OU-6 are provided in Appendix B.

2.3. Remedy Implementation

2.3.1. Western Groundwater Operable Unit (OU-3)

The containment system, conveyance, treatment plant, and treated water disposition components of the OU-3 remedy consist of six GET systems: GET EF, GET H, GET J, GET K, GET LA, and GET LB. GET EF and GET J serve as the Inner-Barrier GET System, the intent of which is to intercept chemicals migrating off Aerojet property. All other OU-3 GET system components serve as the Outer-Barrier GET System, the intent of which is to hydraulically contain the downgradient extent of chemicals in all layers of the aquifer.

Table 2-6: Groundwater Extraction and Treatment (GET) System

Table 1 Groundwater Extraction and Treatment (GET) Systems

On-Property GETs	System Start Date	Total Ext Wells	Currently Operating Ext Wells[1]	Chemicals	Treatment Process[2]	Process Capacity[3] (gpm)	Current Operating Rate (gpm)	Discharge Point	Location
GET AB	2009	58[4]	47	VOCs	UV with Peroxide	3,400	2,200	Buffalo Creek	SE corner of Aerojet Rocketdyne campus
					Air Stripping	3,000+			
				Perchlorate	Ion-exchange Resin	3,000			
				NDMA	UV with Peroxide	3,000			
ARGET	1998	49	24	VOCs	Air Stripping	3,500	2,750	Buffalo Creek	NW corner of Aerojet Rocketdyne campus
				Perchlorate	Ion Exchange Resin	1,500			
GET EF	1999	36[5]	34	VOCs	UV with Peroxide	6,000	4,500[6]	Buffalo Creek	SW corner of Aerojet Rocketdyne campus
					Air Stripping	6,000+			
				Perchlorate	Biological Fluidized Bed Reactor	3,600			
					Ion Exchange Resin	4,500			
				NDMA	UV with Peroxide	6,000			
Off-Property GETs									
GET H	2006	7	7	VOCs	Granular Activated Carbon	3,000	2,200	Morrison Creek	Femoyer Street, Mather Field
				Perchlorate	Ion Exchange Resin	3,000			
GET J	2005	13	13	VOCs	UV with Peroxide	4,500	4,150	Buffalo Creek	Pyrites Way, Rancho Cordova
					Carbon Polish	4,000			
				Perchlorate	Ion Exchange Resin	4,500			
				NDMA	UV with Peroxide	4,200			
GET K	2009	6	6	VOCs	UV with Peroxide	3,000	2,200	Coloma Canal	Coloma Road, Rancho Cordova
				NDMA					
GET LA	2010	1	1	NDMA	UV with Peroxide	800	800	Irrigation for Ancil Hoffman; American River	Ancil Hoffman Regional Park
GET LB	2007	1	1	VOCs	UV with Peroxide	600	600	American River	CWD - Bajamont Facility
				NDMA	Granular Activated Carbon	2,000			

Notes:

GET EF became operational in 1999. Modifications to the GET EF system per the OU-3 ROD were completed prior to or shortly after ROD signature. The GET EF system currently utilizes 23 of its 32 extraction wells (one screened in Layer A, 8 in Layer C, 4 in Layer D, 6 in both Layers C and D, and 4 in Layer E), and a treatment plant that uses fluidized bed ion-exchange resinreactors for biological treatment of perchlorate, UV/OX for NDMA and VOC removal, air stripping towers for VOC removal as a polishing step, and sand filters for removal of biological solids produced by the perchlorate treatment system. Treated water is discharged under National Pollutant Discharge Elimination System (NPDES) Permit CA0083861 to Buffalo Creek, a tributary to the American River.

GET H became operational in 2006 and serves the southern portion of the Outer-Barrier hydraulic containment system. The GET H system consists of seven extraction wells; five wells screened in Layer C and two wells screened in Layer D. Extracted water is conveyed to the GET H-A treatment plant, which consists of bag filters for solids removal, ion exchange for perchlorate removal, and granular activated carbon for low-level VOC removal. Treated water is discharged under NPDES Permit CA0083861 to the Capital Center Ditch, which flows to Morrison Creek. Water supply well AC-18, equipped with a wellhead treatment system for perchlorate removal, also provides hydraulic containment in the southern portion of the Outer-Barrier.

GET J became operational in 2005 and serves a portion of the Outer-Barrier hydraulic containment system in Layers C and D, and a portion of the Inner-Barrier Containment system in Layer E. GET J consists of 13 extraction wells: 4 screened in Layer C, 4 in Layer D, and 5 in Layer E. Extracted water is conveyed to the GET J treatment plant, which currently consists of a filtration system for solids removal (added in 2012 for the Layer E wells only), ion exchange for perchlorate removal; UV/OX with hydrogen peroxide and a carbon polish for VOC; and UV/OX for NDMA destruction. Treated water is discharged under NPDES Permit CA0083861 to Buffalo Creek

GET K became operational in 2009 and serves in the central portion of the Outer-Barrier containment system. GET K consists of 6 extraction wells: 1 screened in Layer A; 2 in Layer C; 1 in Layer D; 1 in Layers, B, C, and D; and 1 at the location of the former water supply well AC-12/1141. Extracted water is conveyed to the GET K treatment plant, which currently consists of UV/OX with hydrogen peroxide addition for destruction of low levels of VOCs. GET K was designed with space to accommodate additional perchlorate treatment if necessary. Treated water from GET K is discharged under NPDES Permit CA0083861 to the Coloma Canal, which flows to the American River. Water supply well AC-6, equipped with a wellhead treatment system for perchlorate removal, also provides hydraulic containment in this portion of the Outer-Barrier.

GETs LA and LB are individual treatment systems located on the north side of the American River. At the time of the signing of the OU-3 ROD, extraction wells on the north side of the American River were not included because contaminants were not known to be present there. However, following the discovery of NDMA north of the American River, EPA required additional response actions. GET LA became operational in 2010 and consists of a single extraction well screened in Layer C. Extracted water is treated using UV/OX with hydrogen peroxide addition for destruction of NDMA. GET LA was designed to accommodate perchlorate treatment if necessary. A significant portion of the treated water is used for irrigation of Ancil Hoffman Park. Unused effluent is discharged under NPDES Permit CA0083861 to the

American River. Aerojet is currently evaluating data from new groundwater wells to select locations for up to two new extraction wells in this area north of the American River.

GET LB became operational in 2007 and consists of a single extraction well screened in Layers C and D. The GET LB treatment plant consists of UV/OX with hydrogen peroxide addition to treat NDMA and liquid phase granulated activated carbon to treat low levels of VOCs. The plant has space available to add perchlorate treatment if necessary. Treated water is discharged under NPDES Permit CA0083861 to the American River.

The SWRCP and LWRCP were finalized in December 2004. Aerojet submitted a revised SWRCP (for both OU-3 and OU-5) in March 2016.

Institutional controls in the form of deed restrictions, which include restrictions on the use of groundwater, are currently on the Aerojet Site through the Partial Consent Decree Paragraph 11 or on lands removed from the Superfund Site through the Environmental Restrictions of the 2002 Stipulation and Order Modifying the Partial Consent Decree. The restrictions include the following:

- No Extraction. No owners or occupants of the Aerojet property shall construct or use a well for the purposes of extracting water for any use unless expressly permitted in writing by the EPA and the RWQCB.
- No Recharge. No owners or occupants of the Aerojet property shall install, operate, or maintain a recharge or sedimentation control basin that is designed to infiltrate water unless expressly permitted in writing by the EPA and the RWQCB.
- No Injection. No owners or occupants of the Aerojet property shall install, operate, or maintain any injection wells for any use unless expressly permitted in writing by the EPA and the RWQCB.
- Excavations. No owners or occupants of the Aerojet property shall conduct sustained extraction of the groundwater that is encountered during excavations for the construction of buildings or other improvements unless expressly permitted in writing by the EPA and the RWQCB.

Groundwater use within OU-3 and not within Aerojet property is regulated under Sacramento County Ordinance. The Sacramento County Environmental Management Department manages a “Consultation Zone” that requires all parties to consult with the RQWCB, Central Valley Region prior to drilling a well within 2,500 feet from chemicals in groundwater around the Aerojet Site.

Groundwater monitoring has been occurring prior to and since the OU-3 ROD; Aerojet submitted the most recent Groundwater Monitoring Plan for review in December 2015. A draft Groundwater Management Zone Plan for OU-3 was submitted in 2006. Groundwater management of OU-3 is currently documented in Performance Evaluation Reports, Groundwater Model Update Reports, annual Groundwater Monitoring Plans, and the SWRCP and LWRCP for OU-3 and OU-5.

2.3.2. Perimeter Groundwater Operable Unit (OU-5)

2.3.2.1 OU-5 Groundwater

The containment system, conveyance, treatment plant, and treated water disposition components of the OU-5 remedy currently consist of two GET systems: American River GET (GET AR) and GET AB.

GET AR became operational in 1998 and includes a total of 44 extraction wells (not all currently operating) which also contains extraction wells initially installed for the recently decommissioned GET D system and the Sailor Bar Regional Park extraction well (1156). The GET AR treatment plant consists of ion exchange for treatment of perchlorate, advanced oxidation with hydrogen peroxide with air stripping for VOCs and advanced oxidation with hydrogen peroxide for 1,4-dioxane. Treated effluent water is discharged to Buffalo Creek, and then to the American River under NPDES Permit CA0083861.

GET AB became operational in 1986 and includes 51 extraction wells (not all currently operating) that serve eastern Zone 2, Zone 3, and Zone 4. The GET AB treatment plant consists of ion exchange for treatment of perchlorate, UV/OX with hydrogen proxide and air stripping for VOC removal, and UV/OX with hydrogen peroxide for NDMA treatment. Beginning in mid-2014, GET AB effluent piping was connected to the Aerojet Rocketdyne industrial water distribution system. The excess water is discharged to Buffalo Creek and then to the American River under NPDES Permit CA0083861.

As stated previously, Aerojet submitted a revised SWRCP (for both OU-3 and OU-5) in March 2016.

Institutional controls in the form of deed restrictions, which include restrictions on the use of groundwater, are currently on the Aerojet Site through the Partial Consent Decree Paragraph 11 or on lands removed from the Superfund Site through the Environmental Restrictions of the 2002 Stipulation and Order Modifying the Partial Consent Decree. The restrictions include the following:

- No Extraction. No owners or occupants of the Aerojet property shall construct or use a well for the purposes of extracting water for any use unless expressly permitted in writing by the EPA and the RWQCB.
- No Recharge. No owners or occupants of the Aerojet property shall install, operate, or maintain a recharge or sedimentation control basin that is designed to infiltrate water unless expressly permitted in writing by the EPA and the RWQCB.
- No Injection. No owners or occupants of the Aerojet property shall install, operate, or maintain any injection wells for any use unless expressly permitted in writing by the EPA and the RWQCB.
- Excavations. No owners or occupants of the Aerojet property shall conduct sustained extraction of the groundwater that is encountered during excavations for the construction of buildings or other improvements unless expressly permitted in writing by the EPA and the RWQCB.

Groundwater use within OU-5 that is not within Aerojet property is regulated under Sacramento County Ordinance. The Sacramento County Environmental Management Department manages a “Consultation Zone” that requires all parties to consult with the RQWCB, Central Valley Region prior to drilling a well within 2,500 feet from chemicals in groundwater around the Aerojet Site.

Groundwater monitoring has been occurring prior to and since the OU-5 ROD. Aerojet submitted the most recent Groundwater Monitoring Plan for review in December 2015. Aerojet submitted a Groundwater Management Zone Plan for OU-5 in February 2015. Groundwater management of OU-5 is also documented in Performance Evaluation Reports, Groundwater Model Update Reports, annual Groundwater Monitoring Plans, and the SWRCP for OU-3 and OU-5.

2.3.2.2 OU-5 Soil

2.3.2.2.1 Areas 10D and 11D

Excavation of soils contaminated primarily with lead, hexavalent chromium, and PCBs above residential performance standards (Table 2-4) occurred in Areas 10D and 11D between November 2009 and March 2010. Approximately 4,930 tons of soil were excavated. Excavated soil was transported to and disposed of in a Class II landfill approved to accept CERCLA waste. Backfill material from two borrow sites on the Aerojet property was used to fill the excavations.

2.3.2.2.2 Areas C4 and C41

In Area C4, excavation of soils with lead and dioxin concentrations exceeding the residential performance standards (Table 2-4) occurred primarily in August 2013, though additional minor excavation occurred in May 2014. Soil excavation depths extended from several inches down to seven feet bgs. Approximately 3,370 tons of soil were excavated and disposed of in facilities approved to accept CERCLA waste. Because contaminated soil was removed to levels identified in the performance standards, no land use restrictions were required. Area C4 was not backfilled as part of the remedial action because it was unknown if future development in the area would require filling or cutting of existing topographic surfaces.

Between July and September 2012, soils in Area C41 with perchlorate concentrations above 0.06 mg/kg (perchlorate cleanup goal in soil in Area C41 is based on the protection of groundwater; see Table 2-4) were excavated to depths of 10 feet bgs. Approximately 12,500 tons of soil were excavated and disposed of in a Class II landfill approved to accept CERCLA waste. Borrow material from within Aerojet property was used to backfill the excavation area. Perchlorate remaining in soil greater than 10 feet bgs will be managed by land use restrictions, groundwater monitoring, and the downgradient GET AR extraction wells (those formerly part of the GET D system). The Sacramento County “Consultation Zone” ordinance applies at C41.

2.3.2.2.3 Areas 32D, 34D, 35D, and 38D

A full-scale SVE system has been constructed in Areas 32D, 34D, 35D, and 38. Initially, six SVE wells were completed and are operating. Extracted vapors are first passed through vapor-liquid separator, then routed through two vapor-phase carbon vessels in series followed by two potassium-permanganate-impregnated zeolite vessels in series. Treated vapors are discharged to the atmosphere. Additional proposed SVE wells have been constructed and include 13 shallow wells and 8 deep extraction wells. Land use is restricted to commercial or industrial use, through appropriate LUCs and soil vapor mitigation methods as necessary, until unrestricted cleanup levels are attained. The selected land use restrictions have not yet been implemented.

2.3.2.2.4 Areas 7D, 33D, and Former Company Store

The selected vapor mitigation methods and land use controls have not yet been implemented.

Vapor mitigation systems may include vapor barriers and venting of vapors from beneath the structure. Appropriate monitoring and LUCs are required for either residential or commercial use of these locations until the potential threat of vapor intrusion is removed.

2.3.3. Boundary Operable Unit (OU-6)

No actions toward implementation of the OU-6 remedy have taken place.

2.4. Operation and Maintenance (O&M)

2.4.1. OU-3 and OU-5 Groundwater

In December 2015, Aerojet submitted a Draft Groundwater Monitoring Plan (GMP) that presented a comprehensive collection of plans for groundwater monitoring at the Aerojet Site; previously, plans for different monitoring programs were submitted separately. The draft GMP includes the monitoring programs for the federal response actions (OU-3 and OU-5), various state response actions (American River Study Area, White Rock North Dump, Inactive Rancho Cordova Test Site, Closed Landfill, and Post-closure Deep Injection Wells), and more generalized monitoring to provide sitewide coverage in areas where specific response actions have not yet been established. Collectively, these plans cover all of the monitoring required for those programs and meet the deliverable requirements for those programs. Since OU5 has not been declared Operational and Functional, OU5 is not in O&M stage yet. However, to facilitate review of Site groundwater data, OU5 is included in the GMP and included as part of the O&M discussion in this report. Below is a summary of the groundwater monitoring program for the federal response actions (i.e., as required in the RODs).

Compliance and sentinel wells, and selected other monitor wells are monitored in OU-3 and OU-5 with the objective of collecting the necessary data to conduct performance evaluations of the hydraulic containment systems. Compliance wells are selected to provide direct indication that capture has been achieved; detections in compliance wells can indicate breaches in capture that may require corrective actions to re-establish compliance. Sentinel wells are located to provide early warning of a COC approaching a water supply or extraction well that does not have treatment capabilities for a specific constituent. If, at any time, non-compliance with cleanup or containment levels is observed in a compliance or sentinel well, Aerojet notifies EPA, RWQCB, and DTSC within 5 days. Depending on the situation, verification samples may be collected, and a Compliance Action Plan may be submitted. Response actions following confirmation of non-compliance may include review of pumping history of nearby extraction wells, adjustment of sampling frequency, evaluation of alternative pumping options/pump rehabilitation, or initiation of modeling studies to evaluate alternative pumping scenarios as necessary to contain the contaminant plume. Aerojet submits Quarterly Compliance Monitoring Reports to EPA, RWQCB, and DTSC.

There are several cases (e.g., GET EF, GET J, and GET H) where monitoring wells identified as compliance or sentinel wells have difficulty meeting the criteria to be considered compliance and sentinel

wells due to the close proximity of water supply wells to the extraction wells and contaminant plumes (e.g., #27 Rockingham). In addition, Aerojet has identified water supply wells that have no sentinel well protectection in place and/or inadequate compliance wells to serve as indicators of remedy performance (e.g., AC22A and AC22B in Layer E). These deficiencies in the monitoring program prevent regulatory agencies (EPA, RWQCB, and DTSC) from implementing and enforcing compliance actions because the triggers for those compliance actions are currently missing. Aerojet is in the process of establishing compliance and sentinel wells for those areas lacking them.

Monitoring of the water supply, domestic, and irrigation wells near the site is conducted to determine if the supplied groundwater requires remedial action. When COCs are detected in these samples above pre-defined trigger levels, Aerojet notifies the water purveyor or well owner and EPA, RWQCB, and DTSC within 24 hours. Aerojet then evaluates the results and develops appropriate response actions, which may include verification monitoring, additional groundwater sampling in the vicinity of the affected well, groundwater modeling to re-evaluate the capture area of the supply well, wellhead treatment, water supply replacement, or additional groundwater capture upgradient of the affected well.

It should be noted that effluent data from the active water supply wells with wellhead treatment systems for perchlorate (AC-6 and AC-18) are not reported in a Performance Evaluation Report. This information is critical to understanding whether the wellhead treatment systems are operating and functioning as intended and providing protection of human health, and should be presented in future Performance Evaluation Reports. Furthermore, operation and maintenance of the wellhead treatment systems is not well documented.

Additional wells are monitored as part of the sitewide plume dynamics monitoring, which is necessary to continually evaluate the nature and extent of the contaminant plumes so that areas of contamination requiring control or capture are appropriately addressed. Selected monitoring wells were identified to supplement the sampling required by other monitoring programs. There are no specific reporting requirements for the sitewide plume dynamics monitoring; however, the sitewide isoconcentration maps are distributed annually and are integrated into other monitoring programs as required. For example, the isoconcentration maps produced using data from this program (together with data from other programs) are used in the evaluation of hydraulic containment as a line of evidence for remedy performance and effectiveness, which is presented in annual performance evaluation reports.

In the 2015 Draft GMP, Aerojet identified existing and to-be-installed monitored wells for Special Evaluation Group Monitoring. The stated objective of this monitoring program is to further evaluate the stability of specific contaminant plumes that are not currently known to be captured by existing extraction systems, so it can be determined whether active extraction will be required to prevent further migration. There are no specific reporting requirements for the Special Evaluation Group monitoring plans; however, the conclusions derived from the data collected as part of this program will be presented as part of the overall assessments of remedy effectiveness (annual performance evaluation reporting). It should be noted, however, that monitored natural attenuation (MNA) is not a component of the selected remedies; without changes to the ROD, the ROD-selected remedies should be used to address deficiencies in containment.

Individual extraction well monitoring is conducted as an overall evaluation of remedial performance and is useful for treatment system planning. Analytical data are used to track remedial performance (e.g., concentration trends and mass removal from specific locations) and to determine if the associated system can treat the influent chemicals at the reported concentrations.

Each of the GET systems has its own O&M manual; the last updates to the O&M manuals were prepared in October 2014. Each of the O&M manuals provide a detailed description of the GET system (extraction wells, pipeline, treatment components), control and monitoring system, operating procedures, maintenance management, contingency plans, recordkeeping and reporting, and safety plan. Additionally, each of the manuals includes a detailed schedule and checklist of semi-weekly, monthly, quarterly, semi-annual, and annual inspections that must take place. The NPDES permits are also included in these manuals.

2.4.2. OU- 5 Soil and Soil Vapor

Because soils in Areas 10D, 11D, C4, and C41 of OU-5 were removed, additional O&M procedures are not necessary.

Stantec, on behalf of Aerojet, prepared an Operations, Maintenance, and Monitoring Plan (OMMP) for the SVE system in Areas 32D, 34D, 35D, and 38D in November 2015. The OMMP briefly describes the SVE system, startup and shutdown procedures, data collection and maintenance schedule, performance criteria and optimization, monitoring and sampling plan, and reporting requirements. Annual effectiveness evaluations for the first four years of SVE system operation will be conducted and included in Performance Evaluation Reports for OU-5; after four years, EPA will determine the frequency of future effectiveness evaluations. Quarterly compliance monitoring reports will include: measured contaminant concentrations at soil vapor extraction wells; charts showing contaminant concentrations versus time at vapor extraction wells; assessments and statements regarding whether Performance Standards are being satisfied by the soil vapor extraction system; predictions, if appropriate, of possible future occurrences of non-compliance; relevant preliminary calculations and supporting data used to evaluate compliance; and any other relevant requirements outlined in the Site-wide monitoring plan. Aerojet must immediately notify the Sacramento Metropolitan Air Quality Management District (SMAQMD) if the emission limits, VOC control efficiency requirement, or carbon breakthrough monitoring limits are found to be non-compliant.

3. Progress Since the Last Five-Year Review

3.1. Previous Five-Year Review Protectiveness Statement and Issues

This is the first FYR for the Aerojet Superfund Site; therefore, there is no protectiveness statement or issues and recommendations from previous FYRs.

4. Five-Year Review Process

4.1. Community Notification and Involvement

A public notice was made available in the *Carmichael Times*, in the *Grapevine Independent*, and in the *Folsom Telegraph* on June 24, 2016 stating that there was a five-year review and inviting the public to submit any comments to the U.S. EPA. The results of the review and the report will be made available at the Site information repository located at the Sacramento Central Library, 828 I Street, Sacramento, CA and the California State University, Sacramento Library, 2000 State University Drive, Sacramento, CA. Copies of the public notice is provided in Appendix C.

In response to the public notice, the City of Sacramento's American River Source Water Protection Program provided its concerns to EPA about the operation of the remedy at the site. The City of Sacramento withdraws its drinking water downstream of the current surface water discharge locations for Aerojet's treated groundwater. The City requested that EPA, as a part of the Five Year Review, include an analysis of impacts of the cumulative risk to the American River, including treated groundwater discharges, groundwater seeps, and stormwater discharge. As part of this review, EPA evaluated the groundwater treatment plant discharges with respect to their NPDES permit compliance and concluded that a cumulative evaluation for all sources is outside the scope of the remdies selected.

4.2. Data Review

Appendix D lists the documents reviewed; they include the most recent Performance Evaluation Reports for OUs 3 and 5, the 2016 Groundwater Monitoring Plan, and Remedial Action Reports for the soil excavation areas of OU-5. Below is a summary of the data reviewed. Additional details regarding the data review are presented in Appendix E.

4.2.1. Groundwater

Sitewide potentiometric maps and contaminant contour maps of perchlorate, TCE, and NDMA are provided in Appendix A.

4.2.1.1 Western Groundwater Operable Unit (OU-3)

OU-3 is separated into two parts: the Inner-Barrier and the Outer-Barrier. GET EF and GET J serve as the Inner-Barrier GET System, the purpose of which is to intercept chemicals migrating off Aerojet property. All other GET system components, which are located off Aerojet property in residential or commercial/industrial areas, serve as the Outer-Barrier GET System, the purpose of which is to hydraulically contain the farthest downgradient extent of chemicals in all layers of the aquifer. Additionally, restoration of on-property and off-property groundwater to beneficial uses is an objective for OU-3.

4.2.1.1.1 Restoration

Based on review of COC concentrations over time in compliance, sentinel, and extraction wells, COC concentrations appear to be generally decreasing or not changing. Increasing trends are seen in TCE concentrations near the central and southern GET EF extraction wells, part of the Inner-Barrier, in Layers

C and D (e.g. extraction well 4615; Figure 4-1). Other increasing trends are seen in perchlorate concentrations south of GET H in water supply well AC-18 (which has wellhead perchlorate treatment) and NDMA concentrations west of GET K in former compliance well 30229 (Figure 4-2). Former compliance well 30229 is within the capture zone of GET K, but the operation of irrigation well 2082 could be drawing NDMA toward it (see Figure 15 in Appendix A for exact locations of these wells in relation to the NDMA plume). COC concentrations in the OU-3 area are, in many locations, orders of magnitude above their respective cleanup levels. The estimated time to achieve restoration (as provided in the OU-3 ROD) is 240 years. The full OU-3 remedy became operational in 2011 and new monitoring and extraction wells are still being considered in order to fill data gaps and provide for full containment. Thus, it is likely too soon to reliably assess when restoration might be achieved.

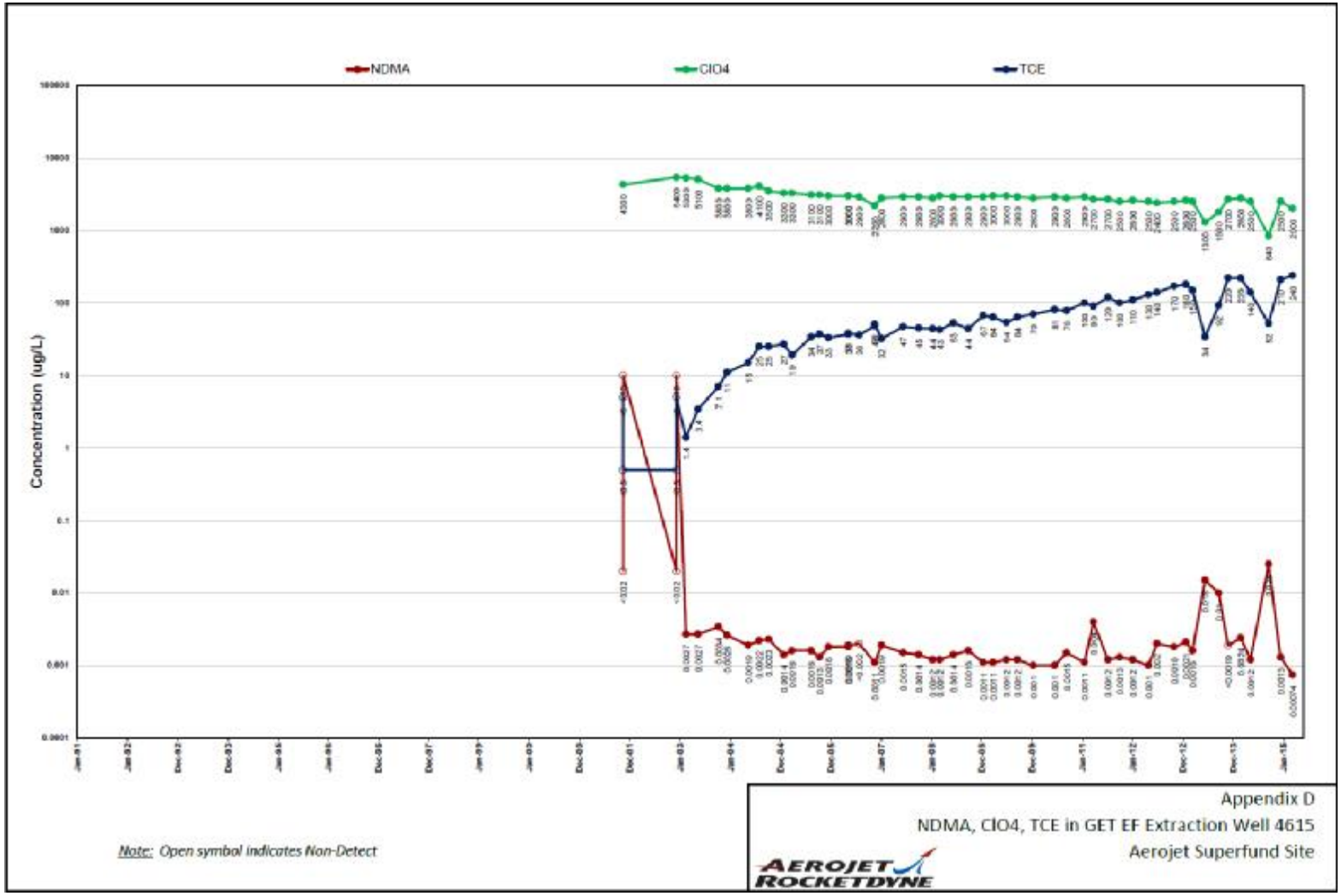

Figure 4-1: COC Concentrations in GET EF Extraction Well 4615

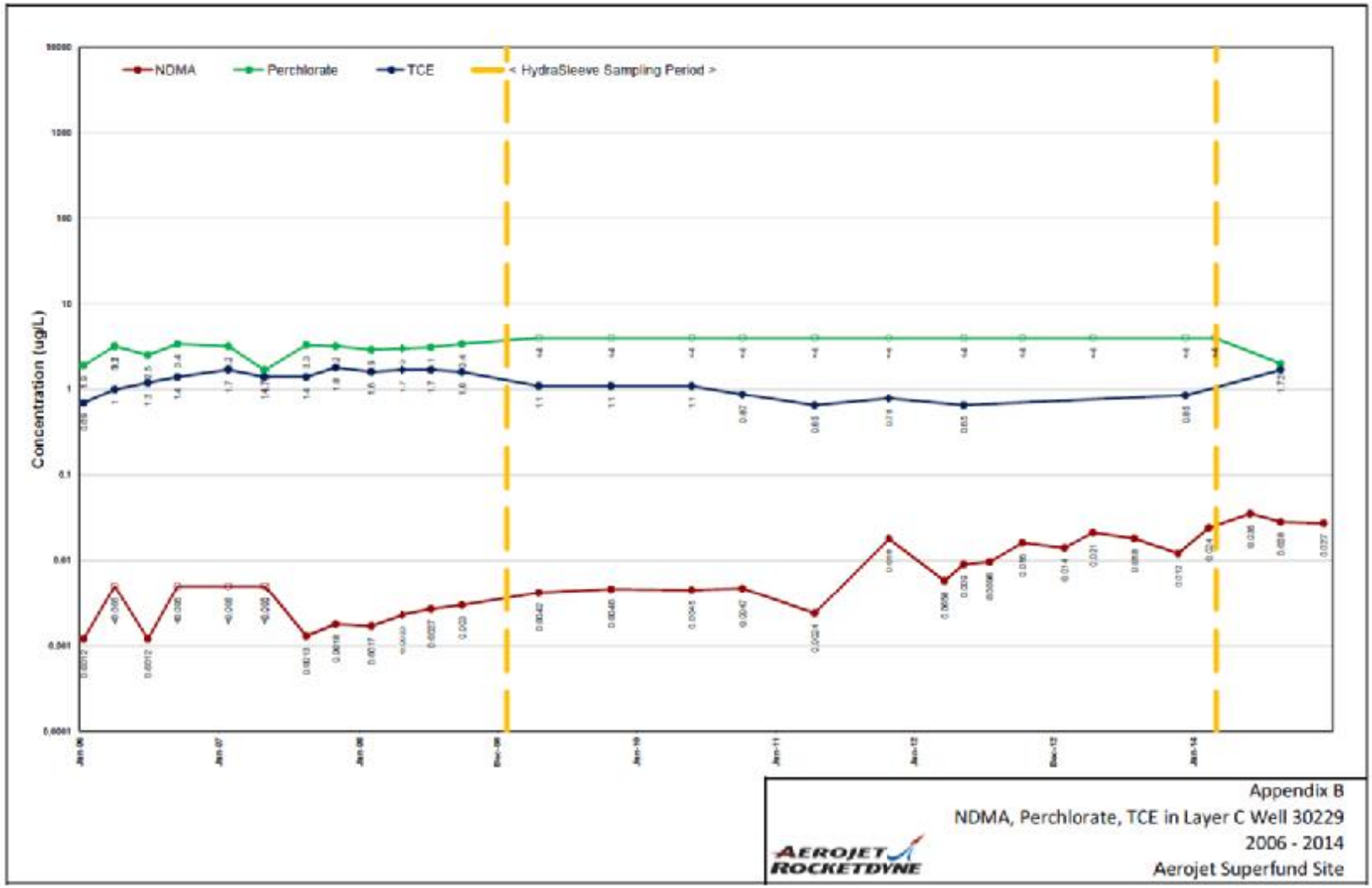

Figure 4-2: COC Concentrations in Former GET K Compliance Well 30229

4.2.1.1.2 Containment

Containment at the Inner-Barrier extraction systems has not been achieved. Excessive downtime during 2014 (due to control equipment repairs, data acquisition system failure, faulty totalizers and the on-going modification and expansion construction activities associated with the GET EF treatment plant) produced low annual average pumping rates at GET EF. Detection of TCE above the cleanup level in Layer C compliance well 30078 (Figure 4-3) coupled with potentially increasing concentrations in nearby wells during this time suggests that groundwater pollutants were already present in Layer C in this area.. Additionally, the pumping rates were below what was necessary to create complete containment, and resulted in gaps in capture zones between extraction wells located in the central portion of the Inner-Barrier extraction system. The current target rate for GET EF is about 5,175 gallons per minute (gpm); however, the average flow rate for 2014 was 3,118 gpm. At GET J, the target pumping rate is 4,150 gpm, and the average flow rate for 2014 was 3,313 gpm. Numerical models suggest adequate containment can be achieved when extraction wells operate at target pumping rates. Previous analyses showed a broad cone of depression enveloping the central GET EF extraction wells that was not evident in the most recent analysis. Pumping rate reductions have likely resulted in the observed gaps between the capture zones of operating wells. Once all GET systems are operating at target pumping rates, hydraulic containment should be achieved. However, adequate containment in this area does not currently exist.

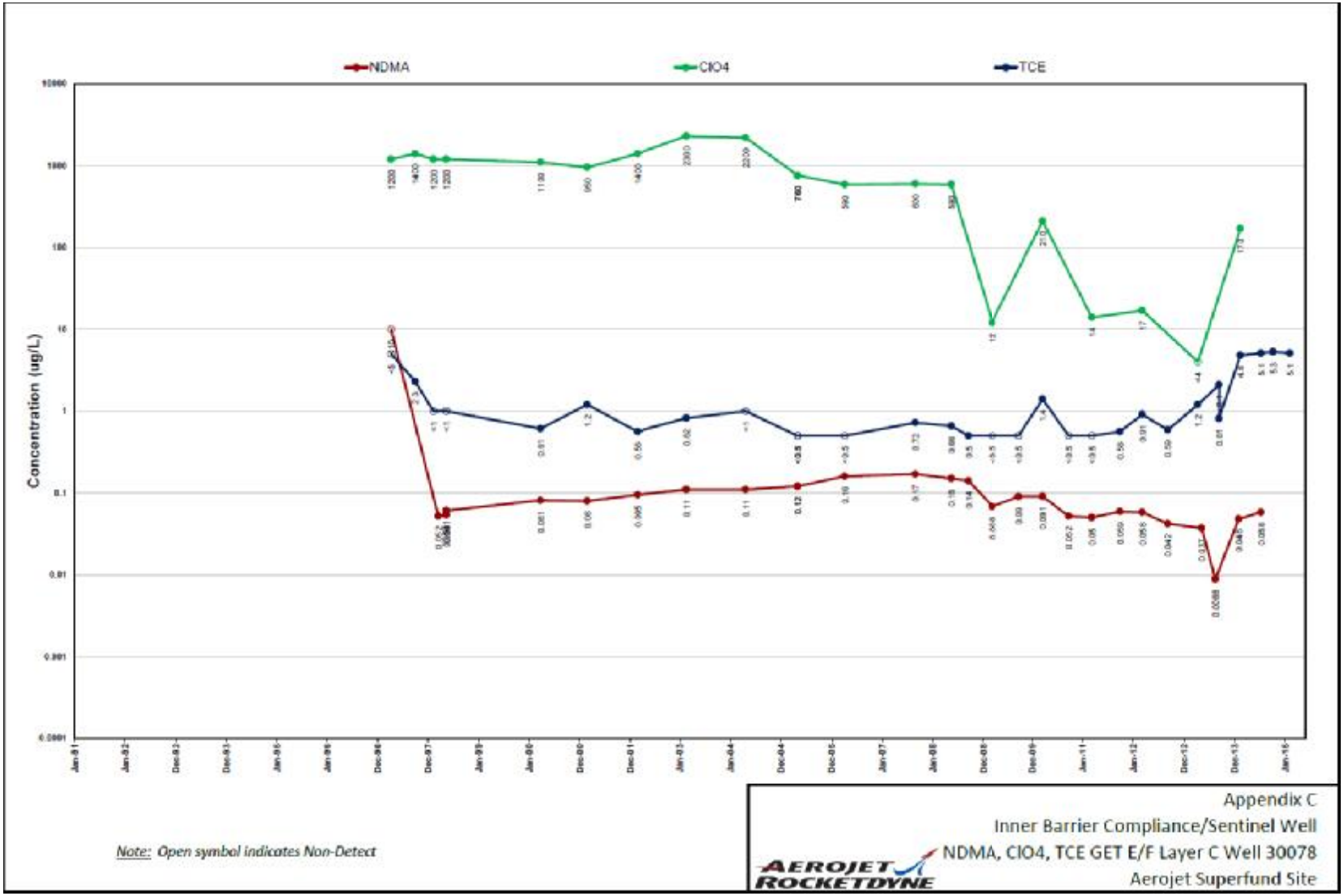

Figure 4-3: COC Concentrations in GET EF Compliance Well 30078

In a few areas, COCs have been detected beyond Inner-Barrier extraction systems but upgradient of Outer-Barrier systems that do not currently have the capability of treating those COCs. Perchlorate and NDMA were detected in recently constructed monitoring well 30456, which is in Layer D downgradient of GET J extraction wells. Chemicals have been present prior to GET J operation and/or monitoring well 30456 installation, but should be monitored due to the absence of treatment for perchlorate downgradient at GET K. Though perchlorate has been detected in this area, levels are not above cleanup action levels. However, it should be noted that GET K was designed to accommodate perchlorate treatment and, if perchlorate is found to be migrating toward GET K extraction wells, then it would be appropriate to upgrade GET K to include perchlorate treatment. Similarly, in Layers C and D, NDMA has been detected downgradient of GET EF extraction wells. GET H, which is downgradient, does not have treatment components for NDMA. Aerojet is currently evaluating NDMA migration between GET EF and GET H to assess possible NDMA arrival at GET H. If NDMA is found to be migrating toward GET H extraction wells, then it would be appropriate to upgrade GET H to treat NDMA; otherwise, additional extraction wells could be installed to intercept NDMA and connected to a treatment facility that is capable of treating NDMA.

TCE, perchlorate, and NDMA have been detected above their respective cleanup levels in Layer F in the northeastern part of OU-3, but there are no extraction wells screened in Layer F in this area. It is uncertain whether extraction in shallower aquifer layers (e.g., Layer E) is sufficient to control migration of contaminated groundwater in Layer F. This should be evaluated. If extraction in shallower aquifer layers is not sufficient to control migration of contaminated groundwater in Layer F, extraction wells should be installed in Layer F to provide for full containment.

Gaps in containment have been identified in the GET K, L, and H areas. A gap in containment through the central GET K/L area in Layers C and D has been observed south of GET LB extraction well 4706. This condition is consistent with observations presented in previous Performance Evaluation Reports. NDMA concentrations are relatively high upgradient of the gap. Containment north of GET LB extraction well 4706 in Layers C and D is uncertain due to limitations in delineating the extent of NDMA. NDMA has been detected well above its cleanup level in newly constructed monitoring well 30454, which is located northwest of GET LB extraction well 4706. This could represent a portion of the plume that existed before operations began at extraction well 4706 or non-containment by extraction well 4706. In either case, capture of this portion of the NDMA plume is not being achieved. Containment of the southern capture zone boundary near GET K in Layer C is uncertain, partially due to limited water level data near Well AC-6/1136, and partially due to uncertainties in delineating the extent of perchlorate. Containment of the southern capture zone boundary near GET K in Layer D appears complete.

Containment through the central and southern GET H area in Layer C appears complete, but containment of northern boundary capture zone in Layer C is uncertain. Different analysis methods produce contradictory results. Also, short-term losses of containment have resulted in perchlorate detections downgradient of GET H when extraction wells or treatment plants are off-line for repairs or maintenance. Water supply well #27 Rockingham is not far downgradient from GET H, and does not currently have wellhead treatment for perchlorate. Discussions are ongoing with the water purveyor regarding the use of wellhead treatment at the Rockingham well. Capture in Layer D at GET H has not yet been evaluated.

OU-3 Containment Summary

There are known or potential containment gaps in the following locations:

- North and south of GET LB extraction well 4706 in Layers C and D
- Southern capture zone boundary near GET K in Layer C
- Northern capture zone boundary near GET H in Layer C
- Northeastern portion of OU-3 in Layer F

Due to the known or potential gaps in containment listed above, full containment has yet to be achieved.

Short-term containment losses due to extraction well or treatment system repairs or maintenance have resulted in:

- Perchlorate detections downgradient of GET H (water supply wells are not far downgradient)
- TCE detections above the cleanup level downgradient of the central GET EF extraction wells

Downtime should be minimized to reduce the likelihood of contaminants migrating past the GET capture zones, even if there are contingency plans for downgradient wells.

COCs have been observed downgradient of Inner-Barrier wells upgradient of Outer-Barrier extraction and treatment systems that do not currently have treatment for those chemicals:

- Perchlorate and NDMA have been detected downgradient of GET K, which does not currently include process units to treat perchlorate
- NDMA has been detected downgradient of GET H, which does not currently include treatment for NDMA.

It make sense to upgrade the treatment plants to treat the appropriate chemicals and install additional extraction wells to intercept the COCs.

Treatment System Performance Summary

During 2014, two samples of the GET EF effluent collected in July and August exceeded the NPDES Permit Maximum Daily Effluent Discharge Limitations. Both exceedances occurred after a GET EF influent stream was added; one influent went to the fluidized bed reactors and one went to the ion exchange systems. High VOC concentrations in one of the influents exceeded the air stripper's ability to meet discharge limitations. In one sample each in July and August, chloroform (up to 0.78 µg/L) exceeded its Maximum Daily Effluent Discharge Limitation of 0.7 µg/L. In the August sample, cis-1,2-DCE (up to 1.1 µg/L) exceeded its Maximum Daily Effluent Discharge Limitation of 0.7 µg/L. These exceedances were deemed by the Central Valley Regional Water Quality Control Board to be within the accepted calibration limits of the system flowmeter and did not constitute violations of the NPDES permit. NPDES discharge limitations have not been exceeded since these exceedences.

More recently, the Central Valley Regional Water Quality Control Board collected samples from the influent and effluent at the GET EF under the NPDES program and analyzed for the emerging

contaminants, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). These compounds were detected in both the influent and the effluent. Influent levels were 74 nanograms per liter (ng/L) and 33 ng/L for PFOS and PFOA, respectively. Effluent levels were 96 ng/L and 24 ng/L for PFOS and PFOA, respectively. These compounds were also detected, at lower concentrations (3ng/L) at GET AB.

During 2014, permitted chemical concentrations in treated water from GET J were below NPDES Effluent Discharge Limitations. GET J exceeded its maximum daily volume limitation of 5.98 million gallons per day (MGD) in June and July 2014. The volume limitation was increased to 6.75 MGD in the October 2014 revision to the NPDES permit.

During 2014, chemical concentrations in treated water from GET H, LA, and LB were below NPDES Effluent Discharge Limitations. One GET K discharge exceeded the NPDES discharge limitations; chloroform was detected at 1.9 µg/L, above its daily maximum discharge limit of 0.5 µg/L. NPDES discharge limitations have not been exceeded since this exceedence.

4.2.1.2 Perimeter Groundwater Operable Unit (OU-5)

OU-5 consists of four zones of contaminated groundwater generally located north and south of Aerojet property. Zones were generally designated based on the groundwater flow direction: Zone 1 to the northwest, Zone 2 to the west and southwest, Zone 3 to the south, and Zone 4 to the north-northwest. OU-5 extraction and treatment systems currently consist of GET AB (which treats groundwater from eastern Zone 2, Zone 3, and Zone 4) and GET AR (which treats groundwater from Zone 1). In addition, GET J and GET EF extract and treat groundwater from Zone 1 and Zone 2, respectively. The White Rock Road GET also provides control over a portion of the perchlorate plume in Zone 3. The purpose of extraction in each of the zones is to achieve containment of the contaminated groundwater above the containment levels with some mass removal in the upgradient portions of the OU-5 plumes.

4.2.1.2.1 Containment

Capture zone analysis was limited to the GET systems in Zone 1 because data was only available through February 2015. Limited containment analysis was completed for GET AR and GET D (decommissioned in 2014; GET D extraction wells connect to an expanded GET AR system), the only OU-5 containment systems with most extraction wells operating during the October 2014 water level measurements. Containment analysis was also completed for GET AR using water level measurements collected during February 2015. Full capture zone analysis for Zones 2, 3, and 4 had not been completed at the time of this review; however, it will be completed and available in 2016.

Capture analysis in Zone 1 showed capture zones for the Layer C and D GET AR extraction wells in the Sailor Bar area (north of the American River) do not reach the northern portion of the TCE plume in Zone 1. The containment gap in Layers C and D in the Sailor Bar area indicates that containment in a portion of Zone 1 is not being achieved.

TCE, perchlorate, and NDMA have been detected above their respective cleanup levels in Layer F in the southern part of Zone 1, but there are no extraction wells screened in Layer F in this area. It is uncertain whether extraction in shallower aquifer layers (e.g., Layer E) is sufficient to control migration of contaminated groundwater in Layer F. Aerojet is currently evaluating extraction and monitoring locations to address capture in the northern portions of Zone 1. If extraction in shallower aquifer layers is not

sufficient to control migration of contaminated groundwater in Layer F, extraction wells should be installed in Layer F to provide for full containment.

OU-5 Containment Summary

Containment analysis has only been evaluated for Zone 1. Additional containment analysis, which will include Zones 2, 3, and 4, will be completed and available in 2016.

In Zone 1, there are known or potential containment gaps in the following locations:

- North of the northernmost Layers C and D extraction wells (Sailor Bar area north of the American River)
- Layer F

Due to the known or potential gaps in containment listed above, containment in Zone 1 has not yet been achieved.

Treatment System Performance Summary

Between January 2014 and April 2015, there were no exceedances of the effluent discharge limits for GET AR or GET AB.

4.2.1.2.2 Mass Removal

The ROD-specified purpose of substantial mass removal in these areas was to reduce the eventual cost, difficulty, and time required for hydraulic control and restoration of the aquifer. The OU-5 Feasibility Study (FS) for groundwater identified specific extraction wells as “mass removal” wells to demonstrate that the remedy is meeting the mass removal RAO. Because most of those identified “mass removal” wells are still operating, some amount of mass removal is occurring at or near the upgradient portions of the OU-5 plumes, which may be consistent with the mass removal RAO. It may be assumed that the intent of the ROD was to achieve mass removal similar to that assumed in the corresponding alternatives in the FS, but clear mass removal performance metrics are not explicitly stated in the ROD. Well-defined mass removal performance metrics should be developed in order to aid in the evaluation of mass removal toward the ROD-specified purpose. Following the development of these metrics, mass removal should be assessed; mass removal specifically at or near the upgradient portions of the OU-5 plumes has not yet been evaluated.

4.2.2. Soil

4.2.2.1 Perimeter Groundwater Operable Unit (OU-5)

Eleven soil cleanup areas were identified in the OU-5 ROD: four areas for SVE, four areas for soil removal, and three areas for vapor mitigation systems and land use controls (LUCs). The SVE system in Areas 32D, 34D, 35D, and 38D has been constructed. All four soil removal area actions (Areas 10D, 11D, C4, and C41) are complete, as described below.

Excavation of soils contaminated primarily with lead, hexavalent chromium, and PCBs above residential performance standards occurred in Areas 10D and 11D between November 2009 and March 2010. Areas

where confirmation samples showed soil contamination above the performance standards at depths below the initial excavation were over-excavated until OU-5 performance standards were reached. Lead concentrations in confirmation samples do not exceed the California Department of Toxic Substances Control (DTSC) current recommended residential lead concentration in soils of 80 mg/kg.

In Area C4, excavation of soils with lead and dioxin concentrations exceeding the residential performance standards occurred primarily in August 2013, though additional minor excavation occurred in May 2014. Soil excavation depths extended from several inches bgs to seven feet bgs. Lead concentrations in 129 confirmation samples taken in Area C4 post-excavation ranged from 2 mg/kg to 120 mg/kg, with an average of 32.8 mg/kg and a 95% upper confidence limit (UCL) on the sample mean of 44.2 mg/kg. At the time of the excavation, DTSC's recommended residential lead concentration in soils was 80 mg/kg. While there were several discrete samples in Area C4 with lead concentrations above 80 mg/kg, the excavation area as a whole has a collective arithmetic average (95% UCL) less than DTSC's recommended residential lead concentration in soils.

Between July and September 2012, soils in Area C41 with perchlorate concentrations above 0.06 mg/kg (perchlorate cleanup goal in soil in Area C41 is based on the protection of groundwater) were excavated to depths of 10 feet bgs. Perchlorate remaining in soil greater than 10 feet bgs will be managed by land use restrictions, groundwater monitoring, and the downgradient GET AR extraction wells (those formerly part of the GET D system). Containment of groundwater in this area appears to be adequate.

4.3. Site Inspection

The inspection of the Site was conducted on November 19, 2015. In attendance were Carmen Santiago-Ocasio and Lynn Keller of the EPA; Aaron King and David Sullivan of USACE; Alex MacDonald of the RWQCB – Central Valley Region; Steven Ross of DTSC; Mark Varljen, Craig Fegan, Jaco Fourie, and Chris Fennessy of Aerojet Rocketdyne; and Peter Phillips and Ailiang Gu of Gilbane Federal. The purpose of the inspection was to assess the protectiveness of the remedy. The inspection included a walkthrough of each of the groundwater treatment plants and the SVE system in OU-3 and OU-5. No extraction or monitoring wells were inspected. The groundwater treatment equipment, tanks, and piping appear to be in very good condition and the systems were operating. Much of the equipment appears essentially new, even though all treatment systems have been operational for several years. Most of the plants are typically standardized and spare parts are readily available. At the time of the site inspection, the SVE system was operating with six wells. The system appears to be in very good, almost new condition. Additional soil vapor extraction wells are scheduled for installation as the system is upgraded to full-scale. The site inspection checklist and trip report are provided in Appendix F.

5. Technical Assessment

5.1. Question A: Is the remedy functioning as intended by the decision documents?

No. The remedy is not functioning as intended by the decision documents. Containment gaps have been identified in multiple areas in both OU-3 and OU-5. Land use restrictions for soil areas in OU-5 have not yet been implemented.

5.1.1. Remedial Action Performance

The groundwater remedies are not operating and functioning as intended. Additional extraction wells are being considered as additional information is gathered. Cleanup levels in OU-3 have not been achieved, though it is important to note that the estimated time to achieve restoration (as provided in the OU-3 ROD) is 240 years. Gaps in containment have been identified in multiple areas in OU-3 and OU-5, including:

- North and south of GET LB extraction well 4706 in Layers C and D
- Southern capture zone boundary near GET K in Layer C
- Northern capture zone boundary near GET H in Layer C
- Northeastern portion of OU-3 and southwestern portion of OU-5 in Layer F
- North of the northernmost Layer C and D extraction wells (Sailor Bar area north of the American River)

Aerojet is constantly refining and updating their sampling strategy based on information from previous sampling rounds. They have at least one crew sampling wells somewhere each day of the year and they want to strategically monitor wells to obtain the most useful and timely information.

The soil excavation remedies are complete for OU5. A full-scale SVE system is in place for Areas 32D, 34D, 35D, and 38D. More SVE wells are being added to the full-scale operation.

5.1.2. System Operations/O&M

It is generally expected that current operating procedures will maintain the effectiveness of the remedy. However, recent maintenance or equipment breakdowns have led to increasing concentrations in wells downgradient of a few extraction systems (GET EF and GET H). In addition, the OU5 remedy has been only partly operating for several years because of treatment capacity limitations. The GET B and EF treatment capacity expansion and modifications have been underway with the intent of getting all the EWs operating as intended. Breakdowns are not frequent, but downtime must be minimized in order to effectively contain the COC plumes. Additionally, there have been short-term exceedences of NPDES discharge limits in discharges associated with GET EF and GET K.

5.1.3. Implementation of Institutional Controls and Other Measures

Groundwater ICs, specifically the deed restriction on Aerojet property and the Sacramento County "Consultation Zone" Ordinance, are in place and effective at preventing exposure. Land use restrictions required for soil areas in OU-5 have not yet been implemented.

5.2. Question B: Are the exposure assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of Remedy Selection Still Valid?

No. Some of the cleanup levels, toxicity data, and exposure assumptions used at the time of the RODs are no longer valid. The federal and state maximum contaminant levels (MCLs) for chloroform have changed since the OU-3 ROD. Due to changes in TCE toxicity data, along with its presence in shallow groundwater in portions of OU-3, OU-6 and OU-5 beneath residences and workplaces, reassessment of the vapor intrusion pathway is warranted for OU-3, OU-6 and OU-5. The selected performance standards for cadmium and mercury in residential soils are above their non-cancer regional screening levels (RSLs). The selected performance standards for cadmium in residential and commercial/industrial soils are above their non-cancer RSLs. The selected performance standards for 1,1,1-TCA in residential and commercial/industrial soil vapor are above their non-cancer RSLs. Thus, the corresponding performance standards may not be protective. In light of the updated RSLs for these chemicals, an evaluation should occur to determine whether the existing performance standards are still protective.

5.2.1. Changes in Standards and TBCs

After signature of the OU-3 ROD, the chloroform standard changed because the federal and state MCLs for the individual compounds were eliminated in favor of a combined MCL. Specifically, the federal and state MCLs for bromoform, chloroform, and dichlorobromomethane were removed and are now regulated as total trihalomethanes (TTHM). The average chloroform concentration in the influent to the GET EF treatment plant has exceeded the current 80 µg/L MCL for TTHM in three of the last five years, indicating that chloroform concentrations in the aquifer addressed by the GET EF extraction wells are also higher than the current TTHM MCL. Because chloroform concentrations in the aquifer exceed the current TTHM MCL, the cleanup level for chloroform in OU-3 will not be protective in the future.

A complete review of ARARs, including changes in standards and to-be-considered criteria (TBCs), isprovided in Appendix G.

5.2.2. Changes in Toxicity and Other Contaminant Characteristics

The groundwater cleanup/containment levels for chloroform and bromodichloromethane are greater than their respective protective cancer risk ranges. However, there is no exposure to contaminated groundwater, so protectiveness is not affected. The selected performance standard for mercury in residential soils is slightly above its non-cancer RSL. The selected performance standards for cadmium in residential and commercial/industrial soils are above their non-cancer RSLs. The selected performance standards for 1,1,1-TCA in residential and commercial/industrial soil vapor are above their non-cancer RSLs. Thus, the corresponding performance standards may not be protective. In light of the updated

RSLs for these chemicals, an evaluation should occur to determine whether the existing performance standards are still protective. Otherwise, soil and soil vapor performance standards for residential and commercial/industrial use are below their respective cancer risk ranges or non-cancer RSLs.

On May 19, 2016, EPA Office of Water released the final Health Effects Support Documents for PFOS and PFOA, publishing toxicity information to support risk assessment to ensure protection of human health. Recently, PFOS was detected in the influent and effluent samples at the GET EF treatment system. Treated water from the GET EF is discharged to the Buffalo Creek under an NPDES permit. Further investigation into the source of the PFOS and PFOA as well as continued monitoring is required.

A complete review of the human health and ecological risk assessments, including changes in toxicity and other contaminant characteristics, is provided in Appendix H.

5.2.3. Changes in Exposure Pathways

Vapor intrusion was evaluated for OU-3, OU-5 and OU-6, as was documented as part of each of the RODs. In 2011, EPA updated the toxicity assessment for TCE, reclassifying TCE as a human carcinogen. Furthermore, in 2014, EPA's Office of Superfund Remediation and Technology Innovation issued a memorandum to the EPA Regional Superfund offices on *Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment.* This memorandum indicates that the risk from indoor air TCE that is greater than the Regional Screening Level may be of concern for short-term exposure.

In 2015, EPA released guidance on how to evaluate the vapor intrusion pathway, OSWER Technical Guide for Assess and mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air, which modifies the protocol for evaluating potential vapor intrusion impacts and would be more protective than previous procedures.

Given the changes in toxicity and assessment procedures, there may be a potential for vapor intrusion from off-gasing of TCE from the shallow aquifer in OU-3 (northeast portion of the Inner-Barrier Groundwater Extraction and Treatment area), OU-5 (Zone 1 and Zone 4 areas) and OU-6. This relatively large geographic area contains residences and workspaces that overlie shallow groundwater plumes that historically contained concentrations of TCE.

Depletion of shallow groundwater across the Aerojet Superfund Site has been observed over the past several years. As the water table drops, residual contamination is stranded in the vadose zone soil above the aquifer. This source of contamination can volatilize and may migrate upwards as soil gas and pose a vapor intrusion threat. For example, at OU-5, subsurface conditions exist along the southern boundary of OU-5 Zones 1 and 4 (east of the 49000 Area). The vadose zone where a formerly saturated layer approximately 45 feet below ground surface was located contains elevated concentrations of TCE. It is reasonable to expect that the same concerns associated TCE vapor intrusion on OU-5 areas exist in OU-3 and OU-6 as well.

The Aerojet Superfund Site is designated as a Special Planning Zone (SPZ). The SPZ has a provision for future development under the Sacramento County Land Use Master Plan that would allow for residential

use. Development of portions of the Aerojet facility is planned to include residential, commercial/industrial, and recreational properties. The RAOs and remedies for all three OUs have taken into account these potential future uses.

5.2.4. Expected Progress Toward Meeting RAOs

In both OUs, on-property and off-property ICs prevent exposure to contaminated groundwater. Short- and long-term contingency plans are in place to protect public drinking water wells.

In OU-3, COC concentrations are generally stable or decreasing, though there are a few key instances of increasing concentrations. Additionally, COC concentrations remain orders of magnitude above the cleanup levels over portions of OU-3. Therefore, restoration has not been achieved, but progress toward restoration generally appears to be occurring. Because data gaps are still being identified and additional extraction wells are being considered, it is too early to assess whether or not the remedy is on pace to meet the restoration objective within the estimated timeframe of 240 years.

In both OU-3 and Zone 1 of OU-5, known or potential gaps in containment have been identified. Containment gaps indicate that capture of contaminated plumes is not being achieved as required by the RODs. Additional containment analysis, which will include Zones 2, 3, and 4, is expected to be completed and available sometime in 2016.

In OU-5, some amount of mass removal is occurring at the upgradient portions of the OU-5 zones. However, clear mass removal performance metrics are not explicitly stated in the ROD. Well-defined mass removal performance metrics should be developed in order to aid in the evaluation of mass removal. Then, mass removal specifically at or near the upgradient portions of the OU-5 plumes should be evaluated.

In OU-5, exposure to concentrations of pollutants in soils and related drainage ditch sediments that pose unacceptable risks has been eliminated at Areas 10D, 11D, C4, and C41. At C41, perchlorate in the subsurface below the depth that may migrate to shallow groundwater is being managed by containment provided by GET AR extraction wells (formerly of GET D); containment of shallow groundwater in this area appears to be adequate. However, leaching of soil contaminants to the groundwater will continue at C41 since the excavation was not deep enough to remove all of the contaminated soil and a cap was not installed, which would prevent infiltration from contacting the remaining contaminated soils. The area of C41 is slated to be residential housing. A full-scale SVE system has been running at Areas 32D, 34D, 35D, and 38D and a full-scale system has been installed. The excavations and SVE systems are intended to both prevent migration of VOCs and perchlorate in soil and prevent exposure to VOCs in soils and soil vapor. However, land use restrictions required for some OU-5 soil areas have not yet been implemented.

5.3. Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

There is no other information that has come to light that could call into question the protectiveness of the remedy.

6. Issues/Recommendations

Table 6-1: Issues and Recommendations Identified in the Five-Year Review

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU-3	**Issue Category: Other** ***ARAR Change***			
	Issue: After signature of the OU-3 ROD, the chloroform standard changed because the federal and state MCLs for the individual compounds were eliminated in favor of a combined MCL. Specifically, the federal and state MCLs for bromoform, chloroform, and dichlorobromomethane were removed and are now regulated as total trihalomethanes (TTHM). Because chloroform concentrations in the aquifer exceed the current TTHM MCL, the chloroform cleanup level will not be protective in the future.			
	Recommendation: Update the risk assessment considering the change in the MCL.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2018
OU(s): OU-3 and OU-5	**Issue Category: Remedy Performance**			
	Issue: Known and potential containment gaps occur in several locations in OU-3 and OU-5. These include: • North and south of GET LB extraction well 4706 in Layers C and D • Southern capture zone boundary near GET K in Layer C • Northern capture zone boundary near GET H in Layer C • Northeastern portion of OU-3 and southwestern portion of OU-5 in Layer F • North of the northernmost Layer C and D extraction wells (Sailor Bar area north of the American River)			
	Recommendation: Assess the lack of containment in these areas and address the containment gaps.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/30/2019
OU(s): OU-3	**Issue Category: Changed Site Conditions**			
	Issue: COCs have been observed downgradient of Inner-Barrier wells upgradient of Outer-Barrier extraction and treatment systems that do not currently have treatment for those COCs: • Perchlorate and NDMA have been detected downgradient of GET J and upgradient of GET K, which does not currently include process units to treat perchlorate. • NDMA has been detected downgradient of GET EF and upgradient of GET H, which does not currently include treatment for NDMA.			

	Recommendation: Evaluate migration of these COC plumes toward their respective downgradient GET. Install or upgrade appropriate treatment at the downgradient GET or install additional extraction wells to intercept the COC plumes and connect them to a treatment facility capable of treating that COC.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/30/2020
OU(s): OU-3, OU-5, and OU-6	**Issue Category: Other** ***Vapor Intrusion***			
	Issue: Due to changes in vapor intrusion assessment proceures and changes in toxicity, potential vapor intrusion exposures are unknown.			
	Recommendation: Reassess vapor intrusion in OU-3, OU-5, and OU-6.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/30/2017
OU(s): OU-5	**Issue Category: Institutional Controls**			
	Issue: Land use restrictions for soil areas 32D, 34D, 35D, 38D, 7D, 33D, and the Former Company store have not yet been implemented.			
	Recommendation: Implement the land use restrictions for soil areas 32D, 34D, 35D, 38D, 7D, 33D, and the Former Company Store.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/30/2017
OU(s): OU-5	**Issue Category: Other** ***Performance Standards for Soil and Soil Vapor***			
	Issue: The selected performance standard for mercury in residential soils is slightly above its non-cancer RSL. The selected performance standards for cadmium in residential and commercial/industrial soils are above their non-cancer RSLs. The selected performance standards for 1,1,1-TCA in residential and commercial/industrial soil vapor are above their non-cancer RSLs.			
	Recommendation: Update the risk assessment considering the changes in the toxicity values for mercury and 1,1,1-TCA.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/30/2018

6.1. *Other Findings*

In addition, the following are recommendations that improve the clarity of the cleanup goals and assessment of remedy performance, but do not affect current and/or future protectiveness and were identified during the FYR:

- Two emergent chemicals, PFOS and PFOA, have been detected in the influent and effluent at GET EF and GET AB. Further sampling is needed to determine the source of these compounds and continual sampling through the NPDES program should be performed.
- The monitoring results for the landfill closure in the northern portion of OU-5 (Zone 4) were not reviewed. The landfill is not part of the remedy; but the monitoring results should be reviewed to to ensure both soil and groundwater protectiveness from this potential source of contamination.
- For cis-1,2-DCE, the OU-5 ROD shows the Soil Vapor Health-Based Levels for the Residential and Industrial Uses as $1.1x10^{2}$ and $2.1x10^{-1}$, respectively. It is unusual for the Industrial Use Health-Based Level to be less than the Residential Use Health-Based Level, so it is suspected that there is a typographical error in the ROD for one of the levels shown. This typographical error should be corrected.
- Deficiencies in the monitoring program prevent regulatory agencies from implementing and enforcing compliance actions because the triggers for those compliance actions are currently missing. Deficiencies in the monitoring program should be addressed.
- The operation and maintenance of the wellhead treatment systems, monitoring, and reporting at water supply wells AC-6 and AC-18 are not well documented. This information is critical for assessing the performance of the wellhead treatment systems, and should be provided in future Performance Evaluation Reports for OU-3.
- Clear mass removal performance standards are not stated in the OU-5 ROD. Clear mass removal performance standards should be established. Well-defined mass removal performance metrics should be developed in order to aid in the evaluation of mass removal toward the OU-5 ROD-specified purpose. Following the development of these metrics, mass removal should be assessed; mass removal specifically at or near the upgradient portions of the OU-5 plumes has not yet been evaluated. In future Performance Evaluation Reports for OU-5, containment analysis for all zones should be completed and presented. Additionally, future Performance Evaluation Reports should evaluate mass removal at or near the upgradient portions of the OU-5 plumes.

7. Protectiveness Statement

Table 7-1: Protectiveness Statement

Protectiveness Statement(s)		
Operable Unit: OU-3	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2017
Protectiveness Statement: A protectiveness determination of the remedy at OU-3 cannot be made at this time until further information is obtained. Further information will be obtained by reassessing the vapor intrusion pathway. It is expected that these actions will take approximately one year to complete, at which time a protectiveness determination will be made.		
Operable Unit: OU-5	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2017
Protectiveness Statement: A protectiveness determination of the remedy at OU-5 cannot be made at this time until further information is obtained. Further information will be obtained by reassessing the vapor intrusion pathway. It is expected that these actions will take approximately one year to complete, at which time a protectiveness determination will be made.		
Operable Unit: OU-6	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2017
Protectiveness Statement: A protectiveness determination of the remedy at OU-6 cannot be made at this time until further information is obtained. Further information will be obtained by reassessing the vapor intrusion pathway. It is expected that these actions will take approximately one years to complete, at which time a protectiveness determination will be made.		

8. Next Review

The next five-year review report for the Aerojet Superfund Site is required five years from the completion date of this review.

Appendix A: October 2015 Site-Wide Potentiometric and Fall 2015 Isoconcentration Contour Maps

Appendix B: Boundary Operable Unit (OU-6) Soil and Soil Vapor Performance Standards

Table 2-2: Performance Standards for Soil[a]

COC	Residential Soil CL for the Protection of HH (mg/kg)	Industrial Soil CL for the Protection of HH (mg/kg)	Source	Soil CL for the Protection of GW (mg/kg)	Source	Soil CL for the Protection of Ecological Receptors (mg/kg)	Primary Source
1,1,2,2-PCA	0.60	2.7	RSL	–	–	–	--
4,4'-DDD	2.2	9.6	RSL	1.5	DLM	0.021	EcoSSL
4,4'-DDE	1.6	6.8	RSL	1.0	DLM	0.021	EcoSSL
4,4'-DDT	1.9	8.6	RSL	1.0	DLM	0.021	EcoSSL
Aluminum	77,000	1,000,000	RSL	40,976	Background threshold value (UTL95) (RCRB soils)	pH <5.5	EcoSSL
	--	--	--	54,000	Background threshold value (UTL95 and Max) (Xerorthents soils)	–	--
Antimony	31	470	RSL	60	DLM	0.42	Background threshold value (UTL95) (RCRB soils)
	--	--	--	–	–	0.46	Background threshold value (UTL95) (Xerorthents soils)
Aroclor-1248	0.24	1.0	RSL	0.034	DLM	0.0072	LANL
Aroclor-1254	0.24	1.0	RSL	0.034	DLM	0.041	LANL
Aroclor-1260	0.24	1.0	RSL	0.034	DLM	0.88	LANL
Barium	15,000	220,000	RSL	10,000	DLM	274	Background threshold value (UTL95) (RCRB soils)
	--	--	--	–	–	320	Background threshold value (Max) (Xerorthents soils)
Benzo(a)anthracene	0.15	2.9	RSL	0.03	DLM	1.1	EcoSSL/high MW
Benzo(a)pyrene	0.015	0.29	RSL	0.029	DLM	1.1	EcoSSL/high MW

Table 2-2: Performance Standards for Soil[a]

COC	Residential Soil CL for the Protection of HH (mg/kg)	Industrial Soil CL for the Protection of HH (mg/kg)	Source	Soil CL for the Protection of GW (mg/kg)	Source	Soil CL for the Protection of Ecological Receptors (mg/kg)	Primary Source
Benzo(b)fluoranthene	0.15	2.9	RSL	0.029	DLM	1.1	EcoSSL/high MW
Benzo(k)fluoranthene	1.5	29	RSL	0.29	DLM	1.1	EcoSSL/high MW
Bis(2-ethylhexyl)phthalate	38	160	RSL	4	DLM	0.02	LANL
Boron	16,000	230,000	RSL	140	DLM	19	Mean CA background (Kearney Foundation 1996)
Cadmium	4.6	6.4	DTSC Note 3	70	RSL	0.72	Background threshold value (UTL95) (RCRB soils)
	--	--	--	–	–	1.2	Background threshold value (Max) (Xerorthents soils)
Chromium	110	110	Background threshold value (Max) (RCRB soils)	500	DLM	110	Background threshold value (Max) (RCRB soils)
	118	118	Background threshold value (UTL95) (Xerorthents soils)	500	DLM	118	Background threshold value (UTL95) (Xerorthents soils)
Chrysene	15	290	RSL	2.9	DLM	1.1	EcoSSL/high MW
Copper	3,100	47,000	RSL	3,000	DLM	63	Background threshold value (UTL95 and Max) (RCRB soils)
	--	--	--	–	–	76	Background threshold value (Max) (Xerorthents soils)

Table 2-2: Performance Standards for Soil[a]

COC	Residential Soil CL for the Protection of HH (mg/kg)	Industrial Soil CL for the Protection of HH (mg/kg)	Source	Soil CL for the Protection of GW (mg/kg)	Source	Soil CL for the Protection of Ecological Receptors (mg/kg)	Primary Source
d-BHC				0.2	DLM	6.4	EPA Region 3 Freshwater Sediment Screening benchmark, 2014
Dibenz(a,h)anthracene	0.015	0.29	RSL	0.009	DLM	1.1	EcoSSL/high MW
Dieldrin	0.033	0.14	RSL	0.002	DLM	0.0049	EcoSSL
Dimethyl phthalate	--	--	--	313,000	DLM	10	LANL
Di-n-butyl phthalate	6,200	82,000	RSL	700	DLM	0.011	LANL
Di-n-octyl phthalate	620	8,200	RSL	–	–	0.91	LANL
Endrin	18	250	RSL	1.8	DLM	0.0014	LANL
Endrin aldehyde[b]	18	250	RSL	1.8	DLM	0.0014	LANL
Hexavalent chromium	0.30	6.3	RSL	0.2	Background threshold value	0.34	LANL
Indeno(1,2,3-c,d)pyrene	0.15	2.9	RSL	0.029	DLM	1.1	EcoSSL/high MW
Iron	55,000	820,000	RSL	42,000	Background threshold value (RCRB and Xerorthents soils)	pH<5.0	EcoSSL
Lead	80	320	DTSC HHRA Note 3	42	Background threshold value (UTL95 and Max) (RCRB soils)	42	Background threshold value (UTL95 and Max) (RCRB soils)
	80	320	DTSC HHRA Note 3	23	Background threshold value (UTL95) (Xerorthents soils)	23	Background threshold value (UTL95) (Xerorthents soils)

Table 2-2: Performance Standards for Soil[a]

COC	Residential Soil CL for the Protection of HH (mg/kg)	Industrial Soil CL for the Protection of HH (mg/kg)	Source	Soil CL for the Protection of GW (mg/kg)	Source	Soil CL for the Protection of Ecological Receptors (mg/kg)	Primary Source
Manganese	1,800	26,000	RSL	1,100	Background threshold value (Max) (RCRB soils)	1,100	Background threshold value (Max) (RCRB soils)
	--	--	--	1,500	Background threshold value (UTL95 and Max) (Xerorthents soils)	1,500	Background threshold value (UTL95 and Max) (Xerorthents soils)
Mercury	9.4	40	RSL	1.2	DLM	0.87	Background threshold value (UTL95) (RCRB soils)
	9.4	40	RSL	1.2	DLM	0. 13	Background threshold value (UTL95) (Xerorthents soils)
Molybdenum	390	5,800	RSL	350	DLM	0.52	Background threshold value (UTL95) (RCRB soils)
	--	--	--	–	–	0.63	Background threshold value (UTL95) (Xerorthents soils)
Naphthalene	3.8	17	RSL	0.140	DLM	29	EcoSSL/low MW
NDMA	0.0023	0.045	RSL	0.00003	DLM	–	--
Nickel	1,500	26,000	RSL	120	DLM	75	Background threshold value (Max) (RCRB soils)
	--	--	--	140	Background threshold value (UTL95 and Max) (Xerorthents soils)	140	Background threshold value (UTL95 and Max) (Xerorthents soils)

Table 2-2: Performance Standards for Soil[a]

COC	Residential Soil CL for the Protection of HH (mg/kg)	Industrial Soil CL for the Protection of HH (mg/kg)	Source	Soil CL for the Protection of GW (mg/kg)	Source	Soil CL for the Protection of Ecological Receptors (mg/kg)	Primary Source
PCE	0.55	2.6	Cal-mod RSL	–	–	0.18	LANL
Perchlorate	0.060	820	EPA[c]	0.06	DLM	0.61 (surface soil) 20.3 (subsurface soil)	Back-calculated
Phenanthrene	--	--	--	–	–	29	EcoSSL/low MW
Phenol	18,000	250,000	RSL	1	DLM	30	ORNL
Prowl (Pendimethylin)	2,500	33,000	RSL	280	DLM	0.624	EcoSSL
Selenium	6.57	6.57	Background threshold value (both RCRB and Xerorthents soils)	300	DLM	6.57	Background threshold value (both RCRB and Xerorthents soils)
Silver	390	5,800	RSL	1,000	DLM	4.2	EcoSSL
TCE	0.94	6	RSL	–	–	42	LANL
Thallium	0.78	12	RSL	2,000	DLM	1	EcoSSL
	--	--	--	–	–	3.3	Background threshold value (Xerorthents soils)
Toluene	4,900	47,000	RSL	150	DLM	23	LANL
TPH-D	--	--	--	100	DLM	–	--
TPH-Mo	--	--	--	500	DLM	–	--

Table 2-2: Performance Standards for Soil[a]

COC	Residential Soil CL for the Protection of HH (mg/kg)	Industrial Soil CL for the Protection of HH (mg/kg)	Source	Soil CL for the Protection of GW (mg/kg)	Source	Soil CL for the Protection of Ecological Receptors (mg/kg)	Primary Source
Zinc	23,000	350,000	RSL	50,000	DLM	100	Background threshold value (Max) (RCRB soils)
	--	--	--	–	–	89	Background threshold value (UTL95 and Max) (Xerorthents soils)

Background soil notes:

Xerorthents soils = These soil types are found in areas of dredge tailings near the American River. The soils formed in material that has a high content of gravels and cobbles derived from mixed rock sources. The material was deposited as tailings during mining activities with slopes ranging from 0 to 50 percent.

RCRB soils = Redding-Corning-Red Bluff soils. Moderately well drained soils that are moderately deep over a cemented hard pan. This unit 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.

For more details on Xerorthent or RCRB soil types, see the OU-6 RI/FS Report (Shaw, 2012).

Notes:

[a] The soil cleanup levels for protection of human health and ecological receptors also apply to sediments in those areas where a remedial action is being taken.

[b] Endrin used as a surrogate for endrin aldehyde.

[c] Perchlorate exposure through the home-gardening pathway (EPA, 2012) (See Appendix F)

[d] Additional analysis conducted for selenium by Aerojet in 2014.

-- = No COCs were identified that posed a risk for this pathway.

CL = cleanup level

COC = contaminant of concern

DLM = designated level methodology (*Designated Level Methodology for Waste Classification and Cleanup Level Determination* [RWQCB, 1989])

DTSC HHRA Note 3= California Department of Toxic Substances Control, Human Health Risk Assessment Note 3, July 14, 2014

EcoSSL = ecological soil screening levels (White Paper – Ecological Risk Assessment [Aerojet, 2015])

GW = groundwater

HH = human health

LANL = Los Alamos National Laboratory

Max = Maximum detected value from Appendix C – Concentrations in Background Soils, BOU Final RI (ERM-West, 2010)

mg/kg = milligrams per kilogram

MW = molecular weight

ORNL = Oak Ridge National Laboratory

RCRB = Redding-Corning-Red Bluff

RSL = Regional Screening Level (EPA, January 2015) UTL95 = Upper threshold limit (95th percentile) value from Appendix C – Concentrations in Background Soils, BOU RI (ERM-West, 2010)

Table 2-3: Performance Standards for Soil Vapor in Ambient Air

COC	Residential Use CL ($\mu g/m^3$)	Risk Basis	Industrial Use CL ($\mu g/m^3$)	Risk Basis
Benzene	0.084	DTSC HHRA Note 3 July 2014	0.42	DTSC HHRA Note 3 July 2014
Chloroform	0.12	Cancer 10^{-6} risk level	0.53	Cancer 10^{-6} risk level
1,1-Dichloroethene	73	DTSC HHRA Note 3 July 2014	310	DTSC HHRA Note 3 July 2014
cis-1,2-Dichloroethene	7.3	DTSC HHRA Note 3 July 2014	31	DTSC HHRA Note 3 July 2014
1,2-Dichloroethane	0.11	Cancer 10^{-6} risk level	0.47	Cancer 10^{-6} risk level
Toluene	310	DTSC HHRA Note 3 July 2014	1,300	DTSC HHRA Note 3 July 2014
Trichloroethene	0.48	Cancer 10^{-6} risk level	3	Cancer 10^{-6} risk level
Tetrachloroethene	0.41	DTSC HHRA Note 3 July 2014	2.08	DTSC HHRA Note 3 July 2014
Vinyl chloride	0.031	DTSC HHRA note 3 July 2014	0.16	DTSC HHRA Note 3 July 2014

Notes:
Protective soil vapor levels in subsurface soil are decreased by location- and depth-specific attenuation factors.
DTSC Note 3 regarding modified Air RSLs, July 14, 2014
$\mu g/m^3$ = microgram(s) per cubic meter
CL = cleanup level

Appendix C: Press Notice

Says

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LEGAL NOTICE

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EPA FIVE-YEAR REVIEW OF THE AEROJET SUPERFUND SITE

The United States Environmental Protection Agency (EPA) began its first Five-Year Review (FYR) of the cleanup actions within the Aerojet Superfund Site (Site) in Rancho Cordova, California. The purpose of a FYR is to evaluate whether the cleanup actions for the Site are protective of human health and the environment.

THE REVIEW PROCESS

Superfund law requires EPA to evaluate the protectiveness of remedial systems every five years until the Site has been cleaned up sufficiently to allow unrestricted access to the property. Upon completion of the review, which is due by September 30, 2016, a copy of the final report will be placed in the information repositories listed below and online at EPA's web page at http://www.epa.gov/superfund/aerojet. The Site will continue to be cleaned up and monitored during the review, and the next FYR will be in 2021.

CLEANUP

The Site covers 5,900 acres near Rancho Cordova. Since 1953, Aerojet and its subsidiaries have manufactured liquid and solid propellant rocket engines for military and commercial applications, and, have in the process, formulated a number of chemicals. In addition, the Cordova Chemical Company operated chemical manufacturing facilities on the Aerojet complex from 1974 to 1979. Both companies disposed of unknown quantities of hazardous waste, including trichloroethene (TCE) and other chemicals associated with rocket propellants and various chemical processing wastes. Wastes were disposed of in man-made ponds, landfills, injected into very deep wells, rainfall and other sources mixed with waste in soil and move down to groundwater, and by open burning. In 1979, volatile organic compounds were found off-site in private wells, and, in 1983 the American River. In January 1997, perchlorate was found in drinking water wells off-site. The most prevalent contaminants in groundwater are TCE, perchlorate, and *N*-Nitrosodimethylamine. The Site was divided into eight sections, or operable units, to assist prioritizing the cleanup plan schedule for this Site. The Western Ground Water Operable Unit (OU-3), Perimeter Goundwater OU (OU-5) and Boundary OU (OU-6) have Record of Decisions in place. The remaining OUs where cleanup decisions will be made are OU-1, OU-4, OU-7, OU-8, and OU-9. This review will primarily cover any interim and present cleanup actions on the Site for Western Ground Water OU (OU-3) and Perimeter Goundwater OU (OU-5), which are the only two OUs with remedies in place.

COMMUNITY INVOLVEMENT

If you would like to participate in the FYR process, please contact Jackie Lane, Community Involvement Coordinator at 1(415) 972-3236 or by email at lane.jackie@epa.gov no later than July 15, 2016.

CONTACT INFORMATION

For more Site information, please visit EPA's website at web site above. For specific questions about the Site cleanup, please contact Lynn Keller, Remedial Project Manager at 1(415) 947-4162, email: keller.lynn@epa.gov.

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CARMICHAEL TIMES 6/24/16

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EPA FIVE-YEAR REVIEW OF THE AEROJET SUPERFUND SITE

The United States Environmental Protection Agency (EPA) began its first Five-Year Review (FYR) of the cleanup actions within the Aerojet Superfund Site (Site) in Rancho Cordova, California. The purpose of a FYR is to evaluate whether the cleanup actions for the Site are protective of human health and the environment.

THE REVIEW PROCESS

Superfund law requires EPA to evaluate the protectiveness of remedial systems every five years until the Site has been cleaned up sufficiently to allow unrestricted access to the property. Upon completion of the review, which is due by September 30, 2016, a copy of the final report will be placed in the information repositories listed below and online at EPA's web page at http://www.epa.gov/superfund/aerojet. The Site will continue to be cleaned up and monitored during the review, and the next FYR will be in 2021.

CLEANUP

The Site covers 5,900 acres near Rancho Cordova. Since 1953, Aerojet and its subsidiaries have manufactured liquid and solid propellant rocket engines for military and commercial applications, and, have in the process, formulated a number of chemicals. In addition, the Cordova Chemical Company operated chemical manufacturing facilities on the Aerojet complex from 1974 to 1979. Both companies disposed of unknown quantities of hazardous waste, including trichloroethene (TCE) and other chemicals associated with rocket propellants and various chemical processing wastes. Wastes were disposed of in man-made ponds, landfills, injected into very deep wells, rainfall and other sources mixed with waste in soil and move down to groundwater, and by open burning. In 1979, volatile organic compounds were found off-site in private wells, and, in 1983 the American River. In January 1997, perchlorate was found in drinking water wells off-site. The most prevalent contaminants in groundwater are TCE, perchlorate, and *N*-Nitrosodimethylamine. The Site was divided into eight sections, or operable units, to assist prioritizing the cleanup plan schedule for this Site. The Western Ground Water Operable Unit (OU-3), Perimeter Goundwater OU (OU-5) and Boundary OU (OU-6) have Record of Decisions in place. The remaining OUs where cleanup decisions will be made are OU-1, OU-4, OU-7, OU-8, and OU-9. This review will primarily cover any interim and present cleanup actions on the Site for Western Ground Water OU (OU-3) and Perimeter Goundwater OU (OU-5), which are the only two OUs with remedies in place.

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STATE OF CALIFORNIA
County of Sacramento

I am a citizen of the United States and employed by a publication in the County aforesaid. I am over the age of eighteen years, and not a party to the mentioned matter. I am the principal clerk of **The Folsom Telegraph**, a newspaper of general circulation, in the **City of Folsom**, which is printed and published in the **County of Placer.** This newspaper has been judged a newspaper of general circulation by the Superior Court of the State of California, in and for the **County of Sacramento**, on the date of April 1, 1952, Superior Court Order Number 89429. The notice, of which the attached is a printed copy (set in type not smaller than nonpareil) has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to-wit:

16623674 / CNS #2889296

LEGAL NOTICE
EPA FIVE-YEAR REVIEW OF THE AEROJET SUPERFUND SITE

PUBLICATION DATE / DATES:

JUNE 29

I certify, under penalty of perjury, that the foregoing is true and correct.

Signature
Terry Clark

Dated in Folsom, California

JUNE 29, 2016

16623674

LEGAL NOTICE

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PUBLISHED IN FOLSOM TELEGRAPH: JUNE 29, 2016

PROOF OF PUBLICATION
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Appendix D: List of Documents Reviewed

List of Documents Reviewed

Aerojet. 2000. Western Groundwater Operable Unit Remedial Investigation/Feasibility Study. Prepared for Aerojet General Corporaton. Prepared by Engineering Management Support, Inc. with assistance from Aerojet General Corporation and HSI Geotrans. April 2000.

Aerojet. 2009. Part 1 Perimeter Groundwater Operable Unit (OU-5) Remedial Investigation/Feasibility Study Report. Prepared by Aerojet General Corporation with assistance from Engineering Management Support, Inc. and Central Valley Environmental, Inc. June 2009.

Aerojet. 2010. Final Removal Action Report Perimeter Groundwater Operable Unit (OU-5), Source Areas 10D and 11D Soil Removal. May 2010.

Aerojet. 2011. RE: Buffalo Creek Soil and Vegetation Removal Report, Aerojet Superfund Site, Sacramento County, California. February 2011.

Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.). 2012. Final Remedial Action Report Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site, Sacramento, California. April 2012.

Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.). 2013. Final Remedial Action Report, Area C41, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. June 2013.

Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.). 2014. Final Remedial Action Report, Area C4, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. June 2014.

Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.). 2015a. Draft Groundwater Management Zone Plan, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. February 2015.

Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.). 2015b. Draft Outer-Barrier Performance Evaluation Report, Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site, Sacramento, California. April 2015.

CVEI (Central Valley Environmental, Inc.). 2015a. Draft Interim Performance Evaluation Report Zones 1, 2, 3, and 4, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site. Prepared for Aerojet Rocketdyne. July 2015.

CVEI (Central Valley Environmental, Inc.). 2015b. Draft Regional Groundwater Flow Model Update Report, Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site, Sacramento County, California. Prepared for Aerojet Rocketdyne. August 2015.

CVEI (Central Valley Environmental, Inc.). 2015c. Draft Inner-Barrier Performance Evaluation Report, Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site, Sacramento County, California. Prepared for Aerojet Rocketdyne. September 2015.

Geosyntec Consultants. 2015. Third Quarter 2015 Compliance Monitoring Report: Western Groundwater Operable Unit, Aerojet Superfund Site, Rancho Cordova, California. Prepared for Aerojet Rocketdyne. November 2015.

Geosyntec (Geosyntec Consultants). 2015. 2016 Groundwater Monitoring Plan, Aerojet Superfund Site, Rancho Cordova, California. Prepared for Aerojet Rocketdyne. December 2015.

Stantec (Stantec Consulting Services, Inc.). 2015. Operation, Maintenance, and Monitoring Plan Soil Vapor Extraction System, Aerojet Rocketdyne, Central 49000 Area, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. Prepared for Aerojet Rocketdyne. November 2015.

USEPA (U.S. Environmental Protection Agency). 2001. Record of Decision for the Western Groundwater Operable Unit OU-3, Aerojet Sacramento Site, Rancho Cordova, California. Prepared by USEPA Region 9. July 2001.

USEPA. 2011. Interim Record of Decision for Groundwater and Final Record of Decision for Soil for the Perimeter Groundwater Operable Unit OU-5, Aerojet General Corporation Superfund Site, Rancho Cordova, California. Prepared by USEPA Region 9. February 2011.

USEPA. 2015. Final Record of Decision for the Boundary Operable Unit OU-6, Aerojet Superfund Site, Rancho Cordova, California. Prepared by USEPA Region 9. August 2015.

Appendix E: Data Review

Appendix E: Aerojet Data Review

1. Groundwater

Several activities are ongoing, including installation or consideration of several new monitoring wells and extraction wells. The regional groundwater flow model was updated, and additional analyses are also planned. Site-wide potentiometric maps and the contaminant contour maps of the perchlorate, trichloroethene (TCE), and N-nitrosodimethylamine (NDMA) are provided in Appendix A.

1.1. Western Groundwater Operable Unit (OU-3)

The following reports were reviewed for this section:

- CVEI, 2015. Draft Outer-Barrier Performance Evaluation Report Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site Sacramento County, California. Central Valley Environmental, Inc. April 2015.
- CVEI, 2015. Draft Regional Groundwater Flow Model Update Report, Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site. Central Valley Environmental, Inc. August 2015.
- CVEI, 2015. Draft Inner-Barrier Performance Evaluation Report Western Groundwater Operable Unit (OU-3), Aerojet Superfund Site Sacramento County, California. Central Valley Environmental, Inc. Sept 2015.
- Geosyntec, 2015. Third Quarter 2015 Compliance Monitoring Report, Western Groundwater Operable Unit, Aerojet Superfund Site, Rancho Cordova, California. Geosyntec Consultants. November 2015.
- Geosyntec, 2015. Draft 2016 Groundwater Monitoring Plan, Aerojet Superfund Site, Rancho Cordova, California. Geosyntec Consultants. December 2015.

An OU-3 site map is presented as Figure 1 and OU-3 facility locations are shown in Figures 2 through 4. OU-3 currently includes a total of 46 extraction wells and 6 treatment systems. There are about 2,500 monitoring wells sitewide. Fifteen contaminants of concern (COCs) are found in OU-3, with three primary COCs: TCE, perchlorate, and NDMA. The site contains six aquifer layers (A through F). Layer A COCs, where present, are below cleanup levels. Layer B COCs are present in concentrations slightly above cleanup levels. Layers C and D generally contain the highest concentrations of COCs that are well above cleanup levels. Layers E and F are similar in nature to Layers A and B with respect to COC concentrations.

To address the remediation of groundwater, OU-3 is separated into two parts: the Inner-Barrier and the Outer-Barrier. GET E/F and GET J serve as the Inner-Barrier GET System, the purpose of which is to intercept chemicals migrating off Aerojet property. All other GET system components, which are located off Aerojet property in residential, commercial/industrial or park areas, serve as the Outer-Barrier GET System, the purpose of which is to hydraulically contain the farthest downgradient extent of chemicals in all layers of the aquifer. Additionally, restoration of on-property and off-property groundwater to

beneficial uses is an objective for OU3. The data analyses for the Inner-Barrier and Outer-Barrier systems are discussed in the following sections.

1.1.1. Inner-Barrier

The Inner-Barrier area consists of two treatment systems, GET E/F and GET J. GET E/F is located near the western boundary of the Aerojet property. GET J is generally located north of the GET E/F system. There are 22 extraction wells connected to the GET E/F system, and 10 extraction wells connected to the GET J system.

1.1.1.1 Restoration

Based on review of COC concentrations over time in compliance, sentinel, and extraction wells, COC concentrations appear to be generally either decreasing or not changing. The few increasing trends are seen primarily in TCE concentrations near the central and southern GET E/F extraction wells, part of the Inner-Barrier in Layers C and D (e.g., extraction well 4615; Figure 8). COC concentrations in the Inner-Barrier area are, in many locations, orders of magnitude above their respective cleanup levels. The estimated time to achieve restoration (as provided in the ROD) is 240 years. The full OU-3 remedy only became operational in 2011 and new monitoring and extraction wells are still being considered. Thus, it is likely too soon to reliably assess when achievement of restoration might be achieved.

1.1.1.2 Containment

Five methods were used to estimate capture by GETs E/F and J, which provide multiple lines of evidence and are consistent with EPA guidance and industry standards. The five methods include: two methods of determining analytical capture zone calculations, two methods of gradient analysis, and numerical modeling. Figures 5 through 7 show the results of the April 2015 Inner-Barrier capture zone analysis for Layers C through E.

Excessive downtime during 2014 (due to control equipment repairs, data acquisition system failure, faulty totalizers and the on-going modification and expansion constructions activities associated with the GET EF treatment plant) produced low annual average pumping rates at GET E/F. Detection of TCE above the cleanup level in Layer C compliance well 30078 (Figure 9) coupled with potentially increasing concentrations in nearby wells during this time suggests that groundwater pollutants were already present in Layer C in this area.. Additionally, the pumping rates were below what was necessary to create complete containment, and resulted in gaps in capture zones between central extraction wells. The current target rate for GET E/F is about 5,175 gallons per minute (gpm); however, the average flow rate for 2014 was 3,118 gpm. At GET J, the target pumping rate is 4,150 gpm, and the average flow rate for 2014 was 3,313 gpm. Numerical models suggest adequate containment can be achieved when extraction wells operate at target pumping rates. Previous analyses showed a broad cone of depression enveloping the central GET E/F extraction wells that was not evident in the most recent analysis. Pumping rate reductions have likely resulted in the observed gaps between the capture zones of operating wells. Once all GET systems are operating at target pumping rates, hydraulic containment should be achieved. However, adequate containment in this area does not currently exist.

Perchlorate and NDMA were detected in recently constructed monitoring well 30456, which is in Layer D downgradient of GET J extraction wells. Chemicals have been present prior to GET J operation and/or

monitoring well 30456 installation, but should be monitored due to the absence of treatment for perchlorate downgradient at GET K. Though perchlorate has been detected in this area, levels are not above cleanup action levels. However, it should be noted that GET K was designed to accommodate perchlorate treatment and, if perchlorate is found to be migrating toward GET K extraction wells, it will make sense to upgrade GET K to include perchlorate treatment and install additional extraction wells to intercept these COCs.

In Layers C and D, NDMA has been detected downgradient of GET E/F extraction wells. GET H, which is downgradient, does not have treatment components for NDMA. Aerojet is currently evaluating NDMA migration between GET E/F and GET H to assess possible NDMA arrival at GET H. If NDMA is found to be migrating toward GET H extraction wells, then it may make sense to upgrade GET H to treat NDMA; otherwise, additional extraction wells could be installed to intercept NDMA and connected to a treatment facility that is capable of treating NDMA.

TCE, perchlorate, and NDMA have been detected above their respective cleanup levels in Layer F in the northeastern part of OU-3, but there are no extraction wells screened in Layer F in this area. It is uncertain whether extraction in shallower aquifer layers (e.g., Layer E) is sufficient to control migration of contaminated groundwater in Layer F. This should be evaluated. If extraction in shallower aquifer layers is not sufficient to control migration of contaminated groundwater in Layer F, extraction wells should be installed in Layer F to provide for full containment.

1.1.1.3 Treatment System Performance

Since 2007, the fluidized bed reactors at the GET E/F treatment plant have experienced periodic episodes of incomplete perchlorate destruction, resulting in prolonged shutdowns for equipment maintenance and replacement. This condition was alleviated in March 2014 by the completion of the northern ion exchange resin system that reduced the volume of water treated by the fluidized bed reactors. Also, a second ion exchange resin system and a fourth air stripper have been added to the GET E/F treatment facility.

During 2014, two samples of the GET E/F effluent collected in July and August exceeded the NPDES Permit Maximum Daily Effluent Discharge Limitations. Both exceedances occurred after a GET E/F influent stream was added; one influent went to the fluidized bed reactors and one went to the ion exchange systems. High VOC concentrations in one of the influents exceeded the air stripper's ability to meet discharge limitations. In one sample each in July and August, chloroform (up to 0.78 µg/L) exceeded its Maximum Daily Effluent Discharge Limitation of 0.7 µg/L. In the August sample, cis-1,2-DCE (up to 1.1 µg/L) exceeded its Maximum Daily Effluent Discharge Limitation of 0.7 µg/L. NPDES discharge limitations have not been exceeded since these exceedances.

During 2014, permitted chemical concentrations in treated water from GET J were below NPDES Effluent Discharge Limitations. GET J exceeded its maximum daily volume limitation of 5.98 million gallons per day (MGD) in June and July 2014. These exceedances were deemed by the Central Valley Regional Water Quality Control Board to be within the accepted calibration limits of the system flowmeter and did not constitute violations of the NPDES permit. The volume limitation was increased to 6.75 MGD in the October 2014 revision to the NPDES permit.

1.1.2. Outer-Barrier

The Outer-Barrier area consists of four treatment systems, GET H, GET K, and GETs L-A and L-B, all of which are off Aerojet property in residential or commercial industrial areas. GET H is southwest of GET E/F. GET K is north of GET H, and GET L-A is west of GET K. GET L-B is north of GET L-A. There are seven extraction wells connected to the GET H system, five extraction wells connected to the GET K system, and one extraction well connected to each of the GET L-A and L-B systems. There are at least eight water supply wells downgradient of and within approximately 1.5 miles of GET H extraction wells; water supply well AC-18, south of the GET H extraction wells and AC-6, south of the GET K extraction wells, include wellhead treatment for perchlorate. At least two irrigation wells and two water supply wells are downgradient and within approximately one mile of the GET K extraction wells.

1.1.2.1 Restoration

Based on review of COC concentrations over time in compliance, sentinel, and extraction wells, COC concentrations appear to be generally either decreasing or not changing. However, increasing trends are seen in perchlorate concentrations south of GET H in water supply well AC-18 (which has wellhead perchlorate treatment) and NDMA concentrations west of GET K in former compliance well 30229 (Figure 10). This condition has been anticipated as the highest COC concentrations in groundwater are to the north and east of the GET systems which were constructed at the toe of the perchlorate plume. Former compliance well 30229 is within the capture zone of GET K, but the operation of irrigation well 2082 could be drawing NDMA toward it. COC concentrations between the Inner-Barrier and Outer-Barrier are, in many locations, well above their respective cleanup levels. The estimated time to achieve restoration (as provided in the ROD) is 240 years. The full OU-3 remedy only became operational in 2011, and new monitoring and extraction wells are still being considered. Thus, it is too soon to assess when achievement of restoration might be achieved.

1.1.2.2 Containment

The methods of capture zone analysis for the Outer-Barrier are the same as for the Inner-Barrier. Figures 11 and 12 show the results of the October 2014 Outer-Barrier capture zone analysis for Layers C and D.

A gap in containment through the central GET K/L area in Layers C and D has been observed south of GET L-B extraction well 4706. This condition is consistent with the observations in previous Performance Evaluation Reports. NDMA concentrations are relatively high upgradient of the gap. Containment north of GET L-B extraction well 4706 in Layers C and D is uncertain due to limitations in delineating the extent of NDMA. NDMA has been detected well above its cleanup level in newly constructed monitoring well 30454, which is located northwest of GET L-B extraction well 4706. This could represent a portion of the plume that existed before operations began at extraction well 4706 or non-containment by extraction well 4706. Either way, capture of this portion of the NDMA plume is not being achieved. Containment of the southern capture zone boundary near GET K in Layer C is uncertain, partially due to limited water level data near water supply well AC-6/1136, and partially due to uncertainties in delineating the extent of perchlorate. Containment of the southern capture zone boundary near GET K in Layer D appears complete.

Containment through the central and southern GET H area in Layer C appears complete, but containment of northern boundary capture zone in Layer C is uncertain. Different analysis methods produce

contradictory results. Also, short-term losses of containment have resulted in perchlorate detections downgradient of GET H when extraction wells or the treatment plant are off-line for repairs or maintenance. Water supply well #27 Rockingham is not far downgradient, and does not currently have wellhead treatment for perchlorate. Discussions are ongoing with the water purveyor regarding the use of wellhead treatment at the Rockingham well. Capture in Layer D at GET H has not yet been evaluated.

The containment gaps or uncertainties in containment discussed above for the Outer-Barrier extraction system may indicate that full containment is not being achieved, and there are no remedy-related extraction wells downgradient of the Outer-Barrier extraction system. Aerojet is currently in the process of addressing these gaps and uncertainties in order to achieve full containment of the contaminated groundwater as required by the selected remedy for OU-3.

1.1.2.3 Treatment System Performance

During 2014, chemical concentrations in treated water from GET H, L-A, and L-B were below NPDES Effluent Discharge Limitations. One GET K discharge exceeded the NPDES discharge limitations; chloroform was detected at 1.9 µg/L, above its daily maximum discharge limit of 0.5 µg/L. NPDES discharge limitations have not been exceeded since this exceedance.

1.2. Perimeter Groundwater Operable Unit (OU-5)

The following reports were reviewed for this section:

- Aerojet, 2009. Part 1 Perimeter Groundwater Operable Unit (OU-5) Remedial Investigation/Feasibility Study Report. Prepared by Aerojet General Corporation with assistance from Engineering Management Support, Inc. and Central Valley Environmental, Inc. June 2009.
- CVEI, 2015. Draft Interim Performance Evaluation Report Zones 1, 2, 3, and 4 Perimeter Groundwater Operable Unit (OU-5) Aerojet Superfund Site Sacramento County, California. Central Valley Environmental, Inc. July 2015.
- Geosyntec, 2015. Draft 2016 Groundwater Monitoring Plan, Aerojet Superfund Site, Rancho Cordova, California. Geosyntec Consultants. December 2015.

An OU-5 site location map is presented in Figure 13 and facility locations are shown in Figures 14 through 17. OU-5 consists of four zones of contaminated groundwater generally located north and south of Aerojet property. Zones were generally designated based on the groundwater flow direction: Zone 1 to the northwest, Zone 2 to the west and southwest, Zone 3 to the south, and Zone 4 to the north-northwest (Figure 13). OU-5 currently consists of GET AB (which treats groundwater from eastern Zone 2, Zone 3, and Zone 4) and GET AR (which treats groundwater from Zone 1). In addition, GET J and GET EF extract and treat groundwater from Zone 1 and Zone 2, respectively. The White Rock Road GET also provides control over a portion of the perchlorate plume in Zone 3. In 2014, once the GET AR system expansion was completed, GET D was decommissioned. The GET AB treatment system includes 53 extraction wells and GET AR includes 19 extraction wells. The purpose of extraction in each of the zones is to achieve containment of the contaminated groundwater above the containment levels with some mass removal in the upgradient portions of the plumes. Seventeen COCs are found in groundwater in OU-5, with four primary COCs: TCE, perchlorate, chloroform and NDMA. Layers A and B generally contain contamination well above the containment levels in Zones 2, 3, and/or 4. Layers C and D generally

contain the highest concentrations of COCs, to levels well above containment levels. Layer E is generally similar in nature to Layers A and B with respect to COC concentrations. COC concentrations in Layer F are also above containment levels, but are generally lower than observed in most other layers, with the exception of NDMA which is present in very high concentrations in Layer F in Zone 3.

1.2.1. Containment

A majority of construction associated with implementing the OU-5 remedy is complete, and as of May 2015, the downgradient containment systems are operational in each zone. However, capture zone analysis was limited to the GET system in Zone 1 because data was only available through February 2015. Limited containment analysis was completed for GET AR and GET D, the only OU-5 containment systems with most extraction wells operating during the October 2014 water level measurements. Containment analysis was also completed for GET AR using water level measurements collected during February 2015. Water levels were not collected in the GET D area, Zone 2, Zone 3, or Zone 4 during February 2015. Additional containment analysis should be completed and available in Fall 2016.

1.2.1.1 Zone 1

The October 2014 containment analysis for GET D and February 2015 containment analysis for all of Zone 1 are presented in Figures 18 through 21 (Layers B through E). Twelve of the twenty original GET D wells screened in Layer B cannot operate due to low water levels; the remaining eight wells produce a total of approximately 80 to 90 gpm. Despite limited pumping, drawdown is evident and the capture zone encompasses the Layer B target capture boundary.

Each method of capture analysis showed capture zones for the Layer C and D GET AR extraction wells in the Sailor Bar area (north of the American River) do not reach the northern portion of the TCE plume in Zone 1. In other areas, relatively higher TCE concentrations appear to be contained in Layer C by extraction well 4737 and in Layers D and E by extraction well 1156. Containment in Layers D and E appears to be effective and Aerojet is currently evaluating extraction and monitoring locations to address capture in the northern portions of Zone 1.

TCE, perchlorate, and NDMA have been detected above their respective cleanup levels in Layer F in the southern part of Zone 1, but there are no extraction wells screened in Layer F in this area. It is uncertain whether extraction in shallower aquifer layers (e.g., Layer E) is sufficient to control migration of contaminated groundwater in Layer F. This should be evaluated. If extraction in shallower aquifer layers is not sufficient to control migration of contaminated groundwater in Layer F, extraction wells should be installed in Layer F to provide for full containment.

The containment gap in Layers C and D in the Sailor Bar area indicates that containment in a portion of Zone 1 is not being achieved. This gap must be addressed in order to achieve containment of the contaminated groundwater in Zone 1 as required by the selected remedy for OU-5.

1.2.1.2 Zone 2

Containment analysis in Zone 2 was limited to numerical modeling (Figures 22 through 24) because the extraction wells were not operating in October 2014; extraction wells 4670 and 4742 started initial operations in January 2015, and extraction wells 4740 and 4741 started operating in May 2015.

Numerical modeling suggests capture zones for extraction wells 4740 and 4741 should contain the southern margins of the TCE and perchlorate plumes. These wells are installed upgradient of known Inactive Rancho Cordova Test Site (IRCTS) contaminant sources and groundwater remedies that are jointly managed by Aerojet Rocketdyne and the Boeing Company under a separate state order. The northern extent of perchlorate in Layer C is commingled with perchlorate from other areas, and it is generally not possible to differentiate plumes from the other GET systems. If the Zone 2 remedy is effective at containing the TCE perchlorate plumes in Layers B and C, the southern margins of the plume should contract.

1.2.1.3 Zone 3

Containment analysis was limited to numerical modeling in Zone 3 (Figures 25 through 28) because containment systems were only partially operational and the required data were not available at the time of the analysis. Numerical modeling suggests potential containment gaps between the capture zones of Layer E extraction wells 4725 and 4733, and Layer F extraction wells 4724 and 4732. Contingency wells are planned to be constructed if COCs are detected above containment levels in monitoring wells outside of the capture zones.

1.2.1.4 Zone 4

Containment analysis was limited to numerical modeling in Zone 4 (Figures 29 through 30) because the telemetry systems were not properly recording or transmitting the necessary pumping data to the treatment systems; telemetry system upgrades have since been completed. Numerical modeling suggests containment for Layer A is adequate for eastern Zone 4. Relatively narrow capture zones are suggested for the two operating Layer A extraction wells in western Zone 4. Model-simulated capture for Layer B suggests that extraction well 4712 should cut off the plume at the property boundary, but will not capture perchlorate and NDMA already beyond the property boundary.

1.2.2. Treatment System Performance

Between January 2014 and April 2015, there were no exceedances of the effluent discharge limits for ARGET or GET AB.

1.2.3. Mass Removal

Mass removal at or near the upgradient portions of the OU-5 plumes is generally occurring. The OU-5 Feasibility Study (FS) for groundwater identified specific extraction wells as “mass removal” wells to demonstrate that the remedy is meeting the mass removal RAO. In Zone 1, former GET D extraction wells 4035, 4220, and 4320 were to be operated as mass removal wells; all three of these wells are still being operated. In Zone 2, extraction well 4420 was to be operated for mass removal. However, extraction well 4420 was not included in the Zone 2 containment analysis, and is shown as inoperable in the Draft 2016 Groundwater Monitoring Plan. Extraction well 4670, which is located southwest of well 4420, is being operated and appears to serve the same function as 4420. In Zone 3, extraction wells 4011, 4303, 4405, 4450, 4475, and 4480 were to be operated as mass removal wells to allow containment of the toe of the groundwater contaminant plume while expansion and upgrade construction activities at GET AB were completed. Of these six wells, five are still operating; only 4011 is not operating. In Zone 4,

extraction wells 4012, 4013, and 4430 were to be operated for mass removal; all three of these wells are still being operated.

Because most of the mass removal wells, as identified in the FS, are still operating, some amount of mass removal is occurring at or near the upgradient portions of the OU-5 plumes, which may be consistent with the mass removal RAO. The ROD-specified purpose of substantial mass removal in these areas was to reduce the eventual cost, difficulty, and time required for hydraulic control and restoration of the aquifer. It may be assumed that the intent of the ROD was to achieve mass removal similar to that assumed in the corresponding alternatives in the FS, but clear mass removal performance metrics are not explicitly stated in the ROD. Well-defined mass removal performance metrics should be developed in order to aid in the evaluation of mass removal toward the ROD-specified purpose. Following (or in parallel with) the development of these metrics, mass removal should be assessed; mass removal specifically at or near the upgradient portions of the OU-5 plumes has not yet been evaluated.

2. Soil

2.1. Perimeter Groundwater Operable Unit (OU-5)

The following reports were reviewed for this section:

- Aerojet, 2010. Final Removal Action Report Perimeter Groundwater Operable Unit (OU-5), Source Areas 10D and 11D Soil Removal. May 2010.
- Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.), 2013. Final Remedial Action Report, Area C41, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. June 2013.
- Aerojet Rocketdyne and CVEI (Central Valley Environmental, Inc.), 2014. Final Remedial Action Report, Area C4, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. June 2014.
- CVEI, 2015. Draft Interim Performance Evaluation Report Zones 1, 2, 3, and 4 Perimeter Groundwater Operable Unit (OU-5) Aerojet Superfund Site Sacramento County, California. Central Valley Environmental, Inc. July 2015.
- Geosyntec, 2015. 2016 Draft Groundwater Monitoring Plan, Aerojet Superfund Site, Rancho Cordova, California. Geosyntec Consultants. December 2015.
- Stantec, 2015. Operation, Maintenance, and Monitoring Plan Soil Vapor Extraction System, Central 49000 Area, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. November 2015.

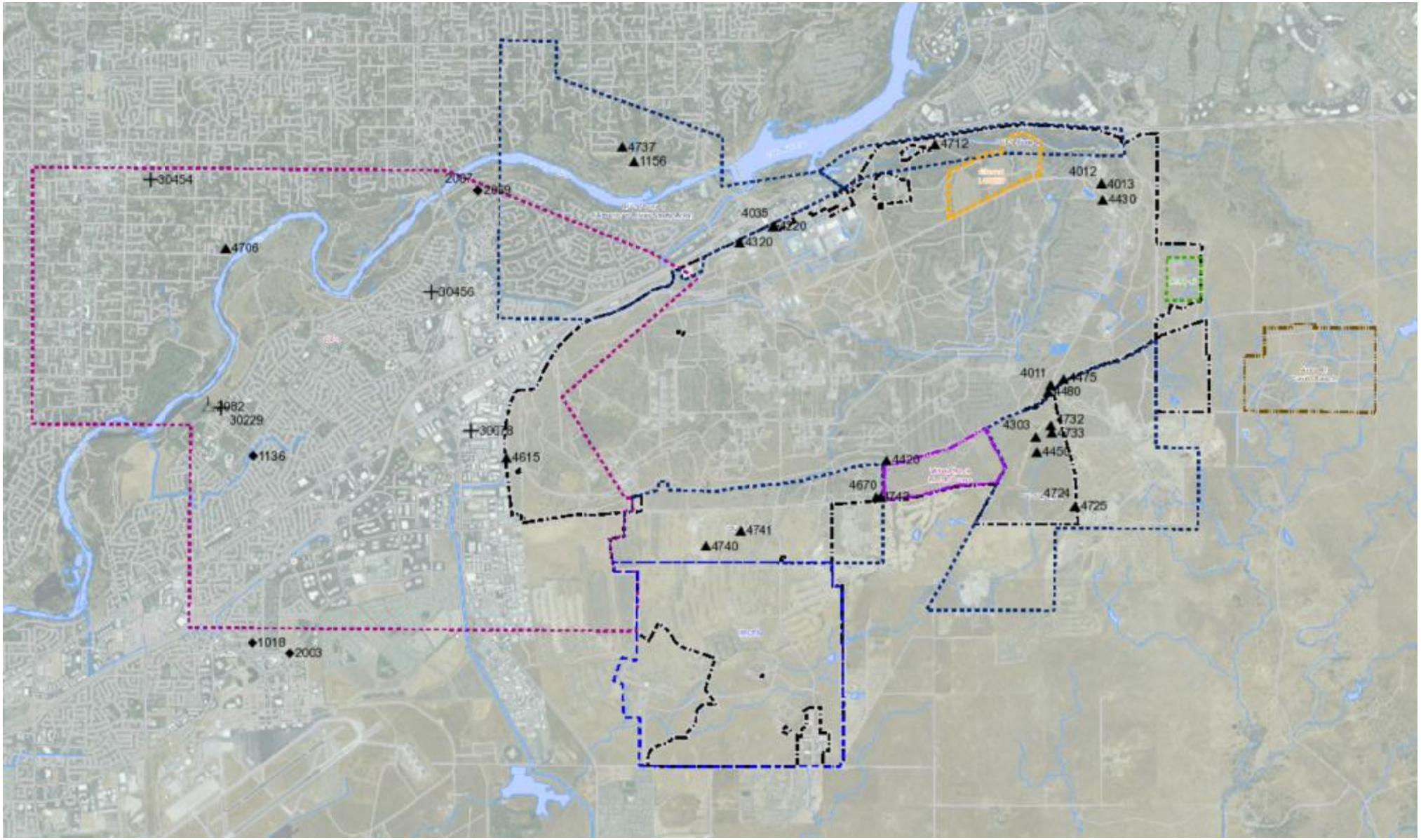
Figure 31 presents OU-5 soil site locations.

Eleven soil cleanup areas were identified in the OU-5 ROD: four areas for soil vapor extraction (SVE); four areas for soil removal; and three areas for vapor mitigation systems and land use controls (LUCs). The full-scale SVE system in Areas 32D, 34D, 35D, and 38D was recently constructed and is operating. All four soil removal area actions (Areas 10D, 11D, C4, and C41) are complete, as described below.

Excavation of soils contaminated primarily with lead, hexavalent chromium, and PCBs above residential performance standards occurred in Areas 10D and 11D between November 2009 and March 2010. Areas where confirmation samples showed soil contamination above the performance standards below the original excavation were over-excavated until OU-5 performance standards were reached. Lead concentrations in confirmation samples do not exceed DTSC's current recommended residential lead concentration in soils of 80 mg/kg.

In Area C4, excavation of soils with lead and dioxin concentrations exceeding the residential performance standards occurred primarily in August 2013, though additional minor excavation occurred in May 2014. Soil excavation depths extended from several inches down to seven feet. Lead concentrations in 129 confirmation samples taken in Area C4 post excavation ranged from 2 mg/kg to 120 mg/kg, with an average of 32.8 mg/kg and a 95% upper confidence limit (UCL) on the sample mean of 44.2 mg/kg. At the time of the excavation, DTSC's recommended residential lead concentration in soils was 80 mg/kg. While there were several discrete samples in Area C4 with lead concentrations above 80 mg/kg, the excavation area as a whole has a collective arithmetic average (95% UCL) less than DTSC's recommended residential lead concentration in soils.

Between July and September 2012, soils in Area C41 with perchlorate concentrations above 0.06 mg/kg (perchlorate cleanup goal in soil in Area C41 is based on the protection of groundwater) were excavated to depths of 10 feet below ground surface (bgs). Perchlorate remaining in soil greater than 10 feet bgs will be managed by land use restrictions, groundwater monitoring, and the downgradient ARGET extraction wells (those formerly part of the GET D system).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Appendix F: Site Inspection Checklist and Trip Report

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Aerojet General Corporation	**Date of inspection:** November 18-19, 2015
Location: Rancho Cordova, California	**EPA ID:** CAD980358832
Agency, office, or company leading the five-year review: EPA	**Weather/temperature:** sunny, ~65°F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Soil excavations, soil-vapor extraction (SVE)
- ☐ Monitored natural attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager**
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no.
   Problems, suggestions; ☐ Report attached

2. **O&M staff** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

   n/a

4. **Other interviews** (optional) ☐ Report attached.

No interviews were conducted.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☒Readily available	☒ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks Aerojet well logs and provides updates on well maintenance/repair in reports.

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A
   Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A
   Remarks Aerojet and their contractors keep a health and safety plan for samplers and operators. Health and safety plan is located at each plant.

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐N/A
   Remarks Aerojet and their contractors keep OSHA training records for samplers and operators.

4.	**Permits and Service Agreements** ☒ Air discharge permit ☒ Readily available ☒ Up to date ☐ N/A ☒ Effluent discharge ☒ Readily available ☒Up to date ☐ N/A ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☐ N/A ☐ Other permits_____ ☐ Readily available ☐ Up to date ☐ N/A Remarks Air strippers are regulated under a whole facility permit; effluent discharge is regulated under an NPDES permit.
5.	**Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
6.	**Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
7.	**Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐N/A Remarks Groundwater performance evaluation reports and groundwater monitoring plans are submitted annually.
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☒ Water (effluent) ☒ Readily available ☒ Up to date ☐ N/A Remarks Treated water discharge records are provided in performance evaluation reports, but also to the RWQCB.
10.	**Daily Access/Security Logs** ☐Readily available ☐ Up to date ☒ N/A Remarks The onsite and offsite groundwater treatment facilities are tightly secured. Security key codes track who has been to each facility and when.
	IV. O&M COSTS
1.	**O&M Organization** ☐ State in-house ☐ Contractor for State ☒ PRP in-house ☐ Contractor for PRP ☐Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other_____ _____
2.	**O&M Cost Records** ☐ Readily available ☐ Up to date ☒ Funding mechanism/agreement in place Original O&M cost estimate_____ ☐ Breakdown attached Total annual cost by year for review period if available Not available
3.	**Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: none

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A
A. Fencing
1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A Remarks Fencing and gates are in good condition.
B. Other Access Restrictions
1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Security personnel for the property owner are present onsite. Gates operated by security personnel. Offsite facilities are kept locked and secured.
C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☒ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☒ N/A Type of monitoring (*e.g.*, self-reporting, drive by) _____ Frequency _____ Responsible party/agency _____ Contact _____ _____ _____ _____ Name Title Date Phone no. Reporting is up-to-date ☐ Yes ☐ No ☒ N/A Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A Specific requirements in deed or decision documents have been met ☒ Yes ☒ No ☐ N/A Violations have been reported ☐ Yes ☒ No ☐ N/A Other problems or suggestions: ☐ Report attached
2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks ICs will be adequate when all of them are in place.
D. General
1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks
2. **Land use changes on site** ☒ N/A Remarks Land use changes are planned for the future; there are redevelopment plans.
3. **Land use changes off site** ☒ N/A Remarks
VI. GENERAL SITE CONDITIONS
A. Roads ☒ Applicable ☐ N/A
1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks
B. Other Site Conditions
Remarks Site is well secured. Operations still take place on site, but these do not interfere with remedy.

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
   ☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A

Remarks: Extraction wells were not visited.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☐ Good condition ☐ Needs Maintenance

Remarks: Extraction wells not visited.

3. **Spare Parts and Equipment**
   ☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: Generally, spare parts and equipment kept at one location.

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   ☐ Metals removal ☐ Oil/water separation ☒ Bioremediation
   ☒ Air stripping ☒ Carbon adsorbers
   ☒ Filters
   ☒ Additive (oxidants)
   ☒ Others (UV oxidation/hydrogen peroxide/ozone; ion-exchange)
   ☒ Good condition ☐ Needs Maintenance
   ☒ Sampling ports properly marked and functional
   ☐ Sampling/maintenance log displayed and up to date
   ☒ Equipment properly identified
   ☐ Quantity of groundwater treated annually:
   ☐ Quantity of surface water treated annually_____

Remarks:

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks:

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance

Remarks:

4. **Discharge Structure and Appurtenances**
   ☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks:

5. **Treatment Building(s)**
   ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
   ☒ Chemicals and equipment properly stored

Remarks: Buildings carefully designed to ensure adequate chemical storage and safety.

6.	**Monitoring Wells** (pump and treatment remedy) ☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks: Monitoring wells were not visited during the site visit. Many shallower wells are now dry.	
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining (generally over the long-term)
E. Monitored Natural Attenuation – N/A	
X. OTHER REMEDIES	
OU-Soil Remedy- Excavations (complete) and SVE pilot (currently working on implementing full-scale system). The SVE pilot system currently consists of 6 wells, but more will be drilled as it is transitioned to a full-scale system. The pilot system was in very good, almost new condition.	
XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). In OU-3, the objectives are to achieve full containment and restore the aquifer to beneficial uses. Restoration was estimated to take about 240 years, but the remedy is still relatively new. Trends are stable or decreasing in some areas, increasing in others. Contaminant concentrations are still well above the cleanup levels in several areas. Thus, restoration has not been achieved, and it is likely too early to assess whether restoration is still estimated to take 240 years. Regarding containment, the extraction systems are generally successful, but there are some gaps in containment; furthermore, additional information from new wells suggests that the plume is beyond some GET K/L extraction wells, and probably was prior to installation of the system. New monitoring wells and extraction wells are being considered to augment the current system. In OU-5, the objectives for groundwater are containment of groundwater with concentrations above the containment level and mass removal in upgradient portions of the OU-5 plumes. There is a gap in containment to the north in Zone 1. Installing wells is this area has been historically difficult due to Zones 2-4 capture zones haven't been formally evaluated (in a report) for reasons varying from unavailable data (some systems only recently became fully operational) or faulty equipment (which made capture difficult to assess). Repairs have been made and Aerojet plans to assess capture in all OU-5 zones in subsequent OU-5 performance evaluation reports. Regarding mass removal, wells are operating in the upgradient portions of the plumes in each Zone, and thus, some amount of mass removal is occurring. However, the ROD is not specific regarding performance metrics for mass removal.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Aerojet is generally very proactive with O&M, or otherwise quick to react when a problem is observed (though some problems may take more than a few days to fix). Downtime of specific wells may be responsible for some increasing trends (e.g., downgradient of GET E/F).

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. Gaps in containment and some equipment malfunctions have occurred recently. Aerojet is generally aggressive in fixing faulty equipment, though. GET E/F was down for a substantial amount of time (due to repairs due the SCADA system failure and some faulty totalizers) and was recently modified with a set of ion-exchange units. Follow installation of the ion-exchange systems, two exceedances of the VOC discharge limitations occurred in July and August 2014. There have not been any exceedances since.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Due to the very large number of wells that are present on site, Aerojet is constantly refining and updating their sampling strategy based on information from previous sampling rounds; essentially, Aerojet has at least one crew sampling wells somewhere on each day of the year and they want to make sure that they monitor wells strategically in order to obtain the most useful and timely information.

Trip Report
Aerojet General Corporation Superfund Site, Rancho Cordova, California

1. INTRODUCTION

a. Date of Visit: November 18-19, 2015

b. Location: Rancho Cordova, California

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Aaron King	USACE, Environmental Engineer	(206) 764-6744
David Sullivan	USACE, Geologist	(206) 764-6694
Julie Santiago-Ocasio	EPA, RPM	(415) 972-3525
Lynn Keller	EPA, RPM	(415) 947-4162
Alex MacDonald	RWQCB-CVR	(916) 464-4625
Steven Ross	DTSC	(916) 255-3694
Pete Phillips	Gilbane	(916) 317-3244
Ai Liang Gu	Gilbane	(480) 381-6308
Mark Varljen	Aerojet Rocketdyne	(916) 355-2121
Jaco Fourie	Aerojet Rocketdyne	(916) 355-6169
Chris Fennessy	Aerojet Rocketdyne	
Craig Fegan	Aerojet Rocketdyne	

2. SUMMARY

A site visit to the Aerojet General Corporation Superfund Site was conducted November 18-19, 2015. On November 18, Mr. Varljen and Mr. Fennessy gave presentations that provided an overview of the entire site (all operable units) and discussed operations and progress at the site. Following the presentations, Mr. Fennessy led a small group to inspect the GET J. On November 19, Mr. Fegan lead the Five-Year Review team on a tour of the SVE pilot system, followed by tours of each the remaining GET treatment systems (AB, ARGET, E/F, H, K, L-A, L-B). Generally, the site is in good condition. COC concentrations are currently below cleanup levels in all wells except one.

3. DISCUSSION

On 17 November 2015, Mr. King and Mr. Sullivan flew from Seattle, Washington to Sacramento, California and drove to Folsom, California. On 18 November 2015 at approximately 9:00 AM, Mr. King and Mr. Sullivan met the rest of the participants at an Aerojet office/facility in Rancho Cordova, California. Mr. Varljen and Mr. Fennessy gave presentations that provided an overview of the entire site (all operable units) and discussed operations and progress at the site. Following the presentations, Mr. Fennessy led a small group to inspect the GET J, which is next door to the office space (no pictures were allowed on Aerojet property). GET J appeared was operating and appeared to be well maintained. The GET J outfall was observed from the edge of the property. At approximately 4:00 PM, the group disbanded for the evening.

On 19 November 2015 at approximately 9:00 AM, Mr. King and Mr. Sullivan met the rest of the participants at the Aerojet security office to receive visitor badges. The group then split. Mr. Fegan first led the FYR group first inspected the pilot SVE system in Area 49000 (Areas 32D, 34D, 35D, and 38D). Six SVE wells were installed and operating, though 20 or more are planned to be installed as the system transitions from pilot to full scale. The system treats VOCs using vapor phase granular activated carbon vessels and a potassium permanganate impregnated zeolite vessel (for vinyl chloride). The pilot system was clean and tidy. Following, the FYR group visited each of the remaining GET treatment facilities: AB, ARGET, E/F, H, K, L-A, and L-B. The treatment plants are generally standard, sharing the same models and components as other treatment plants. The GET E/F fluidized bed reactors are a major exception. Otherwise, the treatment plants generally include ion-exchange units for perchlorate treatment, air strippers for VOC treatment, and an advanced oxidation process (UV plus hydrogen peroxide or ozone plus hydrogen peroxide) for NDMA treatment. Liquid phase granular activated carbon treatment is provided as a polishing step at a few of the facilities. Most treated water is discharged under an NPDES permit (eventually flowing to the American River), though some from GET AB serves the industrial water system for Aerojet and some from GET L-A is used to water a nearby golf course. The treatment facilities were operating at the time of the visit. Components and piping were properly labeled. Chemicals were stored properly; buildings were designed such that chemicals were isolated from other areas. Each of the facilities looked almost new, despite some of them having operated for many years. The Rockingham Well (domestic supply well) near GET H was also visited. The water purveyor does not intend to install wellhead treatment at the well, but COC concentrations have been non-detect thus far. More extraction wells are being considered for GET L-B, and a newer UV system is planned (the older system will be removed).

The site visit ended at approximately 4:00 PM.

4. ACTIONS

The USACE will incorporate information obtained from the site visit into the Five Year Review report.

Aaron King
Environmental Engineer
CENWS-EN-TS-ET

Appendix G: ARAR Assessment

Appendix G: Aerojet ARAR Analysis

Section 121(d)(1)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that remedial actions at CERCLA sites attain (or justify the waiver of) any federal or state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). The CERCLA implementing regulation, the National Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] 300.5) further defines applicable requirements as the more stringent among those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site. A requirement may not be applicable, but nevertheless may be relevant and appropriate. Relevant and appropriate requirements address problems or situations sufficiently similar to those encountered at CERCLA sites that their use is well suited to the particular site. Federal ARARs may include requirements promulgated under any federal environmental laws. State ARARs may only include promulgated, enforceable environmental or facility-siting laws of general application that are more stringent or broader in scope than federal requirements and that are identified by the state in a timely manner. ARARs are identified on a site-specific basis from information about the chemicals at the site, the RAs contemplated, the physical characteristics of the site, and other appropriate factors. ARARs include only substantive, not administrative, requirements and pertain only to onsite activities. There are three general categories of ARARs: chemical-specific, location-specific, and action-specific.

Chemical-specific ARARs and to-be-considered criteria (TBCs) that bear on the protectiveness of the remedy identified in the selected remedy within the OU-3 and OU-5 RODs and considered for this FYR for continued groundwater treatment are shown in Table G-1. Contaminants with cleanup or containment levels that exceed their current Maximum Contaminant Level (MCL) are highlighted in yellow.

Only one COC has a cleanup level above its respective current MCL. After signature of the OU-3 ROD, the chloroform MCL changed because the federal and state MCLs for the individual compounds were eliminated in favor of a combined MCL. Specifically, the federal and state MCLs for bromoform, chloroform, and dichlorobromomethane were removed and are now regulated as total trihalomethanes (TTHM). The average chloroform concentration in the influent to the GET E/F treatment plant has exceeded the current 80 µg/L MCL for TTHM in three of the last five years, indicating that chloroform concentrations in the aquifer addressed by the E/F extraction wells are also higher than the current TTHM MCL. Because chloroform concentrations in the OU-3 aquifer exceed the current TTHM MCL, the cleanup level for chloroform in OU-3 will not be protective in the future. Also, there is no longer a federal or state MCL for 1,2-DCE, but rather there are now MCLs for each of the 1,2-DCE isomers: cis-1,2-DCE and trans-1,2-DCE.

Cleanup levels identified in the OU-5 ROD for soil and soil vapor are based on EPA's Regional Screening Levels (RSLs), which were identified as a TBC. Changes to the RSLs are evaluated in the Risk Assessment Review and Toxicity Analysis appendix.

Table G-1: Summary of OU-3 and OU-5 Groundwater ARAR Changes

Contaminant of Concern	2001 OU-3 ROD Cleanup Levels (µg/L)	2011 OU-5 ROD Containment Levels (µg/L)	Current State MCL (µg/L)	Current Federal MCL (µg/L)	Is the cleanup/ containment level above the current MCL?
Perchlorate	4.0	6	6	--	No
N-nitrosodimethylamine (NDMA)	0.0013	0.003	--	--	No[a]
Trichloroethene (TCE)	5	5	5	5	No
Tetrachloroethene (PCE)	5	5	5	5	No
1,1-Dichloroethane (DCA)	5	--	5	--	No
1,2-DCA	0.5	0.5	0.5	5	No
1,1,2-Trichloroethane (TCA)	5	5	5	5	No
1,1,2,2-Tetrachloroethane	--	1	1	--	No
1,1-Dichloroethene (DCE)	6	6	6	7	No
1,2-DCE	6	--	--[b]	--[b]	--
cis-1,2-DCE	--	6	6	70	No
trans-1,2-DCE	--	10	10	100	No
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	1,200	--	1,200	--	No
1,4-Dioxane	--	1	--	--	No[c]
Chloroform	100	80	80[d]	80[d]	Yes (OU-3); No (OU-5)
Bromodichloromethane	--	80	80[d]	80[d]	No
Dibromochloromethane	--	80	80[d]	80[d]	No
Methylene chloride	--	5	5	5	No
Vinyl chloride	0.5	0.5	0.5	2	No
Carbon tetrachloride	0.5	0.5	0.5	5	No
Nitrate (as Nitrogen)	10,000	--	10,000	10,000	No
Nitrite (as Nitrogen)	1,000	--	1,000	1,000	No

Notes:

[a] There is no state or federal MCL for NDMA, but the current California Public Health Goal (PHG; which is a TBC) is 0.003 µg/L. The OU-3 cleanup level and OU-5 containment level for NDMA do not exceed the current California PHG.

[b] 1,2-DCE no longer has a California MCL. Rather, there are current state and federal MCLs for each of its isomers: *cis*-1,2-DCE and *trans*-1,2-DCE.

[c] There is no state or federal MCL for 1,4-dioxane, but the current California Department of Public Health (CDPH) drinking water notification level (which is a TBC) is 1 µg/L. The OU-5 containment level for 1,4-dioxane does not exceed the current CDPH notification level.

[d] MCL value is for Total Trihalomethanes (TTHM), the sum of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

Federal and state laws and regulations other than the chemical-specific ARARs that have been promulgated or changed since the signing of the RODs are described in Table G-2. The table does not include those ARARs identified from the 2001 OU-3 and 2011 OU-5 RODs that are no longer pertinent; however, it was assumed that all ARARs were still pertinent because OU-5 remedy construction is still occurring and additional construction may be required for OU-3 pending the results of additional data gathering and performance evaluations. Many of the ARARs identified for the selected OU-5 remedies are the same as those identified for the OU-3 remedy. However, there have been no revisions to laws or regulations that affect protectiveness of the remedy.

The following location- and action-specific ARARs identified in the OU-3 ROD have not changed since the 2001 ROD signing; and therefore, do not affect protectiveness:

- 23 California Code of Regulations (CCR) 2235 et seq.
- 40 CFR 131.6
- 40 CFR Part 6, Appendix A
- Executive Order Nos. 11990 and 11988
- Fish and Game Commission Wetlands Policy (adopted 1987) included in Fish and Game Code Addenda
- 22 CCR 66264.18(b)
- 40 CFR Section 262.34
- State Water Resources Control Board (SWB) Resolution Nos. 68-16 and 92-49
- SWB Basin Plan (wastewater reuse policy)
- 27 CCR, Division 2, Subdivision 1
- Air Emission Standards for Process Vents; 40 CFR §§ 265.1030-1032
- 22 CCR §§66265.1030-66265.1035

The following location- and action-specific ARARs identified in the OU-5 ROD have not changed since 2011 ROD signing; and therefore, do not affect protectiveness:

- Substantive Requirements of Cal. Fish & Game Code § 1602
- 36 CFR Part 800
- CA Endangered Species Act, Cal. Fish & Game Code § 2080
- Migratory Bird Treaty Act; 16 United States Code (USC) §§ 703, et seq.
- Cal. Civ. Code §1471
- 22 CCR § 67391.1(a)
- 42 USC § 9621(d)(3)
- 40 CFR Part 300.440 (“Offsite Rule”)

- Section IV-16 (Policy for Application of Water Quality Objectives) of the Basin Plan for Sacramento River and San Joaquin River Basins
- Sacramento Metropolitan Air Quality Management District Rules; Cal. Health & Safety Code, §§ 39602, 39606, 40001; Rule 402 Nuisance; Rule 403 Fugitive Dust; Rule 404 Particulate Matter; Rule 441 Organic Solvents

Table G-2: Applicable or Relevant and Appropriate Requirements Evaluation

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
National Pollutant Elimination Discharge System (NPDES) Permit 40 CFR Parts 122 and 125 and	2001 OU-3 ROD; 2011 OU-5 ROD	Establishes treatment and monitoring requirements for discharges to surface water. Discharge to surface water on-Site will comply with the substantive requirements of an NPDES Permit; discharge to surface water off-Site will require a NPDES Permit.	Pertinent revisions to 40 CFR Part 122: • Amend and clarify existing regulations requiring States to identify waters not meeting State water quality standards and establish total maximum daily loads (TMDLs) to restore the quality of those waters. The action also lays out time frames under which EPA will assure that lists of waters not meeting water quality standards and TMDLs are completed as scheduled, and that necessary source controls are implemented to meet TMDLs. • Change certain requirements of the General Pretreatment Regulations to be consistent with NPDES requirements for direct dischargers to surface waters. • Modify the testing procedures approved for analysis and sampling under the Clean Water Act and Safe Drinking Water Act. • Codify that where EPA-approved methods exist, NPDES applicants must use sufficiently sensitive EPA-approved analytical methods when quantifying the presence of pollutants in a discharge. • Clarify the scope of "Waters of the United States." • Require electronic reporting and sharing of NPDES program information instead of paper-based reporting of this information. All revisions of 40 CFR Part 125 pertain to cooling water intake structures, which are not pertinent to this site.	40 CFR Part 122 has been revised many times since 2001. Pertinent revisions occurred on: • October 18, 2001 • October 14, 2005 • March 12, 2007 • August 19, 2014 • June 29, 2015 • October 22, 2015 40 CFR Part 125 has been revised several times since 2001, but revisions are not pertinent to the remedy.	The changes to 40 CFR Part 122 do not affect protectiveness. The changes to 40 CFR Part 125 do not affect protectiveness.

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
40 CFR Part 122.26	2001 OU-3 ROD; 2011 OU-5 ROD	Establishes, monitoring, and pollutant control requirements for storm water from industrial activities. The substantive requirements would be applicable if construction activities associated with the remedial action disturb an area of 5 acres or greater.	The revisions to 40 CFR Part 122.26 are administrative and/or clerical.	40 CFR Part 122.26: • January 31, 2002 • June 24, 2002	The changes to 40 CFR Part 122.26 do not affect protectiveness.
National Toxics Rule, 40 CFR 131.36 ; California Toxics Rule 40 CFR 131.38	2001 OU-3 ROD; 2011 OU-5 ROD	Establishes the appropriate aquatic and human health criteria for priority toxic pollutants in inland surface waters and enclosed bays and estuaries. Included in the National Rule are EPA promulgated specific criteria for certain water bodies in California the presence or discharge of which could reasonably be expected to interfere with maintaining designated uses. May be applicable for off-Site discharge subject to NPDES permits and for on-Site discharge subject to substantive requirements of an NPDES permit.	The revisions to 40 CFR 131.36 revise or withdraw certain federal water quality criteria for waters in states other than California. The revisions to 40 CFR 131.38 amends the Federal regulations to withdraw aquatic life water quality criteria for copper and nickel applicable to south San Francisco Bay (the area located south of the Dumbarton Bridge), and cyanide criteria applicable to San Francisco Bay. These revisions are not pertinent to the site.	40 CFR Part 131.36 has been revised many times since 2001, but none of the revisions are pertinent. 40 CFR Part 131.38 was revised on: • November 6, 2003 • April 4, 2013	The changes to 40 CFR Part 131.36 do not affect protectiveness The changes to 40 CFR Part 131.38 do not affect protectiveness because the Site is not near San Francisco Bay.
Fish and Wildlife Coordination Act (16 USC Section 661 et seq.) and 40 CFR Part 302	2001 OU-3 ROD; 2011 OU-5 ROD	Restrictions on diversion, channeling or other activity that modifies a stream or river and affects fish or wildlife. Applicable if a water body is controlled or modified by the action. Applicable if treated water is discharged to surface water. Discharge to surface water shall comply with these restrictions.	16 USC Section 661 et seq. has been revised to direct Federal agencies to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitats (Executive Order No. 13443). This revision is not pertinent to the site The revisions to 40 CFR Part 302 since 2001 are either administrative, clerical, or not pertinent to the site.	16 USC Section 661 et seq. was revised on August 16, 2007, but the revision is not pertinent. 40 CFR Part 302 has been revised many times since 2001, but the revisions are either administrative or not pertinent to the site.	The change to 16 USC Section 661 et seq. does not affect protectiveness. The changes to 40 CFR Part 302 do not affect protectiveness.

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
Fish and Wildlife Coordination Act (16 USC Section 661 et seq.), and 40 CFR Part 6.302	2001 OU-3 ROD	Constructing groundwater treatment facilities in a 100 year flood plain will be avoided. If it cannot be avoided, the potential harm to the flood plain shall be minimized.	16 USC Section 661 et seq. has been revised to direct Federal agencies to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitats (Executive Order No. 13443). 40 CFR Part 6.302 has been revised since 2001 to clarify Responsible Official Requirements under NEPA.	16 USC Section 661 et seq. was revised on August 16, 2007, but the revision is not pertinent. 40 CFR part 6.302 was revised September 19, 2007.	The change to 16 USC Section 661 et seq. does not affect protectiveness. The change to 40 CFR Part 6.302 does not affect protectiveness.
40 CFR 264.18(b)	2001 OU-3 ROD; 2011 OU-5 ROD	A Resource Conservation and Recovery Act (RCRA) facility located in a 100-year flood plain must be designated, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood. Since the treatment facilities will generate hazardous waste, any facility constructed within a 100 year flood plain shall comply with this requirement.	40 CFR 264.18(b) was revised since 2001 to correct a typographical error.	40 CFR 264.18(b) was revised July 14, 2006.	The changes to 40 CFR 264.18(b) do not affect protectiveness.
National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65	2001 OU-3 ROD	Alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeological data may require actions to recover and preserve artifacts. The remedy will not alter or destroy any known prehistoric or historic archeological features west of the Aerojet Site. Areas west of the Aerojet Site are essentially completely developed. However, because there is always a possibility that buried historic or prehistoric remains could be discovered during construction, this regulation would require action to recover and preserve artifacts.	16 USC Section 469 has been omitted following the enactment of Title 54. 36 CFR Part 65 has not been revised since 2001. Authority for this section is now under 16 USC 461 *et seq. and;* 16 USC 470 *et seq*.	16 USC Section 469 was repealed on Dec 19, 2014. There have been no revisions to 36 CFR Part 65.	The repeal of 16 USC Section 469 does not affect protectiveness. 36 CFR Part 65 has not changed since the signing of the 2001 ROD; therefore, protectiveness is not affected.

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
National Historic Preservation Act (16 USC Section 470, et seq.)	2011 OU-5 ROD	Provides for protection of sites with historic places and structures. Federal agencies are required to take into account their undertakings on historic properties and afford the State Historic Preservation Office a reasonable time to comment. Applicable if a federal undertaking (cleanup) could adversely affect historic properties which are included in or eligible for inclusion in the National Register of Historic Places. The remedy is expected to not alter or destroy any known prehistoric or historic archeological features in OU-5 of the Aerojet Site. However, because there is always a possibility that buried historic or prehistoric remains could be discovered during such actions, this requirement would require action to address such areas.	Parts of 16 USC Section 470, et seq. were either transferred to Title 54 or omitted.	The transfer or omission of parts of 16 USC Section 470 occurred on Dec 19, 2014.	The transfer or omission of parts of 16 USC Section 470 do not affect protectiveness.

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
Substantive portions of the Endangered Species Act of 1973 (16 USC Section 1531 et seq.); 50 CFR Part 200 and 50 CFR Part 402;	2001 OU-3 ROD; 2011 OU-5 ROD	Requires action to conserve endangered species or threatened species, including consultation with the Department of Interior, Fish and Wildlife Service. Two endangered floral species are known to occur within Sacramento County: the Sacramento Orcutt grass (Orcuttia Viscinda) and the Boggs Lake hedge hyssop (Gratiola Heterospala). Four endangered wildlife species are expected to occur within 25 miles of the Aerojet Site: Bald Eagle, Peregrine Falcon, Giant Garter Snake, and the Valley Elderberry Longhorn Beetle. The Aerojet Site may be a habitat for the Burrowing Owl, a species of concern in CA. Any action that may impact or threaten the impact an endangered species shall comply with this requirement. Prohibits the illegal taking of plant and animal species designated as either threatened or endangered in the state of California.	In addition to a few administrative changes, 16 USC Section 1531 et seq. was revised to include Executive Order No 13648, which directs Federal agencies to take appropriate actions within their authority to combat wildlife trafficking. This is not pertinent to the site. 50 CFR Parts 200 and 402 have been revised since 2001, but the revisions are either administrative or not pertinent to the site.	Executive Order No. 13648 was added to 16 USC Section 1531 et seq. on July 1, 2013, but the change is not pertinent. 50 CFR Parts 200 and 402 have been revised since 2001, but the revisions are either administrative or not pertinent.	The changes to 16 USC Section 1531 does not affect protectiveness. The changes to 50 CFR Parts 200 and 402 does not affect protectiveness.
40 CFR Part 261 and 22 CCR § 66261	2001 OU-3 ROD; 2011 OU-5 ROD	Establishes procedures and numeric limits for identification and management of characteristic hazardous wastes, listed hazardous wastes, and State-only (non-RCRA) hazardous wastes. These requirements are applicable to management of waste materials generated as a result of construction of the selected remedial action or operation of a groundwater treatment plant.	40 CFR Part 261 has been revised numerous times since 2001, but the revisions are either administrative, clerical, or not pertinent to the Site. 22 CCR § 66261 has been revised numerous times since 2001, but the revisions are administrative, clerical, or not pertinent to the site.	40 CFR Part 261 has been revised numerous times since 2001, but the revisions are either administrative or not pertinent. 22 CCR § 66261 has been revised numerous times since 2001, but the revisions are either administrative, clerical, or not pertinent to the site.	The changes to 40 CFR Part 261 do not affect protectiveness. The changes to 22 CCR § 66261 do not affect protectiveness.

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
40 CFR Section 262.11 and 22 CCR Section 66262.11	2001 OU-3 ROD; 2011 OU-5 ROD	Requires waste generators to determine if wastes are hazardous wastes and establishes procedures for such determinations. These requirements are applicable to management of waste materials generated as a result of construction of the selected remedial action or operation of a groundwater treatment plant.	40 CFR 262.11 was revised once since 2001 to clarify regulatory citations and address incorrect citations. 22 CCR Section 66262.11 has been revised twice since 2001. The revisions clarified waste determination procedures pursuant to other CCRs.	40 CFR 262.11 was revised on March 18, 2010. 22 CCR Section 66262.11 was revised February 8, 2002 and March 15, 2003.	The change to 40 CFR 262.11 does not affect protectiveness. The changes to 22 CCR Section 66262.11 do not affect protectiveness.
22 CFR 66262.34	2001 OU-3 ROD; 2011 OU-5 ROD	Specifies maximum amounts and maximum periods for accumulation of hazardous waste on-site under generator status. These requirements are potentially applicable to management of waste materials generated as a result of construction of the remedial action and operation of any groundwater treatment plant if these waste materials are hazardous wastes.	22 CFR 66262.34 has been changed twice with no regulatory effect.	22 CFR 66262.34 has been changed twice with no regulatory affect.	The changes to 22 CFR 66262.34 do not affect protectiveness.
22 CCR § 67391.1(d)	2011 OU-5 ROD	Substantive requirements for placing an environmental restrictive covenant on contaminated land in the state of California. Requires Aerojet to record environmental restrictive covenants on contaminated land and to name EPA as a third party beneficiary in the covenants.	22 CCR § 67391.1 (d) has been revised once since 2011 without regulatory effect.	22 CCR § 67391.1 (d) was revised on January 7, 2013.	The change to 22 CCR § 67391.1 (d) does not affect protectiveness.
33 USC Section 1251, *et seq*. and 40 CFR Parts 230 & 231	2011 OU-5 ROD	Regulates discharge of dredged or fill material into waters of the United States, including wetlands. Substantive portions applicable. Permit is not required for on-Site activities.	33 USC Section 1251, *et seq*. and 40 CFR Part 231 have not been revised since 2011. 40 CFR Part 230 has been revised once since 2011 to update the definition of "Waters of the United States".	33 USC Section 1251, *et seq*. and 40 CFR Part 231 have not been revised since 2011. The revision to 40 CFR Part 230 occurred on June 29, 2015.	There have been no revisions to 33 USC Section 1251, *et seq*. or 40 CFR Part 231; therefore protectiveness is not affected. The revision to 40 CFR Part 230 does not affect protectiveness.

Original ARAR	Document	Original ARAR requirement	Revised requirement	Revision Date	Effect on Protectiveness
Air Emission Standards for Process Vents; 40 CFR §§ 265.1033-1035;	2001 OU-3 ROD; 2011 OU-5 ROD	Applies to treatment, storage, and disposal facilities with process vents associated with solvent extraction or air or steam stripping operations managing RCRA hazardous wastes with organic concentrations of at least 10 ppm. These operations must reduce total organic emissions below specified device to reduce total organic emissions by 95 percent by weight. The requirements are relevant and appropriate for groundwater extraction and air-stripping operations for the remedy where organic concentrations are at least 10 ppm.	40 CFR §265.1033 has been revised once since 2001. The revision was typographical in nature. 40 CFR §265.1034 has been revised once since 2001. The revision clarified testing procedures. 40 CFR §265.1035 has been revised once since 2001. The revision was typographical in nature.	40 CFR §265.1033 was revised July 14, 2006. 40 CFR §265.1034 was revised June 14, 2005. 40 CFR §265.1035 was revised July 14, 2006.	Protectiveness is not affected.

Appendix H: Human Health and the Environment Risk Assessment

Appendix H: Aerojet Risk Assessment Review and Toxicity Analysis

Risk assessments for the Western Groundwater Operable Unit (OU-3) and the Perimeter Groundwater Operable Unit (OU-5) were reviewed to identify any changes in exposure or toxicity that would impact protectiveness.

1. Human Health Exposure

1.1. Western Groundwater Operable Unit (OU-3)

A human health risk assessment was completed for the Western Groundwater Operable Unit (OU-3) and summarized in the 2001 OU-3 Record of Decision (ROD). Exposure pathways included ingestion, dermal contact while showering, and inhalation of volatiles. The City of Folsom supplies up-gradient potable and non-potable water to Aerojet. The potential pathway is remote for future hypothetical workers and owners for the portions of the main Aerojet facility that may be sold for development because institutional controls will limit access to contaminated groundwater through land use covenants and Aerojet will retain the water rights for groundwater. Construction workers excavating on-property are not anticipated to contact contaminated groundwater because the shallowest groundwater in the OU-3 area is at a depth of 50 feet below ground surface (bgs), well below the expected construction zone of 10 feet bgs. The potential pathway for industrial workers at groundwater treatment plants is not complete because the treatment plants operate as “closed systems” and there is very limited potential for workers to contact the water.

There are several potentially complete exposure pathways off-property for untreated or incompletely treated contaminated groundwater. Groundwater beneath the OU-3 area is used as a source of potable and non-potable water, and the pathway for human and/or ecological receptors is potentially complete if there is no treatment of the contaminated groundwater or monitoring to remove the contaminated drinking water wells from service. Aerojet, the water purveyors, and the California Department of Public Health (CDPH) monitor public and private water supply wells to ensure that concentrations of chemicals do not exceed acceptable health-based levels. There are no known seeps or artesian groundwater sources of contaminated groundwater for ecological receptors at nearby surface waters.

1.2. Perimeter Groundwater Operable Unit (OU-5)

A human health risk assessment was completed for the Perimeter Groundwater Operable Unit (OU-5) and summarized in the 2011 OU-5 ROD. There is no known current use of groundwater for residential water supply from unmonitored or untreated wells either at or beyond the property boundary within OU-5. Additionally, future use of groundwater is restricted by existing institutional controls. However, recognizing the State’s designation of the aquifer of OU-5 as a potential drinking water source, the Risk Assessment included the hypothetical use of untreated groundwater for residential water supply. It was assumed that maximum contamination levels are contained in overlapping plumes (all contaminants in a layer are summed at the maximum concentration level), which may not occur at any given well. The analysis considered hypothetical exposure to groundwater constituents via the following routes: ingestion, dermal contact, and inhalation of volatile organic compounds (VOCs) released during household non-

ingestion use (i.e., showering, cooking, laundering, and dishwashing). Based on the hydrostratigraphic data and the detection of contaminants of potential concern (COPCs), the discharge of groundwater to surface water in Alder Creek and Administration Ditches was examined in the Remedial Investigation/Feasibility Study (RI/FS) as a potentially complete pathway in the Risk Assessment. However, exposures to constituents in Alder Creek and Administration Ditches are expected to be negligible and limited to occasional dermal contact under a recreational scenario, which was evaluated in the Risk Assessment.

Additionally, the OU-5 risk assessment assessed residential exposures (direct contact, ingestion, and/or inhalation of contaminants of concern (COCs;) to contaminated soils; 11 soil areas were found to be contaminated with one or more COCs above health-based levels for unrestricted use such as residential development. The OU-5 Risk Assessment also concluded that remedial action for soil gas in the vadose zone was justified in four areas because one or more COCs exceeded protective levels for inhalation of VOCs. Furthermore, the OU-5 Risk Assessment found that perchlorate in the soil at Area C41 poses a significant risk for both surface exposure and transport to groundwater.

1.3. Human Health Exposure Summary

For both OU-3 and OU-5, the exposure scenarios/pathways evaluated in the Risk Assessments are still valid. However, it is uncertain if the conclusions reached regarding vapor intrusion in OU-3 and OU-5 are still valid (see below). There have been no changes in land use or expected land use on or near the site, and physical site conditions have not changed. There are no new or revised analytical procedures that alter EPA's understanding of the nature and extent of contamination at the site.

2. Vapor Intrusion

EPA's understanding of contaminant migration from soil gas and/or groundwater into buildings has evolved over the past few years, leading to the conclusion that vapor intrusion may have a greater potential for posing risk to human health than assumed when the ROD was prepared. EPA evaluates the potential for vapor intrusion using a "multiple lines of evidence" approach consistent with its 2015 vapor intrusion guide, "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air," OSWER Publication 9200.2-154. Numerical screening levels are derived in the Vapor Intrusion Screening Level calculator, http://www2.epa.gov/vaporintrusion.

Vapor intrusion was evaluated, to some extent, for both OU 3 and OU-5. According to the OU-3 RI (Appendix A of the OU-3 RI/FS), soil gas samples collected from hundreds of locations across the Aerojet Site from 1991 to 1993 have shown that vapor diffusion from groundwater into the vadose zone is negligible in areas where there are no vadose zone source sites, and predicted no impacts to indoor air. However, there is little to no documentation regarding the methodology used to arrive at this conclusion; the sample point locations, concentrations, and any associated risk calculations are not documented. Therefore, it is unclear if the conclusion that there are no impacts to indoor air from OU-3 groundwater is still valid.

As described in the OU-5 Baseline Risk Assessment (BLRA) for Groundwater (Appendix E of the OU-5 RI/FS), Aerojet conducted a site-specific investigation and analysis of the vapor intrusion pathway to support the use of the Johnson and Ettinger vapor intrusion model in the risk assessment. This evaluation included the collection of groundwater data, soil gas data, site-specific soil physical property measurements, and the implementation of a vapor migration model to establish the input assumptions for the vapor intrusion model. Theoretical risks associated with the modeled migration of VOCs into indoor air from groundwater present at depths less than 100 feet were evaluated quantitatively for residential and commercial land uses. The vapor intrusion pathway was then evaluated for Zones 1, 2, and 4; Zone 3 was not evaluated because depth to groundwater was greater than 100 feet bgs. The results suggested that there was not a vapor intrusion risk for indoor air.

However, in 2011, EPA released an updated assessment for TCE which included a risk of fetal cardiac malformations due to short-term in utero exposures to TCE as a result of inhalation. This IRIS assessment set a reference concentration (RfC) of 2 $\mu g/m^3$; in contrast, the OU-5 BLA for Groundwater used inhalation RfC values of 35 µg/L and 600 µg/L. Use of the revised RfC may cause the Hazard Indices (HIs) for the child and adult receptors to exceed 1, which is the threshold above which non-carcinogenic effects may be expected. . Furthermore, in 2014, EPA's Office of Superfund Remediation and Technology Innovation issued a memorandum to the EPA Regional Superfund offices on *Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment.* This memorandum indicates that the risk from indoor air TCE that is greater than the Regional Screening Level may be of concern for short-term exposure. This memorandum indicate that the risk from indoor air TCE that is greater than the RSL may be of concern for short-term exposure. This is of particular concern in Zone 1 of OU-5 and OU-3 near Zone 1 (northeast portion of OU-3) because shallow TCE plumes exist below residences and workspaces. Also, TCE concentrations in these portions of shallow groundwater exceed its residential or commercial/industrial use vapor intrusion screening levels (VISLs).

Depletion of shallow groundwater across the Aerojet Superfund Site has been observed over the past several years. As the water table drops, residual contamination is stranded in the vadose zone soil above the aquifer. This source of contamination can volatilize and may migrate upwards as soil gas and pose a vapor intrusion threat. For example, at OU-5, subsurface conditions exist along the southern boundary of OU-5 Zones 1 and 4 (east of the 49000 Area). The vadose zone where a formerly saturated layer approximately 45 feet below ground surface was located contains elevated concentrations of TCE. It is reasonable to expect that the same concerns associated TCE vapor intrusion on OU-5 areas exist in OU-3 and OU-6 as well.

3. Toxicity Values

EPA's Integrated Risk Information System (IRIS) has a program to update toxicity values used by the Agency in risk assessment when newer scientific information becomes available. Media-specific concentration results are compared to EPA's Regional Screening Levels (RSLs) as a first step in determining whether response actions may be needed to address potential human health exposures (Tables H-1 through H-5). The RSLs are chemical-specific concentrations for individual contaminants that correspond to an excess cancer risk level of $1x10^{-6}$ or a Hazard Quotient (HQ) of 1 for non-carcinogens, and they have been developed for a variety of exposures scenarios (e.g. residential,

commercial/industrial). RSLs are not de facto cleanup standards for a Superfund site, but they do provide a good indication of whether actions may be needed. Comparisons to California Modified RSLs are made where those are more stringent than EPA RSLs, as noted in the tables below.

Table H-1: Summary of Tapwater RSLs (November 2015) for COCs at the Site

Contaminant of Concern	RSL for cancer risk in excess of $1x10^{-6}$ (µg/L)	Protective cancer risk range (µg/L)	RSL for non-cancer hazard (µg/L)	Selected Cleanup/Containment Level (µg/L)
Perchlorate	--	--	14	4.0 (OU-3); 6 (OU-5)
N-nitrosodimethylamine (NDMA)	0.00011	0.00011 – 0.011	0.055	0.0013 (OU-3); 0.003(OU-5)
Trichloroethene (TCE)	0.49	0.49 – 49	2.8	5 (both OUs)
Tetrachloroethene (PCE)	0.083[a]	0.083 – 8.3	38[a]	5 (both OUs)
1,1-Dichloroethane (DCA)	2.7[a]	2.7 – 270	1,200[a]	5 (OU-3 only)
1,2-DCA	0.17	0.17 - 17	13	0.5 (both OUs)
1,1,2-Trichloroethane (TCA)	0.28	0.28 – 28	0.41	5 (both OUs)
1,1,2,2-Tetrachloroethane	0.07[a]	0.07 – 7	110[a]	1 (OU-5 only)
1,1-Dichloroethene (DCE)	--	--	280	6 (both OUs)
1,2-DCE	--	--	--	6 (OU-3 only)
cis-1,2-DCE	--	--	36	6 (OU-5 only)
trans-1,2-DCE	--	--	360	10 (OU-5 only)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	--	--	5,500	1,200 (OU-3 only)
1,4-Dioxane	0.46	0.46 – 46	57	1 (OU-5 only)
Chloroform	0.22	0.22 – 22	97	100 (OU-3); 80[b] (OU-5)
Bromodichloromethane	0.13	0.13 – 13	380	80[b] (OU-5 only)
Dibromochloromethane	0.87	0.87 – 87	380	80[b] (OU-5 only)
Methylene chloride	0.93[a]	0.93 – 93	100[a]	5 (OU-5 only)
Vinyl chloride	0.019	0.019 – 1.9	44	0.5 (both OUs)
Carbon tetrachloride	0.1[a]	0.1 – 10	36[a]	0.5 (both OUs)
Nitrate (as Nitrogen)	--	--	32,000	10,000 (OU-3 only)
Nitrite (as Nitrogen)	--	--	2,000	1,000 (OU-3 only)

Notes:

[a] Values shown are based on California's Modified RSLs, California Department of Toxic Substances Control Human Health Risk Assessment Note 3, January 2016

[b] MCL value is for Total Trihalomethanes (TTHM), the sum of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

The COCs whose residential tapwater RSLs for cancer risk in excess of 10^{-6} are below the cleanup/containment levels include: NDMA, TCE, PCE, 1,1-DCA, 1,2-DCA, 1,1,2-TCA, 1,1,2,2-tetrachloroethane, 1,4-dioxane, chloroform, bromodichloromethane, dibromochloromethane, vinyl chloride, and carbon tetrachloride. For NDMA, TCE, PCE, 1,1-DCA, 1,2-DCA, 1,1,2-TCA, 1,1,2,2-tetrachloroethane, 1,4-dioxane, dibromochloromethane, vinyl chloride, and carbon tetrachloride, the selected cleanup/containment level is within the protective cancer risk range and is, therefore, protective. However, the chloroform and bromodichloromethane cleanup/containment levels are above the protective cancer risk range. The average chloroform concentration in the influent to the GET E/F treatment plant, which ranges from 78 to 96 µg/L, has been above the protective cancer risk range (0.22 - 22 µg/L) in each of the last five years, indicating that chloroform concentrations in the aquifer addressed by the GET E/F

extraction wells are also higher than the protective cancer risk range. However, there is no exposure to contaminated groundwater in this or other areas, so receptors are not affected.

Additionally, the cleanup level for chloroform OU-3 and the cleanup/containment levels for TCE and 1,1,2-TCA (both OUs) are above their respective non-cancer RSLs. The cleanup level for chloroform in OU-3 was set at the federal MCL at the time of the 2001 ROD (though, as discussed in the ARARs section, there is no longer a specific MCL for chloroform; rather, chloroform in drinking water is regulated using the MCL of 80 µg/L for total trihalomethanes). The cleanup/containment levels for TCE and 1,1,2-TCA are also based on federal MCLs. MCLs are set at levels that EPA deems protective of human health. Therefore, the cleanup level for chloroform in OU-3 and the cleanup/containment levels for TCE and 1,1,2-TCA are considered protective for non-cancer risks.

Table H-2: Summary of Residential Soil RSLs (November 2015) for COCs at the Site

Contaminant of Concern	RSL for cancer risk in excess of $1x10^{-6}$ (mg/kg)	Protective cancer risk range (mg/kg)	RSL for non-cancer hazard (mg/kg)	Selected Performance Standard (mg/kg)
2,3,7,8-TCDD (Dioxin)	$4.8x10^{-6}$	$4.8x10^{-6}$ – $4.8x10^{-4}$	$5.1x10^{-5}$	$3.9x10^{-6}$
Antimony	--	--	31	31
Bis(2-ethylhexyl)phthalate	39	39 – 3,900	1,300	35
Cadmium	2,100	2,100 – 210,000	5.2[a]	48
Diethyl phthalate	--	--	51,000	49,000
Di-n-butyl phthalate	--	--	6,300	6,110
Hexavalent chromium	0.3	0.3 – 30	230	1.4
Lead	--	--	80[a]	127
Mercury	--	--	23	23.5
Perchlorate	--	--	55	55
PCB-1254	0.24	0.24 - 24	1.2	0.09
PCB-1260	0.24	0.24 - 24	--	0.09
Silver	--	--	390	390
Zinc	--	--	23,400	23,400

Notes:

[a] Values shown are based on California's Modified RSLs, California Department of Toxic Substances Control Human Health Risk Assessment Note 3, January 2016

The residential soil RSL for hexavalent chromium is less than the selected soil performance standard from the OU-5 ROD. However, the selected soil performance standard for hexavalent chromium is within the protective cancer risk range and is, therefore, protective. The non-cancer RSLs for cadmium, lead, and mercury are below their selected performance standards. For lead, though, concentrations in confirmation samples or on average in excavation areas following excavations were less than DTSC's modified RSL for lead in residential soils. The non-cancer mercury RSL is only slightly below its selected performance standard. For all other COCs, the selected soil performance standards are below or equal to their respective protective cancer risk ranges and non-cancer RSLs and therefore are protective.

Table H-3: Summary of Commercial/Industrial Soil RSLs (November 2015) for COCs at the Site

Contaminant of Concern	RSL for cancer risk in excess of $1x10^{-6}$ (mg/kg)	Protective cancer risk range (mg/kg)	RSL for non-cancer hazard (mg/kg)	Selected Performance Standard (mg/kg)
2,3,7,8-TCDD (Dioxin)	$2.2x10^{-5}$	$2.2x10^{-5}$ – $2.2x10^{-3}$	$7.2x10^{-4}$	$1.6x10^{-5}$
Antimony	--	--	470	120
Bis(2-ethylhexyl)phthalate	160	160 – 16,000	16,000	123
Cadmium	9,300	9,300 – 930,000	7.3[a]	48
Diethyl phthalate	--	--	660,000	186,000
Di-n-butyl phthalate	--	--	82,000	23,280
Hexavalent chromium	6.3	6.3 – 630	3,500	1.4
Lead	--	--	320[a]	531
Mercury	--	--	350	84
Perchlorate	--	--	820	210
PCB-1254	0.97	0.97 – 97	15	0.3
PCB-1260	0.99	0.99 - 99	--	0.3
Silver	--	--	5,800	1,500
Zinc	--	--	350,000	90,000

Notes:
[a] Values shown are based on California's Modified RSLs, California Department of Toxic Substances Control Human Health Risk Assessment Note 3, January 2016

The non-cancer RSLs for cadmium and lead are below their selected performance standards, and may not be protective. For lead, though, concentrations in confirmation samples excavations were less than DTSC's modified RSL for lead in industrial soils. For all other COCs, the selected commercial/industrial soil performance standards are below or equal to their respective protective cancer risk ranges and non-cancer RSLs and therefore are protective.

Table H-4: Summary of Residential Ambient Air RSLs (November 2015) for COCs at the Site

Contaminant of Concern	RSL for cancer risk in excess of $1x10^{-6}$ ($\mu g/m^3$)	Protective cancer risk range ($\mu g/m^3$)	RSL for non-cancer hazard ($\mu g/m^3$)	Selected Performance Standard ($\mu g/m^3$)
Benzene	0.097[a]	0.097 – 9.7	3.1	0.31
Chloroform	0.12	0.12 – 12	100	0.11
cis-1,2-DCE	--	--	--	110
1,1,1-TCA	--	--	1,000[a]	5,200
TCE	0.48	0.48 – 48	2.1	1.2
PCE	0.48[a]	0.48 – 48	37[a]	0.41

Notes:
[a] Values shown are based on California's Modified RSLs, California Department of Toxic Substances Control Human Health Risk Assessment Note 3, January 2016

The residential ambient air RSL for TCE is less than the residential use soil vapor performance standard from the OU-5 ROD. However, the selected soil vapor performance standard is within the protective cancer risk range and is, therefore, protective. The non-cancer California modified RSL for 1,1,1-TCA is

less than its selected performance standard; thus, the performance standard may not be protective. For all other COCs, the selected soil vapor performance standards are below or equal to their respective protective cancer risk ranges and non-cancer RSLs and therefore are protective.

Table H-5: Summary of Commercial/Industrial Ambient Air RSLs (Nov. 2015) for COCs at the Site

Contaminant of Concern	RSL for cancer risk in excess of $1x10^{-6}$ (µg/m^3)	Protective cancer risk range (µg/m^3)	RSL for non-cancer hazard (µg/m^3)	Selected Performance Standard (µg/m^3)
Benzene	0.42[a]	0.42 - 42	13[a]	1.6
Chloroform	0.53	0.53 - 53	430	0.53
cis-1,2-DCE	--	--	--	0.21
1,1,1-TCA	--	--	4,400[a]	22,000
TCE	3	3 – 300	8.8	6.1
PCE	2.1[a]	2.1 – 210	150[a]	2.1

Notes:
[a] Values shown are based on California's Modified RSLs, California Department of Toxic Substances Control Human Health Risk Assessment Note 3, January 2016

The commercial/industrial ambient air RSLs for TCE and benzene are less than the commercial/industrial soil vapor performance standard from the OU-5 ROD. However, the selected soil vapor performance standards are within the protective cancer risk range and are, therefore, protective. The non-cancer California modified RSL for 1,1,1-TCA is less than its selected performance standard; thus, the performance standard may not be protective. For all other COCs, the selected soil vapor performance standards are below or equal to their respective protective cancer risk ranges and non-cancer RSLs and therefore are protective.

4. Ecological risk

4.1. Western Groundwater Operable Unit (OU-3)

The OU-3 risk assessment reviewed potential ecological receptors and concluded there were no significant completed pathways of significance. Within OU-3, the contamination is deep below ground and contaminants do not rise to the surface or enter surface waters; there are no known seeps or artesian groundwater sources of contaminated groundwater for ecological receptors at nearby surface waters.

4.2. Perimeter Groundwater Operable Unit (OU-5)

The results of the OU-5 RI indicated that Alder Creek in Zone 4 is the only surface water feature that supports ecological receptors that could potentially receive discharge from OU-5 groundwater. The analysis of surface water samples collected from Alder Creek detected trace concentrations of acetone, chloromethane, naphthalene, perchlorate, NDMA, and various metals. Screening of these detected constituents against conservative ecological screening levels identified barium, boron, cadmium, manganese, and selenium as COPCs. Further evaluation indicated that the presence of those metals in Alder Creek did not appear to be site-related and/or did not pose a potential risk to aquatic receptors. A

bioassessment of Alder Creek was also performed to further evaluate the potential effects on biota from the discharge of impacted groundwater in Zone 4. The bioassessment involved the collection, identification, and comparison of benthic macroinvertebrates (BMI) at three locations along Alder Creek. The bioassessment found that, in general, the BMI communities at the three locations were not substantially different and did not indicate a potential for site related impact. Minor variations in the BMI communities appear due to physical characteristics of the stream such as shading and sediment compaction. The results of the screening and bioassessment identified no specific impacts related to the Site, and therefore, no further sampling or ecological risk assessment was warranted.

The OU-5 RI indicated that there is a potential for contaminants in OU-5 soil, even in the largely disturbed areas, to pose an adverse risk to ecological receptors under the exposure conditions assumed at several of the contaminated soil areas, including the Former Company Store. However, the RI indicated a current lack of suitable habitat in impacted areas and exposure of the ecological receptors to elevated background levels of COPCs that are not associated with OU-5 releases. As a result, the ecological risk assessment concluded that no significant future ecological risk is likely.

4.3. Ecological Risk Summary

For both OU-3 and OU-5, there have been no changes in conditions that may affect ecological receptors; conditions are the same as when ecological risks were evaluated. There are no known new ecological receptors present, and ecological exposure pathways have not changed.